Canadian Energy Outlook

The State of Energy and GHG Emissions in Canada

3rd edition

INSTITUT DE L'ÉNERGIE TROTTIER

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Introduction

This first report of the Canadian Energy Outlook 3rd edition provides an overview of the main trends in energy consumption and production across Canada. It also indicates how these trends relate to a broader assessment of the evolution of greenhouse gas (GHG) emissions. The five chapters following this introduction focus on the basic features of the state of the energy system and GHG sources in Canada in 2023.

Energy services are strongly associated with quality of life and standards of living, transportation of people and goods, and heating and cooling buildings. In short, they provide the power to ensure the operation of society as a whole. Yet the role of energy in global warming has given rise to various international, national, provincial and community objectives that call for a deep transformation of the global energy system. This also applies to Canada, where the relationship between the provision of these services and the climate crisis is paramount: for the country as a whole, 81% of greenhouse gas (GHG) emissions are directly associated with the production, transport and consumption of energy itself. Moreover, most other sources of GHG emissions processes also involve energy use, be they from agricultural production using fossil fuel-based fertilizer or from the chemical transformations made possible by the use of energy in industrial processes.

Understanding the current state of Canada's energy system is necessary for two main reasons. First, it helps understanding and evaluating how recent policies, as well as social and technological developments, affect our energy reality as a society. Second, to more effectively measure and analyze the meaning of the different pathways to net-zero emissions that will be constructed from modelling in the second report of this Outlook, a thorough presentation of recent data helps establish a concrete and well-informed starting point for discussion.

Analyzing how net-zero pathways contrast with current trends, and how much effort the planned transformations will require, is essential to understand the implications of the energy transition that will extend over the decades to come. As such, a clear presentation of the current state of Canada's energy system is also essential to highlight its size, depth and the close integration of its various energy sources with its economy through energy production, transport and usages. In view of some of the choices that Canadians contemplate and the potential they hold for improving their quality of life in conjunction with the transition, the characteristics of the energy system outlined above are impossible to ignore.

To answer these needs, this report has three main objectives:

1. To provide a detailed snapshot of past trends and the current structure of energy production, transformation and consumption across the country, in addition to sources and trends for GHG emissions;
2. To identify areas where the data indicates that important decarbonization transformations are already ongoing, despite limited public discussion;
3. To propose a thorough discussion of variations within these trends and the characteristics of the current energy and GHG situation. In particular, keeping provincial variations in mind is crucial in this context given that:
   - **a.** The make-up of the energy system and the relative importance of different sources of GHG emissions vary quite substantially across the provinces. This make-up helps explain some of the variation in political efforts to bring about emission reductions, which are further based on differences in the structure of provincial and territorial economies, the size of their populations and their spread among rural and urban regions, as well as the prevailing preferences of their populations and political classes.
   - **b.** Furthermore, these differences occur in the context of a federation, where a significant share of jurisdiction for energy issues lies with the provinces. While this situation complicates national initiatives to coordinate emission reduction efforts and transform the economy, it also points to the fact that some transformations might benefit from thinking beyond provincial borders to regional or national terms for lower–and more efficiently distributed–transition costs.

1.1 Recent developments in Canada's energy sector

Before providing a detailed description of the current state of Canada's energy system and GHG profile, it is worth reviewing recent developments affecting energy issues and GHG reduction efforts. Notably, although the country has seen a progressive retreat of virtually all public health restrictions respecting the COVID-19 pandemic, the extent of the pandemic's impact on emissions and the energy sector is starting to become better understood.

In parallel, the outbreak of war in Ukraine in early 2022 sparked significant disruptions in energy markets worldwide, with world oil prices shooting up to over $100 per barrel in the following months, for the first time in close to a decade. The situation was made even more dire for natural gas prices (and by extension, electricity prices) in Europe, where Russian gas imports constitute a large share of the energy mix in many countries like Germany and the United Kingdom. While cross-Atlantic trade in natural gas is much more limited than in oil, prices in North America were not completely shielded. And although these developments increased investments in renewable energy in Europe, they also triggered significant interest in accelerating the buildout of liquefied natural gas (LNG) export facilities in North America to supply world markets, bolstering the link between natural gas prices of different regions.

Despite the prominence of these crises, many other developments have contributed to the evolution of Canada's energy sector since the publication of the previous Canadian Energy Outlook in 2021. As described below, such developments played out against a backdrop of more dire projections from the United Nations' Intergovernmental Panel on Climate Change (IPCC) on the growing impacts of global warming worldwide.

1.1.1 Electricity

The electricity sector saw several developments since the publication of the previous Outlook in 2021. During the federal election campaign in the fall of 2021, the current government announced a net-zero emissions target for this sector by 2035. In August of 2023, a draft of the proposed Clean Electricity Regulations was released, launching consultations that concluded in early November 2023. The draft outlines the various options available to provinces under the regulations, taking a technology-neutral approach while imposing GHG performance requirements. In parallel to this development, the government formed the Canada Electricity Advisory Council, which was mandated to advise the Minister of Natural Resources on how best to "accelerate investment, and promote sustainable, affordable and reliable electricity systems." The council, which is funded for one year, will submit its final report to the Minister in the spring of 2024.

In February 2023, Quebec Premier François Legault and Newfoundland and Labrador Premier Andrew Furey held energy talks primarily aimed at initiating discussion over the long-standing contract under which Hydro-Quebec purchases the electricity produced at Churchill Falls in Labrador. Given that benefits from the agreement have largely favoured Hydro-Quebec since its signature in 1969, the talks were aimed at opening discussions on what will happen when it expires in 2041. A potential new hydroelectric project to be developed at Gull Island, also in Labrador, was also discussed.

The talks were held in a context where the Quebec government is conducting consultations to inform the revamping of the province's principal energy laws to adapt them to more effectively serve efforts targeting net-zero emissions. The roles and mandates of the provincial electricity utility, Hydro-Quebec, and the regulating agency (the Régie de l'énergie du Québec) are among the topics addressed. Hydro-Quebec, the largest electric utility in the country, also released its Action Plan 2035, which includes $185 billion investments before 2035 to significantly expand production and improve reliability in support of decarbonization efforts. The plan also specifies that reaching the net-zero objective in 2050 for the province will require a doubling of electricity consumption from current levels.

The federal government also convinced Volkswagen to build a large-scale battery manufacturing plant in Ontario. Other provincial governments are also endeavouring to attract investment for manufacturing capacity linked to the electrification of energy services, including Quebec's "battery strategy," an attempt to build a full electric vehicle battery supply chain. As part of this strategy, the Quebec government announced several projects, including a large-scale Northvolt battery cell manufacturing plant east of Montreal. However, concerns over how to provide the electricity needed to power these installations, including the Volkswagen plant and other industrial projects in Quebec, in the short term have been raised. More specifically, these efforts highlighted the fact that natural gas-fired electricity may need to be used to supply the energy for these projects.

Finally, Ontario, Alberta, Saskatchewan and New Brunswick announced a joint strategic plan for the deployment of nuclear small modular reactors (SMRs) in 2022. The provinces committed to work together on the path forward for SMRs. Ontario is the most advanced at this point, having started to build the first grid-scale SMR at its Darlington nuclear site. Ontario also announced plans to put two more reactors into operation between 2034 and 2036 to meet growing electricity needs in the provinces. No SMR is currently in operation worldwide.

In parallel, the Government of Canada has now committed close to $1 billion in developing SMRs, including $907 million through the Canada Infrastructure Bank to support building the first reactor at Darlington. Other federal programs were announced in the 2023 budget to support research and development for SMRs.

1.1.2 Oil and gas infrastructure

There has been a great deal of activity in the oil and gas sector over the past two years. First, the Trans Mountain pipeline continued to encounter financial difficulties. Purchased by the Government of Canada in 2018, with a planned expansion project in 2019, its construction is administered by a crown corporation and has continued ever since. However, in 2023, the costs of the project were reported to have risen to $30.9 billion, compared with the $7.4 billion forecast by the original owner in 2017. With such an explosion in cost, the federal government had to guarantee a total of $12 billion in debt for the project as of 2023, after repeated construction delays.

In April of 2022, despite concerns by environmental groups, the federal government approved the Bay du Nord project for oil extraction off the coast of Newfoundland, arguing that one of the conditions for approval was that the project would have to be net-zero emissions by 2050. A year later however the project was officially put on hold for three years by Equinor, the project's main actor, which cited challenging market conditions as the main reasons for this postponement.

While the Bay du Nord project received a green light from the authorities, the GNL Quebec project, which was designed to transport natural gas from Western Canada to the Saguenay region in Quebec for transformation and export to Europe and Asia, was formally rejected by the provincial government in early 2022. This rejection was subsequent to an evaluation by the Environmental Impact Assessment Agency of Canada, which concluded that the project was not justifiable in light of its likely environmental impacts. Although discussions between Canada and Europe to build LNG export facilities in the wake of the war in Ukraine refocused attention on the project, the federal government declared that it was not planning to reconsider it.

In addition to rejecting the GNL Project, the Quebec government promulgated a law in 2022 banning all exploration and exploitation of fossil fuels on its territory, as well as the public financing of such activities, becoming the first government in the world to do so.

Enbridge's replacement of the Line 3 pipeline (now called Line 93), which faced legal challenges that went to the Minnesota Supreme Court after opposition to a section of the proposed route, won the court battle and construction was completed in 2021. In operation since that time, the pipeline transports 760,000 barrels from the oil sands on a daily basis.

In British Columbia, 85% of the construction of the LNG Canada project, which will become the first liquefied natural gas export facility in the country, was completed. Financed by the subsidiaries of five international firms involved in natural gas, the project is set to start operation in 2025.

Also in British Columbia, several projects involving natural gas led to increased participation from First Nations. FortisBC signed an agreement with the Snuneymuxw First Nation on its Tilbury LNG projects, which aim to supply growing demand for LNG as a marine fuel. As part of the agreement, FortisBC committed to share benefits from the projects and support the community through educational opportunities and continued investments, while the Snuneymuxw community committed to support the projects and participate in regulatory processes associated with it. The Government of British Columbia also approved the $3 billion Cedra LNG facility proposed by the Haisla Nation, which is poised to become the first Indigenous majority-owned LNG export facility in the country.

However, other projects, such as the Coastal Gaslink pipeline, geared toward supplying the LNG Canada terminal, have continued to face opposition from First Nations. The Coastal Gaslink pipeline project sparked country-wide protests in early 2020 because of opposition from the Wet'suwet'en nation's hereditary chiefs. A tentative agreement in 2020 broke down in 2021 and was followed by renewed opposition to the project.

Finally, in June 2022, the six largest companies operating in the oil sands formed the Pathways Alliance, pledging to achieve net-zero emissions from oil sands operations by 2050. The alliance then announced a $16.5 billion carbon capture and sequestration (CCS) project that would collect CO_2 from several facilities and transport it to the Cold Lake area in Alberta, storing it in underground rock formations.

1.1.3 Hydrogen

In December 2020, the federal government published its Hydrogen Strategy, which outlined the potential for this energy source on the 2030 and 2050 horizons. While Canada signed a memorandum of understanding with the Netherlands in 2021 to foster cooperation on hydrogen, the agreement that drew the most attention was the more recent Canada-Germany Hydrogen Alliance. Signed in August 2022 in the wake of Europe's energy crisis triggered by the Russian invasion of Ukraine, it aims to explore mechanisms to facilitate the trade of hydrogen and its derivatives between Canada and Germany. Although projects for hydrogen and ammonia export facilities are being explored, few concrete developments have ensued to date.

Several provinces have now also released such strategies. In 2022, Quebec published the Hydrogen and Bioenergy Strategy (Stratégie Québécoise sur l'hydrogène et les bioénergies), followed by a roadmap to create a "favourable environment" to develop these sources. In the same year, Ontario released its Low-Carbon Hydrogen Strategy, which is part of the province's broader energy policy objectives to make it a clean manufacturing hub.

In the western provinces, Alberta launched its Hydrogen Roadmap in 2021 to expand its hydrogen production. In 2021 as well, British Columbia's Hydrogen Strategy also aimed to expand production, although it is more geared toward exploring the fuel's use across sectors, especially for transport and as a part of the natural gas mix.

Finally, despite the absence of a formal hydrogen strategy in Newfoundland and Labrador, the province has repeatedly signaled in recent years that it wishes to explore hydrogen potential. This includes a dedicated section in its 2021 renewable energy strategy and a fiscal framework that the provincial government released in 2022 for green hydrogen production projects using wind power. While several such projects have since been proposed, it is too early to indicate which, if any, will move forward.

The development of these strategies aims to clarify the terms under which hydrogen is considered as part of decarbonization strategies, as well as the export potential of Canadian production. While several projects have already been selected to move forward with government financing, some parts of the strategies are being criticized as too optimistic. In 2022, an audit of the federal strategy by the Commissioner of the Environment and Sustainable Development found it to be "overly optimistic," forcing the government to revisit it (Office of the Auditor General of Canada 2022).

1.1.4 Impacts of extreme weather events

The growing impact of climate change was felt through several high-intensity weather events. This edition of the Canadian Energy Outlook is being written in a record year for forest fires across the country. In 2023, Alberta set a record for forest area burned in the spring, and Quebec experienced its worst forest fire year on record in terms of area burned. Overall, the total area burned across the country in 2023 was more than twice that of any year since 1983.

The repercussions were important for air quality in the southern part of the province, where public health warnings asking people to stay inside were issued in several regions. For most of June, Montreal was among the urban regions worldwide having the worst air quality. Ontario similarly saw forest fires worsening air quality during the month of June, particularly in the Ottawa region.

Several other weather events have also highlighted the need for a significant improvement in the energy system's resilience. Repeated spring flooding in Quebec and Ontario is one example and Hurricane Fiona's destruction in the Atlantic provinces is another case in point. After the passage of the latter through Prince Edward Island, for instance, all residents in the province were deprived of electricity for over a week, a situation that questions the assumptions behind the planning of the electricity grid in the face of more frequent and intense events like these.

1.1.5 Electoral and political developments

The fall of 2021 saw the re-election of a minority Liberal government led by Justin Trudeau, prolonging the previous government setting in Ottawa. In line with campaign promises, efforts to push the decarbonization of the Canadian economy further were formally introduced, including the net-zero emissions target for the electricity sector, a cap on the emissions from oil and natural gas production, as well as a 2035 sale target for 100% zero-emission vehicles. Most high-level announcements such as these are still being examined through a consultation process before being finalized.

In March 2022, the federal government also published its 2030 Emissions Reduction Plan, which provides details on the government's approach and expectations on how the country can meet its 2030 GHG reduction target. The plan was followed by two budgets (2022 and 2023) that increased financial support for measures, including a controversial tax credit for carbon capture storage and reutilization projects. Furthermore, in 2022, the government sent its long-term low GHG emission development strategy (LT-LEDS) to the United Nations, a process strongly encouraged by the Paris Agreement to outline a signatory's strategy to achieve net-zero emissions.

While the Emissions Reduction Plan provided a more detailed roadmap of what policies would target, its projections of these policies' impact on GHG emissions reductions were called into question by the Commissioner of the Environment and Sustainable Development in November 2023. The commissioner's report highlighted implementation delays and overly optimistic assumptions in the modelling of policy measures with regard to the 2030 GHG reduction target (Office of the Auditor General of Canada 2023).

Several provincial elections have also been held since the Outlook's last edition, including one in Alberta, where Danielle Smith was elected, after having replaced Jason Kenney as Premier when the latter stepped down in 2022. That same year, Premiers Doug Ford and François Legault, respectively in Ontario and Quebec, were re-elected with strong majorities. Prince Edward Island's Dennis King was also re-elected in 2023.

Just like the nomination of Pierre Poilièvre as the new leader of the federal Conservative Party, Danielle Smith's election signals strong opposition to the Trudeau government's current policies in some constituencies. While these disagreements are not uniquely centered on climate policy, the high-profile measures of the federal carbon pricing and the promised cap on emissions from oil and natural gas are directly targeted by Smith and Poilièvre, signaling difficulties ahead for the full implementation of the Trudeau government's climate platform.

South of the border, the Biden administration passed the Inflation Reduction Act (IRA) in 2022. The policy, which, despite its name, is strongly focused on public support for renewable energy deployment, includes $500 billion in new spending and tax breaks aimed at expanding clean energy, reducing healthcare costs, and increasing tax revenues. Part of the IRA approach targets the development of a domestic manufacturing capacity surrounding decarbonization efforts, including several production tax credits for clean technologies and energy sources.

The IRA is also part of a broader industrial policy shift by the Biden administration to foster clean energy development while protecting domestic players. Notably, the CHIPS and Science Act of 2022, which was passed in parallel to the IRA, commits $280 billion, mainly to expand domestic semiconductor capacity, while restricting funding recipients from manufacturing semiconductors in China and countries defined by the US as posing a national security threat.

The passage of these two laws in the United States can be viewed as part of a broader trend towards protectionism surrounding decarbonization efforts. European energy policy has similarly attempted to impose more restrictions on imports due to decarbonization or other environmental rationales, including a border adjustment mechanism on the European Emissions Trading System. Decarbonization efforts in Canada are affected by this trend since the passage of the IRA notably creates intense competition for attracting clean energy investment through government measures.

These developments affect different parts of the Canadian energy system. The rest of the description in this report provides a more detailed look at the various dimensions of this system, helping to further understand the impact—and in some cases the causes—of these events.

1.2 Overview of this report

In order to present a full description of the current energy and GHG situation in Canada, Chapter 2 begins with a profile of energy production and trade in Canada; Chapter 3 discusses recent trends in consumption in different sectors; and Chapter 4 presents an assessment of the importance of energy in the Canadian economy. Since GHG emissions reduction scenarios require significant transformations to the way we use energy, these chapters provide details on the current state, and therefore starting point, for the energy system.

Chapter 5 then presents a profile of GHG emissions across the country, including those from sources beyond energy-related activities. It subsequently provides an overview of current policies announced or in place for reducing emissions. These four chapters set out a thorough description of the energy system and GHG policy efforts across the country. Chapter 6 presents a conclusion.

1.3 References

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2

Energy production, transformation and trade

The Canadian energy system was developed around an exceptional energy resource endowment. Because of the uneven geographical distribution of these resources, a number of the main components of Canada's energy production sector differ substantially across the regions. This chapter presents an overview of the country's energy production, transformation and trade.

Highlights

- One of the world's largest energy producers and exporters, Canada has significant fossil fuel and uranium ore extraction sectors.
- The main destination for Canada's energy exports is by far the United States, which is also the main source of energy imports into Canada.
- Following a temporary price plunge in 2020 that affected oil and gas production, prices recovered a few months later and then rapidly escalated subsequent to the invasion of Ukraine. Oil production, in particular, decreased by 4.7% in 2020 but bounced back in 2021 to reach an all-time high.
- Eighty-two percent of Canada's electricity production comes from low-carbon sources, with wind being the fastest growing in the past decade. However, the source mix used for electricity generation varies considerably between provinces.
- Since there has been no increase in electricity production over most of the past 20 years, provincial grids are unprepared for expected changes in demand, especially in association with net-zero pathways.
- Data gaps and scatteredness make it difficult to precisely quantify bioenergy's exact role in the energy system.

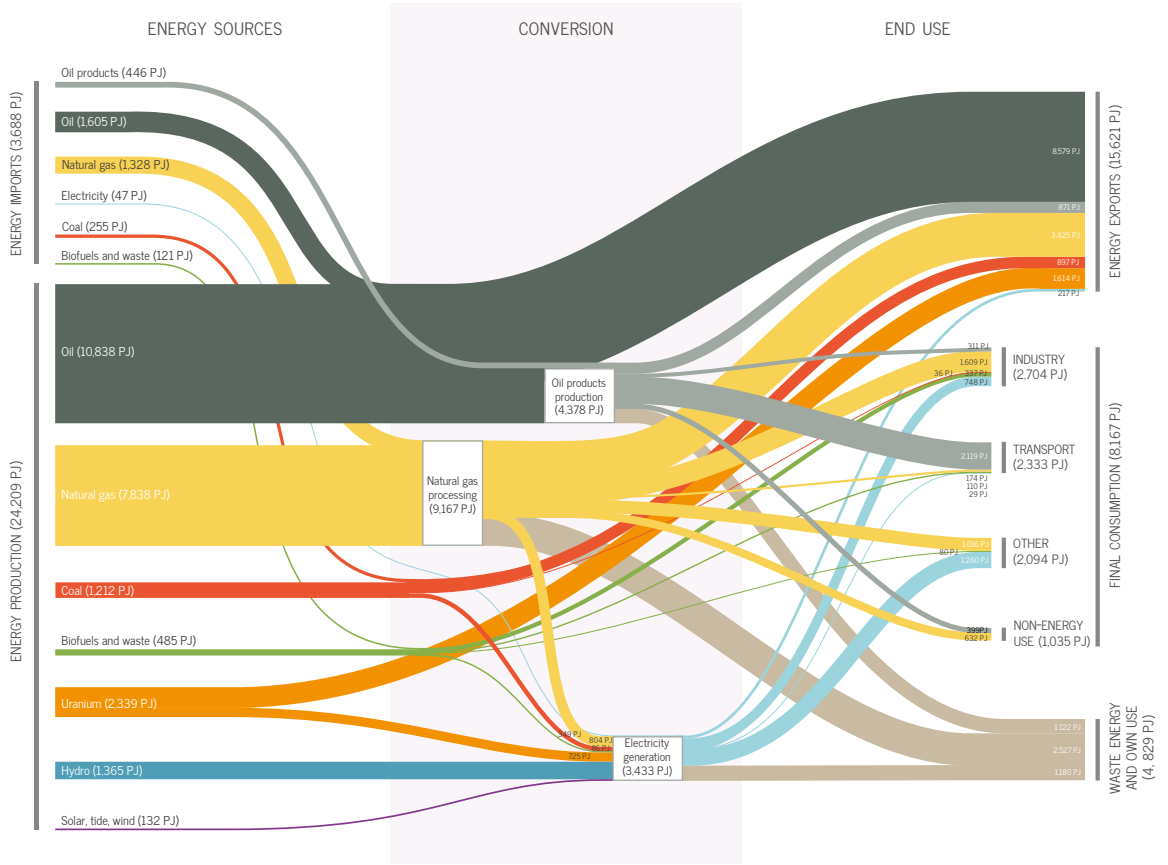
2.1 General characteristics

2.1.1 The energy system at a glance

Figure 2.1 illustrates the main energy flows of the Canadian energy system. While the country's abundant resource endowment has led to the development of a major production and export capability, it has also shaped certain energy consumption profiles across provinces and sectors.

