Independent Statistics & Analysis
U.S. Energy Information Administration

Country Analysis Executive Summary: Canada

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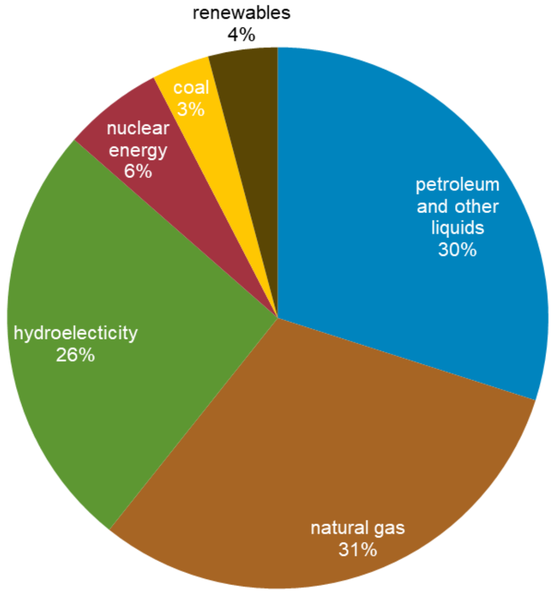
Overview

- Canada is a net exporter of most energy commodities and is a significant producer of natural gas, hydroelectricity, and crude oil and other liquids. Most of Canada's energy exports are destined for the United States.
- Canada ranked fourth in 2021 among top energy producers of petroleum and total liquids in the world, behind only the United States, Russia, and Saudi Arabia.
- In 2021, energy consumption in Canada, which totaled 13 quadrillion British thermal units (quads), accounted for less than 3% of total world energy consumption.[1] Canada's domestic consumption of energy largely consists of oil, natural gas, and hydroelectricity (Figure 1).
- In 2018, the government of Canada announced regulations to phase out traditional coal-fired electricity by 2030. It also announced greenhouse gas regulations for natural gas-fired electricity.[2] Following these announcements, the government imposed a 20 Canadian dollars per ton (CAD20/t) carbon tax on Ontario, Saskatchewan, Manitoba, and New Brunswick, effective from January 2019 under the Greenhouse Gas Pollution Pricing Act. These tariffs increased from CAD10/t per year to CAD50/t on April 1, 2022.[3]

Figure 1. Total primary energy consumption in Canada by fuel type, 2021



Data source: *BP Statistical Review of Energy, 2022*

Petroleum and other liquids

Reserves

- The *Oil & Gas Journal* estimates that as of January 2022, Canada had 168 billion barrels of proved oil reserves, ranking fourth in the world.[4] Only Venezuela, Saudi Arabia, and Iran hold larger reserves. Oil sands make up most of the country's proved oil reserves.
- Canada's oil sands have significantly contributed to the recent growth in liquid fuel supply. In 2021, non-OPEC petroleum liquids grew by 0.8 million barrels per day (b/d), 0.3 million b/d of which were from Canada (primarily from oil sands).

