CANADA'S BALANCE SHEET

Commissioned By:
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Executive Summary

Canada needs to meet international commitments agreed to under the Paris Agreement while also ensuring that oil and gas corporations are held responsible for the damages that they stand to leave behind alongside the necessary phase out of fossil fuels. With a focus on the western provinces of British Columbia, Alberta, and Saskatchewan, this report explores what climate responsible fossil fuel production might look like for Canada's fossil fuel industry.

Fossil fuels are by far the largest contributor to human-induced climate change. As such, their production needs to be drastically slowed if nations are to make serious efforts toward limiting warming to 1.5 °C in accordance with the Paris Agreement. Canada is a wealthy and high-emitting country with vast stores of fossil fuels and globally significant historical extraction. In this, Canada and its energy sector need to think realistically about what proportion of these stores can be extracted and consumed while staying within their fair share of the global carbon budget.

A focus on the decarbonization of fossil fuel production is favoured by industry and governments in Canada, however, this positioning is both inadequate for meeting national targets and distracts from the more pressing goal of global emissions reductions. As a more promising accounting approach, this report considers extracted carbon - the amount of carbon from fossil fuels that is mined and released into the atmosphere[1,2].

The following pages present a starting point for discussion around what Canada needs to do to address climate change, and the balance between climate responsible fossil fuel production and the legal obligations extractive corporations have to deal with their environmental liabilities. Using 2019 to 2022 as the baseline, recognizing 2020 as a unique year due to the Covid-19 pandemic, oil and gas liabilities are balanced against different scenarios for fair and climate responsible production.

[1] Lee, M. (2018). Extracted carbon and Canada's international trade in fossil fuels. *Studies in Political Economy*, *99*(2), 114–129.
[2] Calverley, D., & Anderson, K. 2022. *Phaseout Pathways for Fossil Fuel Production Within Paris-compliant Carbon Budgets*. https://www.research.manchester.ac.uk/portal/files/213256008/Tyndall_Production_Phaseout_Report_final_text_3_.pdf

Canada's fair share

A country's responsibility to take actions toward addressing climate change is often referred to as its "fair share". While countries agree that fairness entails that the most advantaged countries have a greater responsibility and capacity to address climate change, there exists various interpretations of what fairness looks like in a policy context[3]. This has resulted in a range of attempts to quantify Canada's fair share, the majority of which indicate that the country is in a climate debt. This means Canada would not be considered as having legitimate title to any of the world's remaining carbon budget.

Keeping this in mind, three scenarios are explored based on estimates of Canada's share of the global carbon budget for a 50/50 chance of achieving the limit of 1.5 °C: a fair share (EPC), an economically efficient share (EF), and a 'business as usual' share (GPE) based on Canada's current fossil fuel production levels. These shares are used to calculate whether there is room for climate responsible oil and gas production, and if so, the size of the country's production budget.

Estimations of Canada's climate responsible production budget ranged from 2.6 billion barrels of oil equivalent in the fair share scenario, to 53.4 billion barrels in the 'business as usual' scenario. Years left at current and sustained production levels were estimated to be: one year in the fair share scenario, six years in the economic efficiency scenario, and 17 years in the 'business as usual' scenario. This is a tall order and realistically production will need to be phased out rather than coming to a full halt at the end of the given time periods. However, even the most conservative estimate (the 'business as usual' scenario) will require immediate action and careful thought around where remaining fossil fuel resources are used.

The polluter's debt

Oil and gas corporations in Canada are making record profits while at the same time their environmental liabilities are growing. In accordance with the polluter pays principle, regulations across Canada hold these companies liable for cleaning up every well they drill, every pipeline they lay, and every shovel full of soil they remove. However, there is a track record of companies entering into bankruptcy, leaving the public to bear the cost of these activities. Large companies have been known to bundle and sell off near spent oil and gas wells to smaller, often struggling companies, exacerbating this issue[4]. Furthermore, solvent companies delay cleaning up inactive infrastructure resulting in increasing backlogs of necessary remediations and reclamations[5].

Environmental liabilities from oil and gas production are significantly large. The current situation regarding oil and gas liabilities in the Western provinces is estimated across the three provinces. Within these liabilities are the need for nearly 350,000 oil and gas well abandonments, 450,000 well site reclamations, 97,000 hectares of oil sands mine reclamation, and 1,400 million cubic meters of oil sands tailings in need of remediation. Due to a lack of available data, pipelines and facilities are not included in this report's estimates. Estimated liabilities, some of which are already part of provincial orphan well inventories, amount to over $123 billion.

Scenario balance sheets

To estimate corporate profits and government takes from additional oil and gas production this report takes the top five oil and gas producers in Canada as benchmark companies, plus Tourmaline, Canada's largest gas producer. Previously referred to as the 'big five', Suncor Energy, Canadian Natural Resources Limited (CNRL), Cenovus Energy, Imperial Oil, and Husky Energy (who in 2021 merged with Cenovus)

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[3] Vegard Tørstad & Håkon Sælen. 2018. Fairness in the climate negotiations: what explains variation in parties' expressed conceptions? Climate Policy, 18:5, 642-654, https://doi.org/10.1080/14693062.2017.1341372

[4] Jeff Lewis, Jeffrey Jones, Chen Wang, Renata D'Aliesio. 2018. Hustle in the oil patch: Inside a looming financial and environmental crisis. Globe and Mail.

[5] The companies with the largest backlogs of abandoned wells are Canadian Natural Resources Limited, Husky/Cenovus Energy, Imperial Oil Resources, and Suncor Energy. The Globe and Mail. October 2020. *Oil patch fails to clean up growing stockpile of abandoned wells*. https://www.theglobeandmail.com/canada/article-oil-patch-fails-to-clean-up-growing-stockpile-of-abandoned-wells/. Accessed November 2022.

operate 86 per cent of oil sands production and own substantial refining and upgrading facilities[6]. Potential government revenues and corporate profits were balanced against current and future environmental liabilities across the three scenarios explored in this report. The following are important findings and considerations for discussion.

The Canadian oil and gas industry is past its economic limit. The EPC scenario is the fairest of the three scenarios, though still low ranking compared to other commonly referenced 'fair share' carbon budgets. This scenario shows us that Canada has already seen the point where fossil fuel production in the country has surpassed its economic limit, meaning the cost of clean-up and environmental damages have overtaken the fair-share Paris-aligned potential for future revenues. In this scenario corporate profits from remaining extraction show a deficit of approximately $58.5 billion and what government revenues will exist from oil and gas production will not be enough to cover the shortfall. Given emissions in 2022, this scenario is consistent with past findings that Canada is already in a carbon debt and suggests that the industry is also in environmental debt.

Holding corporations accountable is a necessity, but public funding for oil and gas clean-up is not. In the EF and GPE scenarios corporate profits from remaining production are enough to cover existing oil and gas liabilities. However, covering the costs will make deep cuts into corporate profits. This finding points toward two important considerations: public funding for the clean-up of environmental liabilities held by solvent owners is an unnecessary and inefficient subsidy to oil and gas corporations, but corporations are unlikely to do the work on their own without considerable increases in spending mandated by provincial regulators.

Soaring returns for shareholders cannot continue in a climate responsible sector. Shareholders have seen soaring returns and have been promised by Canadian oil and gas producers that this trend will continue[7]. This narrative ignores corporations' responsibility toward existing and growing environmental liabilities and fails to consider the costs associated with the industry's own climate commitments.

Considering the EF and GPE scenarios, if the Canadian oil and gas sector honours both the polluter pay's principle in Western Canada and its own commitments to decarbonize, the bill comes in between $178 billion and $223 billion in the EF scenario, and between $224 billion $299 billion in the GPE scenario. These numbers are staggering and are likely to have considerable implications for shareholder returns. However, at the high end, they still only comprise 55 and 25 per cent of estimated corporate profits from remaining production. The industry can afford it without public subsidization; however, these numbers strongly suggest that oil and gas corporations in Canada cannot prioritize profits for executives and shareholders while both claiming to be climate responsible producers and fulfilling their legal obligations toward clean-ups.

[6] Oil Sands Magazine (OSM). 2022. *Oil Sands Operations*. May 20. https:// www.oilsandsmagazine.com/projects/bitumen-production

[7] Amir Barnea. March 2022. Record profits in oil and gas should be used to fight climate change. Toronto Star. https://www.thestar.com/business/opinion/2022/03/12/record-profits-in-oil-and-gas-should-be-used-to-fight-climate-change.html

1. Introduction

The country of Canada holds a challenging position within the arena of global climate action. As a wealthy, high-emitting country with vast stores of fossil fuels and a history rooted in their extraction, the country needs to balance domestic responsibilities with international obligations agreed to under the Paris Agreement. Doing this is complicated by an economic interdependence with a fossil fuel industry reluctant to change.

Under increasing pressure, Canadians must address climate change with hard cuts to the consumption and production of fossil fuels while ensuring that the fossil fuel industry does not leave the public on the hook for the damages wrought by more than a century of fossil fuel extraction. This will require both government and corporations to think realistically about how much more fossil fuel can be extracted while staying within global carbon budgets and adhering to the polluter pays principle- meaning industry's legal obligation to cover the cost of environmental liabilities left by extraction. This report provides a starting point for understanding what this balance sheet might look like by weighing the potential for oil and gas production in line with Canada's commitment to the Paris agreement - referred to here as climate responsible production, with fossil fuel liabilities in the western provinces of Canada.

