

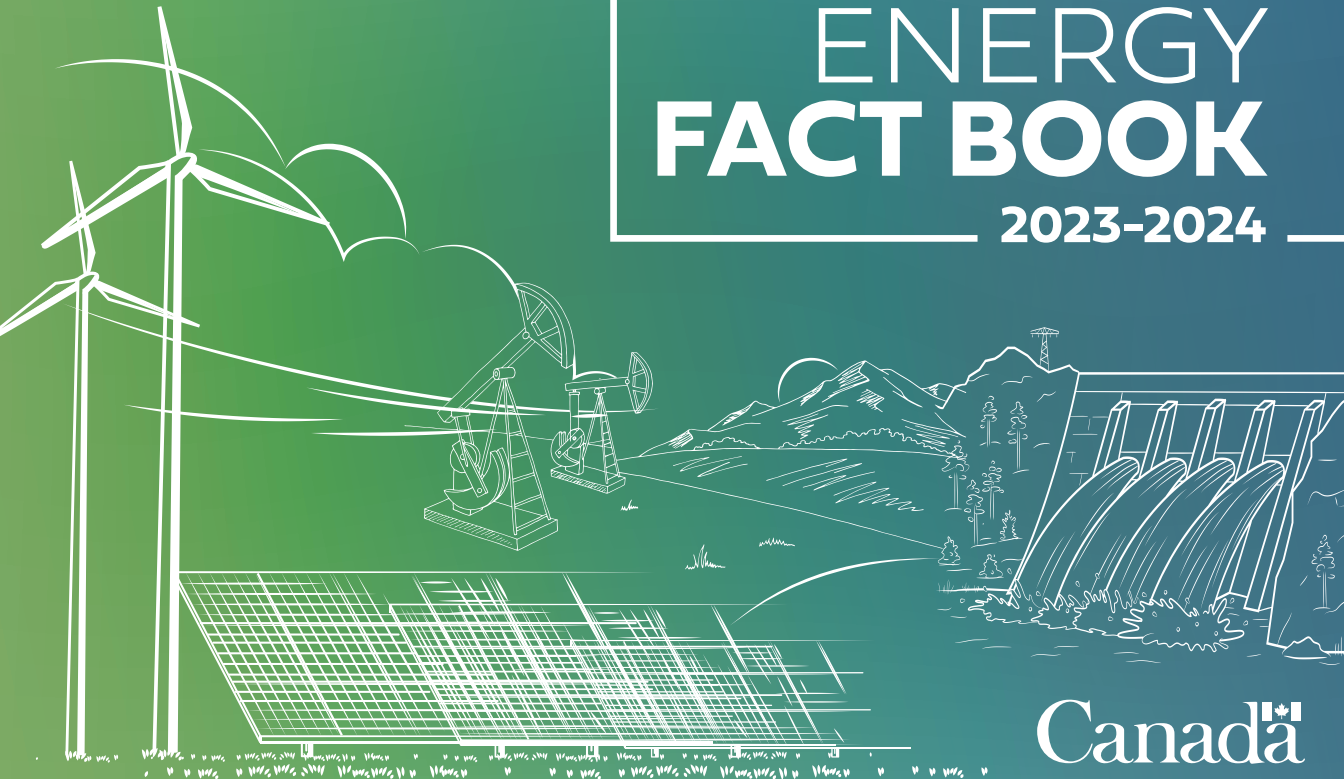


Natural Resources
Canada

Ressources naturelles
Canada

ENERGY FACT BOOK

2023-2024



Canada



Natural Resources
Canada

Ressources naturelles
Canada

ENERGY **FACT BOOK** 2023–2024

Canada 

Aussi disponible en français sous le titre : Cahier d'information sur l'énergie, 2023-2024

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PREFACE

The purpose of the *Energy Fact Book* is to provide key information on energy markets in Canada in a format that is easy to consult. Resources including a summary of units and conversion factors, abbreviations, and data sources used throughout this publication are available in the annexes.

All data is subject to revisions by statistical sources. In some instances, more than one source may be available and discrepancies in numbers may occur because of conceptual or methodological differences. In addition, some numbers may not add up precisely due to rounding.

This publication was assembled by the Energy and Economic Analysis Division of the Energy Policy Branch with the help of subject experts from across Natural Resources Canada (NRCan).

For questions or comments, contact NRCan at **energyfacts-faitsenergetiques@nrcan-rncan.gc.ca**.

In this publication, energy industries are generally considered to include oil and gas extraction; coal mining; uranium mining; electric power generation, transmission and distribution; pipeline transportation; natural gas distribution; biofuels production; petroleum refineries; and support activities for oil and gas extraction. The petroleum sector is a subset of these industries, and in this publication consists of oil and gas extraction and support activities, pipeline transportation and distribution of oil and gas, and petroleum refineries.

Clean energy industries such as renewable and nuclear electricity generation, biofuels production and carbon capture and storage facilities are contained within the definition of energy industries. Some energy-related industries (e.g. petroleum product wholesaler-distributors and coal product manufacturing) are excluded because of a lack of data.

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INTRODUCTION

From an energy perspective, Canada is very fortunate. We have a large land mass, small population and one of the largest and most diverse supplies of energy in the world. Our rivers discharge close to 7% of the world's renewable water – a tremendous source of hydroelectric power. We have the fourth-largest proven oil reserves and third-largest reserves of uranium; our energy resources are a source of strength that continues to shape our economy and society.

Canada is at the forefront of innovative technologies for how we produce and use energy. For example, low- or non-emitting forms of energy are growing in significance as part of our evolving electricity mix. In fact, wind and solar photovoltaic (PV) energy are the fastest-growing sources of electricity generation in Canada. In addition, technological advancements, such as co-generation, have resulted in an increase in energy-efficient practices and a reduction in greenhouse gas (GHG) emissions in areas such as the oil sands. Ongoing developments in areas such as grid-scale electricity storage, carbon capture and storage, hydrogen, and electric and alternative fuel vehicles have the potential to further transform the energy system.

For over ten years, the *Energy Fact Book* has provided a solid foundation for Canadians to understand and discuss important developments across the energy sector. A significant milestone in Canadian energy information was achieved in 2019 with the launch of the Canadian Center for Energy Information (CCEI). Housed at Statistics Canada, the CCEI brings together Canada's existing energy information in one place, facilitating access to products like the *Energy Fact Book*.

Section 1:

Key Energy, Economic and Environmental Indicators

Energy production and supply

Economic contributions

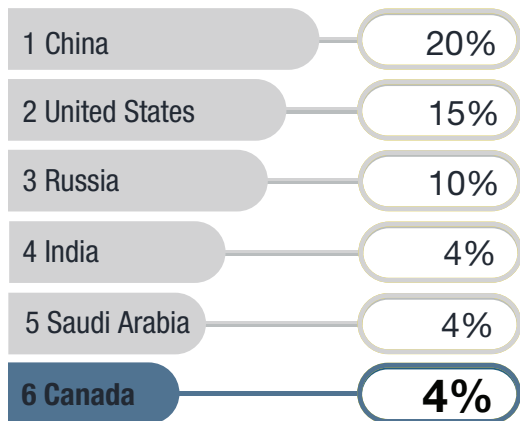
Energy and GHG emissions

ENERGY PRODUCTION AND SUPPLY

CANADA: A GLOBAL ENERGY LEADER

The amount of primary energy produced by Canada in 2021 is **35% more** than in 2005. The world, on average, has increased energy production by **27%** in the same period.

WORLD TOTAL PRIMARY ENERGY PRODUCTION TOP ENERGY PRODUCERS, 2021



GLOBAL ENERGY RANKINGS FOR CANADA

	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

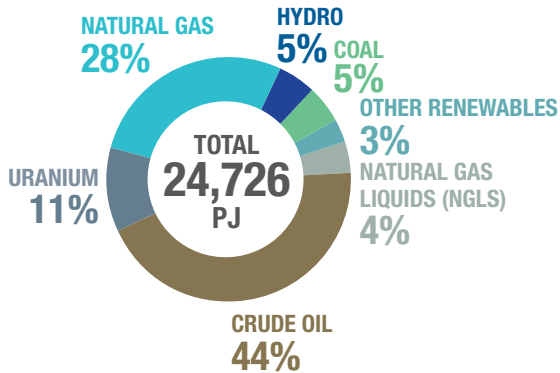
CANADIAN ENERGY PRODUCTION

Primary energy is energy that is found in nature before any processing or conversion. The *Energy Fact Book* calculates primary energy production by using two methods. The first method treats the energy embodied in uranium as primary energy, thereby capturing the uranium Canada produces and then exports. This method provides a more accurate picture of energy production in Canada.

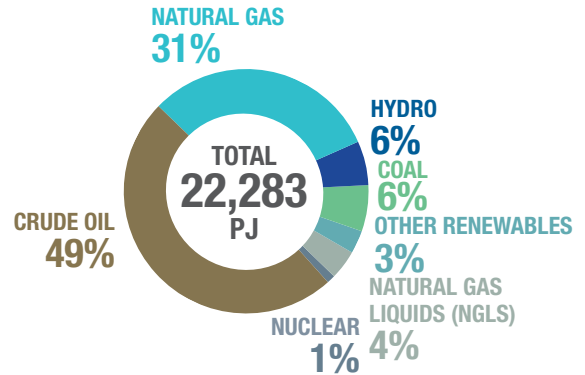
The second method—also employed by the International Energy Agency (IEA), the Energy Information Administration (EIA) and others—treats domestic electricity production from nuclear energy as primary energy, but not uranium itself. Uranium is energy-dense, and Canada exports most of its uranium production, which explains why the two methods produce such different results.

PRIMARY ENERGY PRODUCTION BY SOURCE (2021)

PRIMARY ENERGY PRODUCTION,
INCLUDING URANIUM



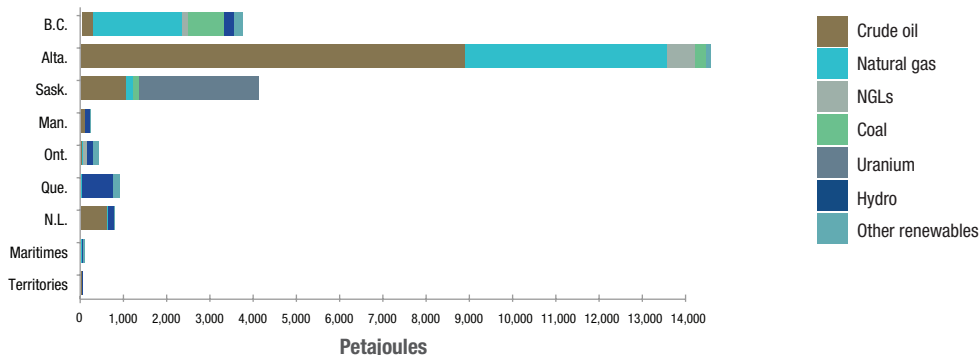
PRIMARY ENERGY PRODUCTION,
EXCLUDING URANIUM



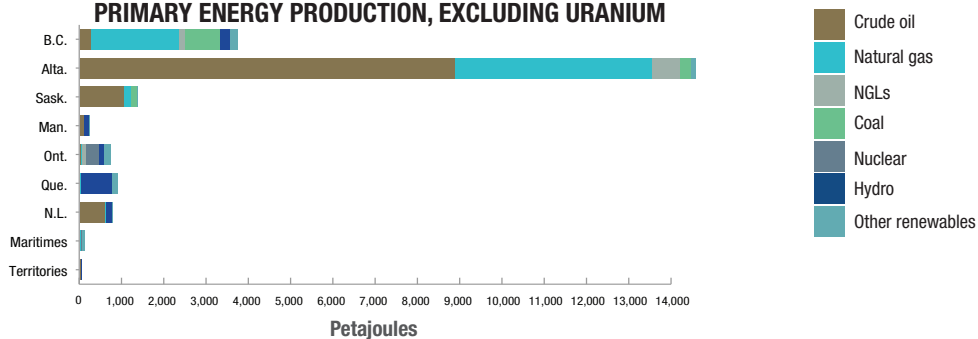
"Other renewables" includes wind, solar, wood/wood waste, biofuels and municipal waste.

PRIMARY ENERGY PRODUCTION BY REGION AND SOURCE (2021)

PRIMARY ENERGY PRODUCTION, INCLUDING URANIUM



PRIMARY ENERGY PRODUCTION, EXCLUDING URANIUM

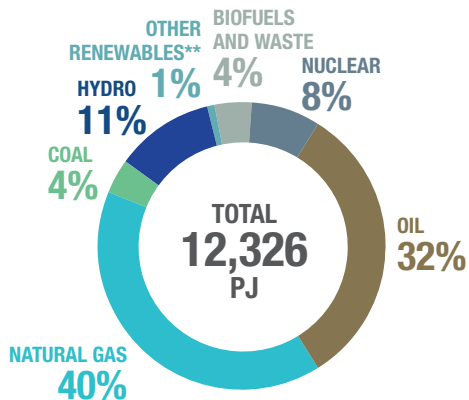


CANADA'S ENERGY SUPPLY

A look at Canada's total energy supply (TES) helps to better understand the impact of energy sources on GHG emissions. The TES¹ is calculated as:

$$\text{TES} = \text{PRODUCTION} + \text{IMPORTS} - \text{EXPORTS} + \text{STOCK CHANGES}$$

**CANADA TOTAL ENERGY SUPPLY,*
BY SOURCE, 2021**



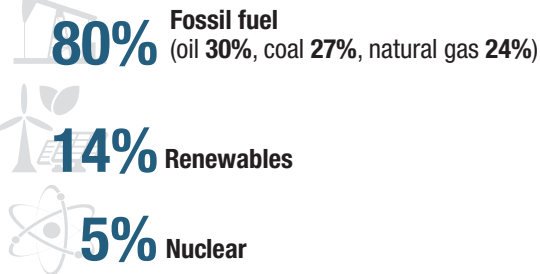
* not including electricity trade

**"Other renewables" includes wind, solar and geothermal.

¹ For the purposes of TES, electricity production is calculated by using the energy content of the electricity (i.e. at a rate of 1 TWh = 0.086 Mtoe), with the exception of nuclear electricity, which is calculated assuming a 33% conversion efficiency factor increase (i.e. 1 TWh = 0.086 ÷ 0.33 Mtoe).

- Fossil fuels made up **76%** of Canada's TES in 2021.
- Renewable energy sources made up **16.6%** of Canada's TES in 2021.

Comparatively, the global TES is made up of

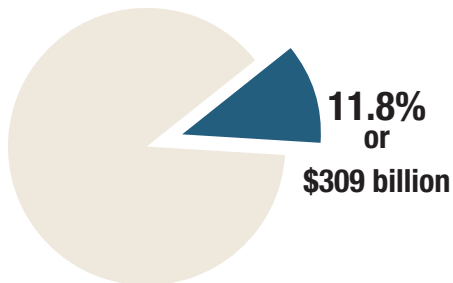


ECONOMIC CONTRIBUTIONS

NOMINAL GROSS DOMESTIC PRODUCT (2022)

ENERGY'S NOMINAL GDP CONTRIBUTION FOR CANADA

NOMINAL GDP (% OF CURRENT DOLLARS)



CANADIAN GDP

ENERGY DIRECT 9.4% (\$245 billion)

PETROLEUM 7.2%

ELECTRICITY 1.7%

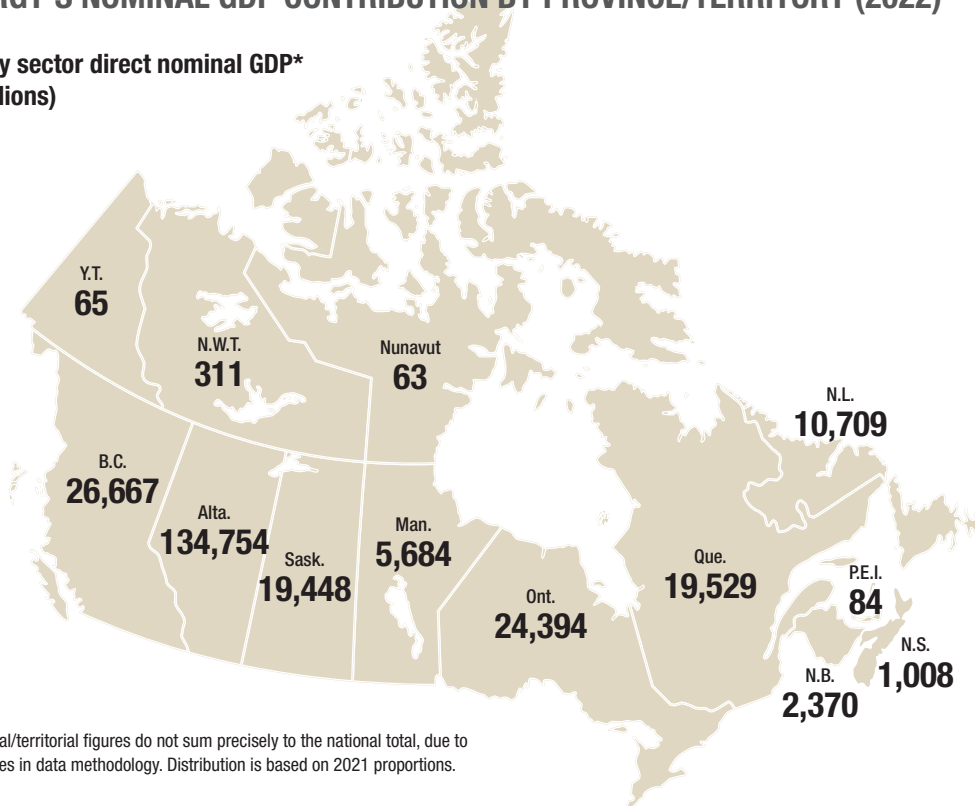
OTHER 0.5%

ENERGY INDIRECT 2.4% (\$64 billion)

Parts may not sum to total due to rounding. For more information on the methodology used by Statistics Canada to estimate indirect contributions, please contact statcan.iadinfoddc-dciinfoiad.statcan@statcan.gc.ca.

ENERGY'S NOMINAL GDP CONTRIBUTION BY PROVINCE/TERRITORY (2022)

Energy sector direct nominal GDP*
(\$ millions)



*Provincial/territorial figures do not sum precisely to the national total, due to differences in data methodology. Distribution is based on 2021 proportions.

EMPLOYMENT IN CANADA'S ENERGY SECTOR (2022)

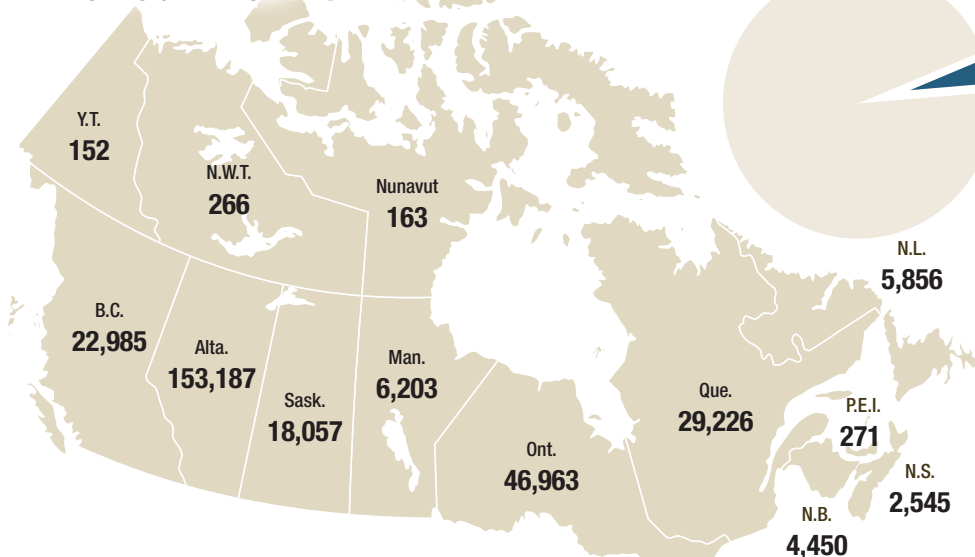
DIRECT: 290,300 JOBS

INDIRECT: 405,800 JOBS

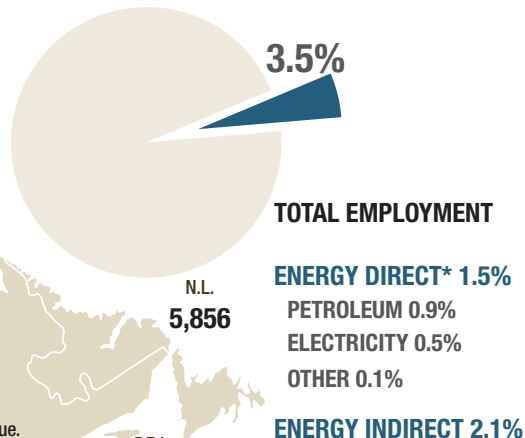
TOTAL: 696,100 JOBS

- About **15,800 Indigenous people** are directly employed in the energy sector.

ENERGY SECTOR DIRECT EMPLOYMENT BY PROVINCE/TERRITORY*



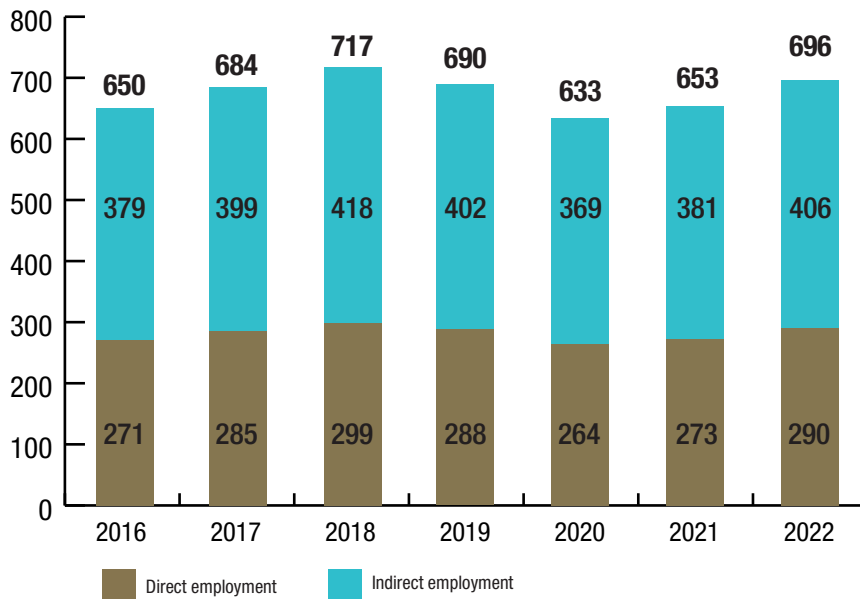
SHARE OF TOTAL EMPLOYMENT, 2022



*Provincial/territorial and sectoral employment figures do not sum precisely to the national total due to rounding.

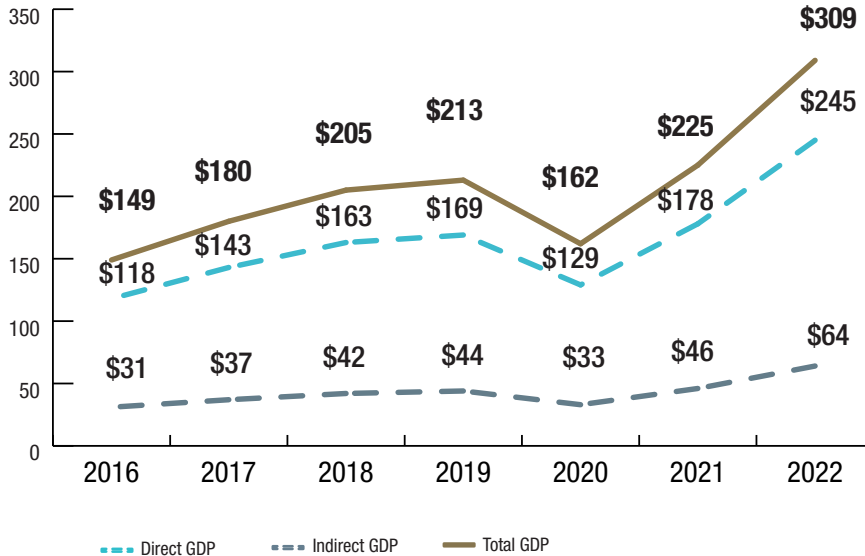
The indirect contribution is not comparable to previously published estimates due to revisions and a change in estimation methodology by Statistics Canada. For more information on Statistics Canada's estimation methodology, please contact statcan.iadinfoddc-dciinfoiad.statcan@statcan.gc.ca.

ENERGY SECTOR EMPLOYMENT (Thousands of jobs)



Parts may not sum to total due to rounding. The indirect contribution is not comparable to previously published estimates due to revisions and a change in estimation methodology by Statistics Canada. For more information on Statistics Canada's estimation methodology, please contact statcan.iadinfoddc1-dciinfoiad.statcan@statcan.gc.ca.

ENERGY SECTOR GDP (Billions of dollars)



Parts may not sum to total due to rounding. The indirect contribution is not comparable to previously published estimates due to revisions and a change in estimation methodology by Statistics Canada. For more information on Statistics Canada's estimation methodology, please contact statcan.iadinfoddc-dciinfoiad.statcan@statcan.gc.ca.

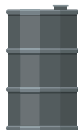
ENERGY TRADE (2022)

Energy exports

\$240.5 billion
representing

33%

of total Canadian
goods exports

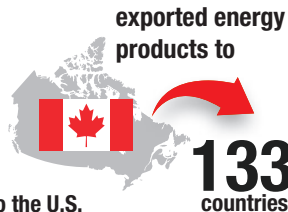


Oil and gas domestic
exports totalled

\$217 billion

of which

96% were to the U.S.



The U.S. accounts for



90%

of energy exports
by value
(\$216.5 billion)

Exports to the U.S.



Crude oil

Natural gas

Electricity

Coal

% of Canadian exports destined for U.S.	% of Canadian production exported to U.S.	% of U.S. imports coming from Canada	% of U.S. consumption supplied by Canada
97	77	60	24
100*	46	99	9
100	8	92	1
3	1	28	0.3

*Canada exports trace amounts of Liquefied Natural Gas (LNG) to trade partners other than the United States.

Energy imports

\$65.3 billion
representing



of total Canadian
goods imports

imported energy
products from



117
countries

The U.S. accounts for



76%

of energy imports
by value
(\$50 billion)

Imports from the U.S.



Crude oil



Natural gas



Electricity



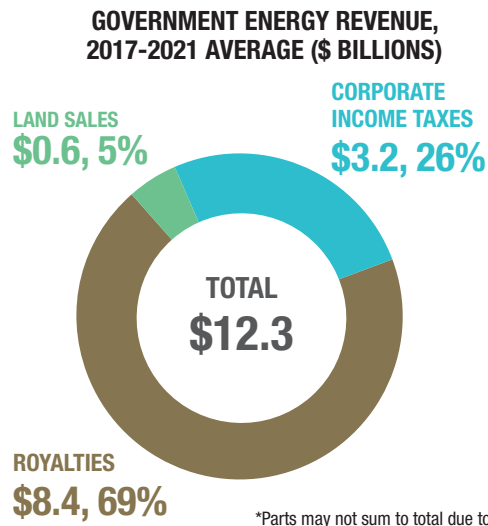
Coal



% of Canadian imports originating from U.S.	% of U.S. exports destined for Canada	% of Canadian consumption supplied by U.S.
50	9	20
99	14	20
100	67	2
75	5	28

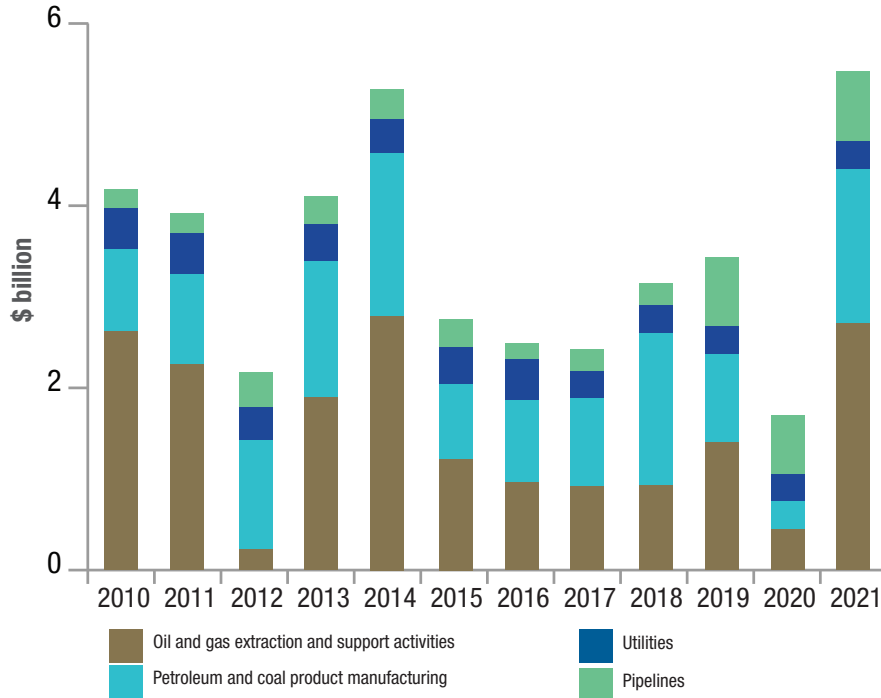
GOVERNMENT REVENUES

Federal and provincial/territorial governments in Canada receive direct revenues from energy industries through corporate income taxes, crown royalties, which are the share of the value of oil and gas extracted that is paid to the Crown as the resource owner, and crown land sales, which are paid to the Crown in order to acquire the resource use for specific properties.