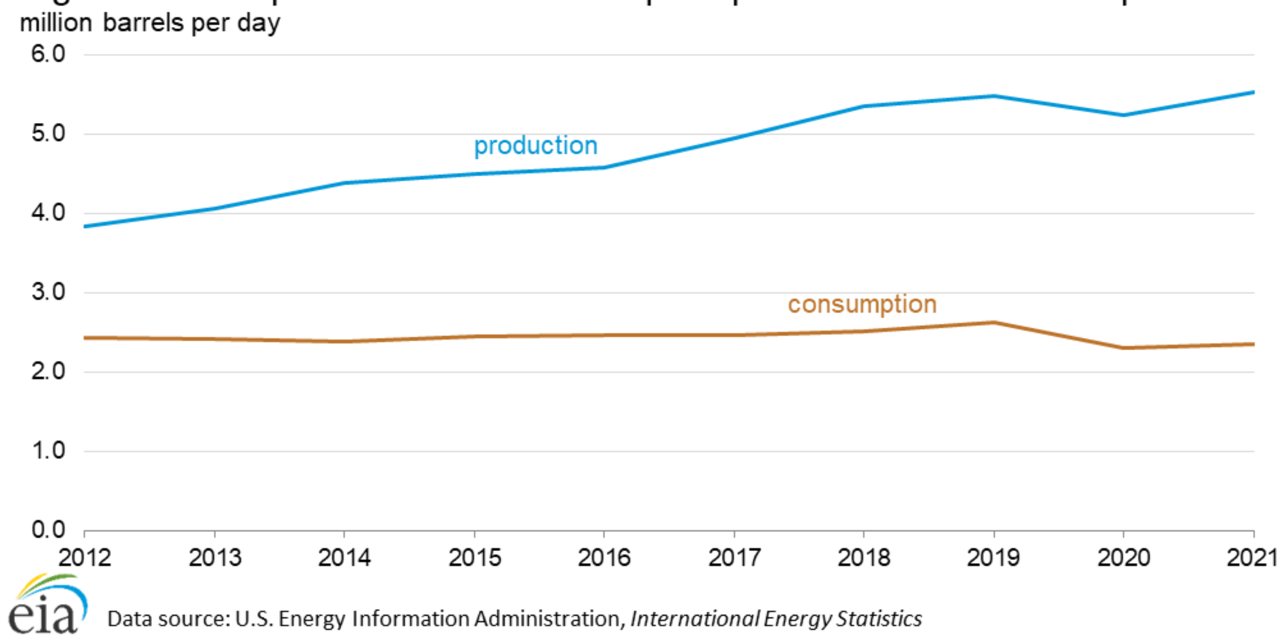
Production and consumption

- In 2021, Canada was the world's fourth-largest petroleum and other liquids producer and was a net exporter of oil. As a neighboring country, the United States is a market for Canadian oil. In addition, American refineries are designed to process heavy oils such as oil sands.
- Canada produced 5.5 million b/d of petroleum and other liquid fuels in 2021, an increase of more than 300,000 b/d from the previous year. Crude oil (including condensate) accounted for 4.3 million b/d, and the remainder included biofuels and natural gas liquids (NGLs) (Figure 2).
- Bitumen and upgraded synthetic crude oil produced from the Alberta oil sands have driven recent growth in Canada's liquid fuels production. Canada's oil sands remain the primary source of hydrocarbon production and make up more than 97% of the country's total oil reserves; about 80% of total output in 2021 originated in Alberta.[5] These heavy deposits are found in three areas: Athabasca, Peace River, and Cold Lake in the provinces of Alberta and Saskatchewan. Most of Canada's proved oil reserves and future growth in the country's liquid fuels production will come from these resources.
- Canada's offshore production is located in the eastern provinces and accounts for less than 5% of total output in Canada.[6] Harsh weather and challenging deep-water conditions have limited

development of offshore projects in Newfoundland, Labrador, and Nova Scotia. These challenges raise both the technical difficulty and the cost of exploration and production.

- We expect that Canada's production will grow in 2022 and 2023 because of several factors. The government of Alberta rescinded mandatory production curtailments set in 2019. Additional export pipeline capacity will also likely lead to increased production. Enbridge Inc.'s Line 3 Replacement Project (370,000 b/d incremental capacity)[7] came online in late 2021, and Trans Mountain Corporation's Trans Mountain pipeline expansion project (590,000 b/d incremental capacity) is expected to be operational in 2023.[8]
- Producers in the Western Canadian Sedimentary Basin (WCSB) have traditionally focused on the production of natural gas, however, a continued lack of midstream takeaway infrastructure and export capacity for these volumes has shifted their focus to the production of liquids that can be used as domestic diluents at nearby oil sands projects. The extra-heavy crude oil produced in Alberta must be blended with lighter liquids products, such as plant condensate or pentanes, to flow through pipelines and reach downstream facilities. We expect that additional supply will also come from producing field condensate and natural gasoline in the liquids-rich Montney and Duvernay plays, located in the southwestern region of Alberta.
- In 2020, refined products demand fell to 2.3 million b/d from 2.6 million b/d in 2019 as a result of responses to efforts to reduce the spread of COVID-19. In 2021, demand increased to 2.4 million b/d as COVID-19 restrictions were eased.
- In 2021, most of the liquid fuels consumed in Canada were used for transportation; motor gasoline had a 34% share of demand and distillate fuel had a 26% share.

