Canada's Energy Sector

Status, evolution, revenue, employment, production forecasts, emissions and implications for emissions reduction

By J. David Hughes

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CORPORATE MAPPING PROJECT

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ABOUT THE AUTHOR

J. DAVID HUGHES is an earth scientist who has studied the energy resources of Canada for more than four decades, including 32 years with the Geological Survey of Canada as a scientist and research manager. He developed the National Coal Inventory to determine the availability and environmental constraints associated with Canada's coal resources. As Team Leader for Unconventional Gas on the Canadian Gas Potential Committee, he coordinated the publication of a comprehensive assessment of Canada's unconventional natural gas potential.

Over the past two decades, Hughes has researched, published and lectured widely on global energy and sustainability issues in North America and internationally. In his work for the Canadian Centre for Policy Alternatives, Hughes authored *A Clear View of BC LNG* in 2015, which examined the issues surrounding a proposed massive scale-up of shale gas production in British Columbia for LNG export, *Can Canada increase oil and gas production, build pipelines and meet its climate commitments?* in 2016, which examined the issues surrounding climate change and the Trans Mountain pipeline expansion (now updated in this paper), *Canada's Energy Outlook: Current realities and implications for a carbon-constrained future* in 2018, and *BC's Carbon Conundrum: Why LNG exports doom emissions-reduction targets and compromise Canada's long-term energy security* earlier in 2020. Later in 2020 he authored *Reassessment of Need for the Trans Mountain Pipeline Expansion: Project Production forecasts, economics and environmental considerations*. He has also authored multiple reports on unconventional oil and gas development in the United States, consulted for the private sector on unconventional oil and gas, and served as an expert witness on hearings for energy projects in the US and Canada.

Hughes is president of Global Sustainability Research, a consultancy dedicated to research on energy and sustainability issues. He is also a board member of Physicians, Scientists & Engineers for Healthy Energy (PSE Healthy Energy) and is a Fellow of the Post Carbon Institute. His work has been featured in *Nature, Canadian Business*, *Bloomberg* and *USA Today*, as well as other popular press, radio and television.

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Production of oil and gas creates one-quarter of Canada's greenhouse gas emissions at a time when Canada has committed to a 40 per cent reduction from 2005 levels by 2030 and "net-zero" emissions by 2050.

ALTHOUGH THE ENERGY SECTOR HAS BEEN A SIGNIFICANT CONTRIBUTOR to Canada's economy, its contributions in terms of employment and revenue from royalties and taxes are declining, even though production is at an all-time high. Production of oil and gas creates one-quarter of Canada's greenhouse gas emissions at a time when Canada has committed to a 40 per cent reduction from 2005 levels by 2030 and "net-zero" emissions by 2050 (through Bill C-12, although in 2016 Canada agreed to an 80 per cent reduction target by 2050).[1,2,3] Despite these trends, governments and industry tout increasing oil and gas production and exports as critically important for Canada's economic future.

The energy sector's contribution to Canada's GDP, currently at 9 per cent, has declined over the past two decades, and government revenues from royalties and taxes have dropped precipitously. Despite record production levels, royalty revenue is down 45 per cent since 2000, and tax revenues from the oil and gas sector, which totalled over 14 per cent of all industry taxes as recently as 2009, declined to less than 4 per cent in 2018. Direct employment, which peaked at over 226,000 workers in 2014, was down by 53,000 in 2019 although production was at an all-time high due to efficiencies adopted by the industry. In Alberta, which produces a large proportion of Canada's oil and gas, total non-renewable resource revenue was down 61 per cent from 2000 levels in 2019, and 72 per cent on a revenue per barrel of oil equivalent basis.

At the same time, emissions from oil and gas production have continued to climb due to record production levels, which is largely driven by expansion of exports. Even with substantial reductions in emissions per barrel from the oil sands, along with reductions in fugitive methane emissions from natural gas, growth in oil and gas production will result in Canada failing to meet its emissions-reduction targets unless production is reduced.

1 John Paul Tasker and Aaron Wherry, "Trudeau Pledges to Slash Greenhouse Gas Emissions by at Least 40% by 2030," CBC News, April 22, 2021, https://www.cbc.ca/news/politics/trudeau-climate-emissions-40-per-cent-1.5997613.

2 "Net-zero" refers to reducing emissions to zero through domestic emissions reductions, purchased carbon offsets, and sequestration through carbon capture and storage (CCS) and direct air capture (DAC) of emissions. CCS and DAC are technologies that have been demonstrated but not proven to be viable at the scale required.

3 Bill C-12 has not yet become law. As of April 16, 2021, it had received second reading in the House of Commons. See https://openparliament.ca/bills/43-2/C-12/ (accessed April 26, 2021) and on April 27 Minister Catherine McKenna announced there would be five more hours of second reading, then the discussion would be closed to further questions.

The Canada Energy Regulator's (CER) forecasts for oil and gas production through 2050 show concerning trends.[4] In its Evolving Energy System Scenario (evolving scenario), which assumes governments will continue to introduce new policies over time to address climate change and emissions reduction, the oil and gas sector alone will cause Canada to exceed its Paris Agreement emissions target of an 80 per cent reduction from 2005 levels by 2050, let alone the "net-zero" target by 2050 adopted in Bill C-12. Even if emissions from all other sectors of the economy were reduced to zero, emissions from oil and gas production would cause the country to miss an 80 per cent by 2050 reduction target by 32 per cent (assuming emissions per barrel in the oil sands could be reduced by 30 per cent). In the CER's Reference Energy System Scenario (reference scenario), which assumes no new policies are adopted to reduce emissions, oil and gas production on its own would result in Canada missing this target by 94 per cent.

Current emissions from oil and gas production account for 26 per cent of Canada's total. As of 2019, the most recent year for which data are available, Canada had only reduced its emissions by 1.2 per cent from 2005 levels. This modest reduction is primarily due to the phase-out of coal-fired power in Ontario and Alberta, which has largely been replaced by natural gas in Alberta and nuclear power from refurbished reactors in Ontario. This was the "low-hanging fruit" for our emissions reductions — the next tranche of emissions reductions to meet the 40 per cent required by 2030 will be much more difficult.

Jobs are often cited by industry proponents as a reason to support expansion of oil and gas production. Yet despite record production levels, jobs in the oil and gas sector are down.

Recent growth in Canada's emissions is the highest of any G7 country. Of the two G7 countries that have increased emissions since the Paris Agreement was signed in 2016, Canada, at 3.3 per cent, was the worst, followed by the US at 0.6 per cent.[5] The other five G7 countries decreased emissions from between 4.4 per cent (Italy) and 10.8 per cent (Germany).

Jobs are often cited by industry proponents as a reason to support expansion of oil and gas production. Yet despite record production levels, jobs in the oil and gas sector are down from their peak in 2014 by 23 per cent (Figure S1). Thanks to technological advances, the sector has become more efficient and is able to increase production using fewer workers, meaning employment levels are unlikely to reach previous highs even as production grows. This jobs scenario is particularly true in the oil sands, where much of the production growth is expected. Oil sands production per employee is 70 per cent higher than it was in 2011 (production per employee has increased by 37 per cent in conventional oil and gas and by 50 per cent in the sector overall since 2011). In Canada's overall employment picture, the oil and gas sector accounted for only 1 per cent of direct employment in 2019 (5.5 per cent in Alberta). So, while production is projected to increase, efficiency and automation in the sector mean previous levels of employment are unlikely to return.

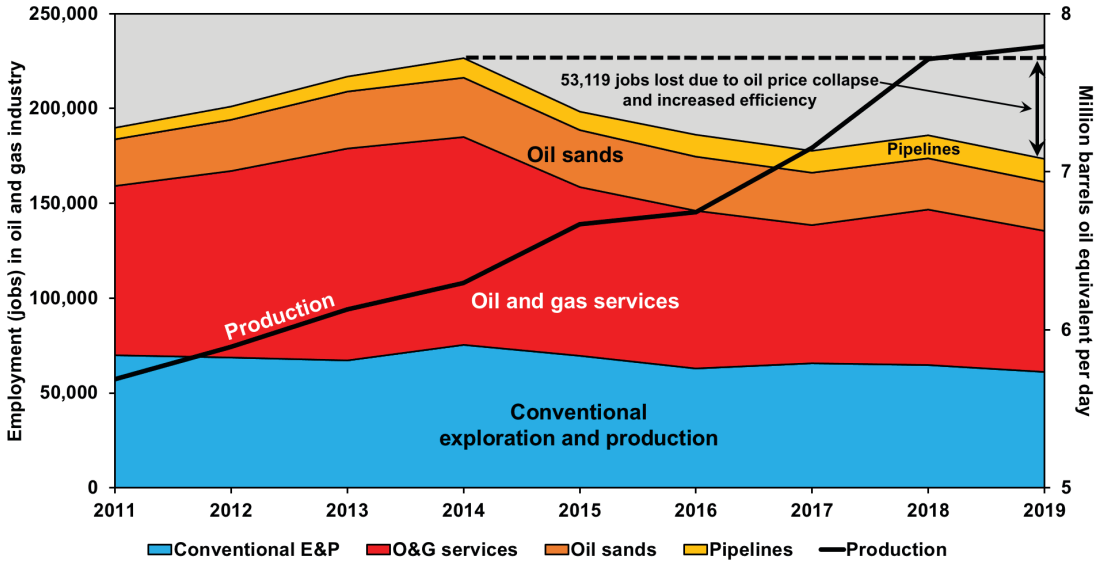
Governments receive revenues from oil and gas production through royalties and taxes, as well as lease sales. As noted above, while production has continued to increase, revenues received by governments have fallen dramatically. Royalty revenues have decreased by 45 per cent since 2000 and by 62 per cent on a per barrel basis (Figures S2 and S3). Non-renewable resource revenue in Alberta, where oil and gas production is highest, has fallen even more sharply — by 61 per cent since 2000 and by 72 per cent on a per barrel basis as of 2019. Revenue paid to governments from oil and gas through taxes has also fallen from a high of more than 14 per cent as a share of total industry taxes as recently as 2009 to less than 4 per cent in 2018 (Figure S4).

4 Canada Energy Regulator, *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050,* https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2020/index.html.

5 United Nations, National Inventory Submissions 2021, https://unfccc.int/ghg-inventories-annex-i-parties/2021.

Figure S1: Employment in the oil and gas industry in Canada by sector component from 2011 to 2019, based on PetroLMI data (LHS)

Also shown is oil and gas production over the period (RHS).

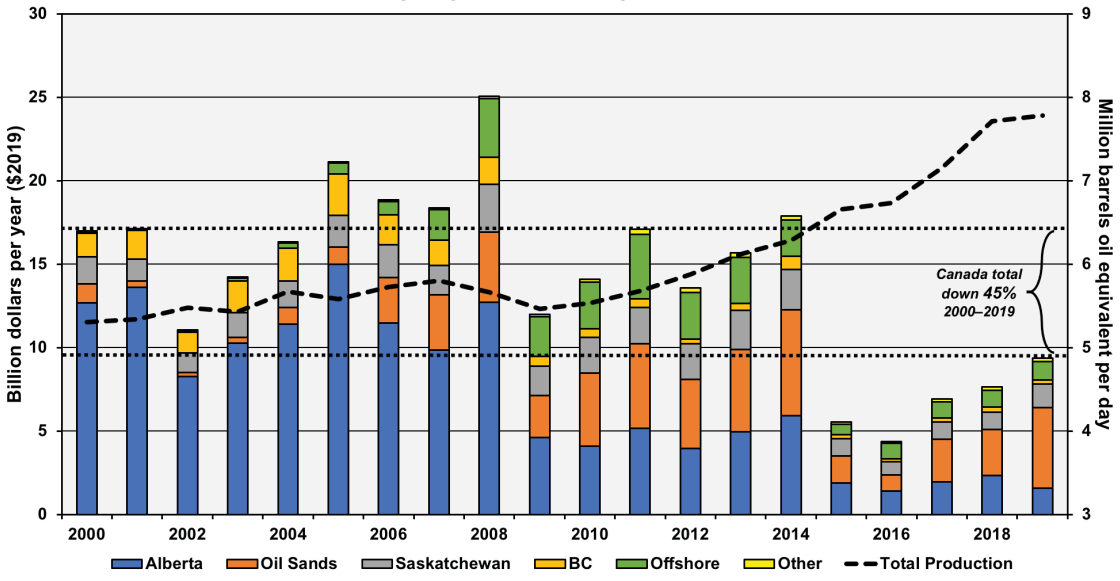


Notes: 2019 is a forecast and 2018 is an estimate.
LHS = left-hand side; RHS = right-hand side.

Source: Employment data from Petroleum Labour Market Information, *2019 Oil and Gas Labour Market Update* (Calgary: PetroLMI, 2019) and earlier labour market updates, https://careersinoilandgas.com/wp-content/uploads/2019/06/2019_Labour_Market_Update_Public_Spreadsheet_FINAL.xlsx (accessed June 10, 2020). Production data from Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 21, 2020).

Figure S2: Royalty revenue from oil and gas production by province from 2000 to 2019 (LHS)

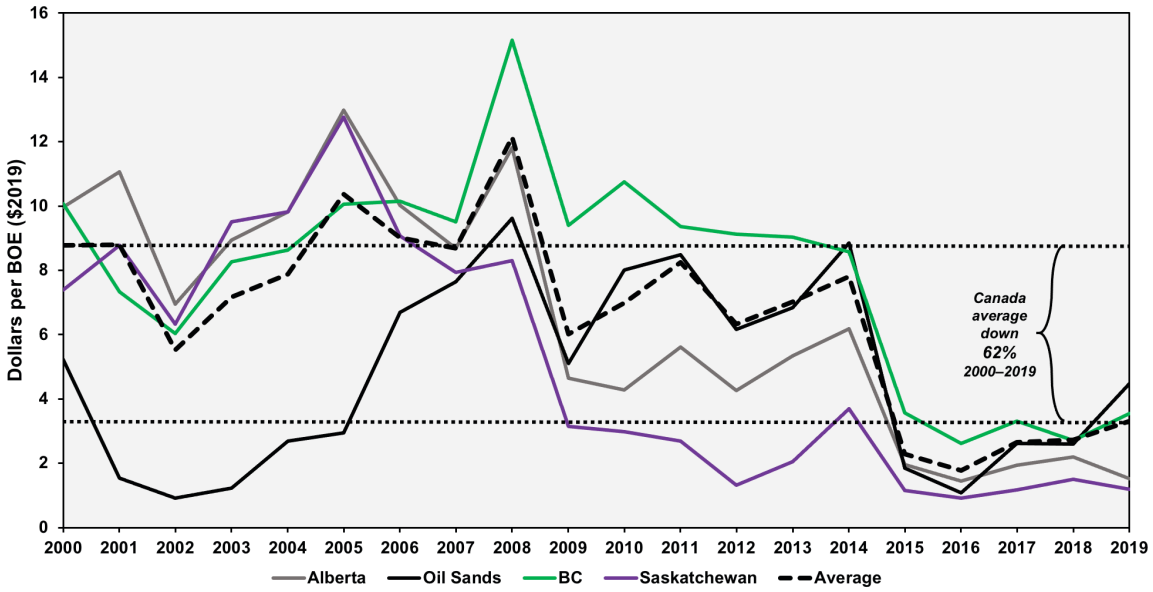
Total Canadian oil and gas production is also shown (RHS).



Notes: "Oil sands" is primarily Alberta oil sands and "offshore" is Newfoundland offshore.

Source: Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 21, 2020).

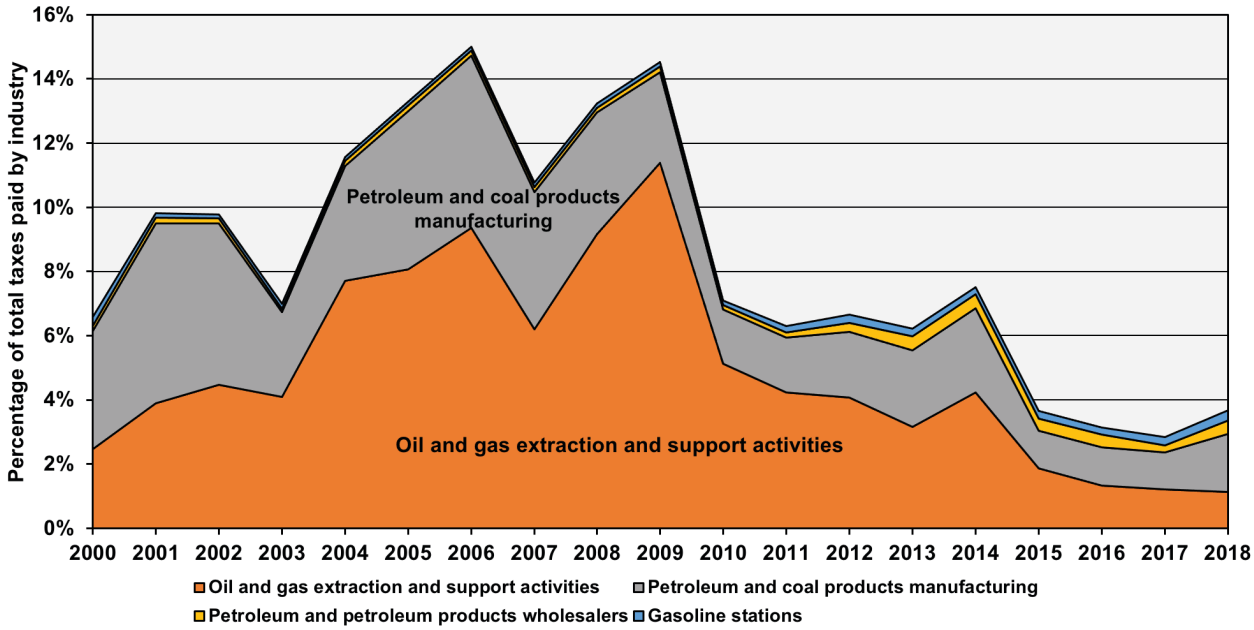
Figure S3: Royalty revenue from oil and gas production by province in dollars per barrel of oil equivalent (BOE) from 2000 to 2019



Note: "Oil sands" refers primarily to Alberta oil sands.

Source: Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 22, 2020).

Figure S4: Tax contribution of the oil and gas sector as a percentage of total industrial taxes paid by industry in Canada from 2000 to 2018



Source: Statistics Canada, Table 33-10-0006-01, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3310000601 (accessed August 25, 2020).

The CER projects electricity for end-use energy demand will increase from the 2019 level of 16.3 per cent to 26.5 per cent by 2050, primarily through growth in wind and solar generation. However, it also projects a continued heavy reliance on fossil fuels. In 2019, 77 per cent of Canada's end-use energy came from fossil fuels, and the CER projections show that level dropping to just 64 per cent by 2050. The smaller share of energy use that belongs to electricity is a significant challenge for reducing Canada's emissions, and strengthening policies such as building retrofits and more efficient transportation infrastructure that reduce energy consumption must be a major part of the solution.

Although domestic consumption of fossil fuels is projected by CER to decrease over time, production is projected to continue climbing due to a dramatic rise in oil and gas exports. From 2019 levels, the CER evolving scenario projects net exports of oil and gas to grow by 42 per cent and 186 per cent, respectively, by 2050. It is clear that the only way Canada can meet its climate change commitments is by decreasing production of oil and gas from these projected levels.

Canada's existing plans to build pipelines and other export infrastructure to facilitate production growth must change to meet its emissions-reduction targets:

Canada's existing plans to build pipelines and other export infrastructure to facilitate production growth must change to meet its emissions-reduction targets.

- Using the CER estimates of existing pipeline export capacity and its evolving scenario production, neither the Trans Mountain pipeline expansion (TMX) nor the recently cancelled Keystone XL pipeline are needed. Cancelling the taxpayer-funded TMX project will save $12.6 billion[6] (less funds spent to date) that could be spent on aggressive emissions-reduction measures.
- If 420 thousand barrels per day (kbpd) of announced expansions on existing export pipelines, which were not included in the CER estimate of existing export capacity, are added, the 330 kbpd Enbridge Line 3 expansion project now under construction in Minnesota is not needed either. (Announced expansions include 190 kbpd on the existing Enbridge mainline, 140 kbpd through reversal of Enbridge's Southern Lights pipeline, and 90 kbpd remaining on a permit for expansion of the capacity of the existing TC Energy Keystone pipeline.)
- Developing a liquefied natural gas (LNG) export industry in BC will render BC's CleanBC plan impossible to achieve. The CER evolving scenario forecast for BC would mean that its oil and gas sector alone would exceed the CleanBC 2050 target by 93 per cent, even if every other sector of the BC economy reduced emissions to zero. If emissions from the three LNG export terminals now either proposed or under construction are included, BC would miss its 2050 target by 147 per cent. Despite the emissions implications, both the BC and federal governments have provided subsidies for BC LNG exports.

The CER evolving scenario clearly shows oil and gas production growth will result in certain failure to meet Canada's emissions-reduction targets, so a stark change in direction is needed. The good news is that production growth is not related to energy needs at home, as domestic demand in Canada for oil and gas is projected to drop in the years and decades ahead. Rather, it is oil and gas exports that are driving the projected production growth.

Although the Canadian government intends to rely on carbon capture and storage (CCS) to achieve a significant part of its targets,[7] as well as purchasing carbon offsets, there are serious questions as to the efficacy of that approach. CCS has been demonstrated at small scales com-

6 Canadian dollars unless otherwise indicated.

7 Joel Dryden, "When asked about emission targets, Freeland says carbon capture plans will 'turbocharge' industry," *CBC*, April 25, 2021, https://www.cbc.ca/news/canada/calgary/chrystia-freeland-duane-bratt-alberta-carbon-capture-1.6001762.

pared to the reductions required, and much of the captured carbon dioxide has been used for enhanced oil recovery. This use of industrial carbon removal (ICR) has led researchers to conclude: "We found that the commercial ICR (C-ICR) methods being incentivized by governments are net CO_2 additive: CO_2 emissions exceed removals."[8] The practice of purchasing carbon offsets is also controversial, as it does not result in net emissions reductions in many cases.[9]

Canada, as a northern country with high heating loads in the winter, does face a significant challenge in reducing emissions by meeting domestic energy use exclusively with renewables like wind and solar energy. That means some fossil fuels will likely need to be part of the country's energy mix for the foreseeable future. As noted above, in 2019, 77 per cent of our end-use energy demand came from fossil fuels. The CER evolving scenario shows that rate dropping to 64 per cent by 2050, which still amounts to a significant share of domestic energy consumption. Oil and gas are finite resources and Western Canada, where most of these resources are produced, is a mature exploration region. Given that these resources will be needed at some level for the foreseeable future, and that they are a major source of emissions, we should be retaining remaining resources to meet our own needs rather than expanding the export market.