- An important share of government revenues is collected from the petroleum sector, which averaged **\$12 billion** over the last five years, including **\$10 billion** from upstream oil and gas extraction and its support activities.
- Between 2017 and 2021, the energy sector's share of taxes paid by all industries was **4.6%**. Operating revenues of the energy sector represented **8.6%** of all operating revenues earned by industries in Canada.

CORPORATE INCOME TAXES PAID BY ENERGY INDUSTRIES (Federal and Provincial)



ENERGY AND GHG EMISSIONS



In 2020,

77%

of global GHG emissions from human activity were from the production and consumption of energy.



This includes activities such as using gasoline for transportation, fossil fuel-fired electricity generation, oil and gas production, and heating and cooling buildings.



In Canada, **about 81%** of emissions come from energy. Canadians use more energy because of our extreme temperatures, vast landscape and dispersed population.

The challenges of **transitioning to a lower-carbon energy system** are numerous, but they also present opportunities for **Canada to be a global leader by supporting innovative technologies in the energy sector**, including promoting our growing renewables and cleantech sectors.



Since 2000, there has been a decoupling between the growth of Canada's economy and GHG emissions, largely because of technological improvements, regulations, and more efficient practices and equipment.

In 2021, emissions increased slightly as economic activity began to recover from the impacts of the COVID-19 pandemic, with 2021 emissions 53 Mt lower than in 2019 (-7.4%).


Between 2000 and 2021,
Canada's GHG emissions
decreased by

 **6.8%**

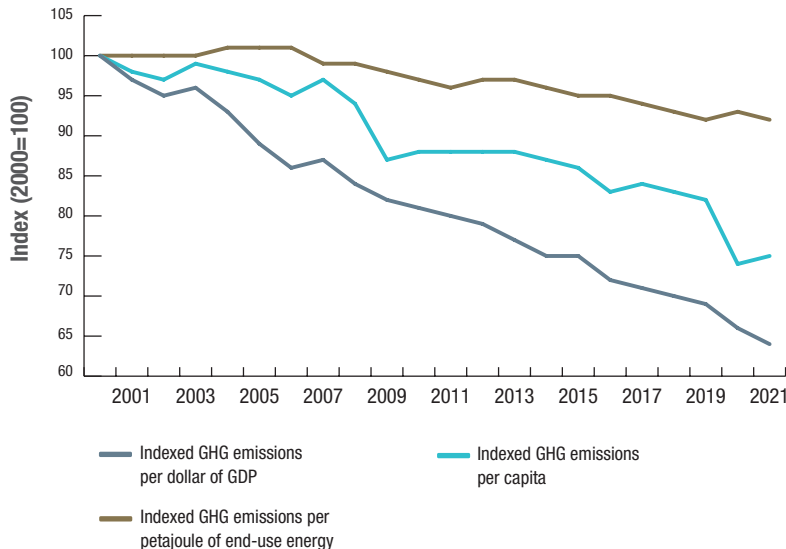
while GDP increased

 **46%**

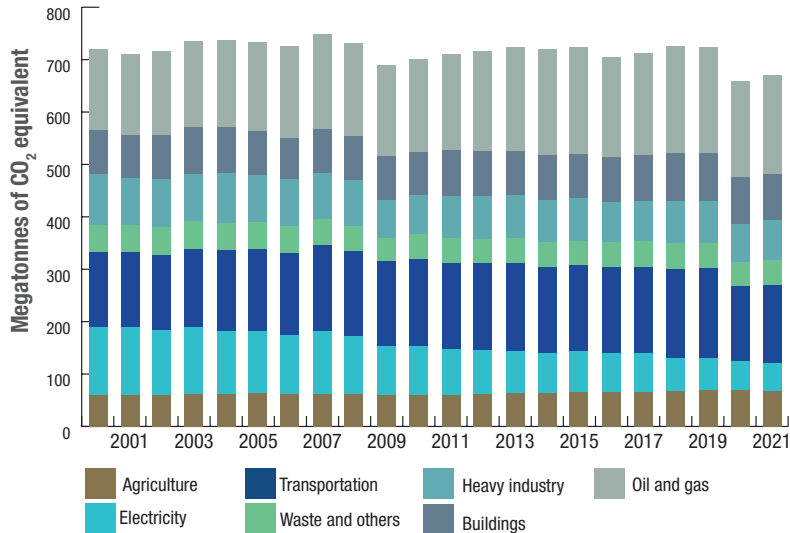
GHG emissions decreased

 **36%**
per dollar of GDP and
25%
per capita.

INDEXED TREND IN GHG EMISSIONS PER PERSON, PER UNIT OF GDP AND PER UNIT OF ENERGY CONSUMED, 2000–2021



GHG EMISSIONS BY CANADIAN ECONOMIC SECTOR, 2000–2021



- Between 2000 and 2021, **emissions from electricity production decreased 60%**, largely because of Ontario's successful coal phase-out action plan, which started in 2001.
- **Emissions from oil and gas production increased 23%** largely due to an increase of 59% in production.
- **Emissions from heavy industry have decreased by 21%** despite an increase in output of the industrial sector. This is due in part to improvements in energy efficiency and fuel switching.

Section 2:

Investment

Capital expenditures

Canada's Energy Infrastructure and Major Energy Projects

Foreign Direct Investment and Canadian Direct Investment Abroad

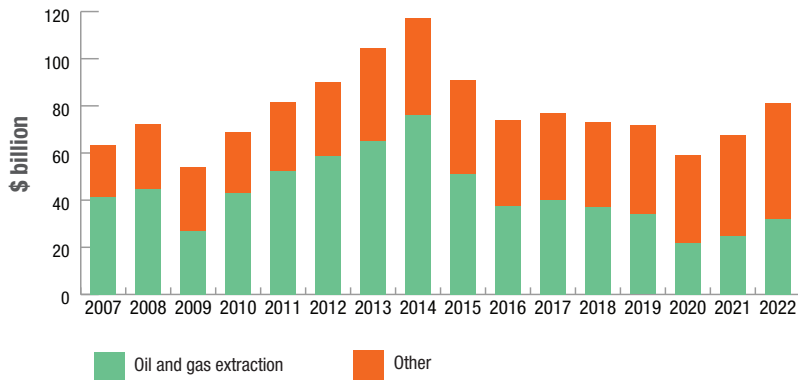
Canadian Energy Assets Abroad, foreign control of assets

RD&D and Mission Innovation

Environmental Protection Expenditures

CAPITAL EXPENDITURES

Capital expenditures* in the energy industry, 2007-2022

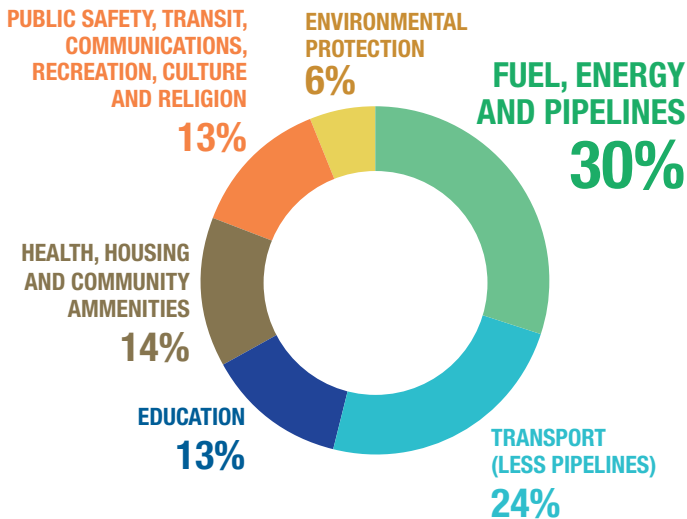


- Capital expenditures in Canada's energy sector totaled **\$80 billion** in 2022, a decrease of 32% from a peak in 2014.
- After reaching an eleven year low of **\$59 billion** in 2020, investment has rebounded to **\$80 billion** in 2022.
- Oil and gas extraction was the largest area of energy sector capital expenditure at **\$31.9 billion** in 2022, followed by electrical power generation and distribution (\$27.6 billion).

*Excludes residential expenditures and intellectual property investments such as exploration expenses. Includes investments in renewable electricity, does not capture other forms of renewable energy.

CANADA'S ENERGY INFRASTRUCTURE

Fuel, energy and pipeline infrastructure made up the largest proportion of Canada's infrastructure at **30%** of net stock in 2022.



Statistics Canada defines infrastructure as:

“

the physical structures and systems that support the production of goods and services and their delivery to and consumption by governments, businesses and citizens.

”

Fuel, energy and pipeline infrastructure includes electric power infrastructure like wind and solar, hydro, nuclear, and thermal generation, power transmission and distribution lines and oil and gas pipelines.

FUEL, ENERGY AND PIPELINE INFRASTRUCTURE INVESTMENT AND OPERATIONS

supported
142.6k jobs

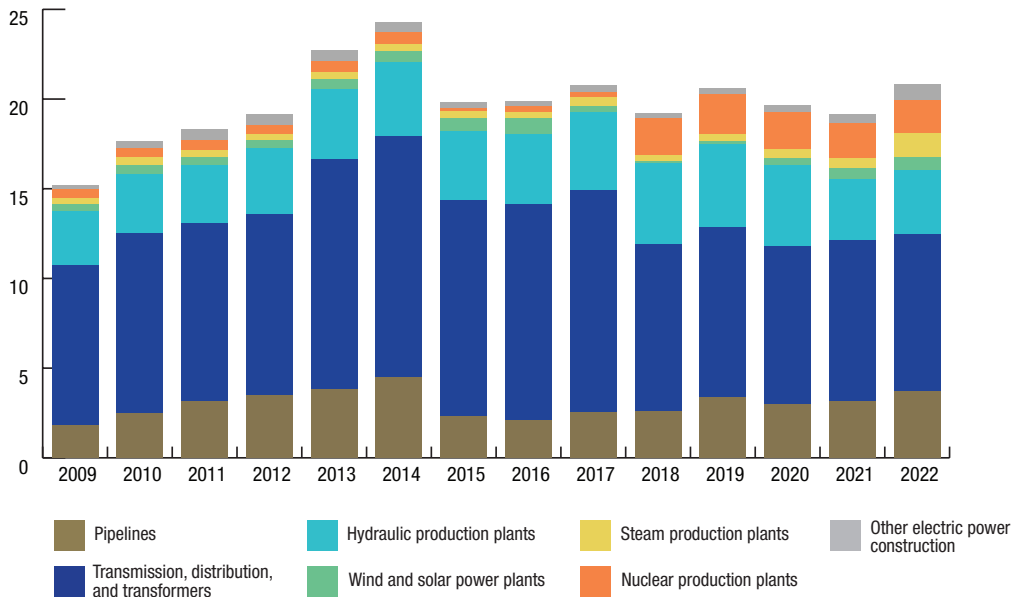
generated **\$12.2 billion**
in employment income

and **\$22.8 billion**
in GDP
in 2022
(direct and indirect contributions).



Public and private investment in fuel, energy and pipeline infrastructure in 2022 was **\$29.5 billion** (nominal).

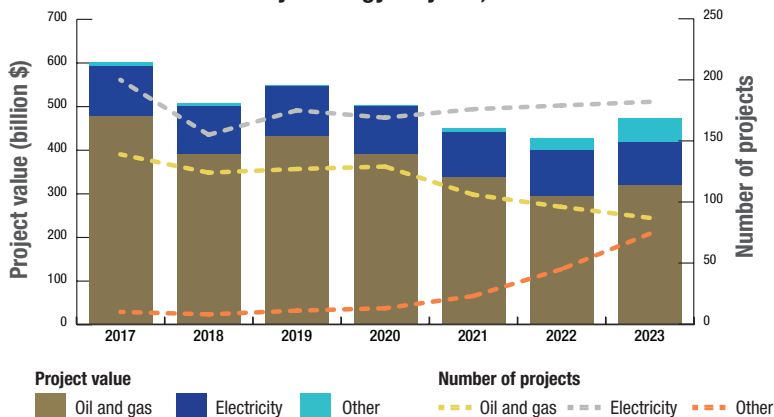
Public and private investment in fuel, energy and pipeline infrastructure, billion \$ (constant 2012)



CANADA'S MAJOR ENERGY PROJECTS

- In 2023, there were 223 planned (announced, under review, or approved) energy projects worth **\$294B**, and 120 energy projects under construction worth **\$180B**.
- Oil and gas sector projects accounted for the largest portion of project value (\$319B), while there were more electricity projects overall (182).
- There were **233 clean technology projects** valued at **\$159B**.

Trends in Major Energy Projects, 2017-2023



Natural Resources Canada's Major Projects Inventory captures information on major natural resource projects in Canada that are either currently under construction or planned in the next 10 years.

Minimum capital thresholds for inclusion are: **\$50 million** for oil and gas, **\$20 million** for electricity, and **\$10 million** for other clean energy or technology projects.

Projects that are either announced, under review, approved and under construction are included.

CLEAN TECHNOLOGY PROJECT TRENDS 2018-2023

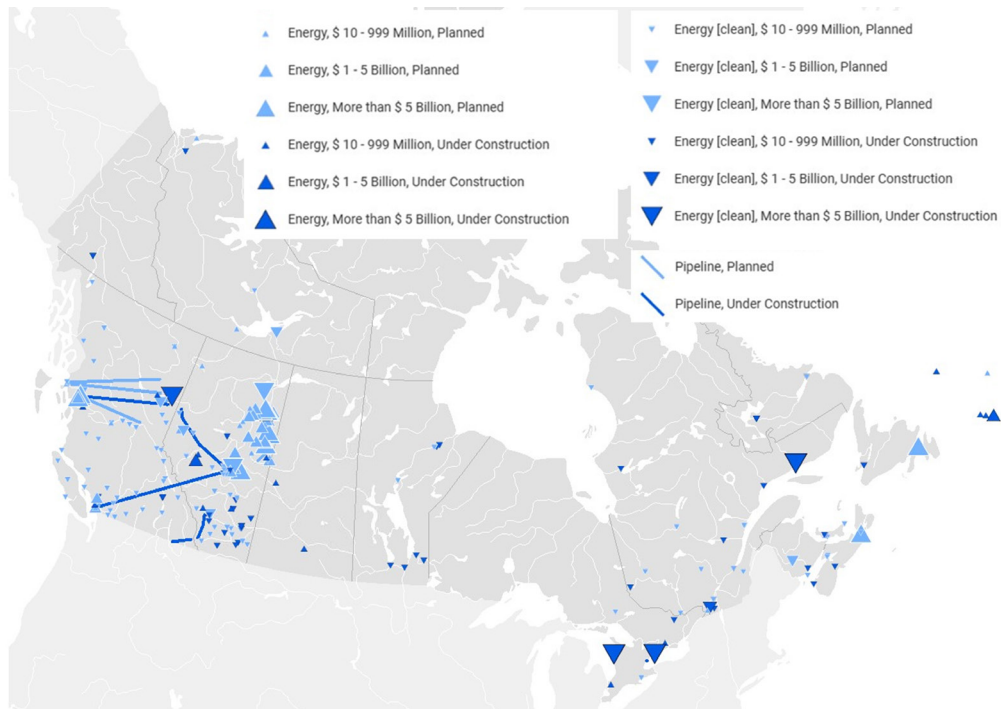
	2018	2019	2020	2021	2022	2023
Total Clean Technology Projects	144 projects (\$109.5B)	151 projects (\$99.3B)	159 projects (\$99.4B)	178 projects (\$104B)	197 projects (\$118B)	233 projects (\$159B)
Hydro	65 projects (\$48.2B)	70 projects (\$50.0B)	61 projects (\$52.0B)	58 projects (\$39.2B)	63 projects (\$44.8B)	78 projects (\$38.9B)
Wind	27 projects (\$9.1B)	31 projects (\$9.4B)	36 projects (\$8.3B)	41 projects (\$14.6B)	35 projects (\$13.4B)	31 projects (\$12.3B)
Biomass/Biofuels	33 projects (\$6.4B)	32 projects (\$3.0B)	29 projects (\$4.6B)	31 projects (\$8.0B)	35 projects (\$9.4B)	42 projects (\$13.8B)
Solar	7 projects (\$0.9B)	6 projects (\$0.7B)	13 projects (\$1.4B)	22 projects (\$2.2B)	30 projects (\$3.0B)	31 projects (\$6.2B)
Nuclear	5 projects (\$28.5B)	5 projects (\$28.5B)	3 projects (\$26.1B)	4 projects (\$27.4B)	3 projects (\$26.1B)	2 projects (\$25.8B)
Carbon Capture and Storage	3 projects (\$16.3B)	2 projects (\$7.2B)	1 project (\$6.0B)	2 projects (\$11.3B)	6 projects (\$15.5B)	9 projects (\$38.3B)
Geothermal	1 project (\$0.0B)	2 projects (\$0.2B)	3 projects (\$0.3B)	5 projects (\$0.4B)	4 projects (\$0.4B)	4 projects (\$0.4B)
Tidal	0 project (\$0.0B)	1 project (\$0.1B)	6 projects (\$0.3B)	6 projects (\$0.3B)	7 projects (\$0.4B)	7 projects (\$0.4B)
Multiple¹	0 project (\$0.0B)	0 project (\$0.0B)	0 project (\$0.0B)	1 project (\$0.03B)	1 project (\$0.03B)	1 project (\$0.03B)
Other²	3 projects (\$0.1B)	2 projects (\$0.1B)	7 projects (\$0.4B)	8 projects (\$0.5B)	13 projects (\$5.3B)	28 projects (\$22.6B)

Certain values from 2020 to 2022 have been revised due to updated data.

¹ The Haida Gwaii Clean Energy Project is a multi-phased project consisting of hydro and solar sites.

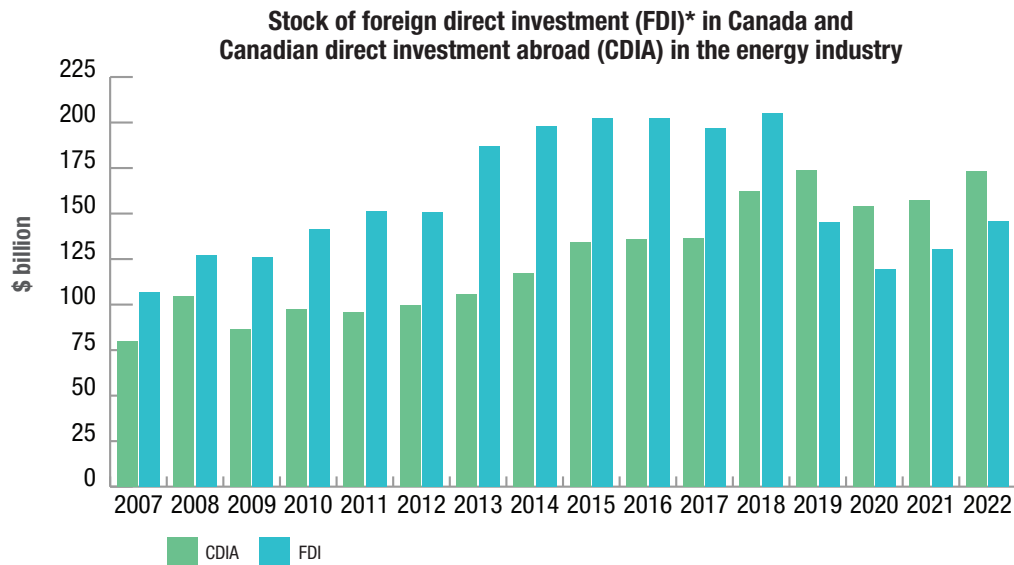
² "Other" includes novel initiatives such as micro-grid projects, battery storage projects, bioplastics, and a helium purification plant.

MAJOR ENERGY PROJECTS PLANNED AND UNDER CONSTRUCTION, 2023-2033



INTERNATIONAL INVESTMENTS AND INVESTORS

Canada's energy industries operate in free markets, where investments by both Canadian and foreign companies ensure an efficient, competitive and innovative energy system.



* Direct investment is defined as a company owning a minimum of 10% of voting equity interest in a foreign enterprise and is measured as the total equity value at the time of acquisition. Excludes residential expenditures and intellectual property investments such as exploration expenses.

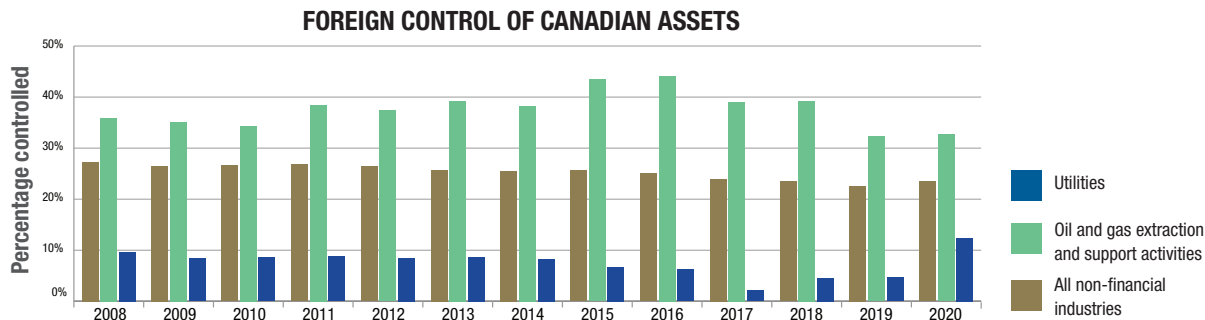
FDI and CDIA include investments in renewable electricity, do not capture other forms of renewable energy.

STOCK OF FOREIGN DIRECT INVESTMENT IN CANADA AND CANADIAN DIRECT INVESTMENT ABROAD

- The stock of **foreign direct investment (FDI)** in the energy sector rose in 2022 to **\$146 billion** (+11.9% over the previous year).
- The energy industry's share of overall FDI in Canada was **12%** in 2022, increasing from 11% in 2021.
- The stock of **Canadian direct investment abroad (CDIA)** was valued at **\$173 billion** in 2022, up 10% from 2021.
- Investment in oil and gas extraction accounted for **\$32 billion** of the CDIA stock in 2022.

FOREIGN CONTROL OF CANADIAN ASSETS

Foreign control is a measure of the extent to which foreign entities operate in Canada. Generally, a corporation is deemed to be foreign-controlled if **more than 50%** of its shares are owned by one or more foreign companies.



CANADIAN ENERGY ASSETS

The total value of Canadian* energy assets (CEA) went down in 2020 to **\$695 billion**, a slight decrease of **2.5%** from **\$712 billion** in 2019. In 2020, domestic CEA totaled **\$480 billion**, **down 4.0%** from 2019, while CEA abroad totaled **\$215 billion**, up from **\$213 billion**.

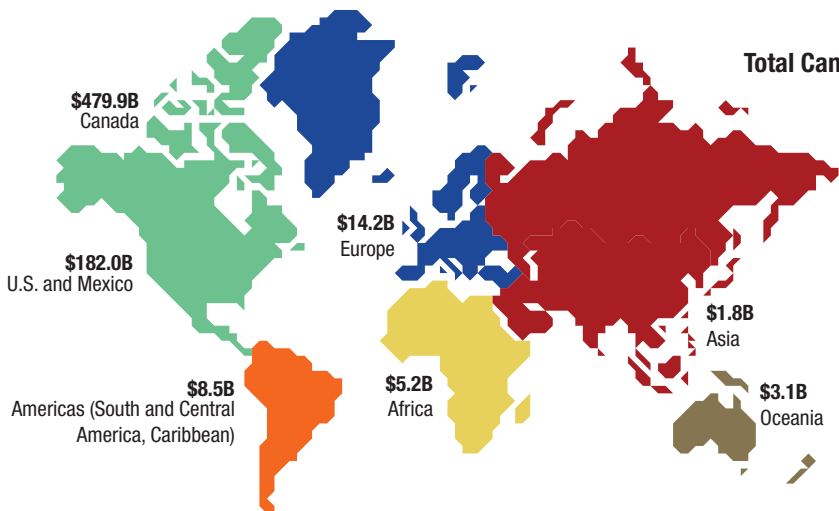
CANADIAN ENERGY ASSETS BY REGION, 2020

Total Canadian energy assets

\$695B

Total Canadian energy assets abroad

\$215B



* A Canadian company is here defined as a publicly traded company headquartered in Canada and not foreign-controlled.

RESEARCH, DEVELOPMENT AND DEMONSTRATION

CANADIAN TOTAL EXPENDITURES ON ENERGY RD&D

In 2021-22, federal energy RD&D expenditures were **\$1,001M** and provincial and territorial (P&T) government energy RD&D expenditures were **\$411M**, for a combined total of **\$1,412M**.



In 2021-22, federal spending increased by **20% (\$164M) compared to 2020-21**. Energy efficiency accounts for over one third of total **federal** expenditures (\$381M) and investments **have tripled** since 2017-18 (\$130M).



Canada has been an active member of Mission Innovation (MI) since its launch in 2015. Canada surpassed its initial MI commitment to double investments in clean energy RD&D by 2021 and has continued to increase investments as a part of MI's second phase.

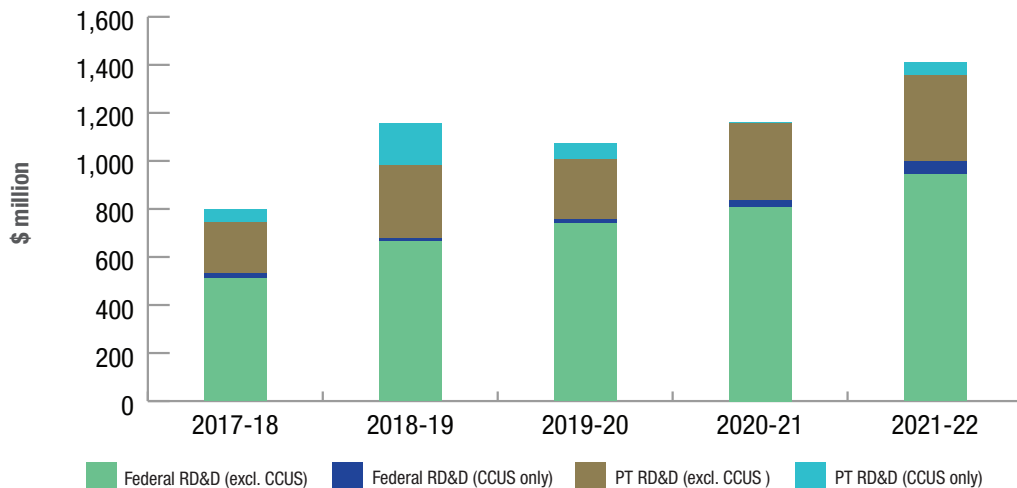
At the September 2022 MI Ministerial, Canada committed \$2B in pre-allocated money to the Clean Energy Technologies Demonstration Challenge, led by the United States to mobilize over \$90B in public investments internationally for clean energy demonstrations by 2026. In its first year, 2021-22 Canada's federal demonstration investments reached \$250M. Federal spending is on track to meet the 2026 commitment.