Figure 2. Total petroleum and other liquids production and consumption



Data source: U.S. Energy Information Administration, *International Energy Statistics*

Refining

- Canada had 16 refineries with a total crude oil processing capacity of 1.85 million b/d as of 2021.[9] Eastern Canada's seven refineries have 1.1 million b/d of capacity, or about 60% of total crude oil refining capacity.[10] Most crude oil is refined into motor gasoline (48%) and diesel fuel (37%).[11]

- Although Canada produces more crude oil than it refines domestically, it imports large amounts of crude oil because the eastern refineries are not as well connected to domestic crude oil production supplies. Western Canada's nine refineries have a total capacity of 784,000 b/d.[12]
- In July 2021, the U.S. private equity group Cresta Fund Management purchased the idled Come by Chance refinery and announced plans to convert the plant to a 15,000 b/d renewable diesel facility by 2022. The refinery was shut down in March 2020 as a result of challenging economics during the COVID-19 pandemic. As part of the acquisition, the refinery was renamed Braya Renewable Fuels.[13]

Table 1: Oil refineries in Canada, 2021

		Eastern Canada	
Owner	**Refinery**	**Location**	**Capacity (thousand b/d)**
Imperial	Nanticoke Refinery	Nanticoke	112
Imperial	Sarnia Refinery	Sarnia	121
Shell	Corunna Refinery	Sarnia	75
Suncor	Sarnia Refinery	Sarnia	85
Suncor	Montreal Refinery	Montreal	137
Valero Energy Corporation (Ultraar)	Jean-Gaulin Refinery	Quebec City	235
Irving	Irving Oil Refinery	Saint John	300
Total Eastern capacity			*1,065*
		Western Canada	
Owner	**Refinery**	**Location**	**Capacity (thousand b/d)**
Shell	Scotford Refinery	Strathcona	114
Cenovus	Lloydminster Refinery	Lloydminister	30
Imperial	Strathcona Refinery	Edmonton	191
Suncor	Edmonton Refinery	Edmonton	146
North West Redwater Partnership	Sturgeon Refinery	Sturgeon County	79
Parkland Fuel	Burnaby Refinery	Burnaby	55
Tidewater Midstream	Prince George Refinery	Prince George	12
FCL	Co-op Refinery	Regina	135
Gibson	Moose Jaw Refinery	Moose Jaw	22
Total Western capacity			*784*
Total capacity			*1,849*

Data source: Canadian Association of Petroleum Producers[14] and Oil Sands Magazine[15]
Note: The 2021 refinery capacity is calculated as 2020 capacity (1.979 million b/d) minus Come by Chance refinery capacity (130,000 million b/d) = 1.849 million b/d.

