

A low-angle photograph of an oil pumpjack against a sunset sky. A worker in a hard hat and orange safety vest stands to the right, holding a clipboard and pen, looking towards the pumpjack. The scene is silhouetted against the bright, colorful sky.

# **International comparisons show Canada doing its part to **reduce methane emissions****

**FEBRUARY 2022**

**CEC Research Brief Twenty-One**  
Ven Venkatachalam and Lennie Kaplan

**Canadian Energy Centre**

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## EXECUTIVE SUMMARY

Methane emissions result from both human activities and natural sources. Methane emissions contribute to overall greenhouse gas (GHG) emissions. Methane emissions continue to increase across the globe, especially in countries that have not signed the Global Methane Pledge. Methane is between 28 and 34 times more potent than carbon dioxide (CO<sub>2</sub>).

This Research Brief analyzes the Canadian oil and gas sector's methane emissions record for upstream (crude oil exploration and production) and downstream (refining and sales) activities relative to that of other countries. Globally, methane emissions from the oil and gas sector are estimated at 77.3 MT, or over 13 percent of global methane emissions.

In 2020, the absolute methane emissions from Canada's oil and natural gas activities was low compared to that from other major oil and gas producers. Russia recorded higher methane emissions than any other country, at 14,886 kilotons (kt) in 2020. Canada's methane emissions that year were 2,098 kt. Russia, the United States, Iran, and Iraq were responsible for more than half of all global methane emissions from oil and gas production. At 5.2 tons of methane per kiloton of oil equivalent (tCH<sub>4</sub> /ktoe), Canada's oil and gas methane emissions intensity is one of the lowest among major energy producers.

Russia accounted for 20 percent of the global upstream oil and gas methane emissions and 17 percent of global downstream oil and gas methane emissions. Canada's global share of methane emissions was just 3 percent of upstream activities and 1.5 percent from downstream activities.

To fully grasp how efficiently Canada has been reducing methane emissions, we compared increases and decreases in methane emissions with increases and decreases in oil production for major energy-producing countries between 2000 and 2018. Canada's methane emissions fell by 16 percent even as its oil production increased by 91 percent between 2000 and 2018. Meanwhile, worldwide methane emissions increased by 27 percent while oil production increased by 38 percent between 2000 and 2018.

Canada is an example of a major oil and gas producing nation that has successfully reduced its methane emissions in the oil and gas sector over the past two decades.

# INTERNATIONAL COMPARISONS SHOW THAT CANADA'S OIL AND GAS SECTOR IS DOING ITS PART TO **REDUCE METHANE EMISSIONS**

## Introduction

Methane is between [28 and 34 times more potent](#) than carbon dioxide (CO<sub>2</sub>). Methane emissions result from human activities and from natural sources. Human activity (anthropogenic emission) releases methane mainly from industrial and agricultural activities and landfills. In nature, methane is emitted from a variety of sources including wetlands. Methane is the second most abundant greenhouse gas (GHG) after CO<sub>2</sub>, accounting for more than [20 percent](#) of global emissions.

In November 2021, 100 countries representing about 70 percent of the global economy launched the [Global Methane Pledge](#). While Canada is a [signatory](#) to the pledge, other major oil and gas producers, including the world's most significant methane emitters, [Russia, China, India](#), and Australia, have not signed it.

Canada is a [significant producer](#) of oil and natural gas. Understanding and quantifying methane emissions from Canada's oil and gas sector compared to such emissions from other oil and gas producing countries is vital to current discussions about climate change. Methane emissions continue to [increase across](#) the globe, especially in countries that have not signed the Global Methane Pledge.

This CEC study analyzes the Canadian oil and gas sector's methane emissions record for upstream (crude oil exploration and production) and downstream (refining and sales) activities relative to that of other countries.

## Measuring and reporting on methane emissions

Methane emissions occur during the production, processing, storage, distribution, and use of natural gas. Oil production can also generate methane during drilling and extraction.

Flaring and venting are two ways an oil or natural gas producer can generate methane. Venting is the intentional controlled release of un-combusted gases directly into the atmosphere, while flaring is the disposal by combustion of natural gas or gas derived from petroleum.