The extraction and consumption of fossil fuels are by far the largest contributor to human-induced climate change[8]. The effects of climate change include more severe storms, increased drought, rising ocean waters, loss of species, disruptions in food supply, human health impacts, and increased poverty and displacement[9]. To avoid the worst of these impacts, parties to the 2015 Paris Agreement committed to perusing efforts to keep global warming below 1.5 °C compared to pre-industrial levels.

Fossil fuels have also provided a cheap source of energy that, for better or worse, has powered human societies through the past two centuries into today. The economic benefits of producing and consuming fossil fuels have been vastly unequal within and between countries. Meanwhile, the effects of climate change are disproportionately concentrated on the poorest and most vulnerable populations[10]. An awareness of these unequal impacts and historically uneven benefits, and the moral obligation to address them, is reflected in the Paris Agreement's 'principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances" (Article 2.2). This mean that countries are obligated to contribute, what is commonly referred to as a "fair share", toward global efforts. A fair share must account for both historical inequities and countries' varying capacities to address climate change[11].

The Canadian federal government has adopted increasingly strong climate targets that as of 2022 committed the country to lowering greenhouse gas (GHG) emissions by 40-45 per cent below 2005 levels by 2030[12]. The federal government's 2030 Emissions Reduction Plan lays out several proposals toward achieving these targets, including a cap on oil and gas sector emissions. Still, these targets and their associated policies and actions have been rated as highly insufficient as Canada's fair share and are not

[8] Coal, oil, and gas account for over 75 per cent of global greenhouse gas emissions and almost 90 per cent of carbon dioxide emissions. United Nations (UN). https://www.un.org/en/climatechange/science/causes-effects-climate-change. Accessed October 2022.

[9] Intergovernmental Panel on Climate Change (IPCC). 2022. AR6 Climate Change 2022: Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/

[10] IPCC, 2022

[11] See the Paris Equity Check (http://paris-equity-check.org/), Climate Action Tracker (http://climateactiontracker.org/), and Climate Equity Reference Project (https://climateequityreference.org/).

[12] Government of Canada. 2022. Net-zero emissions by 2050. Accessed October 2022. https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050.html

consistent with the Paris Agreement's 1.5 °C temperature limit[13]. The combined national climate targets of Paris Agreement signatories already undermine the potential for a 1.5°C world[14]. Furthermore, the GHG emissions accounting used gives us only a partial view of countries' contributions to climate change. National greenhouse gas inventories include emissions produced within a country's borders, but do not consider the carbon extracted within a country and burned elsewhere. This means that for Canada, a major fossil fuel exporter, oil and gas production can continue to grow while the fossil fuel industry can claim strides toward addressing climate change provided that emissions are lowered within the productive process. This is problematic. Global GHG emissions will rise so long as the extraction and use of fossil fuels continues to expand.

A focus on the decarbonization of the production of fossil fuels, and not their end combustion, is favoured by industry and governments, as seen in both in Canada's Emissions Reduction Plan and in the way that the Canadian Association of Petroleum Producers' (CAPP) frames the industry's climate commitments[15]. This positioning is both inadequate for meeting national targets and distracts from the more pressing goal of global emissions reductions and the phase out of fossil fuels. A consideration of extracted carbon – the amount of fossil fuels that are mined and released into the atmosphere[16], allows for a more realistic accounting approach to balancing global emissions and opening conversations of how to justly transition economies with high levels of dependence on fossil fuel extraction[17]. This is relevant for Canada, ranking 3rd worldwide in proven oil reserves, containing considerable reserves of natural gas[18], and remaining favourable to their extraction[19]. Canada continues to expand its fossil fuel industry despite clear evidence that it is counterproductive to emissions reductions[20]. Canada is also considered to be one of the wealthier fossil fuel producing countries, with a diverse economy, meaning a greater capacity for the phase out of fossil fuel production compared to more dependant and lower income countries[21].

Governments are not the only ones responsible for insufficient climate action. Extractive corporations have benefited immensely from fossil fuel production in Canada. They have also played a central role in making fossil fuels ubiquitous in our daily lives, have intentionally cast doubt on climate science, and have worked to delay climate action despite knowledge of fossil fuel's role in climate change[22]. Furthermore, they have left a legacy of unreclaimed and partially reclaimed mine sites, over 1.4 trillion

[13] New Climate Institute & Climate Analytics. Climate Action Tracker: Countries. Climate Action Tracker https://climateactiontracker.org/countries/. Accessed October 2022.

[14] United Nations Environmental Programme. 2022. *Emissions Gap Report 2022*. https://www.unep.org/resources/emissions-gap-report-2022

[15] Canadian Association of Pertroleum Producers. Industry's Climate Commitment. Accessed Jan 2023. https://www.capp.ca/explore/industrys-climate-commitment/

[16] Lee, M. (2018). Extracted carbon and Canada's international trade in fossil fuels. *Studies in Political Economy*, *99*(2), 114–129.

[17] Calverley, D., & Anderson, K. 2022. *Phaseout Pathways for Fossil Fuel Production Within Paris-compliant Carbon Budgets*. https://www.research.manchester.ac.uk/portal/files/213256008/Tyndall_Production_Phaseout_Report_final_text_3_.pdf

[18] BP Statistical Review of World Energy. 2022. https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html. Accessed October 2022.

[19] According to the International Institute of Sustainable Finance, in 2020 the Canadian Federal government provided the fossil fuel industry over $1.9 billion in quantifiable subsidies, several billion more in tax subsidies ($2.3 billion in 2019) and $14 billion in public finance. In addition to this, the provincial governments of British Columbia, Alberta, Saskatchewan and Newfoundland and Labrador provided $2.5 billion. McKenzie, J., Beedell, E., Corkal, V. 2022. Blocking Ambition: Fossil fuel subsidies in Alberta, British Columbia, Saskatchewan, and Newfoundland and Labrador. https://www.iisd.org/system/files/2022-02/blocking-ambition-fossil-fuel-subsidies-canadian-provinces.pdf.

[20] Tong, D. et al. 2019. Committed emissions from existing energy infrastructure jeopardize 1.5 °C climate target. *Nature* 572, 373–377.

[21] Calverley, D., & Anderson, K. 2022.

[22] Grasso, M. 2019. Oily politics: A critical assessment of the oil and gas industry's contribution to climate change. *Energy Research & Social Science, 50,* 106–115.

liters of toxic tailings[23], and hundreds of thousands of inactive oil and gas wells, facilities and pipelines that crisscross the landscape primarily in the western provinces of British Columbia, Alberta, and Saskatchewan. These sites present human health and environmental risks through surface and groundwater contamination and ecological impacts from landscape fragmentation[24]. Oil and gas wells also leak methane, a potent greenhouse gas, at scales that we are only today coming to understand[25].

This report creates a starting point for discussion around what Canada can do to realistically address climate change, and the balance between climate responsible fossil fuel production and the legal obligations extractive corporations owe toward environmental liabilities. Using 2019 to 2022 as the baseline, recognizing 2020 as a unique year due to the Covid-19 pandemic, oil and gas liabilities are balanced against different scenarios for fair and climate responsible production. Adopting this time frame as a snapshot, this report addresses the question: where can we go from here?

There is a broad lack of transparency around oil and gas liabilities, inconsistencies in oil and gas reserve estimates and production reporting, and disagreement in how to measure and track Canada's responsibility and efforts toward addressing climate change. Though the results are coarse, this report draws on available data from government, industry, and various financial estimates around liabilities to quantify how much oil and gas can be extracted while staying within different carbon budgets, and what government and corporate resources might be available to ensure that landscapes are remediated and reclaimed.

The next section estimates the amount of oil and gas that can be responsibly extracted in Canada to remain aligned with commitments to limit warming to 1.5°C. Section 3 explores available data and estimates of what it might cost for oil and gas corporations to clean up environmental harms caused by fossil fuel extraction. Section 4 presents the scenario balance sheets to compare the potential revenues from remaining production with the cost of clean-up. Results are discussed in Section 5.

2. Canada's Fair Share

Before estimating how much more oil and gas can be extracted in Canada while aligning with the Paris Agreement, there must first be a target to aim towards and an understanding of Canada's global responsibility toward achieving it. This is not an easy task and there exists a fair amount of uncertainty and disagreement on both fronts.

Through the 2015 Paris Agreement the international community agreed to limit global warming to well below 2 °C and to pursue efforts toward limiting it to 1.5 °C[26]. The Paris Agreement also implies that there is a maximum amount of carbon dioxide that can be released into the atmosphere while staying within temperature targets at various probability levels. These are referred to as carbon budgets. The Intergovernmental Panel on Climate Change (IPCC) estimates the remaining global carbon budget as of 2020 for a 50/50 chance of staying within 1.5 °C to be 500 $GtCO_2$[27]. For a 67 per cent chance the remaining carbon budget falls to 400 $GtCO_2$.

