



Correcting Canada's "one eye shut" climate policy

Meeting Canada's climate commitments requires ending supports for, and beginning a gradual phase out of, oil and gas production

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Summary

While the Government of Canada has begun to strengthen its climate policies, it does so with “one eye shut” as it continues to avoid the climate consequences of increasing oil and gas production. Rather than constraining oil and gas production as the United States is beginning to do, or committing to phase out fossil fuel production as countries like France, Ireland, Denmark, New Zealand and others are announcing, the Canadian government continues to foster growing oil and gas extraction by providing a range of supports to the sector that is driving up emissions. To begin to meet its emission reduction targets, Canada must withdraw its support from oil and gas extraction and begin a gradual phase out of production.

Canada has a unique responsibility to join the global first movers that are beginning to wind down fossil fuel production: the country has historically benefitted from fossil fuel extraction that has added significantly to global emissions; Canada has the financial capacity to transition; and frontline communities have long contested fossil fuel projects. Yet instead of winding down oil and gas production, Canada features among a handful of countries that, due to their oil and gas extraction ambitions, are making it difficult to limit global warming to 1.5°C.

This paper provides a brief overview of Canada’s historical climate record and notes new efforts by the federal government to make improvements. It then demonstrates how growing oil and gas production has impeded Canada from meeting its climate commitments—and how this trend will continue given anticipated growing oil and gas production until 2050. As a result, all other sectors in the Canadian economy will be required to make deep emission reductions to permit oil and gas expansions if Canada is to meet its 2030 target.

The paper also provides a critical assessment of the multiple ways the federal government is now supporting oil and gas production growth through continued financial support and the legitimization of unproven technological solutions that validate and accelerate future extraction. As a corrective to this federal support for oil and gas expansion, it recommends Canada join its demand-side climate policies with a supply-side approach, noting numerous specific policies the federal government could adopt in the near-term to begin a gradual phase out of oil and gas production.

Key findings

1. Based on the Government of Canada’s anticipated expansion of oil and gas extraction—more oil and gas is expected to be produced in 2050 than in 2019—the oil and gas sector in Canada will still be emitting some 200 megatonnes of CO₂ equivalent in 2050, the year by which the federal government has committed to achieve net-zero emissions.
2. Canada’s 2021-2050 oil and gas production would exhaust about 16 percent of the world’s remaining carbon budget. Canada is indeed a “carbon bomb” of global significance.

3. Banking on unproven and expensive solutions like carbon capture, utilization and sequestration, without complementary supply-side restrictions, will not help Canada meet its climate target—particularly when these solutions are designed to facilitate increased fossil fuel production over the next decades.
4. The oil and gas lobby plays a dominating role in Canadian policy, obstructing supply side policy implementation. In the first year since the onset of the Covid pandemic, fossil fuel industries and associations met with government officials a total of 1,224 times, or more than 4.5 times per working day.
5. While the provinces have a lead role in regulating oil and gas, the federal government has a variety of policy options (regulatory, economic, and informational) to begin to constrain expansion and implement a managed phase out of oil and gas production. These include:
 - prohibiting the leasing of federal lands and waters for fossil fuel production and infrastructure;
 - implementing a “climate test” on all new fossil fuel projects and removing federal impact review exemptions;
 - canceling the Trans Mountain expansion pipeline;
 - divesting federal public investment funds from fossil fuel production; and
 - removing federal subsidies and public financing that supports fossil fuel exploration, production, or transportation, including federal funding for technologies that delay a transition away from oil and gas.

1. Introduction

Pivotal unfolding trends are creating opportunities—and pressure—for a new approach to Canadian climate policy. US President Biden is renewing American climate action, in part by constraining fossil fuel production. The Supreme Court of Canada, in upholding the constitutionality of federal carbon pricing, underscored that the climate crisis is a serious national threat. National governments are placing bans on fossil fuel extraction out of recognition that fossil fuels are primarily responsible for climate change. Major investors and insurers, and even oil companies, are withdrawing from fossil fuels given the economic risk. Support for a global Fossil Fuel Non-Proliferation Treaty is growing.

Yet while the Government of Canada has begun to implement long overdue climate policy like carbon pricing, it continues to confront the climate crisis with “one eye shut,” avoiding the climate consequences of oil and gas production, and instead supporting its expansion. Given multilayered global shifts in markets and climate policy, now is the moment for Canada to assert existing federal authority to begin a gradual oil and gas production phase out by implementing a range of supply-side climate policies.

Here we provide a brief overview of Canada’s historical climate record and new efforts by the federal government to improve it (Section 2). We then demonstrate how growing oil and gas production has impeded Canada from meeting its climate commitments—and this will continue given anticipated growing oil and gas production until 2050 (Section 3). Next, we provide a critical assessment of the multiple ways the federal government is now supporting oil production growth through continued financial support and the legitimization of technological solutions designed to validate and accelerate future extraction (Section 4). Then we outline the unfolding global transition—driven by other countries and also financial actors—away from fossil fuel production (Section 5). In light of this transition, and as a corrective to this federal support for oil and gas expansion, we close by recommending Canada augment its demand-side climate policies with a supply-side approach, noting numerous specific policies the federal government could adopt in the near term to begin a gradual phase out of oil and gas production (Section 6).

Oil and gas producing provinces would vigorously resist any attempt by the federal government to remove support from, or constrain, oil and gas production—as would the politically powerful oil and gas sector. Beginning a gradual phase out will no doubt be challenging in Canada’s highly decentralized federal system. Yet the mounting climate crisis, driven by fossil fuels, poses even graver risks. Now is the time for the federal government to take a leadership role in beginning a gradual phase out of Canadian oil and gas production.

2. Canada’s climate record

Canada has ranked among the top ten global carbon emitters for over a century.¹ Canada briefly demonstrated international climate leadership in the late 1980s,² but then came to be regarded as “one of the world’s pre-eminent climate laggards.”³ Since the first emission reduction target announced over three decades ago,

Canadian governments have produced numerous climate plans and emission reduction targets, most of which were inadequate to align emissions with international climate commitments, and then missed every target. Between the first commitment to reduce GHGs in 1990 until 2015, the country's total emissions *increased* by nearly 20 percent.⁴

Shortly after taking office in 2015, Canadian Prime Minister Trudeau promised change and declared that “Canada is back” and “here to help” in the global effort to fight climate breakdown in his address in Paris to members of the United Nations Framework Convention on Climate Change (UNFCCC). His government moved to enact that commitment by creating the 2016 Pan-Canadian Framework on Clean Growth and Climate Change (PCF) with the provinces, which centred on implementing a \$20 a tonne carbon price on consumers and large industrial emitters that came into effect in 2018.⁵

The Trudeau government has since made some progress primarily on demand-side emission reductions, for example setting and increasing the price of carbon, moving toward clean fuel standards, investing in zero-emissions vehicle infrastructure and public transit, encouraging active transportation, and investing in household energy efficiency. Yet even these measures, especially for energy efficiency and public transit, do not match the scale of investments needed.⁶

The newest federal climate plan, released in December 2020, “A Healthy Environment and a Healthy Economy,” was welcomed by climate policy experts as Canada’s first credible climate plan as it commits to exceeding Canada’s 2030 Paris Agreements emissions reduction targets (getting to 32 to 40 percent below 2005 levels in 2030).⁷ Then the *Canadian Net-Zero Emissions Accountability Act* will create a pathway to net-zero emissions by 2050.⁸ However, whether these targets are met depends in great part on future Canadian oil and gas production.