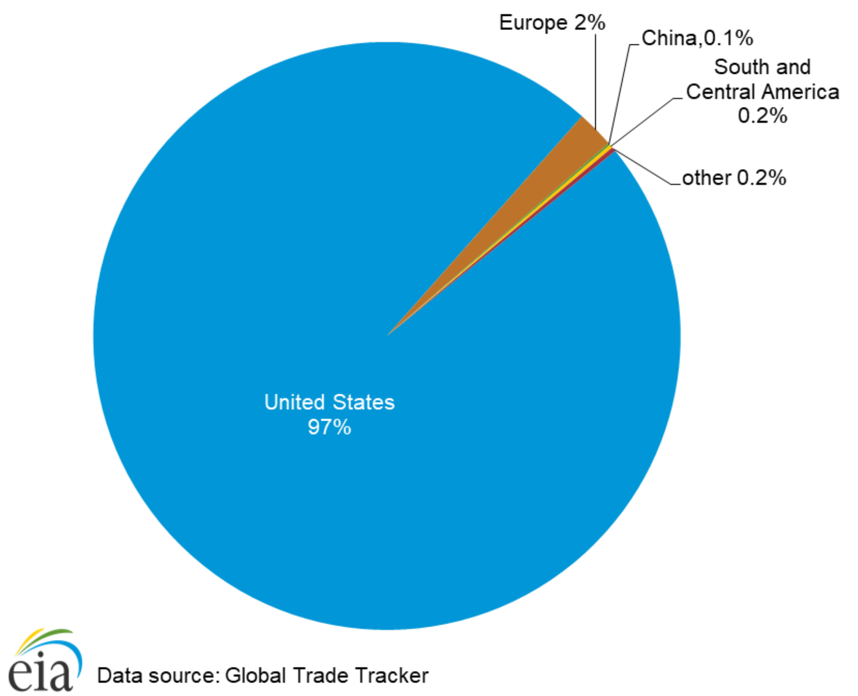
Bitumen upgrading

- The country has significant upgrading capacity because oil sands (bitumen) account for over 60% of Canada's crude oil production. In 2020, four upgraders in Alberta and two in Saskatchewan were active and had a total capacity of 1.4 million b/d.[16]
- Bitumen is a thick, sticky form of crude oil. When extracted from the ground, bitumen is too thick to be transported by pipeline.[17] An upgrader is a facility that processes bitumen or extra heavy oil into synthetic crude oil. Although some upgrading takes place within refineries, the majority is carried out at upgraders in Alberta. The upgraders are usually associated with specific oil sands projects.[18]

Trade

- Nearly all of Canada's crude oil exports were sent to the United States in 2021 (Figure 3). The largest regional market in the United States for Canada's crude oil exports is the Midwest. Almost all of these volumes exported to the Midwest originate in Western Canada.
- Canada is the largest source of U.S. crude oil and refined product imports. U.S. crude oil imports from Canada accounted for 62% of total U.S. crude oil imports in 2021, averaging 3.8 million b/d. U.S.-refined products imported from Canada accounted for 582,000 b/d, or 25% of total U.S. petroleum product imports.
- As the total volume of U.S. crude oil imports from Canada rose in 2021, Canada's share of total U.S. crude oil imports reached 62%. In particular, crude oil imports from Canada replaced imports from Venezuela after the United States stopped importing oil from Venezuela in 2019.[19]
- Currently, producers face complex market and logistical challenges. Oil supply in Western Canada exceeds transport capacity of pipelines serving external markets. Because export pipelines in Canada operate at full capacity and the timing of new capacity remains uncertain, Canada's producers increasingly rely on rail transportation to deliver crude oil to market.
- The reversal in late 2021 of Marathon's Capline pipeline in the United States has allowed increased volumes of oil sands production from Alberta to be shipped to Asia via the Gulf Coast.[20]

Figure 3. Canada crude oil exports by destination, 2021



Natural Gas

Reserves

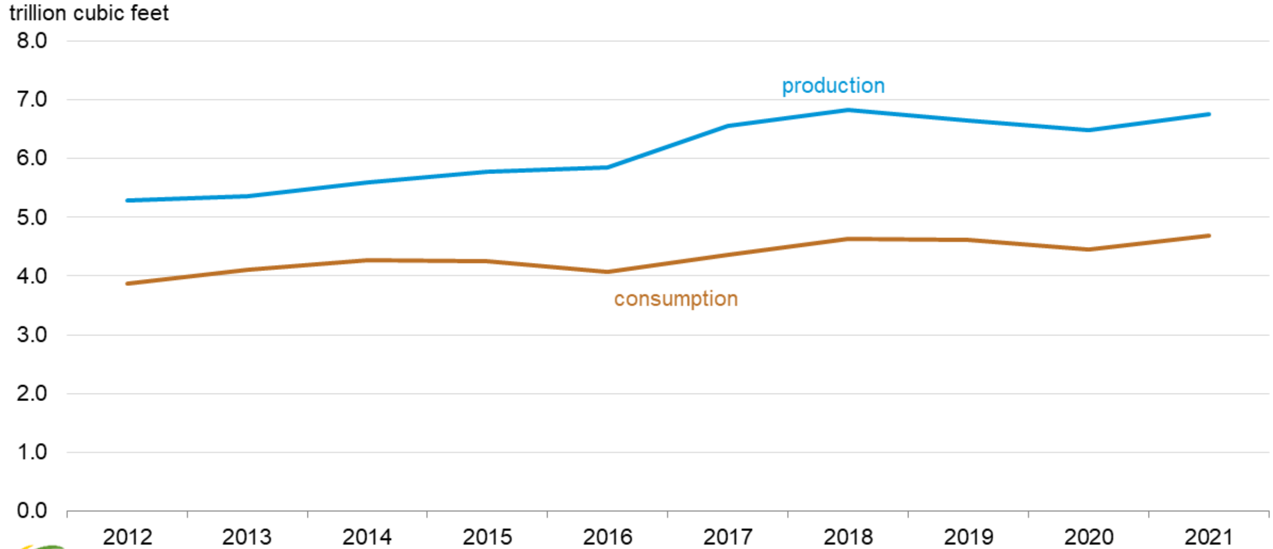
- According to the Oil & Gas Journal, Canada held 83 trillion cubic feet (Tcf) of proved natural gas reserves as of January 2022. [21]
- Most of Canada's natural gas reserves are traditional resources in the WCSB, including those reserves associated with the region's oil fields. Other areas with significant natural gas reserves include offshore fields near the eastern shore of Canada (primarily Newfoundland and Nova Scotia), the Arctic region, and the Pacific coast.
- In March 2016, the Canada Energy Regulator released a study of the Liard Basin, estimating that it contained 219 Tcf of marketable, unconventional natural gas, making it the ninth-largest shale gas resource in the world. [22, 23]