Because of what the Paris Agreement refers to as 'common but differentiated responsibilities and respective capabilities', national level GHG mitigation strategies are supposed to take into consideration culpability (due to historical and continuing GHG emissions) and a country's capacity to decarbonize

[23] Alberta Energy Regulator. 2022. State of fluid tailings management for mineable oil sands 2021. https://static.aer.ca/prd/documents/reports/State-Fluid-Tailings-Management-Mineable-OilSands.pdf

[24] Jordaan, S. M. 2012. Land and water impacts of oil sands production in Alberta. *Environmental Science and Technology*, *46*(7), 3611–3617. https://doi.org/10.1021/es203682m

[25] Mackay, K., Lavoie, M., Bourlon, E., Atherton, E., O'connell, E., Baillie, J., … Risk, D. 2021. Methane emissions from upstream oil and gas production in Canada are underestimated. *Scientific Reports*, *11*, 8041. https://doi.org/10.1038/s41598-021-87610-3.

[26] UNFCCC. Paris Agreement. 2015.

[27] Intergovernmental Panel on Climate Change (IPCC). 2022.

(due to greater wealth, access to technologies, or institutional context)[28]. This means that high emitting and wealthier countries have committed to making more drastic cuts to carbon emissions than their less able counterparts.

A country's responsibility to take actions toward addressing climate change is often referred to as its "fair share". Defining national level fair shares regarding the global carbon budget is a powerful way to communicate the need for climate mitigation and a useful policy tool. However, it has also been a continuous challenge. While countries agree that fairness entails that the most advantaged countries have a greater responsibility and capacity to address climate change, there exists various interpretations of what fairness looks like in a policy context[29]. This results in incongruencies between national level targets that are presented as "fair and ambitious" and the sum of these targets in the context of the global carbon budget. Today the sum of national targets outstrips the remaining carbon budget as estimated by the IPCC[30].

This section reviews current research and selects three national level carbon budgets for Canada: a fair share carbon budget based on equal per capita emissions; a carbon budget that prioritizes a global economic efficiency perspective modeled by Climate Action Tracker, and a budget based on current fossil fuel production levels and calculated using a production budget approach. These carbon budgets are then used to estimate how much additional oil and gas production constitutes, what is referred to in this report as, Canada's remaining climate responsible production.

2.1 Canada's carbon budgets

As mentioned previously, the Government of Canada's plan to reach the country's climate target by 2030 has been deemed highly insufficient for meeting the Paris Agreement temperature goal of 1.5°C warming and is not consistent with a fair share contribution to global efforts[31].

In response to this, there have been several attempts to better quantify Canada's fair share of the 1.5°C global carbon budget[32]. A recent summary of these attempts found a range of results, from a carbon debt of -46.8 $GtCO_2e$ to a remaining budget of 13.9 $GtCO_2e$[33]. Most approaches to calculating Canada's remaining carbon budget that take into consideration cumulative impacts and differing capacities, and therefore could be considered 'fair', indicated the country is in climate debt. This means Canada would not be considered as having legitimate title to any of the world's remaining carbon budget.

This finding around Canada's carbon debt is echoed in *From Paris to Projects* (2019) a report authored by leading experts in the field (see Figure 1). *From Paris to Projects* further notes that when considering Canada's committed emissions from existing energy infrastructure even the positive fair shares are exhausted[34]. Thus, to remain within a fair share carbon budget, Canada would need to decommission existing fossil fuel infrastructure before the end of its economic lifetime.

These scholars highlight an important point; by most standards Canada has already spent its fair share of the global carbon budget. Additionally, a point echoed by both the International Energy Agency and the

[28] Gibson, R. B., Péloffy, K., Greenford, D. H., Doelle, M., Matthews, H. D., Holz, C., … Grenier, F. (2019). From Paris to Projects. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3511932.

[29] Vegard Tørstad & Håkon Sælen. 2018. Fairness in the climate negotiations: what explains variation in parties' expressed conceptions? Climate Policy, 18:5, 642-654, https://doi.org/10.1080/14693062.2017.1341372

[30] Matthews, H. D., Tokarska, K. B., Nicholls, Z. R. J., Rogelj, J., Canadell, J. G., Friedlingstein, P., … Zickfeld, K. (2020). Opportunities and challenges in using remaining carbon budgets to guide climate policy. *Nature Geoscience*, *13*(12), 769–779. https://doi.org/10.1038/s41561-020-00663-3

[31] New Climate Institute & Climate Analytics. Climate Action Tracker: Countries.

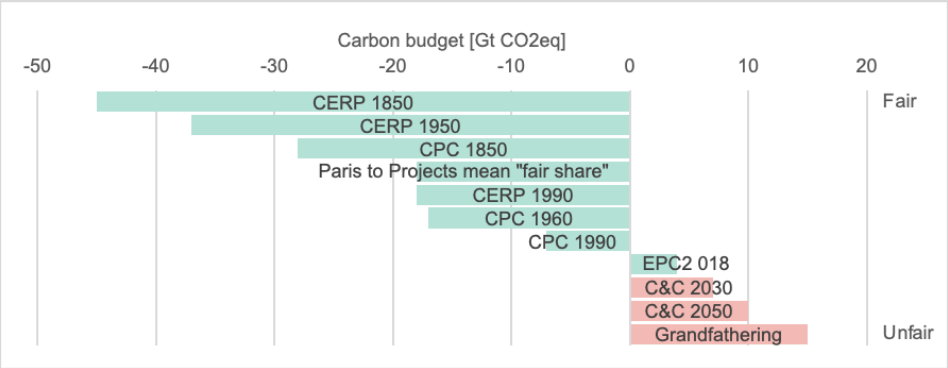
[32] A summary of attempts to quantify Canada's remaining carbon budget as of 2018 can be found in the Paris to Projects final report accessed at https://metcalffoundation.com/publication/from-paris-to-projects/.

[33] Greenford D. 2022. Safe ends with just means: Charting a course to a fossil fuel free economy for Canada and beyond. Doctoral Dissertation. McGill University.

[34] Estimates for committed emissions only included infrastructure up to 2012 and thus represented a lower bound.

IPCC[35], national carbon budgets may allow for continued fossil fuel production, but they do not have space for any new fossil fuel infrastructure or the development of additional oil and gas fields. Exercises in carbon budgeting do still provide a useful starting point for discussion, however, considering these broad findings, estimations in this report will not entertain new fossil fuel infrastructures such as refineries or pipelines as justifiable, but will consider continued investment in existing sources of oil and gas.

Figure 1. From Paris to Projects Estimated fair share carbon budgets for Canada



Note: CERP: Climate Equity Reference Project, CPC: Cumulative equal per capita, EPC: Equal Per Capita (equivalent to CPC except neglects historic emissions), C&C: Contraction and Convergence. See From Paris to Projects report for full research and methodology. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3511932.

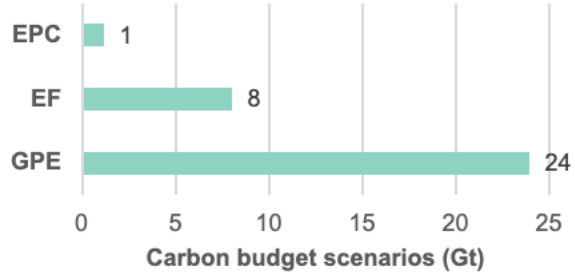
Drawing on the carbon budget approach and beginning in 2022, three scenarios for a 50/50 chance of achieving the limit of 1.5 °C are explored: (1) a 'business as usual' approach referred to as a grandfathered production-emissions share (GPE) has been estimated using a production-emissions budget methodology (see Appendix 1). This share assumes that current levels of production are maintained until the carbon budget is filled and ignores both capacity and culpability; (2) An equal per capita (EPC) share from the *From Paris to Projects* report updated to the beginning of 2022[36]. The EPC share represents an equal allocation for every person on earth as well as historical emissions over the previous two years. This share represents the least equitable of what could be considered a fair share according to Gibson and colleagues (2018); and (3) An economic efficiency (EF) share adapted from Carbon Action Tracker representing the allowable cumulative GHG emissions from 2022 to 2050 while staying within the 1.5°C goal[37] --this share considers Canada's capacity to address climate change but does not consider culpability.

[35] International Energy Agency (IEA). 2021. Net Zero by 2050. IEA, Paris https://www.iea.org/reports/net-zero-by-2050, License: CC BY 4.0. IPCC, 2022.

[36] To update the EPC share a 10-year average of Canada's total GHG emissions as reported by the government of Canada was subtracted for years 2018, 2019 and 2021. For year 2020 the actual recorded GHG emissions were subtracted to account for the reduction in emissions due to COVID-19.

[37] These are upper bound estimates of modeled domestic pathways representing a global economic efficiency perspective.

Figure 2. Canada's remaining carbon budgets as of 2022



Note: EF and EPC are measured in CO_2e. GPE is measured in CO_2. This will be accounted for in production budget estimations.

2.2 Estimating Canada's Production Budget

For Canada to address climate change and the necessary transition towards a low-carbon economy, we need to know how much oil and gas extraction is allowable while still being considered climate responsible production. To this end, carbon budget scenarios (from Figure 2) and emissions factors were used to estimate the total remaining barrels of oil equivalent (boe) left to be extracted from the beginning of 2022 in Canada[38]. A barrel of oil equivalent (boe) is a unit of energy based on the approximate release of burning one barrel of crude oil. This measure is often used by energy companies to combine oil and natural gas production into a single measure and therefore is useful when estimating how much oil and gas can be produced while staying within specific carbon budgets and climate targets.