In 2021-22, P&T spending increased by **27% (\$87M increase)**. CCUS had a significant increase by \$46M to \$54M in 2021-22, compared to \$8M in 2020-21.

Canadian industry spent about **\$1.7B** on energy R&D in 2020, a slight increase from the spending reported in 2019 (**\$1.6B**).

CANADIAN PUBLIC EXPENDITURES ON ENERGY RD&D



* Provincial and territorial (P/T) includes utilities and other publicly owned entities (i.e. State-Owned Entities).

Overall, federal and provincial/territorial energy RD&D spending continues to increase. Combined federal and provincial/territorial CCUS RD&D spending increased threefold in 2021-22, compared to 2020-21.

EXPENDITURES ON ENERGY RD&D BY TECHNOLOGY AREA (\$ MILLIONS)



Federal
(2021-22)



**Provincial and
territorial**
(2021-22)



Industry
(2020)



Hydrocarbons
(including CCUS)

170

139

621



**Renewable and
non-emitting
energy****

408

154

596



Energy end use***

423

118

457

Total*

1,001

411

1,675

* Totals may not be exact due to rounding.

** Renewable and non-emitting energy includes renewable and nuclear energy.

*** Energy end use includes energy efficiency related to transport, industry, and buildings & communities.

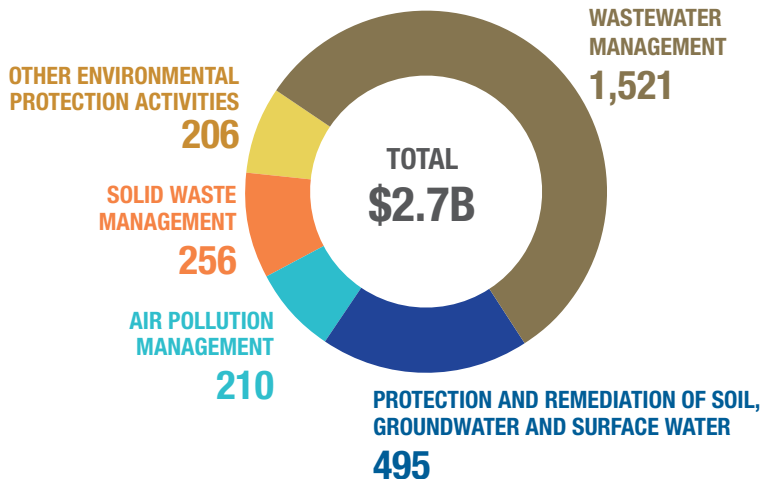
Note: Data for industry spending reflects the latest available at the time of this publication.

ENVIRONMENTAL PROTECTION EXPENDITURES

Environmental protection expenditures (operating and capital spending combined) by the energy sector totalled **\$3.8 billion** in 2020, representing **38%** of expenditures made by all industries.

The oil and gas sector (\$2.7 billion) accounts for the largest share of those expenditures, slightly more than one-quarter (27%) of total environmental protection expenditures made by all industries.

OIL AND GAS EXTRACTION EXPENDITURES PER ENVIRONMENTAL ACTIVITY (2020, \$ MILLIONS)



- Electric power generation, transmission and distribution invested **\$663 million** on environmental protection measures.
- Petroleum and coal product manufacturing invested **\$317 million** in environmental protection activities, with the largest percentage of spending (93%) in pollution abatement and control.

Section 3: **Skills, Diversity and Community**

The background is a dense, repeating pattern of white line-art icons on a dark purple background. The icons represent various concepts such as technology (lightbulbs, gears), community (hands, people silhouettes), business (charts, dollar signs), and nature (a plant).

Energy sector demographics

Energy affordability

Energy reliant communities

ENERGY SECTOR DEMOGRAPHICS (2021)

Women held **24%** of energy sector jobs.

Nearly **three-quarters (74%)** of employees in the energy sector had more than a high school education and **56%** of workers had a **college diploma or university degree**.

Since 2009, the workforce in the energy sector has become **increasingly diverse**. In 2021, **20%** of the workforce identified as members of a visible minority group, up from **17%** in 2009.

6% of energy sector employees identified as **Indigenous**.

The workforce in the energy sector has been **aging over time**. In 2021 the proportion of employees aged 55 and older stood at **22%**, **up from 17%** in 2009.

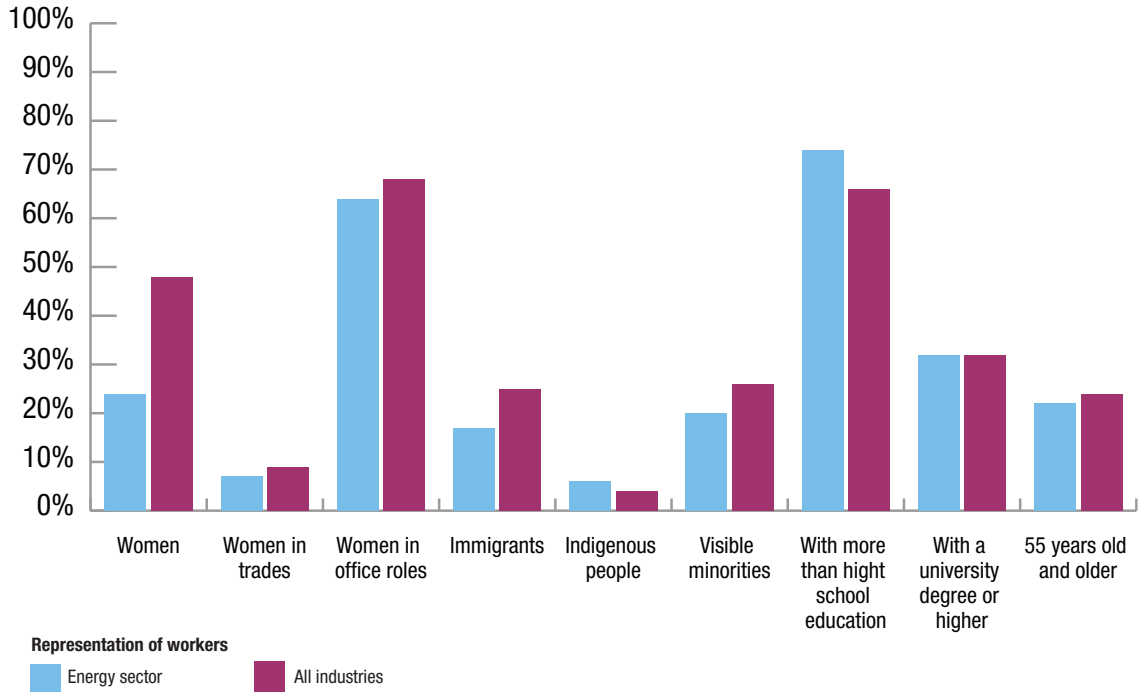
Immigrant workers represented **17%** of energy sector employees compared to **25%** in the total economy.



- Energy sector jobs paid an average of **\$121,435** per year, while the average Canadian job paid **\$62,459**.
- The **gender wage gap** closed slightly in the energy sector in 2021, with women earning on average **85%** of the hourly wage earned by men. In contrast, in 2009, women earned on average **76%** of the hourly wages earned by men.
- Jobs requiring a **university degree** had the highest average compensation, reaching **\$150,541**.
- Among **occupation types**, women in the energy sector are highly represented in office roles (administrative, general office worker, and auditor accountants and investment professionals) at **64%** of these occupations. Men are highly represented in trades (holding **93%** of these occupations).
- Women in the trades earn on average **91%** of the hourly wage earned by men, while those working in administrative occupations earn on average **74%** of the hourly wage earned by men.



Representation of demographic groups in the energy sector compared to all industries



ENERGY AFFORDABILITY

In 2019, in-home energy expenditure by Canadian households averaged **\$2,102**. This represented 3% of the average disposable income.

When households spend 10% or more of their income on energy needs, this is referred to as **energy poverty**.

Overall, 6% of Canadian households spent 10% or more of their income on energy. This share varies considerably across regions and income levels.

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%
Que.	17%	4%	1%	0%	0%	4%
Ont.	20%	5%	0%	0%	0%	5%
Man.	21%	7%	1%	0%	0%	6%
Sask.	34%	8%	2%	0%	0%	9%
Alta.	23%	3%	1%	0%	0%	5%
B.C.	25%	4%	1%	0%	0%	6%

Energy poverty rates are based on the number of energy poor households divided by total households for a given income quintile and region.

Energy, in this context, includes what is needed inside the home (i.e. space heating, appliances), and excludes transportation.

HOUSEHOLD EXPENDITURES ON ENERGY

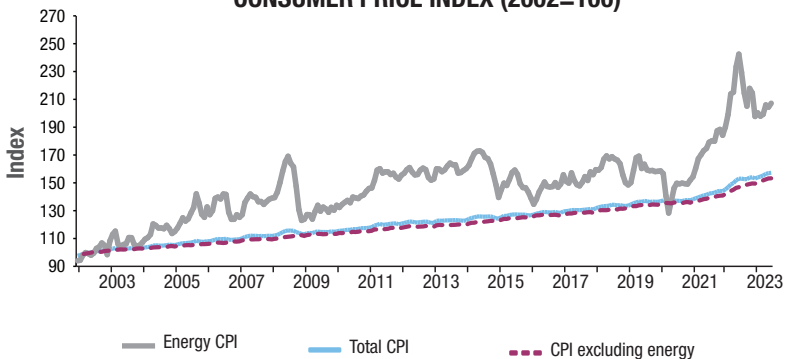


- Canadian households **spent \$4,524** on average on energy in 2019.
- Residential expenditures, including for heating/cooling spaces, lighting and operating appliances, averaged **\$2,102**.
- Transportation expenditures averaged **\$2,422**.
- Energy accounted for **6.6%** of current household consumption. Lower-income households spend a larger share of their disposable income on energy.

ENERGY RETAIL PRICES

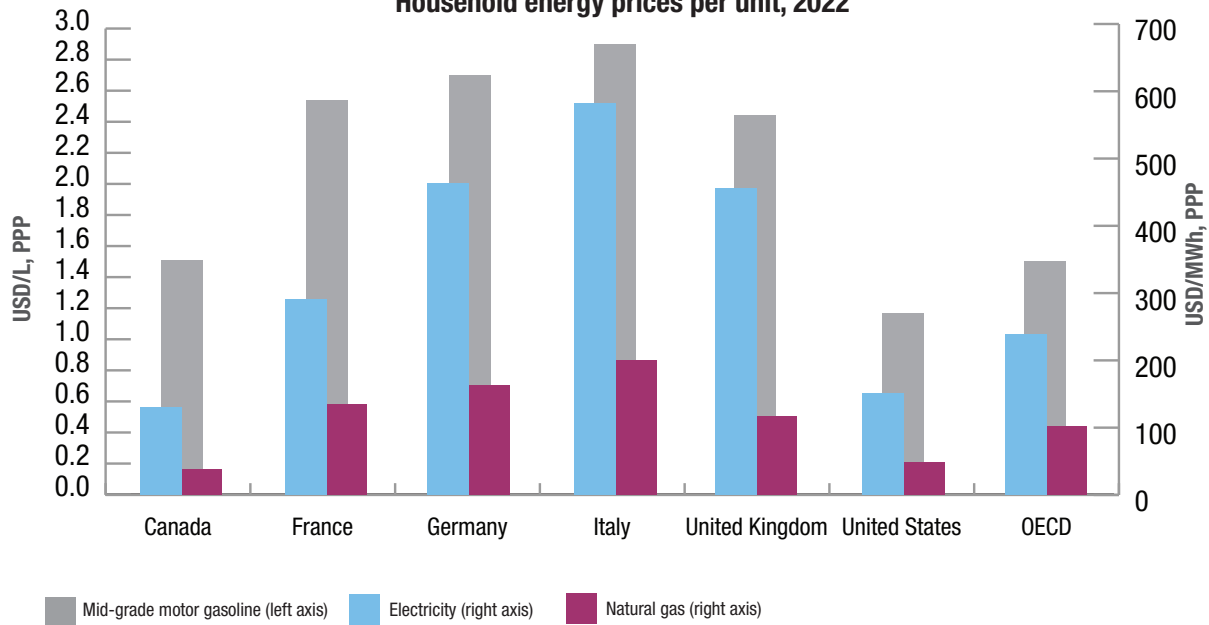
- The “energy” component of the consumer price index (CPI) has been volatile in recent years and has grown much faster than the non-energy component.
- This volatility reflects mostly the variations of upstream oil and gas prices and their impact on consumer products such as gasoline.

CONSUMER PRICE INDEX (2002=100)



**IN COMPARISON WITH OTHER DEVELOPED ECONOMIES,
CANADA'S ENERGY PRICES ARE RELATIVELY LOW.**

Household energy prices per unit, 2022

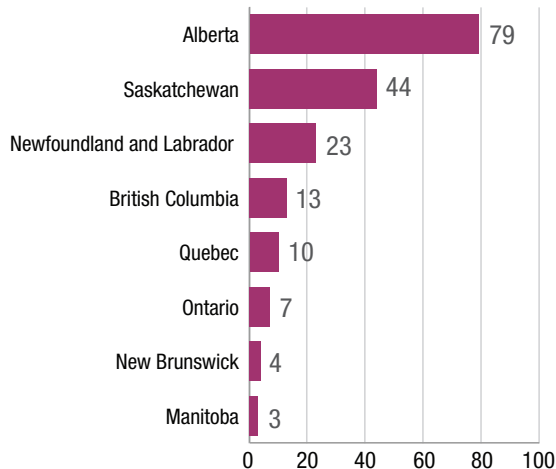


ENERGY RELIANT COMMUNITIES

Communities that have higher shares of employment from a specific sector, a relatively high share of total income from that sector, and relatively low sectoral diversity in their economy compared to the average Canadian community can be described as reliant on that sector.

There are **183 communities across Canada that are at least moderately reliant** on the energy sector. Of these communities, **80% are rural or remote**.

Distribution of energy reliant communities across Canada



Section 4: Energy Efficiency

Energy use

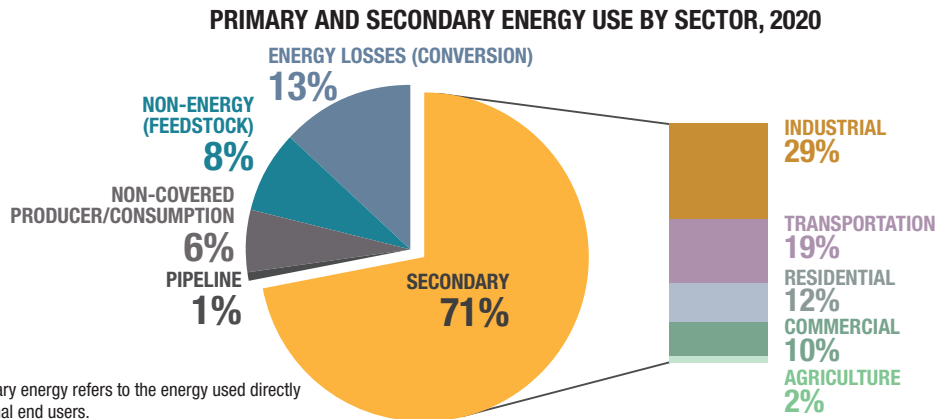
Efficiency trends



ENERGY USE

PRIMARY AND SECONDARY ENERGY USE BY SECTOR (2020)

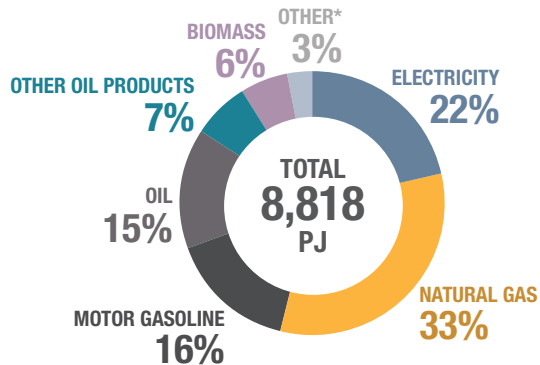
- Primary energy use measures the total energy requirements of all energy users.
- Secondary energy use accounts for the energy used by final consumers in the economy.
- Primary energy use includes secondary energy use. Additionally, primary energy use includes the energy required to transform one form of energy into another (e.g. coal to electricity); the energy used to bring energy supplies to the consumer (e.g. pipeline); and the energy used to feed industrial production processes (e.g. the natural gas used as feedstock by the chemical industries).
- Not every fuel is consumed as energy. For example, hydrocarbon gas liquids in Canada are also used as a non-energy feedstock in the petrochemical industry.
- Canada's primary energy consumed was estimated at **12,339 PJ**.



*Secondary energy refers to the energy used directly by the final end users.

- Secondary energy use includes the energy used to run vehicles; the energy used to heat and cool buildings; and the energy required to run machinery.
- Canada's secondary energy use in 2020 was **8,818 PJ**.
- Total secondary energy use **increased 9%** from 2000 to 2020. Natural gas usage grew by **34%** while electricity usage increased 12%, during the same period.

CANADA'S SECONDARY ENERGY USE BY FUEL TYPE, 2020

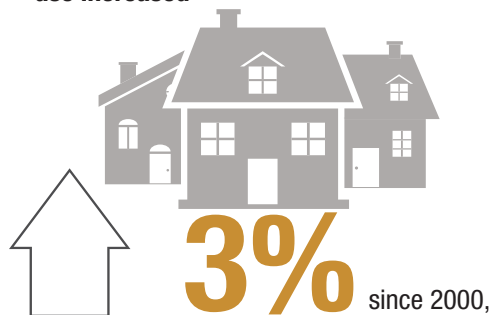


* "Other" includes coal, coke, coke oven gas, NGLs and steam and waste.

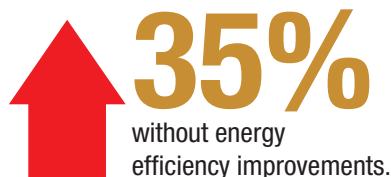
ENERGY IN OUR DAILY LIVES

- Canadian households use energy every day – to power lights and appliances, heat or cool spaces, run personal vehicles, recharge electronics and more.
- **79%** of residential energy consumption is used for space and water heating.
- Residential energy efficiency improved by **32%** between 2000 and 2020, **saving 443 PJ** of energy and **\$8.7 billion in energy costs**.

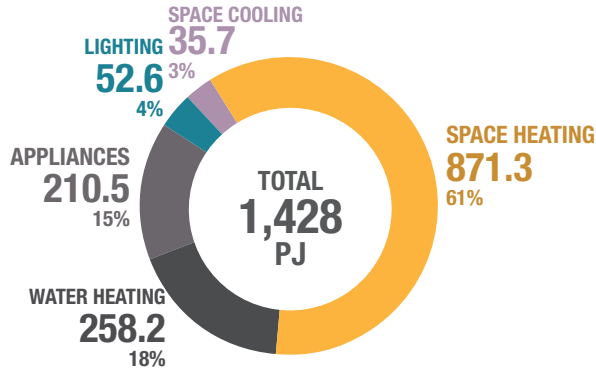
**Residential energy
use increased**



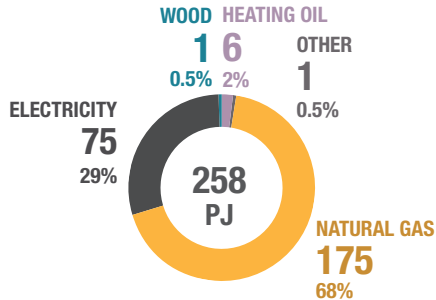
but would have increased by



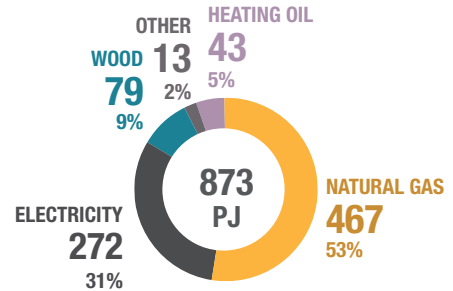
RESIDENTIAL ENERGY USE, BY TYPE (PJ), 2020



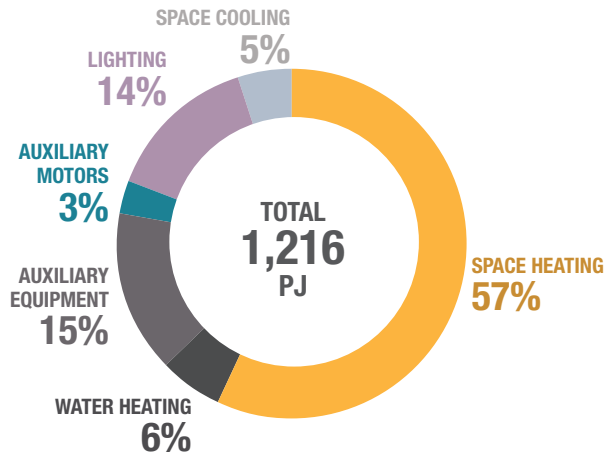
WATER-HEATING ENERGY USE (PJ), 2020



SPACE-HEATING ENERGY USE (PJ), 2020



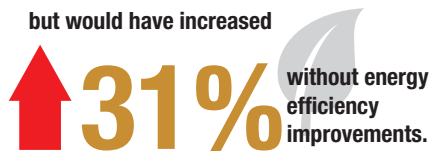
COMMERCIAL AND INSTITUTIONAL ENERGY USE BY END USE, 2020



Commercial and institutional energy use increased between 2000 and 2020



but would have increased

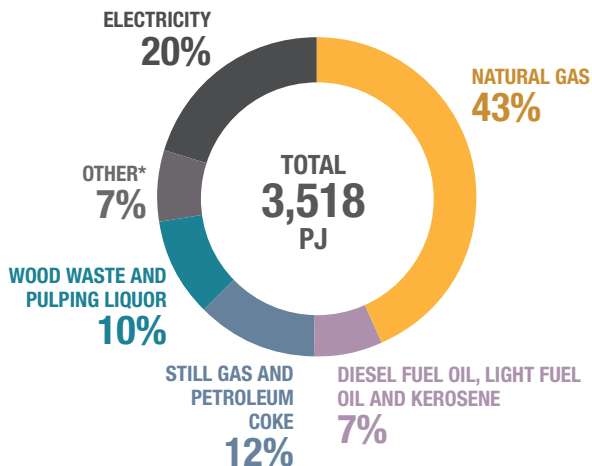


Energy intensity (GJ/m²) decreased



Since 2000, energy efficiency in the commercial and institutional sector has **improved 8%**, saving 82.4 PJ of energy and **\$2.2 billion** in energy costs in 2020.

INDUSTRIAL SECTOR ENERGY USE BY FUEL TYPE, 2020



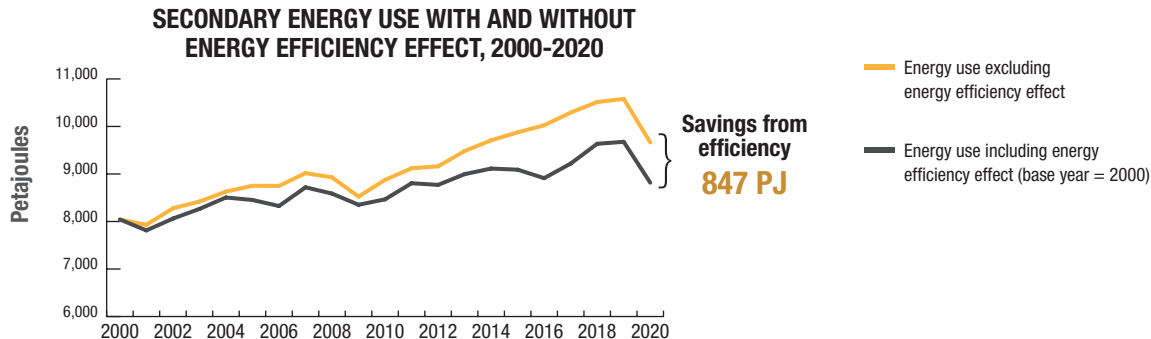
- The **industrial sector** includes all manufacturing, mining (including oil and gas extraction), forestry and construction activities.
- From 2000 to 2020, **industrial energy use increased 11%**. Energy use in resource extraction industries increased over threefold during the same period.
- Excluding resource extraction industries, **energy efficiency improvements of 9%** in the industrial sector resulted in **savings of 209 PJ** and **\$2.5 billion** in energy costs in 2020.

* "Other" includes HFO, coke and coke oven gas, coal, LPGs, NGLs, steam and waste.
Parts may not sum to total due to rounding.

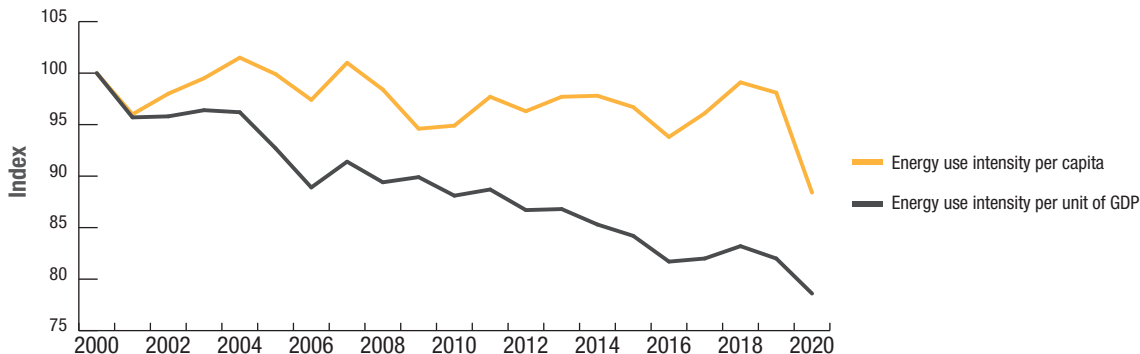
EFFICIENCY TRENDS

HISTORICAL ENERGY EFFICIENCY

- **Energy efficiency** is a measure of how effectively energy is used for a given purpose and is an important path toward decarbonization.
- **Energy intensity** is the ratio of energy use per unit of activity (such as floor space and GDP).
- **Efficiency improvements** slow the rate of growth in energy use.
- **Energy efficiency** in Canada **improved by 13%** between 2000 and 2020.
- **Energy use grew by 10%** between 2000 and 2020. Without energy efficiency improvements, energy use would have **grown by 20%**.
- **Energy efficiency savings** of **847 PJ** in 2020 were equivalent to end-user savings of **\$21 billion**.



INDEXED TOTAL SECONDARY ENERGY USE INTENSITY PER CAPITA AND PER UNIT OF GDP, 2000–2020 (2000=100)



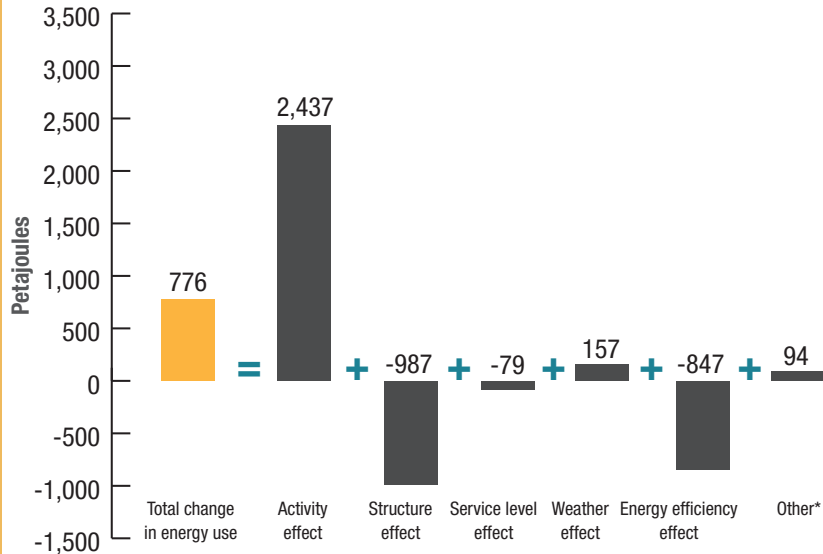
Per capita energy consumption was

12% lower in 2020 than in 2000.

