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Decarbonizing Canada's oil and gas supply

Cutting the sector's emissions by 2030 is key to reaching net-zero by 2050

by Jan Gorski and Janetta McKenzie | March 21, 2022

Make or break

Oil and gas is Canada's largest emitting sector, accounting for 26% of greenhouse gas (GHG) emissions in 2019. Between 2005 and 2019, oil and gas emissions grew by 20%, while emissions in other sectors were declining. Despite reductions in emissions intensity per barrel, overall, Canadian crude oil remains some of the most carbon intensive in the world.

These figures demonstrate that, while every sector of the economy will need to contribute, cuts to oil and gas emissions will be crucial if Canada is to successfully meet its overarching climate goals (of a 40-45% reduction from 2005 levels by 2030, and net-zero by 2050).

Applied directly to the oil and gas sector, a commitment to reduce emissions by 45% amounts to an annual reduction of 103 million tonnes (megatonnes; Mt) from 2019 levels by 2030. This note demonstrates that the sector should be able to achieve this using commercially available technologies and economic means already at its disposal.

> Emissions from the oil and gas sector were 160 Mt in 2005. A 45% reduction from 2005 levels equates to 88 Mt. The last year of reporting of emissions is 2019, when the total for oil and gas was 191 Mt. To get to 88 Mt by 2030, the sector needs to reduce emissions by 103 Mt from 2019 levels.

While several Canadian firms have signalled their climate ambitions (including through industry's *Pathways to Net Zero* initiative, which pledges 22 Mt in GHG reductions by 2030), we suggest that the government set a clear trajectory for oil and gas emissions and quickly develop policy to provide a clear signal for the sector to make the investments needed to successfully play its part in meeting Canada's net-zero commitment.

A shrinking global market

Reducing emissions from the Canadian oil and gas supply is critical not only to meet climate goals, but for the industry remain competitive in an evolving global marketplace. Investors are placing increasing value on the GHG performance of oil and gas, and this pressure on firms'

environmental credentials looks likely to increase in the years ahead. In addition, credible agencies, including oil majors such as BP and Equinor, suggest that — even if climate action remains at its current pace — demand for oil will start to decline before 2030.

The war in Ukraine has resulted in a surge in the price of oil and gas in recent weeks adding to the windfall profits companies have already seen in the last year. It is reasonable to expect countries to respond to this new global crisis by accelerating their response to the climate crisis and more rapidly phasing out the use of fossil fuels. Prior to the conflict, the International Energy Agency's *Net Zero by 2050* report shows that demand will decline more rapidly as countries and populations adapt to meet their climate goals.

Opportunities for significant reductions

Our research has revealed a number short and medium-term actions that, when taken together, could achieve 83 Mt of the 103 Mt reduction required to reach the 2030 target. The further 20 Mt reduction could be achieved through a combination of other factors and decarbonization activities. The effect of these actions together is illustrated in Figure 1 and described below.