A look at the national scale should not obscure substantial variations across provinces and regions. For instance, dominant energy sources for space heating and industry vary significantly, and primary energy and electricity production show distinct regional patterns as well. This chapter provides an overview of the latter, while Chapter 3 focuses on energy consumption.

Figure 2.1 – Supply, transformation and consumption of energy in Canada



Source: authors' own calculations based on Statistics Canada 2023a, 2023b, 2023c, 2023d; NRCan 2023; OEE 2023

Note: Energy flows less than 50 PJ are not displayed. Totals may not add up due to rounding. Final consumption captured under "Other" includes residential, commercial and public services, agriculture and forestry, fishing and non-specified.

2.1.2 Domestic resources

Canada is the world's 6th largest primary energy producer owing to its important production of crude oil (4th in the world in 2021), natural gas (5th), uranium (2nd), and hydroelectricity (2nd). In 2022, 290,300 jobs were directly tied to this sector, generating more than $245 billion of GDP (9.4%) (NRCan 2023).

2.1.3 Low-emission electricity mix

In 2021, 81% of the electricity produced in Canada came from non-emitting sources, including hydroelectricity (60.6%), nuclear (14.0%) and wind (5.5%) (Statistics Canada 2023b, 2023c). Between 2011 and 2021, electricity generated from renewable sources grew by 10%, largely driven by the deployment of wind and solar generation (NRCan 2023). In total, non-emitting electricity production provided 17% of the country's total energy supply and 22% of its final energy consumption.

2.1.4 Low interprovincial trade

Canada's federal system of government places jurisdiction for energy matters largely in the hands of the provinces. Historically, this has contributed to largely independent provincial clusters in energy matters, both in policy making and in the organization of energy systems. Most trade occurs indeed North-South (between provinces and American states) rather than interprovincially, especially in relation to electricity (see Table 2.7).

Table 2.1 – Energy in Canada: world ranking for reserves/capacity, production and exports (2021)

Energy Resource	Proved Reserve/Capacity	Production	Exports
Crude Oil	4	4	3
Uranium	3	2	2
Hydroelectricity	4	2	-
Electricity	8	7	3
Coal	16	14	7
Natural Gas	17	5	6

Source: NRCan 2023

2.2 Fossil fuel production

Canada's sizeable fossil fuel production is mainly in the form of crude oil (54.5%) and natural gas (34.8%), with coal and natural gas liquids providing the remainder. Canada is the world's 4th largest producer of crude oil, although the top three producers (the United States, Russia and Saudi Arabia) have levels well above twice Canadian levels. While the United States and Russia each produce more than four times Canadian levels of natural gas, Canada's production is comparable with the next top producers, Qatar and China.

In contrast to natural gas production levels, which are similar to those of 20 years ago, oil production levels increased by 250% between 2001 and 2021. Although the onset of the pandemic in 2020 led to a 4.7% decrease over 2019 levels, production bounced back in 2021 to reach an all-time high.

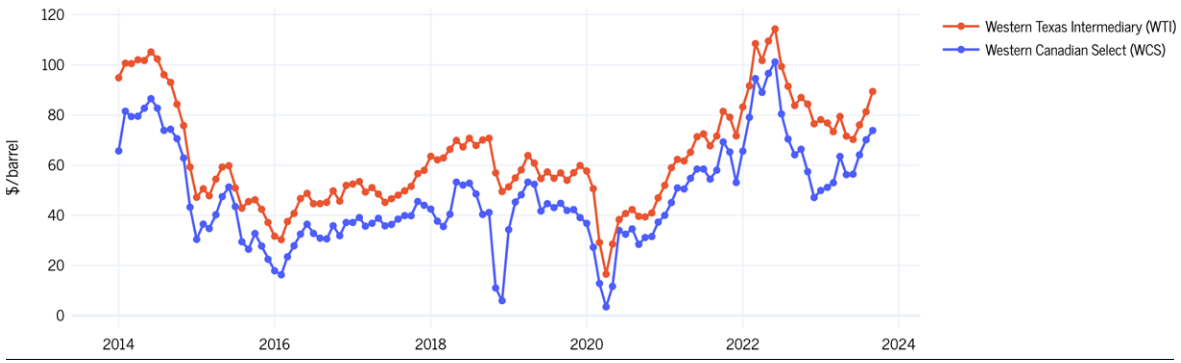
The oversupply orchestrated by the OPEC at the beginning of 2020, followed by the onset of the pandemic, led to a drastic plunge in oil prices that affected both Canadian production and world markets (Figure 2.2). This decline was temporary however and did not differ in magnitude in terms of WCS prices from a previous decrease that occurred in late 2018, due to a combination of refinery maintenance and overproduction. In 2021, a continuous increase in demand brought prices to their highest levels since 2014. In early 2022, prices rose further following the invasion of Ukraine. Although demand and prices for oil remain strong in the short term, uncertainty clouds the longer-term future demand; lower-cost producers could be more likely to adopt more aggressive strategies to reduce competition in a context of less demand for oil triggered by global efforts to reduce GHG emissions (IEA 2022; BP 2023).

Table 2.2 – Fossil fuel production (PJ)

Fuel	2001	2006	2011	2016	2019	2020	2021
Crude oil	4,777	5,905	6,890	8,878	10,735	10,222	10,838
Natural gas	7,196	7,205	6,082	6,637	6,823	6,660	6,927
Coal	1,666	1,457	1,485	1,370	1,205	1,149	1,212
Gas plant natural gas liquids	674	720	620	755	919	891	911

Source: Statistics Canada 2023a

Figure 2.2 – Monthly oil prices (2014-2023)



Source : Alberta 2023

2.3 Uranium

In 2022, Canada produced 7.4kt or 15% of the world's uranium, well behind Kazakhstan (43% of world production). In 2021, uranium production accounted for some 11% of the total primary energy produced in the country (24,726PJ), ranking third in importance after oil and natural gas (NRCan 2023).

2.4 Oil products

Fifteen oil refineries are in operation across Canada, plus one asphalt refinery in Moose Jaw, Saskatchewan and another in Clarkson, Ontario (Table 2.3). Transportation fuels (gasoline, diesel and aviation fuel) make up over two-thirds of the refined products from these facilities. The remaining production consists of a long list of products, including light and heavy fuel oils, asphalt and feedstocks for the petrochemical industry.

Even though Canada as a whole produces more crude oil than its refineries process, eastern refineries are less connected to western crude supply. As a result, some of the refining capacity in the eastern provinces is supplied by crude oil imports. Nevertheless, over the past few decades, production from the oil sands has continuously grown in importance as a supplier to Canadian refineries, largely as a result of inverting the 9B pipeline linking Ontario and Quebec in 2015.

The United States is by far the largest source of crude oil imports, at 336kbbl/d (72% of total imports in 2022), with Saudi Arabia (17%, or 80kbbl/d) and Nigeria (7% or 31kbbl/d) making up most of the remainder (CER 2023a). With the country's largest refining capacity and no connection to pipeline networks, the Irving refinery in New Brunswick receives more than half of national imports.

Similarly, although Canadian refineries produce more refined petroleum products (RPPs) than the country consumes, regional disparities between the supply and demand of some particular RPPs has led to imports for these products. Overall, 80% of the country's RPP imports originate in the United States. Alberta imports them all from the United States, mainly diluent components to blend with the bitumen produced in the oil sands, from the United States. Eastern provinces receive the majority of their RPP imports from the United States, with the rest coming from a host of small sources around the world (the Netherlands being the most important at 9% of the country's total). (CER 2023b).

Table 2.3 – Refining capacity, by installation and province (2023)

Refinery installation	Province	Capacity (kb/day)	Total by province
Prince George (Tidewater Midstream)	British Columbia	12	67
Burnaby (Parkland)	British Columbia	55	
Sturgeon (NWR)	Alberta	80	543
Edmonton (Suncor)	Alberta	146	
Strathcona (Imperial)	Alberta	187	
Lloydminster (Cenovus)	Alberta	30	
Scotford (Shell)	Alberta	100	
Federated Co-op	Saskatchewan	130	152
Moose Jaw (Gibson)	Saskatchewan	22	
Sarnia (Imperial)	Ontario	120	408
Nanticoke (Imperial)	Ontario	112	
Corunna (Shell)	Ontario	75	
Sarnia (Suncor)	Ontario	85	
Clarkson (Petro-Canada Lubricants)	Ontario	16	
Montreal (Suncor)	Quebec	137	402
Jean-Gaulin (Valero)	Quebec	265	
Irving	New Brunswick	318	318

Source: Canadian Fuels Association 2023

Since most Canadian refineries are small compared with newer sites being developed around the globe, their future is uncertain. With growing numbers of electric vehicles on the road, demand for gasoline is expected to shrink, sparking an oversupply in North America. We should thus see consolidation and closures in the coming years as owners review their investments.

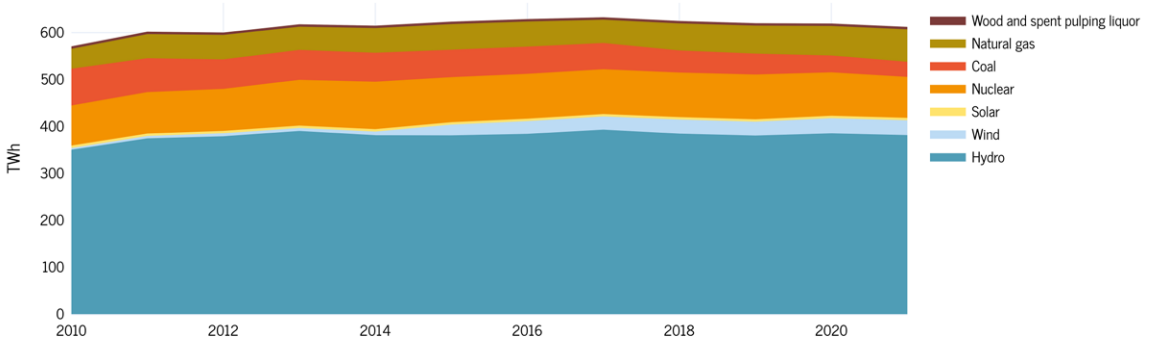
2.5 Electricity generation

Hydropower accounts for over 60% of electricity generated across Canada (Figure 2.3). Wind, biomass and solar, as well as other more marginal sources, contribute to bringing the total renewable sources in electricity production to 68%. Almost all the rest is provided by nuclear (14%), natural gas (11.9%) and coal (5.1%).

From 2019 to 2021, coal's contribution to electricity generation continued to decline, dropping a further 2% in its share of total generation. This decline goes back several years: after Ontario's phaseout – completed in 2014 – drove a large part of this decrease, other provinces closed or retrofitted coal-fired power stations. Alberta, once the province with the largest share of coal-fired electricity generation, has seen its producers either retire coal-fired generating units or convert them to natural gas, with the last coal powerplant (Genesee) being scheduled for conversion by the end of 2023. Saskatchewan has three facilities still burning coal, including the Boundary Dam powerplant, which has one unit equipped with carbon capture technology.

New Brunswick's Belledune station is scheduled to retire by 2030, although it is yet unclear what type of generation will compensate for its closure. Nova Scotia is home to the greatest uncertainty about the retirement of coal-fired generation, where plans for the Lingan, Point Aconi, Point Tupper and Trenton facilities have yet to be announced or confirmed. The release of the federal government's Clean Electricity Regulations in 2024 should help clarify the options being considered by the two Atlantic provinces.

Figure 2.3 – Electricity generation by source (utilities and industrial)



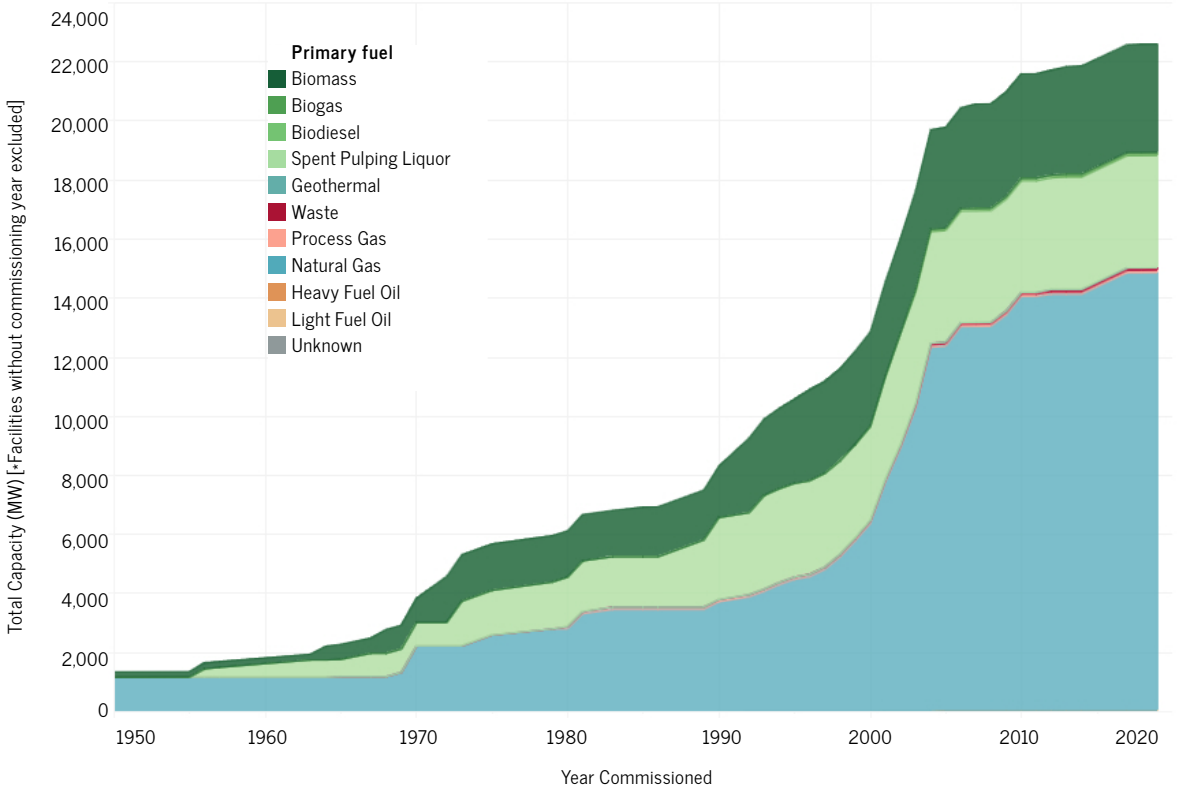
Source: Statistics Canada 2023b, 2023c

Natural gas continued to increase its participation in the electricity mix in both absolute and relative terms, while wind energy also grew its share but at a slower pace. This growing trend is more recent for natural gas than for wind, stemming from the conversion of several generating units formerly fueled by coal, as well as the planned refurbishing and closing of some nuclear reactors in Ontario.

Since 2000, co-generation facilities, which produce both electricity and heat, have more than doubled in capacity across Canada's industrial sector. The total installed capacity of combined heat and power (CHP) has been 9,899 MW for electricity production and 13,969 MW for heat generation since 2019. Around 60% of this capacity comes from the burning of natural gas by the utilities, mining or oil and gas sectors, while most of the rest is almost evenly split between the use of spent pulping liquor and biomass in the pulp and paper industry. Other CHP units are also in operation across other industrial sectors, typically using natural gas (CEEDC 2023).

Half of this co-generation is found in Alberta, with 11,633MW of combined installed capacity for electricity and heat. Most of the rest is in operation across British Columbia (4,057 MW) and Ontario (4,327 MW) (CEEDC 2023).

Figure 2.4 – Cogeneration installed capacity across Canada



Source: CEEDC 2023

2.6 Biomass

Biomass helps produce 25% of Canadian renewable energy, well behind hydro (68%), representing some 4% of the country's total energy supply. Much of this production serves co-generation facilities that produce both electricity and heat, notably in the pulp and paper industry and among independent power producers. Aside from pulping liquor, bioenergy in its primary form derives from wood fuels, around 57% of which is used in industry, 20% in residential heating and 22% in electricity generation (NRCan 2023).

Bioenergy production also includes liquid fuels (bioethanol and biodiesel), which are mixed with their fossil counterparts to enable fuel distributors to meet provincial and federal mandates on gasoline and diesel blends, which vary from 2% to 10%. In place since 2022, the federal government's Clean Fuel Standard has imposed stricter GHG-emission constraints on fuel distributors, which should increase the use of biofuels in the coming years (see Chapter 5).

The majority of biofuels are produced in Saskatchewan and Ontario and are considered first generation since their feedstocks are corn and oilseeds. Second-generation biofuels, produced from dedicated crops, straw, wood or waste, remain marginal. Although biomass feedstock is produced domestically, net imports provide 59% of the biofuels used in Canada (Table 2.4), almost all of which comes from the U.S.

2.7 Hydrogen

Despite Canada's position as one of the world's top 10 hydrogen producers, this production remains marginal in terms of its energy content, with an estimated 3Mt per year representing 1.3 TJ. Most of this production is grey hydrogen (produced from fossil fuels). Limited data is available on green and blue hydrogen projects under development (see for instance Hoornweg *et al.* 2021; Whitmore and Pineau 2023).

Table 2.4 – Production and trade of biofuels in Canada (2022)

	Ethanol (millions litres)	Biodiesel (millions litres)
Production	1,692	369
Imports	1,752	846
Exports	82	379
Domestic consumption	3,343	1,052

Source: NRCan 2023

2.8 Energy trade

Energy exports are almost four times the size of imports across the country. From 2011 to 2021, exports increased by 31.3% to 13,933PJ, mainly owing to the contribution of crude oil, which represented 61% of all energy exports in 2021 (8,579PJ) and grew by 70% over the same period. Conversely, natural gas exports decreased by 15% during this period to reach 3,042PJ. This decrease was largely due to a production boost in low-cost shale gas in the United States from 2007 and explains why natural gas production has yet to regain its 2001 levels (see Table 2.2).

Oil and natural gas exports, which amount to $217 billion and represent 30% of all Canadian exports, also constitute by far the dominant share of all energy exports (worth a total $240 billion in 2022) (see Figure 2.5). It is also worth noting that the expansion of crude oil production over the past 20 years has primarily been destined for export (overwhelmingly to the United States), resulting in a significant growth of Canada's total export revenues. Despite a decline in 2020 subsequent to the COVID19-related economic slowdown, both oil and natural gas exports had recovered to 2019 levels by 2021.

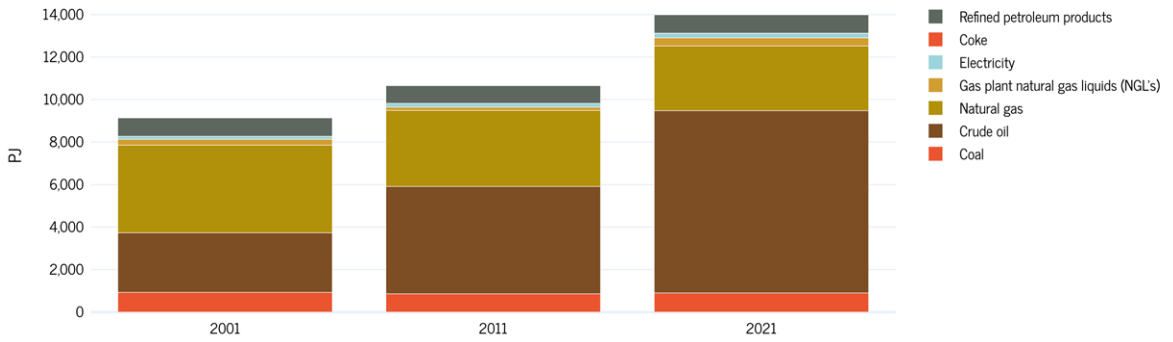
Figure 2.5 shows that although electricity exports increased by 42% between 2001 and 2021, they remain a very small part of the total when comparing sources on their energy content. The recent contracts signed by Canadian utilities for U.S. export markets, notably by Hydro-Quebec, will change this share by only a small margin in the coming years as oil and gas exports will continue to dominate energy exports.

Despite Canada's sizeable energy production and exports, geographic constraints and variations in demand and costs have meant that a substantial share of Canada's energy needs are met through imports. Since the inversion of Enbridge's pipeline 9b between Sarnia and Montreal in 2015, oil production in the western provinces has supplied a large share of the demand in Ontario, Quebec and the Atlantic provinces, the rest coming from the United States (72% of imports in 2022), Saudi Arabia (17% of imports) and Nigeria (7% of imports) (CER 2023a). In 2021, imports from the United States contributed 20% of the crude oil, 20% of the natural gas, 28% of the coal and 4.5% of the refined petroleum products used in Canada (NRCan 2023).

Overall, energy imports remained stable between 2011 and 2021. After a dramatic 711% increase from 2001 to 2011, natural gas imports have since stabilized to constitute 33% of total imports. At 44% of the total, 2021 crude oil imports were also similar to 2011 levels, while refined petroleum products declined by 25% during this period. Although natural gas imports recovered to 2019 levels in 2021 after a drop in 2020, crude oil and refined petroleum products remained well below their 2019 levels in 2021, suggesting a slower recovery of energy consumption in transport.