Canada used

21% less energy per dollar of GDP in 2020 than in 2000.

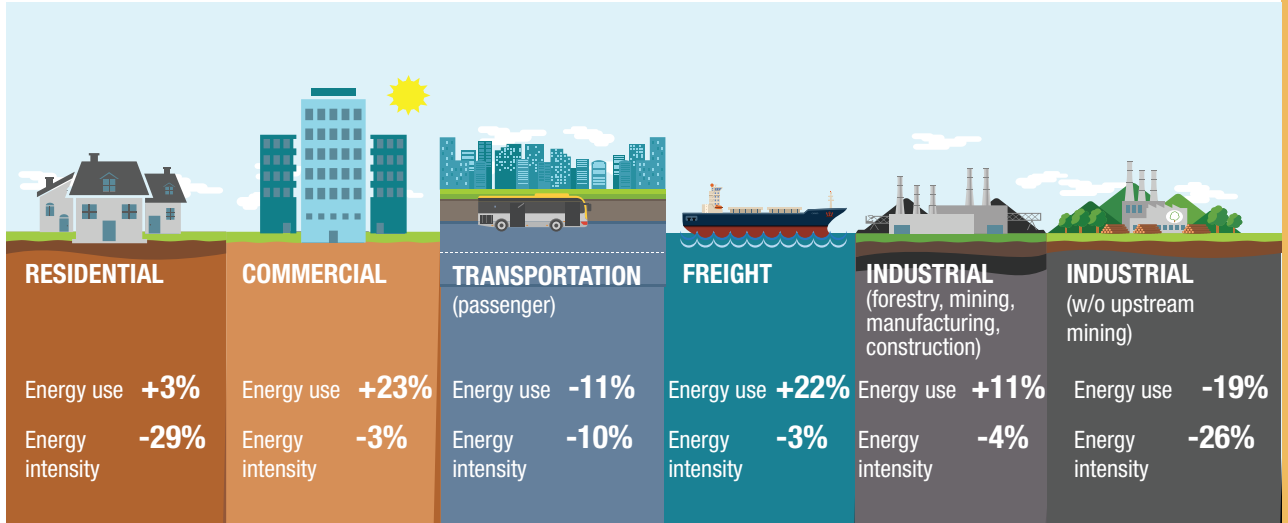
SUMMARY OF FACTORS INFLUENCING THE CHANGE IN ENERGY USE, 2000-2020



- **Activity:** major drivers of energy use in a sector (e.g. floor space area in the commercial/institutional sector)
- **Structure:** refers to change in the makeup of each sector
- **Service level:** increased penetration of auxiliary equipment in commercial/institutional buildings
- **Energy efficiency:** how effectively energy is being used for a given purpose. For example, providing a similar (or better) level of service with less energy consumption on a per unit basis is considered an improvement in energy efficiency.

* "Other" refers to street lighting, non-commercial airline aviation, off-road transportation and agriculture, which are included in the "Total change in energy use" column but are excluded from the factorization analysis.

TRENDS IN ENERGY USE AND INTENSITY BY SECTOR, 2000-2020



Section 5: Clean Power and Low Carbon Fuels



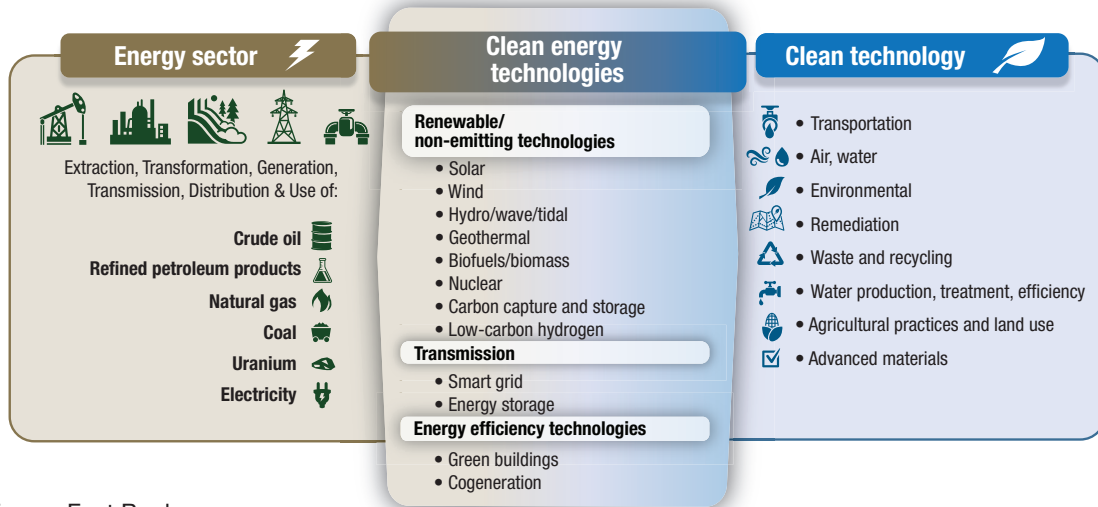
Clean technology and electricity generation mix

Renewable energy

Biofuels and transportation

CLEAN TECHNOLOGY AND THE ECONOMY

- In 2017, the Government of Canada invested in a Clean Technology Data Strategy to provide the foundation for measuring the economic, environmental and social impacts of clean technology in Canada.
- As part of this strategy, Statistics Canada has developed the Environmental and Clean Technology Products Economic Account (ECTPEA), which provides a comprehensive picture of the state of Canada's clean technology economy for the years from 2007 to 2021.
- The ECTPEA includes processes, products and services that reduce environmental impacts through environmental protection and resource management activities and the use of goods that have been adapted to be significantly less energy- or resource-intensive than the industry standard



Environmental and clean technology (2021):

\$73.1 billion of GDP
(3.1% of total GDP)

314,300 jobs representing
1.6% of jobs in the Canadian economy

\$17.9 billion in exports

Of this, clean energy alone accounted for

1.5% of Canada's GDP

and employed

98,194 people.

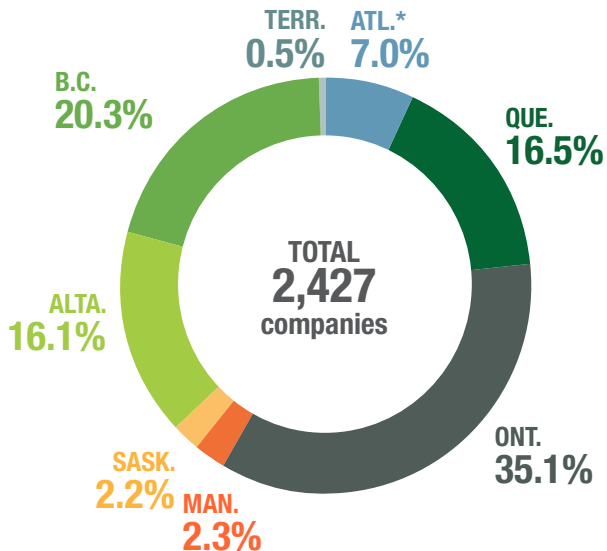


The TSX and TSX-Venture exchanges list **96 companies in the cleantech sector**, with a total market capitalization of **\$56.9 billion**. Of those companies, 83 are headquartered in Canada, with a total market capitalization of **\$48.8 billion** (as of July 31, 2023).

CLEANTECH COMPANIES

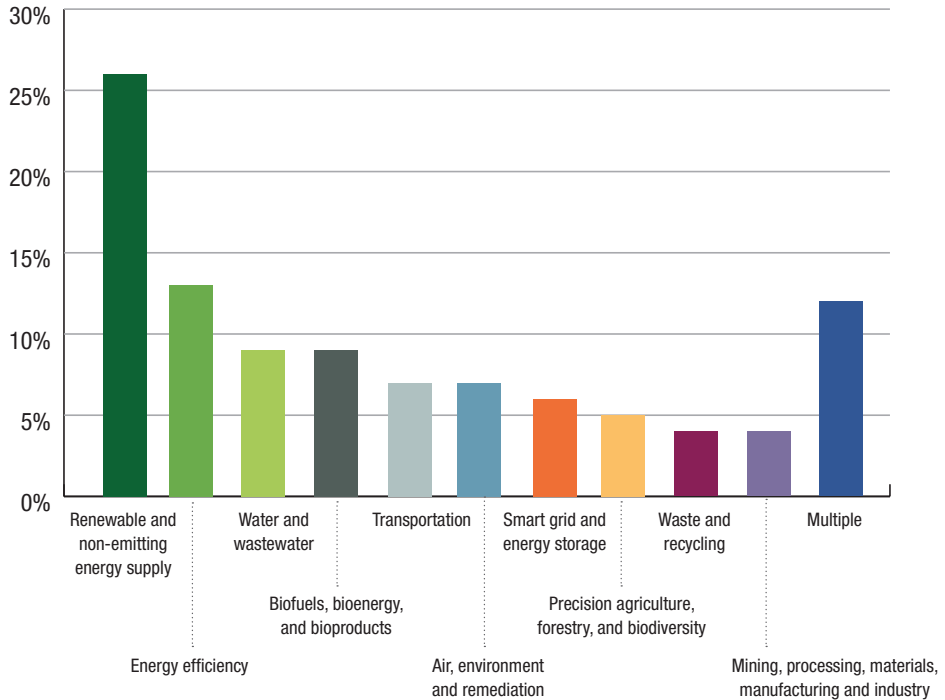
More than half of Canada's 2,427 cleantech companies relate to the energy industry, operating in renewables, energy efficiency, and smart grid technology. They are concentrated in Ontario, British Columbia, Quebec, and Alberta.

CANADIAN CLEANTECH COMPANIES BY PROVINCE, 2022



* Atlantic provinces

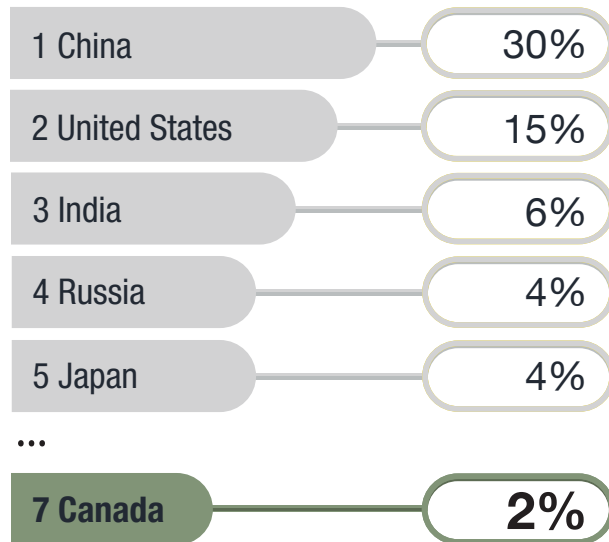
CANADIAN CLEANTECH COMPANIES BY INDUSTRY, 2022



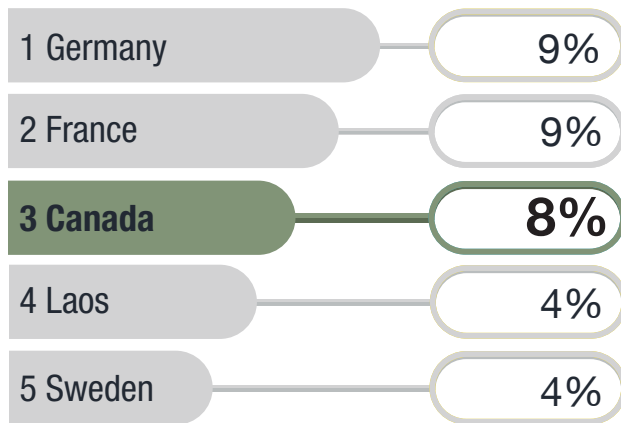
ELECTRICITY

INTERNATIONAL CONTEXT

World production – 28,520 TWh (2021)



World exports – 778 TWh (2021)



TRADE (2022)

All Canadian electricity trade is with the U.S.

EXPORTS



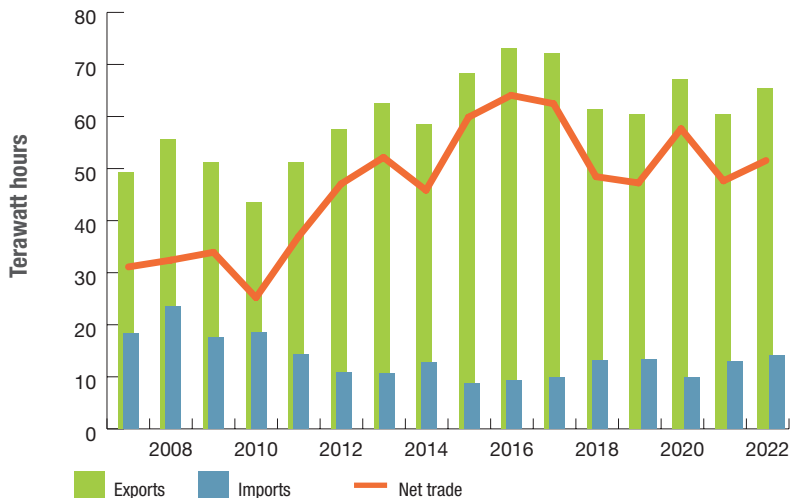
65.4 TWh

IMPORTS



14.1 TWh

CANADA'S ELECTRICITY TRADE WITH THE U.S.*

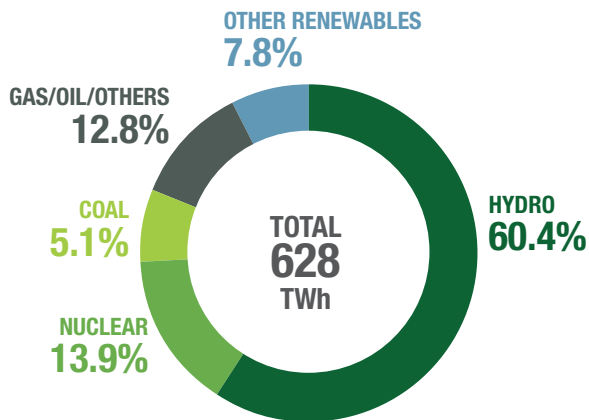


* includes only electricity traded under purchased contracts; excludes electricity transferred under non-financial agreements (e.g. under treaty obligations)

CANADIAN SUPPLY

GENERATION IN CANADA – 628 TWh

GENERATION BY SOURCE, 2021



HYDRO

Canada **60.4%**

N.L.	96.7%
Man.	96.0%
Que.	93.9%
B.C.	88.7%
Y.T.	87.2%
N.W.T.	36.8%
Ont.	24.1%
N.B.	22.8%
Sask.	12.0%
N.S.	8.5%
Alta.	2.8%

NUCLEAR

Canada **13.9%**

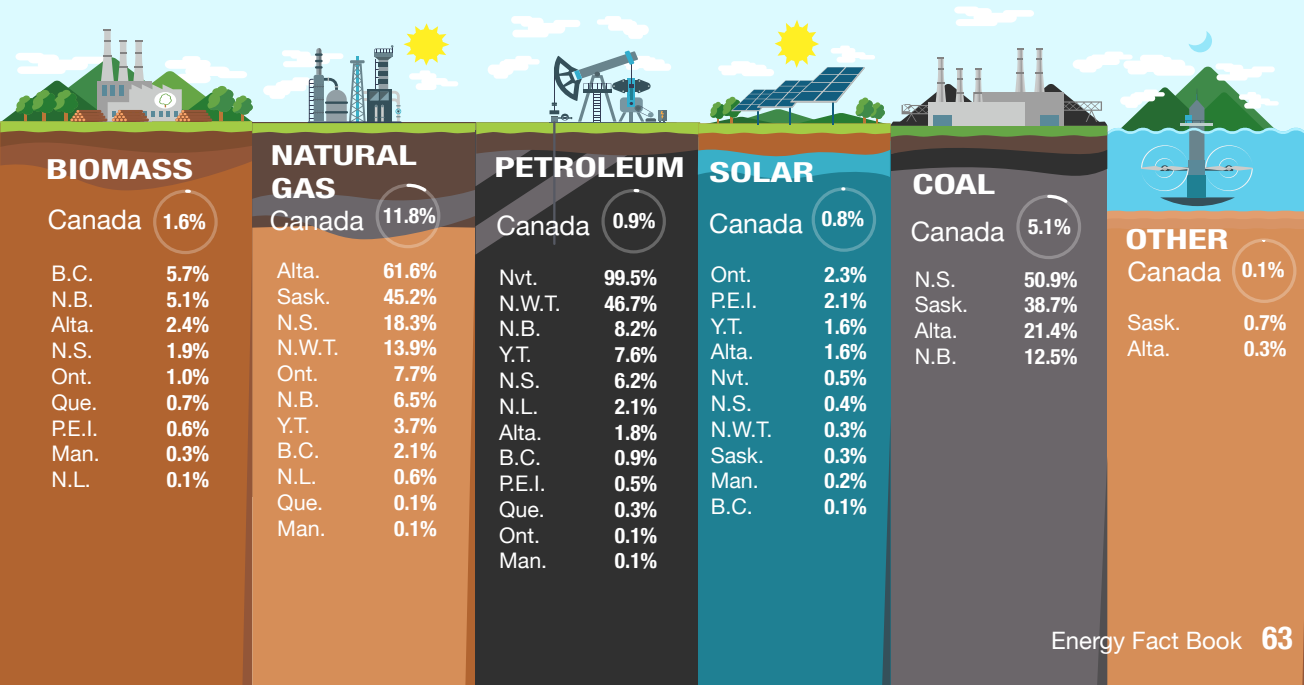
Ont.	57.1%
N.B.	38.3%

WIND

Canada **5.5%**

P.E.I.	96.8%
N.S.	13.9%
Alta.	8.0%
Ont.	7.6%
N.B.	6.6%
Que.	5.1%
Man.	3.3%
Sask.	3.1%
B.C.	2.5%
N.W.T.	2.4%
N.L.	0.4%

PROVINCIAL ELECTRICITY GENERATION BY SOURCE, 2021



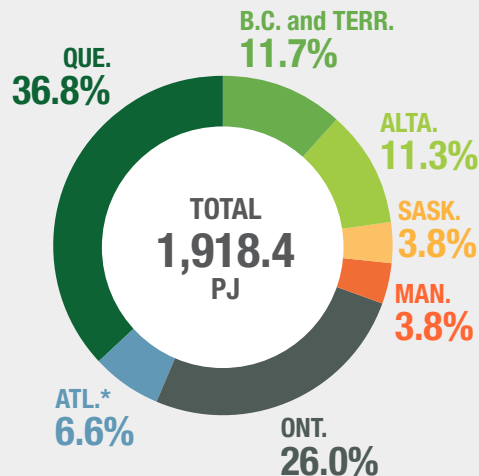
ELECTRICAL ENERGY USE

TOTAL ELECTRICAL ENERGY USE* WAS 1,918.4 PJ IN 2020

Sector	Energy use (PJ)	% of the total
Residential	635.7	33.1%
Commercial	520.7	27.1%
Industrial	719.5	37.5%
Transportation	4.5	0.2%
Agriculture	38.0	2.0%
Total	1,918.4	100%

*secondary energy use

ELECTRICAL ENERGY USE BY PROVINCE, 2020

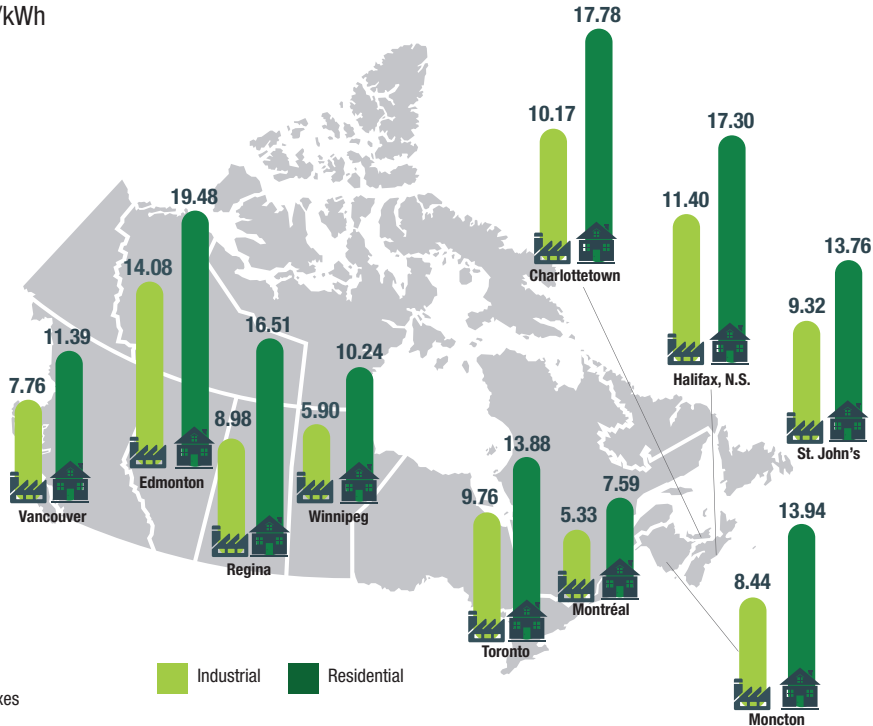


* Atlantic provinces

ELECTRICITY PRICES

AVERAGE LARGE INDUSTRIAL AND RESIDENTIAL ELECTRICITY PRICES* (AS OF APRIL 2022)

in cents/kWh

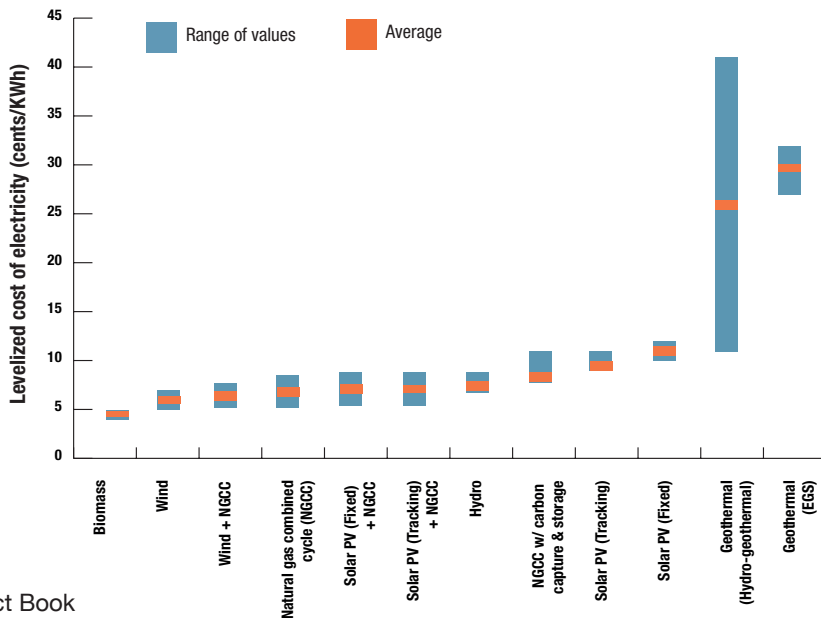


*including taxes

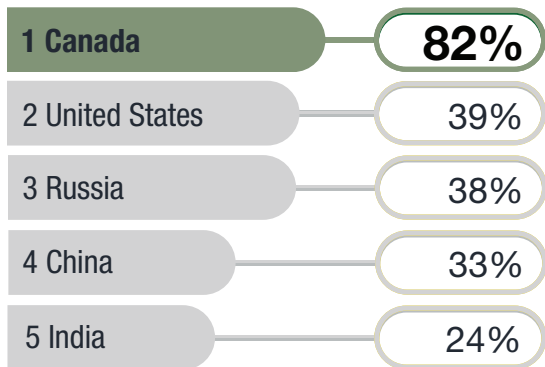
LEVELIZED COST OF ELECTRICITY

One measure used to directly compare costs between generation technologies is the levelized cost of electricity (LCOE). This is the average price an electricity generator must receive for each unit it generates over its lifetime to break even financially.

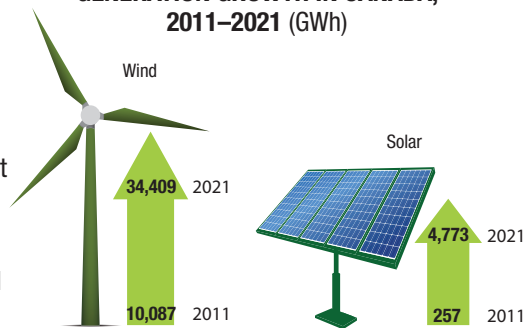
Over the past several years, various groups have conducted analysis of LCOE for energy sources in Canada, including the [Canada Energy Regulator](#) as well as the Canadian Energy Research Institute whose results are presented below. Results can vary depending on methodology, scope and inputs used.



PERCENTAGE OF TOTAL ELECTRICITY FROM NON-EMITTING SOURCES FOR THE TOP FOUR ELECTRICITY-GENERATING COUNTRIES AND CANADA, 2021



WIND AND SOLAR NET ELECTRICITY GENERATION GROWTH IN CANADA, 2011–2021 (GWh)



- **Renewable electricity generation has increased 10%** between 2011 and 2021, with solar and wind having the largest growth.
- In 2021, **82% of electricity in Canada** came from non-GHG emitting sources. **Hydro** made up **60%**, **nuclear was 14%**, and other renewables were the remaining **8%**.

GHG SPOTLIGHT: ELECTRICITY

Total electricity emissions **decreased by 60%** from 2000 to 2021 because of increased generation from non-emitting sources.

Coal-fired electricity generation accounted for **5% of generation** and **61% of electricity-related GHG emissions** in 2021.