A production budget approach can be used to translate carbon budgets into estimations of what fossil resources must remain in the ground or can be extracted while staying within the given target. Sometimes referred to as 'extracted carbon[39]', this approach assumes that all fossil fuels produced are inevitably consumed and recognizes the extent of which fossil fuels are responsible for human-induced climate change. It also shifts the metric for balancing responsibility toward the producers of fossil fuels rather than those who consume them. This is counter to mainstream climate accounting which fails to consider the downstream emissions related to a company or country's value chains, which conversely puts more responsibility on consumers rather than the those who benefit from the production and sale of fossil fuels.

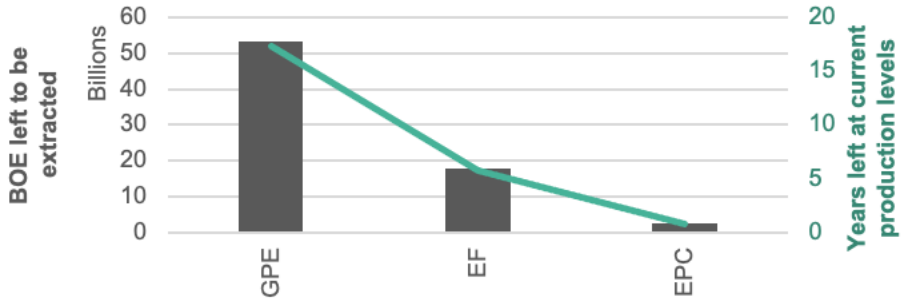
A highly cited study by Welsby et al. (2021) focused on the production side of fossil fuels and found that by 2050 60 per cent of global oil and natural gas reserves and 90 per cent of all coal reserves must stay in the ground to keep within a 1.5°C carbon budget[40]. Considering the carbon intensity of different fossil fuels and their cost-effectiveness, Welsby et al's estimates indicate that Canada would need to leave 83 per cent of its proven reserves of oil in the ground, 56 per cent of its natural gas, and 83 per cent of its coal. This analysis and others that use integrated assessment models considered carbon intensity and cost reductions in the analysis rather than equity and fairness.

Bringing equity into the conversation, Calverley and Anderson (2022), referred to as the Tyndall report, estimate global phaseout pathways for fossil fuel production while acknowledging the need for a fair share approach. The Tyndall report found that the wealthiest and most able producer nations (of which Canada is one) need to cut oil and gas production by 74 per cent by 2030 with a complete phase out by

[38] One boe equates roughly 6,000 cubic feet of natural gas.
[39] In their study of Canada's fossil fuel exports, Lee (2018) defines extracted carbon as "the total amount of fossil fuels removed from Canadian soil that ends up in the atmosphere, whether used for domestic purposes or combusted elsewhere."
[40] Welsby, D., Price, J., Pye, S., & Ekins, P. 2021. Unextractable fossil fuels in a 1.5 °C world. *Nature, 597*(7875), 230–234. https://doi.org/10.1038/s41586-021-03821-8

2034 to have a 50/50 chance of meeting the 1.5°C target[41]. However, this work was a global study and did not use carbon budgets specific to Canada, nor did it estimate a Canada-specific production budget.

Figure 3. Barrels of Oil left to be extracted in Canada while staying in the 1.5°C climate target



Note: For GPE emissions factors for CH_4 and N_2O were included to account for CO_{2eq}.

Figure 3 shows Canada's production budget under the three different scenarios following methods used in the Tyndall report[42]. All three scenarios present production budgets vastly lower than current projections from the Canada Energy Regulator. Accounting for evolution in policies, the Canada Energy Regulator estimates that cumulative production of crude oil and natural gas will exceed 81 billion boe between 2023 and 2050[43]. In the GPE scenario, the largest but least fair scenario, climate responsible production equates to just over 53 billion boe to be extracted. In this scenario oil and gas extraction in Canada can continue at current levels for another 17 years before the country's carbon budget is exceeded. Importantly, this would mean that if current levels are maintained fossil fuel production in the country would have to come to a complete stop by the end of the 17th year.

The EF and EPC scenarios give considerably tighter timelines with 6 years and 1 year at current levels of production, respectively. This is a tall order and realistically production will need to be phased out rather than coming to a full halt at the end of the given time periods. Even the most conservative estimate (the GPE scenario) will require immediate action and careful thought around where remaining fossil fuel resources are used. The International Energy Association (IEA) provides a normative global pathway toward net zero emissions by 2050 with emissions trajectories consistent with the IPCC scenarios for a 50/50 chance at 1.5 C of warming[44]. The scenarios presented here are compatible with IEA trajectories, and in fact, present an additional way of thinking about Canada's role in achieving global net-zero emissions.

3. The Polluters' Debt

Having established various possible caps on the amount of oil and gas that can be extracted while giving a 50/50 chance of staying within 1.5°C warming, the next question is whether revenues from this production will be enough to cover the industry's liabilities. This section will explore existing oil and gas liabilities in the western provinces of British Columbia, Alberta and Saskatchewan, and current research on the costs of clean-up.

Laws and regulations across the western provinces proport to adopt the polluter pays principle and to hold oil and gas corporations liable for cleaning up every well they drill, every pipeline they lay, and every

[41] Calverley, D., & Anderson, K. 2022.
[42] Calverley, D., & Anderson, K. 2022.
[43] Crude oil production by 2050 will be a cumulative 55.9 billion barrels of oil, and natural gas production will be 152,380.2 billion cubic feet. This equates to 81.3 billion barrels of oil equivalent. Canada Energy Regulator. Canada's Energy Future Data Appendices. https://doi.org/10.35002/zjr8-8x75
[44] IEA. Understanding GEC Model scenarios. https://www.iea.org/reports/global-energy-and-climate-model/understanding-gec-model-scenarios

shovel full of soil they remove[45]. However, there is a track record of companies entering into bankruptcy, leaving the public to bear the cost of these activities. Large companies have been known to bundle and sell off near spent oil and gas wells to smaller, often struggling companies, exacerbating this issue[46]. Furthermore, solvent companies delay cleaning up inactive infrastructure resulting in increasing backlogs of necessary remediation and reclamation[47].

Alongside legal obligations, oil and gas corporations bear a moral responsibility for the scale and the tight timelines we now face for transitioning off fossil fuels. The big players in the oil and gas industry have been instrumental in delaying climate action despite full knowledge of their industry's impact[48]. They have involved themselves in politics- lobbying the Canadian federal government around climate and energy policy[49,50]. And, they have done so while prioritizing profits for shareholders and top executives over their own workers[51]. Though the oil and gas industry has contributed to the Canadian economy, averaging around 5 per cent of the country's GDP over the last 10 years[52], recent reports by Parkland Institute (Hussey, 2020a, 2020b) found that job losses between 2014 and 2019 numbered more than 53,119. Trends of automation and digitization mean these job losses are not temporary and continued losses are probable[53]. Capital spending is also slowing in the oil sands industry signaling that the growth phase is over – boom times are not expected to return[54].

As job prospects and capital spending head in one direction, compensation for top executives and shareholders has been going the other. Average CEO compensations between 2019 and 2021 for the 5 largest producers in Canada (Suncor, CNRL, Cenovus, Husky, and Imperial Oil) increased 30 per cent and shareholder dividends were above average for 3 out of the last 4 years and far outweigh the royalties and taxes paid to governments [55] . In the first quarter of 2022 these companies received record profits[56]. As Canada moves to address climate change it is time for corporations to assess their environmental debts, realistically and transparently.

[45] For example, in Alberta, oil sands mine site reclamation is primarily governed by the *Environmental Protection and Enhancement Act* RSA 2000, c E-12 (*EPEA*) and associated *Conservation and Reclamation Regulation* 115/1993 (*CRR*)

[46] Jeff Lewis, Jeffrey Jones, Chen Wang, Renata D'Aliesio. 2018. Hustle in the oil patch: Inside a looming financial and environmental crisis. Globe and Mail.

[47] The companies with the largest backlogs of abandoned wells are Canadian Natural Resources Limited, Husky/Cenovus Energy, Imperial Oil Resources, and Suncor Energy. The Globe and Mail. October 2020. *Oil patch fails to clean up growing stockpile of abandoned wells*. https://www.theglobeandmail.com/canada/article-oil-patch-fails-to-clean-up-growing-stockpile-of-abandoned-wells/. Accessed November 2022.

[48] Grasso, M. 2019.

[49] See CAPP memo to the Canadian Minister of Natural Resources during the Covid-19 pandemic. https://canadians.org/wp-content/uploads/2020/04/leaked-COVID-19-Regulatory-Impact-Request-0320.pdf.

[50] Environmental Defence Canada. 2019. The biggest barrier to climate action in Canada: The oil and gas lobby. https://environmentaldefence.ca/report/oil_barrier_climate_action_canada/.

[51] Hussey, I. 2022a. Job creation or job loss? Big companies use tax cuts to automate away jobs in the oil sands. Parkland Institute. https://www.parklandinstitute.ca/job_creation_or_job_loss.