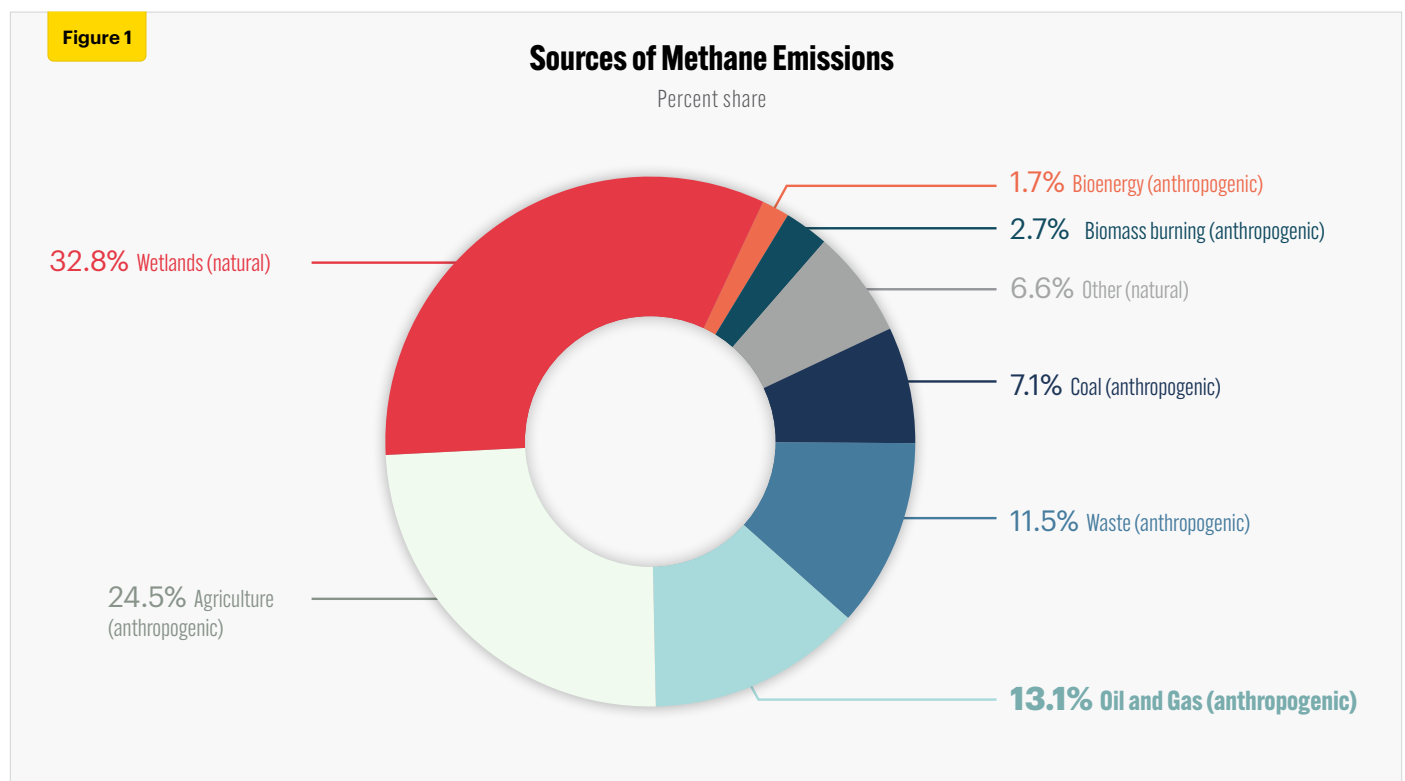
Estimating and reporting on methane emissions is highly technical. It can differ between countries because of differences in sources, measurement, assessment, and—last but not least—inaccurate reporting and underestimating of methane emissions by oil and gas producers, as is the case with [Russia](#).

Essentially, there are two approaches to measuring methane emissions: the “bottom-up” approach and the “top-down” approach. An emissions inventory developed for regulatory purposes is typically a bottom-up estimate that is derived by compiling an inventory of equipment and estimating the associated emissions for that equipment. At the same time, industry itself engages in top-down estimates by periodically evaluating measured emissions for a geographical region or sector using measurements from cameras, drones, and planes or satellites.

The International Energy Agency (IEA) and the World Bank are two of the most authoritative sources that compare methane emissions among countries and are the primary sources used in this study.

## Comparing methane emissions from the oil and gas sector with those from other sources

According to the IEA, there were 591.3 million tonnes (Mt) of methane emitted globally in 2020. The most significant human-caused source of methane emissions is agriculture, which accounted for 145.0 Mt that year, or nearly 25 percent of all methane emissions. The oil and gas sector emitted an estimated 77.3 MT of methane in 2020—over 13 percent of methane emitted globally (see Figure 1).



