Saskatchewan Environmental Society

Oil and Gas Methane Emissions F.A.Q.

Why is methane important?

Methane (CH_4) is an important greenhouse gas because it has the ability to trap more heat than carbon dioxide. According to the 5th Assessment Report by the Intergovernmental Panel on Climate Change (IPCC), methane has a global warming potential – or GWP – 28 times greater than carbon dioxide on a 100-year basis, and even greater in a shorter time span. Methane is typically expressed in terms of "carbon dioxide equivalence" or "CO_2e," which converts the amount of methane to the equivalent amount of carbon dioxide using a GWP multiplier. Canada uses the multiplier of 25 for methane, which was the 100-year GWP reported for methane in the IPCC 4th Assessment Report.

While carbon dioxide remains in the atmosphere for a longer period of time compared to methane, methane is more powerful greenhouse gas. Thus carbon dioxide has the most influence over how warm the planet becomes, while methane can impact the speed of that warming. Research shows that methane is responsible for 25% of current global warming, and thus policy designed to control the release of methane is critical to limit rising average global temperatures.[1]

Methane emissions can also contribute to a host of other issues, such as respiratory problems, air quality, and acidity of surface water and soil.

Where does methane come from?

Methane emissions can originate from a variety of sources. For example, in Saskatchewan methane emissions generally arise from the agricultural sector (5.1 Mt CO_2e), waste disposal (1 Mt CO_2e) and energy production (11.7 Mt CO2e). There are smaller amounts of methane (less than 0.1 Mt CO_2e) emitted from other sources such as residential areas, and road or off-road transportation. In total, the Government of Canada estimates that Saskatchewan's methane emissions are 700 kt or 18 Mt CO_2e.[2] Recent research,[3,4,5] however, suggests these official inventories likely *underestimate* actual methane emissions. Our official inventories currently rely on industry reporting.

The largest single source of methane in Saskatchewan comes from the oil, natural gas and mining sector. The Government of Canada estimates that

90% of methane emissions from this sector originate from oil and gas production, otherwise known as "upstream" emissions.[6]

The reason the oil and gas sector is such a large producer of methane is because methane is the primary component of natural gas, and is produced alongside oil in oil wells and in gas wells that do not produce oil. During the production of oil and gas, methane can be deliberately released or "vented", burned off or "flared", or leaked from equipment. In the latter case, these emissions are sometimes called "fugitive" emissions. Methane emissions can be vented, flared or leaked at many points along the oil and gas supply chain. Some examples are shown in Figure 1 on the next page.

In Saskatchewan, vented/flared/leaked emissions are the largest single source of emissions from the oil, gas and mining sector – and in Saskatchewan overall - accounting for approximately 17% (13 Mt CO_2e) of our total provincial emissions. Approximately 8.4 Mt (CO_2e) are from venting, 1 Mt (CO_2e) from flaring and 3.3 Mt (CO_2e) from equipment leaks. 11 Mt (CO_2e) of these emissions are methane, and about 2 Mt are carbon dioxide.[7]

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1 Shoemekr J.K., Schrag D.P., Molina M.J. and Ramanathan, V. 2013. "What Role for Short-Lived Climate Pollutants in Mitigation Policy?" *Science* 342 (6164): 1323-1324. Available online at http://ramanathan.ucsd.edu/files/pr200.pdf

2 Environment and Climate Change Canada. 2015. "National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada." Pt. 3. Available online at https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=83A34A7A-1

3 Brandt A.R., Heath G.A., Kort E.A., et al. 2014. "Methane Leaks from North American Natural Gas Systems." *Science* 343 (6172): 733-735. Available online at https://nature.berkeley.edu/er100/readings/Brandt_2014.pdf

4 Greenpath Energy Ltd. 2016. "Greenpath 2016 Alberta Fugitive and Vented Emissions Inventory Study." Available online at http://www.greenpathenergy.com/wp-content/uploads/2017/03/GreenPath-AER-Field-Survey-Results_March8_Final_JG.pdf

5 Atherton E., Risk D., Fougere C., Lavoie M., Marshall A., Werring J., Williams J.P. and Christina Minions. 2017. "Mobile measurement of methane emissions from natural gas developments in Northeastern British Columbia, Canada." Discussion Paper. Atmospheric Chemistry and Physics. Available online at https://doi.org/10.5194/acp-2017-109

6 Government of Canada. 2017. "Canada Gazette Part II: Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)." P.2078. Available online at https://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=243