[52] Statistics Canada. 2021. The oil and gas sector in Canada: A year after the start of the pandemic. Accessed Oct 17, 2022. https://www150.statcan.gc.ca/n1/pub/36-28-0001/2021007/article/00003-eng.html.

[53] Hussey, I. 2020b. The future of Alberta's oil sands industry: More production, less capital, fewer jobs. Parkland Institute. https://www.parklandinstitute.ca/the_future_of_albertas_oil_sands_industry

[54] Hussey, I. 2022a.

[55] Hussey, I. 2022a.

[56] Bakx, K. "Canada's oilpatch is flush with cash — so what are they going to do with it?". CBC August, 2020. https://www.cbc.ca/news/business/bakx-wti-brent-profit-oilpatch-2022-1.6552917.

3.1 Oil and gas liabilities in Western Canada

Definitions and well classifications:

Active- a well that is currently producing oil or natural gas.
Inactive – a well or facility that is currently not producing for technical or economic reasons but may at a later date.
Orphan: A well, facility or pipeline where the responsible owner is either insolvent or otherwise unable to deal with its closure and cleanup.
Abandoned – a site that has been permanently dismantled but does not include remediation and reclamation.
Remediation – the cleaning up of a contaminated site to meet specific soil and groundwater standards set by provincial regulators.
Reclamation – returning the land to as close as possible to its original form and use. Requires the replacement of soil and revegetation.

Canadian oil and gas production is centered in the western provinces of British Columbia, Alberta and Saskatchewan, accounting for 95 per cent of crude oil and 98 per cent of natural gas production in 2020[57]. The Alberta oil sands, in particular, makes up around 97 per cent of Canada's remaining established oil reserves and account for over 60 per cent of Canada's oil production[58]. The oil sands are also among the most carbon intensive large scale crude oil operations in the world[59].

The oil and gas industry has left its mark across the landscapes of the western provinces. Oil and gas wells, pipelines and mine sites cause soil and water contamination and contribute to climate change through leaking methane emissions. The clean-up of fossil fuel infrastructures and their resulting footprints are the liabilities of the corporations that have created them. Yet, as discussed above, the work is regularly left uncompleted. This is despite repeated reformulations of provincial frameworks, incentives, and programs that have failed to ensure corporations abide by the polluter pays principle. The cost of clean-up, to an increasing extent, is becoming the burden of the public, with funding from provincial and federal governments at times even subsidizing corporations to do their legally required work[60]. In a world where fossil fuel production needs to be curbed, measures are equally needed to ensure that corporations are held accountable to the legal obligation of the polluter pays principle.

Within liability management frameworks provinces have failed to collect the security necessary to account for failing companies within a boom-and-bust economy[61]. In November of 2022 the Government of Saskatchewan held in security just over 2.5 per cent of the deemed liabilities of oil and gas wells and

[57] Canadian Energy Regulator. 2022. Provincial and Territorial Energy Profiles – Canada. Accessed Oct 17, 2022. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-canada.html.
[58] Natural Resources Canada. 2021. Canada's Energy Fact Book 2021-2022. https://www.nrcan.gc.ca/sites/nrcan/files/energy/energy_fact/2021-2022/PDF/2021_Energy-factbook_december23_EN_accessible.pdf.
[59] Isreal, B. 2017. *The Real GHG trend: Oilsands among the most carbon intensive crudes in North America*. Pembina Institute. https://www.pembina.org/blog/real-ghg-trend-oilsands
[60] See Canada's Covid-19 Economic Response Plan which allocated $1.72 billion to the governments of British Columbia, Alberta and Saskatchewan to clean up oil and gas wells in 2020
[61] Office of the Parliamentary Budget Officer. 2022. Estimated Cost of Cleaning Canada's Orphan Oil and Gas Wells. https://distribution-a617274656661637473.pbo-dpb.ca/44de649e994977a9771ff83959ba6b9563f5c1352ec3ba4f83c4d256f40a6b41.

their accompanying facilities[62]. Alberta held less than 1 per cent[63]. When looking toward oil sands mining in Alberta, the AER reported holding around 3 per cent of the province's estimated financial liability under the Mine Financial Security Program (MFSP)[64]. This leaves the public at risk of having to pay a substantial amount if companies neglect their responsibilities or face financial hardships during a phase out of fossil fuels [65].

Even without active fossil fuel phase out, companies fail. As of October 2022, there were nearly 10,000 orphaned oil and gas wells in Western Canada. These are wells that have been left without decommissioning or clean-up after the liable company became insolvent and is no longer financially capable of doing the work themselves. In 2020 alone, the number of oil and gas wells that became orphaned as a result of companies filing for bankruptcy totaled 15,831 in Alberta and 506 in Saskatchewan[66]. Events like this have resulted in growing inventories of orphaned wells, pipelines and facilities that have garnered the attention of the media, civil society, and governments.

In 2020, with the issue of orphan and inactive wells growing both in scale and within political agendas, $1.72 billion of federal funding was put toward the clean-up of inactive and abandoned (including orphaned) oil and gas infrastructure across the western provinces. The Government of Alberta managed $1 billion of this funding through the newly designed Site Rehabilitation Program. However, this money did not go to orphan wells, nor did it go toward propping up struggling producers at risk of insolvency. Instead, the funding went toward relieving the environmental liabilities of some of Canada's largest and most profitable oil and gas companies[67].

Oil and gas sector subsidies are another way that the polluter pays principle is violated. These subsidies are notoriously hard to track, with huge gaps in information and no records of direct spending by governments. This is despite repeated commitments by the federal government to phase out 'inefficient' subsidies, or what is now being referred to as 'public support the international unabated fossil fuel energy sector"[68]. Environmental Defence Canada was able to track nearly $18.5 billion worth of federal subsidies to the oil and gas industry in 2022[69].

Subsides also come from provincial governments. The International Institute for Sustainable Development tracked an additional $2.5 billion in provincial subsidies across BC, Alberta, and Saskatchewan in the fiscal year of 2020/2021[70]. These funds have also gone toward supporting

[62] Government of Saskatchewan. November 2022. LLR Summary Report.

[63] Alberta Energy Regulator (AER). November 2022. Liability Management Rating Results Report.

[64] This is $33 million less than what was held in 2010.

[65] Saher, M.N. July 2015. Report of the Auditor General of Alberta. p. 25. https://www.oag.ab.ca/reports/report-auditor-general-july-2015/. Accessed November 2022.

[66] Kang, M., Brandt, A. R., Zheng, Z., Boutot, J., Yung, C., Peltz, A. S., & Jackson, R. B. 2021. Orphaned oil and gas well stimulus-Maximizing economic and environmental benefits. *Elementa Science of the Anthropocene*, *9*(1). https://doi.org/10.1525/elementa.2020.20.00161

[67] Egler, M. 2022. *Not Well Spent: A review of $1-billion federal funding to clean up Alberta's inactive oil and gas wells*. Parkland Institute. https://www.parklandinstitute.ca/not_well_spent.

[68] Natural Resources Canada. 2022. Government of Canada delivers on key international climate commitment to end new public support or the international unabated fossil fuel sector. https://www.canada.ca/en/natural-resources-canada/news/2022/12/government-of-canada-delivers-on-key-international-climate-commitment-to-end-new-public-support-for-the-international-unabated-fossil-fuel-energy-s.html

[69] Environmental Defense Canada. 2022. *2022 Federal fossil fuel subsidies.* Accessed Jan 2023. https://environmentaldefence.ca/federal-fossil-fuel-subsidies-tracking/

[70] McKenzie, J., Beedell, E., Corkal, V. 2022. *Blocking Ambition: Fossil fuel subsidies in Alberta, British Columbia, Saskatchewan, and Newfoundland and Labrador.* International Institute of Sustainable Development (IISD). https://www.iisd.org/system/files/2022-02/blocking-ambition-fossil-fuel-subsidies-canadian-provinces.pdf

technologies to remediate oil sands tailings, expanding the natural gas sector, and a variety of other oil and gas projects across Canada through both direct, royalty based, and tax-related subsidies[71].

These examples are symptomatic of a greater trend by governments in Canada of not holding oil and gas companies liable for clean-ups and for using public funds to prop up the industry. When governments fail to hold corporations accountable, and corporations prioritize profits over environmental liabilities, the public is going to be left footing the bill. This stands to be a significant cost. Below, the current situation regarding environmental liabilities from oil and gas extraction in the Western provinces is presented and estimated across the three provinces.

Oil and gas wells

Table 1 gives a breakdown of the number of oil and gas wells in the Western provinces using 2022 data from the Canadian Association of Petroleum Producers (CAPP) Statistical Handbook for wells drilled and wells that are actively producing. Well liability and well license data from provincial regulators was used to estimate the number of well abandonments and reclamations that will be needed. Unfortunately, there is incomplete data on which sites would also require remediation. Orphan well inventories are provided by BC Oil & Gas Commission, Alberta Orphan Well Association, and the Orphan fund Procurement Program in Saskatchewan.