**Notes:** Oil and gas sector emissions are for the year 2020, while non-energy sector emissions are for the year 2017.

Source: IEA (2021a), and percentage share calculation by authors.



# CANADA'S METHANE EMISSIONS RECORD **VERSUS** OTHER MAJOR OIL AND GAS PRODUCERS

## Absolute methane emissions

Figure 2 is based on IEA data and presents absolute methane emissions in 2020 from oil and natural gas activities for major oil and gas producing countries. At 14,886 kilotons (kt), Russia recorded higher methane emissions in absolute terms than any other country. Canada emitted 2,098 kt of methane that year. In 2020, Russia, the United States, Iran, and Iraq were responsible for more than half of all global methane emissions from oil and gas production.

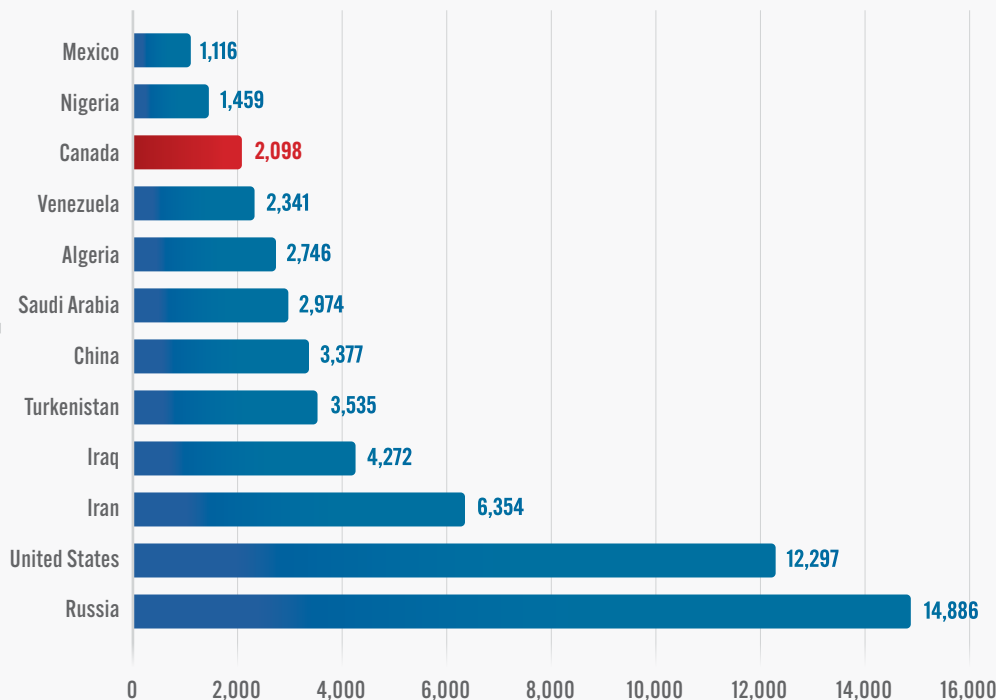
## Methane emissions intensity by country for oil and gas production

The methane emissions intensity<sup>1</sup> of oil and gas production varies widely among countries (see Figure 3). At 5.2 tons of methane per kiloton of oil equivalent (tCH<sub>4</sub> /ktoe), the methane emissions intensity from Canada's oil and gas sector is one of the lowest in the world. At the other end of the scale, Venezuela's methane emissions intensity of 53.4 tCH<sub>4</sub>/ktoe from its oil and gas production is the highest globally.

Figure 2

### Estimated Methane Emissions from Oil and Gas Production, by Country

2020 | In kt



Source: IEA (2021b).

<sup>1</sup> Methane emissions intensity (tons of methane per kilotons of oil equivalent) is the ratio of the volume of methane emitted to the volume of natural gas produced (upstream) or transmitted or distributed (downstream).

The data show that the methane emissions intensity in Venezuela, which produces heavy crude oil similar to Canada, is ten times higher than in Canada. Among major oil and gas producers, only Saudi Arabia's oil and gas production has a methane emissions intensity less than Canada's at 4.9 tCH<sub>4</sub> /ktoe. However, the absolute amount of methane emissions from Saudi Arabia's oil and gas sector was 1.4 times higher than Canada in 2020 (see Figure 2).