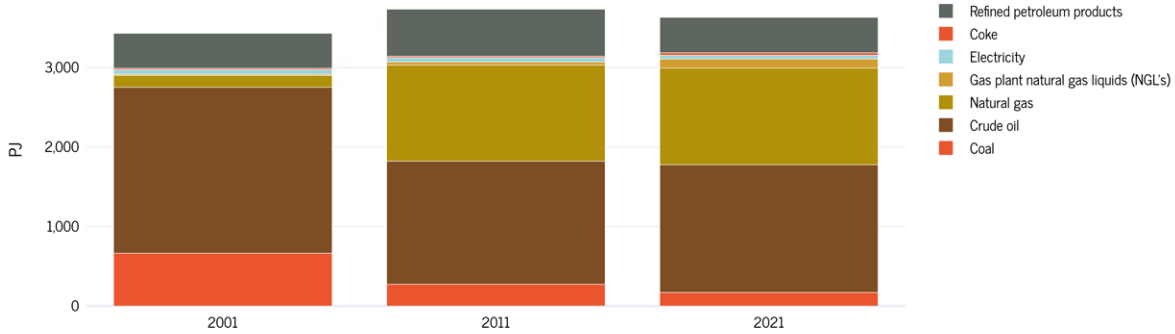
Finally, Table 2.4 provides trading numbers on biofuels. In spite of its land and agricultural sector and increasing clean-fuel requirements, Canada is largely dependent on the U.S. for 59% of its needs. While very little ethanol production is exported, geographical drivers for biodiesel demand have led to some exports since federal and provincial blending mandates are less demanding for this fuel.

Figure 2.5 – Energy exports



Source: Statistics Canada 2023a; IEA 2023

Figure 2.6 – Energy imports



Source: Statistics Canada 2023a

2.9 Variation across provinces

With 81.8% of the total, Alberta continues to dominate oil and gas production in Canada. Most of the other production comes from Saskatchewan (9.4%) and Newfoundland and Labrador (5.4%) in 2021 (Table 2.5). Similarly, Alberta provides 67.2% of the national total of natural gas production, with British Columbia coming a strong second at 30% (Table 2.6).

It is also worth noting that Alberta's crude oil production continued to grow in 2021. Since 2001, its production increased from 3,294PJ to 8,868PJ (169%), an evolution not seen in other producing provinces. Alberta's natural gas production has been more stable for the past several years, in contrast to British Columbia, which has doubled its output since 2001.

The impact of the onset of the pandemic was uneven across oil and gas producing provinces. On the one hand, the decline noted in some provinces (-5% from 2019 to 2020 in Alberta for oil and -4.2% for natural gas, for instance) reversed itself by the end of 2021, with oil in particular reaching even beyond 2019 levels. On the other hand, Saskatchewan, which saw deeper decreases in relative terms, declining 10% for oil and natural gas, has still not recovered at the end of 2021. Oil production in Newfoundland and Labrador and natural gas production in British Columbia were in no way affected, posting growth between 2019 and 2020.

In 2020, coal production was largely concentrated in British Columbia (53%), Alberta (31%) and Saskatchewan (16%), with a very small amount being produced in Nova Scotia (0.4%) (NRCan 2023). Data confidentiality issues prevent a more recent and detailed breakdown. Natural gas liquids are primarily produced in Alberta and Ontario.

Since electricity grids are largely managed and regulated at the provincial level, there are significant variations in the electricity mix from one province to the next (Figure 2.7). Hydroelectricity, the largest source of production nationally, with over 60% of the total, dominates in Quebec, British Columbia, Manitoba, Newfoundland and Labrador as well as the Yukon territory, but not in the other provinces and territories. Electricity production from natural gas and coal dominate in Saskatchewan, Alberta and Nova Scotia, with some capacity remaining in New Brunswick as well. Natural gas is also an important component in Ontario's mix, with 28% of installed capacity, despite providing only 9% of the electricity consumed in the province in 2022 (IESO 2023). Finally,

Table 2.5 – Crude oil production by province (PJ)

	2001	2006	2011	2016	2019	2020	2021	Share (2021)
AB	3,284	4,063	5,076	7,068	8,634	8,205	8,868	81.8%
SK	952	953	987	1,059	1,123	1,005	1,022	9.4%
NL	336	x	x	481	599	650	588	5.4%
BC	103	90	84	140	254	256	254	2.3%
Other	101	97	122	92	101	87	83	0.8%
Canada	4,777	5,905	6,890	8,878	10,735	10,222	10,838	100%

Source: Statistics Canada 2023a

Table 2.6 – Natural gas production by province (PJ)

	2001	2006	2011	2016	2019	2020	2021	Share (2021)
AB	5,594	5,491	4,191	4,773	4,737	4,538	4,657	67.2%
BC	1,008	1,159	1,511	1,556	1,848	1,912	2,079	30.0%
SK	314	363	236	208	198	175	159	2.3%
Other	281	192	144	100	40	35	32	0.5%
Canada	7,196	7,205	6,082	6,637	6,823	6,660	6,927	100%

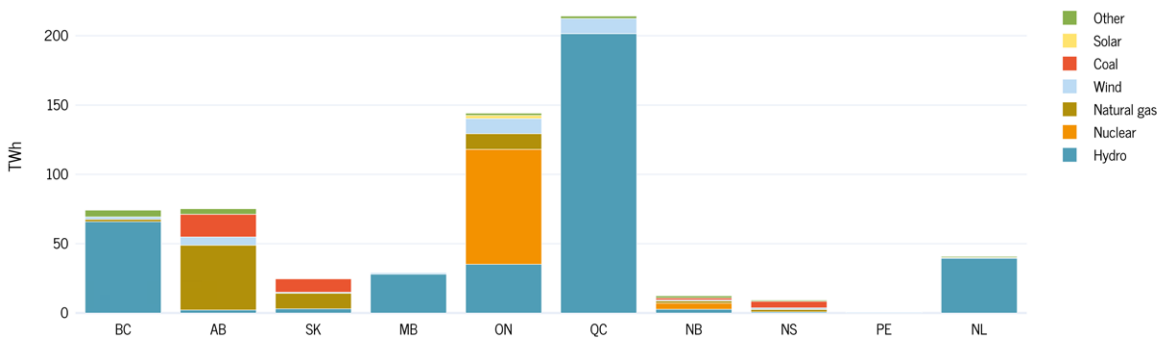
Source: Statistics Canada 2023a

nuclear constitutes 14% of the national production, although it is used only in Ontario and New Brunswick.

Table 2.7 presents electricity trade across the provinces and with the United States. Exports from Labrador to Quebec, which constitute the single largest interprovincial flow, are associated with the long-term contract at the Churchill Falls facility. Quebec also makes the next largest interprovincial deliveries, mainly to Ontario and New Brunswick. As well, Quebec and Ontario export a large quantity of their production to the U.S., while British Columbia (and, to a lesser extent, Alberta) also trade significant quantities with northwestern U.S. jurisdictions. Relative to their size, Newfoundland and Labrador and New Brunswick are also important net exporters to the U.S.

Some provinces' large share of non-emitting generation capacity makes exports attractive to neighbouring jurisdictions wishing to rapidly decarbonize their electricity sector. This is especially the case for Minnesota (importing from Manitoba) and the New England states and New York for the central and eastern provinces. One notable example is the Champlain Hudson Power Express line, which will provide low-emission power from Hydro-Quebec to New York City when it comes into operation in 2026. Several years ago, Hydro-Quebec and Massachusetts signed another export contract of a similar magnitude (the New England Clean Energy Connect). The latter initiative encountered considerable public opposition including a public referendum in Maine, which stopped the project only to be found unconstitutional by the Maine Supreme Judicial Court in 2023. The project is also set to begin operation in 2026.

Figure 2.7 – Provincial electricity generation by source (2021)



Source: Statistics Canada 2023b, 2023c

Table 2.7 – Electricity, interprovincial transfers and U.S. trade (2021)

	Imports from U.S. (TWh)	Interprov. Receipts (TWh)	Total receipts (TWh)	Exports to the U.S. (TWh)	Interprov. Deliveries (TWh)	Total deliveries (TWh)	Exports to U.S. ($1,000,000)
QC	6	33,846	33,852	24,284	13,275	37,559	955
NL	15	36	51	1,153	31,146	32,299	48
ON	522	9,120	9,642	15,628	2,923	18,551	609
BC	7,528	1,409	8,937	11,430	4,660	16,090	1,014
MB	3,073	8	3,081	5,442	1,327	6,769	492
NB	131	5,102	5,234	2,155	2,063	4,217	166
AB	1,584	4,867	6,451	121	1,496	1,617	15
SK	17	656	673	187	275	462	13
PE	0	1,270	1,270	0	312	312	0
NS	138	1,007	1,145	3	0	3	0
Canada	13,014	0	13,014	60,403	0	60,403	3,312

Source: Statistics Canada 2023d

2.10 Takeaways

The above portrait of Canada's energy production shows not only the magnitude of energy exports, but also how these exports have grown significantly over the past 20 years. This growth was largely triggered by the dramatic increase in crude oil production, which is overwhelmingly destined for export. Given that energy exports are made almost exclusively to the United States, **Canada's production levels and revenues are closely linked to the state of the market in that country and the demand in general south of the border**.

As we noted in the last edition of this Outlook, **the value of oil and gas exports dwarf that of other sources**. Although uranium exports constitute large quantities in terms of energy content, low prices on world markets have led to lower export revenues. Electricity exports are also of significantly less value than oil and gas exports, although this is partly due to relatively small volumes. Decarbonization efforts in bordering U.S. states have opened up opportunities for increased electricity exports in recent years. However obstacles to the building of additional production and transmission capacity have hampered the ability of Canadian utilities to take advantage of them.

Overall, Canada thus remains very dependent on oil and gas exports to protect its trade balance; in the short to medium terms, this cannot be compensated by accrued trade in other energy production.

In addition, **the dramatic growth in demand for electricity expected in the coming years raises questions about the true potential for additional exports**. Although this expected growth is now well documented, including in the second report of this Outlook, planning and transformations on the ground have not followed and continue to lag (Edom *et al.* 2022). As Figure 2.3 shows, electricity production has remained more or less stable over the past 20 years, illustrating how planning has not managed to anticipate the needs.

As noted in our past editions, significant gaps remain in data for bioenergy, making it difficult to assess its exact contribution to the total energy supply. The same holds true for final energy consumption in different sectors. While numbers for biofuels production are available, those for biomass use in industry in particular are scattered and complicate a thorough understanding of its role. As competition for access to this resource intensifies, given the variety of contributions it can make in decarbonization pathways, richer and readily available data is essential to provide a clearer picture.

Variations across provinces give rise to different production and trade profiles, largely based on geography and resource endowment. The upcoming Clean Electricity Regulations, which will affect provinces very unevenly, will have an important impact on planning the decarbonization of electricity production in provinces with large shares of thermal generation.

Impacts from events in Europe tied to the invasion of Ukraine raised revenue for oil and gas production facilities in Canada dramatically in 2022, as world prices rose, more than compensating for the pandemic-related decline in 2020. Data is not yet available to show the impact that the altered situation in Europe may have on LNG exports, as well as on hydrogen and ammonia from Canada, given renewed interest in supplying European markets.

Finally, **the pandemic's impact on energy production appears to have been very limited, even at the peak of the economic slowdown tied to confinement measures in 2020**. Data availability for 2022 and 2023 will provide a clearer picture of the overall effect of the pandemic, but it is clear that, so far, the period from 2020 to 2021 did not engender any major structural changes in production.

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3

Energy use across Canada

The world's eighth largest energy user, Canada consumes more energy per capita than any other OECD country except Iceland. While provincial consumption profiles show similarities in some areas, final energy consumption also varies substantially from one province to the next. These profiles are discussed below.

Highlights

- Canada has one of the world's highest per capita energy consumption levels, with large provincial variations partly due to structural differences in industrial sectors.
- Contrary to almost all other sectors, energy consumption in the transport sector has continued to increase over the past 20 years, even on a per capita basis.
- Variations in consumption profiles across the provinces are not limited to industry. In some cases, there are also important differences in freight transport and agriculture, as well as in space heating and transport choices.
- The COVID-19 pandemic had an important impact on consumption across sectors, particularly in transportation. A closer look at subsector variations and partial data available since its advent shows that most consumption levels began to recover in 2021, although the increase in passenger transport since 2020 has been slower.

3.1 Supply and consumption

Despite Canada's endowment in renewable energy resources, 72% of its primary energy supply was provided by oil and natural gas in 2021. With coal and gas plant natural gas liquids, fossil fuels add up to 82% of the overall supply. In order of importance, the rest comes from hydroelectricity, nuclear, biomass, wind, and other renewables (Figure 3.1).

Over the past 20 years, the share of coal has decreased, mainly owing to its elimination from Ontario's electricity generation and dramatic reductions in similar activities in Alberta. In the total energy supply, coal's retreat has largely been compensated by increased use of natural gas, often directly resulting from coal's decline.

Renewables outside of hydroelectricity, in particular wind and biofuels,[1] ave played an increasing but still marginal role in the total supply. These changes were accompanied by an overall 20% increase in the total energy supply between 2000 and 2020, with fossil fuels retaining their share of the total.

The onset of the COVID-19 pandemic in 2020, along with public health restrictions continuing into 2021, had several impacts on energy consumption. In the sections below, we pay particular attention to these years in an attempt to assess these changes and to determine whether they seem to be lasting, based on the data available so far.

A primer on energy concepts: primary, secondary and final energy

Understanding energy supply and consumption statistics is no easy task given the variety of ways the data can be presented. This document applies the typical distinctions made between primary, secondary and final energy used by Statistics Canada and other Canadian energy-related agencies. The following three paragraphs define the main elements for understanding each of these concepts.

Primary energy is the energy available before it is transformed to be used or transported. For instance, coal, crude oil and uranium are primary energy forms. Traditionally, electricity produced directly from renewable sources, such as hydro power, wind and solar, is also considered primary energy. The same is true for electricity produced from nuclear fission.

Secondary energy refers to the primary energy that has been transformed into an energy form that can be transported to end-users. For instance, when natural gas is burned in a powerplant to produce electricity, this electricity is referred to as secondary energy. Other examples include refined petroleum products (such as gasoline and diesel), heat and hydrogen.

Final energy is secondary energy used by consumers to obtain energy services. For example, when gasoline is burned in a car engine, transforming its energy content into movement and heat, or when heat is released by coal in an industrial furnace to produce steel, they both constitute final energy consumption. This consumption is typically differentiated by economic sector (transport and industry, as in the previous examples, as well as buildings and agriculture).

These distinctions serve many purposes, one of which is the ability to quantify the energy losses at different stages in the energy system. Any energy conversion results in losses, some much larger than others. Some of these losses occur during the transformation of primary energy into secondary energy, while others take place later in the chain when the energy is further transformed into a final service. Finally, all the final energy consumed is not useful energy, as the use results in losses as well, when part of the final energy is lost instead of contributing to the service provided. If additional transformations are necessary along a given chain to obtain the service provided, further losses occur. For instance, coal can be burned in a powerplant to produce electricity; the electricity can be used to produce hydrogen; the hydrogen can be (re)converted to electricity in a vehicle powered by a fuel cell engine; and the resulting electricity serves to bring motion by the engine to move the vehicle. Each of these stages results in losses from the original energy content of the coal used.

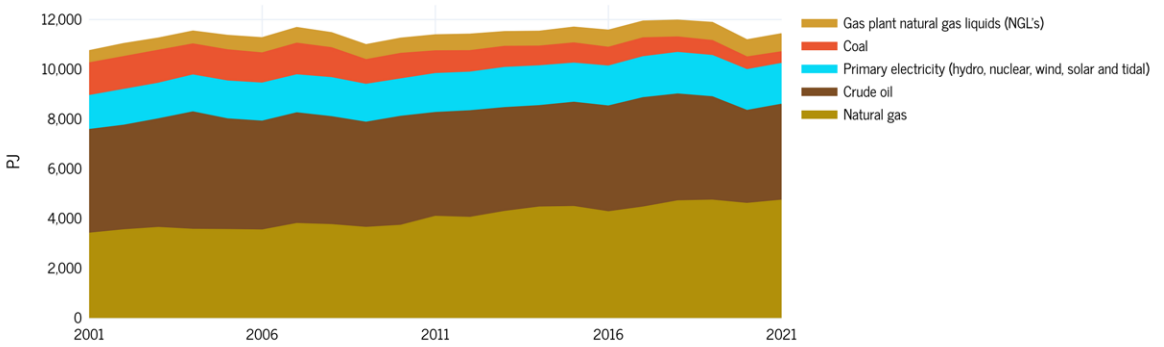
Some two-thirds of the total energy supply in Canada is lost in various ways in order to obtain the energy services needed for transport, industrial production, and powering and heating buildings (CESAR 2014).

[1] Due to data availability issues, Figure 3 1 does not display biomass supply. Solid biomass (mainly wood products) supply was 500 PJ in 2020, while biofuels (ethanol and biodiesel) added another 48 PJ. Solid biomass production has remained fairly constant over the past 20 years, in contrast to the production of biofuels, which has steadily increased (NRCAN 2023).

As for the destination of this supply, Canadian transportation and industrial sectors each make up about one-third of the country's total final energy demand, with the building sector (residential, commercial and institutional) constituting most of the rest. The importance of energy production, primarily oil and gas, and refining is illustrated by the fact that 21.9% of the total net supply is used in producer consumption (where the energy producing industry uses the fuel it produces) and non-energy use (e.g., feedstocks used by the petrochemical industry). Given the high carbon intensity of their activities, energy producers' consumption plays a key role in discussions on GHG emission reductions (see Chapter 5).

This section uses both a 20- and a 10-year horizon to analyze long-term and shorter-term variations. Due to data availability, some charts and tables indicate 2020 as the year with most recent data, while the others indicate 2021.

Figure 3.1 – Domestic total energy supply, 2001-2021



Source: Statistics Canada 2023a

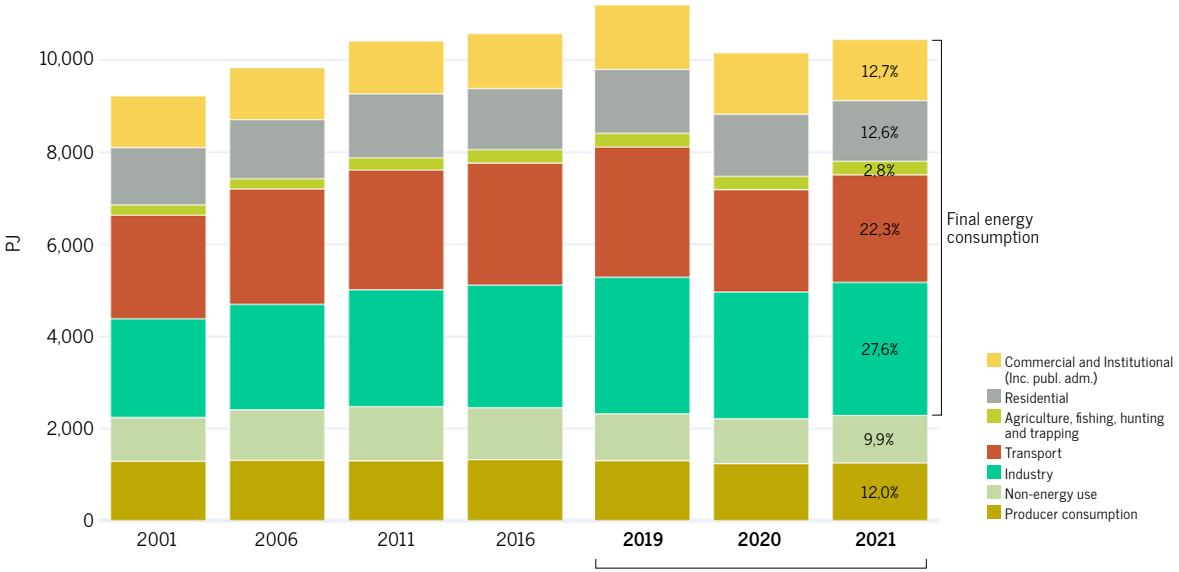
3.1.1 Industry

Seventy-eight point one percent of the energy supply is directed to support energy services (final energy). The rest is used by energy producers to transform a portion of it into desired forms suitable for consumption across sectors (12.0% of the total) or to transform it into non-energy products like asphalt, plastics and lubricants, essentially by the petrochemical industry (9.9% of the total) (Figure 3.2).

Industrial sector consumption is often described in terms of its share of final energy consumption (35.4%) compared with other sectors. However, this description understates the actual consumption, since it does not take the consumption used to power the transformation of energy sources into final energy and for non-energy products into account – two categories of consumption also relevant to industry. The total share of industry consumption from the energy supply is 49.5%, with transportation (22.3%), buildings (25.3%), and agriculture (2.8%) using the rest. Figure 3.3 shows variations across industry sub-sector.

Overall, final energy consumption in industry increased by 11.1% between 2001 and 2021. Similarly to other sectors, energy use in industry decreased from 2019 to 2020, but this decline was reversed by 2021. However, this rate of evolution over time varies across sub-sectors. Driven by oil and gas extraction, the mining, quarrying and oil and gas extraction sectors became the largest industrial consumers, increasing their consumption by 184.5% since 2000 (Figure 3.3).

