PEMBINA Institute

SUBMISSION

Environmental Impacts of Oil and Gas Production

Pembina Institute response to questions from the Standing Senate Committee on Energy, the Environment, and Natural Resources

Contact:

Simon Dyer | Deputy Executive Director | Pembina Institute

Janetta McKenzie | Interim Director, Oil and Gas | Pembina Institute

December 5, 2024

Summary

- Canada's oilsands are comparatively high-cost and emissions intensive, but cash flow analysis shows that carbon capture and storage (CCS) technology should be a viable option for companies.
- Stable carbon markets, in addition to the federal Investment Tax Credit for CCS and grants from the Government of Alberta, should prompt investment in these projects, but progress has been stagnant, underscoring the need for additional regulation.
- Oilsands production also has significant impacts on water and land.

Background

On November 21, 2024, Simon Dyer, Deputy Executive Director of the Pembina Institute, provided expert testimony to the Standing Senate Committee on Energy, the Environment and Natural Resources as part of its study 'Climate Change: Canadian Oil and Gas Industry.'

During that testimony, Senator Rosa Galvez posed a set of questions to the witnesses related to the environmental impacts of oil and gas production and the role of carbon capture and storage technology in reducing emissions from the sector. The questions, as transcribed from the session, were:

- *How much energy is required per barrel of oil sands?*
- *Where this energy that you use to extract the oil and gas is coming from?*
- *How many barrels of water are needed to extract one barrel of oil?*
- *How we balance the amount of water you have used to extract all this oil and the tailing ponds that are accumulating?*
- *What the efficiency of carbon capture and storage is?*
- *Where in the world there is a full-scale CCUS project — and how much to the cost of the production of oil and gas CCUS adds to the cost?*
- *I want to know the subsidies we give to the industry and how that compares with how much the industry pays to all its workers and how it compares to the cost of health issues.*

While we regret that we cannot offer a comprehensive answer to every question, what follows is a selection of existing Pembina Institute research on these topics that we hope the committee, and Senator Galvez, will find useful.

Overall, our body of research supports our testimony that oil and gas emissions should be a priority for additional regulation, given that oilsands emissions in particular have increased by

142% since 2005, and are on a trajectory to increase further in the near term as companies continue to ramp up levels of production.

Canada's oilsands are comparatively high-cost and emissions intensive

Our *Survival of the Cleanest* report from 2023 concludes that Canadian oil remains well above global averages for emissions and breakeven price.

As the figure below shows, the global average production cost per barrel of oil is US$21.50. In Canada the average is US$30.

Canadian oil is also comparatively emissions intensive, at 85 $kgCO_2e$ (kilograms of carbon dioxide equivalent emitted, per barrel of oil that is produced). This compares with the global average of 60 $kgCO_2e$.