If oil and gas production increases will not result in strong growth in jobs and government revenues and will result in Canada missing its emissions-reduction targets, why would the country allow these increases to happen?

Clearly, if Canada is to have any hope of meeting its emissions-reduction targets, the oil and gas production sector will have to reduce emissions to a level far below what is projected in the CER evolving scenario production forecast. Cutting production will have some economic impacts, even though the economic contributions from oil and gas production have already declined markedly in the past two decades. The industry certainly won't disappear, as Canadians will need oil and gas at some level for decades, and reducing production will prolong the lifespan of these finite resources for Canada's domestic use.

The need to radically reduce fossil fuel production to meet net-zero targets has also been recognized by the International Energy Agency (IEA) in its recent *Net-zero by 2050* report.[10] The IEA concluded:

- "Net zero means a huge decline in the use of fossil fuels. They fall from almost four-fifths of total energy supply today to slightly over one-fifth by 2050."
- "Beyond projects already committed as of 2021, there are no new oil and gas fields approved for development in our pathway, and no new coal mines or mine extensions are required. Unabated coal demand declines by 90% to just 1% of total energy use in 2050. Gas demand declines by 55% to 1,750 billion cubic metres and oil declines by 75% to 24 million barrels per day (mb/d), from around 90 mb/d in 2020."
- "Making net-zero emissions a reality hinges on a singular, unwavering focus from all governments — working together with one another, and with businesses, investors and citizens."

The IEA's report underscores the contradiction between Canada's commitment to achieving net-zero by 2050 and its policies of building export pipelines to facilitate increased production and the development of an LNG export industry.

8 June Sekera and Andreas Lichtenberger, "Assessing Carbon Capture: Public Policy, Science, and Societal Need," *Biophysical Economics and Sustainability* 5, no. 14 (2020), https://doi.org/10.1007/s41247-020-00080-5.

9 Robert Watt, "The Fantasy of Carbon Offsetting," *Environmental Politics* (2021): 1–20, https://www.tandfonline.com/doi/full/10.1080/09644016.2021.1877063.

10 International Energy Agency, May, 2021, *Net Zero by 2050*: A Roadmap for the Global Energy Sector, https://www.iea.org/reports/net-zero-by-2050.

With respect to the oil and gas production sector, a credible plan to reduce emissions must include the following:

- Reduce or eliminate the growth in production for exports that is projected through 2050 by CER in its evolving scenario, which forecasts that net oil exports will grow 42 per cent and net gas exports will grow 186 per cent over the 2019 to 2050 period.
- Reduce current exports to the extent possible to reduce the production emissions associated with them. Some 53 per cent of 2019 net oil production was exported along with 15 per cent of net natural gas production.
- Cancel export pipeline projects that are not needed as evidenced by the CER evolving scenario projection, including TMX and the Line 3 expansion. Cancelling TMX would save $12.6 billion tax dollars (less expenses to date), which could then be devoted to investments in infrastructure to give Canadians an alternative to high levels of energy consumption.

Providing incentives to reduce consumption in all sectors and encourage growth in carbon-free energy must, of course, be emphasized. However, these incentives will not achieve emissions-reduction targets on their own unless oil and gas production emissions are also reduced compared to current projections.

Canada must take a step back and look at the big picture of emissions sources and the possibilities for reducing them. If oil and gas production increases will not result in strong growth in jobs and government revenues and *will* result in Canada missing its emissions-reduction targets, why would the country allow these increases to happen? The path ahead to achieve Canada's emissions-reduction targets will be difficult, and reducing emissions from the energy sector will be a critical part of the solution.

Introduction

CANADA'S ENERGY SECTOR HAS BEEN HERALDED as a critical part of the economy, even though oil and gas production is one of the largest contributors to Canadian emissions of greenhouse gas. The Intergovernmental Panel on Climate Change has warned in a recent report that global emissions of carbon must be eliminated over the next few decades to limit warming to 1.5 Celsius above pre-industrial levels and avoid the worst impacts of climate change.[11] In order to address this, the federal government has recently committed to reduce emissions to net-zero by 2050, an increase from its earlier commitment of an 80 per cent reduction by then. The question of how emissions from the upstream production of oil and gas can be reconciled with emissions-reduction targets has not been addressed.

Despite the federal government's commitment to reducing emissions by more than 30 per cent from 2005 levels by 2030, emissions were down just 1.2 per cent as of 2019.

The energy sector contributed about 9 per cent of Canada's gross domestic product (GDP) in 2019, a share that has been declining even though oil and gas production has been increasing. Royalty revenue returned by the oil and gas sector to government has plummeted and employment in the sector has also been declining.

At the same time, emissions from oil and gas production constituted 26 per cent of Canada's total in 2019 (the most recent year for which data are available) and are forecast to continue to grow, even with technological improvements in oil sands production. Despite the federal government's commitment to reducing emissions by more than 30 per cent from 2005 levels by 2030, emissions were down just 1.2 per cent as of 2019. And the government has introduced Bill C-12 calling for net-zero emissions in 2050.

Forecasts by the Canada Energy Regulator (CER) show that, even with improved technology and additional climate policies, Canada's emissions from the oil and gas sector alone are likely to exceed a target of an 80 per cent reduction by 2050 by 32 per cent. Without improved technology, and assuming the CER business-as-usual production forecast, emissions from the oil and gas sector would exceed this target by 94 per cent.

Clearly, increasing oil and gas production as projected in the CER forecasts, even with additional climate policies, is incompatible with reaching the government's net-zero emissions target by 2050. This report assesses the current state of Canada's energy sector, its contributions to the Canadian economy, forecasts of future production and emissions and their implications for energy megaprojects. The report also makes recommendations for the future given Canada's climate commitments.

11 Intergovernmental Panel on Climate Change, *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty (IPCC, 2019)* https://www.ipcc.ch/sr15/.

Status and evolution of the energy sector

77.2 per cent of Canada's consumption in 2019 was provided by fossil fuels — natural gas and refined petroleum products — and only 16.3 per cent by electricity.

AS A PREFACE TO ASSESSING THE CONTRIBUTION OF THE ENERGY SECTOR to the Canadian economy, the following section reviews the supply and emissions from Canada's energy consumption and compares them to other countries globally. The evolution of oil and gas production, much of which is exported, is also reviewed.

Despite the exponential growth of non-hydro renewable energy from solar, wind, biomass, biofuels and geothermal energy sources, fossil fuels in 2019 amounted to 84 per cent of primary energy consumption globally (Figure 1a) and 66 per cent of Canadian consumption (Figure 1b). Although non-hydro renewable energy has grown rapidly since 2005, it still made up only 5 per cent of global consumption and 3.7 per cent of Canadian consumption in 2019.

Canada is the third-largest producer of hydro power in the world after China and Brazil. Thanks to its hydro and nuclear generation, Canada's electricity sector has relatively low-carbon emissions compared with countries that are much more dependent on fossil fuels, such as the US. Nonetheless, without major investments in building new nuclear power plants and refurbishing plants nearing retirement age, Canada will have no nuclear capacity by 2036.[12] New hydro dams face increasing opposition.

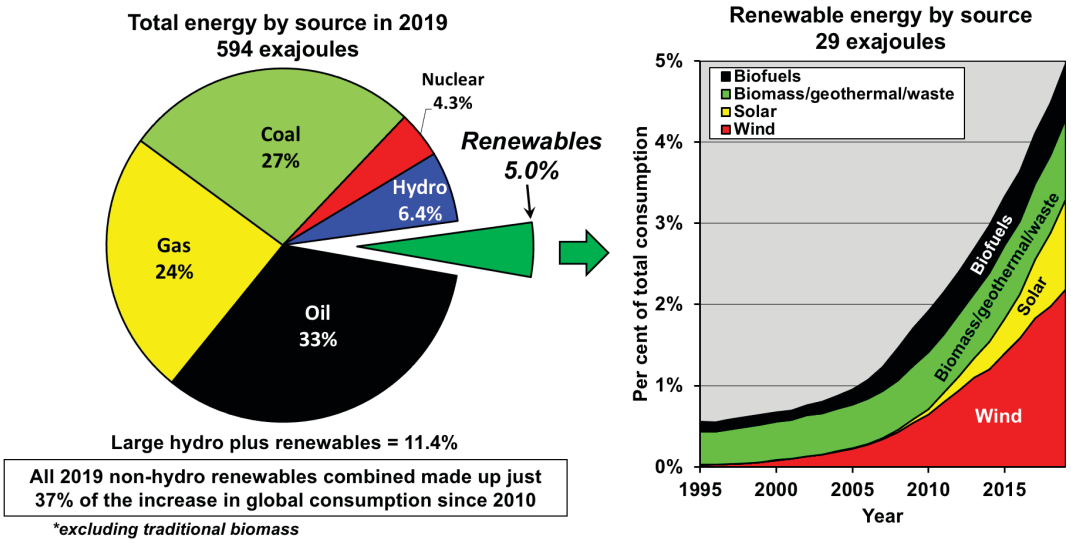
In terms of end-use energy demand, 77.2 per cent of Canada's consumption in 2019 was provided by fossil fuels — natural gas and refined petroleum products — and only 16.3 per cent by electricity (Figure 2). The share of end-use energy consumption provided by electricity is similar in most "developed countries."

Figure 2 also illustrates end-use energy consumption by utilization sector. The industrial sector consumed over half of end-use energy, followed by the transportation sector at 23 per cent, the residential sector at 14 per cent and commercial sector at 12 per cent.

In terms of per capita energy consumption, the "developed world" consumes far more energy than the developing world. Countries in the Organization for Economic Co-operation and Development (OECD), which represent 17 per cent of the world's population, consumed 3.3

12 J. David Hughes, *Canada's Energy Outlook: Current Realities and Implications for a Carbon-Constrained Future* (Vancouver: Canadian Centre for Policy Alternatives–BC Office, 2018), https://energyoutlook.ca/.

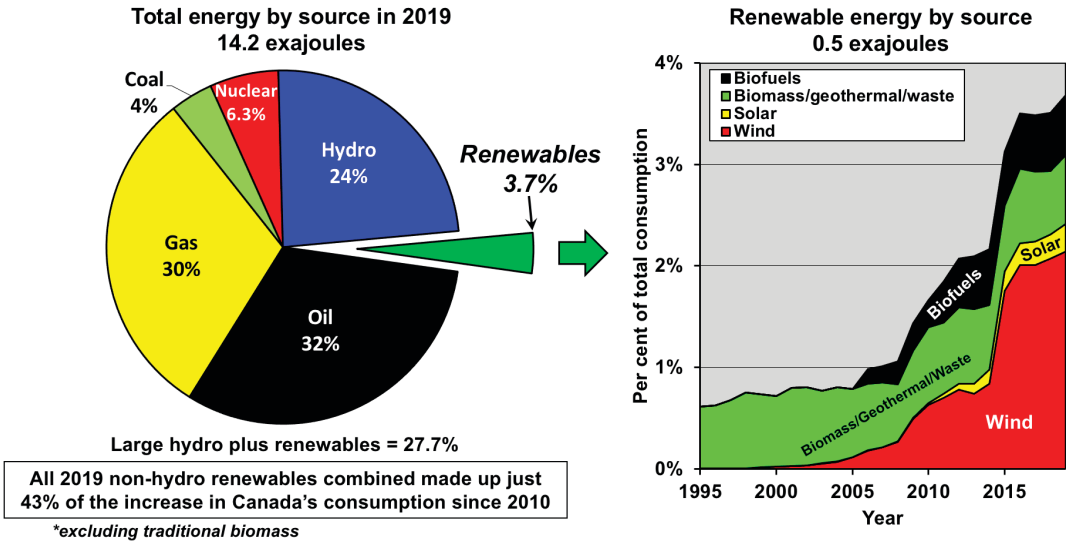
Figure 1a: Global primary energy consumption by fuel in 2019 with a comparison to the growth of total non-hydro renewable energy (excluding traditional biomass) from 1995 to 2019



Note: Primary energy includes the losses from fossil fuel generation of electricity, so direct sources of electricity such as hydro, solar and wind have been increased by 2.63 times to make them comparable to fossil fuel–generated electricity at a thermal efficiency of 38 per cent. Non-hydro renewables combined made up just 37 per cent of the overall increase in global primary energy consumption between 2010 and 2019. Traditional biomass is excluded because it is expected to be phased out.

Source: Data from *bp Statistical Review of World Energy 2020* (London: bp plc, 2020), https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf.

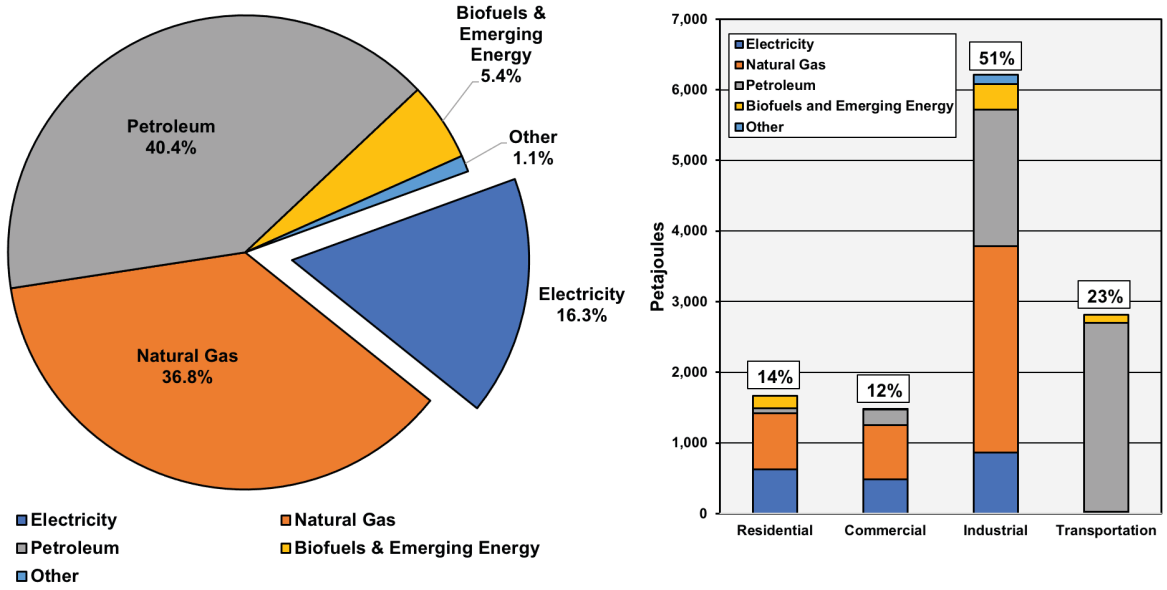
Figure 1b: Canadian primary energy consumption by fuel in 2019 with a comparison to the growth of non-hydro renewable energy (excluding traditional biomass) from 1995 to 2019



Note: Primary energy includes the losses from fossil fuel generation of electricity, so direct sources of electricity such as hydro, solar and wind have been increased by 2.63 times to make them comparable to fossil fuel–generated electricity at a thermal efficiency of 38 per cent. Non-hydro renewables combined made up just 43 per cent of the increase in Canadian primary energy consumption between 2010 and 2019.

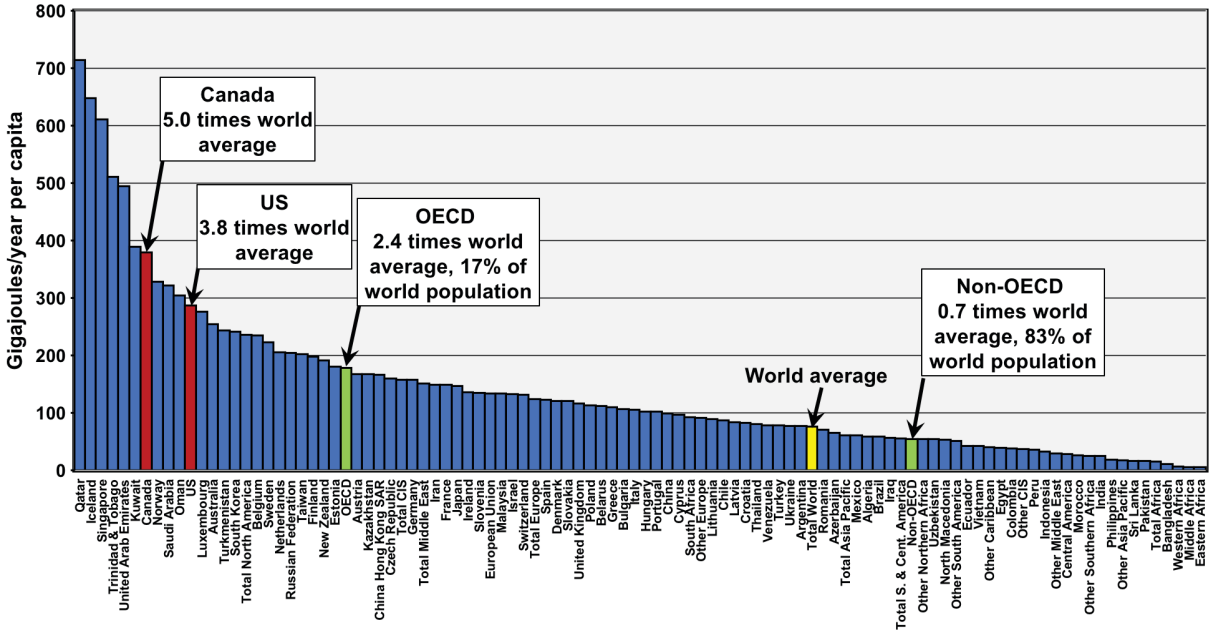
Source: Data from bp *Statistical Review of World Energy 2020* (London: bp plc, 2020), https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf.

Figure 2: End-use energy demand in Canada by fuel source and sector in 2019



Source: Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Figure 3: Energy consumption per capita by country in 2019



Source: *bp Statistical Review of World Energy 2020* (London: bp plc, 2020), https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf.

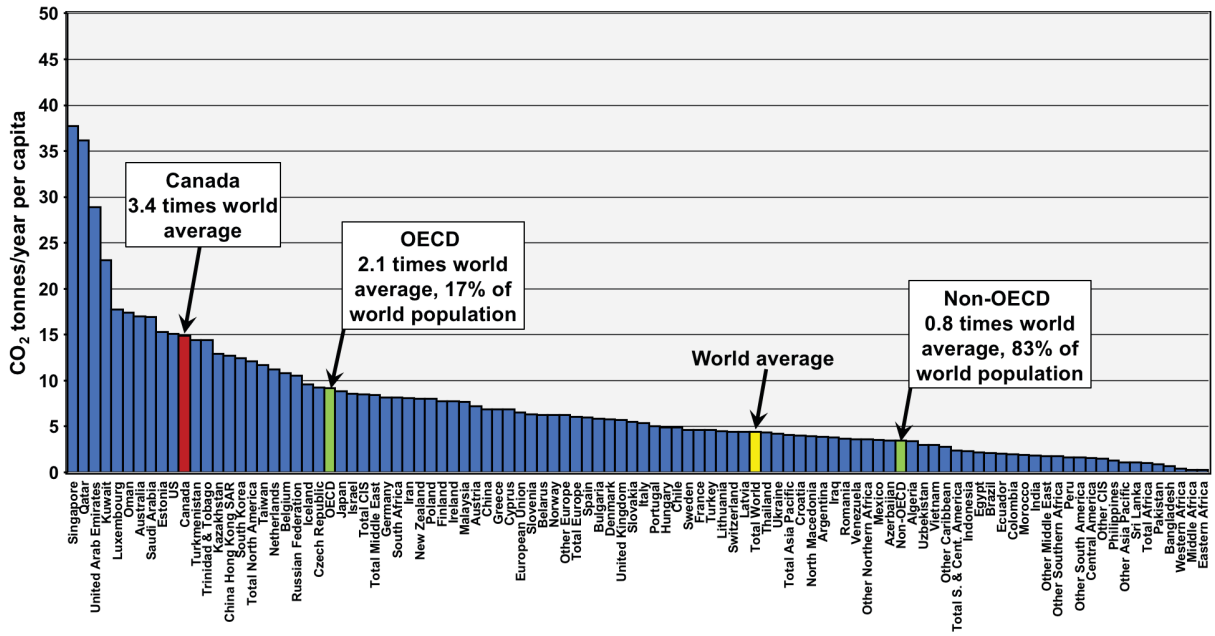
times as much energy per capita in 2019 as the 83 per cent of the population in non-OECD countries (Figure 3). Canadians rank among the highest per capita energy consumers in the world, at five times the world average and 32 per cent higher than Americans.

Given the correlation between economic development and energy consumption, developing countries aspire to ever-increasing levels of energy consumption. In the "developed world," energy consumption is flat or declining due to increased efficiency. The COVID-19 pandemic has resulted in a significant decline in energy consumption globally, but this effect is expected to be temporary. China, for example, has already increased consumption to 2019 levels.

Due to the high reliance on fossil fuels for end-use energy consumption illustrated in Figure 2, Canadians are also among the top per capita emitters from fossil fuel combustion. Canadians emitted 3.4 times the world average in 2019, and OECD countries emitted 2.7 times the emissions per capita of non-OECD countries (Figure 4). Canadians emit slightly less than Americans on a per capita basis due to the high proportion of hydropower in Canada's electricity supply.