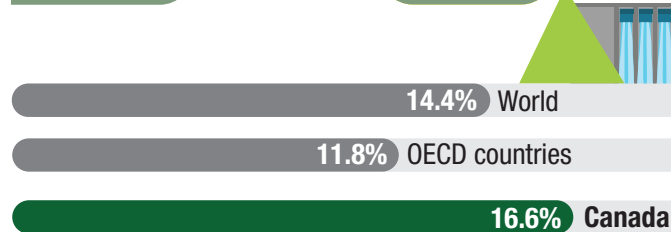
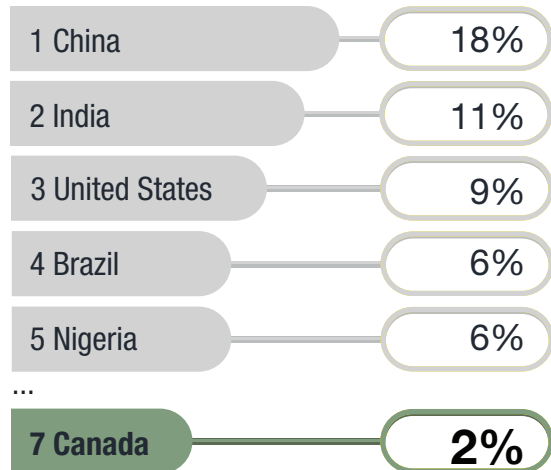
ELECTRICITY SECTOR GHG EMISSIONS FOR CANADA, 2000–2021



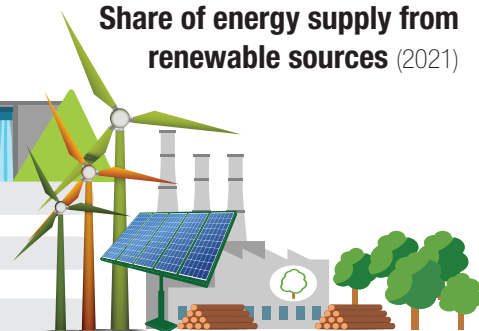
RENEWABLE ENERGY

INTERNATIONAL CONTEXT

World production – 88,124 PJ or 2,045 MTOE (2021)

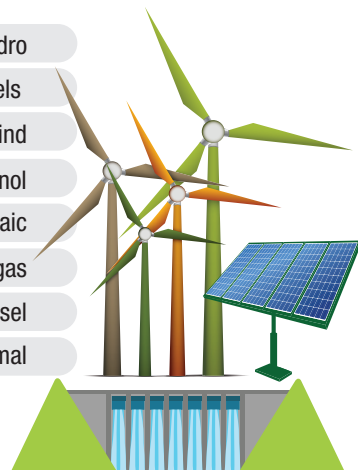
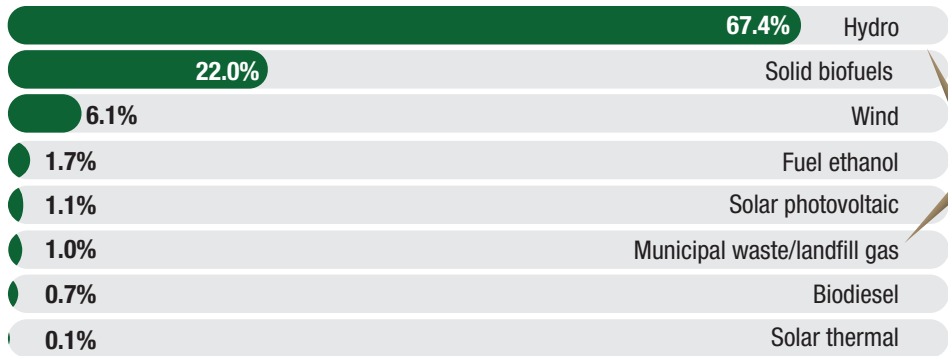


Share of energy supply from renewable sources (2021)



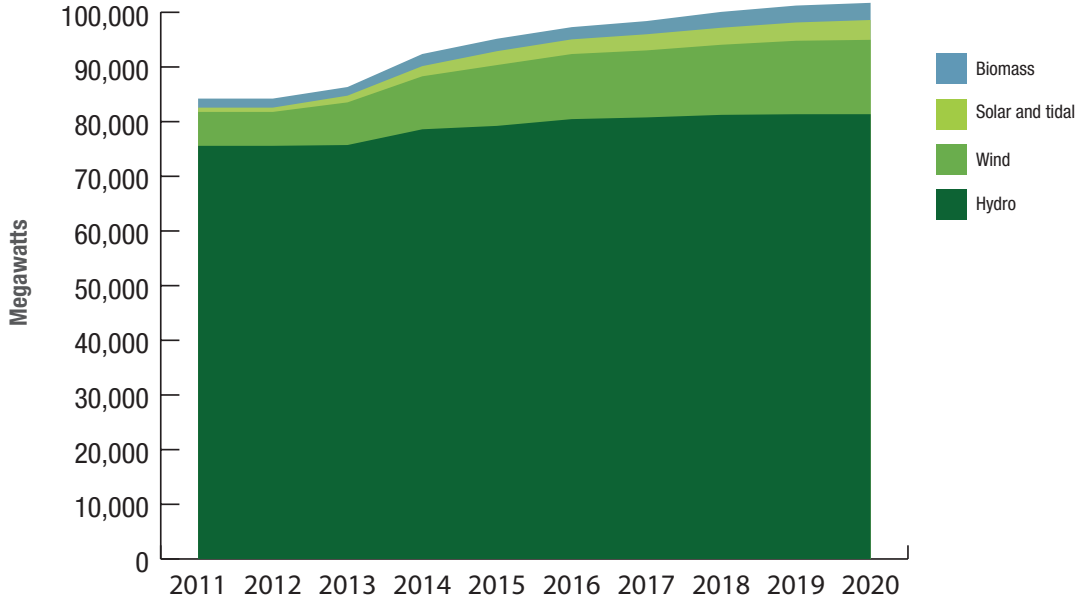
CANADIAN PRODUCTION (2021)

Total renewable energy* – 2,045 PJ or 48.8 MTOE

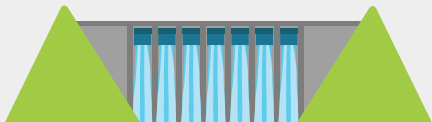


*includes energy consumed for electricity and heat production and for biofuels in the transportation sector

CANADIAN RENEWABLE ELECTRICITY GENERATING CAPACITY



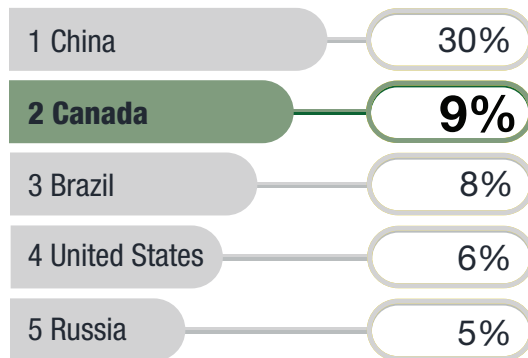
HYDROELECTRICITY



Moving water is the most important renewable energy source in Canada, providing **60%** of Canada's electricity generation. In fact, in 2021, Canada was the second-largest producer of hydroelectricity in the world.

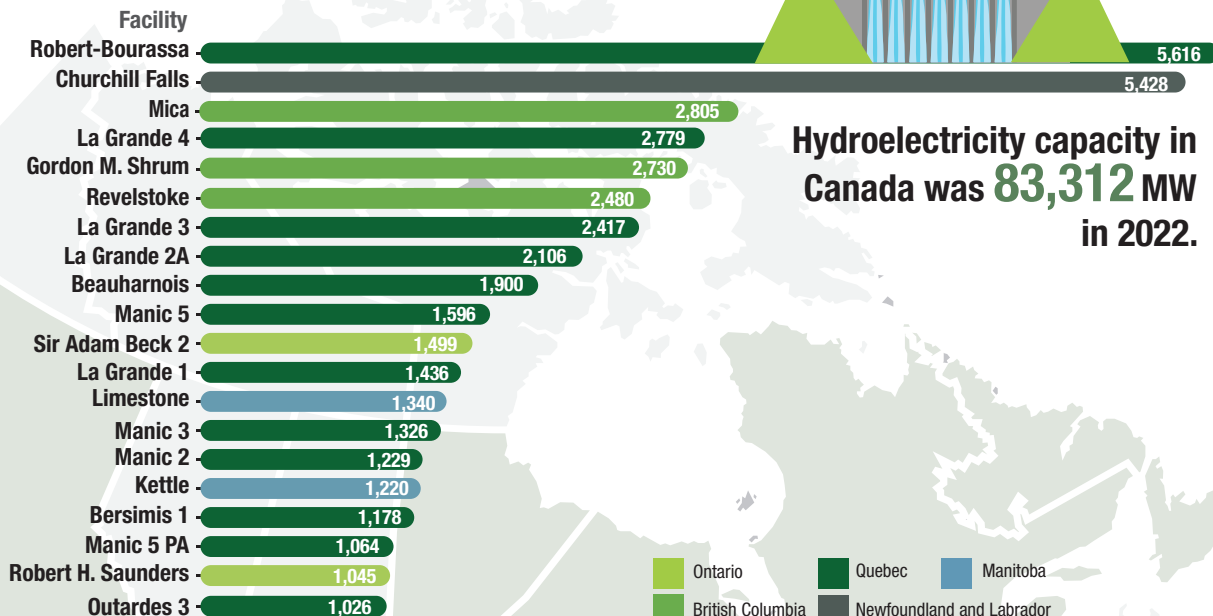
INTERNATIONAL CONTEXT

World generation of hydroelectricity – 4,411 TWh
(2021)



HYDROELECTRICITY CAPACITY IN CANADA

MAJOR HYDRO FACILITIES IN CANADA (≥1,000 MW)



Hydroelectricity capacity in Canada was **83,312 MW** in 2022.

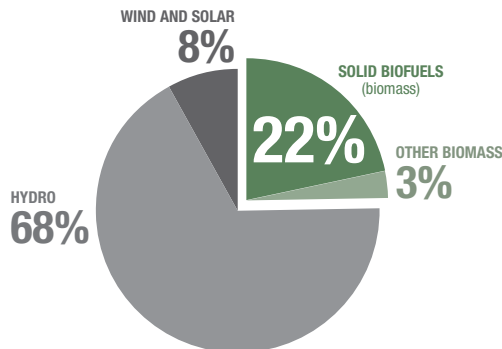
BIOMASS

- Biomass is a renewable energy resource derived from living organisms and/or their by-products.
- In 2021 there were **38 operational** co-generation units at pulp and paper mills and **35 Independent Power Providers (IPP)** using biomass.
- Electrical capacity of pulp and paper co-generation was **1,627 MW**, while heat capacity was **3,762 MW**. IPP capacity for electricity and heat was **640 MW** and **344 MW**, respectively.
- In 2023, there were about **640 operational** bioheat systems with installed capacity of **480 MWth**. **83%** of the biomass heating systems are less than **1 MW** in size.

Biomass* accounts for the **largest share of renewable energy production** in the OECD**, at



In Canada, that share is **25%**.

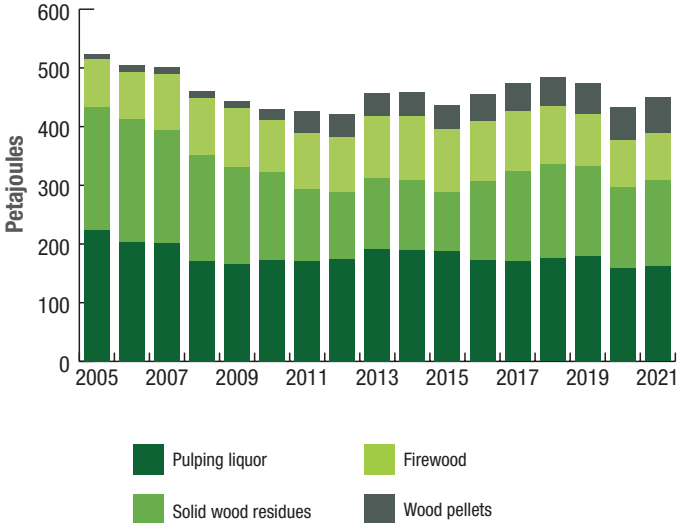


*Includes solid biofuels, liquid biofuels, biogases and renewable municipal waste

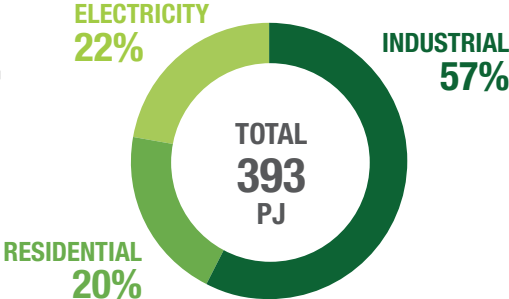
**Organization for Economic Cooperation and Development

CANADIAN PRODUCTION OF SOLID BIOFUELS

CANADIAN PRODUCTION OF SOLID BIOFUELS, 2021



WOOD FUEL USE BY SECTOR, 2021



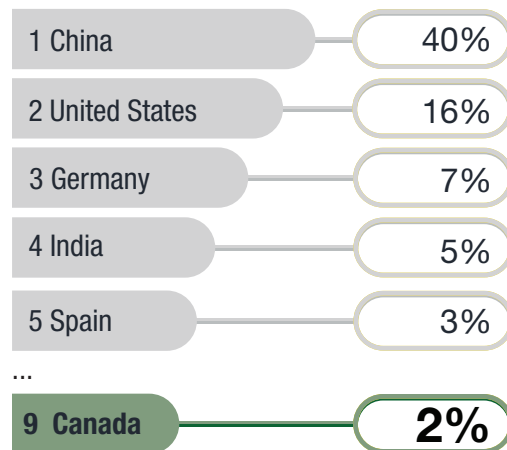
WIND POWER

- Electricity from wind energy is one of the **fastest growing sources** of electricity in the world and in Canada.
- Wind accounted for **5.5%** of electricity generation in Canada in 2021.

INTERNATIONAL CONTEXT

World capacity of wind power – 906,218 MW

(2022)



WIND POWER IN CANADA

Capacity (2022):

15.1 TW

nearly
tripled



Generation (2021):

34.4 TWh

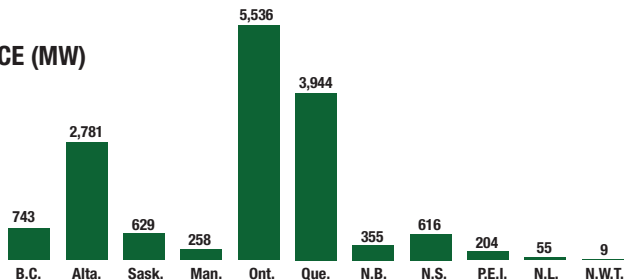
more than
tripled



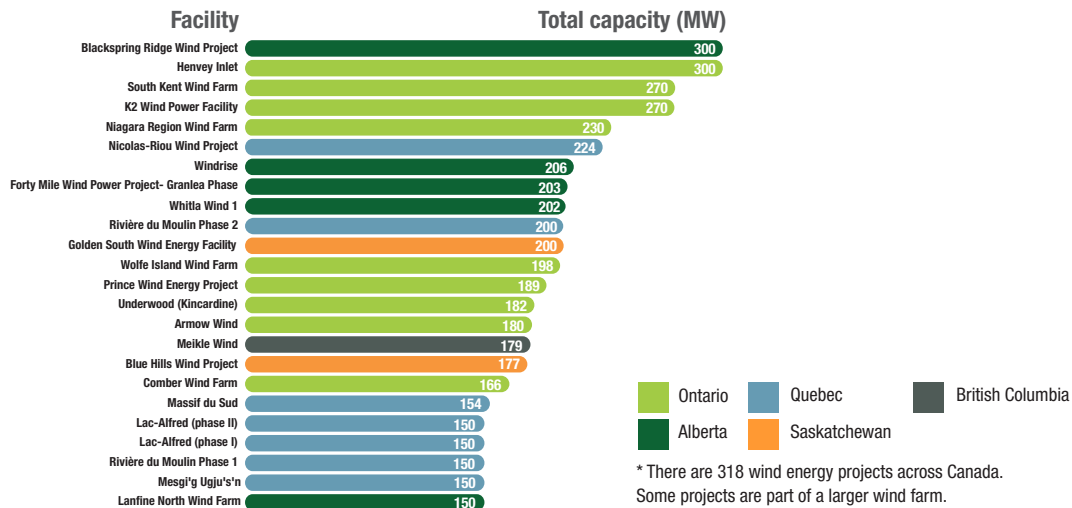
INSTALLED CAPACITY



CAPACITY BY PROVINCE (MW)



LARGEST WIND PROJECTS* (≥150 MW)



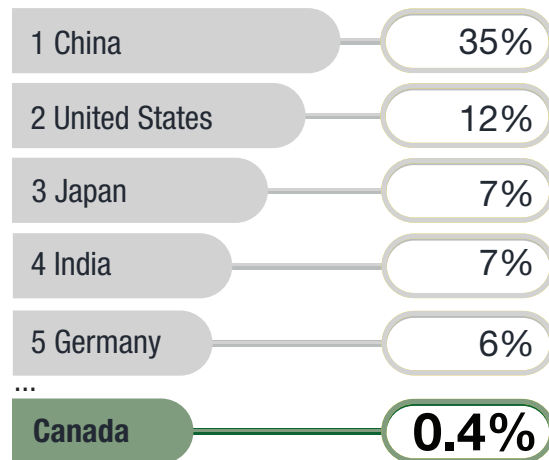
* There are 318 wind energy projects across Canada. Some projects are part of a larger wind farm.

SOLAR PHOTOVOLTAIC

- Solar power is the conversion of energy from sunlight into electricity. Solar PV is rapidly becoming an economical, renewable technology to harness renewable energy from the sun.

INTERNATIONAL CONTEXT

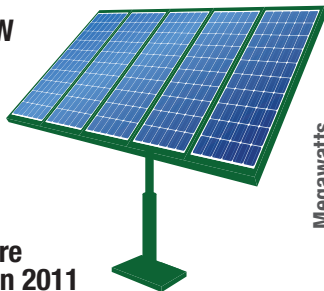
World capacity of solar PV – 1,185 GW (2022)



SOLAR PV IN CANADA

Capacity (2021):

4,554 MW



≈ **8X** more than 2011

Generation (2021):

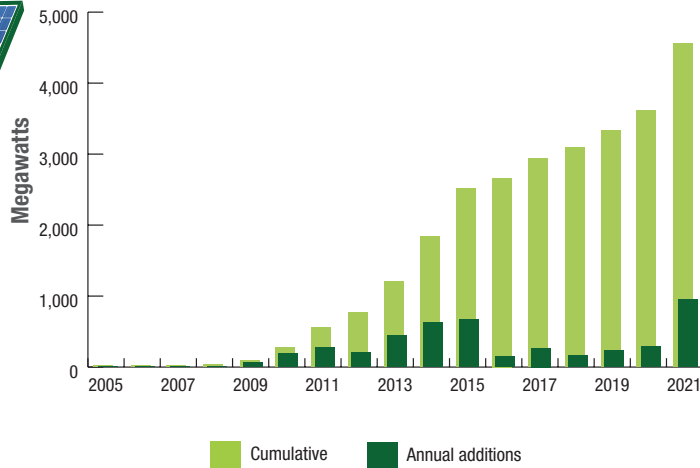
4.8 TWh



≈ **19X** more than in 2011



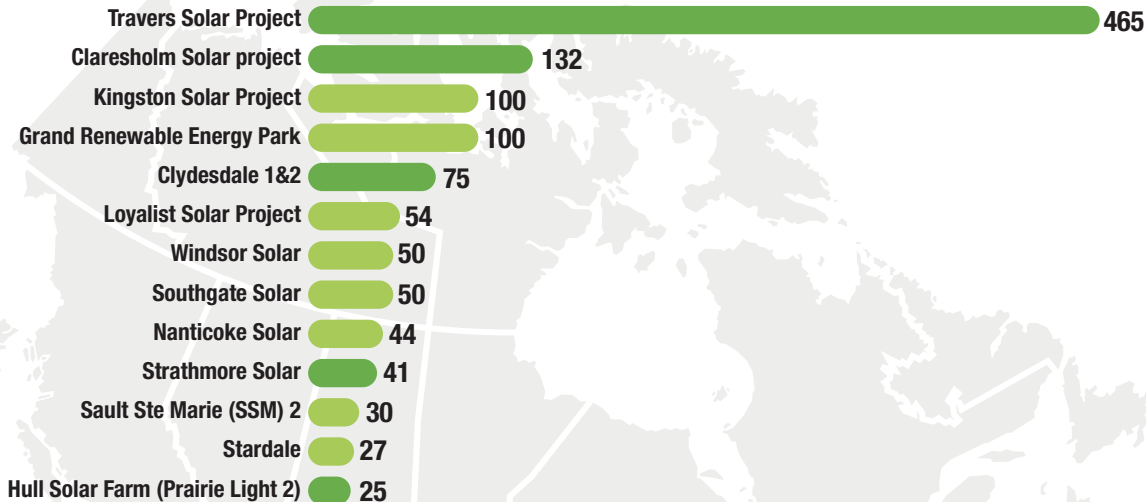
INSTALLED CAPACITY



LARGEST SOLAR PROJECTS* (≥ 25 MW)

Facility

Total capacity (MW)



*Canada has 196 major solar energy projects producing power across the country, and there are around 48,000 solar energy installations across Canada.

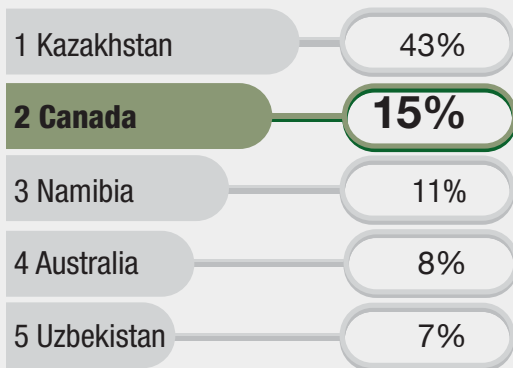
Alberta Ontario

URANIUM

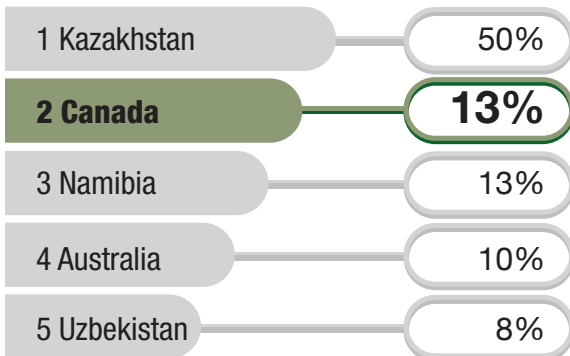
- Uranium is a silvery-white metal and a primary energy source. After raw uranium is mined and milled, it is **processed to make fuel for nuclear reactors** to generate electricity.

INTERNATIONAL CONTEXT

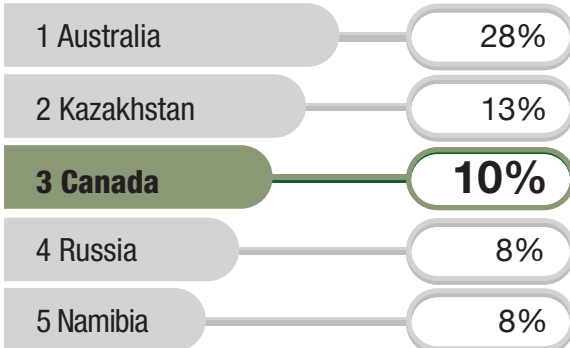
World production – 48.9 kt (2022)



World exports – 42.2 kt (2022)



World known recoverable resources – 6.1 Mt (2021)



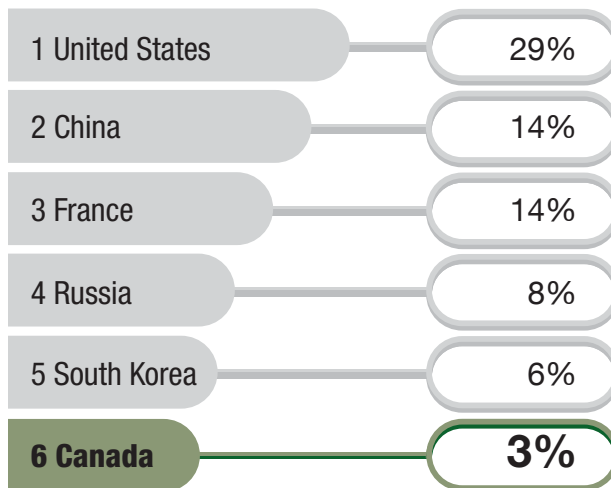
NUCLEAR POWER

- Nuclear energy is the second largest contributor of non-emitting electricity in Canada. In 2021, nuclear energy

provided approximately **14%** of **Canada's total electricity needs** (close to 60% in Ontario).

INTERNATIONAL CONTEXT

World generation – 2,653 TWh (2021)



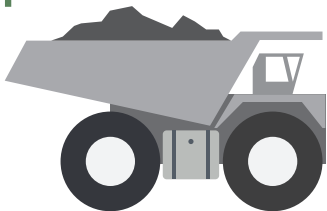
CANADIAN SUPPLY AND DEMAND (2022) URANIUM

Canadian production **7.4 kt**

All uranium comes from mines in Saskatchewan.

VALUED AT
about

\$1.1 billion



80% of production was available for export.

Based on long-term contracts*, uranium sold by Canada is destined for:

- 1) North America/Latin America **64%**
- 2) Asia **19%**
- 3) Europe **17%**

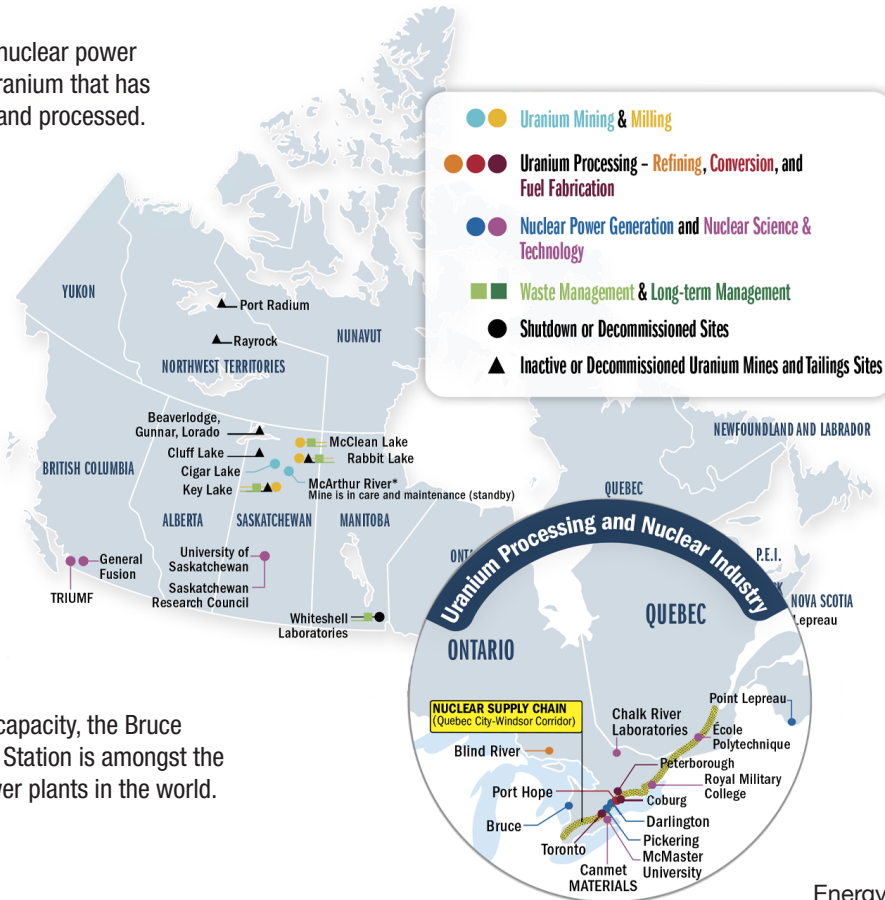
* These values can vary based on changes in regional demand.

27% of uranium purchased by U.S. nuclear reactors in 2022 came from Canada, making Canada the largest foreign supplier of uranium to the U.S.

DOMESTIC USE: 20% of production

Used in Canada's CANDU reactors (Ontario and New Brunswick), including the Bruce Generating Station, amongst the world's largest operating nuclear facilities.

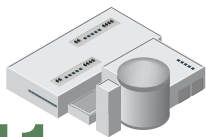
Across the country, nuclear power is generated from uranium that has been mined, milled and processed.



Based on installed capacity, the Bruce Nuclear Generating Station is amongst the largest nuclear power plants in the world.

CANDU NUCLEAR REACTORS

- **Canada has developed a unique nuclear reactor technology called CANDU**, for CANada Deuterium Uranium. Canada is one of roughly half a dozen countries that offer domestically designed reactors to the open commercial market.
- The CANDU reactor is a pressurized heavy water reactor (PHWR) that uses heavy water (deuterium oxide) as a moderator and coolant and natural uranium for fuel. The majority of power reactors in use in the world are light water reactors (LWR), which use normal water as the moderator and coolant and enriched uranium for fuel.
- CANDU technology continues to evolve to enable the use of alternative fuels. Work is underway in Chinese CANDU reactors to demonstrate that they can recycle used fuel from other nuclear power plants, reducing the volume of nuclear waste.
- CANDU reactor refurbishment in Ontario is one of the largest infrastructure projects in Canada and will extend the life of Ontario's nuclear fleet past mid-century.



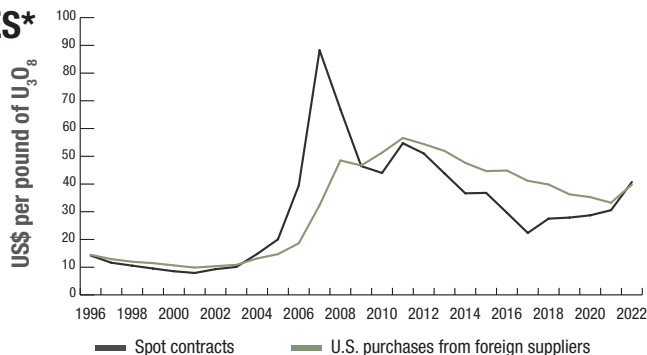
11 CANDU reactors
are in operation outside of Canada.