As of the end of 2022, there were over 10,000 wells in the orphan well inventories of the western provinces. In 2022 Canada's Parliamentary Budget Office (PBO) estimated the national cost of cleaning up orphaned oil and gas wells to be $361 million in 2020 with a potential increase to around $545 million by 2022 and $1 billion by 2025[72]. These dollar figures, by the PBO's own admission, do not include the costs of remediating contaminated soils, cleaning up pipelines, facilities, oil sands, or the 7,400 wells that did not have a solvent owner at the time of the study but had not yet transitioned to orphan status.

According to CAPP there have been over 576,000 wells drilled in Western Canada since 1955, and at the end of 2021 just over 194,000 of these were producing oil or gas[73]. Those remaining are in various states of inactivity, most of which are waiting to be cleaned up.

Table 1. Most recent well data for the Western provinces of Canada (number of wells)

		BC	AB	SK	**Totals**
Total wells drilled since 1955		25,873	424,429	125,864	**576,166**
Producing wells as of the end of 2021					
	Conventional oil wells	743	34,412	27,832	**62,987**
	Bitumen oil wells	-	5,285	-	**5,285**
	Gas wells	8,519	104,726	12,745	**125,990**
Well reclamations approved		3,259	94,225	31,588	**129,072**
Orphan well inventories					
	Well abandonments needed	278	2,565	2,802	**5,645**
	Well reclamations needed	278	6,640	3,417	**10,335**
Well liabilities remaining					
	Well abandonments needed	17,574	247,748	81,433	**344,338**
	Well reclamations needed	22,336	330,204	90,859	**437,242**

Note: Gas wells include conventional, coalbed methane, and shale gas. Orphan well inventories have been subtracted from solvent company well liabilities except for Alberta where orphan inventories are not included in AER well data[74].

[71] McKenzie, J., Beedell, E., Corkal, V. 2022.

[72] PBO, 2022.

[73] Canadian Association of Petroleum Producers, CAPP Statistical Handbook: Wells and meters/feet drilled in Canada. Accessed October 2022. https://www.capp.ca/resources/statistics/.

[74] Correspondence with Alberta Energy Regulator, December 7, 2022.

There are a range of estimates around the cost of cleaning up oil and gas infrastructure. For example, the Alberta Energy Regulator might put the cost of cleaning up Alberta's oil and gas wells around $18.6 billion, whereas the Alberta Liabilities Disclosure Project (ALDP) puts the price tag at $40 to $70 billion[75]. The disagreement is rooted in a lack of transparency around the cost of clean-up activities and the choice of numbers used to produce estimates. Table 2 presents the range of estimates used to calculate the cost of cleaning up oil and gas wells in Canada.

Table2. Estimated costs to clean up an oil and gas well

Estimation	Cost per well
ALDP, 2021	$160,229 to $279,086 CAD
Raimi et al., 2021	$ 96,000 USD
PBO 2022, based on AER Directive 011	$ 86,000 CAD
Alberta Orphan Well Association	$ 45,500 CAD

ALDP estimates are calculated with a rigorous and transparent methodology and thus will be the ones employed in the balance sheet calculations in Section 4[76]. ALDP estimates are also the only estimates in Table 2 that include well remediation. Remediation cost data is limited and variable, and thus is rarely included in estimations for well site clean-ups. This is a potentially large omission. In British Columbia approximately 40 per cent of wells that require reclamation also require some extent of remediation, with the additional liability ranging from $7,250 to $120,500 per well[77]. The cost of abandonment and remediation for problem wells can at times exceed $1 million[78].

Oil sands mines and tailings

Around 20 per cent of oil sands reserves in Canada are recoverable by mining[79]. Mined land requires more extensive remediation and reclamation due to the removal of soil, and the creation of tailings ponds-large industry-made lakes that hold toxic chemicals from oil sands operations.

As seen in Table 3, as of 2020 only 104.3 hectares of oil sands mines have been certified as reclaimed under the Environmental Protection and Enhancement Act compared to the 105,541 hectares that comprise the active footprint of oil sands operations[80]. The volume of fluid tailings as reported by industry to the AER amounted to 1.4 billion cubic meters in 2020[81].

Table 3. Oil sands disturbance and reclamation totals, 2020

Category	unit
EPEA Approved Footprint	159,961 ha
Reclamation Certified	104 ha
Total active footprint	105,541 ha
Reclamation needed (not tailings)	66,812 ha
Tailings area	30,000 ha

[75] Alberta Liabilities Disclosure Project (ALDP). 2021. The Big Clean Up: How enforcing the Polluter Pay Principle can unlock Alberta's next great jobs boom. https://www.aldpcoalition.com/_files/ugd/6ca287_aebaacad30bd4dfe90fe7784a45e7bd1.pdf.

[76] Average costs for reclamation (including remediation) and abandonment are used in balance sheet calculations. See ALDP methodology https://www.aldpcoalition.com/research.

[77] BC Oil & Gas Commission. 2022. Well Liability Report [BCOGC-2826]. https://www.bcogc.ca/data-reports/data-centre/?category=2771. Accessed October 2022.

[78] Carbon Tracker. 2020. *It's closing time: The huge bill to abandon oilfields comes early*. https://legacy-assets.eenews.net/open_files/assets/2020/06/22/document_ew_03.pdf.

[79] Canadian Association of Petroleum Producers (CAPP). What are the oil sands? https://www.capp.ca/oil/what-are-the-oil-sands/

[80] Alberta Environment and Parks. 2022. Oil Sands Mine Reclamation and Disturbance Tracking by Year. Accessed October 2022. http://osip.alberta.ca/library/Dataset/Details/27.

[81] Alberta Energy Regulator. 2022. State of fluid tailings management for mineable oil sands 2020. https://static.aer.ca/prd/documents/reports/2020-State-Fluid-Tailings-Management-Mineable-OilSands.pdf

Reclaimed (not certified)	8,730	ha
Fluid tailings	1,400	Mm^3

Note: Total active footprint includes the cumulative total area of land cleared, in use as part of the mine or plant footprints, land that has been temporarily reclaimed but where future reuse is expected, and land where reclamation activities have begun. Reclamation needed is the total active footprint minus the sum of areas where reclamation has taken place but is yet to be certified. Tailings area is the total area of both fluid tailings and tailings features including dams, berms, beaches, end pit lakes, and areas where reclamation treatments are being attempted[82].

To an even greater extent than oil and gas wells, estimations around what it might cost to clean up the oil sands mines and tailings are uncertain. Total liabilities as calculated by the AER in 2020 equated to more than $30 billion[83]. In 2010, the Pembina Institute used the CAPP growth scenario to estimate oil sands liabilities for 2025. They estimated liabilities would amount somewhere between $17.9 and $33.5 billion but vastly underestimated the volume of tailings that would be produced[84]. The Natural Resources Council and Environmental Defence Canada estimated in 2017 that the cost of remediating tailings and reclaiming mine lands would come in between $29.4 and $53.1 billion[85]. Still, these estimates pale in comparison to internal estimates leaked from the AER of $130 billion in 2018[86].

Inconsistency and the absence of a robust estimate could be due to weak transparency on part of governments and corporations and a general lack of knowledge. The AER currently estimates reclamation costs for oil sands mines to range from $45,000 to $75,000 per hectare but this does not include the remediation of tailings ponds[87]. The cost of tailings remediation is even more uncertain as companies continue to develop and experiment with new ways to adequately treat the toxic fluids. In 2010 the Pembina Institute estimated the cost of tailings remediation. Based off the limited government and industry data available they predicted costs to be between $15.40 and $19.29 per cubic meter of fluid tailings[88]. These estimates were based on consolidated tailings and thickener technologies, still commonly used in Canadian oil sands mines.

To ignore the cost of remediating tailings ponds would be to vastly underestimate liabilities in the oil sands. With little transparency around the AER's estimates but also a lack of alternatives, this report uses the conservative upper bound AER estimate for reclamation. For tailings remediation an average remediation cost of $17.35 per cubic meter of fluid tailings is used as a best estimate, recognizing ongoing advancements in technology and different uses and performance of technologies across sites. It should also be noted that estimates for the reclamation and remediation of oil sands mines do not include the decommissioning of operations facilities.

4. Canada's Balance Sheet

Following from the assumptions and estimations above, liabilities resulting from fossil fuel extraction are balanced against potential revenues from continued extraction. In the situation where these companies

[82] End pit lakes are large artificial lakes with fresh water placed on top of intreated tailings. They are an unproven technology for tailings reclamation. Environmental Defence Canada. 2022.

[83] A number confirmed in media interviews with the AER who in 2020 reported liabilities to be around $31 billion. Sharon J. Riley. 2020. *Ottawa is paying to clean up Alberta's inactive wells. Are the oilsands next?* The Narwhal, November 2020. https://thenarwhal.ca/ottawa-paying-clean-up-albertas-inactive-wells-oilsands-next/.

[84] Lemphers, N., Dyer, S., Grant. J. 2010. Toxic Liability: How Albertans Could End Up Paying for Oil Sands Mine Reclamation. Pembina Institute. https://www.jstor.org/stable/pdf/resrep00265.9.pdf

[85] The Natural Resources Defense Council (NRDC) and Canada's Environmental Defence (ED). 2017. *One Trillion Litres of Toxic Waste and Growing: Alberta's Tailings Ponds.* https://environmentaldefence.ca/wp-content/uploads/2017/06/AlbertaTailingsPondsReportFINAL.pdf

[86] Mike De Souza, Carolyn Jarvis, Emma McIntosh, and David Bruser. *Cleaning up Alberta's Oilpatch Could Cost $260 Billion, Internal Documents Warn*. Global News, November 2018. https://globalnews.ca/news/4617664/cleaning-up-albertas-oilpatch-could-cost-260-billion- regulatory-documents-warn/

[87] AER, 2021. Guide to the Mine Financial Security Program. https://static.aer.ca/prd/documents/liability/MFSP_Guide.pdf.