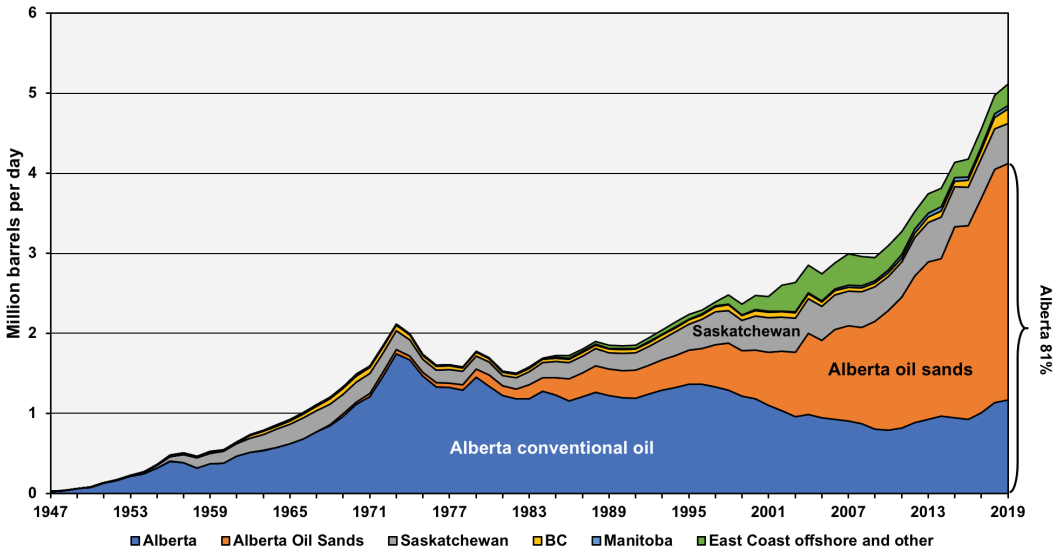
Oil production in Canada began in earnest in the late 1940s (although small amounts have been produced in Ontario since 1858) and rose rapidly to a production peak of conventional oil in 1972 (Figure 5). Although the advent of fracking over the past decade has allowed conventional oil production to increase slightly, it has never exceeded the 1972 peak. Virtually all oil production growth in Western Canada since the early 1980s has come from bitumen and synthetic oil production from the oil sands, which accounted for 58 per cent of Canadian production in 2019. Offshore production in Newfoundland and Labrador began in the 1990s.

Figure 4: Emissions per capita from fossil fuel combustion by country in 2019



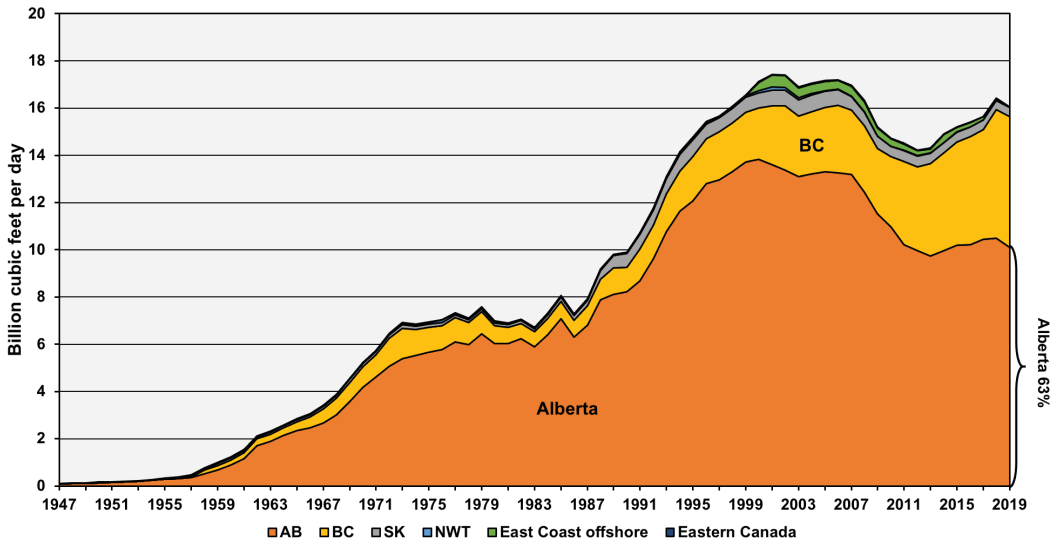
Source: *bp Statistical Review of World Energy 2020* (London: bp plc, 2020), https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf.

Figure 5: Oil production in Canada by province from 1947 through 2019



Source: Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 15, 2020).

Figure 6: Marketed natural gas production in Canada by province from 1947 through 2019



Source: Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 15, 2020).

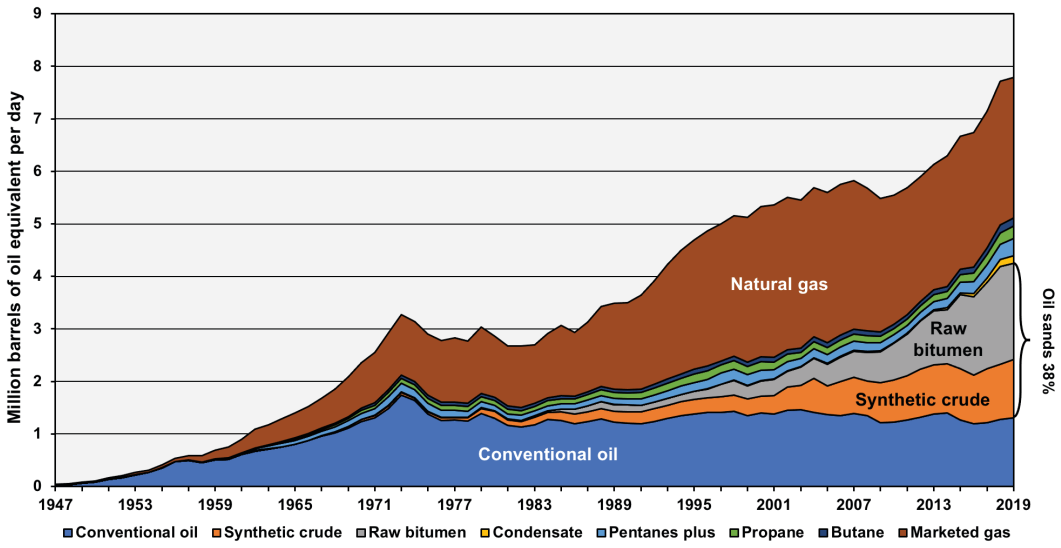
Alberta is by far the largest oil-producing province and accounted for 81 per cent of total production in 2019, followed by Saskatchewan at 10 per cent, the East Coast and Territories at 5.3 per cent, BC at 3.5 per cent and Manitoba at 0.9 per cent.

Natural gas production also began in Canada in the late 1940s and rose to a production peak in 2001 (Figure 6). Although Alberta produced 63 per cent of Canada's gas in 2019, the advent of high-volume fracking combined with horizontal drilling since 2007 has allowed access to low-permeability tight- and shale-gas deposits, particularly in BC. Most of the growth in Canadian production in recent years has come from northeastern BC. Although there has been some gas production since the late 1990s from the Sable Offshore Energy Project in Nova Scotia, it has recently been permanently shut down.[13]

In addition to oil and gas, liquids are often produced in conjunction with natural gas. These include condensate, pentanes plus, propane and butane. Figure 7 illustrates the total energy from oil and gas produced in Canada. Marketed natural gas has been converted to barrels of oil equivalent (on an energy basis, 6,000 cubic feet of marketed natural gas is equivalent to one barrel of oil). On an energy basis, 55 per cent of Canadian energy production comes from oil, 34 per cent from gas and 11 per cent from natural gas liquids. Oil sands amount to 38 per cent of the total oil and gas energy production in Canada.

At current prices, oil is worth about three times as much as gas on an energy-equivalent basis. This difference in value can be attributed to the utility of oil as a transportation fuel and for other uses.

Figure 7: Oil and gas production in Canada by product type from 1947 through 2019



Source: Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 15, 2020).

13 "Sable Offshore Energy Project Permanently Shuts Down after Nearly 20 Years," CTV News, January 1, 2019, https://www.ctvnews.ca/business/sable-offshore-energy-project-permanently-shuts-down-after-nearly-20-years-1.4236819.

Contributions of the energy sector to the Canadian economy

Despite rapid production growth between 1997 and 2019, the contribution of the energy sector to the Canadian economy has declined.

THE ENERGY SECTOR CONTRIBUTES TO THE CANADIAN ECONOMY in terms of GDP, jobs, non-renewable resource payments to provincial governments and corporate taxes. The following section reviews these contributions and their trends over the past two decades.

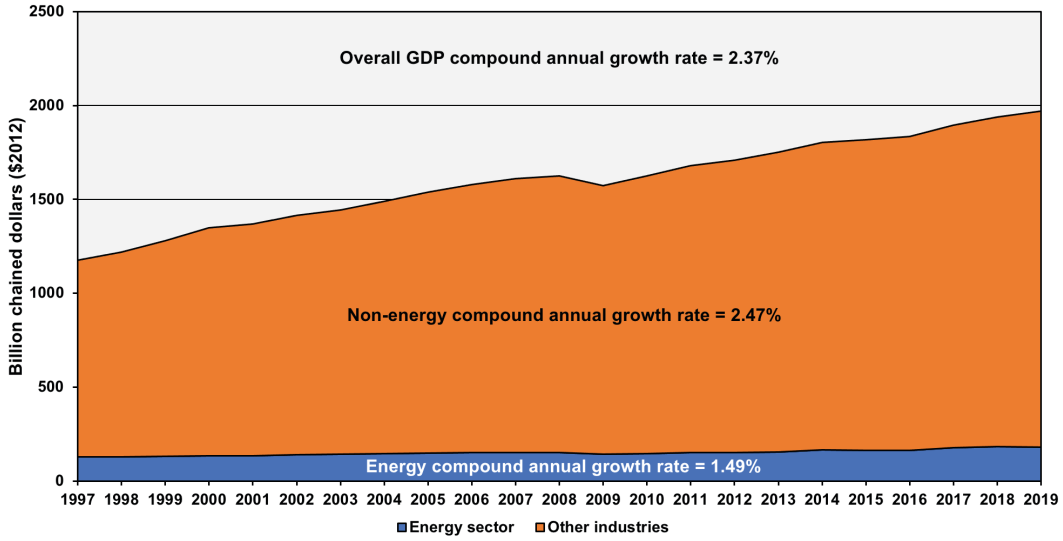
Gross domestic product

The contribution of the energy sector to Canada's GDP is illustrated in Figure 8. Total Canadian GDP in 2019 was $1,970 billion, of which the energy sector contributed $180 billion, or 9.16 per cent. The growth rate of the energy sector between 1997 and 2019, at 1.49 per cent per year, was much slower than the growth rate of the overall economy at 2.37 per cent and the growth rate of the non-energy sector component at 2.49 per cent.

Although Statistics Canada's definition of the "energy sector" includes coal mining and other activities not strictly related to oil and gas, the production and refining of oil and gas along with petrochemicals and agricultural products made from oil and gas account for three-quarters of the energy sector's contributions to total GDP, as illustrated in Figure 9.

Despite rapid production growth between 1997 and 2019 (see Figure 7), the contribution of the energy sector to the Canadian economy has declined from 11 per cent in 1997 to 9.16 per cent in 2019, as illustrated in Figure 10. The energy sector in Alberta was by far the largest contributor, but despite the ramp-up in oil sands production over the past 20 years, the proportional contribution of even Alberta's energy sector to Canadian GDP has declined since 1997.

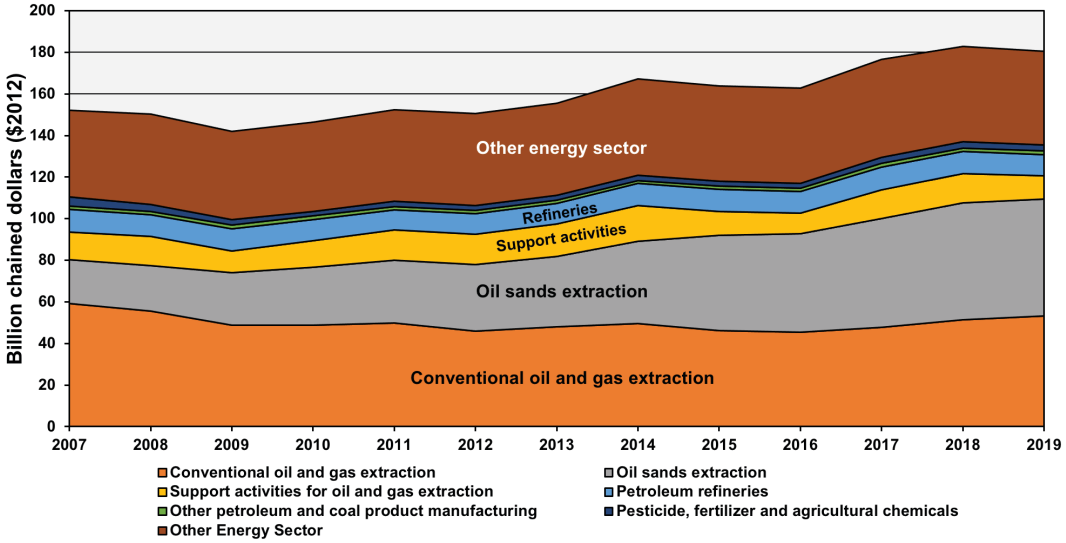
Figure 8: Growth rate of Canada's energy sector compared with the non-energy sector and Canada's overall GDP from 1997 to 2019



Note: Chained dollars refers to inflation-adjusted 2012 dollars.

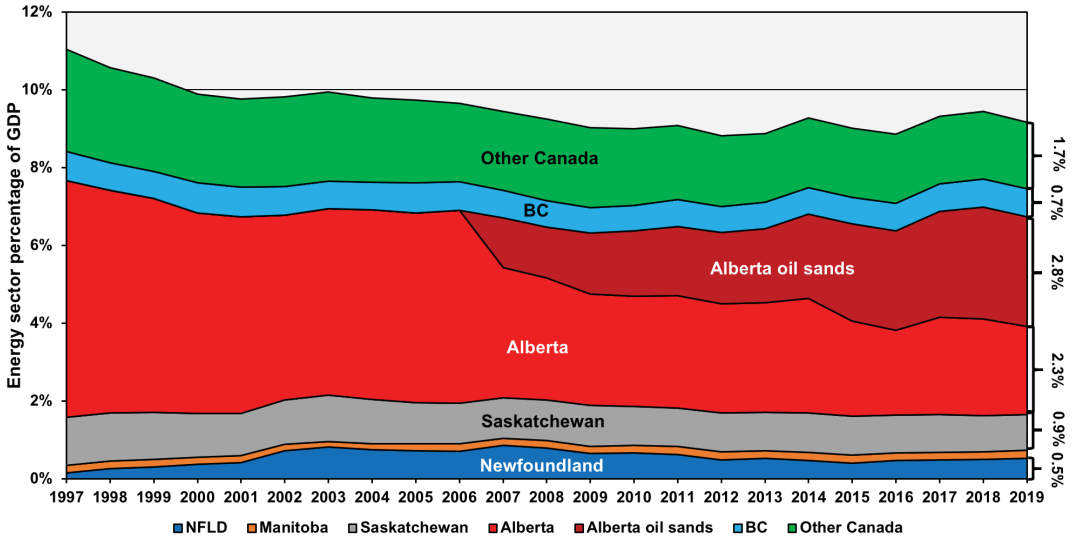
Source: Statistics Canada, Table 36-10-0402-01, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040201 (accessed June 27, 2020).

Figure 9: Contributions of Canada's energy sector to GDP by component from 2007 to 2019



Source: Statistics Canada, Table 36-10-0402-01, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040201 (accessed June 27, 2020).

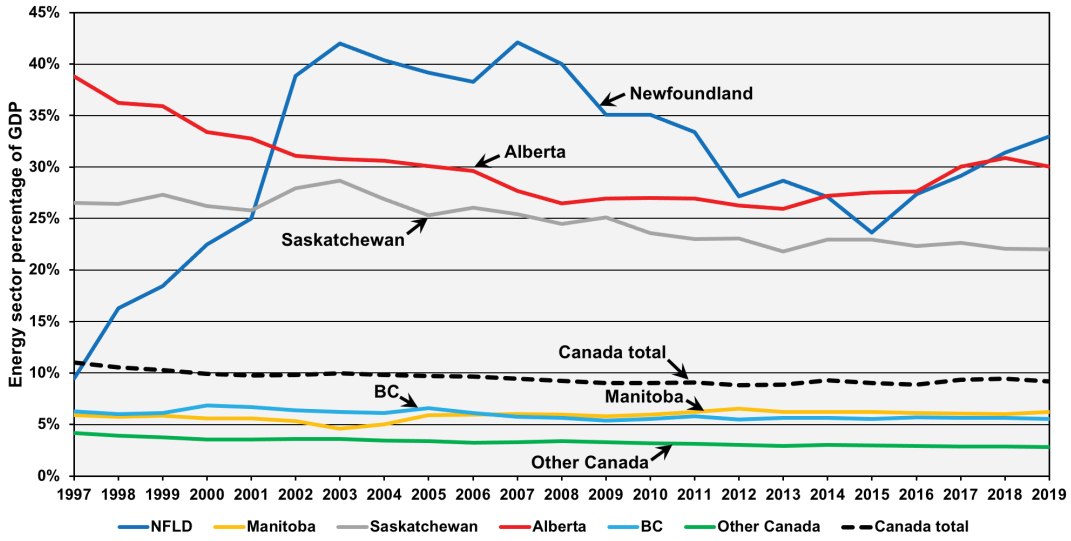
Figure 10: Energy sector share of Canada's total GDP by province from 1997 to 2019



Note: Oil sands contributions were not reported separately until 2007.

Source: Statistics Canada, Table 36-10-0402-01, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040201 (accessed June 27, 2020).

Figure 11: Energy sector share of total provincial GDP by province from 1997 to 2019



Source: Statistics Canada Table 36-10-0402-01, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040201 (accessed June 27, 2020).

The contribution of the energy sector to the GDP of individual provinces is highly variable, which is to be expected given the fact that a large proportion of production is concentrated in Alberta, Saskatchewan and BC. The energy sector constituted 30 per cent of Alberta's GDP in 2019 and 33 per cent in Newfoundland, compared with 22 per cent in Saskatchewan and 6 per cent in BC. Figure 11 illustrates the percentage contribution of the energy sector by province from 1997 to 2019.

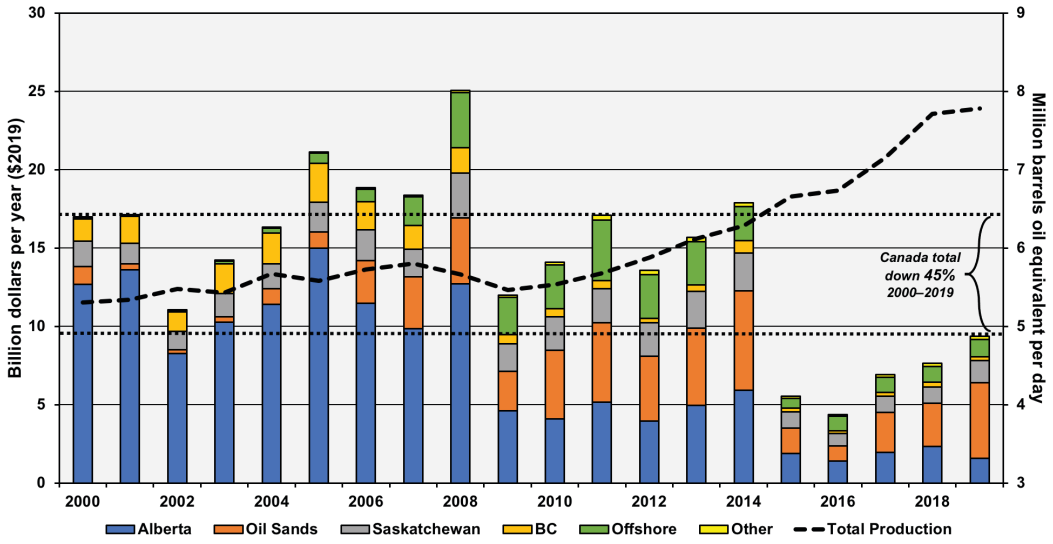
Revenue provided to provincial governments

Revenue collected by provincial governments from the production of non-renewable resources like oil and gas includes royalties, sales of Crown leases, rentals and fees. Royalties are by far the largest revenue component in most provinces.

Figure 12 illustrates the total royalty revenue paid to provincial governments from oil and gas production over the 2000 to 2019 period, calculated in billion dollars per year. Despite an increase of 47 per cent in oil and gas production, total royalty payments collected in Canada fell by 45 per cent. This means Canada is selling off its non-renewable energy resources for ever-lower returns. Politicians claim that oil and gas production is needed to fund roads and hospitals, but clearly oil and gas production is providing less and less revenue despite the increasing pace of extraction.

Figure 12: Royalty revenue from oil and gas production by province from 2000 to 2019 (LHS)

Total Canadian oil and gas production is also shown (RHS).