Figure 3.2 – Net supply of energy (primary and secondary) by sector



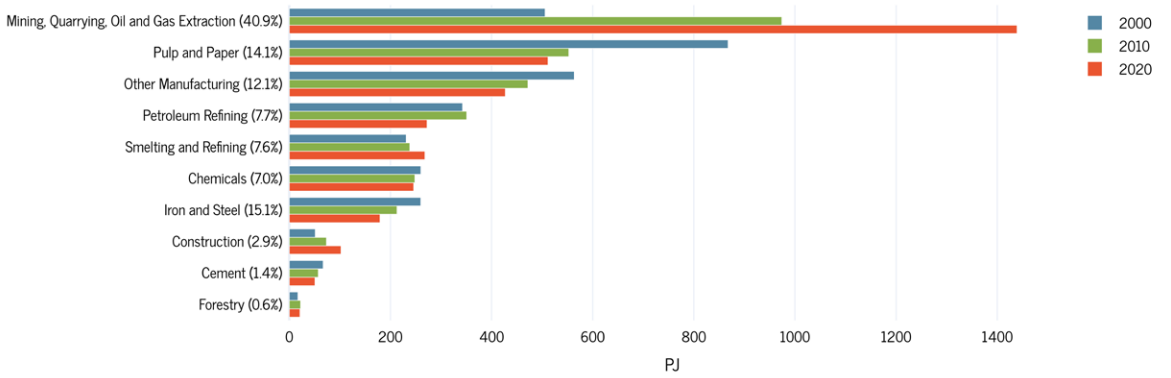
Source: Statistics Canada 2023a

Note: Due to statistical differences, sums may be different from totals

In contrast, from 2000 to 2020, decreases were noted in the pulp and paper (-41.0%), other manufacturing (-24.2%), petroleum refining (-20.5%), iron and steel (-31.0%), and cement (-24.4%) industries. A combination of closures, efficiency improvements and the pandemic-related reduction in activity from 2019 to 2020 explain this decrease, although it should be noted that each of these sub-sectors also posted a decrease over the 2000-2019 period.

Special attention to the 2019-2020 period should be paid to more closely examine these 20-year changes. Forestry and construction, for instance, saw decreases in energy consumption of 15.4% and 11.2% respectively over that period, despite a strong and continuous increase in each sector over the past 20 years, suggesting that the drop observed in 2019-2020 was due to a temporary slowdown associated with public health restrictions. Cement (-17.9%), iron and steel (-20.0%) and petroleum refining (-9.6%) are the other sectors showing the largest decrease in energy use between 2019 and 2020. In these cases, the substantial decline seems to have accelerated a 20-year trend. Since data is not yet available on a subsector breakdown for 2021 and 2022, the snapshot of the pandemic effect is limited to 2020.

Figure 3.3 – Industrial energy use by industry (2000, 2010 and 2020)



Source: OEE 2023

Note: Percentages shown in the vertical axis represent the share of total energy use in the sector (total is not 100% due to rounding)

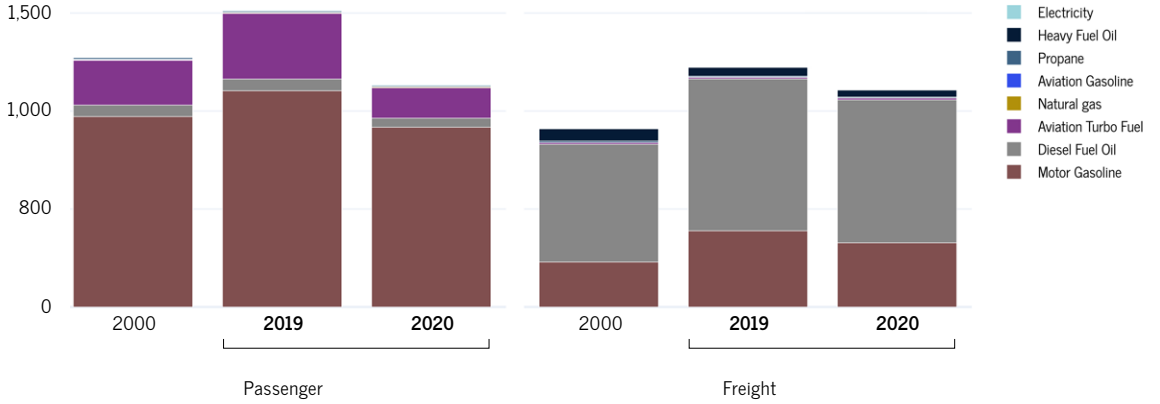
3.1.2 Transport

Transport was the sector where energy consumption was most affected by the 2020 slowdown triggered by the COVID-19 pandemic, posting a 17.3% decrease in energy consumption between 2019 and 2020. Passenger transport was the most influenced (-25.1%), largely owing to the halving of energy consumption for air transport as well as a reduction in road transport. Although freight was less impacted, it nevertheless decreased its energy use by 9.5% that same year. Preliminary data shows a rebound in 2021 for freight, while passenger transport is slower to recover. Partial data for 2022 however suggests that that energy consumption for this sector is again on the rise.

Gasoline and diesel dominate consumption in the sector, although there are important differences between passenger and freight transport (Figure 3.4). Diesel is the main fuel for freight transport, providing 65.8% of energy needs, while it only contributes 4.1% of the energy consumption of passenger transport, where gasoline is the dominant energy source (73%). Aviation turbo fuel also accounts for a sizeable share of passenger transport fuel use (22%), while it is almost negligible in moving freight (1%).[2]

The drive to increase the share of zero-emission vehicles, which in practice has meant electric vehicles so far (whether they are fully electric or plug-in hybrids), has begun changing this mix but almost solely for passenger transport. 123,000 electric vehicles were sold only in 2022, a little above 8% of new vehicle registration. Partial numbers from 2023 suggest that this upward trend is continuing. Importantly, 92.5% of these vehicles were sold in Quebec, Ontario and British Columbia, underlining unequal conditions across the province both in terms of purchase incentives (see Chapter 6) as well as charging infrastructure deployment (Statistics Canada 2023b).

Figure 3.4 – Energy use in transportation, by source (2020)



Source: OEE 2023

Note: Ethanol and biodiesel data were not available and are therefore excluded from totals.

[2] For this description, we use 2019 data for the fuel share breakdown since data for 2020 are affected by the pandemic.

Demand changes underpin the evolution of energy consumption for passenger and freight transport (Table 3.1). Before the onset of the pandemic, 2019 energy demand numbers were 43% higher than in 2000 for passenger transport (in passenger-km), while 2020 numbers wiped out this 20-year change. While demand for freight transport was up 33% in 2019 with respect to 2000, the 2020 decline brought this back to a 26% increase over 2000 levels, as commercial transport was significantly less affected than passenger transport.

Aviation, which is overwhelmingly used for passenger transport, saw its fuel consumption fall by 53.6% between 2019 and 2020 due to lockdowns and air travel restrictions. The decline in demand for air transport explains 63% of the reduction in demand for passenger transport between 2019 and 2020, highlighting a more modest reduction in passenger road transport (-14.8% between 2019 and 2020).

The pandemic effect notwithstanding, the trends since 2000 continue to show how efficiency improvements in passenger transport are offset by increasing numbers of kilometres travelled by individuals, preferences for larger and heavier vehicles, and quantities of goods moved by freight.

Table 3.1 – Demand for transportation services

	2000	2010	2019	2020
Passenger (in millions of passenger-km)	**610,330**	**725,323**	**873,512**	**605,492**
Rail	1,549	1,404	1,729	235
Road	503,900	587,633	638,566	543,218
Air	104,882	136,286	233,217	62,039
Freight (in millions of tonne-km)	**775,466**	**851,246**	**1,031,667**	**974,404**
Air	2,327	2,085	3,257	2,465
Road	240,128	292,997	368,704	341,829
Rail	322,511	341,325	451,277	420,233
Marine	210,499	214,839	208,429	209,877

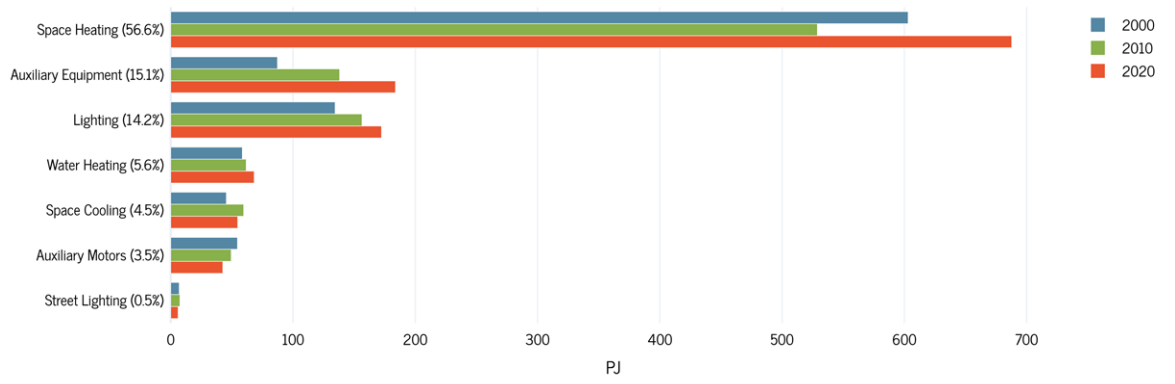
Source: OEE 2023

3.1.3 Buildings

The building sector encompasses residential as well as commercial and institutional (C&I) consumption. In the C&I sector, almost all the energy used is either natural gas (52.6%), which provides over 82% of heating needs, or electricity (42.8%), which powers most of the rest of the energy needs. Total energy use was more or less stable over the 2000-2010 period. However, these numbers began to climb during most of the 2010-2020 period. Overall, demand in the sector is driven by space heating (56.6%) and cooling (4.5%), as well as by auxiliary equipment (15.1%), lighting (14.2%), water heating 5.6% and auxiliary motors (3.5%). Auxiliary equipment like electronic equipment continues to be the fastest increasing demand, rising by 110% between 2000 and 2020.

It is worth noting that in the commercial and institutional sector, the reduction in energy consumption between 2019 and 2020 was limited to space heating and auxiliary equipment. This decline was very modest however as consumption in 2020 even for these sources of demand was similar to (in the case of auxiliary equipment) and higher than (for space heating) in 2018, suggesting that the confinement and working-from-home changes starting in the spring of that year had virtually no effect.

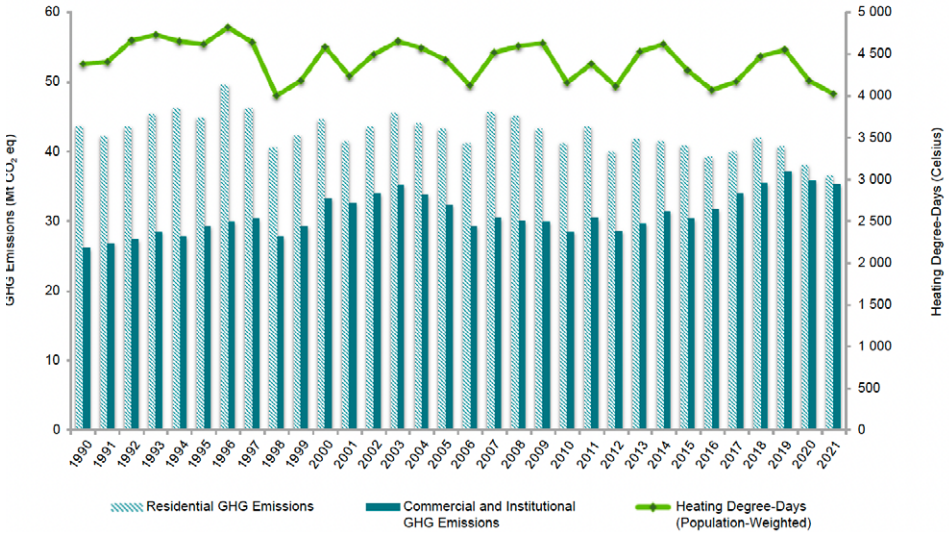
Figure 3.5 – Commercial and institutional energy use by end-use (2000, 2010 and 2020)



Source: OEE 2023

Note: Percentages shown in the vertical axis represent the share of total energy use in the sector (total is not 100% due to rounding)

Figure 3.6 – Heating degree-days and GHG emissions from buildings in Canada



Source: ECCC 2023

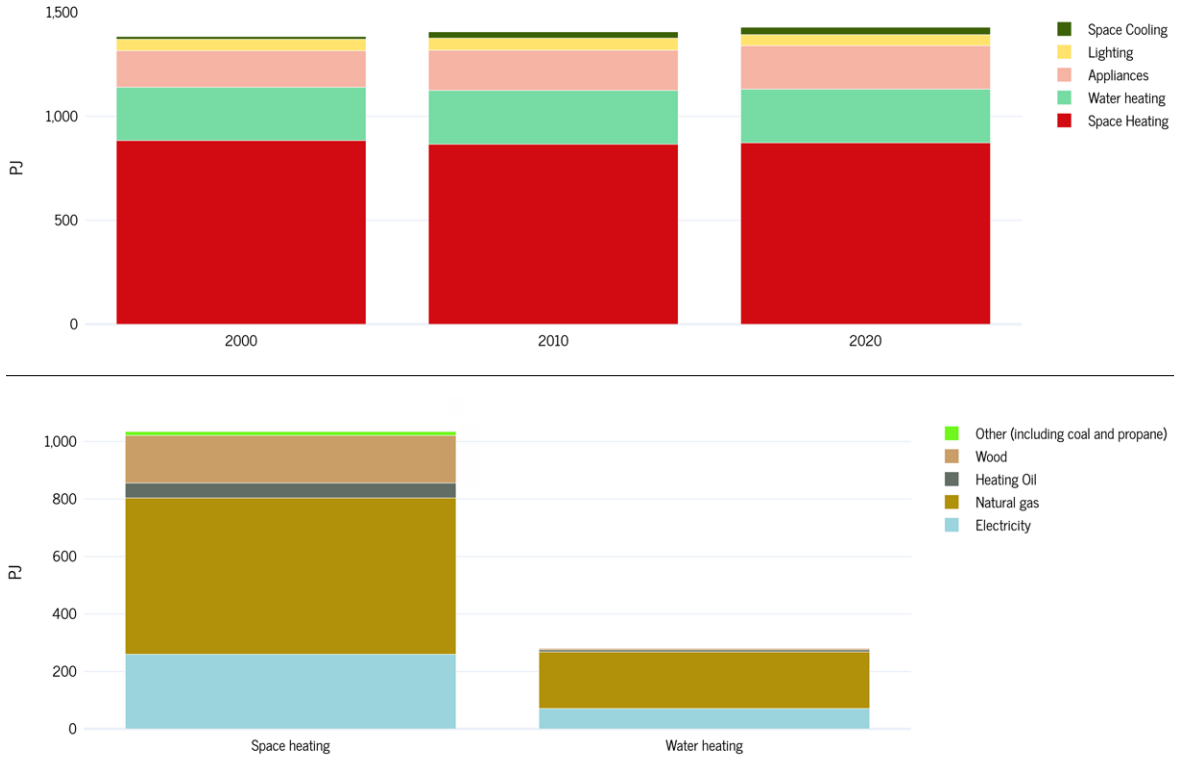
Residential energy use presents a different profile. Space heating takes up an even larger share of total energy consumption (61.1%) than it does in commercial buildings, with water heating (18.1%), appliances (14.6%), lighting (3.7%) and space cooling (2.5%) accounting for the rest. These shares have largely remained stable over the past 20 years, with the exception of space cooling, which doubled in relative importance.

Similarly to that in commercial and institutional buildings, energy consumption in residential buildings does not seem to have been impacted by pandemic-related factors. Most of the variations noted between 2019 and 2020 can be explained by a decline in heating degree days, as was the case for other years (Figure 3.6). However, it is interesting to note that no increase in consumption was recorded in 2020, given that a large part of the population was spending more time at home because of public health restrictions.

Energy sources for the sector evolved more significantly however. Electricity, which constituted 35.9% of energy consumption in 2000, grew to 44.5% in 2020, mainly taking away shares from heating oil. Overall consumption only modestly increased since 2000, despite growth in floor space, reflecting improvements in energy efficiency for space heating in particular.

Figure 3.7also shows that nationally, natural gas is the main source of energy for the two main end-uses (space and water heating), with electricity in second place despite its growth in importance over the past few years. While heating oil also remains an important fuel for space heating (4.9%), its consumption declined in comparison to 20 years ago, when it constituted 13.3% of the total. In contrast, wood has provided an almost constant share of space heating (9.0% compared with 10.2% in 2000). Over the 2000-2020 period, natural gas-fired systems posted the fastest growth in heating systems, now providing heat to 46% of all residential dwellings across the country. Although electric heat pumps have doubled in number since 2000, they still make up only 13% of electric systems and 5% of all heating systems.

Figure 3.7 – Residential energy use by end-use (2000, 2010 and 2020)



Sources of energy for space and water heating (2020)

Source: OEE 2023

Note: Total is not 100% due to rounding

3.1.4 Agriculture

Agriculture production makes up the smallest share of the total final demand. Energy use in the sector comes from both motive energy use like tractors (67.9% of the total) and non-motive energy use like dryers (32.1%). Overall, the sector consumes mainly diesel (51.7%), gasoline (16.1%), natural gas (14.8%) and electricity (13.1%). However, the energy mix varies across these two categories of needs for motive vs. non-motive usage, with some fuels being particularly important for needs that make up a small share of the total but being difficult to replace (for instance, propane used to dry crops for storage).

Energy use in the sector fell by 3.6% from 2019 to 2020, largely due to less use of diesel. However, the role played by the pandemic is unclear since this decrease is similar to the decline in energy use between 2018 and 2019. As a result, part of the 2020 reduction is likely to be due to trends independent of the economic slowdown or public health restrictions.

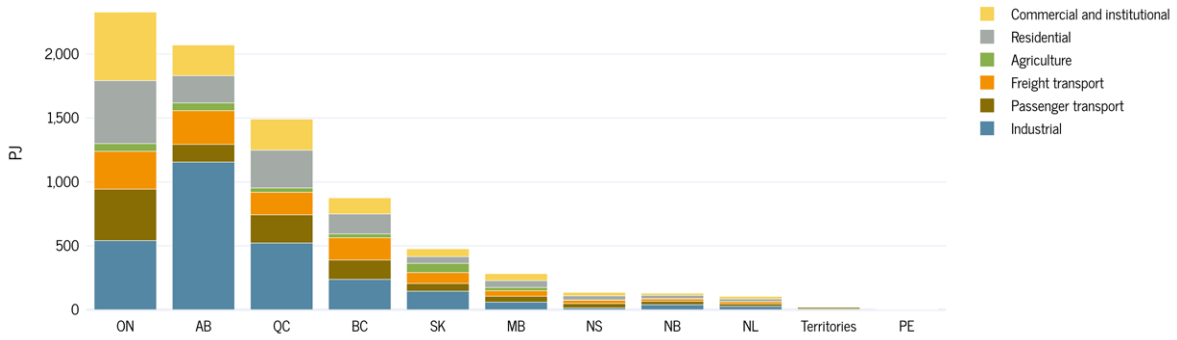
3.2 Variation across provinces

Economic sectors' contribution to energy use varies across provinces (Figure 3.8). Industry composition, for instance, puts Alberta in second place (after Ontario) in terms of total final energy use, despite Alberta's much smaller population than that of third-place Quebec. Similarly, Saskatchewan's energy use is more than half British Columbia's, even though its population is less than 25% of B.C.'s.

Two further observations can be made. First, the final energy consumption data also does not give the complete picture of these interprovincial variations in industry's contribution because producers' consumption of their own fuels is excluded from the total. For instance, when considering full energy use including both producer consumption and final energy consumption, Alberta's total exceeds that of Ontario. Data availability prevents the full inclusion of this producer consumption in Figure 3.8 and Figure 3.9.

Second, it is worth noting that variations in the industry's consumption profile explain only some provincial differences. As Figure 3.8 shows as well, consumption in sectors other than energy production is still very high in Alberta (for transport) and Saskatchewan (for agriculture). A similar assessment can be made for buildings in Alberta, which use almost as much energy as those in Quebec, despite a much smaller population. These latter differences cannot be linked to industry profiles

Figure 3.8 – Total final energy consumption, by province and sector (2020)



Source: Statistics Canada 2023a

and further distinctions (notably in heating fuel profiles, demand drivers for freight transport, and types of agricultural production) must not be ignored in attempts to understand provincial differences.

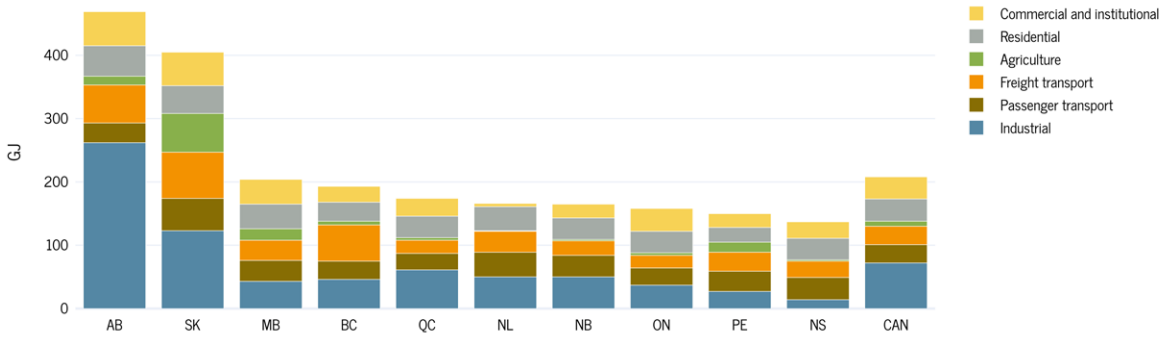
The corollary to total consumption numbers is that some provinces present per capita energy profiles well above the national average (Figure 3.9). Here again, Alberta and Saskatchewan stand out because of their oil and gas production activities (even without including producer consumption). Their non-industry final energy consumption per capita is also higher than in other parts of the country, as is the case for Manitoba and British Columbia as well. Other variations in energy use for buildings and transport in particular are important.