GROSS ELECTRICAL OUTPUT OF NUCLEAR POWER PLANTS IN CANADA

Facility	Province	Gross Electrical Output (MW)	Units
Darlington	Ontario	3,736	4
Bruce B	Ontario	3,507	4
Bruce A	Ontario	3,437	4
Pickering B	Ontario	2,160	4
Pickering A	Ontario	1,084	2
Point Lepreau	New Brunswick	705	1

URANIUM - PRICES*



* The majority of Canadian uranium production is sold by long-term contract, as opposed to the spot market.

BIOFUELS AND TRANSPORTATION

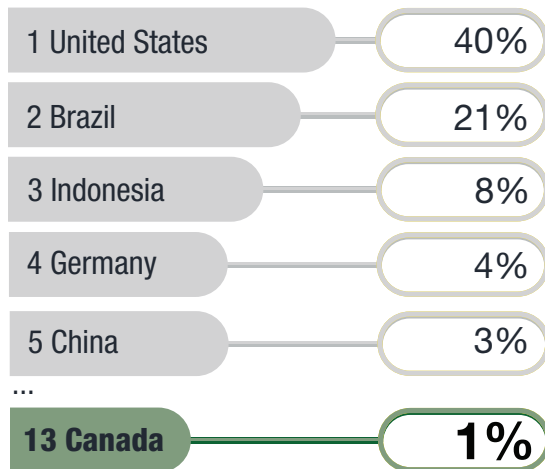
LIQUID BIOFUELS

- Liquid biofuels are enhanced biomass-derived fuels that can take the form of a liquid such as ethanol or renewable diesel fuels. The liquid biofuels are mixed with traditional gasoline and diesel to reduce the overall GHG emissions associated with the blended fuel.
- The federal *Renewable Fuels Regulations* require fuel producers and importers to have an average renewable content of **at least 5%** based on the **volume of gasoline** that they produce or import and **at least 2%** of the **volume of diesel fuel** that they produce and import.*

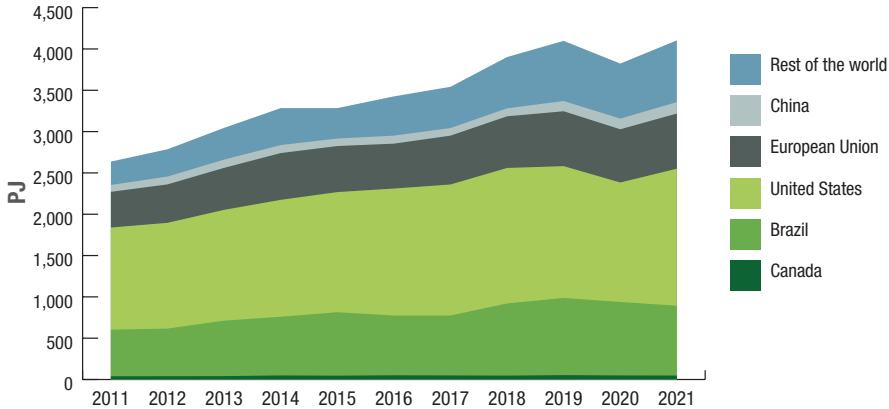
* Heating distillate oil volumes for space-heating purposes are excluded from the diesel regulations.*

INTERNATIONAL CONTEXT

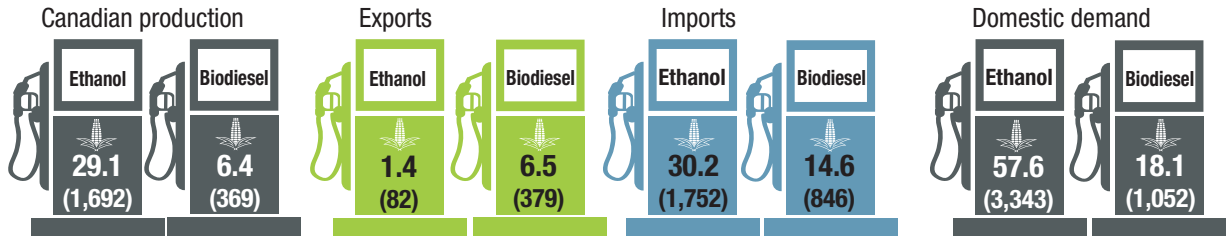
World production of biofuels – 4103 PJ (2021)



WORLD BIOFUELS PRODUCTION

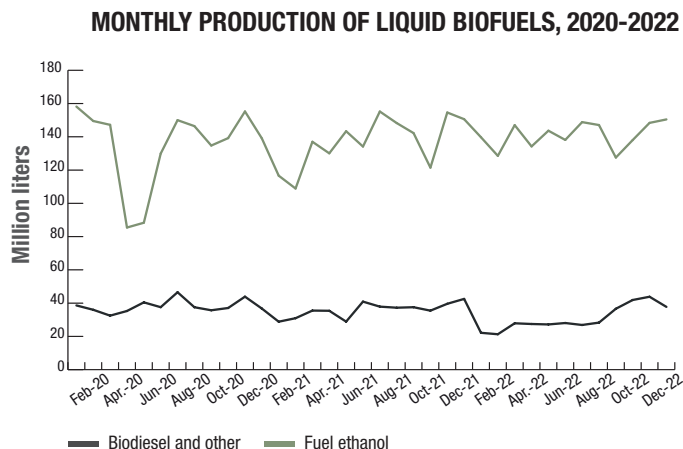


CANADIAN SUPPLY AND DEMAND (2022) - MB/D (MILLION LITRES)



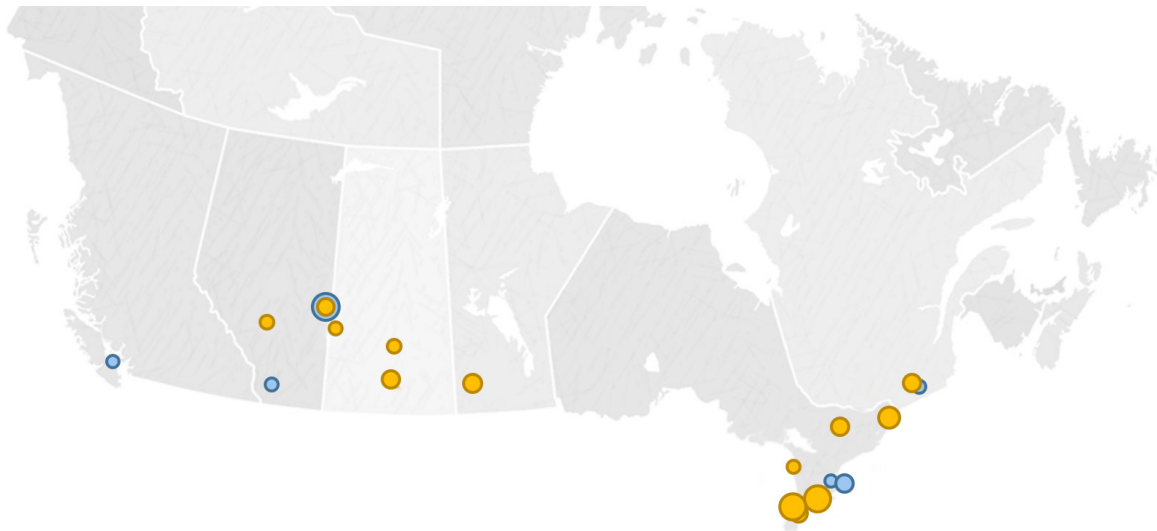
CANADIAN BIOFUEL PRODUCTION

- Liquid biofuels are made of **feedstocks such as cereal grains and vegetable oils**.
- In 2021, **4.5 million tonnes** of cereal grain, and **310 thousand tonnes** of vegetable oil were used in domestic production of biofuels.
- Canada produced **1.7 billion liters of fuel ethanol** and **370 million liters of biodiesel and other products** in 2022.
- Co-products are secondary goods that are generated during the biofuel manufacturing process and can be sold or reused. Biofuel production generated **1.8 million tonnes of co-products in 2022**, primary distillers grains which can be used as animal feed.



Currently the **majority of liquid biofuels** in Canada are **produced in southern Ontario and Saskatchewan.**

CURRENT BIOFUEL PRODUCTION CAPACITY



■ Ethanol
■ Biodiesel

Liquid fuels
Million litres (ML) per year

0 – 100
Small

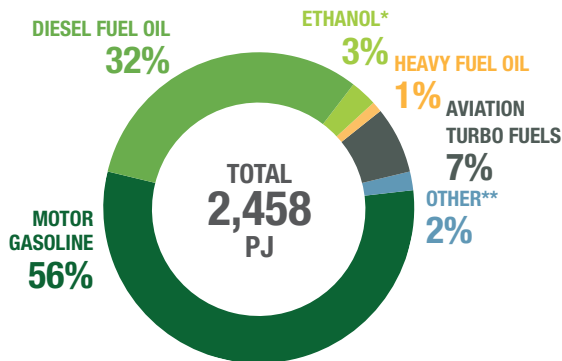
100 – 200
Medium

200 – 300
Large

300+
Giga



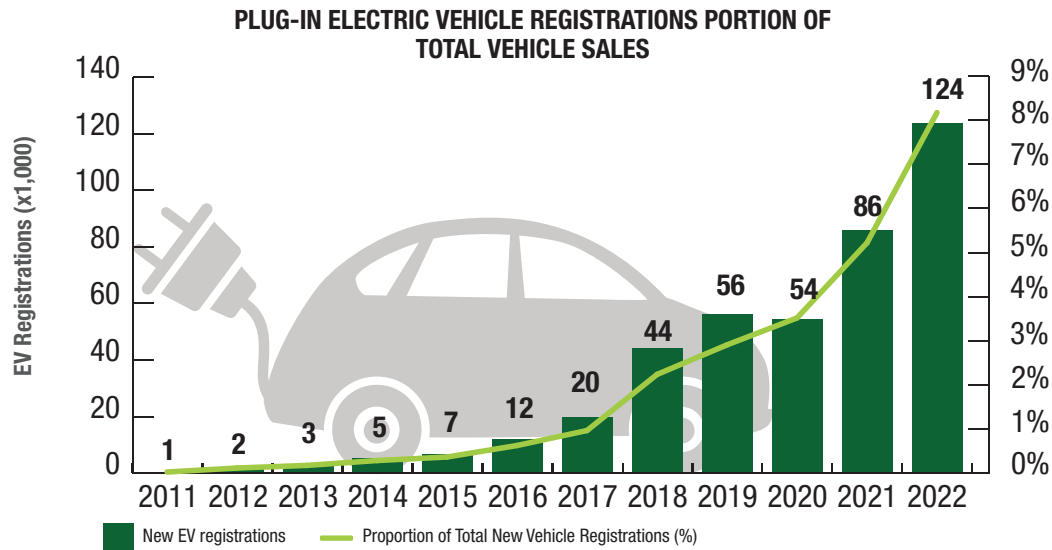
FUEL MIX OF THE TRANSPORTATION SECTOR, 2020



- Total transportation energy use **increased 8%** from 2000 to 2020.
- Energy efficiency improvements in the transportation sector saved Canadians **417 PJ** of energy and over **\$11 billion** in energy costs in 2020.
- Passenger transportation contributes **48%** to the total emissions, freight emissions are **47%**, and off-road emissions are **5%**.

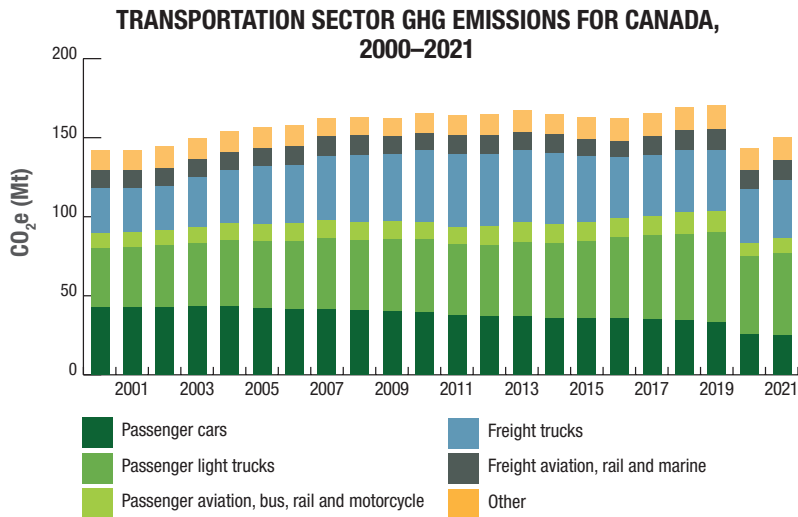
* The ethanol proportion is estimated based on production data.

** The category "Other" includes electricity, natural gas, biodiesel fuel oil, light fuel oil, aviation gasoline and propane



- In 2022, electric vehicle (EV) registrations made up **8.2% of total vehicle registrations**.
- Over **123,000 plug-in EVs** were **registered** in 2022, over six times the number of registrations as in 2017. Sales are highest in the provinces of Quebec, British Columbia and Ontario.

GHG SPOTLIGHT: TRANSPORTATION



- **Transportation GHG emissions** (from passenger, freight, and other forms of transport) **increased 5%** from 2020 to 2021, reflecting a rebound since the first year of the pandemic. Despite the increase, transportation emissions were 12% below their pre-pandemic level in 2019.

HYDROGEN

Hydrogen is a versatile energy carrier that can be produced from a variety of feedstocks.

Hydrogen can be converted to electricity through a fuel-cell in electric vehicles and power generation equipment, combusted to produce heat, or used as a feedstock in a range of chemical and industrial processes.

Hydrogen produced via low-carbon production pathways such as electrolysis or natural gas using carbon abatement can be ideal for decarbonizing hard-to-abate sectors such as heavy industry, truck freight or bus transit.



**Versatile
energy carrier**



**Carbon free at
point of use**



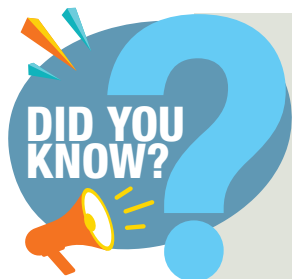
**Can be produced
from variety of
feedstocks**



**Can be
transported
long distances**



**Highest energy
per mass of
any fuel**



The energy in

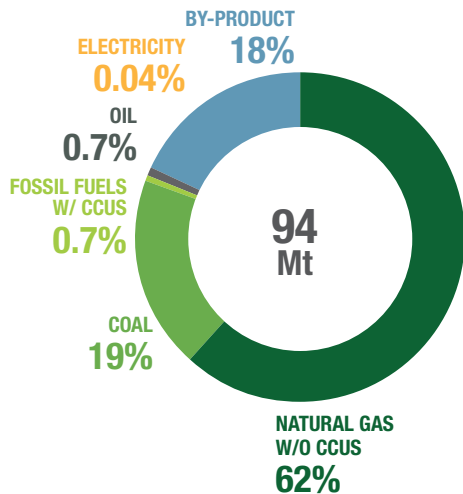
1 kg of hydrogen

is the same as approximately

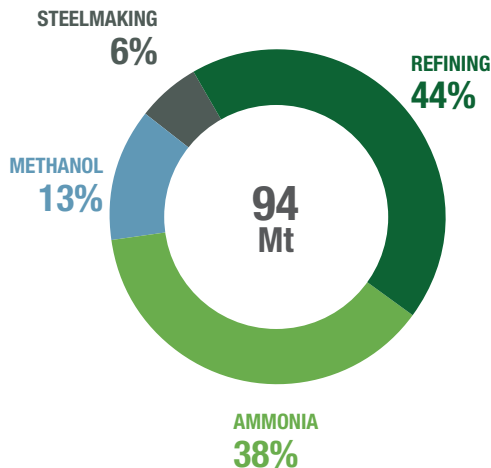
2.8 kg of gasoline.

- The total global production of hydrogen in 2021 was **94 million tonnes (Mt)**, in which **82%** of production was deliberate, and **18%** was produced as a by-product to industrial processes.
- Global demand for hydrogen in 2021 was of **94 Mt**. Hydrogen for oil refining and ammonia production were the most common end-uses, accounting for approximately **44%** and **38%** of total demand, respectively.

**GLOBAL HYDROGEN PRODUCTION
BY ENERGY SOURCE, 2021**



**GLOBAL HYDROGEN DEMAND
BY END-USE 2021**



- Canada is **one of the top 10 hydrogen producers in the world today, with an estimated 3 Mt** of hydrogen produced per year (low-carbon and carbon-intensive).
- Most hydrogen in Canada is produced from natural gas and used by the chemical industry and the oil and gas sector. At the moment, hydrogen is produced without CCS technology, however, interest is growing rapidly in low-carbon production facilities. Currently in Canada, there are over **70 electrolysis or natural gas with CCUS production projects** in various forms of initial planning or development, with a **combined potential value over \$90 billion** and **combined potential production capacity over 2.5 Mt**.
- Air Liquide deployed a **20 MW** electrolyser in Canada in 2021, which at the time was the **world's largest** facility producing low-carbon hydrogen using electricity to split water. Canada's total deployed low-carbon hydrogen production capacity is currently **3,450 tonnes** per year.
- As of 2021, there were more than **100 established hydrogen and fuel cell companies** spanning the full value chain, **employing more than 4,200 people** in direct jobs within Canada, and generating **revenues in excess of \$500 million** and **investing \$125 million** in RD&D.



Section 6:

Oil, natural gas and coal



Crude oil

Natural gas

Hydrocarbon gas liquids (HGLs)

Refined petroleum products (RPPs)

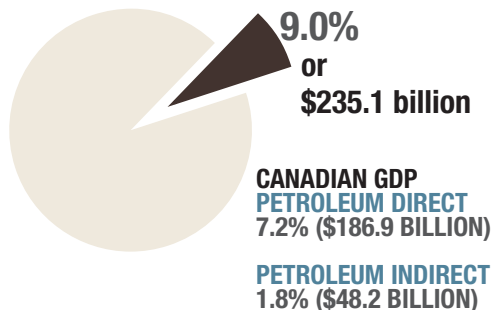
Coal

GHG Emissions from petroleum

PETROLEUM AND THE ECONOMY

NOMINAL GDP CONTRIBUTION FOR CANADA, 2022

NOMINAL GDP (% OF CURRENT DOLLARS)



- Capital Expenditures (2022): **\$53 billion**
- Canada's oil and gas sector represents about **28%** of the country's GHG emissions.
- Exports (2022): **\$217 billion** (30% of total exports)

EMPLOYMENT, 2022

DIRECT: 171,800 JOBS

OIL AND GAS EXTRACTION:	71,700
SUPPORT ACTIVITIES:	52,900
EXPLORATION:	2,800
NATURAL GAS TRANSMISSION AND DISTRIBUTION:	17,000
CRUDE OIL AND OTHER PIPELINE TRANSPORTATION:	5,900
OTHER:	21,500

INDIRECT: 240,800 JOBS

TOTAL: 412,600 JOBS

Approximately
10,800 Indigenous people are employed in the oil and gas sector.



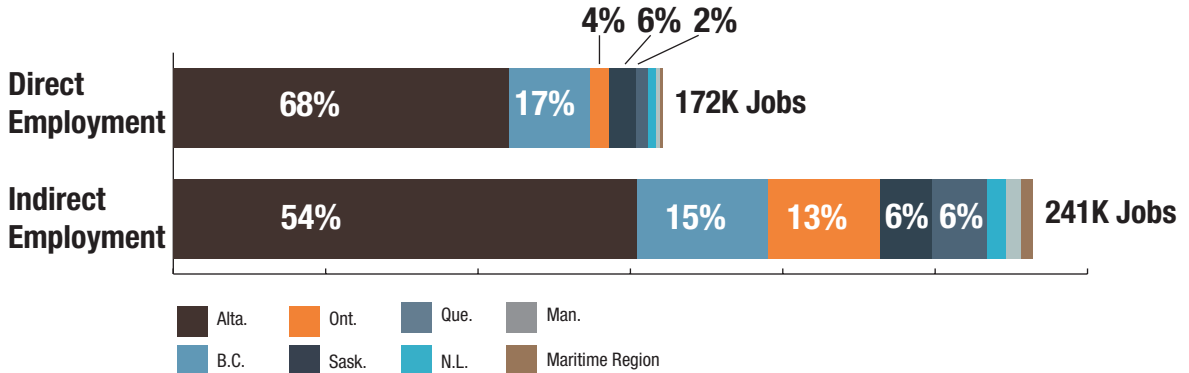
4TH Largest oil producer globally

5TH Largest gas producer globally

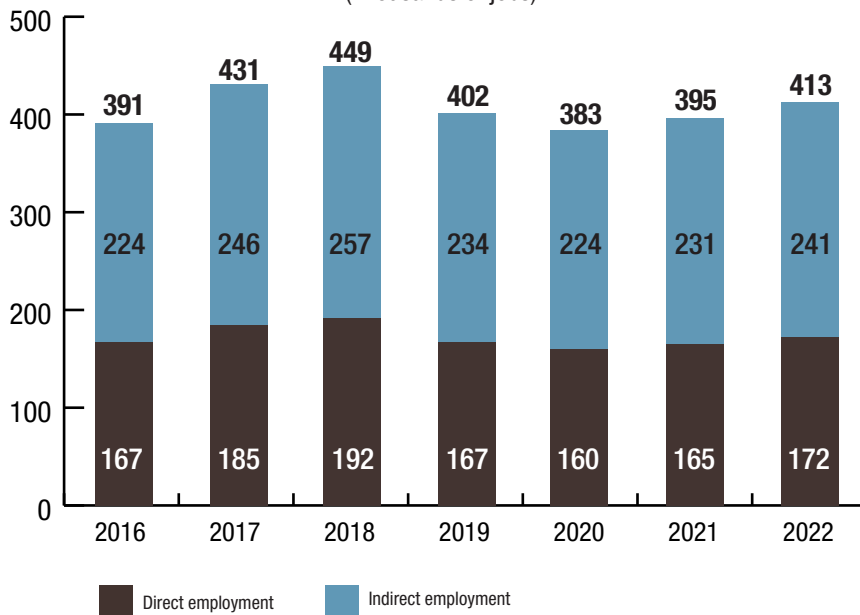
Parts may not sum to total due to rounding. The indirect contribution is not comparable to previously published estimates due to revisions and a change in estimation methodology by Statistics Canada. For more information on Statistics Canada's estimation methodology, please contact statcan.iadinfodcci-dciinfoiad.statcan@statcan.gc.ca.

- While Canada's petroleum sector **directly employed 172K people** in 2022, the sector's use of inputs from other industries created an additional **241K indirect jobs in the supply chain.**

Alberta employed the majority (54%) of the supply chain workers followed by BC (15%). Ontario (13%) and Quebec (6%) also accounted for sizeable shares of supply chain jobs.

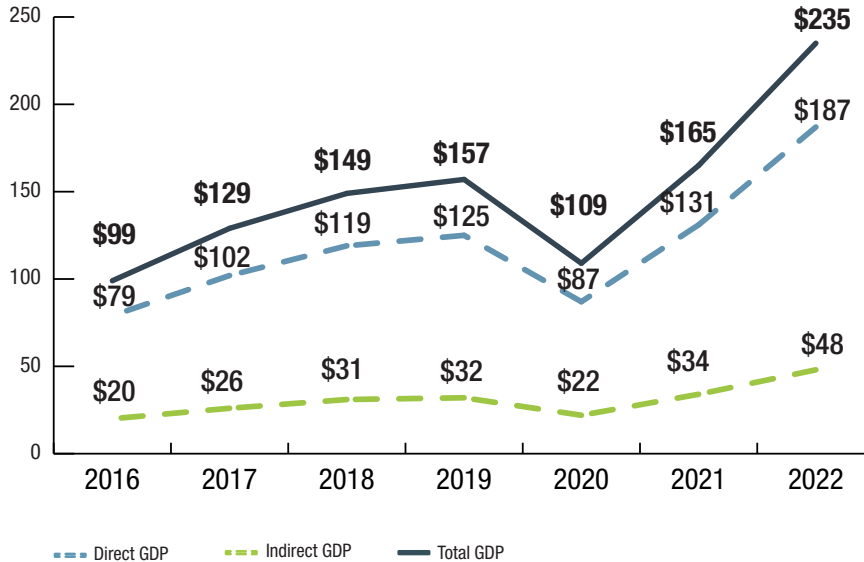


PETROLEUM EMPLOYMENT (Thousands of jobs)



Parts may not sum to total due to rounding. The indirect contribution is not comparable to previously published estimates due to revisions and a change in estimation methodology by Statistics Canada. For more information on Statistics Canada's estimation methodology, please contact statcan.iadinfoddc-dciinfoiad.statcan@statcan.gc.ca.

PETROLEUM GDP (Billions of Canadian Dollars)

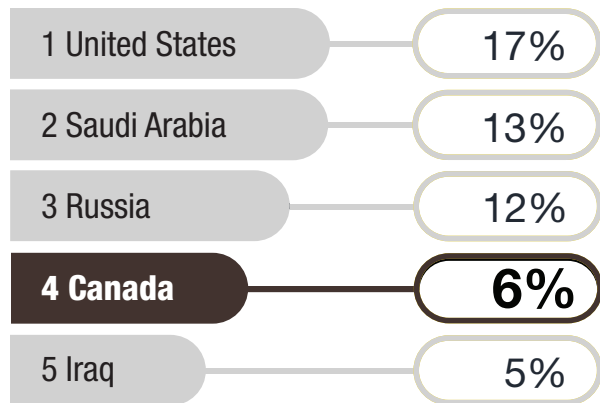


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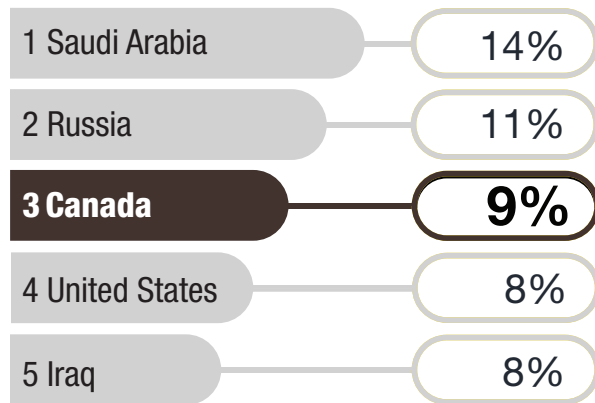
CRUDE OIL

INTERNATIONAL CONTEXT

World production* – 88.0 MMb/d (2022)

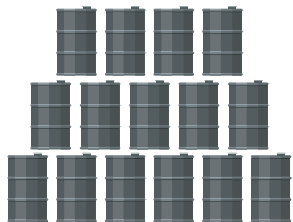


World exports* – 42.8 MMb/d (2021)



* includes crude oil, NGLs, additives and other hydrocarbons (including the receipts of additives).

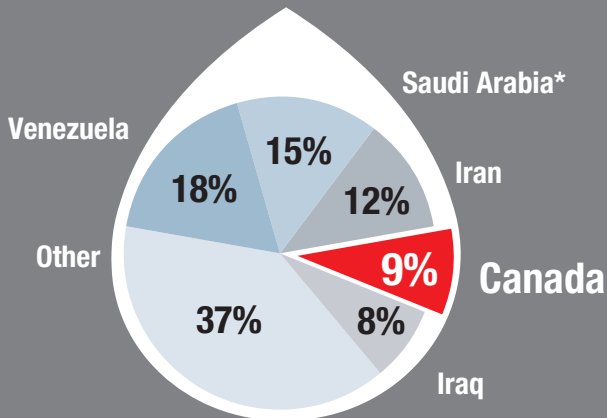
World proved reserves
1,735 billion barrels
(at the end of 2021)



Proved reserves are those reserves expected to be recoverable with a high degree of certainty.



of Canada's proven oil reserves are located in the oil sands.