3. Growing oil and gas production obstructs renewed climate commitments

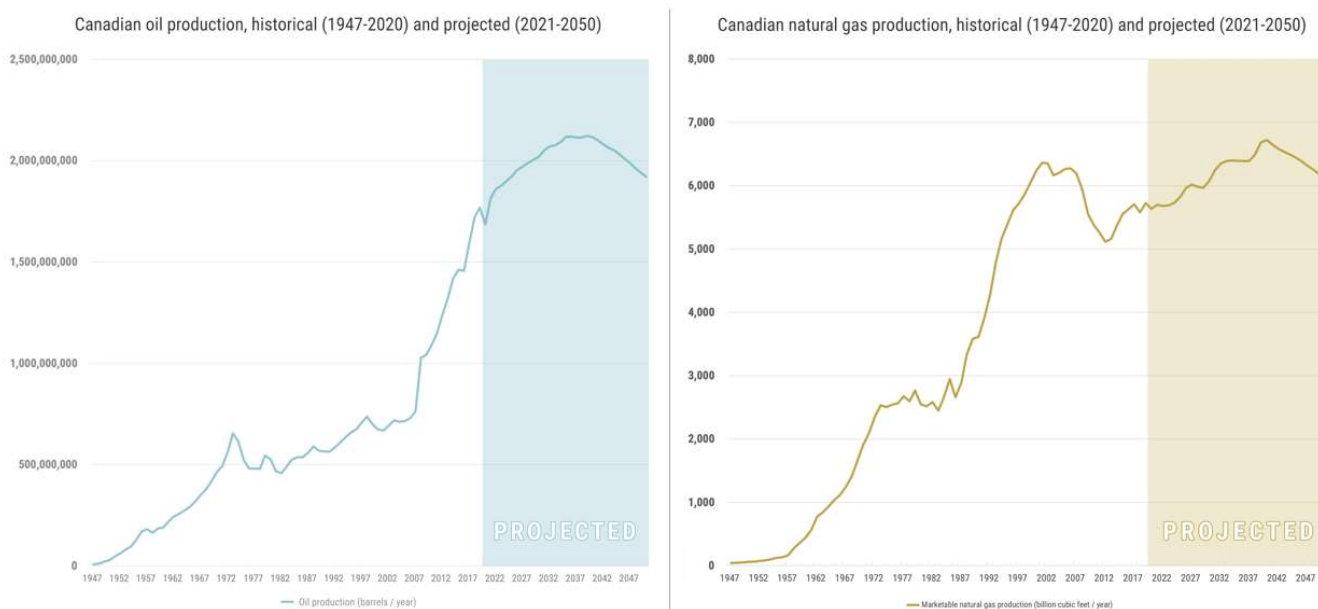
The oil and gas sector was the largest emitting sector in Canada in 2018, representing 26 percent of Canadian emissions and 193 metric tons of carbon dioxide equivalent (Mt of CO₂eq). Moreover, oil and gas extraction was, by far, the fastest growing source of emissions in the country since 1990.⁹ As the Government of Canada reported to the UNFCCC in 2020, over the 1990 to 2018 period, oil and gas sector emissions came predominantly from oil sands production, which grew by nearly 750 percent with its emissions rising by 456 percent.¹⁰

Increasing emissions from the oil and gas sector have overwhelmed reductions undertaken by some provinces and sectors, particularly from a shift off coal-fired power in Ontario, Nova Scotia, and New Brunswick.¹¹ For example, the oil and gas sector's 87 MtCO₂ increase in emissions since 1990 more than wipes out all the climate gains made by the electricity sector (-30 MtCO₂) and heavy industry (-19 MtCO₂).

Trudeau’s new “A Healthy Environment” plan is the first indication that the Government of Canada will attend to this problem of growing oil and gas sector emissions. The plan recognizes that the oil and gas sector is the country’s “largest emitting sector” and concedes that “Without further action, emissions from the oil and gas sector are projected to increase.”¹² Looking ahead to 2030, the federal government projects that over one third of the emissions reductions anticipated from Canada’s economic sectors will come from the oil and gas sector (104 Mt CO₂ eq of the 283 Mt in anticipated reductions), by far the largest share of reductions by sector,¹³ to be accomplished primarily via a price on carbon that will rise to \$170 per tonne by 2030, as well as methane regulations¹⁴ and the forthcoming Clean Fuel Standard.

Yet the plan to reduce emissions from the oil and gas sector is at odds with anticipated growth in production. Last November, the Canada Energy Regulator (CER), using an “evolving scenario” that assumes strengthening climate policies, projected that by 2050 Canada would be producing *even more* oil and gas than pre-Covid (see Figure 1). By these estimates, Canada will hit peak oil production in 2039, producing 2.1 billion barrels that year. By 2050, CER projects the country will produce 1.9 billion barrels of oil—even higher than 2019 levels, when 1.8 billion barrels were produced. Canada’s oil production over the next three decades will primarily and increasingly come from Alberta, which will grow to represent at least 85 percent of the country’s total production from 2034 onward—with over 80 percent of Alberta’s production coming from the oil sands over that period. The federal government holds similar expectations for natural gas: it anticipates production to peak by 2040 (producing 6,720 billion cubic feet that year) and be even higher in 2050 (at 6,114 billion cubic feet) than in 2019 (5,728 billion cubic feet).

Figure 1: Canadian oil and natural gas production: *rising* throughout 2021-2050



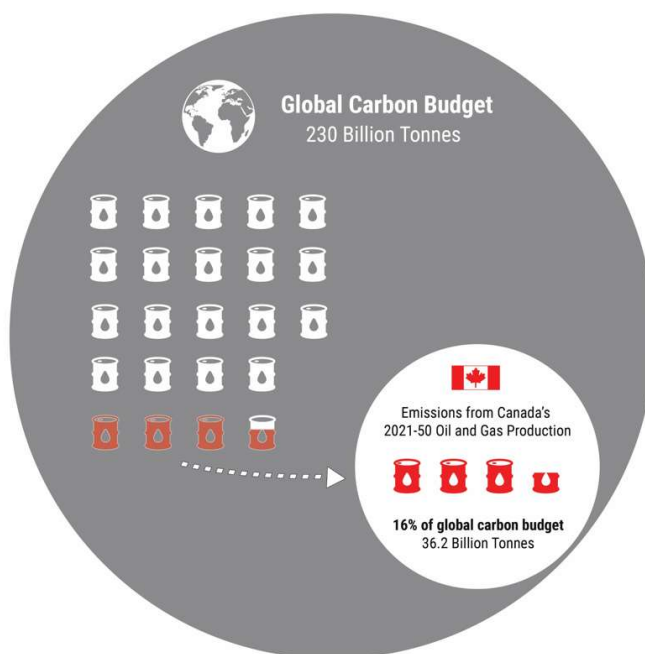
Data sources: CAPP February 2020 Statistical Handbook for historical production; updated to 2020 using CER data; CER “evolving scenario” data for 2021-2050 production projections.¹⁵

This rising oil and gas production will result in emissions that far exceed Canada’s new net-zero commitments—unless Canada places a large emphasis on expensive and problematic domestic and international carbon offsets/credits.¹⁶ Based on this projected fossil fuel extraction expansion, and even including anticipated improvements in the emissions intensity of oil sands production, the oil and gas sector will be emitting approximately 200 megatonnes of CO₂ equivalent by 2050¹⁷—the year by which the federal government claims it will achieve net-zero emissions. This scale of oil and gas emissions is too much to be negated by carbon offsets and removals. Ultimately, to permit the expansion of oil and gas production, all other sectors in the Canadian economy will be required to make deep emission reductions if Canada is to meet its new climate targets.