### Methane emissions from oil and gas production by country for upstream and downstream activities

Both upstream (crude oil exploration and production) and downstream (refining and sales) activities in the oil and gas sector contribute to methane emissions. In 2020, estimated worldwide upstream methane emissions amounted to 61.3 Mt, while estimated downstream methane emissions were approximately 16.0 Mt.

In 2020, Russia was the largest methane emitter in upstream and downstream oil and gas production. Russia accounted for 20 percent of global upstream oil and gas methane emissions, and 17 percent of global downstream oil and gas methane emissions. By contrast, Canada's global share of methane emissions was just 3 percent from upstream activities and 1.5 percent from downstream activities (see Figures 4a and 4b).

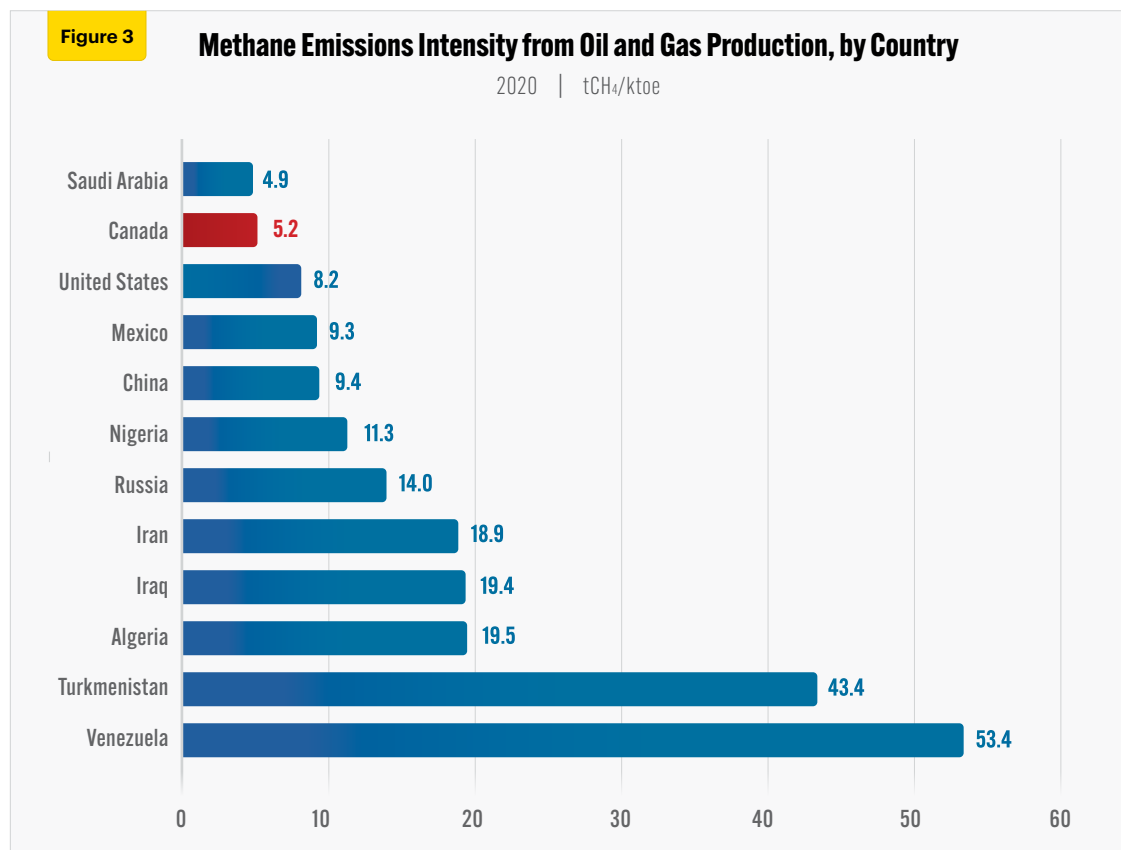
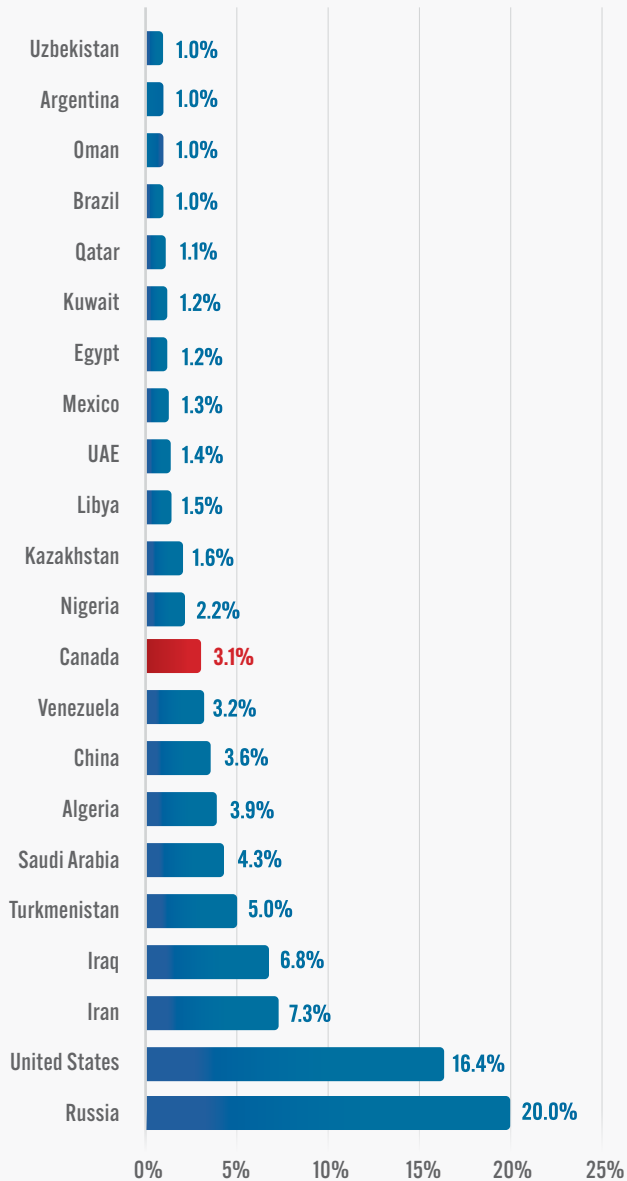