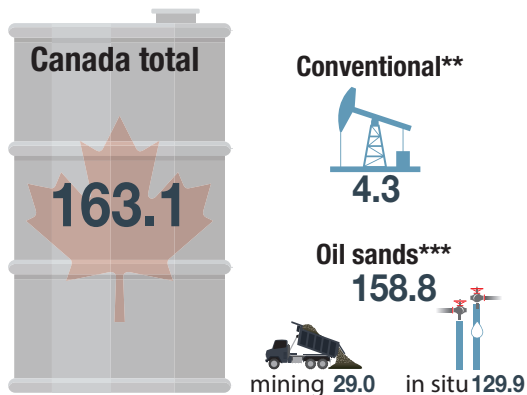


*Saudi Arabia and Kuwait reserves include the Saudi-Kuwaiti "neutral zone," with total proved reserves of 5 billion barrels.

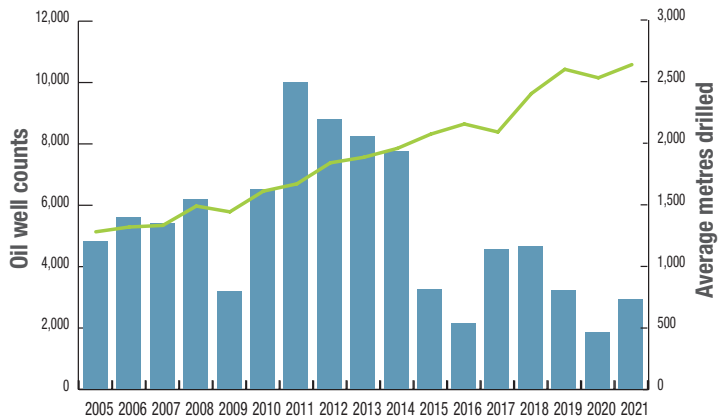
CANADIAN RESOURCES

REMAINING ESTABLISHED RESERVES*

(billion barrels, as of December 2021)



OIL WELLS COMPLETED AND AVERAGE METRES DRILLED IN WESTERN CANADA



■ Wells completed — Average metres drilled

* Reserves known to exist and recoverable under current technological and economic conditions. Totals may not sum due to rounding.

** Reserves also include proved reserves of pentanes plus (a crude-oil equivalent that is associated with oil production).

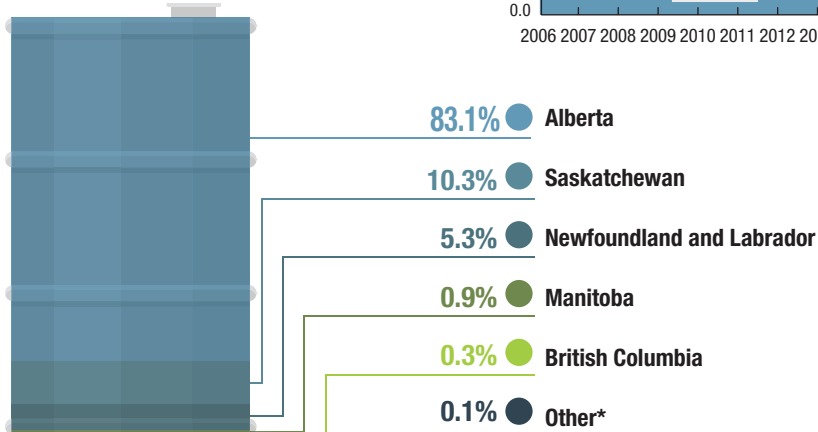
***With improved technology, it is estimated that 315 billion barrels are ultimately recoverable from the oil sands. Totals may not sum due to rounding.

CANADIAN PRODUCTION

Oil sands production has exceeded conventional production since 2010.

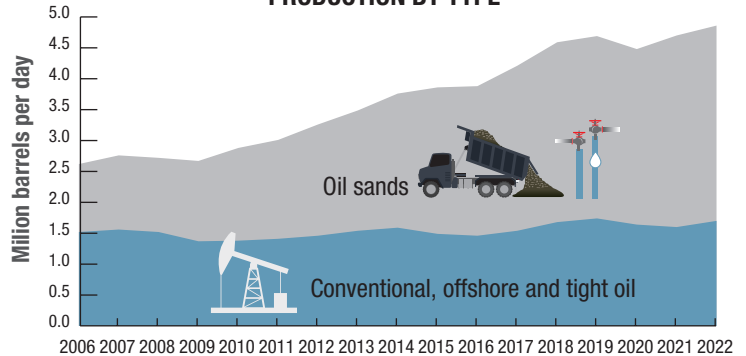
In 2022, oil sands production was **3.2 MMb/d** compared with **1.7 MMb/d** of other oil production.

PRODUCTION BY PROVINCE, 2022



*Other: Nova Scotia, Ontario and the Northwest Territories.

PRODUCTION BY TYPE



CANADIAN SUPPLY AND DEMAND* (2022)

Canadian production



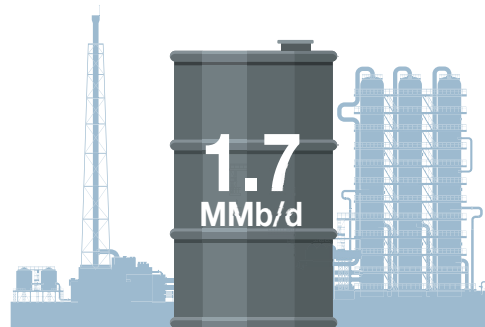
Exports



Imports



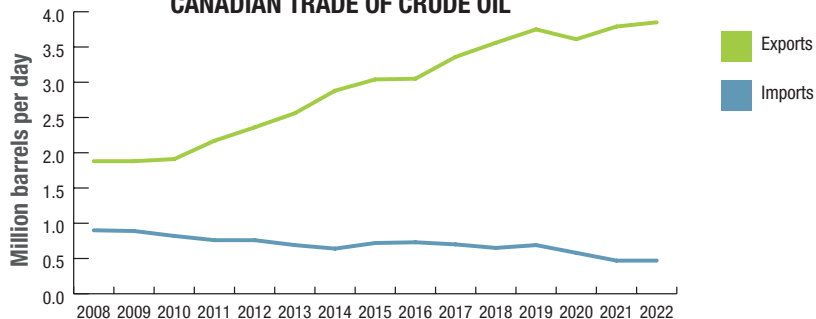
* includes condensates and pentanes plus.



CRUDE OIL INPUT TO DOMESTIC REFINERIES

TRADE

CANADIAN TRADE OF CRUDE OIL



OIL SANDS

An estimated **\$352 billion** of capital investment to date, including

\$11.1 billion in 2022



OF CANADA'S PROVED RESERVES



**OF CANADA'S OIL PRODUCTION IN
2022 OR 3.2 MMb/d**

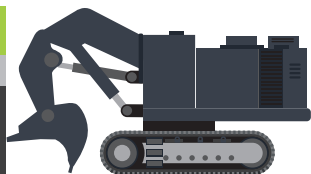
BITUMEN UPGRADING

- Crude bitumen from oil sands may be transported to upgraders for processing to make it lighter – “synthetic crude oil.”
- In 2021, **39%** of the raw bitumen produced was sent for upgrading in Alberta.
- Major companies with upgrading capacity include Syncrude, Suncor, Shell, Canadian Natural Resources, Husky and Nexen-CNOOC.
- The total upgrading capacity in Canada is **1.5 MMb/d**
- Bitumen may also be blended with diluent (e.g. condensates) and sold directly to refineries capable of processing heavier oils.

MINING METHOD

Process: Companies use trucks and shovels to scoop oil sands from the ground. The oil sands are then transported to extraction plants where bitumen is separated from the sand by using steam. Tailings are then pumped into settling basins.

In 2022, **seven projects in Alberta** produced **1,617 Mb/d**: Syncrude Mining Project (**374 Mb/d**), Suncor Base Mine (**258 Mb/d**), CNRL Horizon Mine (**258 Mb/d**), Athabasca Oil Sands Project – Muskeg River (**173 Mb/d**), Jackpine Mine (**130 Mb/d**), Imperial's Kearl Mine (**260 Mb/d**) and Fort Hills (**164 Mb/d**).



↑
formation of
75 m or less
↓

49%

OF CURRENT
PRODUCTION

ROUGHLY
20%

OF OIL SANDS
RESOURCES

IN SITU METHOD

Process: Companies drill vertical and/or horizontal wells to inject steam to facilitate the flow of oil.

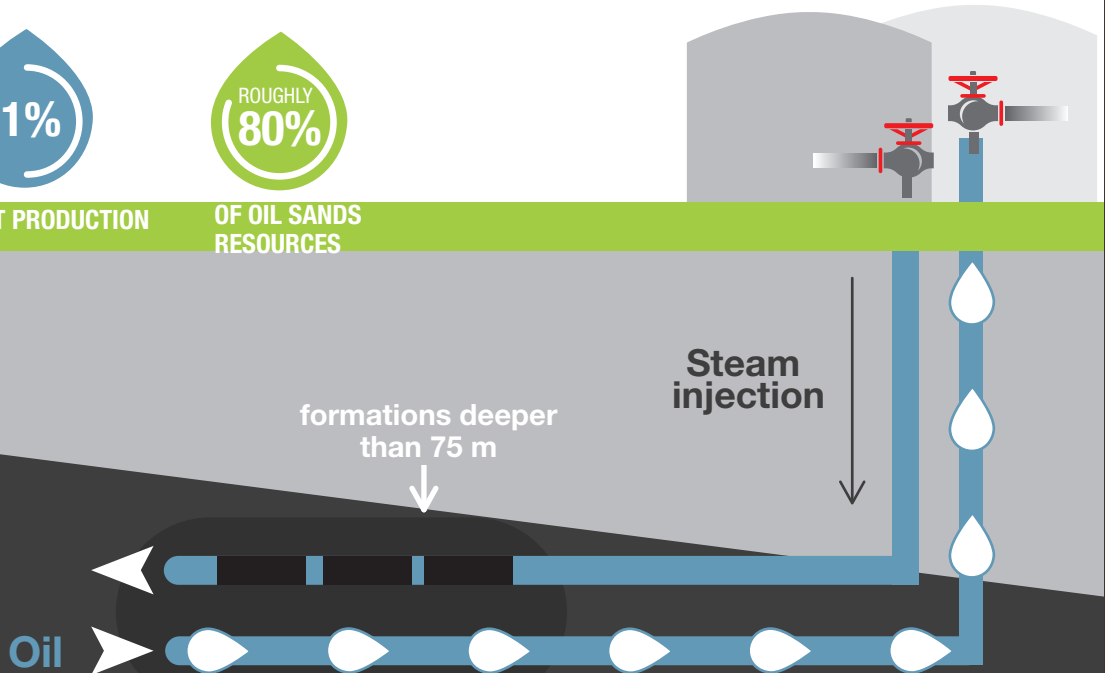
More than 20 projects in Alberta – The largest projects in 2022 were Christina Lake (Cenovus) at **247 Mb/d**, Firebag and MacKay River (Suncor) at **231 Mb/d**, Foster Creek (Cenovus) at **187 Mb/d** and Cold Lake (Imperial Oil) at **145 Mb/d**.



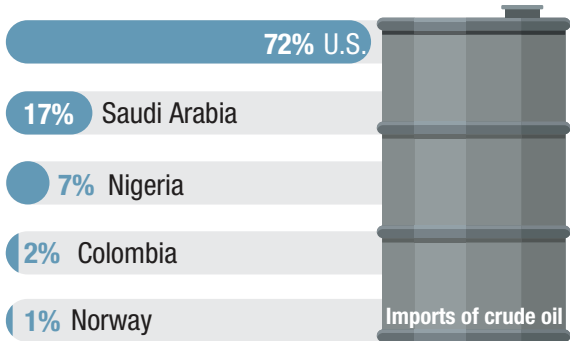
OF CURRENT PRODUCTION



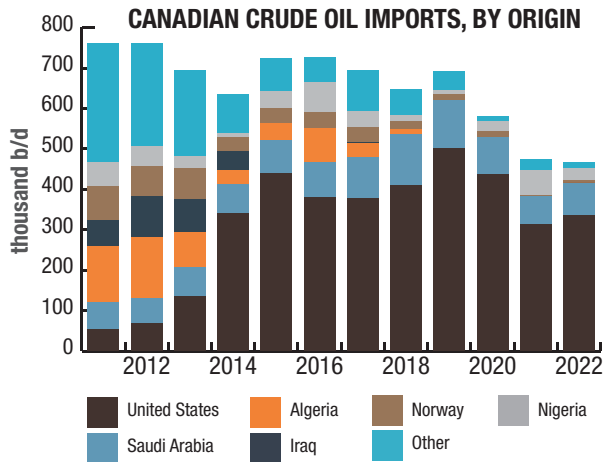
OF OIL SANDS
RESOURCES



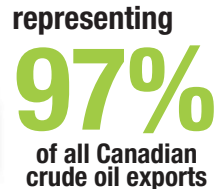
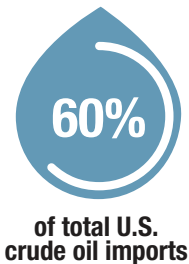
In 2022, imports of crude oil into Canada came from a range of countries including:



Over recent years, the U.S. has become Canada's primary supplier of imported crude oil.



In 2022, Canada was the **largest foreign supplier of crude oil** to the U.S., accounting for



PRICES

WEST TEXAS INTERMEDIATE (WTI)

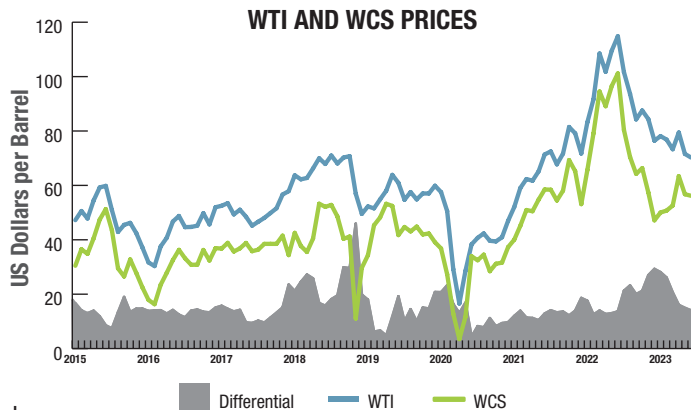
- Reference price for light crude oil delivered at Cushing, Oklahoma (a major pipeline hub)
- Used as the benchmark price for North American crudes and underlies oil futures contracts on the NYMEX

WESTERN CANADIAN SELECT (WCS)

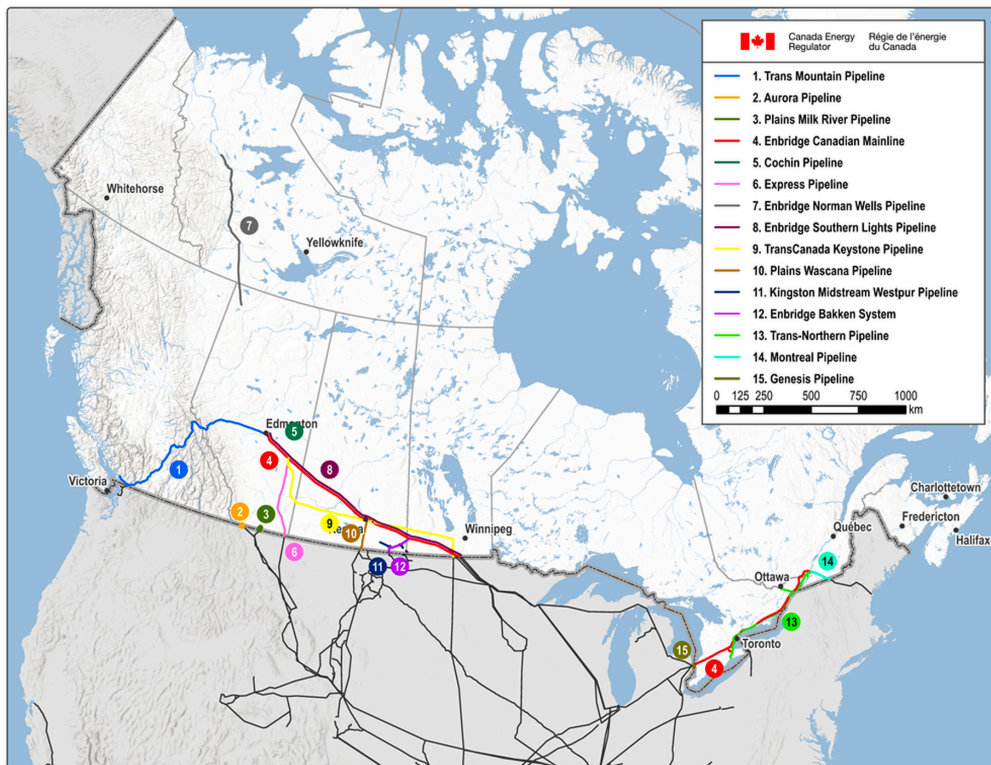
- WCS is the main benchmark price for Canadian heavy crude, specifies delivery at Hardisty, Alberta and is representative of the price of oil from the oil sands.

WTI-WCS DIFFERENTIAL

- WCS is typically sold at a discount to WTI due to differences in quality and transportation costs. Heavy crude is more difficult to process and requires specialized equipment at refineries.
- The WCS-WTI differential has historically averaged between US\$10-\$15 per barrel. However, during the fall of 2018, the differential reached a record high of over US\$50 per barrel due to insufficient pipeline capacity.
- In Q2 2020, oil prices collapsed due to the drop in demand resulting from government-imposed lockdowns to limit the spread of Covid-19. US refineries drastically reduced their refinery runs and purchases of Canadian heavy crude.
- Beginning in Q3 2020, demand recovered as lockdown measures were eased. This resulted in a large price rebound that continued throughout 2021 and the first half of 2022. After peaking in June 2022, following the Russian invasion of Ukraine, prices have partially subsided.



MAJOR CER REGULATED OIL PIPELINES



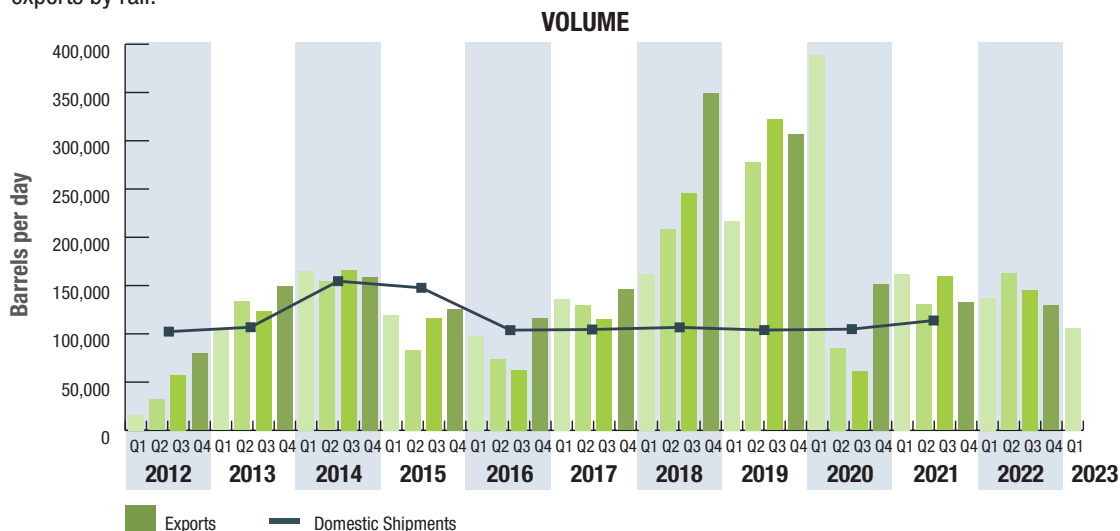
The map is a graphical representation intended for general informational purposes only. Map produced by the CER, June 2021. Last updated on Jun 03

CRUDE BY RAIL

In 2018, as production increases in Western Canada began to outpace pipeline capacity, shipments of crude oil by rail increased to fill the gap, more than doubling from their 2017 levels.

Amidst the economic disruption beginning in Q1 2020, crude shipments surged beyond their 2019 peak, reaching a high of **412 Mb/d** in February 2020. This upswing was promptly reversed in Q2, when shipments fell sharply. After bottoming-out at a four year low in July 2020, volumes started to recover.

Domestic rail shipments of fuel oils and crude petroleum are relatively stable compared to volumes of crude oil exports by rail.

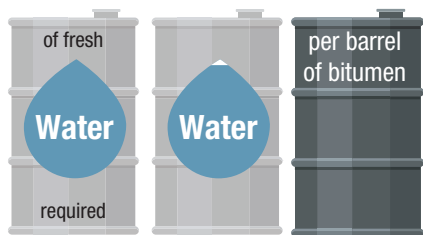


OIL SANDS: ENVIRONMENTAL CONSIDERATIONS

WATER

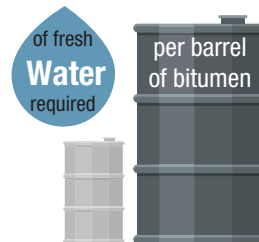
Mining method:

1.9 barrels

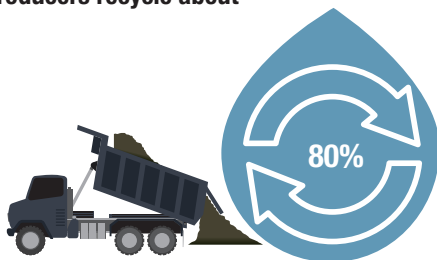


In situ method: an average of

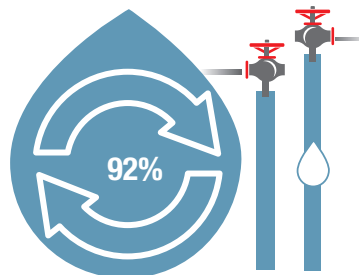
0.15 barrels



Oil sands producers recycle about



OF THE WATER USED FOR
ESTABLISHED MINES



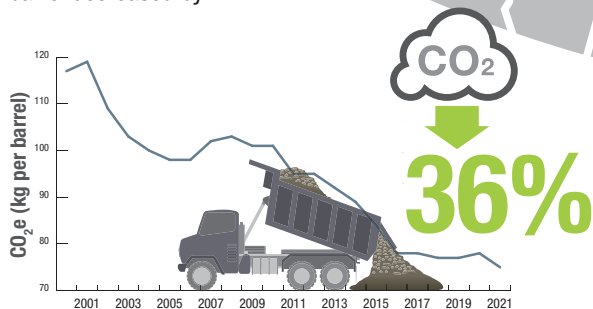
OF THE WATER USED FOR
IN SITU PRODUCTION

GREENHOUSE GASES

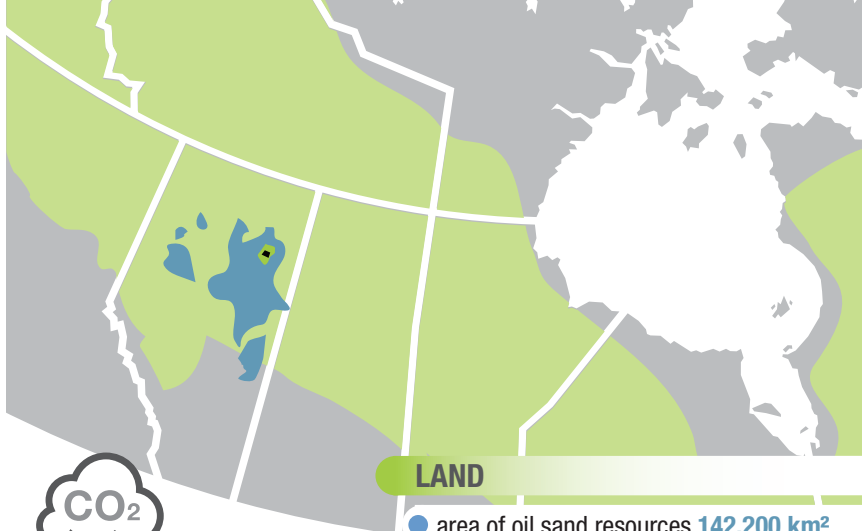
13% of Canada's total
GHG emissions in 2021

and **0.17%** of global
emissions in 2020

From 2000 to 2021,
emissions intensity per
barrel decreased by



as a result of **technological and efficiency improvements**, fewer venting emissions and reductions in the percentage of crude bitumen being upgraded to synthetic crude oil.



LAND

- area of oil sand resources **142,200 km²**
- total mineable area **4,800 km²**
- total area being mined **953 km²**
tailings ponds **257 km²**

For comparison:

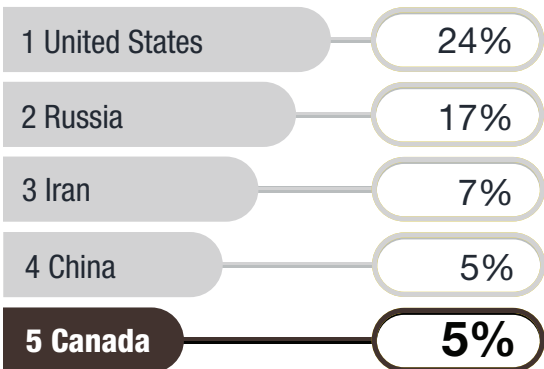
- Canada's area **10,000,000 km²**
- Canada's boreal forest **2,700,000 km²**

NATURAL GAS

INTERNATIONAL CONTEXT

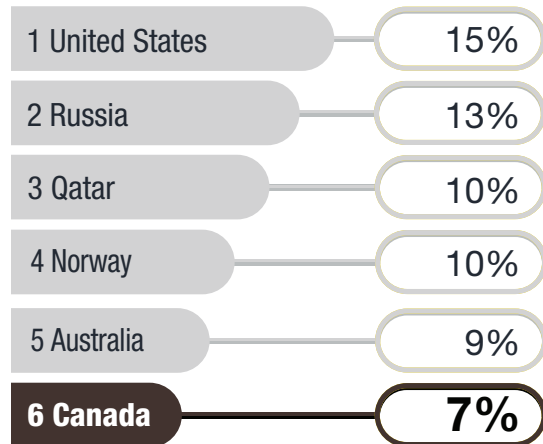
World production – 409 Bcf/d (11.6 Bcm/d)

(2022, PRELIMINARY)

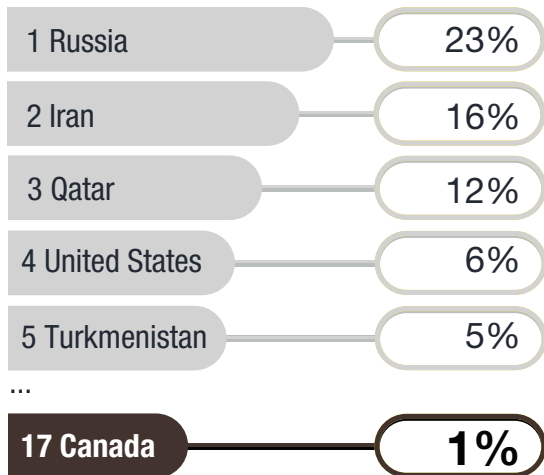


World exports – 123 Bcf/d (3.5 Bcm/d)

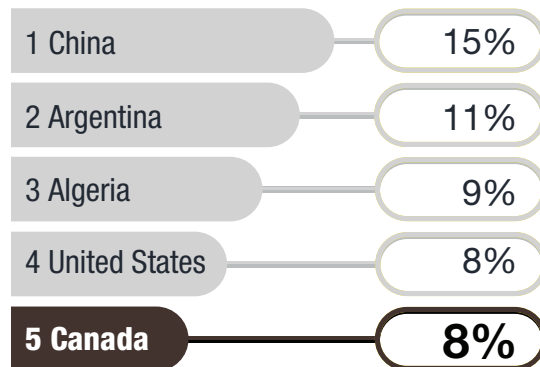
(2022, PRELIMINARY)



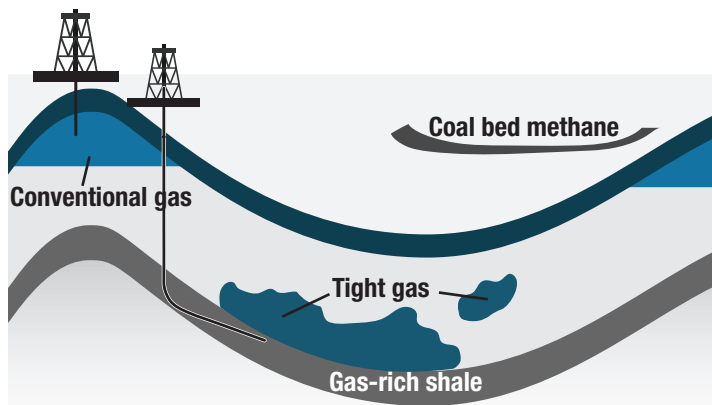
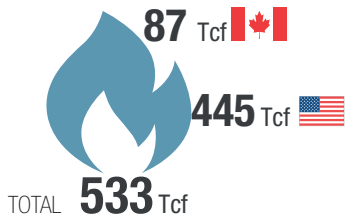
World proved reserves – 7,299 Tcf (207 Tcm) (BEGINNING OF 2022)



World unproved technically recoverable shale resources – 7,577 Tcf (2015)

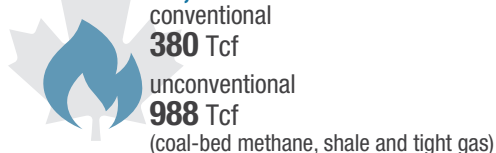


CANADA-U.S. RESOURCES PROVED RESERVES* (2022)

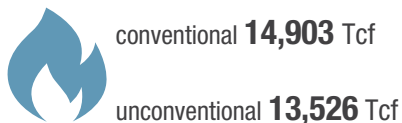


MARKETABLE/TECHNICALLY RECOVERABLE RESOURCES**

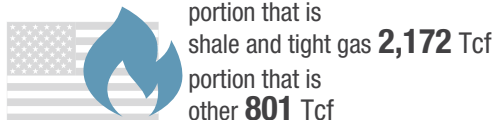
Canada total,
year-end 2022 **1,368** Tcf



World total (year-end 2021) **28,428** Tcf



U.S. total,
year-end 2020 **2,973** Tcf



* Proved reserves are known to exist and are recoverable under current technological and economic conditions.