Yet even these estimates miss the full extent of emissions because they account only for emissions from extraction and processing—the “upstream” emissions. Extraction-based emissions that include “downstream” emissions, when fossil fuels are exported and consumed, are much higher: from 2000 to 2015, emissions from Canada’s fossil fuel exports nearly doubled and are now larger than Canada’s total domestic emissions.¹⁸

Canada’s anticipated oil and gas production is a serious global climate risk. Over 2021-2050, Canada anticipates producing 60.5 billion barrels of oil and 187 trillion cubic feet of natural gas, which would add an estimated 26.1 billion tonnes (gigatonnes) of CO₂ and 10.1 billion tonnes respectively to the atmosphere.¹⁹ To give a 67 percent chance of limiting global temperature increases to 1.5°C, the global carbon budget from 2020 onward is 230 billion tonnes.²⁰ Therefore oil and gas production anticipated by the Canadian government over the next three decades would exhaust approximately 16 percent of the world’s remaining carbon budget (Figure 2). Canada is indeed a “carbon bomb”²¹ of global significance.

Figure 2. Canadian oil and gas (2021-50) as proportion of remaining global carbon budget



The Trudeau government has made important climate advances but the focus has been primarily on lowering emissions from electricity, transportation, and buildings while oil and gas production continues to climb. That growing fossil fuel production is impeding Canada's ability to meet its new climate targets is clear. Yet the federal government is instead fostering increased oil and gas extraction by offering multiple support and subsidies.

4. Supporting fossil-fueled emissions

Federal financial support to the fossil fuel industry poses financial, institutional, and political obstacles²² to a managed phaseout, obstacles that are heightened in light of the complex social and political feedbacks of continued financing.²³ Canada has in recent years made notable progress in ceasing subsidies for coal mining and coal-based power generation,²⁴ yet federal financial support to the fossil fuel sector remains outsized compared to other G7 and G20 countries.^{25,26}

Moreover, the country is lagging in phasing out subsidies and public financing. A recent scorecard ranked Canada last in progress on phasing out support for oil and gas among G20 OECD countries.²⁷ Canada is among the worst performers in ending support for oil and gas production and on transparency, raising skepticism about the country's ability to meet their 2025 G7 commitment on subsidy reform to end inefficient federal subsidies.²⁸ After running on a platform of eliminating subsidies in 2015, and committing to subsidy reform by 2025, the federal government has shown no resolution to fulfill this promise. In supporting the industry, the federal government is artificially propping up fossil fuel production and maintaining carbon inertia.

4.1 Types of federal support

Federal support to the industry comes in the form of tax expenditures (foregone revenue), loans (expected to be paid back by firms), and direct investments (that are not expected to be paid back). Tax expenditures, such as tax credits, accelerated depreciation write-offs, deductions, or deferrals, are designed to increase exploration and development by reducing the costs of production. Canada's *Income Tax Act* provides a number of subsidies on qualifying oil and gas extraction and development activities—through the Canadian Exploration Expense, the Canadian Development Expense, the oil and gas property expense, foreign resource expense, and accelerated capital cost allowances—to expedite write-offs for fossil-fuel energy sources,²⁹ including natural gas.³⁰ Additionally, import tariff exemptions on, for example, steel modules for LNG plants are another form of tax expenditures, representing a subsidy worth approximately \$1 billion per year.³¹ These tax expenditures not only result in foregone revenue, but incentivize investment decisions that lock-in high-carbon infrastructure.³² The government has recently (beginning in 2019) disclosed limited data on tax expenditures, reporting a total of \$20 million from flow-through share deductions in 2018;³³ however, data on tax credits, accelerated depreciation write-offs, and other deductions are not disclosed.³⁴

Non-tax supports, primarily in the form of direct spending, similarly bolsters exploration and development by lowering the operating cost for oil and gas companies. Examples of direct spending include a \$275 million

contribution to LNG Canada's facility in British Columbia, and a \$121 million "Invest in Canada" plan. The International Institute for Sustainable Development (IISD) estimates that non-tax spending in 2019 surpassed 593 million,³⁵ through investments in oil sands remediation, upgrades of diesel-based power plants, and liquified natural gas.

Tax expenditures and direct investments are, however, a small fraction of total support for the industry: public financing provided by crown corporations is a major source of support for fossil fuel businesses and large oil and gas projects. Export Development Canada (EDC) disclosures estimate oil and gas financing ranges between \$8 to \$12 billion a year.³⁶ By assuming lending and insurance risk, EDC provides a substantial commercial and competitive advantage for domestic fossil fuel producers, though it is ultimately Canadian taxpayers who bear the risks and liabilities. Past-due loan write-offs by the EDC may cost taxpayers billions in foregone revenue; however, there is little transparency around the value of these write-offs.³⁷ EDC also finances activities through a Canada account, used to support transactions determined by the government to be in Canada's national interest.³⁸ This includes expenditures like the \$6.5 billion purchase³⁹ (a combined \$12.6 billion as of 2020) of the Trans Mountain pipeline in 2018. Notably, cleantech investments by EDC are growing rapidly, from \$500 million in 2013 to \$4.5 billion in 2020, yet this remains a small fraction of investments in the fossil fuel sector or the country as a whole.

Within the past year, the Covid-19 pandemic has brought with it the opportunity to "build back better," through economic stimulus measures that create jobs and improve infrastructure while accelerating the transition to cleaner energy.⁴⁰ According to data from Energy Policy Tracker,⁴¹ the federal government and the provinces have committed \$66 billion in additional stimulus spending for the energy sector since 2020, 55 percent of which is allocated to clean energy. Yet the oil and gas sector continues to benefit extensively from Canada's stimulus: 36 percent of all funds allocated in 2020 are allotted to oil and gas, half of which is invested in resource development (such as the Government of Alberta's \$6 billion loan guarantee for the Keystone XL pipeline,⁴² the Government of Ontario's \$2.8 billion purchase of natural gas power plants in Ontario,⁴³ the federal government's \$1.7 billion orphan and inactive well clean-up investment,⁴⁴ and \$750 million Emissions Reduction Fund⁴⁵). A significant portion of the support in 2020 (for example to orphan and inactive well clean-up) was provided under a guise of job creation; however, these subsidies simply shift the cost of clean up onto taxpayers, replacing funds and associated jobs that would otherwise need to be allocated by private companies.^{46,47} This trend of supporting fossil fuel development appears to be continuing, with recent calls by provincial governments for financial support to expand Alberta's carbon sequestration and enhanced oil recovery capabilities^{48,49,50} and liquified natural gas production.⁵¹ Support for fossil fuel production and expansion by the federal government continues, now under the semblance of pandemic relief.⁵²