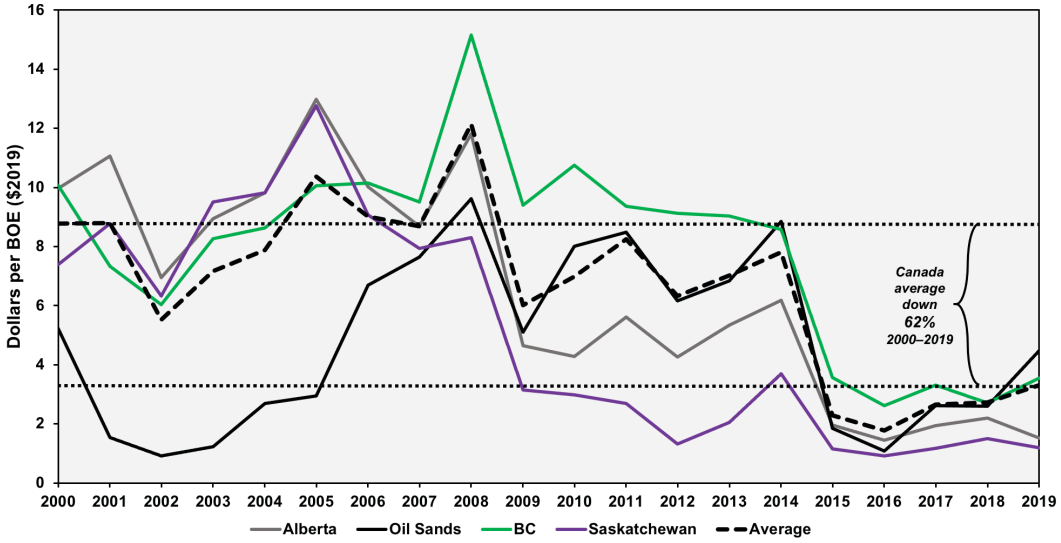


Note: "Oil sands" is primarily Alberta oil sands and "offshore" is Newfoundland offshore.

Source: Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 21, 2020).

Figure 13 illustrates the royalty revenue paid to western provincial governments, and Canada as a whole, from oil and gas production over the 2000 to 2019 period, calculated in dollars per barrel of oil equivalent (BOE). On a per-barrel basis, royalty revenue received from selling off non-renewable oil and gas resources has gone down by 62 per cent since 2000.

Figure 13: Royalty revenue from oil and gas production by province in dollars per barrel of oil equivalent (BOE) from 2000 to 2019

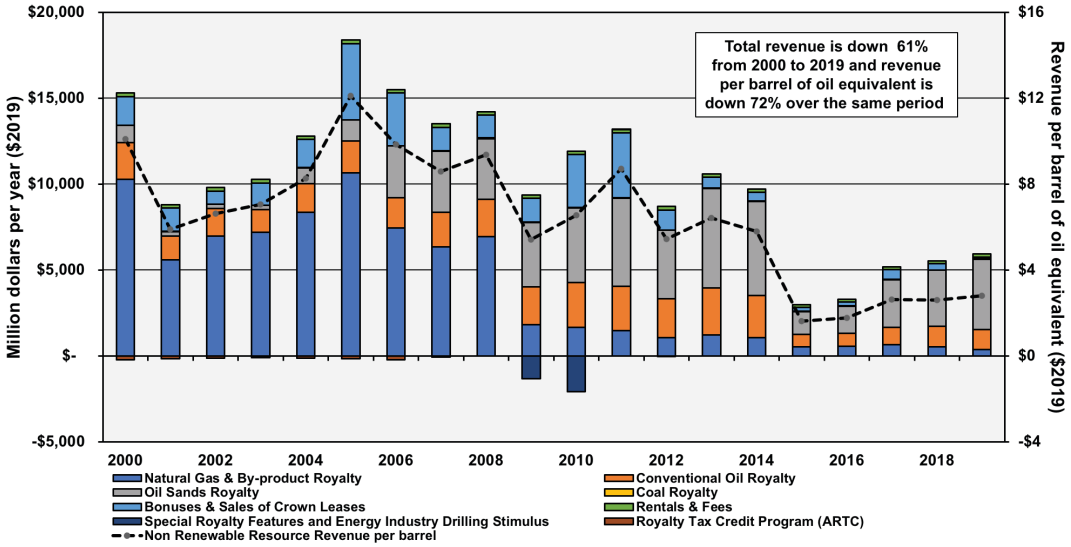


Note: "Oil sands" refers primarily to Alberta oil sands.

Source: Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 22, 2020).

Figure 14: Non-renewable resource revenue in Alberta by component from 2000 to 2019 (LHS)

Also shown is revenue received per barrel of oil equivalent (BOE) produced (RHS).



Source: Revenue data from Government of Alberta, "2020 Historic Royalty Summary Revenue Workbook," https://open.alberta.ca/dataset/382b7a1e-9c34-47c7-9531-38e67ca5441d/resource/94ddf42e-aeb4-4cd1-a0b4-c63c627ebb60/download/energy_royalty_revenue_workbook.xlsx (accessed January 4, 2021). Production data from Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed September 27, 2020).

Alberta provides one of the most complete accounts of revenue received from the sale of non-renewable resources, and is the largest producer by far, so it is instructive to look at revenue trends in that province. Figure 14 breaks down Alberta's non-renewable resource revenue from royalties, lease sales, rentals and fees, as well as the cost of incentive programs.

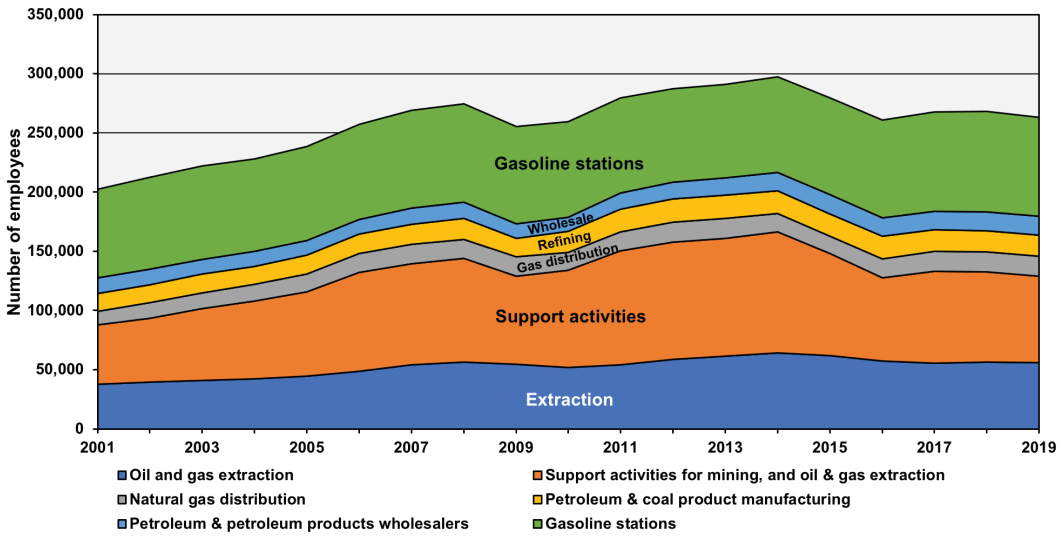
Despite a 42 per cent increase in oil and gas production in Alberta from 2000 to 2019, total non-renewable resource revenue is down 61 per cent, and revenue per barrel of oil equivalent produced is down by 72 per cent over this period. Even if the environmental and emissions implications of maintaining and increasing production are ignored (which are discussed in a following section), ramping up production is providing Canadians with diminishing returns.

Ramping up production is providing Canadians with diminishing returns.

Employment

Politicians hold out jobs as a key reason for maintaining and increasing oil and gas production. However, the number of jobs has declined since 2014 even as production has increased. Figure 15 illustrates employment by component in the oil and gas sector, including retail sales.

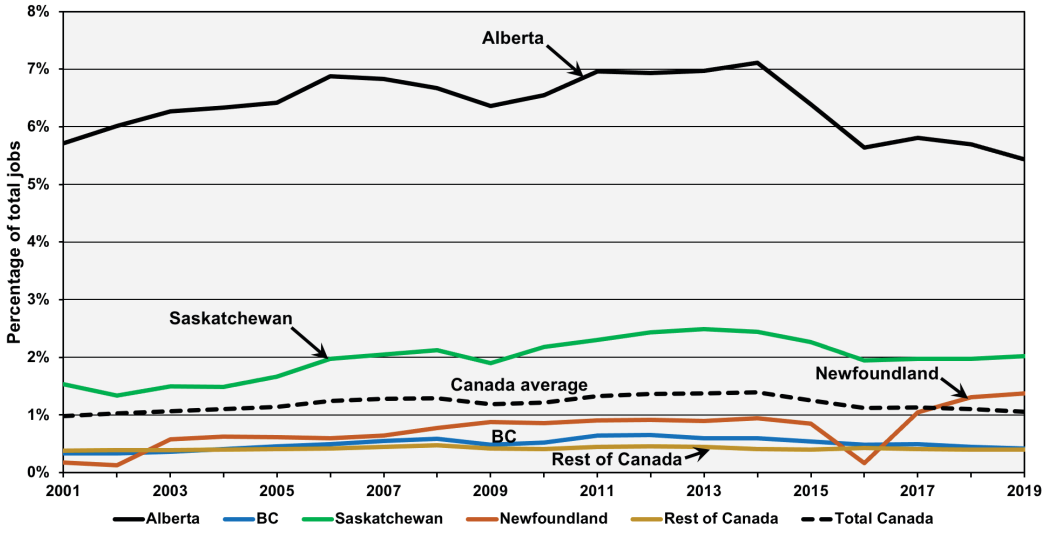
Figure 15: Direct employment by component in the oil and gas sector in Canada from 2001 to 2019



Note: The figure shows jobs in production, distribution, wholesale and retail. Support activities include some mining jobs. The petroleum and coal product manufacturing component includes some jobs in coal product manufacturing.

Source: Statistics Canada, Table 14-10-0202-01, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410020201 (accessed August 2, 2020).

Figure 16: Employment in the oil and gas sector by province (excluding gasoline stations) as a percentage of total industrial employment from 2001 to 2019



Source: Statistics Canada, Table 14-10-0202-01, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410020201 (accessed August 2, 2020).

Figure 16 illustrates oil and gas employment as a percentage of all industry jobs in each province. As expected, given its dominance in production, Alberta depends most heavily on jobs in oil and gas at 5.5 per cent of employment in 2019. Next were Saskatchewan at 2 per cent and Newfoundland at 1.3 per cent. Overall, the oil and gas sector accounts for about 1 per cent of Canadian employment and less than 0.5 per cent in BC and the rest of Canada.

Overall, the oil and gas sector accounts for about 1 per cent of Canadian employment and less than 0.5 per cent in BC and the rest of Canada.

Employment data from Petroleum Labour Market Information (PetroLMI)[14] is broadly similar to employment data from Statistics Canada but includes data provided by industry that is somewhat different. PetroLMI subdivides employment data into different categories than Statistics Canada, which allows a breakdown into exploration and production, oil sands, oil and gas services, and pipelines.

Figure 17 illustrates oil and gas employment by province based on PetroLMI data. Some 53,119 jobs, or 23 per cent of the labour force, were lost between peak employment of 226,460 in 2014 and 2019 — even though production rose 24 per cent to a record high over the same period. Alberta accounted for 83 per cent of total Canadian oil and gas employment in 2019; BC and Saskatchewan, 6 per cent each; and the rest of Canada, 5 per cent.

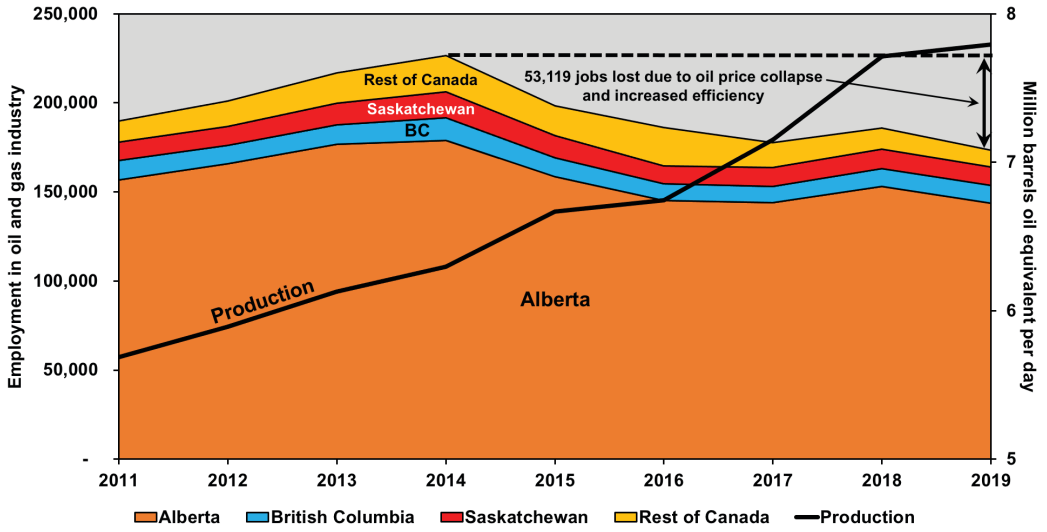
Figure 18 illustrates employment by oil and gas sector component. Even though oil sands accounted for 38 per cent of oil and gas energy produced in Canada, oil sands employment accounted for only 15 per cent of employment in the industry. Employment in conventional oil and gas extraction accounted for 35 per cent of total employment, services for 43 per cent and pipelines for 5 per cent.

As noted above, despite job losses of more than 53,000 since 2014, production is at all-time highs. Digitalization, including the use of artificial intelligence, has made the industry much

14 Petroleum Labour Market Information, What Is LMI, accessed June 10, 2020, www.careersinoilandgas.com.

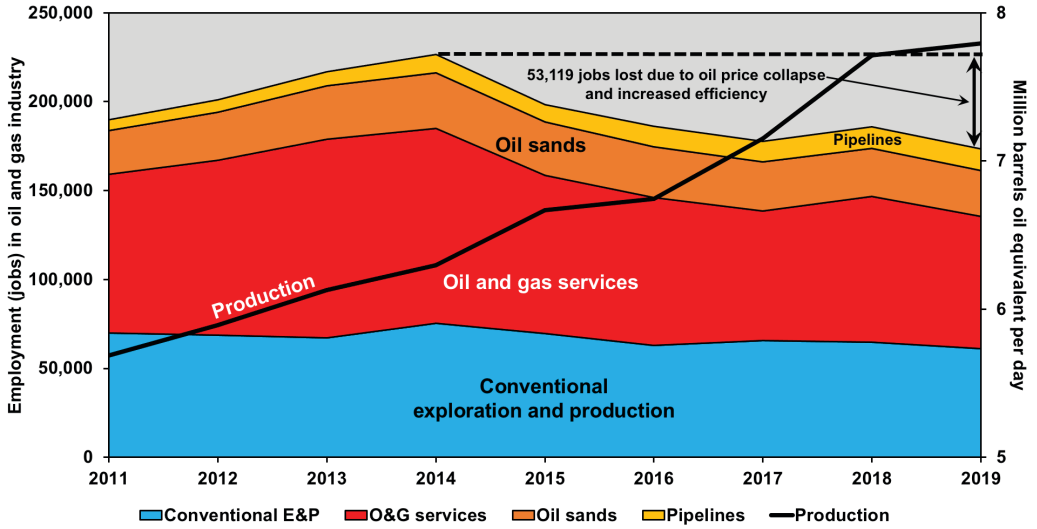
Figure 17: Employment in the oil and gas industry by province from 2011 to 2019, based on PetroLMI data (LHS)

Also shown is oil and gas production over the period in barrels of oil equivalent (BOE) per day (RHS)



Source: Employment data from Petroleum Labour Market Information, 2019 Oil and Gas Labour Market Update (Calgary: PetroLMI, 2019) and earlier labour market updates, https://careersinoilandgas.com/wp-content/uploads/2019/06/2019_Labour_Market_Update_Public_Spreadsheet_FINAL.xlsx (accessed June 10, 2020). Note that 2019 is a forecast and 2018 is an estimate. Production data from Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 21, 2020).

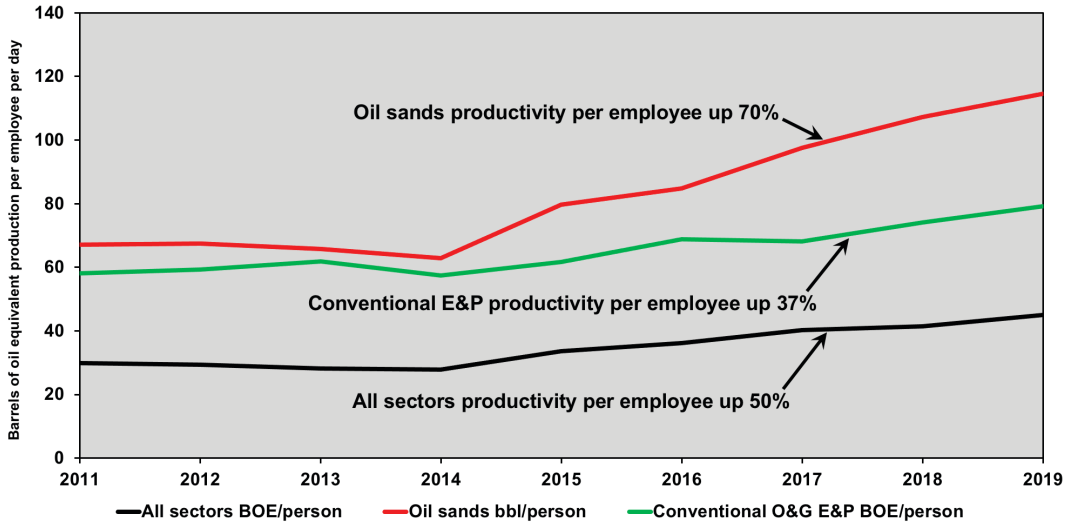
Figure 18: Employment in the oil and gas industry in Canada by sector component from 2011 to 2019, based on PetroLMI data (LHS)



Note: 2019 is a forecast and 2018 is an estimate.

Source: Employment data from Petroleum Labour Market Information, 2019 Oil and Gas Labour Market Update (Calgary: PetroLMI, 2019) and earlier labour market updates, https://careersinoilandgas.com/wp-content/uploads/2019/06/2019_Labour_Market_Update_Public_Spreadsheet_FINAL.xlsx (accessed June 10, 2020). Production data from Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/. (accessed October 21, 2020).

Figure 19: Productivity of employees in the oil and gas industry in Canada from 2011 to 2019, based on PetroLMI data



Notes: Productivity is expressed as the average number of barrels of oil equivalent (BOE) production per employee per day for the exploration and production (E&P) of conventional oil and gas (O&G) and all sectors. Productivity is measured in barrels of oil (bbl) per employee per day for the oil sands.

2019 is a forecast.

Source: Employment data are from Petroleum Labour Market Information, 2019 *Oil and Gas Labour Market Update* (Calgary: PetroLMI, 2019) and earlier labour market updates, https://careersinoilandgas.com/wp-content/uploads/2019/06/2019_Labour_Market_Update_Public_Spreadsheet_FINAL.xlsx (accessed June 10, 2020). Production data from Canadian Association of Petroleum Producers, Statistical Handbook, https://www.capp.ca/resources/statistics/ (accessed October 21, 2020).

more efficient. This efficiency is particularly evident in the oil sands, where production per employee has increased by 70 per cent since 2011. Exploration and production of conventional oil and gas has also increased by 37 per cent since 2011, and productivity in the oil and gas industry overall has increased by an average of 50 per cent.

Even in a scenario of increasing production, employment in the oil and gas sector is unlikely to ever return to 2014 levels.

Figure 19 illustrates the change in labour productivity over the 2011 to 2019 period. The increase in productivity suggests that the jobs lost since 2014 are not coming back. Industry will continue to strive to be more efficient and cut costs. Therefore, even in a scenario of increasing production, employment in the oil and gas sector is unlikely to ever return to 2014 levels.

It is also worth noting that industry lobby groups such as the Canadian Association of Petroleum Producers (CAPP) infer much higher employment numbers by including "indirect" and "induced" jobs. CAPP does not define these terms, but claims 500,000 people were employed in the industry in 2015.[15] The Government of Canada claims there were 282,000 "direct" jobs and 550,500 "indirect" jobs in the energy sector in 2019 (which includes more than just the oil and gas sector).[16]

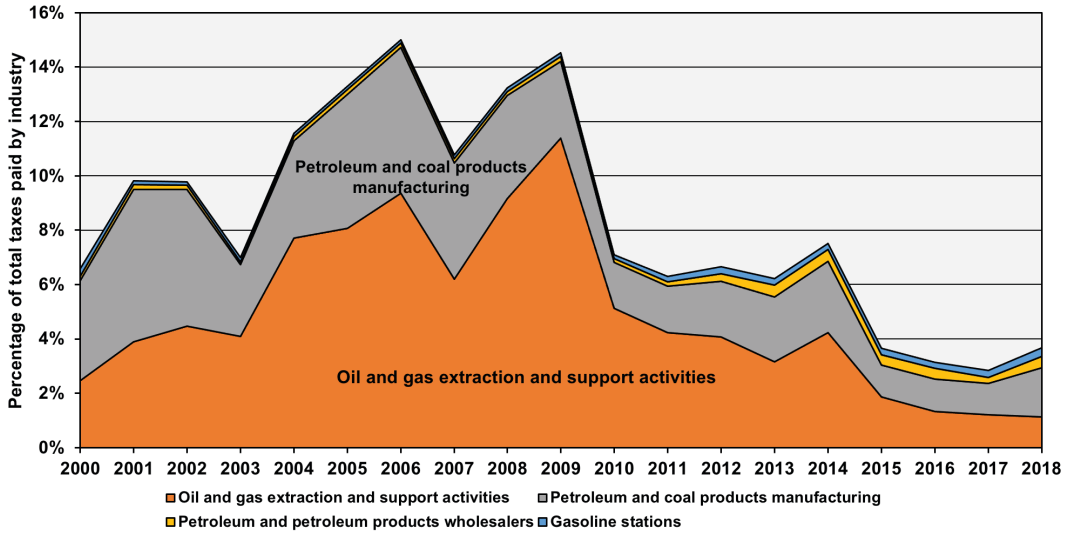
15 Canadian Association of Petroleum Producers, "What Oil and Natural Gas Mean to Canada's Economy," accessed January 26, 2021, https://context.capp.ca/energy-matters/2017/btn_what-oil-and-gas-mean-to-the-economy.

16 Government of Canada, "Employment in Canada's Energy Sector," Natural Resources Canada, accessed January 26, 2021, https://www.nrcan.gc.ca/science-data/data-analysis/energy-data-analysis/energy-facts/energy-and-economy/20062.