Production and consumption

- In 2021, Canada produced 6.7 Tcf of dry natural gas and was the sixth-largest producer behind the United States, Russia, Iran, China, and Qatar (Figure 4). Most of Canada's natural gas production occurs in the prolific WCSB.
- Although Canada's production of conventional natural gas has been declining, unconventional natural gas liquids production in the Montney formation has been rising, driven by drilling activities related to liquefied natural gas (LNG) export projects. Canada's shale gas production potential has been limited because LNG export facilities along the West Coast face continued delays in obtaining the environmental approvals required to link natural gas supplies to the LNG facilities.
- In 2021, natural gas consumption rebounded to 4.7 Tcf following a 2% decline during the COVID-19 pandemic, consistent with an overall energy consumption decrease (Figure 4). [24,25]

- Growth in Canada's natural gas-fired electric power sector will be driven by new power plants, many of which are being developed to replace coal-fired power plants.[26]

Figure 4. Canada's dry natural gas production and consumption



Source data: U.S. Energy Information Administration, *International Energy Statistics*; 2020 and 2021 estimations based on BP Statistical Review of World Energy, 2022

Trade

- Almost all of Canada's natural gas exports go to the United States. In 2021, 99% of all U.S. natural gas imports came from Canada. Most of Canada's natural gas exports to the United States originate in Western Canada and are piped to U.S. markets in the West and Midwest regions.[27]

Liquefied Natural Gas (LNG)

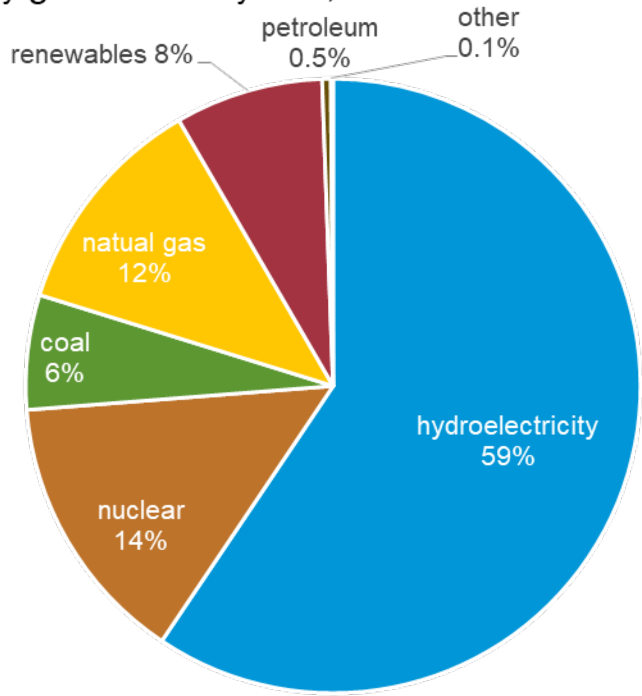
- Currently, Canada does not have any LNG export capacity in operation. As of 2020, 18 LNG export facilities had been proposed, with approximately 29 billion cubic feet per day (Bcf/d) of capacity across British Columbia, Nova Scotia, and Quebec. The projects vary in size and scope, but nearly all of the proposed facilities are by non-producers of Canada's natural gas.[28]
- Only LNG Canada, located in Kitimat, British Columbia, was approved and is currently under construction. LNG Canada is expected to be online in 2025. The export facility will initially consist of two LNG processing trains with a combined export capacity of 3.5 Bcf/d.[29] In the future, the facility might expand to four trains. However, opposition against the Coastal Gas Link pipeline, which is expected to feed the terminal, has intensified and could delay project construction. In February 2022, the Coastal GasLink pipeline work camp was attacked.[30]