The energy mix is also quite different across provinces. Here the sources of the differences are numerous, ranging from the importance of thermal electricity generation to the contribution of natural gas to electricity in space heating. Statistics Canada does not present a fully detailed display of these provincial mixes by source because of confidentiality issues, but since they have a strong correlation with the greenhouse gas emission profile of each province, they are discussed further in Chapter 5.

Accordingly, these per capita consumption profiles show that variations across the provinces transcend the presence of certain industries. variations in the consumption of other sectors, notably agriculture and freight transport, is also significant. Moreover, the energy mix providing various energy services across the sectors also underpins substantial variations.

Intrinsically, no value judgment is associated with these observations. As explained previously, energy use is strongly dependent on industrial basis, energy availability and social preferences. However, as Canada embarks on a major energy transition toward a net-zero society, it is clear that the level and type of energy consumption mean that this transition will have to be very different across the country.

Figure 3.9 – Total per capita final energy consumption, by province and sector (2020)



Source: Statistics Canada 2023a, 2023c

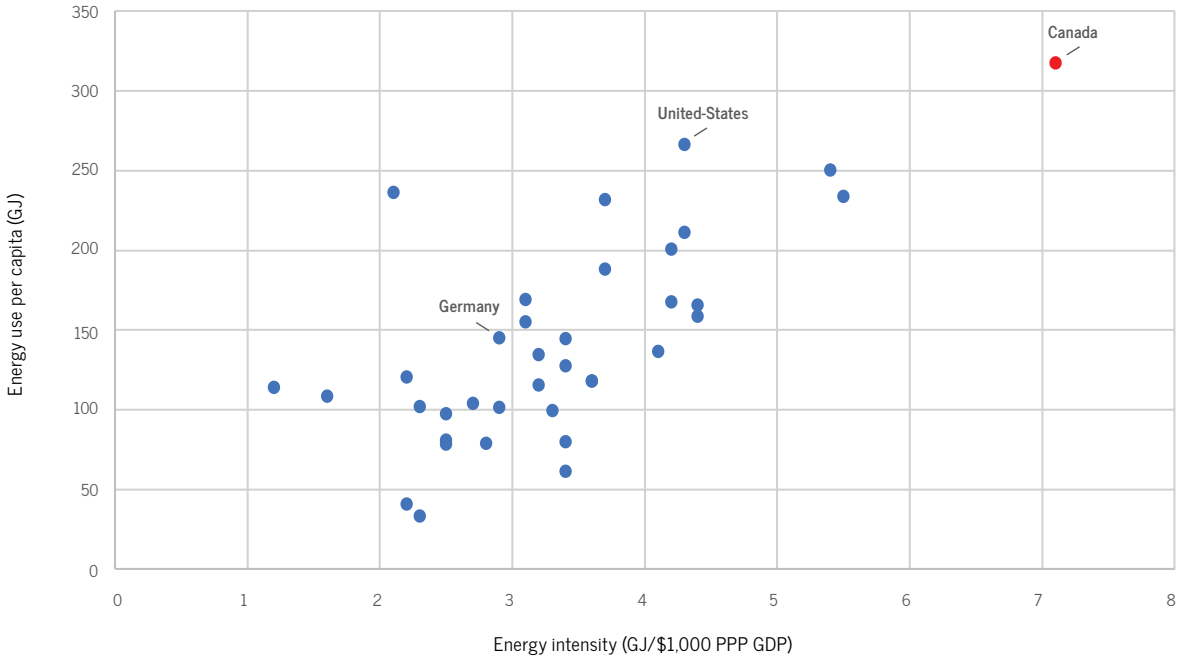
3.3 Energy productivity

With the exception of Iceland, Canada surpasses all the other OECD countries in per capita energy use, with per capita consumption almost twice the OECD average. While part of this consumption can be explained by the industrial and transportation sectors' profiles and the country's climate, energy intensity in Canada is also higher than in all other OECD countries, except for Iceland here again (Figure 3.10).

Decreasing energy intensity implies that a smaller quantity of energy is needed to provide the same service or produce the same goods. Indeed from 2000 to 2021, Canada's overall energy intensity fell by 20%, but Figure 3.10 shows, this was far from enough to catch up to other economies at the same level of development.

While Canada occupies an outlier position in terms of energy consumption and intensity, it is important to unpack these indicators to understand the sources of this inefficiency. For instance, as concerns the industry sector, many energy-intensive industries, producing commodities with little secondary and tertiary transformation (aluminium smelters, pulp and paper mills, oil and gas extraction and transformation), result in a higher energy intensity for the economy overall. Over the last two decades, the rapid growth of the energy-intensive oil and gas sector provides an additional explanation for the variation in energy use in primary energy production across the provinces, with oil-producing provinces being well above the country's average. The largest oil-producing provinces, Alberta and Saskatchewan, post energy use levels per capita that are more than twice the Canadian average.

Figure 3.10 – OECD members energy use and intensity (2021)



Source: IEA 2023

Note: Iceland, at 666 TJ energy use per capita and 13 TJ per $GDP, is omitted from this plot, to facilitate reading.

[3] In Iceland, the expansion of energy-intensive industries like aluminum and the c ountry's very small population explain its outlier energy use profile.

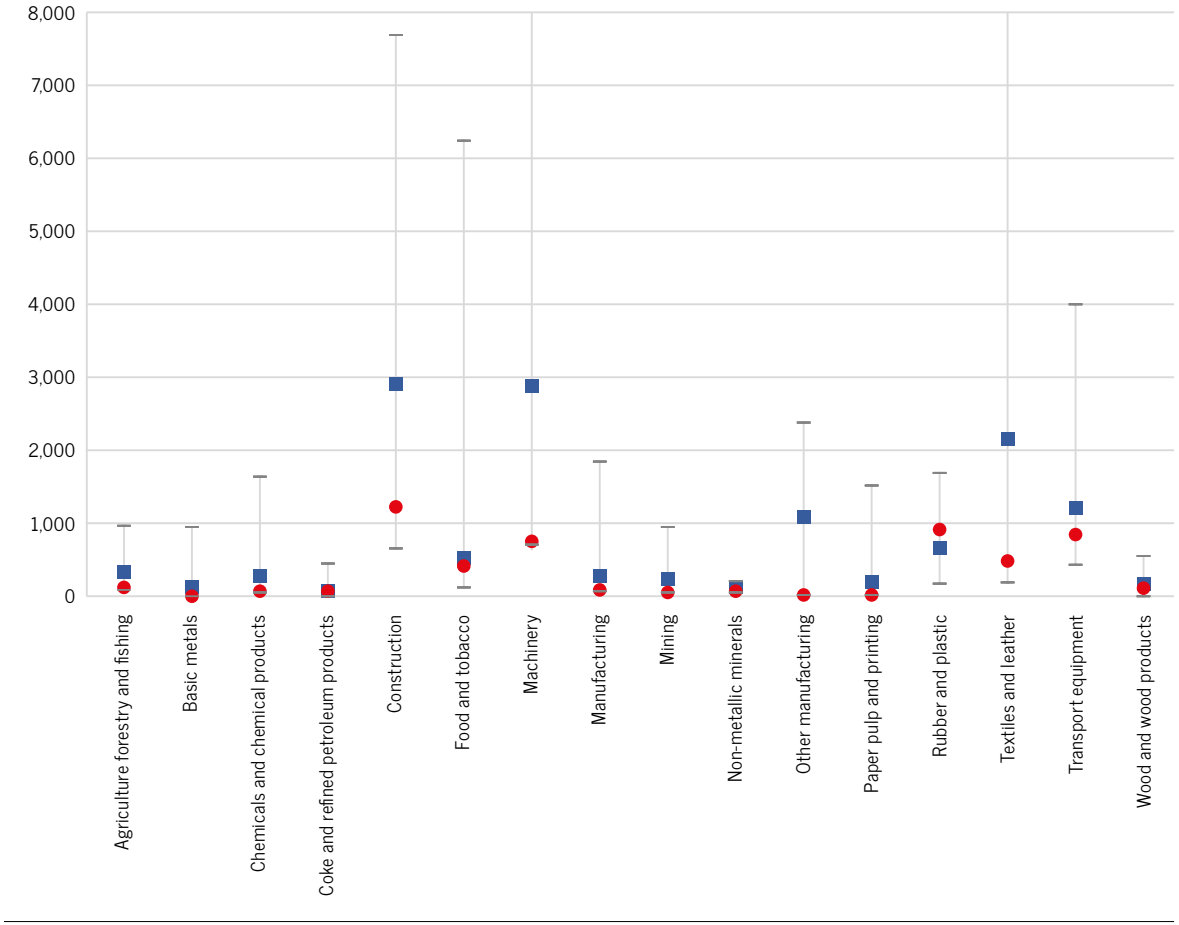
However, this should not obfuscate the poor performance of almost all industrial subsectors compared to their counterparts elsewhere (Figure 3.11). Compared to its OECD peers, all of Canada's industrial subsectors except rubber and plastic perform far more poorly than the OECD average in terms of the productivity of their energy use (the added value created per unit of energy consumed). In a majority of subsectors, Canada even comes in a clear last, reflecting how the industrial sector's inefficient use of energy across Canada, with limited production of high-valued transformed goods, is a key driver behind the poor energy productivity of the economy as a whole.

The commercial sector fares no better: Canada's performance is the worst of the OECD countries in terms of value added per energy use in the services sector, at almost double that of the United States and 10 times that of the United Kingdom (IEA 2023). This consumption has been partly driven by a rapid increase in floor space over the past two decades.

The residential sector's energy intensity is less clear cut. A look at the energy use per square metre of floor space shows that when taking heating needs into account, which vary irrespective of a country's consumption preferences and drivers, Canada's residential buildings perform close to the OECD average.

However, a further look at the residential sector reveals a few conflicting trends. On the one hand, the energy use per unit of floor space declined by 24% between 2000 and 2019; on the other, floor space increased by 46% between 2000 and 2020, well beyond population growth (24%). All building types have seen a significant increase in average floor space, with a rise of 39% for single detached homes, 72% for single attached homes, and 56% for apartments. These figures suggest that new constructions are very significantly larger per unit, irrespective of the evolution of the distribution of building types. In other words, such large increases in the average floor space of building types between 2000 and 2020 are driven by new constructions with much larger floor areas per unit and more than cancel out efficiency gains per unit of floor space.

Figure 3.11 – Energy productivity by industrial subsector in Canada among OECD countries (2020)



Source: IEA 2023

3.4 Takeaways

Sectoral energy consumption profiles are quite different in both their energy mix and their evolution over the past 20 years. All sectors have increased their energy use, particularly freight transport and industry. In the case of the latter however **reductions of consumption in almost all industrial subsectors were compensated by an almost tripling of oil and gas extraction's energy use over the past 20 years**.

In other sectors, changes in consumer and provider preferences have outpaced efficiency improvements. For instance, while vehicles used for passenger transport are more efficient than they were 20 years ago, the expansion of the vehicle fleet and preferences for higher consumption vehicles have more than compensated efficiency improvements. Similarly, the commercial sector's rapidly expanding floor space was not matched by efficiency improvements. As a result, **energy demand rose despite increases in energy efficiency in all sectors, with population growth explaining only a small share of this increase**.

Data for 2020 and 2021 show the impact of the COVID19 pandemic on final energy demand, with the 10.5% decline from 2019 only partly erased from 2020 to 2021. Consumption breakdown is only available for 2020, but it suggests that this impact was nonetheless limited to specific demand areas. Industry consumption decreased by 7.3% in 2020, before returning to almost 2019 levels by 2021. Residential buildings required slightly less energy and, more interestingly, the slight decrease in consumption in commercial and institutional buildings can almost entirely be explained by milder winters in 2020 and 2021, as compared to 2019. The main impact was noted in transportation, with a 17.3% decrease in energy use in 2020, largely driven by less passenger movement. Even here however a cautious look shows that almost two-thirds of the decrease in passenger movement was due to less air travel. Although detailed breakdown data after 2020 will be necessary to document any lasting impact on consumption, **partial data shows a very limited change due to the pandemic, particularly outside of passenger transport**.

Canada continues to underperform in terms of energy productivity compared to its OECD peers around the world. While climate and geography contribute to this performance, a closer look at sectors reveals clearly insufficient progress on energy efficiency and productivity, as well as exacerbating trends in consumer preferences. As also pointed out in the previous edition of this Outlook, these factors suggest not only that **specific attention must be focused on industry and transportation, but also that choices in other sectors should be targeted to reduce consumption and reverse trends, all while more aggressively pushing for greater energy productivity**.

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4

Energy and the economy in Canada

As Chapters 2 and 3 indicate, the structure of energy systems and energy consumption profiles across sectors differ significantly from one province to another in Canada. The political economy resulting from these variations shapes the energy sector's contribution to the economy as a whole and the regional constituencies it creates. This situation presents the country with a series of challenges it has to face in its effort to encourage and orient a low-carbon transition.

Highlights

- Although oil and gas constitute the energy sector's largest contribution to Canada's GDP, they contribute far less in terms of employment because of the high value of exports.
- Export revenues are subject to variations, largely due to the energy sector's vulnerability to changing market conditions in the United States.
- Investment in the renewables sector has a greater impact on job creation despite making a smaller contribution to GDP.
- Vulnerability to energy prices is uneven across the Canadian population because lower-income constituencies spend a larger share of their income on essential energy services and these constituencies represent a greater share of the population in some regions.
- Energy communities for which energy production or transformation represents a significant portion of their economic activity will be particular exposed, positively or negatively, in the coming transition in this sector, which is led by net-zero goals. It will be essential to accompany the segments of the population that suffer most from theses measures.

4.1 GDP, exports and employment

The energy sector employs 696,100 people (3.5% of the total Canadian workforce), contributing 11.8% to the country's GDP.[1] This is largely achieved through energy sector exports, which totaled $240.5 billion in 2022. Overall, 78% of crude oil, 46% of natural gas, 80% of uranium and 10% of electricity produced in Canada is exported (NRCan 2023; Statistics Canada 2023a). Although this production is delivered to a total of 133 countries, 90% of Canada's energy exports were destined for the United States. Imports were considerably smaller, at $65.3 billion (NRCan 2023).

Oil and gas (including refined petroleum products) contribute the largest share of Canada's energy exports in terms of value, pegged at $217 billion in 2022. In fact, 96% percent of these exports are shipped to the United States. Although these exports are much less significant when considering the U.S.'s total consumption, they remain important since they amount to 60% of its crude oil imports, 99% of its natural gas imports, and 27% of its petroleum products imports. Canadian uranium exports also supply 27% of U.S. reactors' purchases. This trade relationship is also significant in the other direction; in value, 76% of Canada's total energy imports come from the U.S. (20% of the crude oil and 20% of the natural gas used in Canada) (NRCan 2023). Overall, Canada's strong dependence on this single export market makes it vulnerable to the evolution of the demand and the price of its energy exports to the U. S.

Table 4.1 – Energy facts (2022)

Direct contribution to GDP	$245 billion (9.4%)
Indirect contribution to GDP	$64 billion (2.4%)
Total contribution to GDP	$309 billion (11.8%)
Direct jobs	290,300
Indirect jobs	405,800
Total jobs	696,100 (3.5% of total)
Exports	$240.5 billion (33% of goods exports)
Imports	$65.3 billion (9% of goods imports)

Source : NRCan 2023

[1] A change in the methodology NRCan used to calculate indirect jobs linked to the energy sector prevents direct comparisons with previous numbers, such as those made in our previous edition.

At 11.8% of the country's GDP, the energy sector's contribution to the economy is not matched by a similar contribution to employment. In fact, only 3.5% of Canadian jobs are directly or indirectly linked to the energy sector. Direct energy sector jobs are even more marginal; only 1.5% of jobs across the country are directly related to this sector.

In 2022, capital expenditures in the energy sector reached $80 billion, with most of this amount being allocated to oil and gas extraction ($31.9 billion) and electric power generation and distribution ($27.6 billion). While this figure constituted a rebound after the lowest figure in a decade was reached in 2020 ($59 billion), 2022 expenditures are around 32% lower than a peak in 2014 (NRCan 2023).

Table 4.2 – Direct jobs and contributions to GDP from the energy sector

Jurisdiction	Direct jobs (2022)[a]	Direct contributions of energy to GDP ($ million, 2022)
Canada	290,300	245,086
Alberta	153,187	134,754
British Columbia	22,985	26,667
Manitoba	6,203	5,684
New Brunswick	4,450	2,370
Newfoundland and Labrador	5,856	10,709
Nova Scotia	2,545	1,008
Ontario	46,963	24,394
Prince Edward Island	271	84
Quebec	29,226	19,529
Saskatchewan	18,057	19,448
Northwest Territories	266	311
Nunavut	163	63
Yukon	152	65

Source: NRCan 2023

a: Provincial and territorial figures do not precisely add up to the national total due to differences in data methodology.

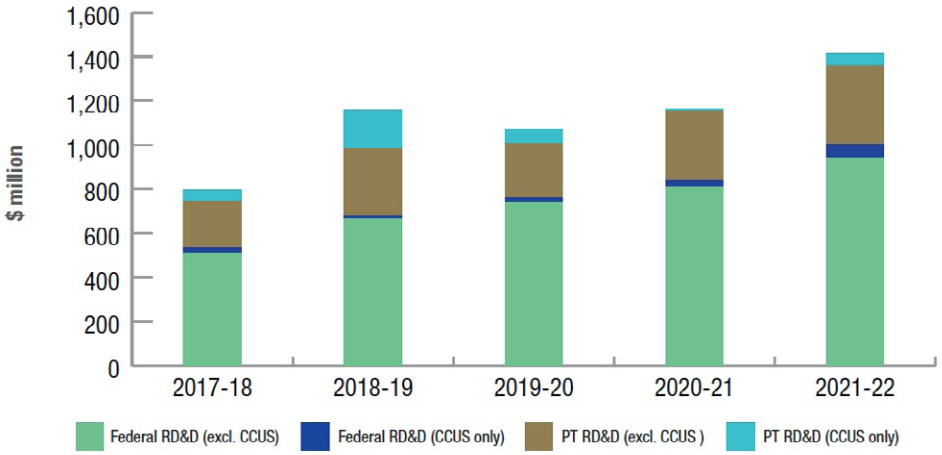
4.2 Research, development and demonstration (RD&D)

Federal RD&D spending on the energy sector increased continuously between 2016 and 2021, and more sharply in 2022. Most of these amounts went to renewable and nuclear energy, as well as energy end-use. Reaching $1,001 million in 2021-2022, this increase shows that Canada exceeded its target to double its spending to $775 million through the Mission Innovation initiative, a global initiative aimed at accelerating global clean energy innovation (Canada 2020).

However, from 2016 to 2021, contributions from the provinces and from industry did not follow and the federal effort constituted the main driver in the increase of the overall energy RD&D spending (Figure 4.1). Nevertheless, provincial spending rose in 2021-2022, partly driven by spending on carbon capture, utilization and storage (CCUS) research. Table 4.3 further breaks down the evolution of energy RD&D into areas of research, presenting spending by federal and provincial/territorial governments and industry.

Although more recent data is not yet available, these numbers must be put in perspective given the significant items announced in the federal government's budgets for 2022 and 2023. Notably, the Energy Innovation Program funds research, development and demonstration projects, including $319 million for advancing the commercial viability of CCUS technologies. The National Research Council's Industrial Research Assistance Program (IRAP) also provides financial support to help industries develop their innovation capacity.

Figure 4.1 – Federal and Provincial/Territorial Public Expenditures on Energy RD&D



Source: NRCan 2023

Table 4.3 – Expenditures on total energy RD&D by technology area ($ million)

	Federal (2021/2022)	Provincial & Territorial (2021/2022)	Industry (2020)
Fossil fuels (incl. CCUS)	170	139	621
Renewable and non-emitting energy (incl. nuclear)	408	154	596
Energy end-use (incl. energy efficiency)	423	118	457
Total	**1,001**	**411**	**1,675**

Source: NRCan 2023

4.3 Vulnerability to transitions in the energy sector

Given the magnitude of energy's role in the Canadian economy as documented above, important factors characterizing its distribution across the Canadian population must be taken into consideration to properly assess this role. Two such factors are examined below. First, many key energy services are considered completely or partially essential: space heating in buildings is not a mere option given Canadian winters, nor is a certain amount of motorized transport. This suggests uneven impacts of energy expenses depending on a household's disposable income. Second, the role of the energy sector in employment and in the Canadian GDP cannot be reduced to national figures because there are remarkable variations across localities and provinces. These two factors are thus discussed below to illustrate some of the main distributional factors to consider in the ongoing energy transition toward a net-zero society.

4.3.1 Energy expenditures and energy poverty

A first distributional issue is the affordability of energy services. Space heating, for instance, is a necessary service for several months for the entire Canadian population, even if the winters are milder in some regions of the country. The same holds true for water heating, basic appliances and lighting. As a result, expenses tied to household energy services cannot fall below a certain threshold (mainly a function of floor space and heating technology) without lowering the quality of life.

While wealthier households have higher heating costs given the larger average floor area of bigger homes, these costs remain a lower percentage of their disposable income compared with households in less wealthy income quintiles. In fact, 2019 data shows this share of direct energy expenditures (which includes space heating, as well as all fuel and electricity purchased for transport or accommodation energy needs) is 6.4% for the bottom income quintile, compared to only 3.7% for the wealthiest quintile (Statistics Canada 2023b).