7 Environment and Climate Change Canada. 2015. "National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada." Pt. 3. Available online at https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=83A34A7A-1

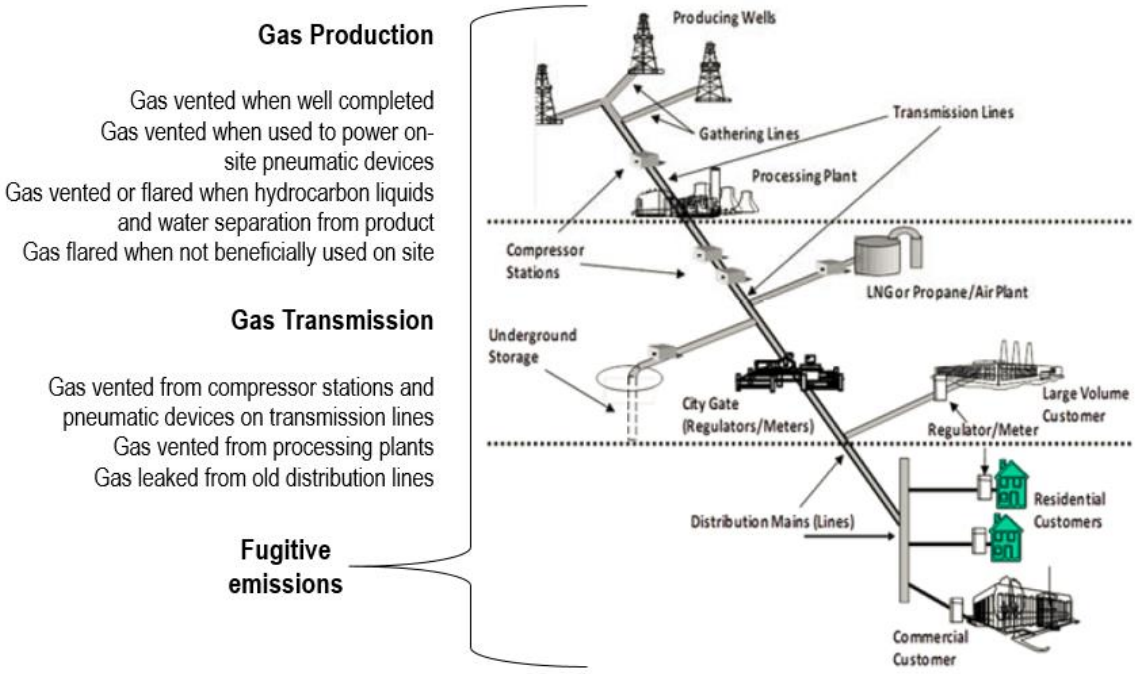

Figure 1. Sources of methane emissions from oil and gas production. Figure adapted from ICF International.[14]

The Canadian Association of Petroleum Producers estimates that the top 5 to 10 percent of leaking components are typically responsible for 80 to 90 percent of emissions. [8]

In Canada, Saskatchewan and Alberta are responsible for most of the methane emissions associated with the oil and gas sector across Canada.

What is Saskatchewan doing about methane?

Like British Columbia and Alberta, Saskatchewan has regulations aimed at controlling methane emissions published under *The Oil and Gas Conservation Act*. These regulations - Directive S-10: Saskatchewan Upstream Petroleum Industry Associated Gas Conservation Directive and Directive S-20: Saskatchewan Upstream Flaring and Incineration Requirements – were last updated in November 2015.

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8 Canadian Association of Petroleum Producers CAPP. 2007. "Best Management Practice: Management of Fugitive Emissions at Upstream Oil and Gas Facilities." Document 2007-0003. Available online at http://www.capp.ca/publications-and-statistics/publications/116116

Under Directive S-10, firms are required to examine the potential to eliminate or reduce emissions. If these cannot be achieved, industries are required to meet performance standards which require them to flare, incinerate or vent at a volume less than 900 m^3/day.[9] Directive S-20 also lists performance standards and provides specification for equipment spacing and setback distances for oil and gas flaring and incineration, applicable to licensed wells and facilities.[10]

Directive S-10 and S-20 however, does not apply to emissions resulting from equipment leaks – a large source of methane emissions in Saskatchewan. To partially fill this gap, industries are encouraged to follow voluntary standards by the Canadian Standards Association – specifically CSA Z620 released in 2016 – and best management practices from the Canadian Association of Petroleum Producers (CAPP).