Electricity

- Canada generated 641 billion kilowatthours (kWh) of electricity in 2021, and nearly 60% of total generation was hydroelectric.[31] Only China and Brazil produce more hydroelectricity than Canada on a kWh basis.[32] Nuclear and natural gas plants satisfy most of Canada's electricity needs not met by hydroelectricity (Figure 5).

- Canada has three power grids: the Western grid, the Eastern grid, and the Quebec grid. The border between the Eastern and Western grids is the Alberta-Saskatchewan border. Canada's grids are also tied into the United States' grids through 37 major transmission lines from New England to the Pacific Northwest.[33]
- The Canada Energy Regulator (CER) describes Canada's electricity grid as "fragmented," with few grid connections that link different locations together. Most of these areas generally supply electricity to meet their own demand. The large grid connections primarily connect provinces to the United States and electricity flows north to south. Only Nunavut in Canada does not have an electricity grid, and the territory relies on local diesel generation.[34]

Figure 5. Electricity generation by fuel, 2021



Data source: *BP Statistical Review of Energy, 2022*

Hydroelectricity

- About 60% of Canada's electricity was generated with hydropower in 2020.[35] That year, Canada was the third-largest producer of hydroelectricity in the world.
- Hydroelectricity has been the main source of power generation in Canada for more than a century.[36] British Columbia, Manitoba, Quebec, Ontario, Newfoundland, and Labrador use hydropower to meet most of their electricity demand. All provinces and territories produce hydroelectricity except Nunavut and Prince Edward Island.[37]
- Several large hydroelectric projects are under construction. These projects include the 1,100 megawatt (MW) Site-C in British Colombia, the 695 MW Keeyask Project in Manitoba, two new generation units with a combined capacity of 640 MW at La Romaine in Quebec,[38] and the 824 MW Muskrat Falls project in Labrador.[39]

Other renewables

- Canada has potential for large renewable energy development in wind, solar, and biomass. The development of non-hydroelectricity renewable energy in Canada is led by the federal and province commitments to reduce carbon emissions in the electricity sector and to increase renewables by 2030. According to Natural Resources Canada, renewable electricity generation increased 18% between 2010 and 2019. Solar and wind contributed the most to the growth.[40]
- The Canada Energy Regulator forecasts that wind capacity will triple over the next 20 years, driven by favorable market conditions and abundant, high-quality wind resource. Solar photovoltaic (PV) is mostly located in Ontario, but British Columbia, Saskatchewan, and Alberta are developing solar PV capacity.[41]
- In November 2015, the government of Alberta announced it would phase out coal-fired power generation by 2030. Renewables and natural gas-fired power plants will replace two-thirds of the coal-fired power capacity.[42,43]
- SaskPower, the main public utility in Saskatchewan, announced that it will increase the share of renewables in its portfolio from 25% to 50% by 2030. The company plans to invest in wind, solar, geothermal, hydropower, and biomass.[44]
- To further support the growth of renewables in electricity, the Smart Renewables and Electrification Pathways Program was announced in June 2021, providing up to $960 million over four years for smart renewable energy and electrical grid modernization projects.[45]

Trade

- Canada is a net exporter of electricity to the United States, which accounts for a small, although locally important, share of bilateral trade. The United States imported 48 million megawatt hours (MWh) of electricity from Canada in 2021, primarily into the Northeast and Midwest. In 2021, the United States exported 10 million MWh to Canada, nearly all of which was from the Pacific Northwest.