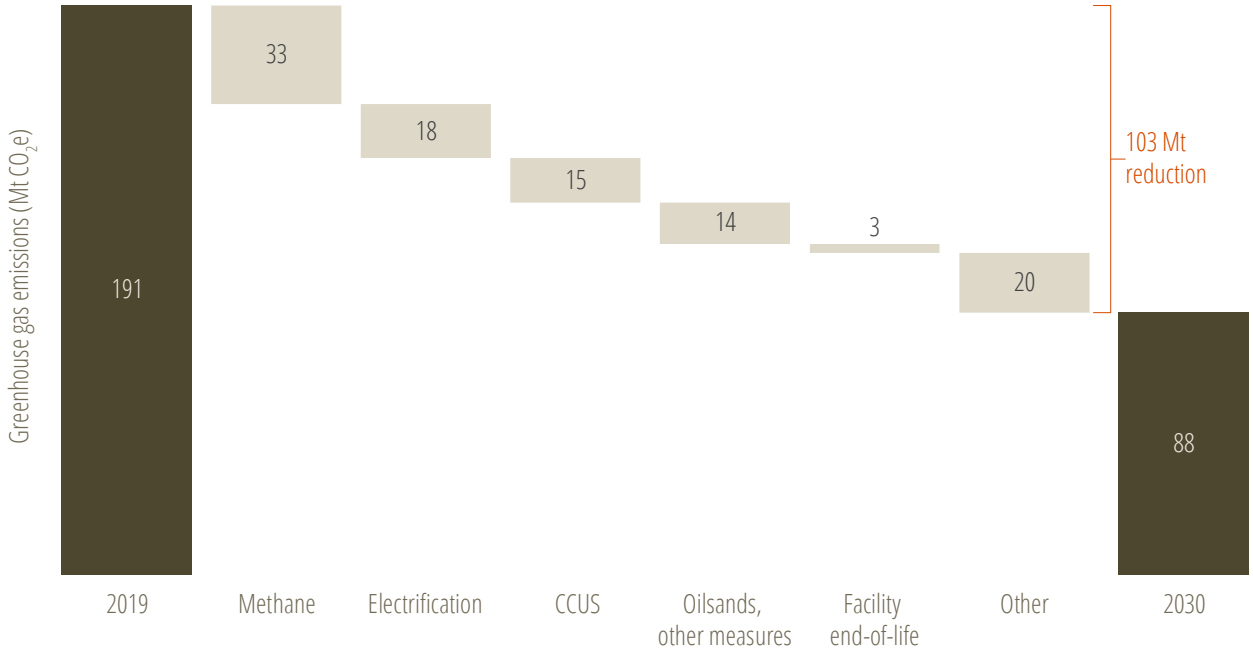

Figure 1. Potential to reduce GHG emissions from oil and gas sector by 2030

- **Methane** leakage is a major source of emissions in the conventional oil and gas sector. Strong regulations requiring regular inspections and relatively easy equipment upgrades could cut methane emissions by at least 33 Mt for less than $25/tonne CO_2e. Even greater reductions are likely to be possible at a price of $170/tonne CO_2e, which is the rate that the federal carbon price will reach by 2030.

- **Electrification** of engines and compressors used in the production, processing, and transport of natural gas and conventional oil could reduce emissions by 18 Mt. British Columbia has already committed to the BC Hydro Electrification Plan, which aims to reduce emissions by 0.93 Mt per year by 2026; this plan includes discounted rates and incentives for fuel-switching by industry. B.C. has also set out a target of 1.1 Mt from industrial electrification in its *CleanBC Roadmap to 2030*.
- **Capturing and storing CO_2** emitted from oilsands facilities (8 Mt), refineries (3 Mt), and gas plants (4 Mt) could reduce emissions by 15 Mt.
- **Additional reductions in the oilsands** sector from process improvements (5 Mt), electrification (4 Mt), energy efficiency (2 Mt) and other measures (3 Mt) could reduce emissions by 14 Mt.
- Facilities reaching their **end-of-life** by 2030 (as demand for oil declines in the next decade) could result in significant reductions. For example, the Suncor base mine in Alberta is expected to reach end-of-life in 2030 (3 Mt).
- The remaining reductions could be made through **other** decarbonization activities for which we do not yet have adequate information. This includes more reductions in the oilsands and methane (due to the fact that methane emissions are likely as much as twice as large as reported in current inventories), as well as facilities that will reach end-of-life but have not yet been publicly disclosed.

The assumptions behind this analysis are explained in Appendix A.

Any new projects require space under a cap

Crucially, to achieve these reductions, Canada must ensure that space is created under a cap when approving new sources of emissions from the sector.

The sector is well-placed to make investments now

Over the last decade, significant public funding and recycled carbon tax revenue have been invested in reducing the climate impact of oil and gas, through industry associations such as Canada's Oil Sands Innovation Alliance (COSIA) and agencies such as Alberta Innovates, Emissions Reduction Alberta (ERA) and the Petroleum Technology Alliance of Canada (PTAC)[1]. As an example, Alberta is a leader in carbon capture, utilisation and storage (CCUS), with three operational CCUS projects and a carbon pipeline that could enable more. At least half of the

[1] Since 2009, COSIA has contributed to 233 projects (https://cosia.ca/about/annual_reports); the ERA has committed $796 million to 220 projects (https://eralberta.ca/); and PTAC has facilitated over 462 projects (https://www.ptac.org/annual-reports/).

cost of each of these projects was funded by the provincial and federal governments, as they sought to demonstrate that CCUS could be done.[2]

The economic landscape has now changed considerably. The oil and gas sector is experiencing record revenues because of rising oil and gas prices and cost-cutting measures achieved though automation, consolidation and workforce streamlining (see Figure 2). Given these high revenues, the sector is well-placed to invest in additional emissions reductions now, but companies have not yet stated their intentions to do so .