The focus of the CSA standards are to prevent the problem at the design and construction phase of the well and facility so that the problem of leakage does not occur in the first place. [11]

In general, CAPP's best management practices encourage reducing leaks via the best technology in design and material selection, direct inspection and maintenance, and through corporate commitment.[12]

To achieve significant reductions from the oil and gas industry however, more concrete efforts are required.

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9 Government of Saskatchewan. 2015. "Directive S-10 Saskatchewan Upstream Petroleum Industry Associated Gas Conservation Directive." Available online at www.publications.gov.sk.ca

10 Government of Saskatchewan. 2015. "Directive S-20: Saskatchewan Upstream Flaring and Incineration Requirements." Available online at www.publications.gov.sk.ca

11 Canadian Standards Association. 2016. "Z620.1-16 – Reduction of fugitive and vented emissions for upstream petroleum and natural gas industry systems." 55 pp.

12 Canadian Association of Petroleum Producers CAPP. 2007. "Best Management Practice: Management of Fugitive Emissions at Upstream Oil and Gas Facilities." Document 2007-0003. Available online at http://www.capp.ca/publications-and-statistics/publications/116116

What does the Government of Canada want to do?

The Government of Canada is seeking to reduce methane emissions from the oil and gas sector to deliver on the commitments made in both the United States-Canada Joint Statement on Climate, Energy and Artic Leadership, the Paris Climate Agreement and the Leaders' Statement on a North American Climate, Clean Energy and Environment partnership. These commitments aim to reduce methane emissions by 40% to 45% below 2012 levels by 2025.

The Government of Canada has published proposed regulations under the Canadian Environmental Protection Act to control methane emissions from the upstream oil and gas sector. [13]

These proposed regulations contain five production, processing and transmission standards designed to reduce fugitive and vented emissions from upstream oil and gas producers. Regulations would apply to facilities producing or receiving more than 60,000 m^3 of hydrogen gas annually. If the regulations are approved, leak detection and repair (LDAR) programs, well completion by hydraulic fracturing and compressor limits will come into force January 2020. Facility production venting requirements and emissions limits for pneumatic devices come into force January 2023.

Specifically, upstream oil and gas facilities would be required to:

- Limit vented volumes to 250 m^3 per month as of January 1, 2023;
- Implement Leak Detection and Repair (LDAR) as of January 1, 2020. Regular inspections will be required 3 times per year and detected leaks are to be repaired within 30 days unless the facility has to be shut down, in which case an action plan must be created;
- Conserve or destroy gas instead of venting as of January 1, 2020 (with the exception of British Columbia and Alberta where regulations are already in place);
- Eliminate hydrocarbon gas emissions from pneumatic controllers with compressor power of 745 kW - or use low emitting controllers - as of January 1, 2023;

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13 Government of Canada. 2017. "Canada Gazette Part II: Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)." P.2078. Available online at https://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=243

- Eliminate gas emitted from pneumatic pumps, or equip an emissions control device, where pumping exceeds 20 L per day. Proponents can seek permits where emission reductions are economically or technically infeasible. This will come into force as of January 1, 2023;
- Measure flow rates, and apply corrective action where emissions exceed 0.023 m^3 per minute for reciprocating compressors or 0.17 m^3 for centrifugal compressors;
- Register and keep timely and reliable records in order to demonstrate compliance.

The government expects that between 2018 and 2035, proposed regulations will reduce 282 Mt (CO_2e) of methane emissions from the upstream oil and gas sector.

What will it cost?

Ultimately, cost will vary across firms, regions and emission reduction strategies. For example, the marginal abatement cost curve shown in Figure 2 on the next page, constructed by ICF International on behalf of the Environmental Defense Fund, shows that mitigation strategies range from a cost savings of $11 to a cost of $41 per tonne of CO_2e methane reduced.[14]

In their proposed regulations, the Government of Canada has prepared a detailed cost-benefit analysis, and provided compliance cost estimates for the oil and gas industry, for the regulator and by province. Overall, proposed regulations are expected to cost the industry $3.3 billion between 2018 and 2035, but industries are expected to capture natural gas equivalent to $1.6 billion.[15]

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14 ICF International. 2015. "Economic Analysis of Methane Emission Reduction Opportunities in the Canadian Oil and Natural Gas Industries." Prepared for the Environmental Defense Fund and the Pembina Institute. p.1-3. Available online at https://www.pembina.org/reports/edf-icf-methane-opportunities.pdf

15 Government of Canada. 2017. "Canada Gazette Part II: Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)." P.2078. Available online at https://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=243