[88] The Pembina Institute. 2010. *Toxic liability fact sheet*. https://www.pembina.org/reports/toxicliabilityfactsheetfinal.pdf.

default, it will be public dollars that make up the short fall. For this reason, corporate profits from oil and gas production as well as potential revenues for government are estimated.

To estimate corporate profits and government takes from additional oil and gas production this report takes the top five oil and gas producers in Canada as benchmark companies plus Tourmaline, Canada's largest gas producer. Previously referred to as the 'big five', Suncor Energy, Canadian Natural Resources Limited (CNRL), Cenovus Energy, Imperial Oil, and Husky Energy (who in 2021 merged with Cenovus) operate 86 per cent of oil sands production and own substantial refining and upgrading facilities[89].

According to the *Oilweek Top 100* which chronicles publicly traded oil and gas producers in Canada, the big five also bring in a high proportion of total after royalty revenues collected by oil and gas corporation operating in Canada, with an average revenue of $26.7 billion dollars in 2019 (ranging from Suncor at around $38 billion and Cenovus at $20 billion)[90]. Tourmaline collected just over $1.8 billion. The revenues from the big five and Tourmaline equal just over 80 per cent of the total revenues earned by top 20 oil and gas producers in the country. Because of the degree to which these companies dominate oil and gas production in Canada, and their financial ability to deal with their environmental liabilities, this report considers them as stable representatives of the industry.

4.1 Corporate profits from oil and gas production

A great degree of uncertainty would be introduced to corporate profits from oil and gas under the assumption of climate responsible production. Throughout the report, the 2019 to 2021 time frame has been considered as a snapshot going forward, asking the question, if the oil and gas industry is to continue as is, what would this look like? In line with this assumption, corporate profits have been estimated using per barrel netbacks.

A netback is a measure used by corporations and investors to evaluate the operating performance of their oil and natural gas assets. In short, it is a measure of net profit per barrel of oil, often seen in barrel oil equivalents, after royalties, production cost, and transportation to market are accounted for. Corporate profits have been estimated assuming an average netback per barrel of oil equivalent based on 2019 and 2021 data, and a 5-year mean for the top oil and gas companies listed above[91]. The average netback per barrel of oil equivalent for the top oil and gas companies in Canada was $24.01/boe in 2019 and $27.55/boe in 2021. The 2019/2021 average skews high in comparison to the 5-year mean (2016-2021) of $22.64. The Alberta Energy Regulator forecasts the price of oil (West Texas Intermediate and West Canadian Select) to decrease from 2022 levels but remain high through 2031[92] with the potential to keep netbacks high, while increases in royalty payments over the next several years (discussed in the next section) stand to lower netbacks. Considering this, the EPC scenario assumes a continuation of the higher average netback (2019/2021) and the EF and GPE scenarios use the more conservative 5-year mean given their longer time horizons.

[89] Oil Sands Magazine (OSM). 2022. *Oil Sands Operations*. May 20. https:// www.oilsandsmagazine.com/projects/bitumen-production

[90] KPMG. 2021. *2021 Top Operators Report*. https://www.jwnenergy.com/article/2021/9/10/2021-top-operators-report-tackling-the-energy-tran/

[91] Netback averages for 2019 and 2021 skew high. The average netback across the 6 top producers (excluding Imperial Oil) according to annual financial reports in 2018 was $23.21 and $23.42 in 2017.

[92] Alberta Energy Regulator. Crude oil prices. Accessed Jan 2023. https://www.aer.ca/providing-information/data-and-reports/statistical-reports/st98/prices-and-capital-expenditure/crude-oil-prices

4.2 Government revenues from oil and gas production

The average royalty per barrel of oil equivalent can be estimated across Canada using production and ESTMA data. ESTMA data is collected in compliance with the Extractive Sector Transparency Measures Act, which requires extractive corporations to submit all payments made to governments each year[93].

ESTMA data for taxes, fees, and royalties were collected and averaged for the 'big five' companies in Canada and Tourmaline Oil. Payments per barrel of oil equivalent production were averaged between 2019 and 2021 (2020 being considered an outlier year due to the Covid-19 pandemic). Averaged estimates came to $0.86/boe taxes, $0.33/boe fees and $4.76/boe royalties. Table 6 presents the average government takes compared to corporate netbacks in 2019 and 2021. It can be seen that corporations made more than 4 times that of the government through taxes, fees and royalties in this time frame.

Table 4. Average government takes and corporate netbacks for top producers in 2019, 2021

	Average per boe	
Taxes	$	0.86
Fees	$	0.33
Royalties	$	4.76
Netbacks	$	25.78

These estimates do not account for subsidies to the oil and gas sector from federal and provincial governments. The phase out of oil and gas subsidies has the potential to increase the government take on a barrel of oil equivalent. Due to a broad lack of transparency on the part of industry and governments, however, accounting for the effect that a phase out of fossil fuel subsidies would have on corporate profits and government takes is highly uncertain. In this report it is assumed that subsidies do not affect netbacks or government revenues.

Additionally, the royalty estimated presented in Table 6 does not account for the adjustments in royalty rates when oil sands projects in Alberta move from pre-payout to post-payout. The point of project payout occurs when a project's cumulative revenue equals or exceed its cumulative costs. In Alberta's royalty framework this means that once a project hits post-payout a greater portion of the revenues generated by production go to the government, increasing the average per barrel royalty rate across the industry. In 2021 five oil sands projects reached post pay-out which has been reflected in the 2021 EMSTA data. However, it has been predicted that there will be an additional two projects moving into post-payout per year from 2022 to 2025[94].

To account for this in the following section, per barrel oil equivalent royalties were weighted with oil sands royalty averages assuming that the two additional projects with the lowest unrecovered balance reach post-payout each year beginning in 2022[95]. Estimated average royalty rates per barrel of oil equivalent are then $5.09 in 2022, $5.24 in 2023, $5.39 in 2024 and $5.53 in 2025. These royalty rates are assumed for calculating government revenues from royalties for the production remaining. After 2025 royalty rates are held constant.

4.3 Scenario balance sheets

The balance sheet presented in this section is intended to weigh oil and gas liabilities in Western Canada against the funds available from climate responsible production. Table 7 presents balance sheet results for

[93] Statistics Canada. 2022. Extractive Sector Transparency Measures Act Data Portal. https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2022008-eng.htm. Accessed October 2022.

[94] Robert Tuttle. August 2022. *Alberta to reap royalties' windfall as oilsands project costs paid off*. Financial Post. https://financialpost.com/commodities/energy/oil-gas/alberta-to-reap-royalties-windfall-as-oilsands-project-costs-paid-off

[95] Weighted average is from oilsands production to total oil and gas production in Western Canada measured in barrels of oil equivalents based on production data from Canada Energy Regulator (Oil sands made up 51 per cent of total production). https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-canada.html

the three carbon budget scenarios discussed above: the fair share or equal per-capita share (EPC); the economic efficiency share (EF); and 'business as usual' or the grandfathered production-emissions share (GPE). Staying consistent with the polluter pays principle the calculated surplus ('polluters pay') considers only corporate profits to cover liabilities. Additional oil and gas production will yield future liabilities, represented in Table 7. These liabilities have been calculated assuming consistent average production levels for the remaining years. Table 8 calculates potential government revenues from remaining extraction.

Table 5. Corporate profits and liabilities from climate responsible production over three scenarios

	EPC	EF	GPE
ASSETS			
Allowable extraction to stay within 1.5C (million boe)	2586	17881	53400
Years left at current production levels	1	6	17
FINANCIAL (billions)			
Corporate profits	**$66.67**	**$404.83**	**$1,208.98**
Current Liabilities	**$123.15**	**$123.15**	**$123.15**
Orphaned wells	$1.95	$1.95	$1.95
Well abandonments	$23.70	$23.70	$23.70
Well reclamations	$65.95	$65.95	$65.95
Oil sands mine reclamation	$7.26	$7.26	$7.26
Liquid tailings remediation	$24.29	$24.29	$24.29
Future Liabilities	**$2.01**	**$24.95**	**$100.53**
New wells drilled	$0.98	$5.85	$17.56
New land disturbed (oil sands mine)	$0.12	$0.71	$2.12
New liquid tailings	$0.92	$18.39	$80.85
Polluters Pay - Total Surplus (deficit)	**$ (58.49)**	**$ 256.73**	**$ 985.30**

Note: New wells drilled, land disturbed, and tailings pond expansion assumes a consistent growth rate equal to the 5-year average growth rate from 2016 to 2020 for the remaining current production years given the carbon budget scenario. Source: CAPP Statistical Handbook, Alberta Environment and Parks data library.