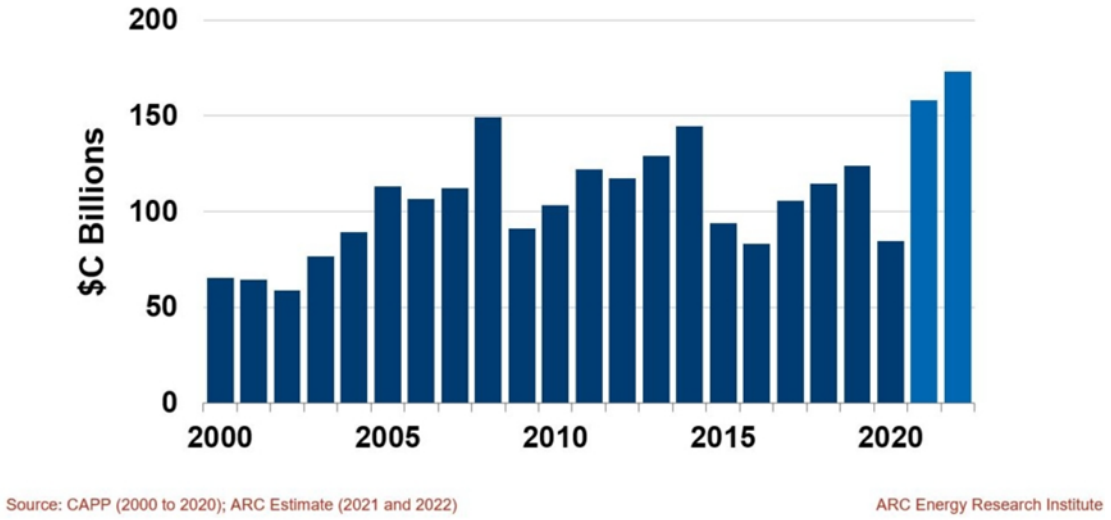

Figure 2. Total revenues from Canadian oil and gas producers

Source: ARC Energy Research Institute [3]

Waiting for certainty

To start making these investment decisions, companies are waiting for certainty from government on policies such as carbon pricing, methane regulations, and the clean fuel standard. As the government develops an emissions cap for the oil and gas sector, it should significantly strengthen these policies. This is the key to ensuring Canada will meet its international climate obligations, while ensuring its oil and gas industry remains competitive in an evolving global market.

[2] Alireza Talaei, Jason Switzer, Sara Hastings-Simon, Brian Mellor, *The CarbonTech innovation system in Canada,* Table 4 (2020). https://www.pembina.org/reports/carbontech-innovation-system.pdf

[3] Peter Tertzakian, "Meet the New Boom, Different from the Last Boom," *ARC Energy Research Institute,* January 18, 2022. https://www.arcenergyinstitute.com/meet-the-new-boom-different-from-the-last-boom

Appendix A: Potential GHG reductions by mitigation measure

The assumptions in the analysis are described in detail below.

Methane: Vented and leaked methane emissions from the oil and gas sector (not including oilsands) could be reduced by at 33 Mt using existing technology.[4]

Electrification: Electrifying engines and compressors used in the production, processing, and transport of natural gas and conventional oil could reduce combustion emissions by 18 Mt. This was calculated as follows:

First, emissions from combustion sources and engines in each province (Table 1) were estimated using the provincial distributions from the 2021 National Inventory Report (which was based on 2019 data), the portion of emissions from combustion sources in B.C. based on the 2020 B.C. provincial inventory, and distribution of oil production between Saskatchewan and Alberta using 2019 data from the Canadian Energy Regulator (CER).[5, 6, 7]

Table 1. GHG emissions from combustion sources in oil and gas sub-sectors across Canada

Province and sub-sector	Combustion (Mt CO_2e)	Engines (Mt CO_2e)
B.C.	**9.1**	**7.9**
Natural gas production and processing	7.9	6.7
Oil, natural gas, and CO_2 transmission	1.2	1.2
Saskatchewan	**6.1**	**4.0**
Natural gas production and processing	1.7	1.2
Conventional light oil production	0.6	0.5

[4] Canadian Energy Research Institute, *Economic and Environmental Impacts of Methane Emissions Reduction in the Natural Gas Supply Chain* (2019). https://ceri.ca/studies/economic-and-environmental-impacts-of-methane-emissions-reduction-in-the-natural-gas-supply-chain

[5] Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources And Sinks In Canada* (2021). https://publications.gc.ca/site/eng/9.506002/publication.html

[6] Government of B.C., "Industrial facility greenhouse gas emissions" (2020). https://www2.gov.bc.ca/gov/content/environment/climate-change/data/industrial-facility-ghg

[7] Canada Energy Regulator, *Canada's Energy Future Data Appendices* (2021). https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA