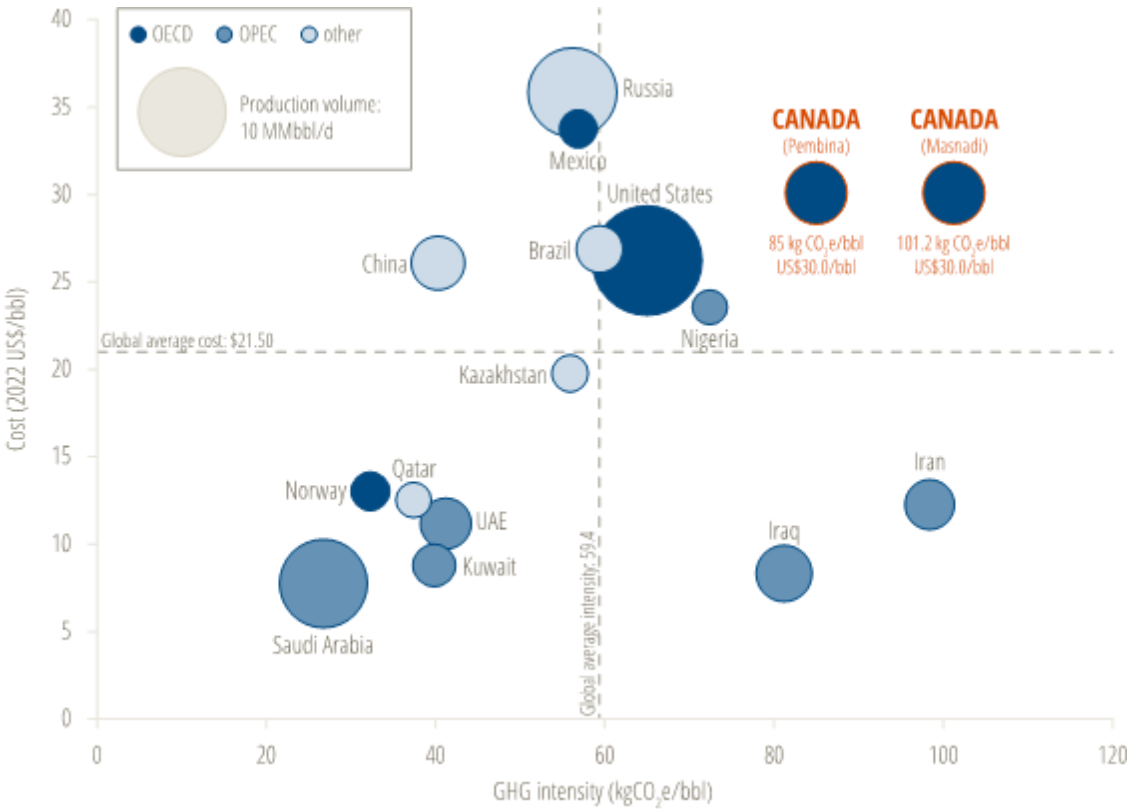

Figure 2 from *Survival of the Cleanest*. Average greenhouse gas emissions intensity and cost for the top 15 producing countries. Oil production in Canada (calculated both by Masnadi et al and by the Pembina Institute) is among the highest average emissions intensity and among the highest cost relative to the other producers.

Canada's oil and gas industry has worked over the past decade to reduce costs, particularly after the deep price slump experienced in 2016. However, global competitors did the same and many Canadian producers are not on track to compete on cost with their global peers.

In terms of emissions intensity, significant emissions reductions are still available to producers of conventional oil and gas globally, in particular through low-cost methane abatement. We have recently expanded on this point in this short article that explores outstanding methane reduction pathways that Canadian producers can explore at relatively low cost to production.

For oilsands producers, the picture is different. Fewer techniques exist to abate the methane associated with oilsands production (which is largely emitted from tailings ponds, rather than from equipment and wells, as is the case in the conventional sector). See further detail below on decarbonization pathways for Canada's oilsands.

Despite some improvements in emissions intensity, total emissions from oil and gas continue to rise and investment in decarbonization is minimal

Our 2020 report *The Oilsands in a Carbon-Constrained Canada* assessed the oilsands' carbon performance and found that, while emissions from the entire oil and gas sector — including the oilsands — increased by 23% between 2005 and 2017, emissions from the oilsands subsector alone more than doubled in that period. At the time of the report's publication, we projected that those emissions would keep growing at a similar pace through to 2030.

These trends have indeed continued since 2020; latest data from the National Inventory Report shows that oilsands emissions have now grown by over 50 million tonnes (megatonnes, Mt), an increase of 142%, from 2005-2022.

As mentioned earlier, there are significant opportunities in the conventional sector for methane abatement. By contrast, oilsands emissions largely originate from the specific extraction and upgrading techniques that are used, which require significant generation of heat and steam. Typically, natural gas is burned to generate that heat and steam, which is then injected into oilsands deposits to lower the viscosity of the bitumen, making it easier to extract. The path to meaningful decarbonization therefore likely involves a combination of significant deployment of carbon capture facilities, as well as solvent use for in situ production, and other efficiencies.

Although industry efforts to reduce emissions intensity resulted in an average decline across the oilsands of 22% from 2011 to 2022 (earliest and latest available data),, emissions intensity trajectories across the different oilsands extraction methods have diverged in recent years. While there have been continued gains from in situ (down 6% since 2018), both mining and mining with integrated upgrade have seen increases in their emissions intensity (by 12% and

8%, respectively) since 2018. Overall, this means that the average emissions per barrel of oil produced in Canada's oilsands has increased by 1% since 2018 – reflecting a stagnation in these efforts in recent years. See the below graph from Pembina Institute's 2024 *Waiting to Launch* update report.