Table 6. Government revenues from climate responsible production over three scenarios

	EPC	EF	GPE
ASSETS			
Allowable extraction to stay within 1.5C (million boe)	2586	17881	53400
Years left at current production levels	1	6	17
FINANCIAL (billions)			
Government revenue	**$16.24**	**$117.54**	**$356.23**
Royalties	*$13.16*	*$96.26*	*$292.68*
Taxes	*$2.22*	*$15.38*	*$45.92*
Fees	*$0.85*	*$5.90*	*$17.62*

The equal parts per capita share (EPC) is the only carbon budget out of the three that could be considered a fair share. This share requires the most immediate action allowing only 2.59 billion boe extraction in 2022. This is around 400 million boe below production levels in 2021 and will almost certainly have been surpassed in 2022 resulting in a climate debt. In this scenario corporate profits from new extraction fail to cover environmental liabilities. This is in violation of the polluter pays principle. Government revenues from extraction in this scenario, equal to 16.42 billion, also fail to cover the shortfall.

The economic efficiency share estimates Canada's share of the global budget considering Canada's capacity to address climate change globally but does not consider Canada's historical emissions. This share increases the allowable extraction to 17.9 billion boe or six years at current production levels. In this scenario corporate profits from new extraction are enough to cover current environmental liabilities. Considering future liabilities, total liabilities reach $148 billion, or 36.6 per cent of corporate profits.

The grandfathered production-emissions share bases Canada's share of the global carbon budget on previous fossil fuel extraction without regard for the country's capacity or culpability. This is in violation to the Paris Agreement. Corporate profits in this scenario are also able to cover environmental liabilities. Total liabilities climb to $223.68 billion, 18.5 per cent of corporate profits.

5. Results Discussion

The Canadian oil and gas industry is past its economic limit

The EPC scenario is the fairest of the three scenarios, though still low ranking compared to other commonly referenced measures seen in Figure 1. This scenario shows us that Canada has already seen the point where fossil fuel production in the country surpassed its economic limit, meaning the cost of clean-up and environmental damages have overtaken the fair-share Paris-aligned potential for future revenues.

Oil and gas liabilities were calculated for Western Canada using available cost estimates for the decommissioning, remediation, and reclamation of well sites and oil sands mines. Current liabilities equated to over $123 billion without the inclusion of pipelines and facilities, meaning actual liabilities could be considerably higher. In the EPC scenario corporate profits from remaining extraction show a deficit of approximately $58.5 billion, and what government revenues that will exist from oil and gas production will not be enough to cover the shortfall.

The production budget associated with this scenario, given emissions in 2022, is consistent with past findings that Canada is already in a carbon debt. This stresses the urgency with which Canada needs to act toward climate change and the necessity of assisting other countries with abatement efforts.

Holding corporations accountable is a necessity, but public funding for oil and gas clean-up is not

In the EF and GPE scenarios corporate profits from remaining production are enough to cover existing oil and gas liabilities. However, covering the costs will make deep cuts into corporate profits. This finding points toward two important considerations.

First, public funding for the clean-up of environmental liabilities held by solvent owners is an unnecessary and inefficient subsidy to oil and gas corporations. As mentioned in Section 3.1, Alberta's Site Rehabilitation Program was an example of how federal funds have ended up in the hands of profitable oil and gas corporations in direct contradiction with the polluter pays principle. The comparison between the level of corporate profits from additional production and existing and future liabilities suggests that the industry is more than capable of fulfilling their legal obligations toward clean-up without public funding.

Second, provincial and federal governments will need to hold corporations accountable. In the EF scenario nearly one quarter of all corporate profits from remaining extraction will be required to cover the $123 billion in environmental liabilities already created. In the more lenient GPE scenario 10 per cent of corporate profits will need to go toward cleaning up environmental liabilities; 18 per cent if new wells are drilled and oil sand mining continues. These percentages are considerable and represent a drastic reprioritization of where money is spent within these corporations.

In 2022 the AER mandated the oil and gas sector in Alberta to increase spending on clean-ups to $700 million per year. At this rate it would take 175 years to clean-up the wells and oil sands mines that exist today. Put another way, in 2022, CNRL, Canada's largest oil and gas producer posted net earnings of $10.9 billion[96]. If CNRL had spent 6.5 per cent of their first quarter earnings on clean-ups, this would have covered the entire industry's mandated spending for the year.

In 2022 CNRL had a net increase of 390 oil and gas wells[97]. More wells are being drilled than cleaned up. Furthermore, the Parliamentary Budget Officer, using very conservative clean-up cost estimates, has

[96] Canadian Natural Resources Limited. 2022. 2022 Annual Report. https://www.cnrl.com/content/uploads/2023/03/2022-Annual-Report.pdf

[97] Canadian Natural Resources Limited. 2022.

warned of an increasing gap between securities held by provincial regulators and the cost to clean up orphaned and abandoned wells[98]. Without adequate government intervention, environmental liabilities will continue to grow alongside the urgency to curb oil and gas production. This is not a promising trajectory. Mandated clean-up budgets need to be realistic in light of climate responsible production. This would mean sector wide budgets in the range of 10 to 25 per cent of corporate profits.

Soaring returns for shareholders cannot continue in a climate responsible sector

Shareholders have seen soaring returns and have been promised by Canadian oil and gas producers that this trend will continue[99]. This narrative ignores corporation's responsibility toward existing and growing environmental liabilities and fails to consider the costs associated with the industry's own climate commitments.

In addition to corporate responsibilities around environmental liabilities, companies representing 95 per cent of oil sands production have committed to achieving net-zero emissions by 2050. This refers to the decarbonization of fossil fuel production, not including off-site processing or extracted carbon. This commitment comes through an industry alliance called The Oil Sands Pathways to Net Zero initiative, which includes Suncor, Cenovus, Canadian Natural Resources Ltd. and Imperial Oil, among others. A report published by the Pembina Institute in 2022 quoted cost estimates of $30 billion to $75 billion for the proposed initiative and found little justification for governments to foot the bill citing the oil sands sector's financial ability to invest in its own decarbonization[100].

Considering the EF and GPE scenarios, if the Canadian oil and gas sector honours both the polluter pay's principle in Western Canada and its own commitments to decarbonize, the bill comes in between $178 billion and $223 billion in the EF scenario, and between $224 billion $299 billion in the GPE scenario. These numbers are staggering and are likely to have considerable implications for shareholder returns. However, at the high end, they still only comprise 55 (EF) and 25 (GPE) per cent of estimated corporate profits from remaining production. The industry can afford it without public subsidization; however, these numbers strongly suggest that oil and gas corporations in Canada cannot prioritize profits for executives and shareholders while both claiming to be climate responsible producers and fulfilling their legal obligations toward clean-ups.

[98] PBO, 2022

[99] Amir Barnea. March 2022. Record profits in oil and gas should be used to fight climate change. Toronto Star. https://www.thestar.com/business/opinion/2022/03/12/record-profits-in-oil-and-gas-should-be-used-to-fight-climate-change.html

[100] Al-Aini, E., Severson-Baker, C., & Gorski, J. 2022. *Getting on track: A primer on challenges to reducing carbon emissions in Canada's oilsands*. Pembina Institute.

Appendix 1

The emissions-production budget methodology uses emissions factors corresponding to fuel types to calculate the amount of CO_{2e} that will be released into the atmosphere if that fuel were to be combusted. Because there are physical limitations on storing excess production, and only a small fraction of fossil fuels is diverted toward non-energy uses, in any given year production volumes can be translated into their inevitable emissions outcomes[101]. This report does not consider carbon capture, utilization, and storage (CCUS) technologies. CCUS has the potential to reduce the carbon intensity of fossil fuel energy, theoretically increasing the quantity of fossil fuels that may be combusted in a given carbon budget. However, these technologies are broadly ineffective and have not been proven at scale[102].

Drawing on the IPCC's global carbon budget for a 50 per cent chance of achieving the limit of 1.5 °C, (500 $GtCO_2$), a grandfathered production share (GPE) is estimated. A grandfathered approach estimates the share of the present remaining carbon budget for a given country proportional to the global emissions the country produces (see equation 1). To keep consistent with the emissions-production budget methodology the estimate used is based on Canada's three-year mean CO_2 emissions from fossil fuels produced as a percentage of total emissions (2019-2021)[103]. Because the IPCC remaining carbon budgets are estimated from the beginning of 2020, Canadian emissions from years 2020 and 2021 were subtracted to calculate Canada's remaining share from the beginning of 2022.

(1) $$Grandfathered\ share = \frac{emissions}{global\ emissions}\ x\ \ remaining\ carbon\ budget$$

[101] See the Tyndall Report section 4.1 for full explanation of the emissions-production budget methodology. Calverley & Anderson, 2022.

[102] Environmental Defence Canada. 2022. *Buyer beware: Fossil fuel subsidies and carbon capture fairy tales in Canada*. https://environmentaldefence.ca/wp-content/uploads/2022/03/Buyer-Beware-FFS-in-2021-March-2022.pdf

[103] Production data for oil, gas and coal was collected from the BP Statistical Review of World Energy, June 2022. Three-year means were then multiplied by their respective IPCC default emissions factors for stationary combustion in the energy industries (tCO_2 / toe): crude oil 3.07, natural gas 2.35, bituminous coal 3.96.