Figure 4a

### Global Share of Methane Emissions from Upstream Oil and Gas Activities, by Country

2020 | Percent



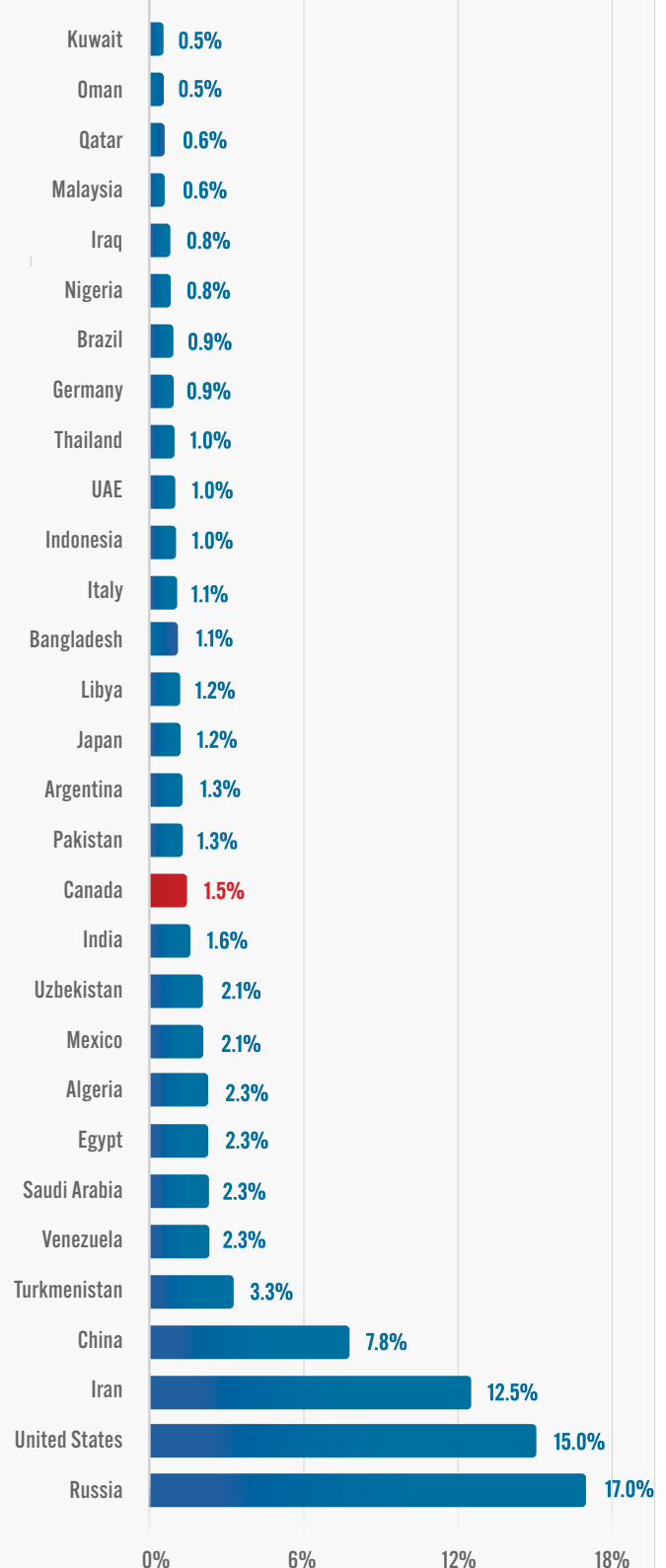
**Notes:** Estimated worldwide methane emissions from upstream oil and gas activities is 61,351 kilotonnes. This includes methane emissions from offshore gas and oil, onshore conventional oil and gas, unconventional oil and gas, and also includes satellite-detected significant emissions.