Another form of distributional inequity tied to affordability is the "essential needs" threshold: people living in less densely populated areas of the country, for instance, may have higher basic needs for transport services and fewer possibilities to meet them. Rural areas in particular are often further away from employment locations and have fewer public transit options. Compared to their urban counterparts, households living outside densely populated areas thus have greater needs for transport services yet have fewer available options. This dichotomy means that a larger share of their income goes toward energy expenses.

The concept of energy poverty is associated with situations where households may have to spend a share of their income on energy services that is above a certain threshold. Natural Resources Canada defines this threshold as 10% of disposable income (NRCan 2023). In other words, households spending more than this percentage for access to basic energy services are said to be facing energy poverty.

While the average household in Canada spends less than 4% of its disposable income on energy services, this figure varies considerably across regions (Table 4.4). As might be expected, energy poverty rates are much higher in the lowest quintile but many people are still facing energy poverty in higher quintiles as well. For many reasons, their needs for energy services may be greater in absolute terms, which in turn forces them to spend more on these services.

Varying energy poverty rates indicate affordability and, partly as a result, availability issues. The Atlantic Provinces, for instance, stand out in Table 4.4, which shows that almost half those in the lowest income quintile spend more than 10% of their disposable income on energy services, and that 19% of the second quintile are in the same situation. This is by far the largest share (15% of the overall population), suggesting that energy prices are higher in this region than in most of the rest of the country.

The numbers in Table 4.4 also indicate that rising energy costs stemming from certain ongoing or upcoming transformations to the Canadian energy system are likely to have a disproportionate impact on specific subsets of the population. As a result, special attention will have to be focused on designing ways to temper this impact on the most vulnerable groups and also, for example, on how electricity tariffs and rates will evolve if widespread electrification is to proceed in all regions, even as expenses for fuel costs diminish as they are being replaced.

Table 4.4 – Energy poverty rates, by income quintile and geography

	Q1 (Lowest)	Q2	Q3	Q4	Q5 (Highest)	Average
Canada	21%	6%	2%	0%	0%	6%
Atlantic Provinces	49%	19%	4%	0%	0%	15%
Quebec	17%	4%	1%	0%	0%	4%
Ontario	20%	5%	0%	0%	0%	5%
Manitoba	21%	7%	1%	0%	0%	6%
Saskatchewan	34%	8%	2%	0%	0%	9%
Alberta	23%	3%	1%	0%	0%	5%
British Columbia	25%	4%	1%	0%	0%	6%

Reproduced from NRCan (2023)

4.3.2 Regional employment and economic development

Another form of vulnerability to the evolution of the energy sector is through its impact on employment and economic activity in specific regional constituencies. Even though the energy sector is responsible for 3.5% of direct and indirect employment Canada-wide, here again the distribution of this employment is very unequal. This imbalance is largely the result of the uneven geographical distribution of fossil fuels exploitation. Oil and gas production takes place mainly in Alberta, Saskatchewan, British Columbia, and Newfoundland and Labrador (see Table 2.5 and Table 2.6). This distribution is in contrast to employment in the electricity sector, which is more evenly distributed across the provinces (when factoring population).

In comparison to provincial variations, the distribution of employment at the municipal level provides an even more precise measure of dependence on specific parts of the energy sector and vulnerability to shocks. For instance, NRCan considers communities with a high share of employment in the energy sector and a relatively low sector diversity in their economy to be energy-reliant communities. Across the country, 300 communities fit this description.

Importantly, a very large share of these communities depend on the fossil fuels extraction sector. As a result, the overwhelming share of energy-reliant communities are found in Alberta (199), Saskatchewan (54), Newfoundland and Labrador (21), and British Columbia (15). These communities are particularly vulnerable to changes effected by transformations in the energy sector, especially in relation to efforts to decrease fossil fuels production, or by price shocks in global markets. It is also worth noting that because 79% of these communities are rural or remote, simple retraining programs are insufficient to tackle unemployment.

4.4 Takeaways

While it is undeniable that the energy sector plays a major role in the Canadian economy, fully grasping the extent of this role requires attention to key variations. In terms of value in GDP, the oil and gas sector contributes the largest share as a result of the high value of exports to the United States. If this is indeed a very important factor to consider in designing a policy to force diversification away from this sector, the oil and gas sector's more modest contribution to employment, the dependence it creates on international market fluctuations around these commodities, and U.S. decisions about its imports cannot be ignored. Similarly, investment figures also suggest that investment has a higher impact on job creation in the renewables sector, despite a smaller contribution to GDP.

Changes and transformations in the energy sector, whether they be induced from policy by design or imposed from developments outside Canada's borders, will affect some population groups much more than others. While consumer preferences may play a role in tempering these impacts when they are negative, this role is limited for the most vulnerable segments of the population. This is particularly the case not only for households facing energy poverty and energy communities, but also, albeit to a lesser extent, rural communities.

Given current efforts to orient the transition toward a net-zero society, the above-mentioned situation elicits the following two observations. The first is that **sufficient public support for this transition will never materialize and be sustained without special attention being focused on both types of inequities outlined above**. Credible solutions and commitments from all levels of government are absolutely essential to ensure that communities and groups with the most to fear from the transformations ahead support the efforts. As electrification can offer a significant increase in energy productivity, focusing away from the cost of energy to frame societal discussions around the cost of energy services instead, for instance, is needed to better inform public debate. Similarly, finding ways to answer the political challenge inherent in the geographical concentration of certain vulnerabilities remains critical.

The second observation relates to the gargantuan infrastructure transformations required on a short timescale to achieve GHG reduction targets (a point that will be covered in the second report of this Outlook). Beyond technical challenges, **the building of this infrastructure poses dire needs for labour, as well as for research and innovation, lest the former become a significant roadblock to meeting future energy needs and the latter prevent important savings**. Daunting numbers of skilled workers in several parts of the construction, energy and regulatory sectors in particular are already needed.[2] Therefore, if well managed, this transition in the labour force may provide answers to some of the questions posed by the vulnerability of current energy communities, even though growth alone will not be able to compensate directly for the long-term reduction in fossil fuel contributions to GDP and exports.

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[2] See for instance, IESO (2022) and Efficiency Canada (2021).

5

GHG emissions and climate policy

As a signatory of the Paris Agreement, Canada has deployed various measures to achieve GHG emissions reduction targets. Some of these are at the federal level, while some provinces and territories have developed action plans based on their specific challenges and circumstances. This chapter addresses the diversity of approaches and ambitions, highlighting the challenge of establishing a coherent national program. It also summarizes targets and policies at the subnational level.

Highlights

- Despite reductions in many sectors, Canada's overall GHG emissions have stagnated since 2005. In addition, subsequent to the major economic slowdown that followed the onset of the COVID-19 pandemic, these emissions fell by only 9% between 2019 and 2020.
- As data becomes available, it seems very clear that the pandemic did not lead to structural transformations in emission sources in Canada. Most sectoral reductions that lasted through 2021 were linked to developments independent of the pandemic, such as the closure or conversion of coal-fired power plants in Alberta.
- The passenger transport sector was the most severely affected by the changes from 2019 to 2020, largely as a result of the strict restrictions on air travel at different times in 2020 and 2021, and to a much lesser extent, an increase in work from home. Partial data for 2022 suggest that both these sub-sectors returned to pre-2020 levels.
- Accounting for more than half the country's emissions, the transport sector and the oil and gas industry also represented the fastest growing emission increases in absolute terms from 1990 to 2019. Although the transport sector has yet to recover fully from the decline in emissions after 2019, oil and gas production and refining emissions had already returned to their 2019 levels in 2021.
- The federal government has deployed a substantial number of measures to reduce GHG emissions across Canada. Some provinces have also introduced considerable measures and plans, while others' efforts have been more limited.
- Although these initiatives appear to have generated some progress on GHG emissions reduction, on the whole, it is too early to determine whether the full implementation of the measures announced will initiate the deep transformations needed to set the country on a path toward net-zero in 2050
- Data on GHG emissions and on associated energy production and consumption continue to be lagging, limiting the ability to evaluate progress and adjust courses of action. This limitation is in part alleviated by an independent effort from the Canadian Climate Institute to provide preliminary estimates of GHG emissions in a more timely fashion.

5.1 GHG emissions in Canada

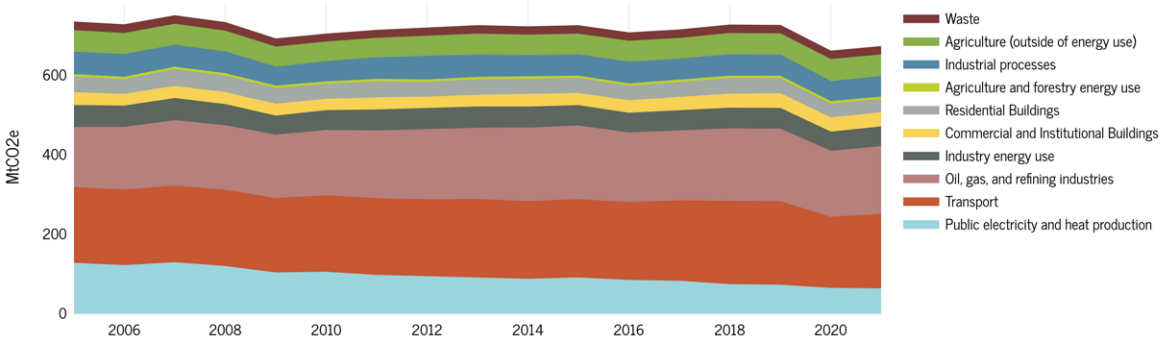
After increasing by 24.4% from 1990 to 2005,[1] Canadian GHG emissions remained fairly constant from 2005 to 2019 (-1.2%). With the advent of the COVID-19 pandemic and the imposition of various sanitary restrictions, emissions fell a further 9.0% in 2020, bouncing back 1.8% in 2021. The result was an 8.4% decrease between 2005 and 2021, most of which occurred during the pandemic. Since 2021 saw confinement measures (re)deployed across the country, it remains unclear at the moment what lasting impact the pandemic will have had on emissions. An analysis of the partial indicators available on this issue is presented below.

As Figure 5.1 shows, energy-related emissions make up 81% of total emissions, a share that has remained stable since 2005. As we noted in our previous edition, the plateau in total GHG emissions from 2005 to 2019 is associated with an overall decrease in emission intensity, as expressed by the following two metrics:

- Adjusted to population growth, per capita emissions were 15.2% lower in 2019 than in 2005;
- Over that same period, carbon intensity per constant dollar of GDP was reduced by almost 26.9%.

Understanding and measuring the impact of the pandemic on GHG emissions is important because it occurred at the same time as an acceleration of policies aimed at reducing them, especially at the federal level. A fine analysis of the changes in emissions from various sources is thus needed to determine: (1) the structural vs. the transitory impacts of the pandemic (in other words which changes are profound enough to last and which can be expected to fully rebound in the coming years); and (2) the early impact, if any, of new GHG reduction policies deployed by the various levels of government in the past few years, which is essential to determine whether efforts are producing the intended outcomes.

Figure 5.1 – GHG Emissions in Canada by sector



Source: ECCC 2023

[1] The years 1990 and 2005 are used as two reference points in GHG emissions charts in this section since they are the two reference years most commonly used in developing GHG reduction targets in Canada. For instance, the federal government's 2030 GHG reduction target is 40%-45% from 2005 levels, while the Quebec government's 2030 target is a 37.5% reduction from 1990 levels. International agreements also use 1990 as a reference year. Given that the most recent GHG emission data available for Canada at the time of writing are for 2021, we present up-to-date data whenever possible throughout this discussion, paying particular attention to 2020 and 2021 to assess the impact of the pandemic and various related public health restrictions.

Accordingly, the changes in emissions from 2019 and 2021 and the likely drivers are addressed below. Between 2019 and 2021:

- Virtually all reductions in emissions nationwide have come from energy-related activities (52.9 $MtCO_2e$), with an additional 0.9 $MtCO_2e$ deriving from industrial processes (from the petrochemical industry and the production and consumption of halocarbons, and SF6 and NF3 industries).
- Electricity and heat production emissions declined by 9.1 $MtCO_2e$, primarily as a result of the shut-down of coal-fired power stations in Alberta or their conversion to natural gas (8 $MtCO_2e$)
- While emissions from oil and gas extraction returned to former level, emissions from refining industries rose by 18.9% (2.5 $MtCO_2e$) over the same two-year period. Almost all these increases were noted in Alberta and New Brunswick.
- Energy-related emissions from manufacturing industries declined by 6.5% (-2.5 $MtCO_2e$), with iron and steel posting the largest decrease (-19.8%), followed by cement (-5.3%) and non-ferrous metals (-7.6%). These reductions stemmed mainly from the economic slowdown in 2020, with all sub-sectors except chemical industries experiencing a rebound in 2021.
- Emissions from commercial buildings fell by 5.1% (-1.8 $MtCO_2e$) between 2019 and 2021, while residential buildings emissions declined by a significant 11.0% (-4.2 $MtCO_2e$). A large part of these reductions is attributed to the lower degree-days in the winters of 2020 and 2021, reducing the need for space heating.
- Although energy-related emissions in the agriculture and forestry sector declined by 13.4% (-0.4 $MtCO_2e$), non-energy emissions from these same sectors rose by 1.1% (0.6 $MtCO_2e$) from 2019 and 2021, suggesting that the sector's slowdown in 2020 and 2021 did not result in lower emissions from soil management.
- Transport emissions shrunk by 12.5% (-22.3 $MtCO_2e$), with aviation posting the steepest decrease (-63.0%) subsequent to restrictions on air travel, while light-duty vehicles emissions fell by 14.6% overall, partly as a result of increased work from home. Heavy-duty road transport decreased more slowly (-7.3%); emissions from rail transport diminished by 9.0%; and marine transport saw a 2.4% increase, indicating a more modest slowdown in merchandise transport.
- Between 2019 and 2021, fugitive emissions, mainly a by-product of natural gas extraction, dropped by 16.6% (-9.2 $MtCO_2e$), most of which is the result of a reduction of emissions in venting activities (-7.7 $MtCO_2e$).

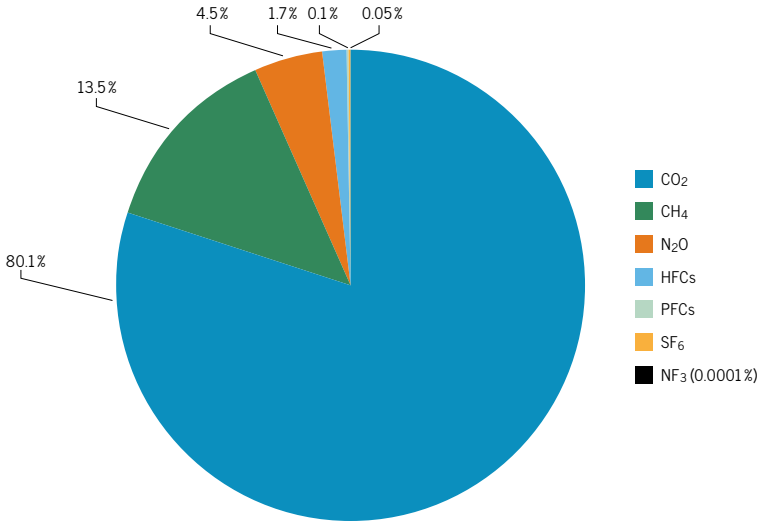
Several gases contribute to global warming at different levels of intensity. Historically, most of the attention has focused on CO_2 given its share of total GHG emissions (80.1% in Canada). More recently, attention on methane emissions has considerably increased. According to Canada's National Inventory Report (ECCC 2023), methane emissions have fallen faster than CO_2 emissions since 2005 (-21.1%). In addition, nitrous oxides, which come primarily from agriculture, have declined by 6.4% since 2005, a trend that is more consistent over the whole period than that for CO_2 emissions.

[2] To account for different intensities in each gas' contribution to global warming, Canada's National Inventory Report uses the 100-year Global Warming Potential, which compares all gases with the global warming contribution of CO_2.

One takeaway from this unpacking of changes in emissions between 2019 and 2021 is that some longer-term trends remain unchanged. Notably, the GHG share of the oil, gas and refining industries has grown systematically over the last 30 years, climbing from 15.9% in 1990 to 20.7% in 2005 and reaching 25.2% of the total in 2021. Despite technological improvements in oil sands production, which reduced emissions per barrel by 36% from 2000 to 2021 (NRCan 2023), this sector contributes close to one-third of energy-related emissions.

The impact of 2020 and 2021 on trends in the transport sector is more uncertain. The share of emissions from transport, which was 24.7% of total emissions in 1990, grew to 26.0% in 2005 and then rose again to 27.9% in 2021. While this figure is lower than the 29.0% high reached in 2019, the decline is modest considering that transport emissions decreased significantly due to the impact of the pandemic in 2020 and 2021. More importantly, even the major impact of the pandemic period did not break the longer-term trends: transport remains the largest source of emissions in the country, with oil, gas and refining coming a close second.

Figure 5.2 – GHG Emissions in Canada by gas, adjusted for GWP (2021)



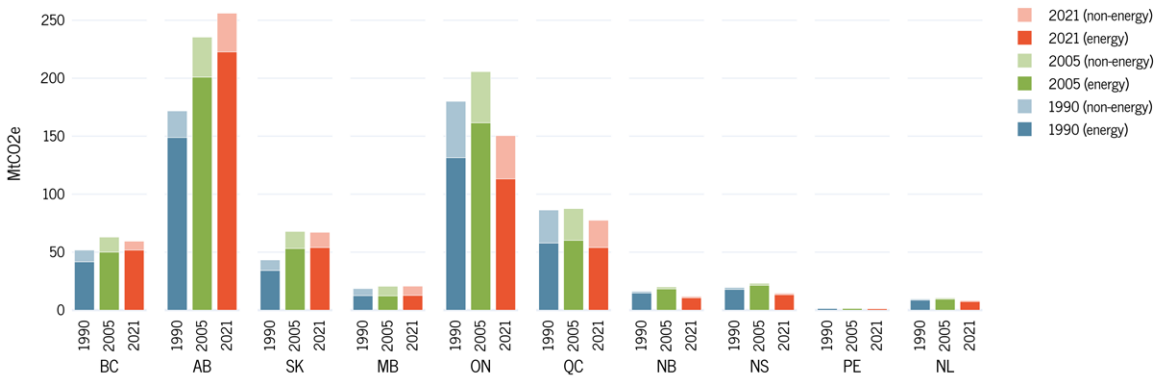
Source: ECCC 2023

5.1.1 Variations across provinces

Beyond the national breakdown of emissions, GHG emissions profiles vary across provinces (Figure 5.3. Owing to the importance of its oil and gas sector, Alberta is by far the province with the largest emissions. Saskatchewan's emissions are also much higher than its population or economic size would suggest. These two provinces also show the greatest increase in overall GHG emissions over both the 1990-2005 and the 1990-2021 period, a direct result of increased oil and gas production. The increase in the second half of the period (2005-2021) is much smaller, partly as a result of the efficiency gains in energy use and production across sectors. However, these improvements have also been uneven across sectors and insufficient overall to reduce emissions compared with 2005 levels.

These trends also lead to a wide discrepancy in per capita emissions between Alberta and Saskatchewan on the one hand, and all other provinces on the other (Figure 5.4), including British Columbia, which showed an 18% decline in per capita emissions between 1990 and 2021, despite a growth in gas production-related emissions.

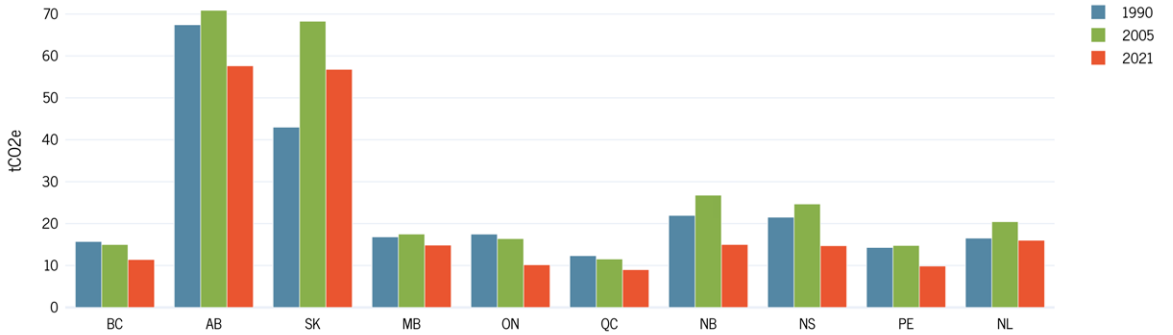
Figure 5.3 – GHG emissions by province



Source: ECCC 2023

Note: Due to data availability issues, data for territories is not presented

Figure 5.4 – Evolution of per capita GHG emissions in Canada



Source: ECCC 2023; Statistics Canada 2023

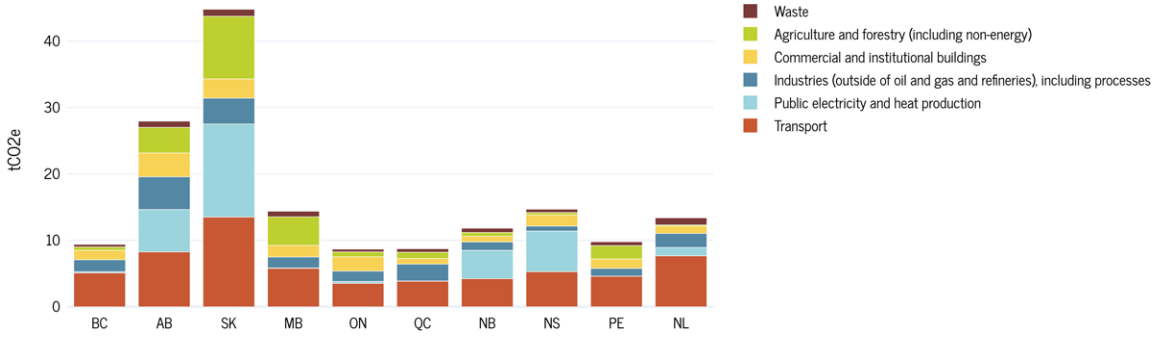
Note: Due to data availability issues, data for territories is not presented

A closer look at the distribution of emissions on a per capita basis shows that the variation across provinces cannot be explained solely by the strong presence of an oil and gas sector alone (Figure 5.5). Emissions from electricity production are considerable in provinces where coal and natural gas are still used to produce power (Alberta, Saskatchewan, New Brunswick and Nova Scotia). Space heating sources also result in differences in emissions from buildings as the share of natural gas for this service varies.