Coal

Reserves

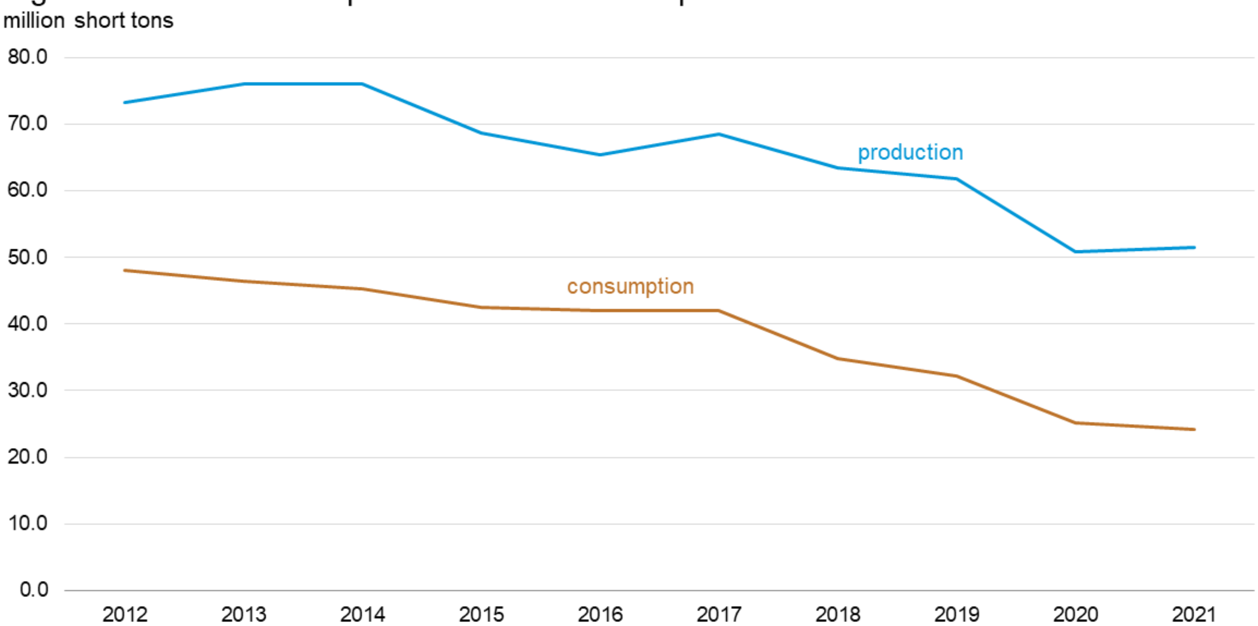
- Canada's total proved coal reserves were about 6.6 billion short tons in 2020.[46] More than 60% of the reserves are anthracite and bituminous coal. The remaining reserves are subbituminous and lignite coal.[47] Coal resources are located across the country, but they are actively mined and produced in Alberta, British Columbia, and Saskatchewan.

Production and consumption

- In 2021, Canada produced 52 million short tons of coal, a slight increase from the previous year. More than 50% of Canada's coal is produced in British Colombia.[48] About 32% of Canada's coal is consumed domestically, which is less than the 5-year average (42%).
- In 2020, thermal coal, which is used for electricity generation, accounted for 93% of coal consumed in Canada while metallurgical coal, which is used for steel manufacturing, accounted for 7%.
- The government of Canada has committed to phasing out its coal generation capacity by 2030. Four provinces operate coal-fired power plants: Alberta, Saskatchewan, New Brunswick, and Nova Scotia. The federal government enacted emissions requirements that require coal-fired

power plants to be shut down at the end of their life expectancy or be retrofitted with carbon capture and storage technology.[49]

Figure 6. Canada's coal production and consumption



Data source: U.S. Energy Information Administration, *International Energy Statistics*; 2021 data from BP *Statistical Review of Energy, 2022*

Trade

- In 2020, Canada exported more than half of the coal it produced, primarily metallurgical coal. Canada is the world's third-largest exporter of metallurgical coal after Australia and the United States.
- Most of Canada's coal exports go to Asia.[50, 51] In 2021, Japan, China, and South Korea, cumulatively, accounted for 74% of Canada's total steam coal exports and 72% of total metallurgical coal exports. In addition, 10% of total metallurgical coal exports from Canada went to OECD Europe.[52]

Notes

- Data presented in the text are the most recent available as of June 15, 2022.
- Data are EIA estimates unless otherwise noted.

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