Source: IEA (2021b) and percentage share calculations by authors.

Figure 4b

### Global Share of Methane Emissions from Downstream Oil and Gas Activities, by Country

2020 | Percent



**Note:** Estimated worldwide methane emissions from downstream oil and gas activities is 15,073 (kt).

Source: IEA (2021b) and percentage share calculations by authors.



# COMPARING THE CHANGE IN METHANE EMISSIONS FROM THE OIL AND GAS SECTOR BY COUNTRY, 2000 VS 2018

Table 1 compares methane emissions from the oil and gas sector by country for 2000 and 2018 (the latest year available) as collected by the World Bank. The World Bank data through 2018 is understandable and standardized.

In absolute terms, China at 739,580 thousand metric tons of CO<sub>2</sub> equivalent (thousand MTCO<sub>2</sub>e) and Russia (at 683,540 thousand MTCO<sub>2</sub>e) had higher methane emissions than any other country. Between 2000 and 2018, methane emissions from oil and gas activities in China and Russia increased by 133 percent and 47 percent, respectively. In contrast, methane emissions from Canada's oil and gas sector were 52,090 thousand MTCO<sub>2</sub>e in 2018. Between 2000 and 2018, methane emissions from Canada's oil and gas sector fell by 16 percent.

Over the past two decades, Canada's oil and gas sector has successfully reduced the amount of methane it emits. Figure 5 compares the change in methane emissions for selected oil and gas-producing countries between 2000 and 2018. Only five countries emitted less methane in 2018 than they did in 2000, while 17 countries saw their methane emissions increase. Canada was one of those five, experiencing a decline of 16 percent, the highest decline other than Venezuela among the major countries measured. It should be noted that Venezuela, which has a methane emissions intensity ten times higher than Canada, saw its absolute methane emissions decline due to the ongoing civil unrest in that country affecting its oil production over the past decade, so for that reason is not considered relevant for our data analysis.

The only other countries that experienced reductions in methane emissions from their oil and gas sectors between 2000 and 2018 were the United States (down 8 percent), Uzbekistan (down 4 percent), and Indonesia (down 11 percent). Aside from China (up 133 percent) and Russia (up 47 percent), several significant producers of oil and gas saw their methane emissions increase between 2000 and 2018, including Azerbaijan (up 182 percent), Iran (up 126 percent), Angola (up 118 percent), Saudi Arabia (up 66 percent), and United Arab Emirates (up 58 percent).