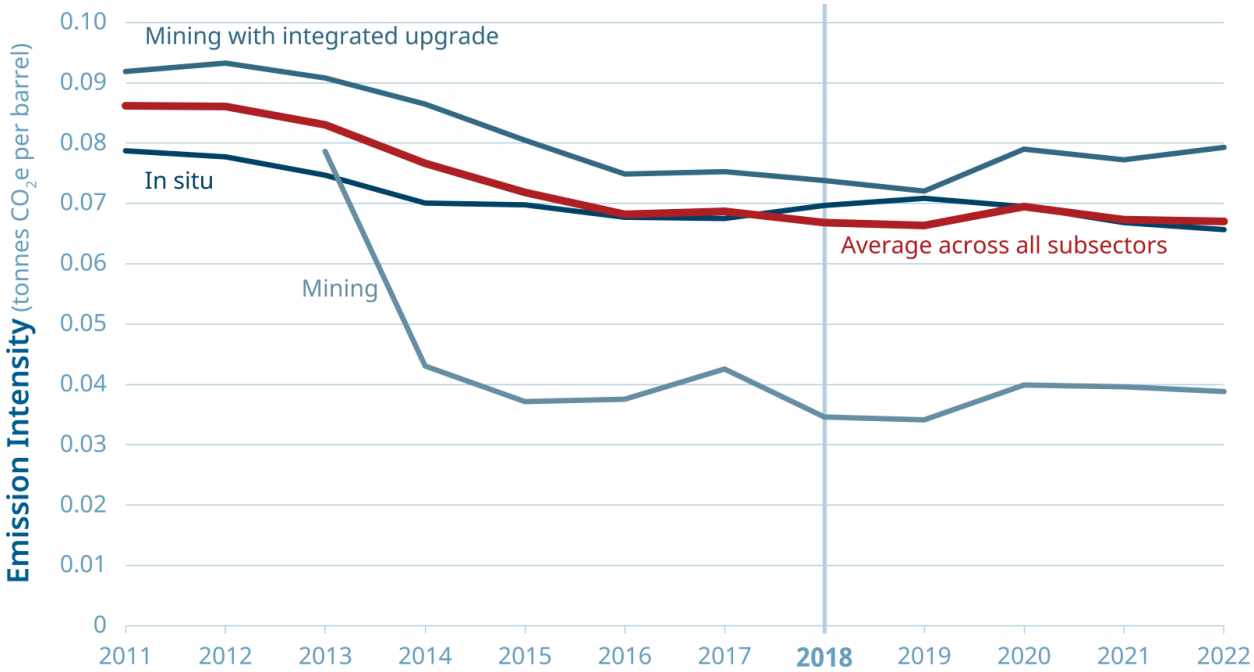

Figure 4 from *Waiting to Launch: 2024 mid-year update*. Oilsands emissions intensity by sub-sector.

Data source: Government of Alberta

Cash flow analysis shows financial viability of carbon capture and storage deployment with existing financial supports — if carbon credits are marketable

In collaboration with the Canadian Climate Institute, in 2023 we developed a cash flow model to assess the costs of CCS projects under existing and announced policies and incentives in Alberta. These incentives included the federal Investment Tax Credit for Carbon Capture Utilization and Storage, as well as the Alberta Carbon Capture Incentive Program (which together provide 62 per cent of the upfront cost of carbon capture projects in Alberta). We examined installing CCS on two typical oilsands facilities: an in-situ facility and a mine with an upgrader.

Our analysis shows that these projects are financially feasible under a range of potential costs and incentives, assuming a consistent carbon price that reached $170 per tonne in 2030. In the oilsands context, CCS is an investment in the carbon competitiveness of the companies' products, as well as in regulatory compliance given existing industrial carbon pricing systems like Alberta's Technology Innovation and Emissions Reduction Regulation. Additionally, our analysis, based on publicly available information, finds that CCS investments could offer

positive returns to companies, above and beyond compliance under carbon pricing regimes. In our model, both hypothetical projects would break even below the headline carbon price in 2030:

- A 1-Mt CCS project at the in situ facility reduces emissions by 63% and achieves internal rates of return of 11%-33%
- A 1-Mt CCS project at a hydrogen plant at an oilsands mine reduces emissions by 12% and achieves internal rates of return of 8%-16%

This technical backgrounder gives more detail of the higher-level overview of our findings, which were also published in Policy Options. It includes the discussion of methodologies, modelling assumptions and results.

However, despite the investment support on offer, as well as the healthy financial position that Canada's oilsands companies currently find themselves in, progress has been minimal in terms of decarbonization investment. For further details, see our *Waiting to Launch* series, where we have been tracking the commitments and progress of the oilsands Pathways Alliance since 2022.

Oilsands production has impacts on water and land, in addition to emissions

In 2013, we quantified a number of metrics of oilsands production on a per-barrel basis, including land disturbance, air emissions, water use, greenhouse gas emissions, and tailings production.

We acknowledge that this publication is now several years old, but believe it provides a comprehensive assessment of the types and scale of environmental impacts of oilsands production.

- Oilsands extraction consumes large amounts of water, despite current recycling efforts. In 2011, fresh water use intensity was 0.45 barrels of water per barrel of oil for in situ operations, and 2.41 barrels of water per barrel of oil for mining operations
- The land use intensity for an in situ oilsands project is based on the physical footprint area and production volumes over the total lifetime of the project. Our analysis finds that the average land use intensity for in situ projects in Alberta equals 1.4 hectares per million barrels, or 0.014 square metres per barrel of bitumen produced.
- There is little comparable or centrally compiled information on the land use intensity of oilsands mining.

Additionally, tailings ponds are a byproduct of the oilsands mining extraction process and contain sand, silt and toxic compounds. Seepage of untreated tailings water into groundwater may negatively impact living things downstream.

For instance, in February 2023, 5.3 million litres of tailings from Imperial Oil's Kearl mine leaked into the surrounding environment. It was later revealed that two previous incidents of tailings leaks had occurred at Kearl in 2022. However, nearby Indigenous communities were not informed until the February 2023 incident, raising serious questions about the sufficiency of existing policies, standards and procedures.

Unlike tailings produced from conventional hard rock mining, the solids in oilsands tailings will take centuries to settle to the bottom of the ponds, which makes managing fluid tailings an ongoing challenge for the oilsands mining industry.

Since oilsands mining operations began in 1967, 1,486 million cubic metres of fluid tailings has accumulated in these open ponds in the Lower Athabasca region, and has increased from 1,075 million cubic metres just since 2014. This is enough to fill more than 400,000 Olympic swimming pools.