Other differences between provinces are noted. For instance, emissions from agriculture are much higher in Saskatchewan than anywhere else, even compared to Alberta and Manitoba. Emissions per capita from transport also vary wildly, with much larger numbers from Saskatchewan and, to a lesser extent, Alberta and Newfoundland and Labrador.

Overall, this comparison shows that while emissions from oil and gas are an important driver of provincial variations in GHG emissions, the make-up of other sectors, the energy sources historically used, and consumption preferences play very important roles in emissions profiles. Accordingly, strategies aiming to eliminate or very significantly reduce sectoral emissions must take provincial realities into account.

Figure 5.5 – Per capita emissions outside of the oil and gas sector, by province and source (2021)



Source: ECCC 2023; Statistics Canada 2023

Note: Due to data availability issues, data for territories is not presented

5.2 The status of carbon capture, utilization and storage (CCUS) in Canada

Until recently, two CCUS technologies operate on a commercial scale in Canada. One is the Quest project in Alberta, where the capture operation is applied during the conversion of bitumen extracted from oil sands into higher grade oils. Another is the Boundary Dam coal-fired power station in Saskatchewan, where CO_2 produced at the combustion stage is captured. More recently, the Alberta Carbon Trunk Line (ACTL) was added, a pipeline designed to carry CO_2 captured from the Heartland region of Alberta to an injection site 240 km to the south. In 2021, 1.24 $MtCO_2$ was captured and injected as part of the project.

Together, these projects provide essential information about real-life working conditions of CCUS technologies. Results are so far mixed. On the one hand, capture capacity has expanded with the completion of the Alberta Carbon Trunk Line. A project to capture CO_2 from the Genesee natural gas-fired powerplant by Capital Power has also reached the limited notice to proceed stage. A final investment decision is expected before the end of 2023.

On the other hand, capture rates remain far below the theoretical potential. Data from the Quest project's 2022 annual report shows gross captured CO_2 to remain around 77.3% of total emissions from the plant. When including the emissions to power the CCUS operation, the net capture rate falls to 60% (Shell 2023). The Boundary Dam project, which has now captured a little over 5 $MtCO_2$ since coming online in 2014, has experienced many more outages than first anticipated, resulting in capture rates that are much lower than the original target of 90%, later revised to 65%. In addition, most of the CO_2 captured is used in enhanced oil recovery operations, which not only bring out more oil but also do not retain 100% of the CO_2 injected. In other words, the storage in wells through this process of injection results in part of the CO_2 being released into the air.

Many questions remain about the financial viability of carbon capture. For now, it remains to be seen whether the $7 billion investment tax credits the federal government announced in its 2023 budget will be sufficient to spearhead projects, as operation costs remain extremely high. Moreover, the financial viability of such projects is also closely linked to demand for enhanced oil recovery as the markets for other forms of permanent storage are underdeveloped. As for the applications of CO_2 capture in the power sector, the draft Clean Electricity Regulations published in August of 2023 have prompted worries from the CCS industry that the potential for 95% capture rates for natural gas-fired powerplants would not be achieved by the 2035 deadline set by the regulations. The final version of the regulation is set to be released in 2024.

5.3 Federal climate policies

For several years now, the policy mix intended to achieve various GHG emissions objectives has developed into a broad array of programs and regulations, at both federal and provincial levels. These policies include various incentives to change energy consumption patterns and behaviours, accelerate the adoption of certain technologies, increase the role of renewable sources in the energy mix, put a price on carbon emissions, or more broadly decrease GHG emissions. These policies share some commonalities and several of their objectives complement one another.

Many (but not all) of these policies are linked to specific, if broader, targets, which are either adopted as official government aspirations or formally legislated. For instance, the federal government regulations on methane emissions are directly linked to the 75% reduction target for 2030.

It is also important to note that this review is intended to provide a snapshot of policy status in 2023. With regard to the modelling done in the second report of this Outlook, scenarios exclude objectives or measures that have simply been announced or are still in the earliest stages of design and implementation, as well as measures with no quantifiable targets. Details on these exclusions are provided in later chapters.

Since it signed the Paris Agreement in late 2015, Canada has been governed by the Liberal Party with Justin Trudeau at its head, first as a majority (2015-2019) and then twice as a minority government (after elections in 2019 and 2021). Efforts to develop a policy mix to support GHG reduction plans presented as part of the Paris Agreement pledges began early in this period, with the introduction of the Pan-Canadian Framework on Clean Growth and Climate Change (PCF). The PCF included high-level objectives to be developed into policies, such as a national carbon pricing system. It also created financial incentives for provinces to participate in the framework, providing low-carbon development funds for projects aligned with its objectives.

Table 5.1 – Main targets and incentives from federal policies[3]

GHG emissions reduction	• -40-45% by 2030 (2005) • Net-zero by 2050 • -40% by 2030 (2005) for government operations • 40-45% for methane by 2025, 75% by 2030
Carbon pricing	• Federal tax on fuel emissions (65$/tonne of CO2e), unless provincial equivalent exists • Output-based pricing for industrial emitters, unless provincial equivalent exists
Renewable energy	• 90% non-emitting electricity sources by 2030 • Net-zero electricity sector by 2035 • 100% clean power in federal government buildings by 2025
Coal phase-out	• Yes, by 2030 (with some exceptions due to equivalency agreements)
Low-emission vehicle incentives and renewable fuel mandates	• 2035 ZEV mandate for new sales of light-duty vehicles (under development) • Cash rebates for low-emission vehicle purchase or leasing and for medium- and heavy-duty vehicle purchase • Clean Fuel Regulations

The 2019 election campaign pledge to implement a 2050 net-zero target was followed by a significant intensification of these efforts. The net-zero target was formalized in June, 2021 in the Net-Zero Accountability Act and the former 2030 GHG reduction target (30% reduction from 2005 levels) was raised to 40%-45%. These measures were followed by a more exhaustive Emissions Reduction Plan (ERP) in 2022, as well as additional financial commitments as part of the 2022 and 2023 budgets. While readers can find an exhaustive list of policies in place and announced in Canada (2022), the sections below present the main components of these strategies and policies.

[3] Each section provides a summary table of the targets and main incentives established by each of the governments from the federal level and the main GHG-emitting provinces, before moving on to review the main policy efforts to meet them. The reference year and the time by which the target must be reached are indicated.

5.3.1 A price on carbon

One of the most high-profile measures under the PCF is the carbon pricing system legislated in the Greenhouse Gas Pollution Pricing Act, which imposes minimum requirements on provinces to implement an explicit price-based system (e.g., a carbon tax or levy) or a cap-and-trade system. If a province's proposal does not meet these minimum standards (both in coverage and in price levels), the federal government imposes a backstop option instead.

The following two elements comprise this backstop carbon-pricing system:

1. A charge on fossil fuels, paid by fuel producers and distributors. This fuel charge started at $20/tonne of CO2e in 2019 and rose to $50/tonne of CO2e in 2022 by $10 yearly increments. A new schedule was then introduced to have the charge increase by $15/year to reach $170/tonne of CO2e in 2030. The first of these latter increases occurred in early 2023, which places the current fuel charge at $65/tonne of CO2e.
2. An output-based pricing system (OBPS), applied only to industrial facilities with high emissions levels (>50,000 tCO2e) that are trade exposed. Facilities covered are evaluated in relation to an emission standard for their activity sector. The federal government issues surplus credits to facilities emitting under this standard, while those emitting above the standard are required to submit government-issued credits, submit eligible offset credits or pay a carbon charge (set at the same level as the above-described charge on fossil fuels). Offset credits are attributed to projects that are not covered but follow federal GHG protocols, which are continuously expanded to cover emission-intensive activities not targeted directly by the pricing system (for instance, reducing emissions in refrigeration systems, or sustainable agriculture practices that enhance sequestration of organic carbon in soil).

Revenues from the fuel charge are sent back to the jurisdiction of origin through quarterly payments. As of 2023, revenues collected under the federal OBPS are put into a fund supporting the Decarbonization Incentive Program and the Future Electricity Fund. The former is intended to support the deployment of clean technology projects to "further reduce GHG emissions by incentivizing long-term decarbonization of Canada's industrial sectors." The latter will support "the production and delivery of clean electricity as well as its efficient use" (Canada 2022, 77).

5.3.2 Coal phase-out

In 2018, the Government of Canada released regulations outlining a coal phase-out in the electricity sector by 2030. This phase-out is intended to help Canada reach its target of 90% emissions-free electricity generation by 2030. The regulation was accompanied by a Transition Task Force for Coal Power Workers, which concluded its work in 2019 and led to a $185 million commitment by the federal government to support economic diversification and skills development in communities most affected by the coal phase-out.

The announcement of the net-zero electricity target for 2035 raises questions for Saskatchewan, New Brunswick and Nova Scotia, provinces that still use coal as a significant part of their electricity mix. The Clean Electricity Regulations, should be finalized in early 2024 and clarify requirements.

5.3.3 Transport sector: taxes, incentives and regulations

The Canadian government's approach to transport sector emissions is multifold. First, it imposes several taxes on fuel consumption, including an excise tax of $0.10/litre on gasoline and $0.04/litre on diesel. It also imposes an excise tax on the purchase of fuel-inefficient vehicles.

Second, for passenger vehicles, purchase incentives are offered for battery-electric, hydrogen fuel cell and longer-range plug-in hybrids ($5,000), as well as for shorter-range plug-in hybrid purchases or leases ($2,500). This initiative is in addition to the Zero Emission Vehicle Infrastructure Program, intended to deploy a network of zero-emission vehicle charging and refueling stations. In freight transport, for medium- and heavy-duty vehicles, incentives of up to $200,000 are available for low-emission vehicles. A zero-emission vehicle mandate is also under development (see 5.4.8 below).

A third transportation program is the Clean Fuel Regulations (CFR), which aims to reduce the carbon footprints of fuel suppliers by using a lifecycle approach. These regulations, which came into effect on July 1, 2023, are intended to avoid specific fuel preferences, as is the case for instance with current biofuels mandates. The CFR is accompanied by the Clean Fuels Fund, which committed $1.5 billion to reduce investment risk for clean fuel production projects; help improve biomass supply chains logistics; and address gaps and misalignment in codes, standards and regulations surrounding production and supply chains for clean fuels.

5.3.4 Green/Clean growth

As part of the 2022 budget, the Canada Growth Fund committed $15 billion over the next five years to help meet a number of goals, including reducing emissions, accelerating the deployment of key technologies such as low-carbon hydrogen and CCUS, scaling up companies that foster clean growth, and strengthening critical supply chains.

The Low Carbon Economy Fund, a key original component of the PCF in 2016, committed $2 billions to help support projects that generate green growth, reduce GHG emissions and help meet or exceed Canada's Paris Agreement commitments. The fund has two components: the Low Carbon Economy Leadership Fund, which initially provided $1.4 billion to provinces and territories to help them achieve their GHG reduction commitments; and the Low Carbon Economy Challenge, which uses the rest of the funds to finance innovations that "leverage Canadian ingenuity to reduce greenhouse gas emissions and generate clean growth" (Canada 2023a). Eligible applicants for the Low Carbon Economy Challenge include provinces and territories, municipalities, Indigenous communities and organizations, businesses, and not-for-profit organizations. The 2030 ERP includes a $2.2 billion recapitalization of the Low Carbon Economy Fund.

5.3.5 Exemplarity

Presented in 2017, the Greening Government Operations, which coordinates the Greening Government Strategy and the Policy on Green Procurement, originally set targets for GHG emissions reductions for government operations at 40% by 2030 and 80% by 2050 (with 2005 as the baseline), the latter of which was subsequently increased to net-zero by 2050. The strategy's main tools to achieve these targets are repairs and retrofits to government buildings, as well as investments in transforming the government vehicle fleet to low-emission vehicles.

5.3.6 Methane

The federal government's methane emissions regulations outlined the target of achieving 40%-45% reductions before 2025, as well as a new schedule for the reduction of HFCs. Equivalency agreements respecting these regulations were reached with British Columbia, Alberta and Saskatchewan. The recently announced target of reducing methane emissions further (-75% by 2030) has led to the ongoing development of updated regulations.

5.3.7 Implementation

A closer look at the implementation of these policies and announcements is essential to provide an assessment of the current state of affairs. First, as Table 5.2 shows, three provinces (Quebec, New Brunswick and British Columbia) and the Northwest Territories have systems that fully comply with federal requirements. Second, the updated carbon pricing schedule introduced in 2022, which outlines annual increases up to $170/tonne of CO2e by 2030, triggered updates and decisions in individual provinces. The main impact was that a greater number of provinces now use the federal backstop fuel charge. This is the case in Alberta, Saskatchewan, Manitoba, Ontario, Nova Scotia, Prince Edward Island, Newfoundland and Labrador, the Yukon, and Nunavut.

The picture is somewhat more complex for the OBPS: as of 2023, the federal system for large industrial emitters applies partly in Saskatchewan and fully in Manitoba, Prince Edward Island, the Yukon and Nunavut.

The recent changes have settled a few issues about applying the new pricing schedule to 2030, notably the very possibility of equivalency agreements for less stringent provincial systems, as was the case in Prince Edward Island and New Brunswick. Questions now concern Quebec's compliance with federal requirements in the coming years if the gap between the fuel charge and the price of emissions under the province's cap-and-trade system continues to expand.

Somewhat similarly to carbon pricing, the announcement of the net-zero electricity target for 2035 will likely trigger a revisiting of existing equivalency agreements on coal phase-out in the electricity sector with Saskatchewan and Nova Scotia. Saskatchewan, which has a CCUS installation at a coal-fired powerplant, had successfully made the case that this should be factored into its meeting the coal phase-out commitment. Nova Scotia set lower emission caps for its electricity sector as a whole, also committing at the time to 50% of electricity from a renewable source by 2020. While Alberta will have completely eliminated coal for power generation by the end of 2023, New Brunswick, Nova Scotia and Saskatchewan should be impacted with regard to coal-fired generation by the upcoming Clean Electricity Regulations.

5.3.8 Upcoming policies

The Emissions Reduction Plan (ERP), launched in the spring of 2022 outlined several additional targets and measures pursued by the federal government, many of them still in development at the time of writing. At a glance, the ERP contains a few highlights: first, an interim target of 20% fewer emissions by 2026; second, a target for reducing emissions from the oil and gas sector by 42% from current levels (31% below 2005). The approach to elicit these emissions cuts includes stricter reductions for methane emissions, significant funding for CCUS projects, and the introduction of an emissions cap for oil and gas production, currently in development and scheduled to be finalized in 2024.

The ERP also sets a net-zero target by 2035 for the electricity sector across the country. The Clean Electricity Regulations, which will outline the rules to reach this target for provinces, will be finalized in 2024. Several programs and initiatives are also being pursued to help speed up the decarbonization of the grid, including the Smart Renewable Electrification Pathways Program, which provides support for smart renewable energy and electrical grid modernization projects and which was recapitalized in Budget 2023. Other support for modernizing the grid and strengthening interconnections took the form of talks involving the Atlantic Loop, which aims to improve interprovincial electricity trade opportunities among the eastern provinces, and the Electricity Advisory Council, created in 2023 as an independent body to provide advice to the government on actions needed to achieve 2035 and 2050 targets.

New policies were also announced for the buildings sector. The Green Buildings Strategy committed $150 million to help with retrofits of existing buildings, while the 2022 budget added $458 million to the Canada Greener Homes Loan Program with similar aims in mind.

The transport sector saw the announcement of a zero-emission vehicle mandate, with targets for light-duty vehicles (60% of vehicles sold in 2030 must be zero-emission and 100% by 2035) and for medium and heavy-duty vehicles (100% sales must be zero-emission by 2040). Draft legislation was released in late 2022.

Table 5.2 – Carbon pricing system by province or territory

Jurisdiction	Prov./terr. pricing	Federal pricing	Mixed	Note
British Columbia	x			
Alberta			x	Federal fuel charge, provincial system for industrial emitters
Saskatchewan			x	Federal fuel charge, split system for industrial emitters
Manitoba		x		
Ontario			x	Federal fuel charge, provincial OPBS
Quebec	x			
New Brunswick	x			Provincial tax; provincial OBPS since 2021
Nova Scotia			x	Federal fuel tax replaced the provincial pricing on July 1, 2023; provincial OBPS since 2023
Prince Edward Island		x		Federal fuel tax replaced the provincial pricing on July 1, 2023
Newfoundland and Labrador			x	Federal fuel tax replaced the provincial pricing on July 1, 2023; provincial OBPS
Yukon		x		
Northwest Territories	x			
Nunavut		x		

Source: Canada 2023b

5.4 Policies in the highest GHG-emitting provinces

5.4.1 British Columbia

Main targets and incentives

GHG emissions reduction

- 16% by 2025 (2007)
- 40% by 2030 (2007)
- 60% by 2040 (2007)
- 80% by 2050 (2007)
- Sectoral targets for 2030 for transportation, industry, oil and gas, and buildings and communities

Carbon pricing (2023)

- $65/tonne provincial tax

Renewable energy

- 93% renewable electricity generation (100% Clean Electricity Standard under development)
- 15% of residential and industrial natural gas consumption derives from renewable gas

Coal phase-out

- N/A

Low-emission vehicle incentives and renewable fuel mandates

- Cash rebates up to $4,000 for the purchase of electric (including longer-range hybrid) and hydrogen fuel cell vehicles
- Share of zero-emission vehicles sales or leases, 26% by 2026, 90% by 2030 and 100% by 2035
- Low Carbon Fuel Standard
- Zero-emission vehicle mandate in development for medium- and high-duty vehicles

Other

- Net-zero emissions from government operations (Carbon Neutral Government Program), already met
- New buildings "net-zero ready" by 2032
- Reduction of methane emissions by 45% (2014)

British Columbia has had its own carbon pricing system since 2008. The original tax, which was designed to be a revenue-neutral tax, was reviewed in 2017 to earmark revenues above $30/tCO2e for GHG reduction or affordability programs. The rate now follows federal requirements and increased to $65/tonne of CO2e in 2023.

Launched in 2020, the CleanBC Roadmap to 2030 upgraded a number of measures in the province's climate plan. The Roadmap announced new requirements to make all new buildings zero-carbon by 2030, a 100% ZEV mandate, the drafting of regulations to nearly eliminate methane emissions by 2035, as well as several other initiatives. While originally set for 2040, the ZEV mandate has since been changed to 2035, with interim targets of 26% by 2026 and 90% by 2030.

Since 2023, the province has also had a Renewable and Low Carbon Fuel requirements regulation, which requires distributers to reduce the carbon intensity of their fuels by up to 30% by 2030. The 2030 upgrade also raises the penalty rate for non-compliance from $200 per tonne to $600 per tonne.

N/A = non applicable

5.4.2 Alberta

Main targets and incentives

GHG emissions reduction

- None

Carbon pricing (2023)

- Federal backstop for carbon tax, split system (federal and provincial) for industrial emitters

Renewable energy

- None

Coal phase-out

- By 2030

Low-emission vehicle incentives and renewable fuel mandates

- Renewable Fuels Standard (5% gasoline, 2% diesel)

Other

- GHG emissions cap of 100Mt for the oil and gas sector
- Reduction of 45% by 2025 for methane emissions in upstream oil and gas production (2014)

In the spring of 2023, the Alberta government presented its Emissions Reduction and Energy Development Plan, which sets a goal to reach net-zero by 2050. No interim GHG reduction target was included in the plan.

Since 2016, Alberta has had a legislated cap of 100 $MtCO_2e$ on emissions from oil sands production, which so far has not been constraining. Since the federal government's announcement of a cap on oil and gas production emissions, due in 2024, it is unclear how such a cap will remain applicable.

Alberta was the first province to introduce a performance-based emissions pricing system for industrial emitters (2007). Since then, the program has morphed several times. The Technology Innovation and Emissions Reduction (TIER) program, which was updated in 2022, is now used. Notably, the amount of GHG that facilities may emit without paying the carbon price will be phased out more quickly.

Although Alberta was the province with the highest share of coal-fired power generation a few years ago, all but one power station fueled by coal has now been either retired or converted to natural gas. With the planned conversion of the Genesee facility by the end of 2023, Alberta will have completed its phase-out of coal for power generation. This is partly owing to a system of transition payments provided to some facilities that were originally slated to be in operation beyond 2030, as well as to decisions made in prior years by coal power generators. An equivalency agreement for cuts in methane emissions was reached with the federal government in late 2020.

5.4.3 Saskatchewan

Main targets and incentives

GHG emissions reduction

- 50% by 2030 (2005) for SaskPower operations

Carbon pricing (2023)

- Federal backstop for the carbon tax, provincial system for industrial emitters

Renewable energy

- 50% of electricity from renewable sources by 2030

Coal phase-out

- Equivalency agreement (exemption for Boundary Dam plant, equipped with CCUS)

Low-emission vehicle incentives and renewable fuel mandates

- 7.5% renewable content in gasoline, 2% in diesel

Other

- Reduction of 40%-45% in methane emissions in flared and vented methane emissions by 2025 (achieved)

Saskatchewan's main reference for climate policy is the Prairie Resilience Action Plan, published in 2017. Although the plan outlines the province's approach and strategy for reducing GHG emissions, it establishes no specific GHG reduction targets. This plan was followed by the introduction of the Climate Resilience Measurement Framework in 2018, which set out a series of 25 targets for the province and municipalities to meet and manage.