Taxes

A final contribution to the Canadian economy by the energy sector is taxes collected by governments. Figure 20 illustrates the sector's contribution to total industrial taxes paid over the 2000 to 2018 period. Taxes paid by the energy sector contributed more than 14 per cent of the total tax paid by industry as recently as 2009 but had declined to less than 4 per cent in 2018, despite rising production.

Figure 20: Tax contribution of the energy sector as a percentage of total industrial taxes paid by industry in Canada from 2000 to 2018



Source: Statistics Canada, Table 33-10-0006-01, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3310000601 (accessed August 25, 2020).

Energy production and consumption forecasts

Given that current measures are insufficient even to meet Canada's commitment under the Paris Agreement it is certain that additional measures to reduce emissions will have to be put in place.

IN NOVEMBER 2020, THE CANADA ENERGY REGULATOR published *Canada's Energy Future 2020*, which provides forecasts for Canada's energy system through 2050.[17] CER presented two scenarios: a Reference Energy System Scenario (reference scenario), where action to reduce greenhouse gas emissions does not develop beyond measures currently in place, and an Evolving Energy System Scenario (evolving scenario), which considers the impact of continuing the historical trend of increasing global action on climate change throughout the projection period.

Given that current measures are insufficient even to meet Canada's commitment under the Paris Agreement (a reduction in emissions to 30 per cent below 2005 levels by 2030) and that Canada's Prime Minister has tabled Bill C-12, which further commits Canada to "net-zero" emissions by 2050, it is certain that additional measures to reduce emissions will have to be put in place. For this reason, only the evolving scenario is considered in detail in the following section (the reference scenario totals are shown for comparison).

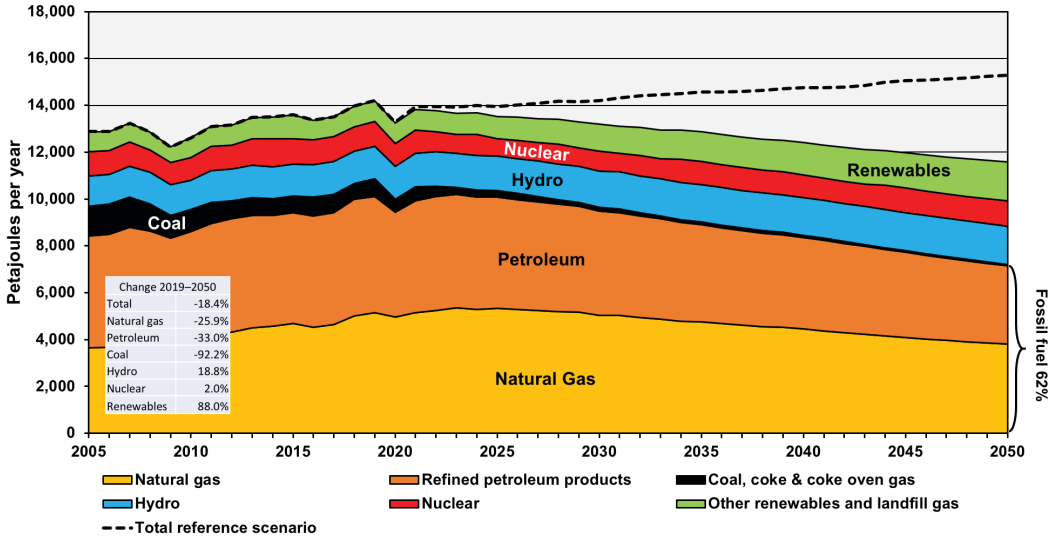
Energy and electricity demand

Figure 21 illustrates primary energy demand in Canada by fuel source through 2050. Primary energy includes fuel losses to generate electricity. Overall demand is projected to decrease by 18.4 per cent from 2019 to 2050 in the CER evolving scenario. And demand for natural gas, petroleum and coal are projected to decrease by 25.9, 33.0 and 92.2 per cent, respectively, over this period, whereas demand for hydro, nuclear and renewables are projected to increase by 18.8, 2.0 and 88.0 per cent, respectively. These projections suggest a number of new large hydro dams will be built, a portion of Canada's existing nuclear fleet will be refurbished and new plants will be constructed (as several reactors in Canada's existing fleet will be decommissioned), and wind, solar, biomass, biofuels and geothermal energy projects will be majorly scaled up. Even though non-hydro renewables and landfill gas are projected to increase by 88 per cent, they will make up just 14.3 per cent of primary energy demand in 2050.

17 Canada Energy Regulator, *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2020/index.html.

Figure 21: Primary energy demand in Canada by fuel source in the Canadian Energy Regulator's evolving scenario

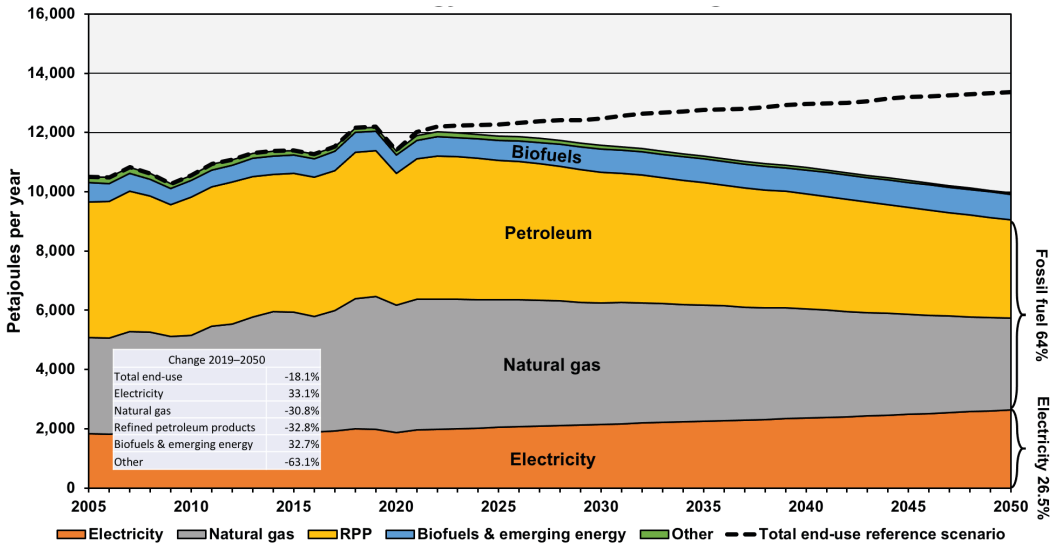
Also shown is total primary energy demand in the CER reference scenario.



Source: Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Figure 22: End-use energy demand in Canada by fuel source in the Canadian Energy Regulator's evolving scenario

Also shown is total end-use energy demand in the CER reference scenario.



Source: Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Despite the government's commitment to net-zero emissions, fossil fuels are projected to make up 64 per cent of end-use energy demand in 2050.

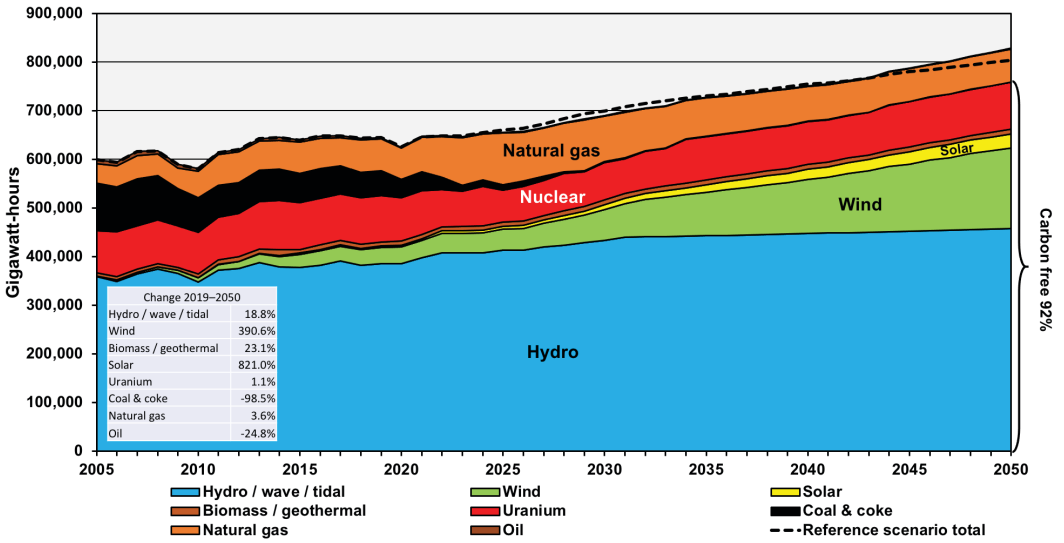
Figure 22 illustrates end-use energy demand in Canada by fuel source through 2050. End-use demand is fuel consumed at point of use after losses from electricity generation, etc. Overall demand in the CER evolving scenario is projected to decrease by 18.1 per cent from 2019 to 2050. Natural gas and refined petroleum products are projected to decrease by 30.8 and 32.8 per cent, respectively, over this period, whereas electricity and biofuels/emerging energy are projected to increase by 33.1 and 32.7 per cent, respectively.

Despite the government's commitment to net-zero emissions, fossil fuels are projected to make up 64 per cent of end-use energy demand in 2050. Electricity, most of which comes from carbon-free hydro, renewables and nuclear sources, is projected to make up only 26.5 per cent of end-use energy demand in 2050.

Figure 23 illustrates projected electricity generation in Canada by fuel source through 2050. In the CER evolving scenario, overall generation is projected to grow 29 per cent over the 2019 to 2050 period. Although wind and solar are forecast to grow by 391 and 821 per cent, respectively, over this period, they will make up only 24 per cent of generation in 2050. Biomass/geothermal generation is projected to grow 23 per cent over this period and make up 2 per cent of generation in 2050. Natural gas is expected to grow 3.6 per cent, oil to decline 25 per cent and coal to decline 99 per cent over the 2019 to 2050 period. Carbon-free electricity from large-hydro/wave/tidal, nuclear and renewable sources is expected to make up 92 per cent of Canada's supply in 2050.

Figure 23: Electricity generation in Canada by fuel source in the Canadian Energy Regulator's evolving scenario

Also shown is total generation in the CER reference scenario.



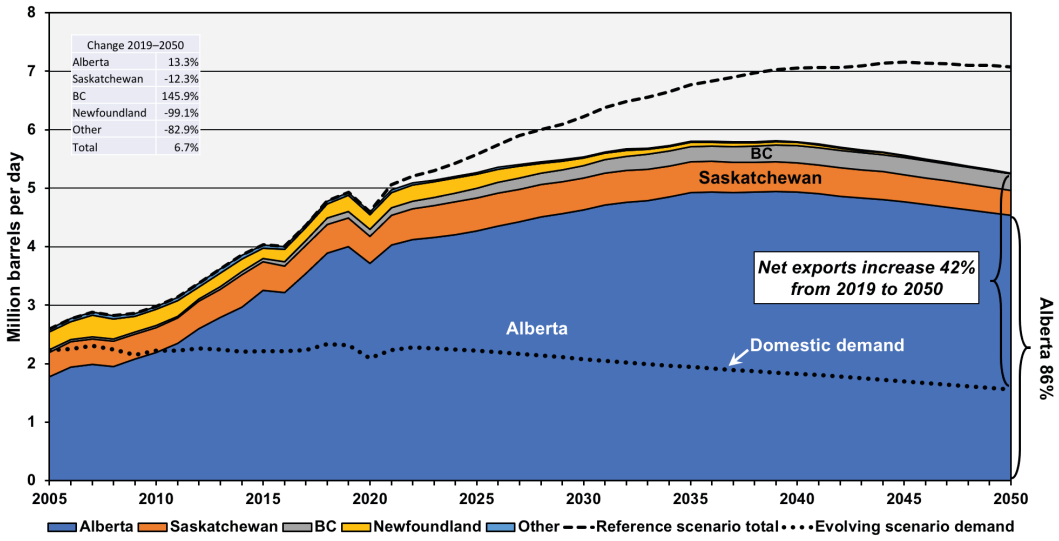
Source: Source: Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Oil production forecast

Oil production in the evolving scenario is projected to peak in 2039 and decline through 2050, although production is forecast to grow overall by 6.7 per cent over the 2019 to 2050 period (Figure 24). All production growth will occur in Alberta and BC, at 13 and 146 per cent, respectively. Saskatchewan is expected to decline by 12 per cent, offshore Newfoundland by 99 per cent and production in the remainder of Canada by 83 per cent. Alberta is projected to make up 86 per cent of Canada's oil production in 2050.

Figure 24: Oil production by province in the Canada Energy Regulator's evolving scenario

Also shown are total oil production in the reference scenario and Canadian domestic demand for oil in the evolving scenario.



Source: Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Newfoundland's offshore production is projected to decline rapidly such that its offshore industry will be almost non-existent by 2040. Much of BC's production will be field condensate produced in conjunction with natural gas, not conventional oil. Field condensate can be used as a diluent for bitumen in the oil sands (bitumen requires an addition of 30 per cent diluent in order to be able to move through a pipeline).

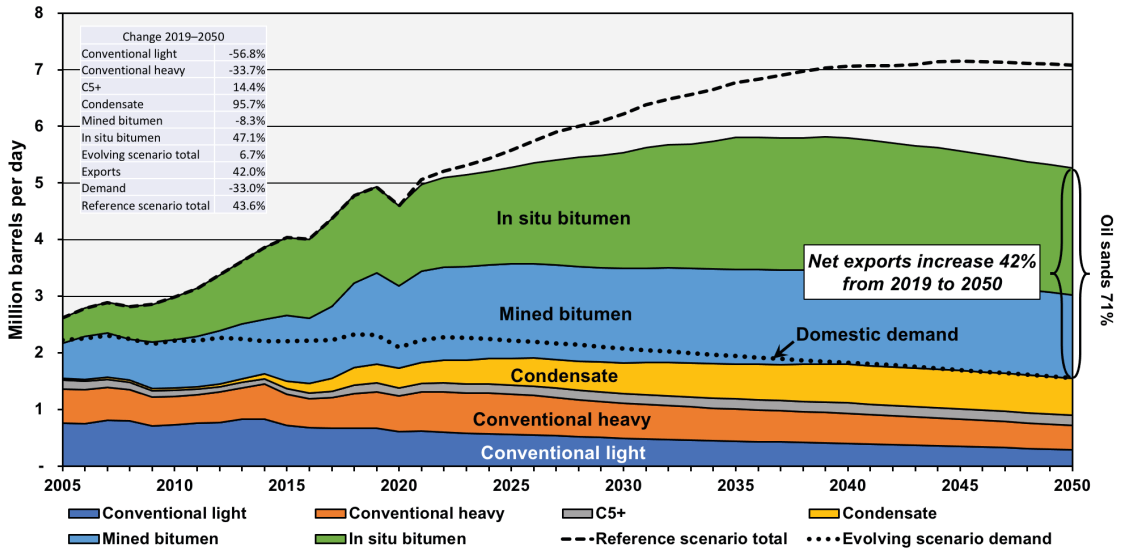
Figure 25 illustrates projected oil production by type in the evolving scenario. Virtually all growth in oil production comes from in situ bitumen as well as liquids produced in conjunction with natural gas, much of both from BC. In situ bitumen production is expected to grow by 47 per cent from 2019 to 2050, whereas mined bitumen is expected to decline by 8 per cent over this period. Condensate and C5+ (also referred to as pentanes plus), which are produced in conjunction with natural gas, are forecast to grow 96 and 14 per cent, respectively, over this period. Oil sands, which are the most emissions intensive source of oil, will make up 71 per cent of Canadian production in 2050.

Western Canada is a very mature exploration region for conventional oil. Some 800,000 wells have been drilled since the 1940s and hence conventional oil production is projected to decline. Conventional light and heavy oil are projected to decline 57 and 34 per cent, respectively, over the 2019 to 2050 period, and offshore production in Newfoundland will decline 99 per cent.

Domestic Canadian oil demand, which is projected to decline by 33 per cent over the 2019 to 2050 period, is also shown in Figure 25. Net oil exports, which are the difference between production and domestic demand, are forecast to increase by 42 per cent over this period, and will make up 71 per cent of production in 2050 (net oil exports were 53 per cent in 2019).

Figure 25: Oil production by type in the Canada Energy Regulator's evolving scenario

Also shown are total oil production in the reference scenario and Canadian domestic demand for oil in the evolving scenario.



Source: Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Implications for new export pipelines

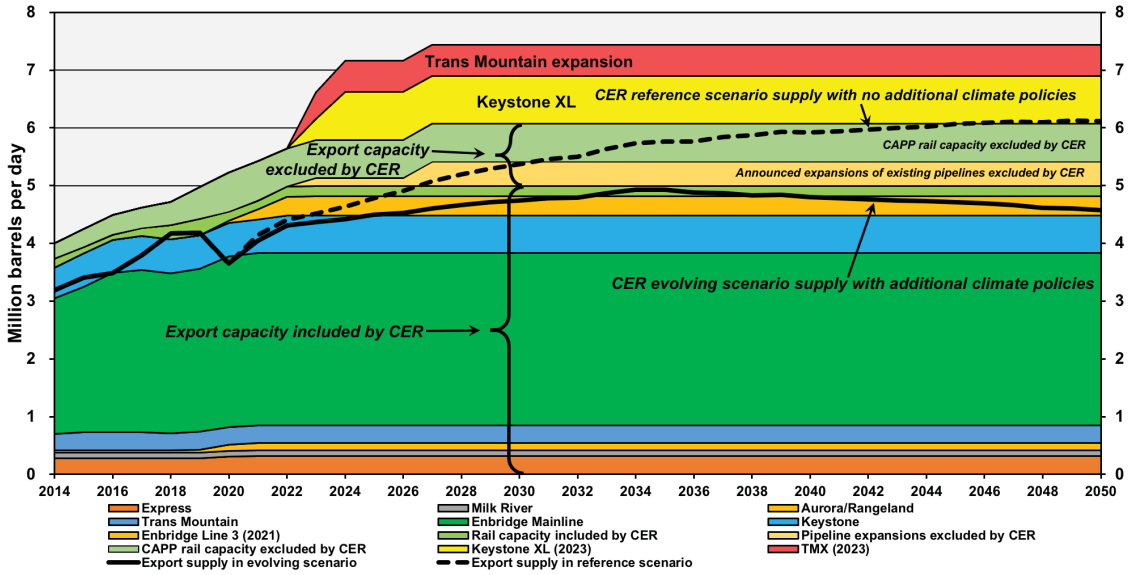
CER provides estimates of export pipeline capacity from Western Canada and supply available for export (export volumes include diluents added to bitumen for shipment by pipeline).[18] The CER estimates are illustrated in Figure 26. These estimates of pipeline export capacity plus a minimal amount of rail along with Enbridge's Line 3 expansion, which will be completed in 2021, suggest enough capacity to carry existing and projected export supply. There is therefore no need for the hotly contested Keystone XL and Trans Mountain expansion (TMX) projects.

However, the CER estimates of pipeline capacity do not include several announced expansions of existing pipeline capacity that can be readily completed should demand be sufficient. These include:

18 Canada Energy Regulator, Figure R.12 in *Canada's Energy Future 2020.*

- Post-2021 optimization and enhancements of the existing Enbridge Mainline, which will provide 200 thousand barrels per day (kbpd) of additional throughput.[19] (It is assumed in Figure 26 that this capacity would be added by 2027 and operate at 95 per cent of capacity.)
- Reversal of the Southern Lights pipeline, which is currently used to import diluent into Western Canada. Diluent supply from domestic production is expected to increase, and reversing the pipeline will add an additional 140 kbpd of useable oil export capacity.[20]
- Approval from the US to increase capacity of the existing Keystone pipeline by 170 kbpd.[21] Although some of this capacity has already been used, an additional 90 kbpd can still be added. (It is assumed in Figure 26 that this remaining capacity would be added by 2027.)
- More rail than was included in the CER analysis (175 kbpd). CAPP estimates that Western Canadian rail-loading capacity is 1,108 kbpd,[22] and 420 kbpd of rail capacity

Figure 26: Existing and proposed pipeline and rail capacity for exporting oil from Western Canada with overlay of oil available for export from the Canada Energy Regulator's evolving and reference scenarios



Note: Export capacity included by CER is from its latest forecast. CAPP rail capacity excluded by CER is the difference between 75 per cent of the Canadian Association of Petroleum Producer's rail-loading capacity and the 175 kbpd included by CER in its estimate.

Source: Canada Energy Regulator, Figure R.12 in "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2020/access-explore/figures.xlsx.

19 Enbridge Inc., "Resilience Discipline Growth" (PowerPoint presentation, investment community presentation, June 2020), 50, https://www.enbridge.com/~/media/Enb/Documents/Investor%20Relations/2020/ENB_Investment_Community_Presentation_June_2020v2.pdf.

20 Enbridge Inc., "Resilience Discipline Growth," 50.

21 Canadian Press, "New U.S. Permit to Boost Keystone Pipeline Oil Exports by Next Year: TC Energy," JWN Energy website, July 30, 2020, https://www.jwnenergy.com/article/2020/7/30/new-us-permit-boost-keystone-pipeline-oil-exports-/.

22 Canadian Association of Petroleum Producers, 2019 Crude Oil Forecast, Markets and Transportation (Calgary: Canadian Association of Petroleum Producers, 2019), 28, https://www.capp.ca/wp-content/uploads/2019/11/CAPP-2019-Crude-Oil-Markets-and-Transportation-338794-1.pdf.

was used in February 2020, according to CER.[23] Figure 26 assumes that up to 75 per cent of CAPP's existing rail-loading capacity could be used if needed, although that is highly unlikely given the existing pipeline capacity available.