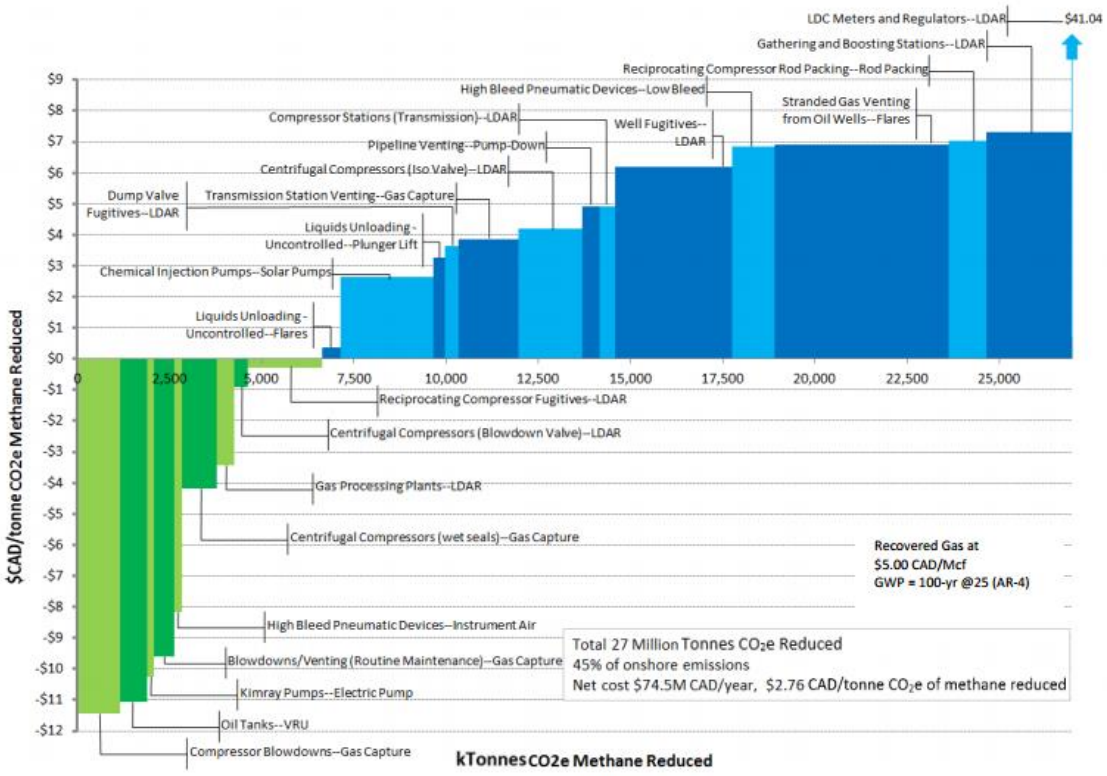

Figure 2. Marginal Abatement Cost Curve for Methane Emission Reductions By Source. Figure from ICF International.[14]

Further, the Government estimates that with the achievement of 282 Mt CO_2e of methane reductions, Canada will avoid $13.4 billion in climate change damages. Net benefits for the proposed regulations are estimated to be $11.7 billion. Detailed estimates per time block are summarized in Table 10 on the next page, extracted from the proposed regulations (p.2107).

The Government expects the most significant costs will be incurred in 2023 due to capital investments. In general, administrative costs per industry, 78% of which is record keeping, is expected to be $1,100. Table 2 (p.2097) and Table 3 (p.2908) extracted from the regulations show the estimated costs of compliance per standard by time block, and the associated administrative costs for industry and government, respectively.

Table 10: Summary of benefits and costs

Monetized Impacts (millions of dollars)	2018–2025	2026–2030	2031–2035	Total
Climate change benefits	3,858	4,873	4,697	13,429
Value of conserved gas	477	586	521	1,585
Total benefits	**4,336**	**5,460**	**5,218**	**15,014**
Industry compliance costs	2,437	446	381	3,265
Industry administrative costs	11	6	5	21
Government administrative costs	5	2	2	8
Total costs	**2,453**	**454**	**389**	**3,295**
Net benefits	**1,883**	**5,006**	**4,895**	**11,719**
Quantified benefits				
Net GHG reduction (Mt CO_2e)	**80**	**102**	**100**	**282**
Gas conserved (PJ)	**184**	**241**	**238**	**663**
VOC reduction (kt)	**186**	**286**	**297**	**769**
Qualitative benefits				
Health and environmental benefits due to VOC emission reductions.				

Note: Numbers may not add up due to rounding. Monetized values are discounted to present value using a 3% discount rate.