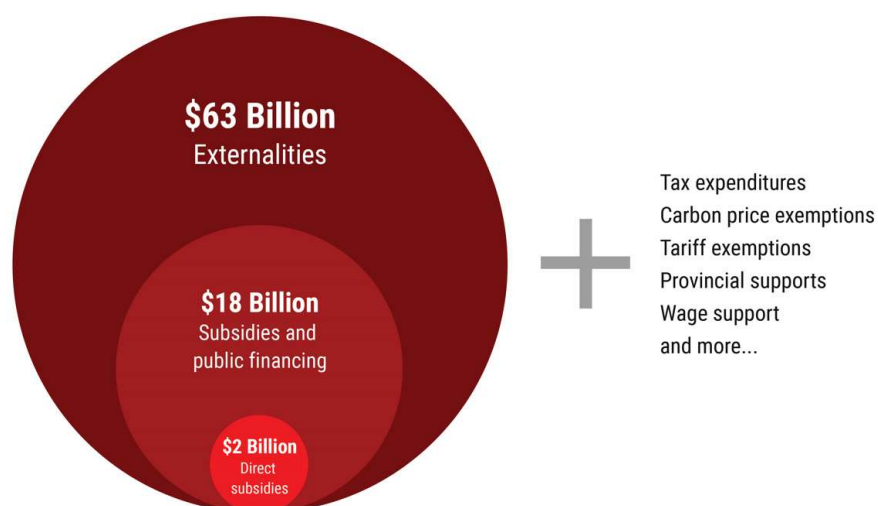
4.2 Total value of federal support to oil and gas

Variability in the estimates of the total value of federal support demonstrates the challenges of quantifying public investments in oil and gas. Values vary substantially based on the definition of federal support, the scope of support included in the analysis, and transparency of data (see Figure 3).⁵³ IISD for example, reports a relatively conservative estimate of \$2 billion in federal support in 2020—but only includes direct subsidies.

Estimates by Environmental Defence, which include public financing from crown corporations like the EDC, value federal support at nearly \$18 billion in 2020.⁵⁴ Meanwhile, the International Monetary Fund factors in externalities like the social cost of carbon, estimating that financial support from the federal government totals nearly \$63 billion a year (based on 2015 data).

Still, these estimates may be the tip of the proverbial iceberg of support the industry receives: federal support is just a fraction of the additional estimated \$4.2 billion a year in support from provinces, such as royalty credits.^{55,56} Estimates may also exclude subsidies that encourage consumption, like aviation or mobility investments. Nuances between subsidy and support also vary. Canada's Emergency Wage Subsidy would not, for example, be counted as a direct fossil fuel subsidy, yet all four oil sand majors collectively received over \$250 million in wage support.⁵⁷ Imperial oil alone received \$120 million in wage support while concurrently issuing \$320 million in dividends.⁵⁸ These examples emphasize the challenge of both evaluating total subsidies and the lack of transparency around federal support.

Figure 3. Federal support for intensifying oil and gas production



The lack of transparency of data by the federal government is likely exasperated by definitional ambiguity. Canada scores sixth among the G7 countries on the comprehensiveness of government reporting on fiscal support and public finance to oil, gas, and coal.⁵⁹ In addition, Canada's definition of an inefficient fossil fuel subsidy does not align with international standards, justifying support for projects that would otherwise be considered inefficient.⁶⁰ Canada's Auditor General recently stated that, "Canada's efforts to phase out inefficient fossil fuel subsidies would benefit from clearly defining what inefficient means."⁶¹

4.3 Banking on wildcards

Canada's strengthened 2020 climate plan is founded on five pillars and contains 64 federal policy solutions, including a combination of existing solutions such as energy-efficient retrofits, electrification and carbon pricing, and technological solutions such as hydrogen and carbon capture, utilization, and sequestration.⁶² The Canadian

Institute for Climate Choices frame these policy solutions as “safe bets” (“low-risk solutions that are available today”) and “wild cards” (“high-risk, high-reward solutions that are still in early stages of development”).⁶³ Banking on wildcard solutions without complementary supply-side restrictions, is an imprudent approach to meeting Canada’s climate target, particularly when these solutions are designed to facilitate increased fossil fuel production over the next decades.

The hydrogen economy. Natural Resources Canada’s report, “Hydrogen Strategy for Canada,” notes the hydrogen economy as a key strategic priority in the country’s climate plan to accelerate the transition toward net-zero emissions by 2050.⁶⁴ The hydrogen economy can expect to receive sizable financial support from the federal government over the next decade.^{65,66} However, hydrogen that relies on fossil fuels as an input and output is not conducive with aggressive emission reductions. Canada’s hydrogen strategy has been lauded by some analysts for offering new economic opportunities domestically and internationally while concurrently advancing Canada’s position on the climate file.⁶⁷ Yet, other stakeholder groups have raised criticism about this silver bullet approach.^{68,69}

Canada’s hydrogen strategy seems not to be driven by climate action but rather by compromise: financing hydrogen development affirms Canada’s expectation of continuing fossil fuel production and extraction for the next three decades. Today, less than 0.7 percent of current hydrogen production globally is generated from renewable inputs.⁷⁰ While Canada has partnered with Germany in ramping up hydrogen research and production,⁷¹ Germany’s €9 billion strategic plan⁷² explicitly states that “only hydrogen that has been produced using renewable energy (green hydrogen) [is] sustainable in the long term.” Canada’s strategy has not acknowledged this fact.

Fossil fuel inputs. Canada is currently one of the largest hydrogen producers in the world, producing over 3 million tonnes of hydrogen annually for industrial uses, the majority of which is produced using natural gas as a feedstock.⁷³ This “grey” hydrogen (that is, hydrogen developed using natural gas and without carbon capture) is no less carbon intensive than its conventional counterparts: it is estimated that grey hydrogen emits more carbon, between 94.8 to 101.4 grams of carbon dioxide equivalent per megajoule of energy (g CO₂e/MJ), than compressed and liquefied natural gas, which emit around 64 and 113 gCO₂e/MJ respectively.⁷⁴ Consequently, grey hydrogen offers no climate benefits; rather, it contributes to carbon emissions.