Conventional heavy oil production	2.5	1.0
Oil, natural gas, and CO_2 transmission	1.3	1.3
Alberta	**28.3**	**22.0**
Natural gas production and processing	20.1	14.5
Conventional light oil production	3.6	3.3
Conventional heavy oil production	0.6	0.3
Oil, natural gas, and CO_2 transmission	4.0	4.0
Ontario and Manitoba	**1.3**	**1.3**
Oil, natural gas, and CO_2 transmission	1.3	1.3

The quantity of combustion emissions attributed to engines (as opposed to heaters and boilers) was estimated using data from the 2014 Clearstone Engineering Ltd inventory of emissions from the upstream oil and gas industry as shown in Table 2.[8]

Table 2. Distribution of fuel burned by equipment type for various oil and gas sub-sectors

Facility type	Engines	Boilers/ heaters
Light/medium crude oil production	91%	9%
Heavy crude oil cold production	50%	50%
Heavy crude oil thermal production	1%	99%
Natural gas production and processing	72%	28%
Natural gas production and processing, B.C.	84%	16%

Then, to estimate GHG reductions from converting these natural gas fired combustion engines to electric-driven (Table 3), the following factors were assumed:

- Combustion engine thermal efficiency: 35%[9]
- Sites with access to the electricity grid: 90% of sites in B.C., 50% in Saskatchewan, 50% in Alberta, and 100% in Manitoba and Ontario.

[8] Clearstone Engineering Ltd., *UOG Emissions Inventory Methodology Manual,* Volume (2014), 36.

[9] *UOG Emissions Inventory Methodology Manual*, Volume 3, 38.

- Electrical grid emission factor, 2030 (in t CO_2e/GWh)[10]: Alberta: 120, Saskatchewan: 84, Ontario: 26, Manitoba: 1

Table 3. GHG emissions and reduction potential from electrifying engines in oil and gas sector in (Mt CO_2e)

Province	Combustion GHGs	Engine GHGs	GHGs from engines with grid access	GHG reduction from electrification
B.C.	9.1	7.9	7.1	7.1
Saskatchewan	6.1	4.0	2.0	1.7
Alberta	28.3	22.0	11.0	8.2
Ontario and Manitoba	1.3	1.3	1.3	1.3
Total	**44.8**	**35.3**	**21.5**	**18.2**

CCUS of vented formation CO_2: Capturing and storing 90% of CO_2 vented from gas processing plants could reduce emissions by 4 Mt.

CCUS at refineries: The four refineries around Edmonton which are close to the Alberta trunk line, and one in Regina, have total emissions of 6 Mt. Capturing and storing 50% of the emissions at these refineries could reduce emissions by 3 Mt.

Oilsands: CCUS and other measures: The Oil Sands *Pathways to Net Zero* initiative, a consortium of the six major oilsands producers, assumes that emissions from the oilsands can be reduced by 8 Mt through CCUS, with additional reductions of 14 Mt from process improvements, electrification, energy efficiency and other measures for a total of 22 Mt by 2030. This amount is a conservative estimate.

End-of-life projects: The Suncor base mine is expected to reach end-of-life by 2030. If Suncor's current proposal to extend its lifetime by expanding the mine is not approved, emissions from the entire facility would drop by 3 Mt.[11]

[10] Canada Energy Regulator, *Canada's Energy Future* (2021), net-zero base scenario. https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2021/index.html

[11] Suncor Energy Inc., *Base Mine Extension, Detailed Project Description Summary* (2020), 23. https://iaac-aeic.gc.ca/050/documents/p80521/135634E.pdf

Other: The remaining reductions could be made through other decarbonization activities for which we do not yet have adequate information. This includes more reductions in the oilsands, as well as facilities that will reach end-of-life but have not yet been publicly disclosed.

Additional reductions are also likely to be achieved due to the fact that methane emissions are currently underestimated and easy to abate. In 2019, methane emission from oil and gas production accounted for 39 Mt, but this number could be twice as high.[12] While this would increase 2005 baseline emissions, it would also increase the portion of reductions that could be achieved from methane, as technology exists to easily abate these emissions.

Summary

Table 4. Potential GHG reductions in the oil and gas sector by 2030

Mitigation measure	Emissions (Mt CO_2e)
Methane abatement	33
Electrification of engines and compressors	18
CCUS	
from vented CO_2	4
from refineries near Edmonton	3
from oilsands	8
Other oilsands reductions	14
End-of-life projects (Suncor base mine)	3
Other	20
Total	**103**

[12] Elton Chan et al., "Eight-Year Estimates of Methane Emissions from Oil and Gas Operations in Western Canada Are Nearly Twice Those Reported in Inventories," *Environmental Science & Technology*, 54, 23, (2020). https://pubs.acs.org/doi/10.1021/acs.est.0c04117