With this oil-transport capacity in reserve, again there is clearly no need for either the Trans Mountain expansion project or the Keystone XL pipeline. The federal government, which owns TMX, has claimed higher prices are available in offshore markets that could be accessed by completing the TMX project. This is clearly not the case, as a detailed analysis of historical prices in Asia and transportation costs has shown.[24] In fact, shippers on TMX stand to lose US$4–6 per barrel compared with US exports on existing pipelines. Furthermore, production will very likely have to be much lower than projected in the CER evolving scenario, given the government's commitment to net-zero emissions by 2050 (discussed in the following section).

There is clearly no need for either the Trans Mountain expansion project or the Keystone XL pipeline.

If the announced expansions of existing pipelines not factored into the CER estimate of existing capacity are included, some 420 kbpd of export-pipeline capacity would be added, as noted in Figure 26. This capacity could replace the Line 3 expansion project, which is currently under construction in Minnesota and will have an estimated 330 kbpd of export capacity when completed, according to CER.

Gas production forecast

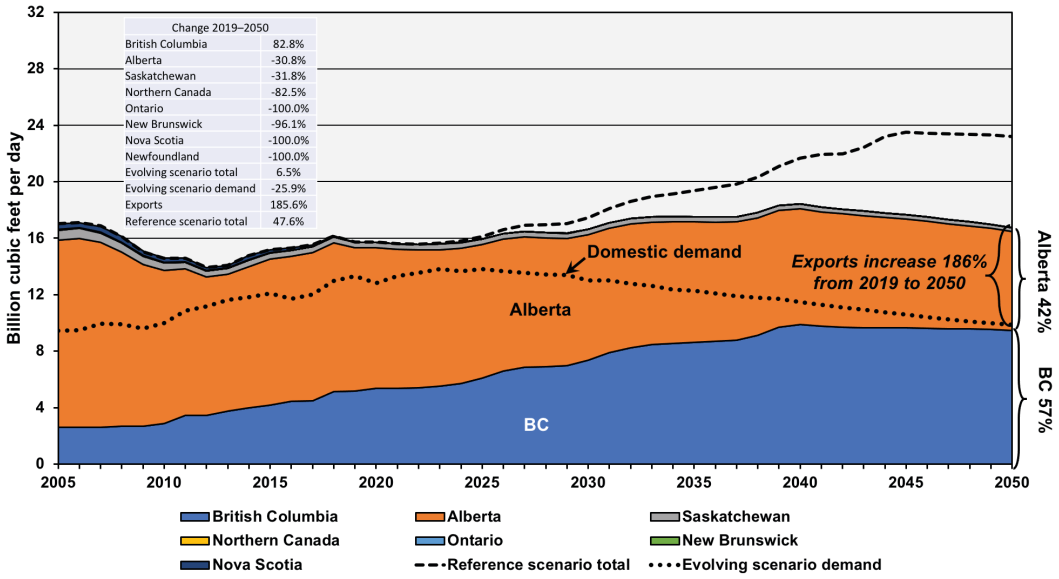
Figure 27 illustrates the CER evolving scenario projection of natural gas production by province. Although it forecast overall production to grow by 6.5 per cent from 2019 to 2050, production in every province except BC is expected to decline sharply. In Eastern Canada, the permanent closure of the Sable offshore oil platform in 2018 means there will be no gas production in the region in 2050 except in New Brunswick, which is projected to decline by 96 per cent over the 2019 to 2050 period. In Western Canada, natural gas production in Alberta and Saskatchewan is projected to decline 31 and 32 per cent, respectively, over the 2019 to 2050 period. This decline is not surprising given Western Canada's maturity as an exploration area. Only in BC is gas production expected to increase by a projected 83 per cent over the 2019 to 2050 period. This growth is due to the emergence of fracking technology that has allowed access to tight- and shale-gas reservoirs that were previously inaccessible due to their low permeability. BC gas production is forecast to grow to 57 per cent of total Canadian production in 2050 compared with 42 per cent for Alberta and one per cent combined for all other areas of Canada. Net exports of natural gas are forecast to rise 186 per cent from 2019 levels by 2050 (from 15 per cent in 2019 to 41 per cent in 2050).

23 Canada Energy Regulator, "Canadian Crude Oil Exports by Rail — Monthly Data," accessed January 29, 2021, https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/crude-oil-petroleum-products/statistics/canadian-crude-oil-exports-rail-monthly-data.html.

24 J. David Hughes, *Reassessment of Need for the Trans Mountain Pipeline Expansion Project: Production Forecasts, Economics and Environmental Considerations*, (Vancouver: Canadian Centre for Policy Alternatives–BC Office, October 2021), https://www.policyalternatives.ca/publications/reports/reassessment-need-trans-mountain-pipeline-expansion-project.

Figure 27: Natural gas production by province in the Canada Energy Regulator's evolving scenario

Also shown are total natural gas production in the reference scenario and Canadian domestic demand for natural gas in the evolving scenario.



Source: Source: Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

CAPP reports annual "remaining established reserves" of natural gas, which it defines as:

> Those reserves recoverable under current technology and present and anticipated economic conditions, specifically proved by drilling, testing or production, plus that judgement portion of contiguous recoverable reserves that are interpreted to exist, from geological, geophysical or similar information, with reasonable certainty.[25]

Table 1 provides the 2019 CAPP estimates of remaining established natural gas reserves by province, and also the amount to be produced over the 2020 to 2050 period according to the CER evolving scenario. Although CAPP's estimate of remaining established reserves in 2019 is 88 trillion cubic feet (tcf), CER projects that 193 tcf, or 2.2 times as much, will be produced over the 2020 to 2050 period in its evolving scenario.

25 Canadian Association of Petroleum Producers, Statistical Handbook (accessed January 30, 2021).

Table 1: Remaining established natural gas reserves by province, according to Canadian Association of Petroleum Producers' estimates

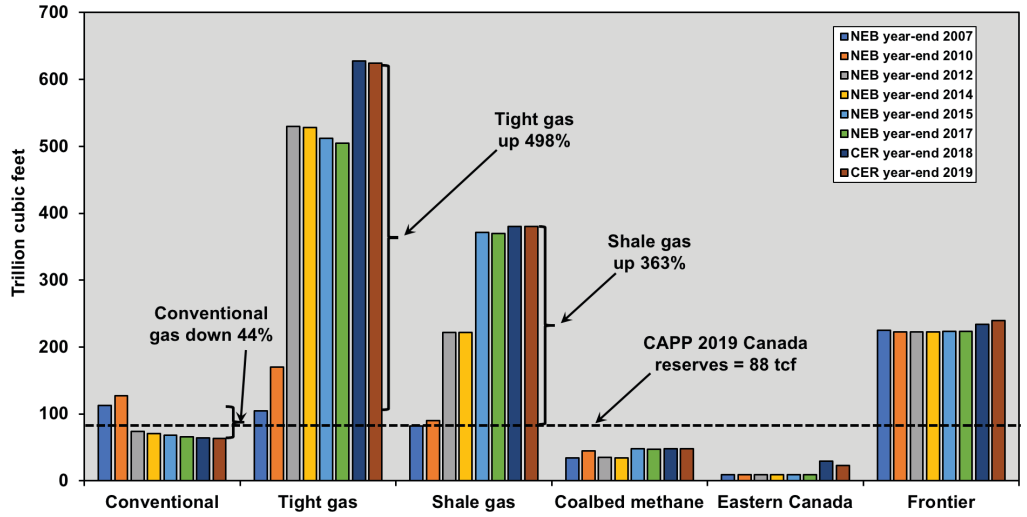
Province	CAPP 2019 reserves (tcf)	CER 2020–2050 production (tcf)	Production exceeds reserves (tcf)
British Columbia	58.63	92.06	33.43
Alberta	26.59	96.07	69.48
Saskatchewan	1.28	3.98	2.70
Ontario	0.67	0.01	-0.66
New Brunswick	0.09	0.01	-0.08
Territories	0.45	0.04	-0.41
East Coast offshore	0.03	0.00	-0.03
Total	**87.72**	**192.80**	**104.45**
The CER evolving scenario exceeds CAPP reserves by 2.2 times.			
The CER reference scenario exceeds CAPP reserves by 2.5 times.			

Note: Also shown are projections of natural gas production by province from 2020 to 2050 under the CER evolving scenario, and the difference between CAPP's reserve estimates and the CER production estimates.
Source: Canadian Association of Petroleum Producers, *2019 Crude Oil Forecast, Markets and Transportation (Calgary: Canadian Association of Petroleum Producers, 2019), 28,* https://www.capp.ca/wp-content/uploads/2019/11/CAPP-2019-Crude-Oil-Markets-and-Transportation-338794-1.pdf?.

Estimates of remaining established reserves do evolve over time with more drilling and changing economics and prices. CER and its predecessor, the National Energy Board (NEB), have produced a series of estimates of natural gas "resources." Whether or not these resources exist is much less certain than the "reserves," owing to the extrapolation of geological assumptions over broad areas without drilling information to support them and without considering economic viability. Figure 28 illustrates these estimates by resource type from 2007 to 2019.

The CER estimates of tight gas and shale gas resources have increased severalfold since 2007, as fracking has opened up previously inaccessible deposits of these gases primarily in northeastern BC and northwestern Alberta. Resource estimates for other types of natural gas deposits have not changed significantly over this period. Although the CER resource estimates are many times the CAPP reserve estimates, they have a much lower certainty of existence.

Figure 28: Estimates of natural gas resources in Canada by type from 2007 to 2019

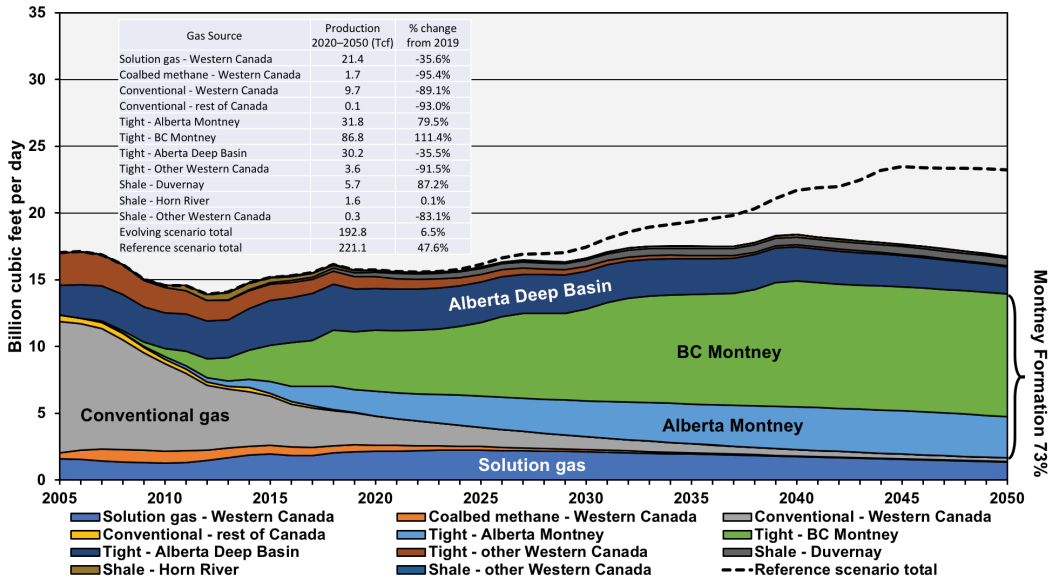


Note: Frontier refers to the East and West Coast offshore, the Yukon and Northwest Territories and the Arctic.

Source: Canada Energy Regulator and National Energy Board in a series of reports from 2009 through 2020. The most recent data are from Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Figure 29: Natural gas production by province in the Canada Energy Regulator evolving scenario

Also shown is total natural gas production in the reference scenario.



Gas Source	Production 2020–2050 (Tcf)	% change from 2019
Solution gas - Western Canada	21.4	-35.6%
Coalbed methane - Western Canada	1.7	-95.4%
Conventional - Western Canada	9.7	-89.1%
Conventional - rest of Canada	0.1	-93.0%
Tight - Alberta Montney	31.8	79.5%
Tight - BC Montney	86.8	111.4%
Tight - Aberta Deep Basin	30.2	-35.5%
Tight - Other Western Canada	3.6	-91.5%
Shale - Duvernay	5.7	87.2%
Shale - Horn River	1.6	0.1%
Shale - Other Western Canada	0.3	-83.1%
Evolving scenario total	192.8	6.5%
Reference scenario total	221.1	47.6%

Source: Canada Energy Regulator, "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Figure 29 illustrates the production forecast by resource type under the CER evolving scenario. Tight gas and shale gas, accessible primarily through fracking, make up 83 per cent of production from 2020 to 2050. The Montney tight-gas formation in northeastern BC and northwestern Alberta makes up 61 per cent of Canada's 2020 to 2050 production in the CER evolving scenario, and the BC portion of the Montney formation makes up 45 per cent of Canada's total. Much of the CER forecast for BC production is projected to be exported as LNG.

As Figure 29 illustrates, all natural gas resource sectors other than tight gas and shale gas, which depend on fracking, will be in steep decline in the CER evolving scenario forecast. Given that natural gas is a finite resource, that extracting it via fracking has a large environmental footprint, that CER estimates of how much gas remains are likely highly optimistic and that Canadians will need natural gas at some level for the foreseeable future, the wisdom of extracting this resource as fast as possible must be questioned. The significant greenhouse gas emissions from extracting natural gas, which are another major consideration in light of the government's net-zero aspirations, are discussed in the following section.

Emissions trends and climate commitments

IN 2016, CANADA SIGNED THE PARIS AGREEMENT and committed to a 30 per cent reduction in greenhouse gas emissions from 2005 levels by 2030.[26] Canada later committed to an 80 per cent reduction in overall emissions by 2050.[27] In November 2020, the Government of Canada introduced Bill C-12, *An Act respecting transparency and accountability in Canada's efforts to achieve net-zero greenhouse gas emissions by the year 2050*.[28] Bill C-12 has yet to become law but has received its second reading in parliament.[29] On Earth Day (April 22, 2021), Canada increased its Paris Agreement commitment for emissions reduction from 2005 levels to 40–45 per cent by 2030.[30]

Figure 30 illustrates emissions by economic sector in Canada from 1990 to 2019, which are the most recent emissions data available. Also shown are Canada's emissions reduction targets. As of year-end 2019, emissions were down just 1.2 per cent from 2005 levels. Oil and gas production amounted to 26 per cent of 2019 emissions.

As of year-end 2019, emissions were down just 1.2 per cent from 2005 levels. Oil and gas production amounted to 26 per cent of 2019 emissions.

26 Government of Canada, "Progress towards Canada's Greenhouse Gas Emissions Reduction Target," January 9, 2020, https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/progress-towards-canada-greenhouse-gas-emissions-reduction-target.html.

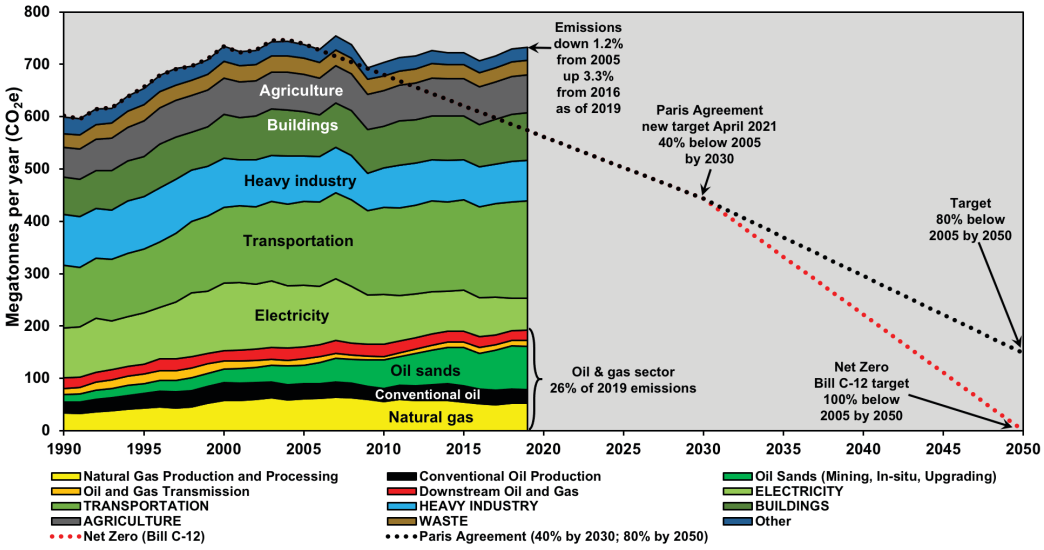
27 Taryn Fransen, "How Do New 2050 Climate Strategies from Canada, Mexico and the US Stack Up?," World Resources Institute, November 18, 2016, https://www.wri.org/blog/2016/11/how-do-new-2050-climate-strategies-canada-mexico-and-us-stack.

28 Government of Canada, Bill C-12, An Act respecting transparency and accountability in Canada's efforts to achieve net-zero greenhouse gas emissions by the year 2050, 2nd Sess, 43rd Parl, 2020, (as passed by the House of Commons 19 November 2020), https://parl.ca/DocumentViewer/en/43-2/bill/C-12/first-reading.

29 Bill C-12 has not yet become law and as of April 16, 2021, had received second reading https://openparliament.ca/bills/43-2/C-12/.

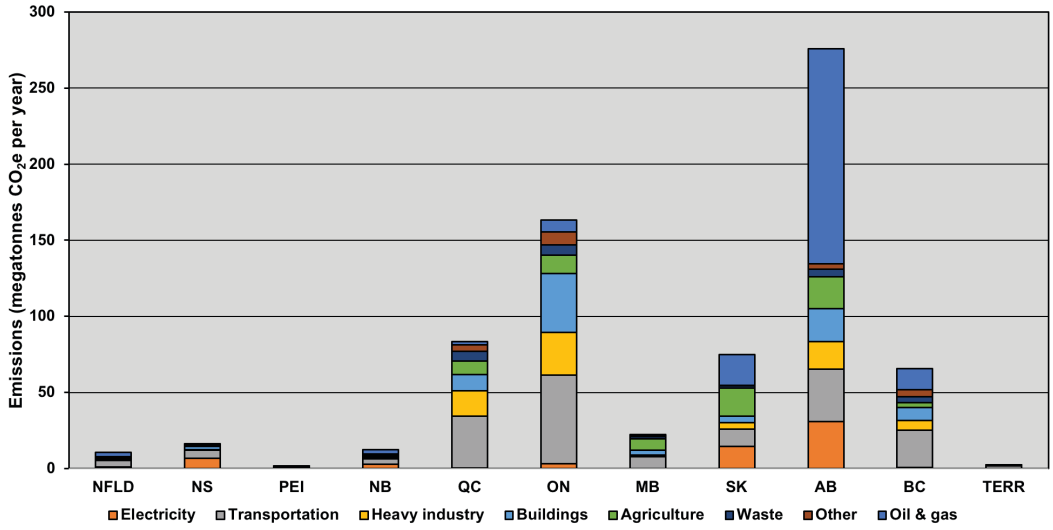
30 John Paul Tasker and Aaron Wherry, "Trudeau pledges to slash greenhouse gas emissions by at least 40% by 2030," CBC, April 22, 2021, https://www.cbc.ca/news/politics/trudeau-climate-emissions-40-per-cent-1.5997613.

Figure 30: Emissions in Canada by economic sector from 1990 to 2019 and emissions targets the Government of Canada has committed to for 2030 and 2050



Source: Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2020), https://unfccc.int/documents/224829.

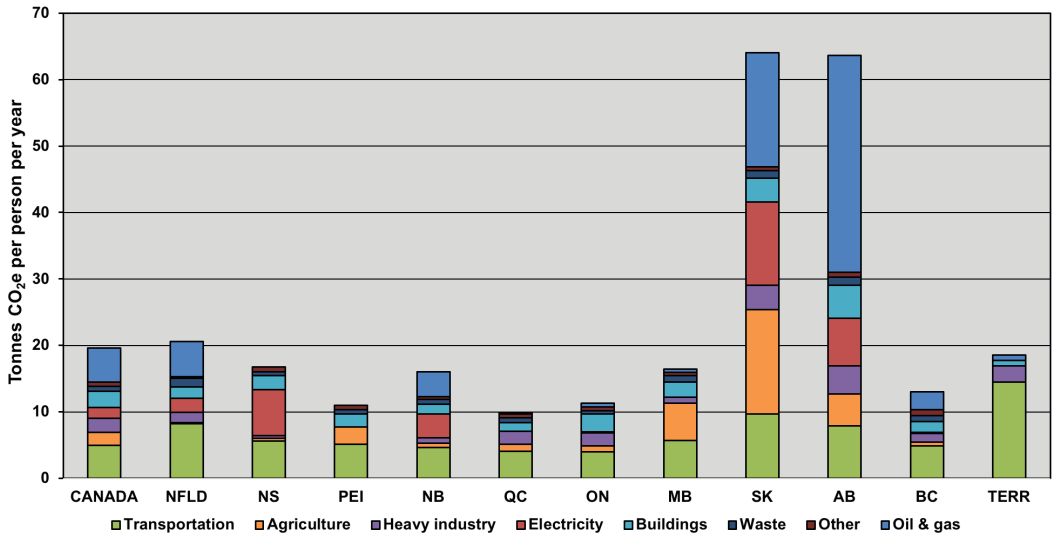
Figure 31: Emissions by province and economic sector in 2019



Source: Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493.

Figure 31 illustrates Canada's emissions by province and economic sector. Alberta has by far the largest overall emissions, half of which are from the production of oil and gas. Saskatchewan and BC are second and third, respectively, in emissions from the oil and gas sector. Other provinces benefit from the oil and gas produced in Alberta, Saskatchewan and BC — using it for transportation, heating and other purposes; however, the emissions from production are counted in the provinces where the oil and gas are extracted.

Figure 32: Per capita emissions by province and economic sector in 2019



Source: Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493.

Figure 32 illustrates per capita emissions by province and economic sector. As a result of oil and gas production, coal- and gas-fired electricity and agriculture, per capita emissions in Alberta and Saskatchewan dwarf those of other provinces. However, per capita emissions of all provinces are much higher than the world average of 4.4 tonnes per annum (see Figure 4).