Efforts are underway to combine grey hydrogen with carbon capture, usage, and sequestration (CCUS) to reduce its carbon intensity. This “blue” method of hydrogen production is a mainstay in both Canada and Alberta’s strategic plans, proposed as a solution to bridge the disconnect between achieving a low carbon future, while maintaining Canada’s position as a carbon major. Although exact projections are not publicly available, it can be anticipated that, at least in the near term, hydrogen will largely be derived from Canada’s natural gas reserves as either grey or blue hydrogen.⁷⁵ However, blue hydrogen similarly relies on fossil fuel inputs, which reinforces the industry’s position in Canada’s climate plan. The protection of the industry appears to remain the government’s primary intent. Natural Resources Minister O’Regan articulated this position clearly, noting that in Canada, “energy is our family business.”⁷⁶

Fossil fuel outputs. Equally important to the discussion on hydrogen is its end use. Hydrogen retains a central role in the government's strategy as a feedstock in the fossil fuel production process. Oil refining is among the top applications of (primarily grey) hydrogen production today.⁷⁷ Canada's hydrogen strategy maintains that hydrogen (primarily from natural gas reforming methods) will continue to be used to refine, upgrade, and reduce emissions associated with fossil fuel production.⁷⁸ The report is explicit that the petroleum sector will remain at the heart of Canada's hydrogen economy, providing a "long term answer for Canada's natural gas utilities to stay competitive in a carbon constrained future." In other words, carbon intensive grey and blue hydrogen will be leveraged by the fossil fuel industry to sustain oil production. Consequently, the application of hydrogen as a feedstock in fossil fuel production prevents a necessary decline/transition of the oil and gas sector.

Failure to diversify. Hydrogen is presented as a means by which Alberta can diversify its economy. As emphasized in the province's "Natural Gas Vision and Strategy" report,⁷⁹ Alberta is anticipated to lead the country's production of blue hydrogen, "to reduce Alberta's emissions while diversifying its economy."⁸⁰ Yet, blue hydrogen will not diversify Alberta's economy but will serve to maintain fossil fuel production. Blue hydrogen will also require substantial new infrastructure (equivalent in scale to today's oil and gas pipeline and marine transport networks),⁸¹ effectively locking the province into continued carbon production and impeding the country from fulfilling its international obligations.

A fool's gambit. Finally, the economic viability of hydrogen at scale is unconvincing, primarily due to its reliance on CCUS, and inefficient energy conversion. First, the viability of blue hydrogen depends on the rate of uptake and efficacy of CCUS;⁸² incorporating carbon capture technologies in the production process of hydrogen derived from natural gas can theoretically reduce carbon emissions by up to 90 percent.⁸³ However, real-world applications, such as the Boundary Dam, have fallen far short of these aspirational targets.⁸⁴ Moreover, CCUS projects have proved to be much more expensive than anticipated. While the IEA estimates that carbon capture will cost between \$80 to \$115 US per tonne of carbon dioxide,⁸⁵ the abatement cost of the Quest carbon capture and storage project⁸⁶ (among the most lauded demonstrations of CCUS in Canada today) is estimated to be around \$337 a tonne.⁸⁷ Despite decades of public support globally, it is estimated that significant technological breakthroughs⁸⁸ and billions in additional financial support⁸⁹ will still be required to economically capture carbon. The capital cost per tonne is simply not competitive in today's climate. Consequently, CCUS has proven to be far less effective in practice, producing a fraction of what is promised at substantially higher costs.⁹⁰

Notably, the majority of carbon capture to date is not used in the hydrogen process, but rather in enhanced oil recovery (EOR), where sequestered carbon is injected into underground reserves to extract additional oil and gas. EOR is among the leading applications of carbon capture to date, accounting for 88 percent of global utilization.⁹¹ Even though EOR can reduce carbon intensity through sequestration of carbon, it also propagates the continued production of fossil fuels, acting as a feedstock in stimulating oil and gas production from depleted oil reservoirs.⁹² Moreover, the majority (85 percent) of carbon used in the utilization process is extracted from terrestrial carbon reservoirs (carbon that was naturally sequestered), rather than captured from anthropogenic sources.⁹³ Thus, CCUS technologies that do not curtail production and subsidies for EOR are just another form of fossil fuel support.

Finally, the production and consumption of hydrogen is highly wasteful. It is estimated that 30 to 45 percent of energy is lost during the process of conversion while an additional 55 percent is lost when hydrogen is converted back into electricity.⁹⁴ For hydrogen produced from natural gas, more energy is needed to produce hydrogen than can be recovered, resulting in higher gas consumption and carbon emissions. While the technology is there, operationalization and scalability does not make economic sense.⁹⁵ Consequently, using electricity directly would result in fewer energy losses.

Near-net-zero “green” hydrogen from renewable sources is considered infeasible in Canada’s hydrogen strategy. The strategy maintains that blue hydrogen is Canada’s cheapest option for the short-term based on today’s technologies (CCUS) and commodity costs (low-cost natural gas).⁹⁶ Consequently, while green hydrogen raises the legitimacy of all forms of hydrogen as a low-carbon alternative, a focus on enabling renewable hydrogen is the only way to have an emission-free hydrogen strategy that aligns with the profound transformation required to move Canada’s energy system from one largely based on fossil fuels to renewable energy systems.

Due to the economic and technological limitations of CCUS and hydrogen, in combination with depressed price forecasts for oil and international pressure to curtail oil production, prospects for blue hydrogen may fall far shorter than expected. Through multiple subsidies and support to the fossil fuel sector, and new fossil fuel or technology development that ultimately support that sector, Canada is increasing fossil fuel production and emissions. This approach stands in opposition with Canada’s climate commitments—as well as with the fossil fuel phase out now underway.

5. The global fossil fuel phase out imperative

Pressure to phase out fossil fuel production is mounting and the wind down has already been initiated by a growing number of governments and financial actors. Recognizing that fossil fuels are primarily responsible for climate change, a number of countries has begun to place bans on fossil fuel extraction. Starting in late 2017 (building from Costa Rica’s example in 2002), numerous nation states implemented partial bans on oil, gas, or coal exploration or production—notably France, Belize, Denmark, New Zealand, Ireland, Spain, and Germany.⁹⁷ These and other national governments are preparing to end oil and gas production by 2050. Meanwhile, a global fossil fuel non-proliferation treaty is being developed to lay the groundwork for an international agreement to keep fossil fuels in the ground.⁹⁸

Major investors and insurers—and even oil companies—are also withdrawing from fossil fuels given the economic risk. Markets have responded to climate risk, perhaps much faster than the industry anticipated. Traditionally, energy share prices depend in part on future production capacity; that is, proven fossil fuel reserves. However, BP’s announcement to cut reserves and invest in renewables was met with a 6.5 percent increase in their share price. Oil companies are slashing future oil market price forecasts, pledging to keep \$87 billion worth of proven oil reserves in the ground.⁹⁹ Much of this will impact the oil sands, given higher extraction costs. Looking forward, the overall trend suggests that with demand plateauing^{100,101} and no sign of supply-side constraints, an ongoing era of overproduction and low prices is ahead. Unless the fossil fuel sector

can significantly reduce its cost base, low prices will squeeze its margins and damage returns on capital—returns that are increasingly unattractive given the volatility and political uncertainty of aggressive climate policy (such as diminishing public subsidies) and restricted private financing. While some may succeed,¹⁰² a rapid pivot toward renewables will be very difficult for most incumbents.¹⁰³