Table 2: Industry compliance costs by proposed standard (millions of dollars)

Proposed Standard	2018–2025	2026–2030	2031–2035	Total
Facility production venting requirements	749	229	222	**1,201**
Leak detection and repairs	187	102	85	**374**
Well completion requirements	16	17	8	**41**
Pneumatic controllers and pumps	1,411	53	28	**1,492**
Compressors	74	45	38	**157**
Total	**2,437**	**446**	**381**	**3,265**

Note: Numbers may not add up due to rounding. Monetized values are discounted to present value using a 3% discount rate.

Table 3: Administrative costs for industry and Government (millions of dollars)

	2018–2025	2026–2030	2031–2035	Total
Industry administrative costs	11	6	5	**21**
Government administrative costs	5	2	2	**8**
Total administrative costs	**15**	**8**	**7**	**29**

Note: Numbers may not add up due to rounding. Monetized values are discounted to present value using a 3% discount rate.

Many groups advocating for methane emission reductions have long argued that it is one of the most cost-effective ways of achieving emission reductions. For example, an economic analysis commissioned by the Pembina Institute and the Environmental Defense Fund shows that a 45% reduction could come at a cost of $74.5 million per year (with captured natural gas being sold at full economic value), and an initial capital cost of $726.7 million.[16] Used to estimate the cost between 2017 and 2025, this is approximately $1.3 billion (compared to the Government of Canada's estimate of $2.4 billion) and comes at a cost of about $2.67 per tonne of CO_2e reduced.

Alternatively, the Canadian Association of Petroleum Producers (CAPP) estimates that the proposed regulations will cost the industry much more - $4.1 billion between 2018 and 2025.[17] CAPP also argues that regulations could have significant impact of profitability and viability of Canadian production and that Canadian gas production is at risk of being displaced by US competitors.

At surface these cost estimates appear very different, ranging from approximately $1.3 billion to $4.1 billion between 2017 and 2025. Within the context of annual expenditures of the oil, gas and mining sector however, this range represents 0.2% to 0.6% of the expenditures the industry could theoretically make between 2017 and 2025.[18]

Will reducing methane emissions impact our ability to compete internationally?

The evidence suggests 'no'. Some of our largest competitors from the United States, such as North Dakota and California, have much stricter methane regulations and have had them in place for years.

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16 ICF International. 2015. "Economic Analysis of Methane Emission Reduction Opportunities in the Canadian Oil and Natural Gas Industries." Prepared for the Environmental Defense Fund and the Pembina Institute. Available online at https://www.pembina.org/reports/edf-icf-methane-opportunities.pdf

17 The Canadian Association of Petroleum Producers CAPP. 2016. "CAPP Assessment of Federal Draft Regulatory Model for Methane Emissions Reduction." Presentation available online at https://drive.google.com/file/d/0B_0MqnZ4wmcMWUNwU2FpZE5XMm8/view

18 Average annual expenditures from the oil, gas and mining sector between 2010 and 2014 was approximately $81 billion. The estimates above are expressed as a percentage of $81 billion spent every year for 8 years, or $648 billion. Data from Statistics Canada. 2014. "Capital expenditures by sector, by province and territory." Catalogue no. 61-205-XIB. CANSIM table 029-0005. Available online at http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/busi03a-eng.htm.

For example, North Dakota banned the practice of venting emissions in 2012, and gas must be flared or captured. The State adopted regulations requiring operators to meet declining annual targets for flared gas beginning in 2014. These measures are reducing emissions; since flaring targets were implemented, emissions from flaring have fallen from 35% to less than 15% of total natural gas production.[19] North Dakota's economic performance also remains strong – oil production has risen from less than 400,000 barrels per day in 2010 to more than 1 million barrels per day in 2016.[20]

Another reasons for reduced flaring is that industries have a financial incentive to comply because they pay tax and royalties on all natural gas flaring in North Dakota. As firms have increasingly invested in ways to control venting and flaring, they have built pipeline infrastructure to capture more of the natural gas that previously was released. Thus while North Dakota's production of natural gas keeps expanding, methane emissions are continually reduced.

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19 U.S. Energy Information Administration. 2016. "Natural gas flaring in North Dakota has declined sharply since 2014." Available online at https://www.eia.gov/todayinenergy/detail.php?id=26632

20 Government of North Dakota. 2017. "ND Monthly Oil Production Statistics." Available online at https://www.dmr.nd.gov/oilgas/stats/historicaloilprodstats.pdf