Table 1

**Methane Emissions from the Energy Sector, by Country, 2000 and 2018**Thousand metric tons of CO<sub>2</sub> equivalent

Country	2000	2018	2000 to 2018 change	2000 to 2018 change (%)
	MT CO <sub>2</sub>			
Algeria	25,600	28,920	3,320	13%
Angola	8,020	17,460	9,440	118%
Australia	34,760	39,180	4,420	13%
Azerbaijan	12,810	36,170	23,360	182%
Brazil	12,800	18,260	5,460	43%
Canada	62,040	52,090	-9,950	-16%
China	316,900	739,580	422,680	133%
Colombia	9,540	17,030	7,490	79%
India	74,790	99,080	24,290	32%
Indonesia	43,740	38,710	-5,030	-11%
Iran	45,040	101,770	56,730	126%
Kazakhstan	12,960	20,130	7,170	55%
Malaysia	19,260	21,700	2,440	13%
Mexico	34,820	39,690	4,870	14%
Nigeria	46,800	70,680	23,880	51%
Russia	465,960	683,540	217,580	47%
Saudi Arabia	8,660	14,340	5,680	66%
Turkmenistan	26,060	41,820	15,760	60%
United Arab Emirates	19,930	31,550	11,620	58%
United States	319,290	293,600	-25,690	-8%
Uzbekistan	80,150	77,050	-3,100	-4%
Venezuela	46,950	34,430	-12,520	-27%
World	2,317,220	3,187,680	870,460	38%

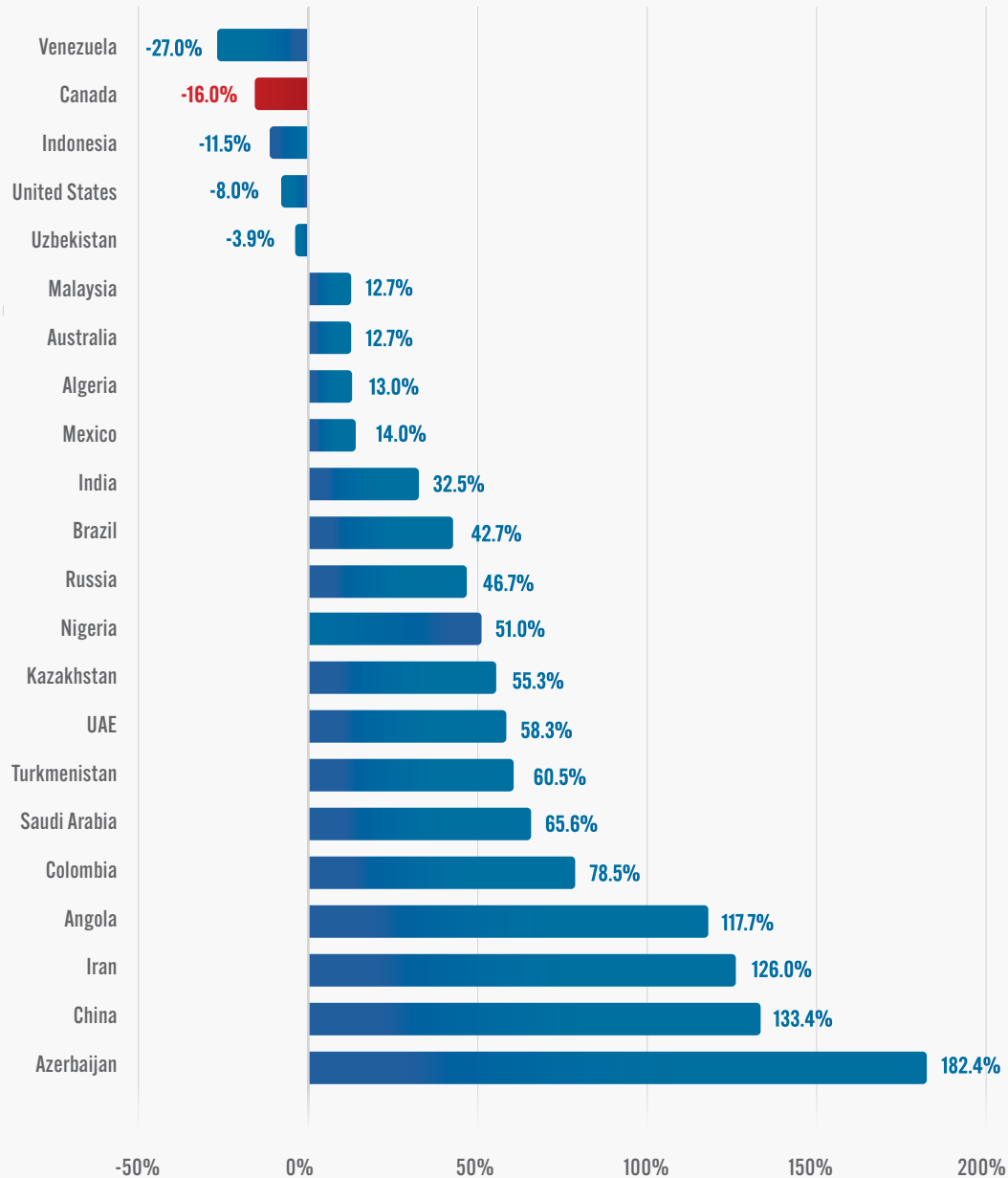
**Note:** Methane emissions from the oil and gas sector are emissions from the production, handling, transmission and combustion of fossil fuels and biofuels.