By discounting future production, markets now indicate that fossil fuel holdings are an increasingly risky investment and consequently investors recognize they do not need fossil fuel holdings to maintain competitive returns. Therefore, equity markets¹⁰⁴ are rapidly exiting fossil fuel investments,¹⁰⁵ whether explicitly through divestment commitments,¹⁰⁶ or implicitly through a rebalancing of portfolios. Energy equities now encompass a fraction of market indices, which, in combination with high capital cost and political uncertainty, depresses access to new capital. On lending, many of the world's most influential banks, including BNP Paribas, HSBC, ING, and the World Bank have made commitments to provide no additional lending to particular fossil fuel development, such as coal, oil sands, and arctic drilling. Similarly, the world's largest insurers like AXA, Allianz, Zurich, and Swiss RE no longer provide insurance to select fossil fuel developments. Consequently, fossil fuel firms are finding it increasingly difficult to find financiers and insurers, particularly in high-cost, high-carbon sources like Canada's oil sands.¹⁰⁷

Yet, as the world's largest asset managers and insurance companies begin distancing themselves from the oil sands, Canadian banks, pension funds, and governments have doubled down.¹⁰⁸ The temptation to fill the private financing gap through federal and provincial supports artificially props up the industry with capital that would otherwise be financially uncompetitive.^{109,110} These supports have ramifications for Canada's private capital markets, by reassuring banks to support Canadian industries: Scotiabank, RBC, TD, BMO, and CIBC have collectively lent \$726 billion to the fossil fuel industry since 2016.¹¹¹ Canada's largest pension funds have similarly taken a position of engagement,¹¹² despite facing billions in losses from fossil fuel investments in recent years.^{113,114} Yet, by relying on engagement, many of Canada's pension funds are either betting billions on fossil fuel companies overshooting their carbon budget or risking billions in stranded assets.¹¹⁵

As these pressures increase globally, the fossil fuel industry in Canada has sought government protection. Since the beginning of the Covid pandemic, representatives of the fossil fuel sector have intensified their lobbying efforts federally and provincially, requesting the roll-back or relaxation of environmental and climate regulations and even consultation requirements with Indigenous communities, as well as further financial supports.¹¹⁶ Over the last year (March 2020 to March 2021), fossil fuel industries and associations met with government officials at Natural Resources Canada, Finance Canada, and Export Development Canada, among others, 1,224 times, for an average of 4.5 times per workday (as compared to 303 meetings between government officials and environmental non-governmental organizations).¹¹⁷

Industry representatives justify their demands by claiming the oil and gas sector provides substantial revenues to government as well as jobs. Yet from 2000-2019, while oil and gas production grew by 47 percent, royalty revenues fell precipitously by 45 percent. Effective taxes from the oil and gas sector to government (predominantly to the provinces) dropped from 15 percent to 4 percent over 2006-2018.¹¹⁸ As for jobs, in 2019, the oil and gas sector represented just 1 percent of direct employment in Canada, and 5.5 percent in Alberta. To save costs, the industry has aggressively cut jobs, by 23 percent over the 2014 to 2019 period, even as oil and

gas production increased by 24 percent, reaching record highs, over that same period.¹¹⁹ Put simply, before the Covid pandemic, Canada's oil and gas sector shed workers and provided far less revenues to the provinces as oil and gas production reached unprecedented levels.

The phasing out of fossil fuel production is unfolding, signaled by countries taking climate leadership roles, as well as by global financial actors that are shifting away from long-term positions in fossil fuels in response to anticipated declines in demand stemming from the electrification of transport and the decarbonization of electricity generation. This shift is happening regardless of how Canadian institutions respond. Canada can minimize its transition costs and position the country to thrive in the future by adopting supply side climate policy measures.

6. Canada's supply side climate policy options

To date, Canada's predominantly demand-side climate policies focused on carbon pricing have not resulted in the scale of emissions reductions required to avert deepening climate crises.¹²⁰ Given the limits of this approach, some researchers and policy practitioners are now focusing on supply-side policies that limit fossil fuel production.¹²¹ The aim is to "cut with both sides of the scissors," targeting emissions from demand *and* supply.¹²²

The burning of fossil fuels (oil, gas, and coal) has been responsible for approximately 80 percent of emissions that are causing the climate crisis since the start of the industrial revolution.¹²³ The average global temperature continues to rise, driven by these fossil fuel emissions.¹²⁴ Supply side research therefore addresses the source of emissions causing the climate crisis, exploring options to wind down existing fossil fuel extraction and refuse further fossil fuel exploration to meet global emission reduction goals. The Production Gap report, developed in collaboration with leading international climate research institutes and the UN Environment Programme, estimates that global fossil fuel production must decrease by about 6 percent per year from 2020 to 2030 to align with a "median 1.5°C-consistent pathway."¹²⁵ What is more, significant quantities of fossil fuels must remain in the ground—initial calculations of "unburnable carbon" estimated two-thirds of global fossil fuel reserves must be kept in the ground to ensure global warming did not surpass 2°C,¹²⁶ and over 70 percent of Canada's oil reserves.¹²⁷ More recent estimates indicate even higher estimates of fossil fuels that cannot be extracted to align with a 1.5°C global carbon budget.¹²⁸

Canada can address the climate risks of its rising oil and gas production by implementing a range of supply-side climate policies, including regulation, economic, and informational measures.¹²⁹ Canada has already pursued supply-side policies to address coal, via Canada's Task Force on Just Transition for Canadian Coal Power Workers and Communities. This is one model that could be adapted to apply to oil and gas.¹³⁰

Indeed, any supply side climate policy directed at phasing out fossil fuel production must involve a just transition for workers, communities, and small businesses that are currently dependent on the fossil fuel industry.¹³¹ A just transition involves governments, working in collaboration with affected local communities, to: redirect subsidies

for fossil fuels toward job creation in low carbon industries; support workers in their transition from fossil fuel industries to low carbon sectors by providing opportunities for re-skilling (via vocational training and post-secondary education); and ensure social protections (income and benefit support; pension bridging and early retirement assistance) are available for workers who cannot transition.¹³² The Trudeau government committed to introduce a *Just Transition Act* in 2019 but has not yet tabled legislation.¹³³

There are limits on federal authority: the provinces have jurisdiction over exploring for, developing, selling, and managing fossil fuels on provincial lands and for enforcing penalties for provincial law violations. Moreover, the federal government has gradually downloaded regulatory authority to the provinces or deregulated environmental policy,¹³⁴ a trend that intensified until the mid-2010s. Along the way, the fallout of Alberta's reaction to the federal government's 1980 National Energy Program has helped shape the federal government's timid role in environmental policy particularly surrounding oil development.¹³⁵ Without a doubt, any federal attempt to withdraw support from, or constrain the production of, oil and gas extraction in the producing provinces (particularly Alberta, from where most production is expected to come over the next three decades) would be met with intense resistance. The political stakes would be high for any federal government.

Nonetheless, the federal government has jurisdiction in multiple relevant areas to oil and gas production¹³⁶ and can draw further confidence from the March 25 Supreme Court of Canada decision that confirmed the constitutionality of federal carbon pricing. The majority justified the decision by underscoring that the climate crisis is a matter of national concern, drawing on the Peace, Order and Good Government (POGG) clause (S.91 of *The Constitution Act, 1867*). In so doing, it emphasized that climate change is "a grave threat to humanity's future": the majority of justices stressed it is "a threat of the highest order to the country, and indeed to the world."¹³⁷

Given the out-sized impact of fossil fuel extractions on emissions that are hastening the climate crisis, the extreme impacts of the climate crisis on Canada (the country is warming at approximately twice the global average¹³⁸), and the federal government's commitments to respond to this crisis, the federal government must use the levers it has at its disposal, outlined below, to begin a gradual phase out of oil and gas production.