Carbon pricing in Saskatchewan uses the federal carbon tax system, while industrial emitters are targeted under a split system. The federal pricing system applies as an output-based pricing system (OBPS) for electricity generation and natural gas transmission pipelines that covers facilities from sectors emitting 50,000 tonnes or more of CO_2 equivalent annually. It also applies a charge on fossil fuels, which is generally paid by registered distributors (fuel producers and distributors).

Saskatchewan is one of the four provinces that uses coal to generate electricity, with the particularity that the province runs the Boundary Dam Carbon Capture Project, a power plant with CCS equipment. In 2019, Saskatchewan signed an equivalency agreement with Ottawa, targeting emissions from the electricity sector and raising emissions limits until 2029, with a minimum of 40% of electrical generation coming from non-emitting sources by 2030. However, the upcoming Clean Electricity Regulation will change the parameters, providing the requirement for past 2030.

The province has also adopted a Methane Action Plan, which was released in 2019. This Plan was followed by the Oil and Gas Emission Management Regulations, a measure aimed at reducing methane emissions by 40% by 2025. According to the second annual report mandated by the regulation and published in 2022, methane emissions fell by 60% in 2021, making the 2025 target moot.

5.4.4 Ontario

Main targets and incentives

GHG emissions reduction

- 30% by 2030 (2005)

Carbon pricing (2023)

- Federal system applies for the carbon tax; provincial OBPS for industrial emitters

Renewable energy

- N/A

Coal phase-out

- N/A

Low-emission vehicle incentives and renewable fuel mandates

- 10% renewable content in gasoline (to be increased to 15% in 2030), 4% in diesel

At the time of its adoption in 2018, the Ontario government's 30% GHG reduction target corresponded to the federal target. The province has already achieved two-thirds of this goal, mainly as a result of the shutdown of coal-fired generation in the early 2010s.

In 2022, the Ontario government announced a revisiting of several of the measures set out in the 2018 Preserving and Protecting our Environment for Future Generations plan. The Ontario Carbon Trust, an emissions reduction fund intended to encourage private investment in clean technology solutions, was retired. The new plan also did not include any GHG reductions from electric vehicle uptake, which accounted for 15% of the reductions in the previous plan's projections. The remaining emission cuts needed to achieve the 2030 target are now planned to come from additional renewable content in gasoline, stricter emissions standards for heavy industry, and the electrification of large segments of steel manufacturing.

The federal fuel charge applies in Ontario, although the province transitioned to a provincial carbon pricing system in 2022 for large industrial emitters. The system imposes emissions performance standards, prescribing targets Ontario industrial facilities are required to meet each year, with standards becoming more stringent over time. Compliance (when emitting more than the imposed limit) can be achieved through the purchase of excess units from the government, set at the current carbon price and/or through the purchase of performance units tradable from other firms.

N/A = non applicable

5.4.5 Quebec

Main targets and incentives

GHG emissions reduction

- 37.5% by 2030 (1990)
- Net-zero by 2050

Carbon pricing (2023)

- Cap-and-trade system linked with California

Renewable energy

- +50% in bioenergy production by 2030
- +25% overall renewable energy output by 2030

Coal phase-out

- Elimination of the use of thermal coal by 2030

Low-emission vehicle incentives and renewable fuel mandates

- Zero-emission vehicle standard, increasing to 22% of new sales by 2025
- Cash rebates (up to $7,000) for the purchase of low-emission vehicles
- Renewable content in gasoline (15%) and diesel (10%) by 2030

Other

- 2 million EVs on the road by 2030
- No sales of new gasoline-powered vehicles from 2035
- -40% of consumption of oil products by 2030 (2016)
- +15% in energy efficiency
- -50% in space heating emissions by 2030 (1990)
- 55% of urban buses and 65% of school buses powered by electricity by 2030

In 2022, the Quebec government released an update to its Plan pour une économie verte (Plan for a green economy), which relies heavily on electrification. The plan sets out various targets, including zero sales of gasoline-powered vehicles from 2035, a 50% reduction in emissions from building space heating by 2030 from 1990 levels, and 10% renewable gas in the natural gas distribution network by 2030. A large part of the effort is to be achieved through investments from the Fonds d'électrification et de changements climatiques (Fund for electrification and climate changes), a fund dedicated to projects with GHG reduction potential, financed mainly by proceeds from Quebec's participation in the Western Climate Initiative's cap-and-trade system with California since 2013. The system covers fossil fuel distributors and companies in the industrial and electricity sectors that emit more than 25,000 tonnes of CO2e.

In 2022, Quebec also released its Stratégie Québécoise sur l'hydrogène vert et les bioénergies (Quebec strategies on green hydrogen and bioenergies), aiming to create a framework to develop and deploy these sources. The details of the measures proposed will be published in a roadmap in 2023.

Quebec also has a zero-emissions vehicles mandate, enabling automakers to accumulate credits by selling zero-emission or low-emission vehicles in order to meet progressively more stringent targets for the share of zero-emission or low-emission vehicles. A similar mandate for heavy-duty vehicles is planned but has yet to be formally announced. A second transport electrification policy offers cash rebates (up to $7,000) for the purchase of electric vehicles.

5.5 Policy overview in other provinces and in territories

5.5.1 Manitoba

Main targets and incentives

GHG emissions reduction

- 5-year rolling targets based on the recommendations of an expert advisory council (recently announced target: -5.6Mt by 2027)

Carbon pricing

- Federal system applies

Renewable energy

- N/A

Coal phase-out

- N/A

Low-emission vehicle incentives and renewable fuel mandates

- Renewable content in gasoline (10%) and diesel (5%)

Other

- +11.25% energy efficiency in domestic natural gas consumption by 2032
- +22.5% energy efficiency in electricity consumption by 2032

5.5.2 New Brunswick

Main targets and incentives

GHG emissions reduction

- -46% by 2030 (2005)
- Net-zero by 2050

Carbon pricing

- Provincial tax since April 2020; provincial OBPS since 2021

Renewable energy

- N/A

Coal phase-out

- Yes (2030)

Low-emission vehicle incentives and renewable fuel mandates

- 20,000 electric vehicles by 2030
- Purchase incentive for electric vehicles (up to $5,000)

Other

- Carbon neutral government by 2030

N/A = non applicable

5.5.3 Nova Scotia

Main targets and incentives

GHG emissions reduction

- -53% by 2030 (2005)
- Net-zero carbon footprint by 2050

Carbon pricing

- Provincial cap-and-trade system replaced by provincial OBPS in 2023 and federal fuel charge from July 1, 2023

Renewable energy

- 80% renewable electricity by 2030

Coal phase-out

- by 2030

Low-emission vehicle incentives and renewable fuel mandates

- Up to $3,000 for a new battery-electric vehicle or plug-in hybrid

5.5.4 Prince Edward Island

Main targets and incentives

GHG emissions reduction

- 1.2 Mt (~-40%) by 2030 (2005)
- Net-zero by 2040

Carbon pricing

- Provincial system for the carbon tax replaced by federal fuel charge on July 1, 2023 and federal OBPS applies to industrial emitters

Renewable energy

- None

Coal phase-out

- N/A

Low-emission vehicle incentives and renewable fuel mandates

- Free electric vehicle registration
- The Electric Vehicle Rebate Program provides rebates of $2,500 for the purchase of a plug-in hybrid or up to $5,000 towards the purchase of a new or used EV.

N/A = non applicable

5.5.5 Newfoundland and Labrador

Main targets and incentives

GHG emissions reduction

- -30% by 2030 (2005)

Carbon pricing

- Federal fuel charge since 2023, provincial OBPS since 2023

Renewable energy

- None

Coal phase-out

- N/A

Low-emission vehicle incentives and renewable fuel mandates

- Up to $2,500 for new and used electric vehicles

5.5.6 Territories

Main targets and incentives

GHG emissions reduction

- Yukon: -45% for 2030 (2010)
- Northwest Territories: -30% by 2030 (2005); -25% in emissions from diesel-generated electricity; -10% per capita transport emissions by 2030 (2016)

Carbon pricing

- Federal system in the Yukon and Nunavut, Northwest Territories specific carbon tax

Renewable energy

- Yukon: reduction in diesel use for electricity generation in communities not connected to the main electricity grid (-30% over 2010 levels); 50% of heating needs met by renewable sources by 2030
- Northwest Territories: 40% share in energy used for community heat

Coal phase-out

- N/A

Low-emission vehicle incentives and renewable fuel mandates

- NWT: up to $7,500 for electric vehicles
- Yukon: up to $5,000 for electric or hydrogen-powered vehicles

N/A = non applicable

5.6 Takeaways

This chapter addresses the main policies put forward by the federal government and its counterparts in the provinces and territories. The following observations can be drawn from this overview.

Over the past two years, the federal government has continued efforts to further the development of aggressive and detailed emission reduction policies, despite a lack of interest in some provinces. The publication of the 2022 ERP is an attempt to further clarify the measures proposed, while the development or publication of high-level regulations like the Clean Electricity Regulations, the emission cap on oil and gas production, and the zero-emission vehicle mandate has solidified some of the ERP's main commitments. However, provinces continue to be sharply divided on many of these measures. Despite the Supreme Court's settlement of the jurisdictional disagreement over carbon pricing in 2021, federal-provincial clashes continue, particularly as concerns the federal government's aspirations to make electricity net-zero by 2035 and to put a cap on emissions from oil and gas production.

While the federal government has so far been largely successful in pushing through these efforts, despite opposition from provinces, the intensification of measures with medium-term deadlines continues to add to unresolved tensions. For instance, changing electricity decarbonization objectives from a phase-out of coal in 2030 to net-zero production in 2035 makes natural gas-fired generation much more constrained, renders any equivalency agreements more difficult to design or apply, and gives little time for provinces with a large share of thermal generation to make the necessary changes at a reasonable cost.

Despite these considerable efforts, the efficiency of some of these policies is quite low in terms of GHG reductions and the long delays in implementation raise the question of whether the measures set out in the ERP can fully be deployed by 2030 to meet the 40% reduction target. While choosing more efficient policies can certainly be achieved, these caveats illustrate the depth of the transformations that are required to put Canada on a net-zero trajectory. Many constraints surrounding even the most effective measures complicate their implementation, be they tied to labour shortages, social acceptance barriers, or supply chain issues for the technologies favoured by the measures. The industry-wide, years-long delays in obtaining electric vehicles at the time of writing are a sharp illustration of these constraints.

Overall, this overview provides a preview of tough choices that lie ahead on the road to net-zero, as the country becomes more and more serious about, and successful in, tackling GHG emissions. Most of the transformations involve transformational and drastic changes in the organization of energy systems, and all at a pace rarely seen in the past.

Even if measures at the federal level continue to be implemented, the fact that most responsibility for delivering reductions in line with Canada's GHG reduction objectives rests largely in the constitutional realm of the provinces will continue to pose a significant problem in harmonizing and making coherent the national approach.

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6

Conclusion

This review of the recent trends and current state of energy and GHG emissions in Canada provides several important conclusions about the evolution of its energy system in a world torn between preserving the status quo and reducing GHG emissions.

Canada has some of the richest energy resources in the world, including fossil fuels, uranium, hydro and wind power. It also can count on considerable solar and biomass energy. Energy production and export account for a significant part of Canada's economy. However, because these resources are not uniformly distributed across the country, any transformation of the energy system, driven largely by the response to climate change in Canada and the rest of the world, will affect various parts of the country differently.

Although an energy transition is well under way, the full impact of its long-term effect on Canada's dependence on trade partners in energy matters remains uncertain.

Canada's energy system remains strongly dependent on the United States for its oil and gas exports, which are crucial for the country's trade balance, with swings in prices and demands directly affecting employment and development in the sector.

A number of the changes under way are affecting this dynamic; some examples are the fast-paced growth in needs for low-emission electricity production, the increased reliance on electricity to provide energy services in transport and buildings, and the more general push to decarbonize the energy mix. Each of these trends suggests a reduction in the importance of fossil fuels (including their production) in Canada's activities and trade.

However, **these changes may be reshaping and enhancing, rather than reducing, the dependence of the country's energy sector on its trade partners**. For instance, most clean technologies are produced elsewhere in the world and competition is bound to continue to grow harsher for both consumption and production technologies, as it will for components and minerals used in their manufacturing.

The drive for net-zero in various parts of the world has sparked some large-scale trends, not only for renewable energy production, but also for transformations to energy service delivery. **Therefore, it seems likely that most trends associated with the transition currently underway will continue to intensify.**

While opportunities for Canada in a net-zero economy are immense, it is unlikely that simple substitution for current fossil fuel exports can occur.

It is unlikely that export revenues from oil and gas production can be replaced by exports from other sources. For example, the perspective for much larger clean electricity exports to the United States, which was popular just a few years ago, was short-lived for two reasons. First, the dramatic growth in demand for electricity expected for the coming years and decades suggests instead that electricity exports are likely to shrink rather than expand, as many provinces try to meet this domestic demand. Second, Canada does not have a significant competitive advantage for the production of electricity, with costs in line with those of many states in the USA.

Certainly, as in most of the OECD countries at least, energy production and consumption across Canada will continue to be transformed by changing technologies, economics and preferences. **The potential economic impacts extend beyond reduced export revenues**: energy communities, for which energy production or transformation represents a significant share of their economic activity, will be particularly exposed–some positively, others negatively–by the coming transformation, led largely by net-zero goals. It will be essential to **accompany those who are most vulnerable**.

The COVID19 pandemic did not produce major structural shifts in energy production or consumption.

It is hard to understate the societal impact of the COVID19 pandemic in the years since the last edition of this Outlook. Nevertheless, data for energy consumption and production, as well as for GHG emissions, suggest that very few structural transformations took place because of the pandemic. This is not to say that temporary impacts were negligible or that no major transformation occurred over the past three years: merely, impacts directly tied to the pandemic have largely receded and most major changes noted are linked to developments independent of the public health crisis.

For instance, emissions from energy consumption across sectors fell by a sizeable margin in 2020 and, to a lesser extent, in 2021, notably for the transportation of airplane passengers, which were fewer in number following public health restrictions. Nevertheless, most of these reductions were eliminated in 2021 and partial numbers for 2022 suggest a complete recovery. Similarly, during the pandemic years, the electricity sector experienced its largest emissions decline since the closure of Ontario's coal-fired production in the early 2010s. A closer look reveals however that this was not because of decreased demand, but rather because of the elimination of coal in electricity production in Alberta.

The overview provided in the last few chapters is only partial: most data stop at 2021 and full data for 2022 and 2023 will provide a clearer and more refined picture of the pandemic's impacts. However, **the signs from the available data are clear, suggesting that very important opportunities to capitalize on the temporary pressures on emissions imposed by the pandemic and make certain transformations more permanent were missed**.

Policy efforts to decarbonize the Canadian energy system have intensified, but their effectiveness remains limited so far and important blind spots remain.

The re-election of the Trudeau government at the federal level and of certain provincial governments has resulted in some continuity in decarbonization efforts. Notably, the federal government developed its Emissions Reduction Plan in 2022 and launched work on major decarbonization policies announced during the 2021 election campaign, more specifically, the Clean Electricity Regulations making the sector net-zero by 2035, a cap on oil and gas production emissions, and a zero-emission vehicle mandate prohibiting the sale of gasoline-powered vehicles in 2035.

This multiplication of policy efforts has not eliminated concerns about the ineffectiveness of GHG reduction policies. Despite the lag in emissions data, there are limited indicators so far that show emissions in most sectors declining, let alone at a rate that is sufficient and sustainable enough to reach either 2030 or 2050 targets. **Given the flurry of announcements for new measures since 2021, a more effective and proactive evaluation process of policy implementation issues and overall GHG reduction effectiveness is urgently needed.**

As we noted in another study (Langlois-Bertrand *et al.* 2021), there are practical concerns surrounding measures aimed for the 2030 target, given the absence of planning and action on supporting the transformations required to make them a reality. Utility planning of rapid electricity grid expansion and upgrades to adjust to changing patterns of electricity demand is also lacking (Edom *et al.* 2022). Furthermore, no demand control strategies have been developed to at least ease this pressure on grids in the short to medium term. Similarly, labour shortages and supply chain constraints are all but certain to significantly slow down this implementation, even when it is ambitious. In other words, **beyond the effectiveness of individual measures, some crucial gaps seem to remain in the overall vision of the transformations these measures target**.

Finally, we note the absence of coherent, comprehensive and aggressive **sectoral** strategies to plan for energy demand transformation and reduction, beyond certain efforts that continue to timidly focus on energy efficiency. **Roadmaps and strategies to address the demand side must extend beyond general directions and address the particularities of each sector.** While electrification will in some cases provide some efficiency improvements, choices in all sectors should be targeted to reduce consumption and reverse trends, all while more aggressively pushing for greater energy productivity where a large gap with other OECD countries can be filled. This is especially important in order to adapt net-zero strategies to the greater population growth projections that have been released in recent years.

Canada's efforts to orient or accelerate the transition are becoming limited due to the persistence of federal-provincial clashes over energy and GHG reduction matters.

The clash between the provinces and the federal government over the goals and methods to transform the energy sector continues to be significant. Energy is an area of jurisdiction largely in the realm of provinces. So far, the federal government has used levers in its capacity to regulate environmental issues to play a role in shaping the energy transition. In this context, most provinces have significant reservations about the extent to which the federal government should dictate the terms of these transformations, requiring the latter to carefully design net-zero policies in consultation with its provincial counterparts when measures target particular sectors.

Some provinces, perhaps more outstandingly, seem opposed to any such action because of a combination of jurisdictional disagreements and preferences for less government intervention in the matter. It is important to reiterate that the uneven energy landscape across provinces does not simply result in key sectors being geographically concentrated. Rather, it is clear that a few provinces face a combination of decarbonization challenges as regards net-zero trajectories. These challenges will require a drastic reduction in emissions from fossil fuel production, an overhaul of electricity production sources, a replacement of almost all heating systems used in buildings, in addition to the other major challenges of decarbonizing transport and other industrial sectors.

Given both this combination of challenges and the sometimes difficult collaboration between federal and provincial governments, net-zero efforts are bound to exacerbate these tensions very soon as the federal government's increasingly comprehensive measures to decarbonize reach the limits of the "equivalence agreement" approach that was until recently used to bring even reluctant partners on board. One example is tied to the phaseout of coal-fired electricity generation. In other words, **up to now tensions across orders of governments have in some cases reduced the effectiveness of the measures put in place at either the federal or the provincial level. This situation is bound to become worse barring major changes in the management of these tensions**.

The above suggests that **a much better demonstration of the benefits of the net-zero transition and clearer roadmaps of how key sectors could transform away from fossil fuels, while seizing the economic opportunities provided by a net-zero economy, are urgently needed** to temper these tensions and enable progress toward the societal transformations implied by net-zero trajectories. The spectacular needs for new electricity and hydrogen infrastructure and for manufacturing and putting in place the electrification technologies across sectors, for instance, may constitute the right opportunities.

Energy and emissions data access continues to be difficult and lagging, with some improvements.

As we noted in the last edition, data access for energy production and consumption needs to be improved to enable observers, analysts, researchers, and policymakers to have a clear picture of key developments. This includes trends, the impacts of certain events and, importantly, the level of success of key policies. Very partial data on bioenergy (especially in the industrial sector) or partly hidden data on fossil fuel production in some provinces (for confidentiality reasons) are two of many examples of important data access limitations.

Similarly, even the available data lags significantly, with energy data being published with more than a year's delay. This is also the case for GHG emissions data. Detailed data for energy consumption is even worse, with an additional year of delay. **This lag largely prevents an informed discussion about the direction of the transition, especially in some sectors and sub-sectors.**

The creation of the Canadian Centre for Energy Information in 2019, which aimed to facilitate access to this very data, has not resulted in the hoped-for improvements. This initiative, which has failed to improve the above two key issues, simply helps with exploring the partial and lagging data made available by other agencies. Notable efforts by the Canadian Climate Institute to estimate emissions data ahead of their publication is welcome.

Canada is transforming toward net-zero, but not fast enough.

The above observations indicate that Canada is not yet on a pathway to net-zero. To be clear, the adoption of a net-zero target and the tightening of the 2030 GHG reduction targets from 30% to 40-45% in 2020, and the adoption of the Net-Zero Accountability Act in 2021, signalled the ambitions much more clearly and, crucially, the deployment of the many measures since have supported this commitment. The schedule for the carbon pricing increase until 2030, the Clean Fuel Regulations, and the Clean Electricity Regulations, to name but a few high-level measures, are important building blocks in setting the parameters of the net-zero future for Canada, clarifying the expectations for the many actors across the country.

Nevertheless, these measures are not producing rapid enough transformations: emissions have barely declined, except for the temporary pandemic effect. From a top-down perspective, despite more developed reduction plans at the federal level and in some provinces, partial data shows that the extent of the transformation induced by the measures is limited. Moreover, **a fully coherent approach, one that would ensure structural changes so that the most ambitious measures could achieve their potential, remains lacking. In particular, planning** for the building of infrastructure for net-zero trajectories to be realized remains scant and, in any case, poses dire needs for labour, research and innovation, which have yet to be addressed.

From a bottom-up perspective, we should note that **while the ongoing push from citizens and corporations to decarbonize their own activities is not yet visible in the numbers presented in this report, the bottom-up drive is already present across Canada**. Linked to the desire to contribute to emissions reduction, to protect export markets, or simply because moving away from fossil fuels is economically preferable, this movement is already straining electric utilities and we expect to see its effects on the energy sector rapidly.

6.1 References

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