Source: World Bank Data (2021), and calculation by authors.

**Figure 5**

### Change in Methane Emissions from the Energy Sector

2000 vs. 2018 | percent change



**Note:** Methane emissions from the energy sector are emissions from the production, handling, transmission, and combustion of fossil fuels and biofuels.

Source: World Bank Data (2021) and percentage calculation by authors.

## Comparing increases and decreases in methane emissions to increases and decreases in oil production by country

To fully grasp how efficiently Canada has been in reducing emissions in the its oil and gas sector, Table 2 compares the increases or decreases in methane emissions with increases or decreases in oil production for major energy-producing countries between 2000 and 2018 (see Table 2).

- Canada's methane emissions fell by 16 percent even as its oil production increased by 91 percent between 2000 and 2018;
- In the United States, methane emissions dropped by 8 percent, while oil production increased by 99 percent between 2000 and 2018;
- Other than Canada and the United States, between 2000 and 2018, major energy-producing countries experienced drops in methane emissions and decreased production (Indonesia and Uzbekistan); increases in methane emissions and increases in oil production (Azerbaijan, Kazakhstan, Brazil, Angola, Turkmenistan, United Arab Emirates, Saudi Arabia, Colombia, Iran, India, China, and Russia); or increases in methane emissions and decreases in oil production (Malaysia, Algeria, Nigeria, Mexico, and Australia);
- Worldwide, methane emissions increased by 27 percent and oil production increased by 38 percent between 2000 and 2018.

Table 2

### Comparing Countries on Oil Production and Methane Emissions

2000 vs. 2018 | Percent change

Rank*	Country	Oil Production increase/decrease	Methane emissions increase/decrease
1	Azerbaijan	183%	182%
2	Kazakhstan	160%	55%
3	Brazil	110%	43%
4	Angola	104%	118%
5	United States	99%	-8%
6	Canada	91%	-16%
7	Turkmenistan	79%	60%
8	Russia	74%	47%
9	United Arab Emirates	51%	58%
10	Saudi Arabia	34%	66%
11	Colombia	26%	79%
12	Iran	25%	126%
13	India	20%	32%
14	China	17%	133%
15	Malaysia	-2%	13%
16	Algeria	-2%	13%
17	Nigeria	-8%	51%
18	Mexico	-40%	14%
19	Indonesia	-44%	-11%
20	Venezuela	-53%	-27%
21	Australia	-56%	13%
22	Uzbekistan	-60%	-4%
	World	27%	38%

**Note:** Ranking based on increase or decrease in oil production (in thousands of barrels per day) and methane emissions data in thousands of metric tonnes of CO<sub>2</sub> equivalent.

Sources: BP Statistical Review of World Energy Database, World Bank, and percentage calculations by authors.



## CONCLUSION

Methane is a greenhouse gas, so global methane emissions contribute to GHG emissions. Canada's oil and gas sector has been doing its part to reduce methane emissions over the past two decades. The sector's methane emissions have declined 16 percent between 2000 and 2018—one of the best records among major oil and gas producing countries in the world—even as the amount of oil and gas Canada produces has risen by 91 percent in the same period.

Thus, in the debate over Canada's role in reducing global GHG emissions, Canada should be seen as an example of a country that is a major player in oil and gas production which has successfully reduced its methane emissions, not only in absolute terms but also while increasing its oil production.

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## About the Canadian Energy Centre

The Canadian Energy Centre's mandate is to promote Canada as the supplier of choice for the world's growing demand for responsibly produced energy. It is an independent provincial corporation that is primarily supported by the Government of Alberta's industry-funded Technology, Innovation and Emissions Reduction (TIER) fund. [www.canadianenergycentre.ca](http://www.canadianenergycentre.ca).

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### About the authors

This CEC Research Brief was compiled by Ven Venkatachalam, Chief Research Analyst for the Canadian Energy Centre, and Lennie Kaplan, Executive Director of Research for the Canadian Energy Centre.

### Acknowledgments and Notes

The authors and the Canadian Energy Centre would like to acknowledge the assistance of Philip Cross as well as the assistance of an anonymous reviewer.

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