6.1 Regulations

1. Ensure climate and energy policy-making—including project approvals for fossil fuel related projects—are contingent on respecting and meaningfully including Indigenous Peoples, adhering to the United Nations' Declaration on the Rights of Indigenous Peoples (UNDRIP), and the right to Free, Prior and Informed Consent (FPIC).¹³⁹
2. Prohibit the leasing of federal lands and waters for fossil fuel production and infrastructure, and begin to retire any existing licences. This would involve implementing a permanent ban on Arctic oil and gas activities (a federal moratorium was implemented in 2016 and is set to expire in December 2021).
3. Cancel the Trans Mountain pipeline expansion project. The environmental costs of the project (emissions and the risk of oil spills) are high, while the most impacted Indigenous communities along the

route have not given their consent. Further, the expansion is unnecessary given reduced future oil demand and existing pipeline capacity, which poses significant economic costs to Canadians.

4. Use federal authority via the *Impact Assessment Act* (IAA) to ensure all new fossil fuel extraction projects and infrastructure (pipelines and terminals) requiring federal approval pass a robust “climate test” that accounts for both upstream and downstream emissions. Project proponents must be required to demonstrate that there is room for emissions associated with new projects or infrastructure given Canada’s emission reduction targets.
5. Strengthen the list of projects requiring federal impact review to include all forms of fossil fuel exploration, extraction, upgrading, and transportation—or return to the pre-2021 federal environmental assessment approach that relied on a list of “triggers” for federal review.¹⁴⁰ Remove exemptions from federal review for oil and gas development activities, notably for in situ extraction (the primary and emissions-intensive method of bitumen extraction) and exploratory drilling projects in the Canada-Newfoundland and Labrador offshore.
6. Work with oil-producing provinces to develop sectoral carbon budgets aligned with 1.5°C warming limits that are annually ratcheted down until net-zero emissions in 2050;¹⁴¹ ensure regular reporting on progress toward meeting the budgets.
7. Require oil sands project operators to use low-carbon technology to cut their emissions dramatically, paid for by fossil fuel firms, as originally proposed by the Harper government in 2008.¹⁴²

6.2 Economic policies

1. Strengthen the output-based carbon pricing system so that the oil and gas sector pays for all of its emissions (currently the majority of the sector’s emissions are exempt) without resorting to offsets.¹⁴³
2. Remove federal subsidies and public financing that supports fossil fuel exploration, production, or transportation, including support for technologies that delay a transition away from oil and gas. This requires the federal government to:
 - acknowledge that blue hydrogen is not compatible with a managed phaseout;
 - invest in scaling green hydrogen capacities using renewable inputs like hydro;
 - prohibit the use of grey and blue hydrogen as feedstock in fossil fuel production;
 - prohibit the use of carbon capture technologies for enhanced oil recovery;
 - ensure that fossil fuel firms receiving federal subsidies or public financing, for example through Canada’s Emergency Wage Subsidies or the funding of liabilities like orphan wells and tailing ponds, suspend share buybacks and shareholder dividends until liabilities are paid; and

- reduce or eliminate preferential tax benefits, bridge loans, and other forms of public financing for all fossil fuel firms that pay dividends, offer share buybacks, or give “excessive” salaries to executives.¹⁴⁴
3. Ensure fossil fuel companies fund liabilities (notably orphan and inactive wells, tailings ponds, and damaged lands). This could take the form of a production tax to fund environmental remediation and reclamation where provincial programs do not cover the full cost. Ensure any additional federal loans respect the “polluter pays” principle. Unfunded liabilities left to the public are subsidies by another name.
 4. Divest federal public investment funds from fossil fuel production. The sheer size and long-term investment horizons of public pension funds like the Canada Pension Plan and Investment Board make them particularly suited to restrict equity and loan financing in investments that contribute to carbon lock in. Government entities like the Bank of Canada can reinterpret the legal duties of public pension funds, such that: 1) incorporation of climate related financial risk does not breach fiduciary duty; and 2) inaction on climate related financial risk under the guise of willful ignorance does breach fiduciary duty.
 5. Require private financial institutions to adopt a fossil fuel disengagement strategy¹⁴⁵ including the public disclosure of 1) a schedule to phase out fossil fuel financing, 2) an assessment of a portfolio’s exposure to climate risk, and 3) an alignment of investment portfolios with a 1.5°C scenario. Establish legally binding mandates to systematically reduce financing fossil fuel exploration, extraction, and transportation.
 6. Require fossil fuel firms who seek private financing to adopt a climate-aligned public disclosure strategy through disclosure of a 1.5°C-compliant scenario analysis and disclosure of climate-related financial risks associated with failing to meet the 1.5°C target. Discourage investments in companies that do not align with a 1.5°C-compliant scenario by increasing the cost of borrowing through higher loan rates and tapering returns on investment through restrictions on share buybacks and dividends.

6.3 Informational policies

1. Require the Canadian Energy Regulator to develop fossil fuel extraction projections that are compliant with Canada’s Paris Agreement targets, the new net-zero by 2050 target, and the IPCC’s imperative to keep global temperature increases to 1.5°C. There must be a government-wide acknowledgement of the need to begin a gradual phase out of oil and gas production.
2. Ensure fossil fuel corporations track and disclose life-cycle emissions, from exploration and extraction through to combustion (scope 1, 2, and 3 emissions).
3. Empower Health Canada to track the health and social costs of carbon emissions from fossil fuel exploration, extraction, and transportation and to provide transparent, regular reporting to the public on these costs.

4. Improve Bill C-12, the *Net-Zero Emissions Accountability Act*, tabled in November 2020 to provide legislative support to Canada's net-zero-by-2050 commitment. Amend it to align with limiting global temperature increases to 1.5°C and to create legally mandated 5-year sector-by-sector carbon budgets (rather than emission reduction targets) with frequent (every 2-3 years, starting now, rather than in 2028 as planned) progress reporting to a credible third party, and enforcement mechanisms to ensure budgets are met. Carbon-budget-based reductions must begin now, rather than waiting until 2030—the next ten years are critically important to bending the emissions curve to meet net-zero emissions in 2050.