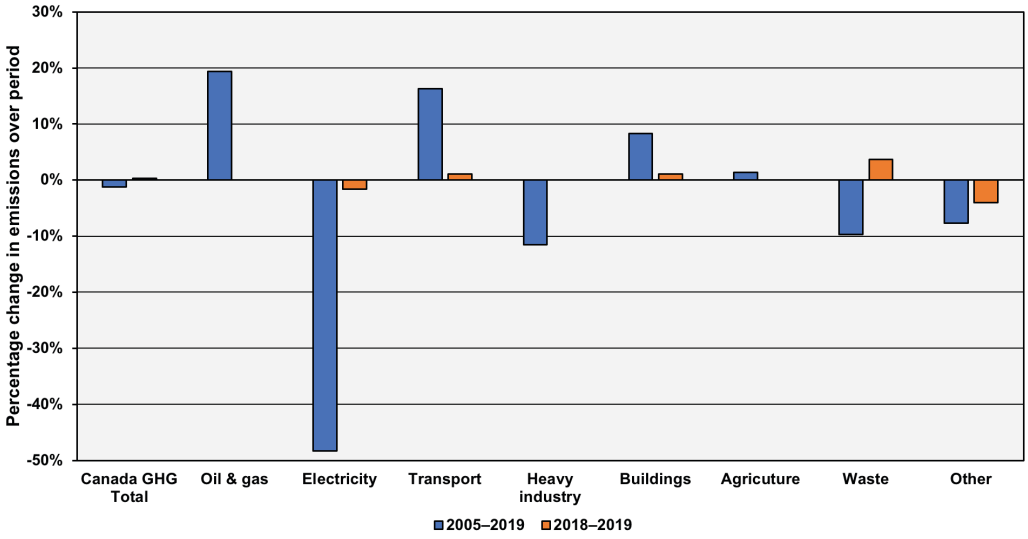
Figure 33 illustrates the change in emissions in Canada by economic sector from 2005 to 2019, and in the most recent year. Emissions reduction in the electricity sector is by far the largest, followed by heavy industry and waste. All other sectors increased emissions from 2005 levels. In the most recent year for which data are available, only the electricity sector achieved emissions reductions.

Alberta has by far the largest overall emissions, half of which are from the production of oil and gas. Saskatchewan and BC are second and third.

Emissions reductions in the electricity sector were achieved mainly by phasing out coal-fired generation in Ontario and Alberta. In Alberta, coal was replaced mostly with natural gas, and in Ontario, with power from refurbished nuclear reactors and also some wind and solar. Although producing natural gas generates more emissions than producing coal, the emissions from natural gas at the burner tip are about half those of coal per unit of heat produced. Without refurbishment of the Bruce and Darlington reactors, and the retirement of the Pickering reactors in 2024, Ontario may become increasingly dependent on natural gas.[31]

31 John Michael McGrath, "Why Ontario's Electricity Is about to Get Dirtier," The Ontario Educational Communications Authority (TVO), September 20, 2019, https://www.tvo.org/article/why-ontarios-electricity-is-about-to-get-dirtier.

Figure 33: Change in emissions in Canada by economic sector from 2005 to 2019 and from 2018 to 2019



Source: Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493.

Figure 34 illustrates the change in emissions by economic sector and province from 2005 to 2019. Overall, there have been large increases in the oil and gas and transportation sectors with a lesser increase in the building sector. Almost all of the decrease has come from the electricity sector as a result of phasing out coal in Ontario and Alberta, with some decrease also from heavy industry.

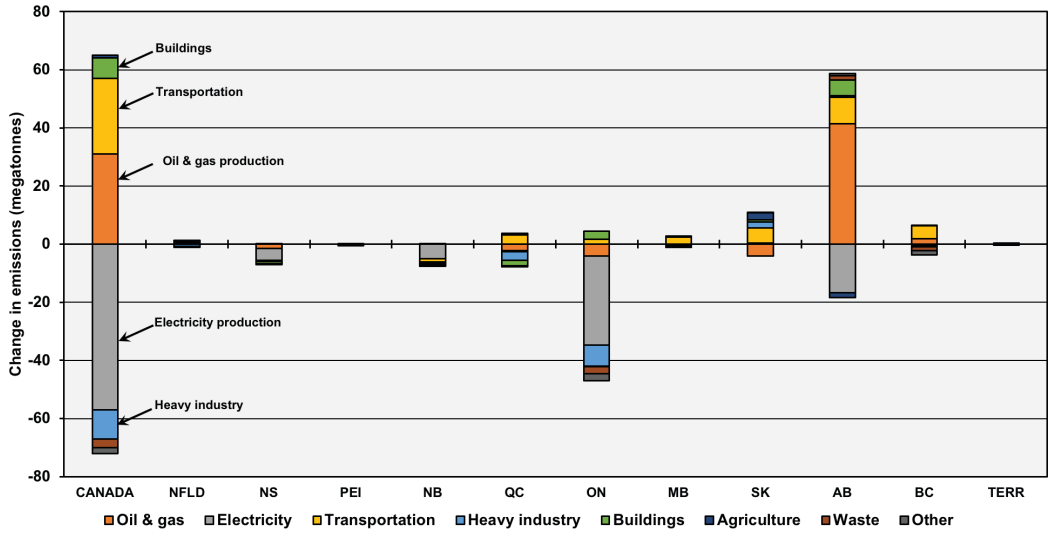
In terms of meeting Canada's emissions reduction targets, phasing out coal was the easy, low-hanging fruit.

In terms of meeting Canada's emissions reduction targets, phasing out coal was the easy, low-hanging fruit. The decision to replace coal made economic sense given the low price of gas in Alberta and the availability of refurbished reactors in Ontario. The next tranche of reductions will be much more difficult and must be much more aggressive if Canada is to achieve its emissions targets. Indeed, as of 2019, Canada had achieved only a 1.2 per cent reduction in emissions from 2005 levels, and Canada's emissions are up 3.3 per cent since 2016 when the Paris Agreement was signed. Of the two G7 countries that have increased emissions since 2016, Canada was the worst, followed by the US at 0.6 per cent.[32] The other five G7 countries decreased emissions from between 4.4 per cent (Italy) and 10.8 per cent (Germany).

Overall changes in emissions by province from 2005 to 2019 are illustrated in Figure 35. Emissions in oil and gas–producing provinces have increased over this period whereas emissions in others have declined significantly. Alberta's emissions increased by 17.1 per cent whereas New Brunswick's emissions declined by 38 per cent along with Nova Scotia at 30.2 per cent and Ontario at 20.7 per cent.

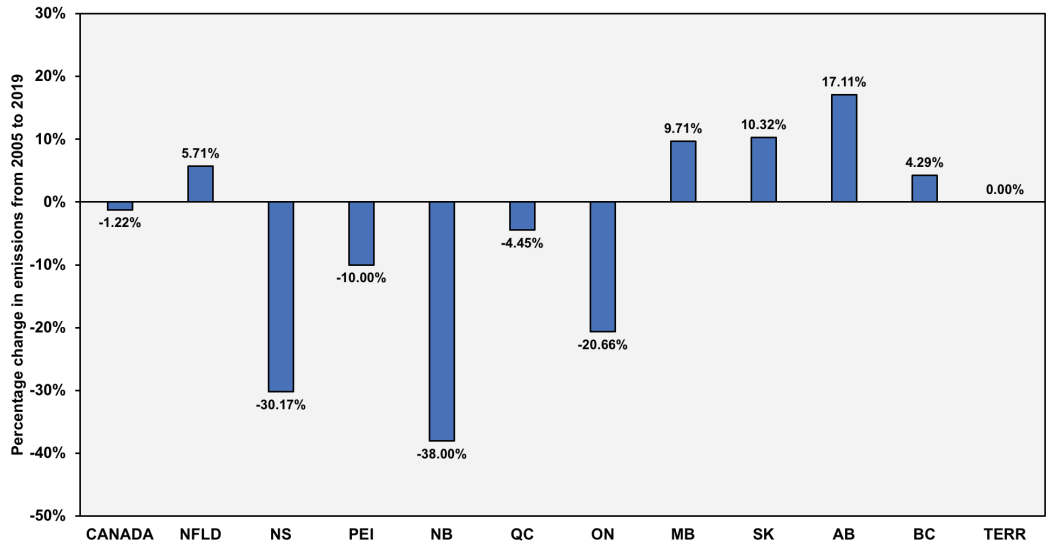
32 United Nations, "National Inventory Submissions 2021," https://unfccc.int/ghg-inventories-annex-i-parties/2021.

Figure 34: Change in emissons by province and economic sector from 2005 to 2019



Source: Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493.

Figure 35: Overall change in emissions by province from 2005 to 2019



Source: Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493.

Implications for energy megaprojects and future production

In the CER evolving scenario, emissions from the oil and gas sector alone would be 32 per cent above the 80 per cent reduction target by 2050, even if all other sectors of the economy reduced emissions to zero.

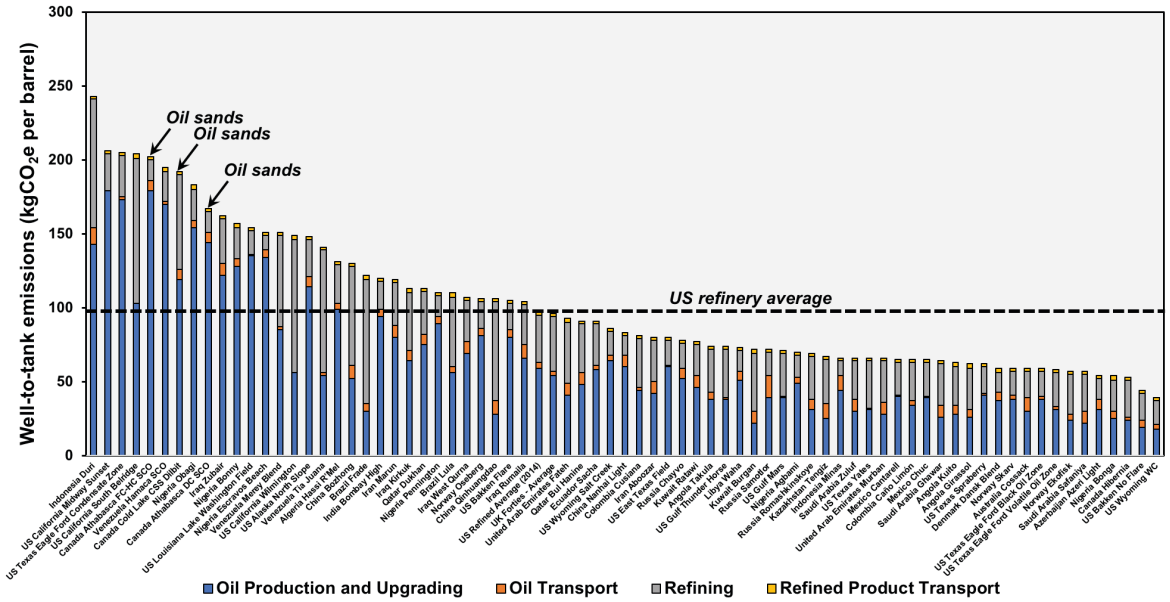
THE ENERGY SECTOR IS A MAJOR AND GROWING SOURCE OF EMISSIONS in Canada and the largest source of emissions growth since 2005 (see Figure 34). The major source of growth in future oil production will be oil sands, according to the CER evolving scenario projection (see Figure 25). Producing oil from oil sands is very energy and emissions intensive, particularly in situ bitumen, which is projected to be the major source of production growth. Figure 36 illustrates the well-to-tank emissions of oil sands compared to other sources of crude oil in the world. Oil sands are close to the highest source of emissions and nearly double the US refinery crude oil average.

In its evolving scenario, CER projects a reduction of 18 to 31 per cent in emissions produced per barrel of oil sands by 2050. This would occur, according to CER, with increased use of solvents for in situ production, in-pit extraction for mining, and other improvements.[33] The reduction in oil sands emissions by production technique assumed in the CER evolving scenario is illustrated in Figure 37. Whether these emissions reductions can be achieved is speculative because the highest-quality resources are always extracted first. The lower-quality, more energy- and emissions-intensive resources are higher cost and are therefore extracted after the lowest-cost resources are gone.

Figure 38 illustrates emissions of the oil and gas sector in the CER evolving scenario if the emissions improvements in the oil sands illustrated in Figure 37 are achieved. These are compared to the Canadian government's 2016 commitment to reach an 80 per cent reduction in emissions from 2005 levels by 2050. In the CER evolving scenario, emissions from the oil and gas sector alone would be 32 per cent above the 80 per cent reduction target by 2050, even if all other sectors of the economy reduced emissions to zero. In the CER reference scenario, oil and gas sector emissions alone are 94 per cent higher than the 2050 target.

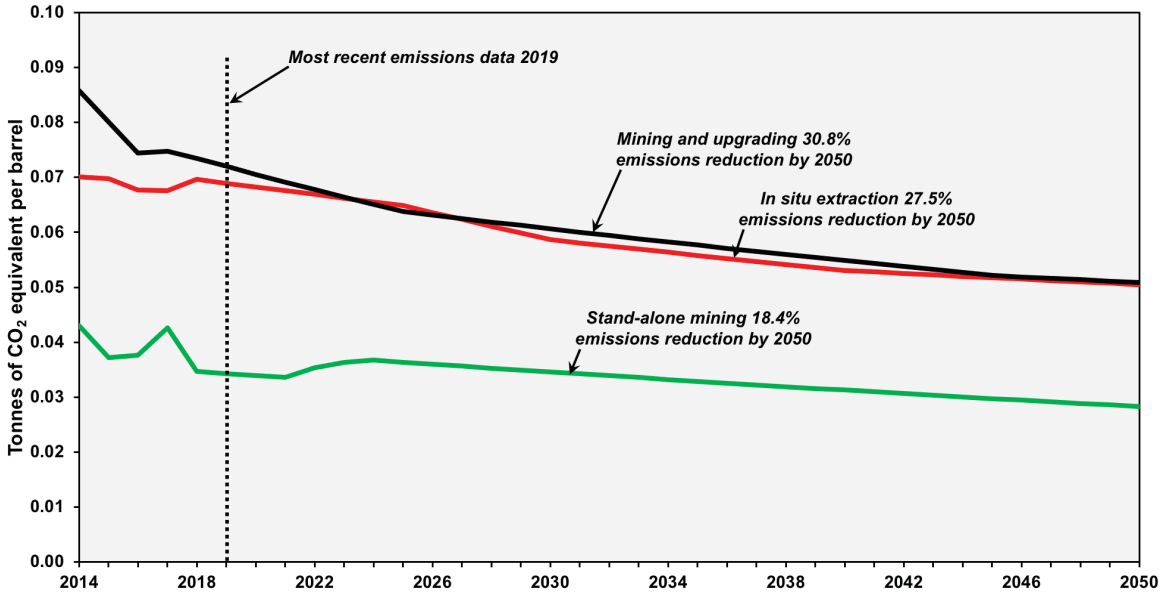
33 Canada Energy Regulator, *Canada's Energy Future 2020.*

Figure 36: Well-to-tank emissions from oil production from various sources around the world compared to the US refinery average



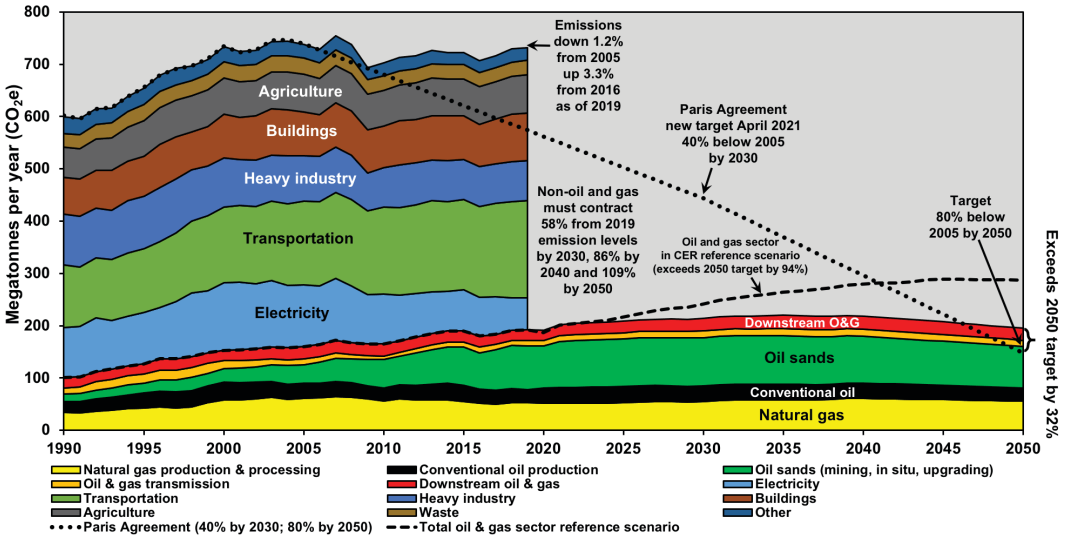
Source: Jackie Forrest and Marcus Rocque, *Crude Oil Investing in a Carbon Constrained World: 2017 Update* (Calgary: ARC Energy Research Institute, 2017), Crude-Oil-Investing-in-a-Carbon-Constrained-World-2017-Update.pdf.

Figure 37: Projected reduction in emissions from 2018 levels in oil sands production by method in the Canada Energy Regulator's evolving scenario



Source: Canada Energy Regulator, Figure OS.2 in "Canada's Energy Future Data Appendices," *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2020/access-explore/figures.xlsx.

Figure 38: Canadian emissions to 2050 assuming the Canada Energy Regulator's evolving scenario production projection and oil sands emissions reductions illustrated in Figure 37



Note: Emissions for oil and gas are based on an average of 2016 to 2019 emissions per unit of production.

Sources: Emissions data are from Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493. Production data are from Canada Energy Regulator, *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

Reducing exports of oil and natural gas would help Canada achieve emissions-reduction targets without having an impact on domestic supply.

Clearly, proceeding with an oil and gas production ramp-up, as projected by CER, makes achieving Canada's emissions-reduction commitments impossible. To meet them, production will have to be sharply reduced. Given that more than half of Canadian oil is exported, along with a significant proportion of natural gas (see Section 4), reducing exports would help Canada achieve emissions-reduction targets without having an impact on domestic supply. Aggressive measures to reduce domestic consumption will also have to be implemented. The CER evolving scenario projections of increasing production and increasing net exports by 42 per cent for oil and 186 per cent for gas make little sense if Canada is serious about meeting its emissions-reduction targets.

The need to radically reduce fossil fuel production to meet net-zero targets has also been recognized by the International Energy Agency (IEA) in its recent *Net-zero by 2050* report.[34] The IEA concluded:

- "Net zero means a huge decline in the use of fossil fuels. They fall from almost four-fifths of total energy supply today to slightly over one-fifth by 2050."
- "Beyond projects already committed as of 2021, there are no new oil and gas fields approved for development in our pathway, and no new coal mines or mine extensions are required. Unabated coal demand declines by 90% to just 1% of total energy use in 2050. Gas demand declines by 55% to 1,750 billion cubic metres and oil declines by 75% to 24 million barrels per day (mb/d), from around 90 mb/d in 2020."

34 International Energy Agency, May, 2021, *Net Zero by 2050: A Roadmap for the Global Energy Sector*, https://www.iea.org/reports/net-zero-by-2050.

- "Making net-zero emissions a reality hinges on a singular, unwavering focus from all governments — working together with one another, and with businesses, investors and citizens."

The IEA's report underscores the contradiction between Canada's commitment to achieving net-zero by 2050 and its policies of building export pipelines to facilitate increased production and the development of an LNG export industry.

The Canadian government intends to rely on carbon capture and storage (CCS) to achieve a significant part of its targets, as well as purchasing carbon offsets.[35] Although CCS has been demonstrated at small scales compared to the reductions required, much of the captured carbon dioxide has been used for enhanced oil recovery. This use of industrial carbon removal (ICR) has led researchers to conclude: "We found that the commercial ICR (C-ICR) methods being incentivized by governments are net CO_2 additive: CO_2 emissions exceed removals."[36] The practice of purchasing carbon offsets is also controversial, as it does not result in net emissions reductions in many cases.

As discussed in Section 4.3, the $12.6 billion government-funded TMX project is not needed even with the production projection from the CER evolving scenario. And considering the need to reduce production to meet Canada's emissions-reduction targets, this project is even less necessary.

In BC, the $40 billion LNG Canada natural gas export project is under construction along with the Coastal GasLink pipeline to bring the gas from northeastern BC.[37] Two other LNG export projects have been approved — Kitimat LNG and Woodfibre LNG — although they have not yet reached a final investment decision. Most of the gas required by these three projects will be produced in BC, and the CER evolving scenario projects that 4.88 billion cubic feet per day, or 26 per cent of Canada's gas production, will be exported as LNG by 2050.[38] The first phase of LNG Canada is expected to be operational by 2025. Both the BC and federal governments have supported LNG exports with subsidies, despite the implications of emissions for their greenhouse gas reduction targets.[39]

Both the BC and federal governments have supported LNG exports with subsidies, despite the implications of emissions for their greenhouse gas reduction targets.

The BC government's CleanBC plan mandates an emissions reduction of 40 per cent from 2007 levels by 2030 and of 80 per cent by 2050.[40] Despite being one of the first jurisdictions in Canada to implement a carbon tax, BC's emissions are up 4.3 per cent from 2005 levels as of 2019.[41]

35 Joel Dryden, "When asked about emission targets, Freeland says carbon capture plans will 'turbocharge' industry," CBC, April 25, 2021, https://www.cbc.ca/news/canada/calgary/chrystia-freeland-duane-bratt-alberta-carbon-capture-1.6001762.

36 June Sekera and Andreas Lichtenberger, "Assessing Carbon Capture: Public Policy, Science, and Societal Need," *Biophysical Economics and Sustainability* 5, no. 14 (2020), https://doi.org/10.1007/s41247-020-00080-5.

37 Nelson Bennett, "$40 Billion Megaproject Begins to Take Shape in Kitimat," from *Business in Vancouver on LNG Canada website, November 13, 2019,* https://www.lngcanada.ca/news/40-billion-megaproject-begins-to-take-shape-in-kitimat/.

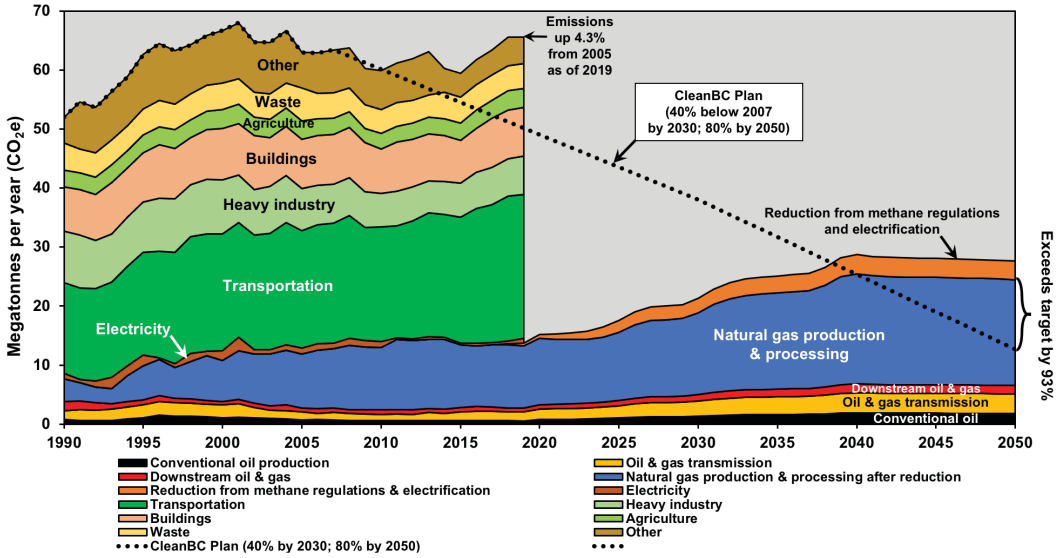
38 Canada Energy Regulator, Figure A.5 in *Canada's Energy Future 2020.*

39 J. David Hughes, *BC's Carbon Conundrum: Why LNG Exports Doom Emissions-Reduction Targets and Compromise Canada's Long-Term Energy Security (*Vancouver: Canadian Centre for Policy Alternative–BC Office, 2020), https://www.policyalternatives.ca/bc-carbon-conundrum.

40 Government of British Columbia, CleanBC, https://cleanbc.gov.bc.ca/.

41 Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493.

Figure 39: BC emissions projections for the oil and gas sector in the Canada Energy Regulator's evolving scenario, excluding emissions from LNG terminals



Note: Emissions per unit of oil and gas production are based on the 2016 to 2019 average. Emissions from natural gas production assume that methane reduction emission regulations will be successful by 2025 and that emissions will be further reduced by electrifying upstream production. Overall emissions are reduced by 15 per cent from 2025 to 2050 compared to the 2016 to 2019 average.

Source: Emissions data are from BC's contribution to Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493. Production data are from Canada Energy Regulator, *Canada's Energy Future 2021: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

The claim that LNG exports will improve the world's prospects for minimizing climate change is false.

Figure 39 illustrates the emissions from BC's oil and gas sector in the CER evolving scenario. Even if BC is successful in meeting its methane emissions-reduction target (a 45 per cent reduction from 2014 levels by 2025),[42] using more more renewable sources in the electrification of upstream production facilities, and reducing its emissions in all other sectors of the economy to zero, it will not reach its 2050 emissions-reduction target. Emissions from the oil and gas sector alone will be 93 per cent higher, or nearly double, the target. And this doesn't include emissions from the LNG liquefaction terminals.

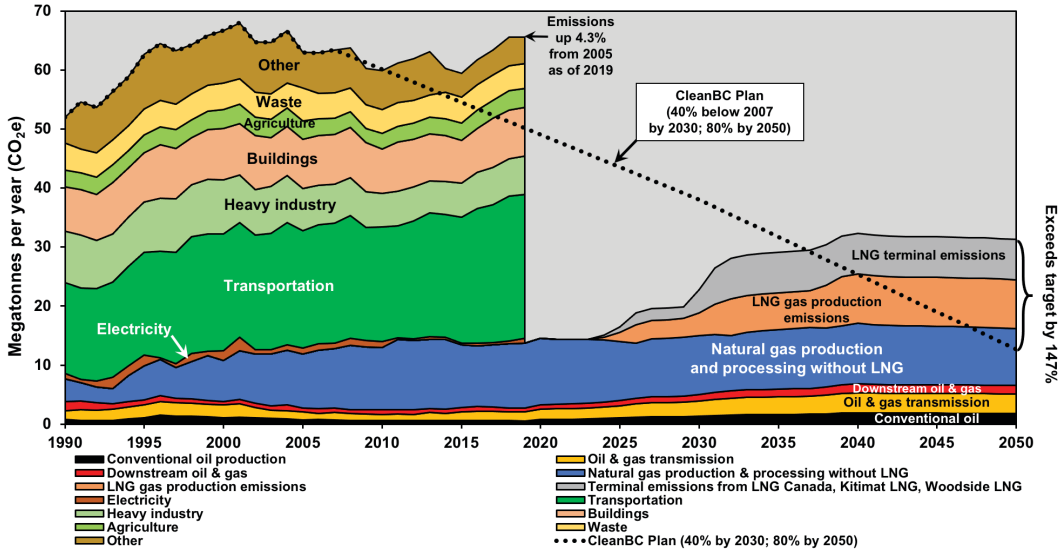
BC has one LNG export terminal, LNG Canada, under construction and two others which may be developed in the next decade (other projects, which once numbered as many as 20, are less advanced). Figure 40 illustrates the overall impact of BC's LNG megaprojects on emissions, assuming that 90 per cent of the natural gas for LNG export in the CER evolving scenario would be sourced in BC (some of the gas for export from BC LNG terminals may be sourced in Alberta).

Figure 40 includes the additional emissions from the three LNG terminals that are likely to be developed in the next decade (LNG Canada, Kitimat LNG and Woodfibre LNG). LNG Canada has committed to building a terminal with what will be the lowest emissions per unit of production in the world,[43] and it is assumed the other two terminals would match LNG Canada's performance.

42 BC Oil and Gas Commission, "Commission Introduces New Regulations to Meet Methane Targets (IB 2019-01)," Industry bulletin, January 16, 2019, https://www.bcogc.ca/news/commission-introduces-new-regulations-to-meet-methane-targets/.

43 Susannah Pierce, "Living Up to Climate Promises," LNG Canada, March 23, 2020, https://www.lngcanada.ca/news/living-up-to-climate-promises/.

Figure 40: BC emissions projections for the oil and gas sector in the Canada Energy Regulator's evolving scenario, including emissions from Canada LNG, Kitimat LNG and Woodfibre LNG



Note: The LNG gas production emissions assume that 90 per cent of the natural gas for LNG export in the CER evolving scenario will be sourced in BC. The LNG terminal emissions assume that LNG Canada, Kitimat LNG and Woodfibre LNG will be built and that they will have the lowest emissions per unit of production of any LNG terminal in the world.

Source: Emissions data are from BC's contribution to Environment and Climate Change Canada, *National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada* (Ottawa: Environment and Climate Change Canada, 2021), https://unfccc.int/documents/271493. Production data are from Canada Energy Regulator, *Canada's Energy Future 2021: Energy Supply and Demand Projections to 2050*, https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

If terminal emissions are added, emissions from the oil and gas sector in BC in 2050 will be 147 per cent above the levels the province has committed to under its CleanBC emissions-reduction commitment, even if all other sectors of the economy are reduced to zero. Even without the natural gas production required for LNG export or the LNG terminals, the oil and gas sector would exceed CleanBC's emissions-reduction target in 2050 by 43 per cent.

Clearly, there is no case for LNG exports if BC and Canada are to have any chance of achieving the emissions-reduction targets they have committed to. The claim that LNG exports will improve the world's prospects for minimizing climate change is also false. In fact, given that methane is the largest component of natural gas and that it traps substantially more heat radiation than carbon dioxide, BC LNG exports to Asia would make the climate problem worse for at least the next three decades compared to best-technology coal in China (China has one of the most efficient coal-fired power plant fleets in the world).[44]

Canada's current pathway on emissions reduction, if the CER evolving scenario is followed, leaves no hope of achieving emissions-reduction targets. And even in the CER evolving scenario, there is no need for Canada to spend $12.6 billion on the TMX project and provide subsidies to LNG export projects. Building these projects will only serve to lock in an unsustainable emissions trajectory.

44 J. David Hughes, *BC's Carbon Conundrum.*

Conclusions

Oil and gas production has reached all-time high levels in the case of oil and is near all-time highs in the case of natural gas.

THE ENERGY SECTOR REPRESENTS ABOUT 9 PER CENT OF CANADA'S GROSS DOMESTIC PRODUCT, a share that has been declining over the past two decades. Oil and gas production, which began in earnest in the 1940s, has reached all-time high levels in the case of oil and is near all-time highs in the case of natural gas.

Despite this production growth, royalty revenue obtained by governments from oil and gas production has fallen by 45 per cent since 2000, and by 62 per cent on a revenue-per-barrel basis. In Alberta, which is by far the province with the largest oil and gas production, total non-renewable resource revenue has fallen 61 per cent since 2000, and is down 72 per cent on a revenue-per-barrel basis as of 2019. Revenue paid to governments from oil and gas through taxes has also fallen from a high of more than 14 per cent as a share of total industry taxes as recently as 2009 to less than 4 per cent in 2018.

Jobs in the oil and gas sector, of which 86 per cent are in Alberta, are often held up as a reason to expand the industry. Yet oil and gas jobs have declined by 23 per cent since peaking in 2014, despite record production. This decline is due to the fact that the sector has become more efficient. Since 2011, production per employee has increased by 70 per cent for the oil sands, 37 per cent for conventional oil and gas and 50 per cent for the industry overall. The oil and gas industry will continue to aggressively cut costs, hence employment highs will likely never return to 2014 levels, even with expanded production. Although the oil and gas industry made up 5.5 per cent of Alberta's jobs in 2019, it made up only 1 per cent of Canada's direct employment.

Through the Paris Agreement, Canada in 2016 committed to cut its greenhouse gas emissions by 30 per cent from 2005 levels by 2030, and committed through Bill C-12 to cut emissions to "net-zero" by 2050, which is an improvement on its previous target of an 80 per cent reduction by 2050.[45,46] On Earth Day (April 22, 2021), Canada increased its Paris Agreement commitment for emissions reduction from 2005 levels to 40–45 per cent by 2030.[47]

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45 Bill C-12 has not yet become law and as of April 16, 2021, had received second reading https://openparliament.ca/bills/43-2/C-12/. Accessed April 26, 2021.

46 "Net-zero" refers to reducing emissions to zero through domestic emissions reductions, purchased carbon offsets and sequestration through carbon capture and storage (CCS) and direct air capture (DAC) of emissions. CCS and DAC are both technologies that have been demonstrated but not proven to be viable at the scale required.

47 John Paul Tasker and Aaron Wherry, "Trudeau Pledges to Slash Greenhouse Gas Emissions by at Least 40% by 2030," *CBC*, April 22, 2021, https://www.cbc.ca/news/politics/trudeau-climate-emissions-40-per-cent-1.5997613.

Yet as of year-end 2019, Canada's emissions were down just 1.2 per cent from 2005 levels due mainly to phasing out coal for power generation in Ontario and Alberta. Although the decision to replace coal also made economic sense given the low price of gas in Alberta, much of the power from Ontario's coal phaseout was made up by refurbished nuclear reactors. Given that there were economically viable alternatives available at scale, the emissions cuts achieved by the coal phaseout must be considered the "low-hanging fruit." Indeed, of the two G7 countries that have increased emissions since 2016 when the Paris Agreement was signed, Canada is the worst at 3.3 per cent, followed by the US at 0.6 per cent.[48] The other five G7 countries decreased emissions from between 4.4 per cent (Italy) and 10.8 per cent (Germany).

Meanwhile, emissions from oil and gas production, transportation and buildings increased by as much as the reduction from electricity generation since 2005. Emissions in Alberta have increased by 17.1 per cent since 2005, and emissions from the country's oil and gas sector amounted to 26 per cent of Canada's emissions in 2019, the most recent year for which data are available.

The Canadian government intends to rely on carbon capture and storage to achieve a significant part of its targets, as well as purchasing carbon offsets.[49] Although CCS has been demonstrated at small scales compared to the reductions required, much of the captured carbon dioxide has been used for enhanced oil recovery, resulting in researchers to conclude "We found that the commercial ICR (C-ICR) methods being incentivized by governments are net CO_2 additive: CO_2 emissions exceed removals."[50] The practice of purchasing carbon offsets is also controversial, as it does not result in net emissions reduction in many cases.[51]

Of the two G7 countries that have increased emissions since 2016 when the Paris Agreement was signed, Canada is the worst at 3.3 per cent.

The CER has released new forecasts of oil and gas production through 2050, which show that Canada will fall short of its emissions-reduction targets.[52] Its evolving scenario assumes that additional climate policies will be implemented to meet Canada's emissions-reduction commitments and that oil sands production will become much less emissions intensive. Under the evolving scenario, Canada's emissions in 2050 from the oil and gas sector alone would still be 32 per cent above the level required to meet an 80 per cent reduction target. The CER reference scenario assumes that no additional policies will be implemented to reduce emissions and projects that oil and gas production will be higher. Under the reference scenario, emissions from the oil and gas sector alone would be 94 percent above an 80 per cent reduction target.

CER also projects that Canadians will depend on fossil fuels for 64 per cent of end-use energy in 2050. Electricity use is forecast to increase from 16.3 per cent of end-use energy in 2019 to 26.5 per cent by 2050 through a severalfold increase in wind and solar generation. Even so, Canadians are projected to be heavily reliant on fossil fuels in 2050.

It is clear that the only way for Canada to have any hope of meeting its emissions-reduction commitments is to cut oil and gas production from the levels forecast by the CER evolving scenario. Currently, over half of the oil produced is exported along with a significant proportion of natural

48 United Nations, National Inventory Submissions 2021, https://unfccc.int/ghg-inventories-annex-i-parties/2021.

49 Joel Dryden, "When Asked about Emission Targets, Freeland Says Carbon Capture Plans Will 'Turbocharge' Industry," *CBC*, April 25, 2021, https://www.cbc.ca/news/canada/calgary/chrystia-freeland-duane-bratt-alberta-carbon-capture-1.6001762.

50 June Sekera and Andreas Lichtenberger, "Assessing Carbon Capture: Public Policy, Science, and Societal Need," *Biophysical Economics and Sustainability 5, no. 14 (2020),* https://doi.org/10.1007/s41247-020-00080-5.

51 Robert Watt, "The fantasy of carbon offsetting," *Environmental Politics (2021),* https://www.tandfonline.com/doi/full/10.1080/09644016.2021.1877063.

52 Canada Energy Regulator, *Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050,* https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2020/index.html.

gas. This scenario projects that net exports of oil will grow 42 per cent over the 2019 to 2050 period and that net exports of natural gas will grow by 186 per cent. This growth makes absolutely no sense if Canada is to reach its emissions-reduction targets. Canada must cut oil and gas production to the extent possible. As well, Canada must aggressively implement measures to cut emissions domestically through building retrofits, more efficient transportation infrastructure, more renewable energy, and other measures, some of which are part of existing plans.

Canada also needs to revisit its plans to expand export pipelines and LNG exports if it is to have any hope of meeting its emissions-reduction commitments:

- Using the CER estimates of existing pipeline export capacity and its evolving scenario production projection, neither the Trans Mountain pipeline expansion nor the Keystone XL pipeline (which was recently cancelled by US President Biden) are needed. Cancelling the taxpayer-funded TMX project will save $12.6 billion (less funds spent to date), which could be spent on aggressive emissions-reduction measures.
- If 420 thousand barrels per day (kbpd) of announced expansions on existing export pipelines, which were not included in the CER estimate of existing export capacity, are added, the 330 kbpd Enbridge Line 3 expansion project now under construction in Minnesota is not needed either. (Announced expansions include 190 kbpd on the existing Enbridge Mainline pipeline, 140 kbpd through reversal of Enbridge's Southern Lights pipeline and 90 kbpd remaining on a permit to expand the capacity of the existing TC Energy Keystone pipeline.)
- Developing an LNG export industry in British Columbia will render the province's CleanBC climate plan impossible to achieve. The CER evolving scenario for BC projects that emissions from the province's oil and gas sector alone would exceed the CleanBC 2050 target by 93 per cent, even if every other sector of the BC economy reduced emissions to zero. If emissions from the three proposed LNG export terminals are included, the CleanBC 2050 target would be exceeded by 147 per cent. Despite the emissions implications, both the BC and federal governments have provided subsidies for the province's LNG exports.

Oil and gas are finite, non-renewable resources and producing them constitutes the largest source of Canada's emissions.

The need to radically reduce fossil fuel production to meet net-zero targets has also been recognized by the International Energy Agency (IEA) in its recent *Net-zero by 2050* report.[53] The IEA concluded:

- "Net zero means a huge decline in the use of fossil fuels. They fall from almost four-fifths of total energy supply today to slightly over one-fifth by 2050."
- "Beyond projects already committed as of 2021, there are no new oil and gas fields approved for development in our pathway, and no new coal mines or mine extensions are required. Unabated coal demand declines by 90% to just 1% of total energy use in 2050. Gas demand declines by 55% to 1,750 billion cubic metres and oil declines by 75% to 24 million barrels per day (mb/d), from around 90 mb/d in 2020."
- "Making net-zero emissions a reality hinges on a singular, unwavering focus from all governments — working together with one another, and with businesses, investors and citizens."

53 International Energy Agency, May, 2021, *Net Zero by 2050: A Roadmap for the Global Energy Sector*, https://www.iea.org/reports/net-zero-by-2050.

The IEA's report underscores the contradiction between Canada's commitment to achieving net-zero by 2050 and its policies of building export pipelines to facilitate increased production and the development of an LNG export industry.

Canada must take a step back and look at the big picture of emissions sources and the possibilities for reducing them. Getting to even the previous target of an 80 per cent reduction of emissions by 2050, while maintaining a semblance of economic prosperity, will be an extremely difficult challenge. Canadians live in a northern country with high heating loads in the winter that are difficult to meet with carbon-free energy sources such as wind and solar. As a result, it is likely that fossil fuels will be needed at some level for the foreseeable future.

Oil and gas are finite, non-renewable resources and producing them constitutes the largest source of Canada's emissions. Canada is a mature oil and gas exploration region, with more than 800,000 wells drilled in Western Canada since the 1940s. Conventional oil and gas production is in decline, and as a result the main prospects for growth are in situ bitumen and fracked natural gas, both of which have higher production emissions than conventional oil and gas.

If Canada is to have any hope of meeting its emissions-reductions targets, the oil and gas production sector will have to reduce emissions to a level far below what is projected in the CER evolving scenario.

Any plan to reduce emissions enough to reach the government's net-zero emissions target by 2050, or even the previous target of 80 per cent below 2005 levels by 2050, must objectively consider all sectors of the economy. Although Canada's electricity sector is one of the cleanest in the world, fossil fuels supplied 77 per cent of Canada's end-use energy in 2019 according to the CER — accounting for 96 per cent of the energy use by the transportation sector, 78 per cent by the industrial sector, 67 per cent by the commercial sector and 52 per cent by the residential sector.

In the CER evolving scenario, fossil fuels are projected to provide 64 per cent of Canada's end-use energy in 2050, including 77 per cent of transportation, 70 per cent of industry, 48 per cent of commercial and 37 per cent of residential end-use energy. As noted above, emissions from the oil and gas production sector alone would exceed an 80 per cent emissions-reduction target in 2050 by 32 per cent in the CER evolving scenario production forecast, even if all other sectors of the economy were reduced to zero — and there is no pathway to completely eliminate emissions in all other economic sectors given Canada's climate and northerly latitude.

Clearly if Canada is to have any hope of meeting its emissions-reductions targets, the oil and gas production sector will have to reduce emissions to a level far below what is projected in the CER evolving scenario. The only way this can be done is to radically reduce production, and cutting production will have economic impacts. The economic contributions of oil and gas production have already declined markedly in the past two decades. The industry certainly won't disappear, as Canadians will need oil and gas as some level for decades, and reducing production will prolong the lifespan of these finite resources for Canada's domestic use.

With respect to the oil and gas production sector, a credible emissions plan must include the following:

- Reduce or eliminate the growth in production for exports that is projected through 2050 by CER in its evolving scenario, which forecasts that net oil exports will grow 42 per cent and net gas exports will grow 186 per cent over the 2019 to 2050 period.
- Reduce current exports to the extent possible to reduce the production emissions associated with them. Some 53 per cent of 2019 net oil production was exported along with 15 per cent of net natural gas production.
- Cancel export pipeline projects that are not needed as evidenced by the CER evolving scenario projection, including TMX and the Line 3 expansion. Cancelling TMX would

save $12.6 billion tax dollars (less expenses to date), which could then be devoted to investments in infrastructure to give Canadians an alternative to high levels of energy consumption.

Providing incentives to reduce consumption in all sectors and encourage growth in carbon-free energy must, of course, be emphasized. However, these incentives will not achieve emissions-reduction targets unless oil and gas production emissions are also addressed.

This report is part of the Corporate Mapping Project (CMP), a research and public engagement initiative investigating the power of the fossil fuel industry. The CMP is jointly led by the University of Victoria, Canadian Centre for Policy Alternatives BC and Saskatchewan Offices, and Parkland Institute. The initiative is a partnership of academic and community-based researchers and advisors who share a commitment to advancing reliable knowledge that supports citizen action and transparent public policy making. This research was supported by the Social Sciences and Humanities Research Council of Canada (SSHRC).

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