7. Conclusion

From a global equity standpoint, countries that have the responsibility to lead in phasing out fossil fuel production are those that have historically benefitted from fossil fuel extraction and therefore already contributed significantly to global emissions, and those that also have the financial capacity to transition (wealthy countries), particularly those with carbon-intensive fossil fuel reserves where frontline communities contest fossil fuel extraction.¹⁴⁶

Canada meets all of these criteria. Yet, instead of taking a leadership role, the country is increasingly out of step with the global fossil fuel production wind down imperative. Why? Fossil fuel proponents have vigorously intervened in policymaking and in public discourse for decades to convince political leaders and the general public about the benefits of supporting Canada's fossil fuel sector. In Canada, there is a "cohesive network" of fossil fuel companies and major financial corporations —created through lending and investment relationships as well as overlapping corporate board appointments—that depend on promoting fossil fuel expansion.¹⁴⁷ This network has mobilized via well-financed business advocacy groups to contest climate action that would impede fossil fuel production. It instead proposes climate policies that focus on incremental changes, oil and gas extraction "efficiencies," and interventions on fossil fuel consumption (not its supply).¹⁴⁸ A highly resourced and well-organized "regime of obstruction" has developed in Canada to block effective climate action and ensure increased fossil fuel extraction.¹⁴⁹

But now political-economic and also technological conditions are changing, signaling a global transition away from fossil fuel development.¹⁵⁰ Central in this moment is renewed US climate leadership that is beginning to constrain fossil fuel production to align with climate imperatives. President Biden has revoked the Keystone XL pipeline permit, frozen new oil and gas leasing on federal lands and offshore waters, committed to reviewing existing fossil fuel leases, and instructed federal agencies to end direct and indirect fossil fuel subsidies. At the same time, the US is encouraging Canada to enhance its climate action and align with this new approach.

Prime Minister Trudeau has signaled enhancements to Canadian climate policy are coming. But without moving to constrain fossil fuel production, any new emission reduction targets that Trudeau might announce will be a continuation of "one eye shut" climate policy and unmet climate commitments. To begin to meet its emission

reduction targets, Canada must remove supports for the oil and gas sector and begin a gradual phase out of production.

Notes

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² In the late 1980s, under the leadership of Conservative Prime Minister Mulroney, Canada played a lead role in establishing global climate policy conferences and institutions, notably supporting the creation of the UNFCCC. Mulroney made Canada's first commitment to reduce greenhouse gas emissions in 1990; MacNeil, R. (2019). *Thirty Years of Failure: Understanding Canadian Climate Policy*. Halifax: Fernwood Publishing.

³ MacNeil, R. (2019). *Thirty Years of Failure: Understanding Canadian Climate Policy*. Fernwood Publishing. P. 39.

⁴ By 2018, Canadian emissions had increased by 21 per cent over 1990 levels; Environment and Climate Change Canada. (2020). *National Inventory Report —2020 Edition Part 1, Table ES-3*.

⁵ Alberta's participation in the framework came at the price of Trudeau agreeing to approve Kinder Morgan's Trans Mountain Pipeline expansion, which the federal government later purchased to salvage the project when the company threatened to withdraw from it. Alberta has since abandoned its carbon pricing legislation (the federal government then stepped in to apply the backstop) and three provinces challenged the constitutionality of the federal carbon price. The Alberta Court of Appeal found the *Greenhouse Gas Pollution Pricing Act* to be unconstitutional, whereas courts of appeal in Saskatchewan and Ontario upheld the legitimacy of the Act, as did the Supreme Court of Canada on March 25, 2021.

⁶ Corkal, V. Beedell, E., & Gass, P. (2021). *Investing for Tomorrow, Today: How Canada's Budget 2021 can enable critical climate action and a green recovery*. International Institute for Sustainable Development. <https://www.iisd.org/publications/canada-budget-2021-climate-action-green-recovery>

⁷ This new target is, however, not aligned with recommendations to stay within 1.5°C of warming, which require deeper emissions cuts, estimated at 60 per cent below 2005 levels by 2030; Climate Action Network. (2019). *Getting Real about Canada's Climate Plan*. p2. <https://climateactionnetwork.ca/2019/06/14/getting-real-about-canadas-climate-plan/>

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⁹ Environment and Climate Change Canada. (2020). *National Inventory Report—2020 Part 1, Table 2-3*.

¹⁰ Environment and Climate Change Canada. (2020). *National Inventory Report—2020 Part 1, p. 53-4*.

¹¹ Plumptre, B. (2020). *National emissions numbers underscore need to invest in clean economy*. Pembina Institute. <https://www.pembina.org/blog/national-emissions-numbers-underscore-need-invest-clean-economy>

¹² Environment and Climate Change Canada. (2020). *A Healthy Environment and a Healthy Economy*. p. 38.

¹³ Environment and Climate Change Canada. (2021). *Canadian Environmental Sustainability Indicators: Progress towards Canada's greenhouse gas emissions reduction target*. p. 7.

¹⁴ Methane regulations are expected to result in 40 to 45 per cent emissions reductions from the oil and gas sector by 2025, with new targets to come in 2030, potentially to encourage emissions reduction by as much as 75 per cent by that year (Environment and Climate Change Canada. (2020). *A Healthy Environment and a Healthy Economy*. p. 38). However, accounting for methane emissions (self-reported by industry with no independent monitoring) can be unreliable and miss significant emissions, particularly fugitive emissions.

¹⁵ The 2021-2050 projections are based on the "evolving scenario," which accounts for growing global climate change policies until 2050. These projections were made in November 2020, prior to the Government of Canada committing to a

net zero by 2050 target. The CER may release data aligned with that 2050 target in November 2021. Following the CER convention, oil production data include conventional, upgraded bitumen, non-upgraded bitumen, and condensate (used to dilute bitumen).

¹⁶ Lee, M. (forthcoming 2021). *Nothin' but Net: A Critic's Guide to Net Zero Pledges in Canada*. Canadian Centre for Policy Alternatives.

¹⁷ Hughes, D. (forthcoming 2021). *Canada's Oil and Gas Sector: Status, evolution, revenue, employment, production forecasts, emissions and implications for emissions reduction*.

¹⁸ SEI, IISD, ODI, Climate Analytics, CICERO, & UNEP. (2019). *The Production Gap: The discrepancy between countries' planned fossil fuel production and global production levels consistent with limiting warming to 1.5°C or 2°C*. International Institute for Sustainable Development. P. 36 <https://www.iisd.org/publications/production-gap-discrepancy-between-countries-planned-fossil-fuel-production-and-global>; Lee, M. (2018). Extracted carbon and Canada's international trade in fossil fuels. *Studies in Political Economy*, 99(2), 114–129. <https://doi.org/10.1080/07078552.2018.1492214>.

¹⁹ Oil emission factors based on US EPA estimates (which are low for the 2021-2050 period, as the emissions intensity of oil production will likely rise, given that oil production will increasingly come from the higher-emitting oil sands; natural gas emissions factor from Canada's National Inventory Report.

²⁰ Matthews, D. H., Tokarska, K. B., Rogelj, J. et al. (2021) An integrated approach to quantifying uncertainties in the remaining carbon budget. *Commun Earth Environ* 2, 7. <https://doi.org/10.1038/s43247-020-00064-9>.

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²⁶ Tucker, B., DeAngelis, K., & Doukas, A. (2020). *Still Digging: G20 Governments Continue to Finance the Climate Crisis*. Oil Change International. <http://priceofoil.org/content/uploads/2020/05/G20-Still-Digging.pdf>

²⁷ Geddes, A., Gerasimchuk, I., Viswanathan, B., et al. (2020). *Doubling Back and Doubling Down: G20 scorecard on fossil fuel funding*. International Institute for Sustainable Development. <https://www.iisd.org/publications/g20-scorecard>

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