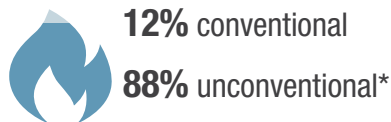
** Canadian marketable resources: natural gas that is in a marketable condition, after the removal of impurities and after accounting for any volumes used to fuel surface facilities. Marketable resources are recoverable using existing technologies, based on geological information, but much of the drilling necessary to produce the natural gas has not yet been performed. U.S. technically recoverable resources: gas estimated to be recoverable as drilling and infrastructure expands (similar to Canadian marketable resources)

CANADA-U.S. MARKET (2022)

Canada's natural gas market is heavily integrated with that of the U.S. largely because of the location of supply basins, demand centres, and the availability of transportation infrastructure, as well as existing Canada-U.S. trade agreements. These factors allow for consumers and distributors on either side of the border to freely access natural gas from the lowest cost supplier.

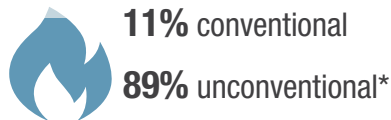
Canadian average marketable production

18.0 Bcf/d (0.51 Bcm/d)

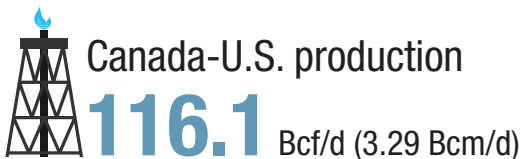


U.S. average marketable production

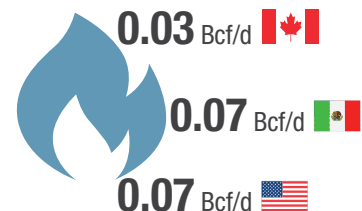
98.1 Bcf/d (2.78 Bcm/d)



* Unconventional gas includes tight gas, coal bed methane and shale gas.



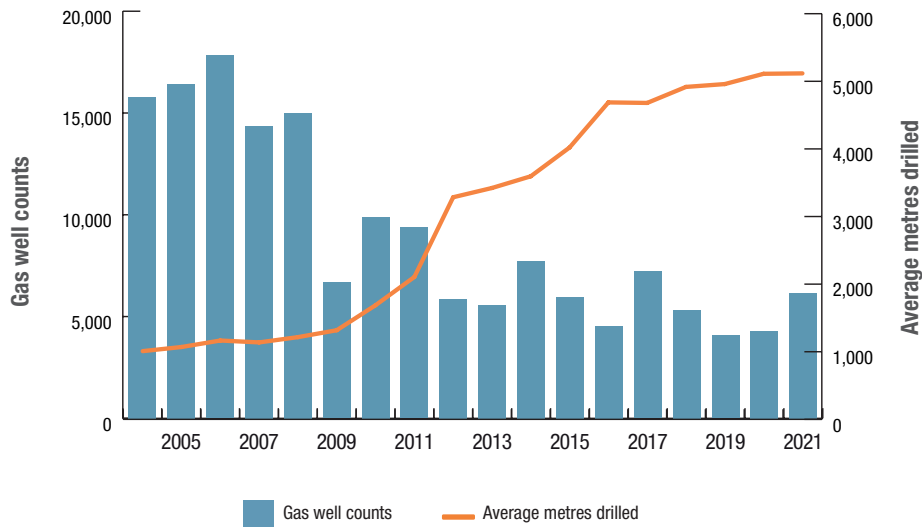
LNG imports of North American countries



LNG exports of North American countries

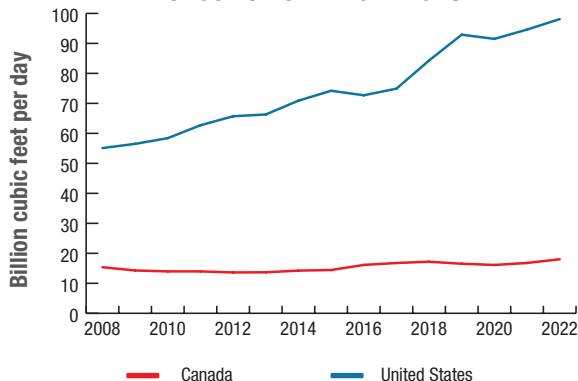


NATURAL GAS WELLS COMPLETED AND AVERAGE METRES DRILLED IN WESTERN CANADA

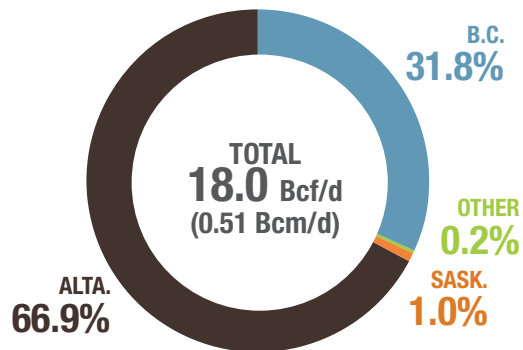


While Canadian natural gas production remained relatively flat and the number of wells drilled declined, the well productivity has increased over time. This reflects the increased use of horizontal drilling and increased well length.

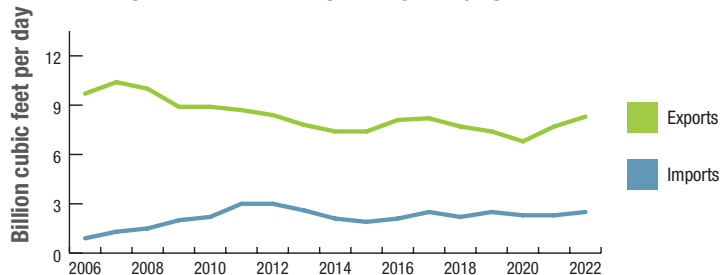
CANADIAN AND U.S. MARKETABLE PRODUCTION OF NATURAL GAS



MARKETABLE PRODUCTION BY PROVINCE, 2022



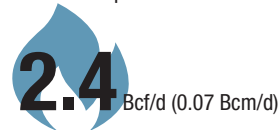
CANADIAN TRADE OF NATURAL GAS




Canadian exports to the U.S.



Canadian imports from the U.S.



- Natural gas imports from the U.S. into Eastern Canada are on the rise because of higher supplies in the U.S. Northeast and shorter transportation distances from these U.S. natural gas basins.
- Canadian natural gas exports to the western U.S. and U.S. Midwest remain significant.
- Since 2009, Canada has also imported small amounts of liquefied natural gas from other countries through the Canaport LNG terminal in Saint John, N.B.



46% of Canadian production is exported.

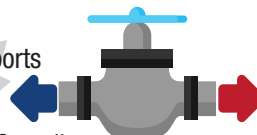


Canadian exports are largely destined for the U.S.



99% of U.S. imports and **9%** of U.S. consumption comes from Canada.

The value of Canadian net exports (exports minus imports) was **\$17.4 billion** in 2022.



99% of Canada's imports and **20%** of Canadian consumption comes from the U.S.



UPSTREAM PRICES

The AECO hub is Canada's largest natural gas trading hub, and the AECO price serves as a benchmark for Alberta wholesale natural gas transactions.

AECO PRICE

Average: 2008–2019 **\$3.39/MMbtu**

Average: 2016 **\$2.18/MMbtu**

Average: 2017 **\$2.20/MMbtu**

Average: 2018 **\$1.54/MMbtu**

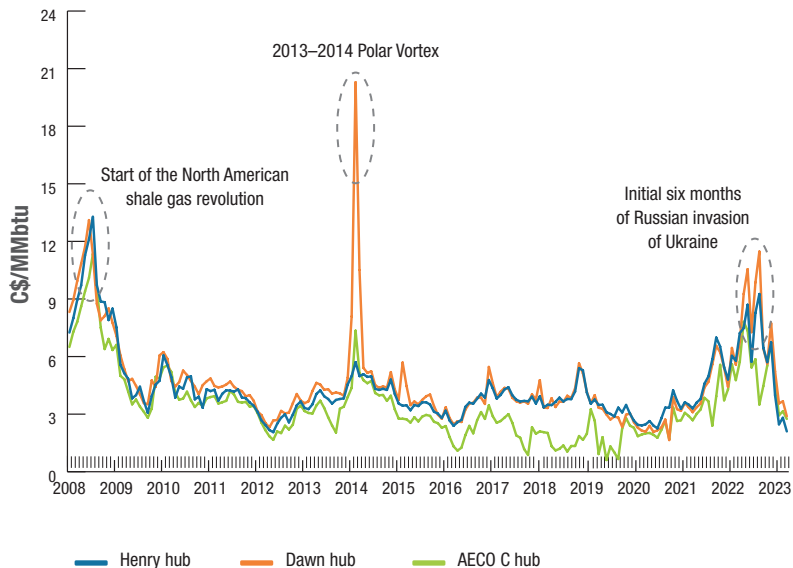
Average: 2019 **\$1.80/MMbtu**

Average: 2020 **\$2.19/MMbtu**

Average: 2021 **\$3.39/MMbtu**

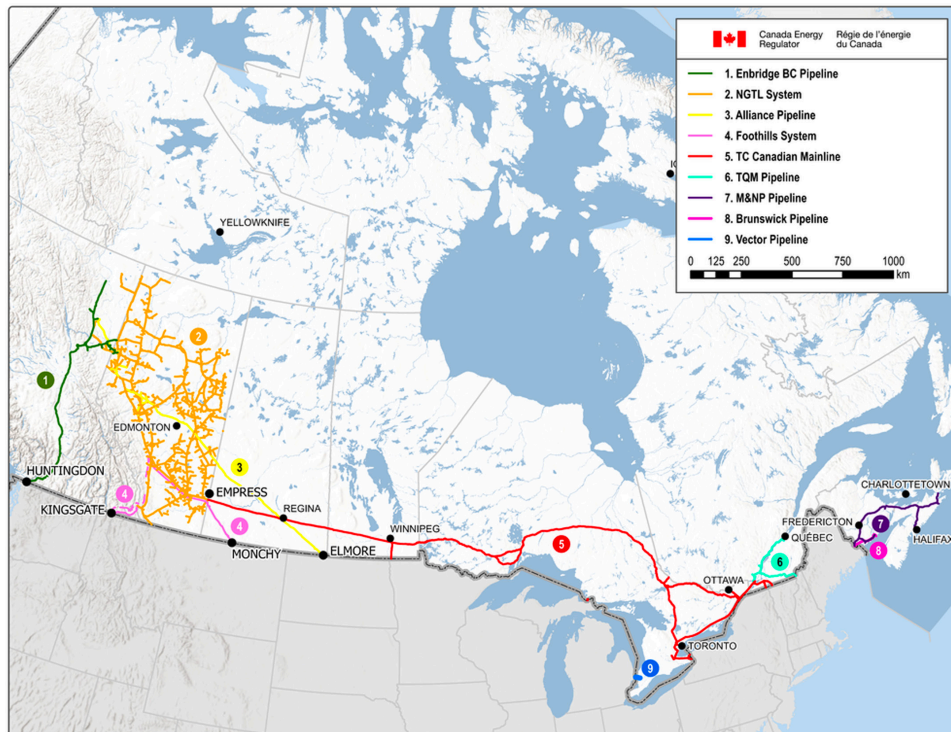
Average: 2022 **\$5.59/MMbtu**

MONTHLY AVERAGE NATURAL GAS SPOT PRICES



TRANSPORTATION

CER REGULATED GAS PIPELINES



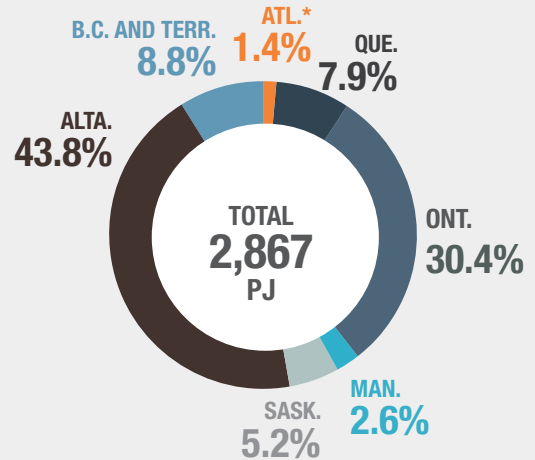
The map is a graphical representation intended for general informational purposes only. Map produced by the CER, December 2020. Last updated on Oct 20

NATURAL GAS ENERGY USE

NATURAL GAS END USE BY SECTOR, 2020

Sector	Energy use (PJ)	Energy use (Bcf/d)	% of the total
Residential	650.4	1.61	22.7%
Commercial	639.7	1.59	22.3%
Industrial	1,529.2	3.79	53.3%
Transportation	4.6	0.01	0.2%
Agriculture	42.9	0.11	1.5%
Total	2866.8	7.11	100%

NATURAL GAS ENERGY USE BY PROVINCE, 2020



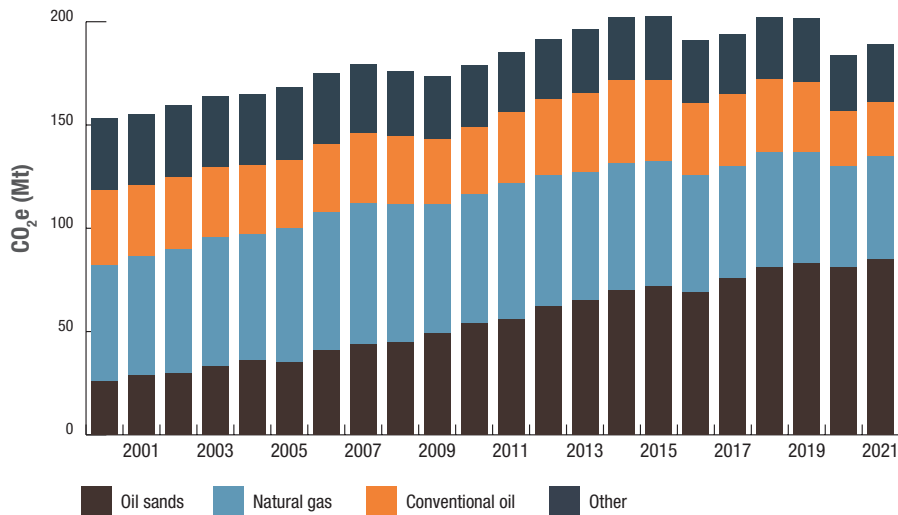
* Atlantic provinces

GHG SPOTLIGHT: OIL AND GAS

GHG emissions from oil and gas production **have gone up 23% between 2000 and 2021**, largely from increased oil sands production, particularly in situ extraction.

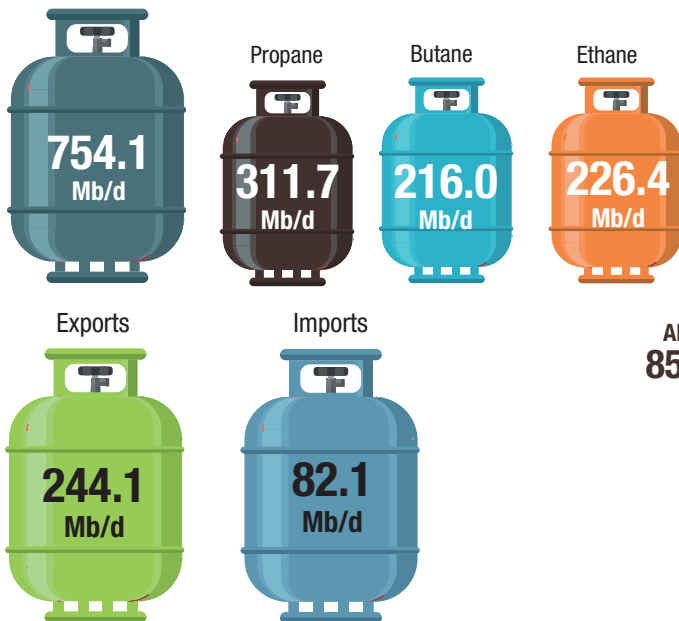
During this period, oil sands production emissions **more than tripled** while conventional oil and natural gas emissions **decreased by 18%**.

OIL AND GAS SECTOR GHG EMISSIONS FOR CANADA, 2000–2021

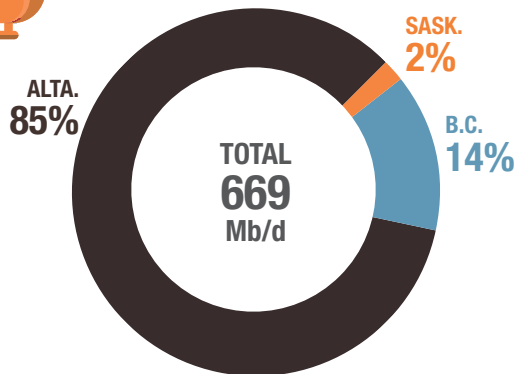


HYDROCARBON GAS LIQUIDS (HGLs) SUPPLY AND DEMAND* (2022)

Canadian production



GAS PROCESSING PLANT PRODUCTION
OF NGLS BY PROVINCE (2021)



* excludes condensates and pentanes plus, which are included as part of crude oil, and includes refinery-produced LPGs.

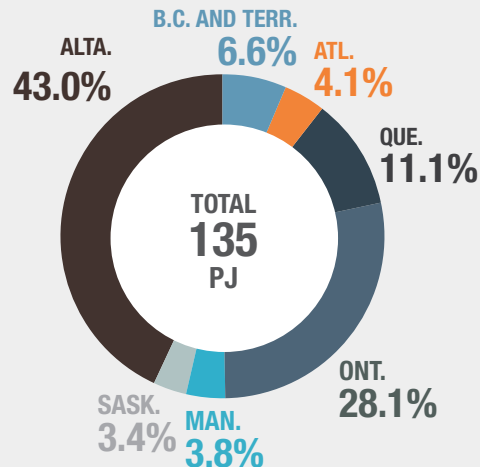
NATURAL GAS LIQUIDS ENERGY USE

TOTAL NATURAL GAS LIQUIDS ENERGY USE WAS 135.5 PJ IN 2020.

Sector	Energy use* (PJ)	% of the total
Residential	14.3	10.5%
Commercial	34.2	25.2%
Industrial	67.4	49.8%
Transportation	10.5	7.7%
Agriculture	9.1	6.7%
Total	135.5	100%

*secondary energy use

NATURAL GAS LIQUIDS ENERGY USE BY PROVINCE, 2020



REFINED PETROLEUM PRODUCTS (RPPs)

PETROLEUM REFINERIES

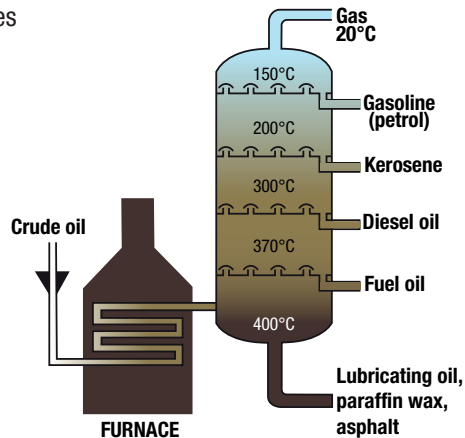
Petroleum refineries transform crude oil into a wide range of refined petroleum products (RPPs, e.g. gasoline, diesel). Other facilities such as asphalt plants, lubricant plants, upgraders and some petrochemical plants also process crude oil to produce a limited range of products.

REFINERY ACTIVITIES

- **crude oil distillation:** separating products from crude oil by heating
- **additional processing:** e.g. catalytic cracking, reforming, coking
- **product blending:** end-use RPPs are usually blended with additives or renewable fuels

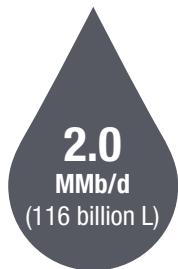
REFINERY OUTPUTS

- transportation fuels: gasoline, diesel, aviation fuels, heavy fuel oil
- heating oil
- liquid petroleum gases: propane and butane from refineries
- petrochemical feedstock
- other products: e.g. kerosene, lubricating oils, greases, waxes, asphalt

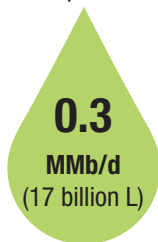


SUPPLY AND DEMAND* (2022)

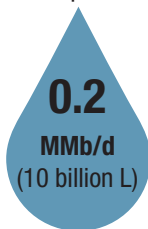
Canadian net production



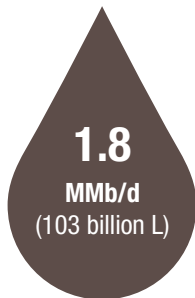
Exports



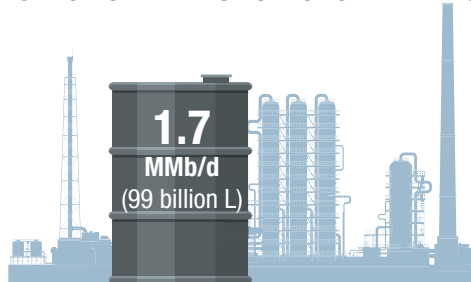
Imports



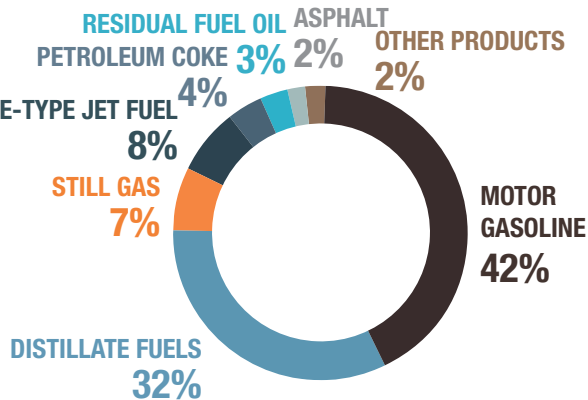
Domestic Consumption



CRUDE OIL SHIPPED TO DOMESTIC REFINERIES



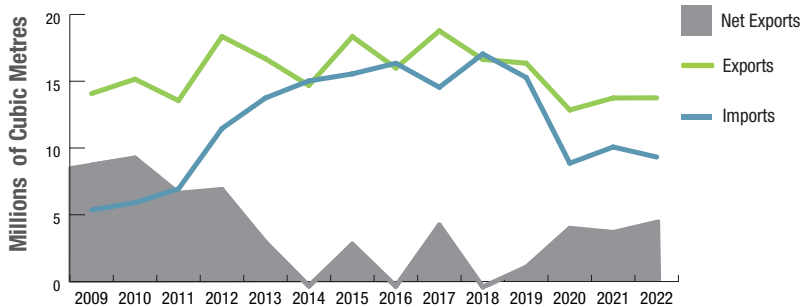
DOMESTIC CONSUMPTION BY PRODUCT*



* Certain product shares are based on Natural Resources Canada estimates.

TRADE

CANADIAN TRADE OF MAJOR REFINED PETROLEUM PRODUCTS



Primarily motor gasoline, diesel, jet fuel, fuel oil, and kerosene



15%

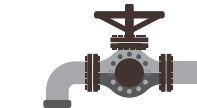
of Canadian production of refined petroleum products is exported

91%

of the dollar value of Canadian refined petroleum products exports are to the United States.

27%

of United States imports come from Canada.



8%

of total Canadian consumption is imported.

In value terms:

69%

United States

12%

Netherlands

4%

United Kingdom

2%

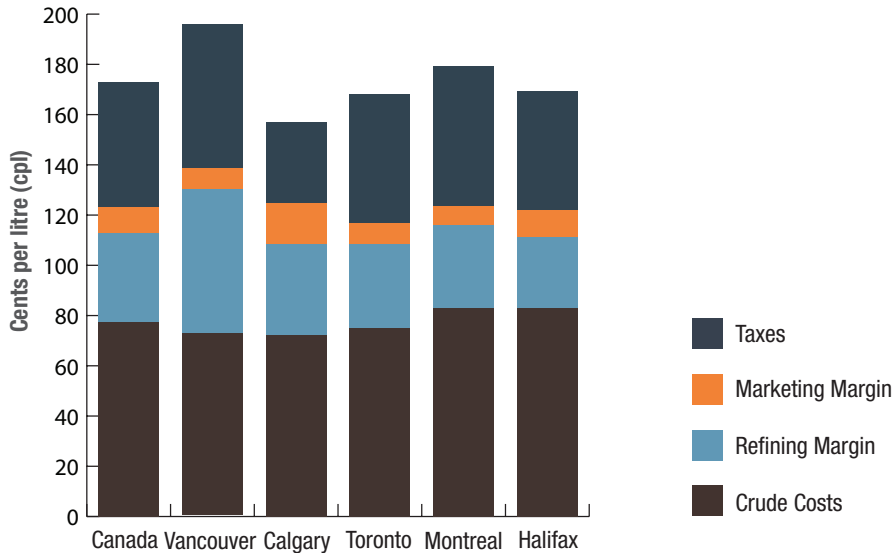
India

2%

Kuwait

RETAIL PRICES

AVERAGE CANADIAN REGULAR GASOLINE PRICES, 2022



REFINERY CAPACITY

CANADIAN PETROLEUM REFINERIES BY COUNT AND CAPACITY*, 2022

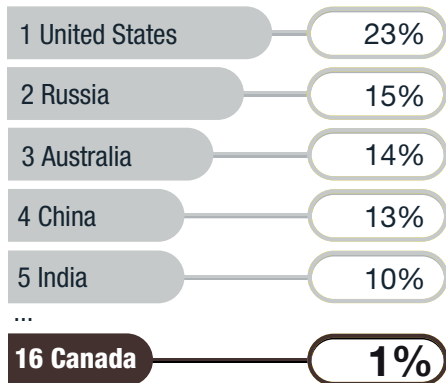
Province	Petroleum refinery		Asphalt plants		Lubricant plants (using crude oil as feedstock)		Total	
	Count	Capacity	Count	Capacity	Count	Capacity	Count	Capacity
Alberta	4	530	-	-	-	-	4	530
British Columbia	2	67	-	-	-	-	2	67
New Brunswick	1	300	-	-	-	-	1	300
Ontario	4	393	-	-	1	16	5	409
Quebec	2	372	-	-	-	-	2	372
Saskatchewan	1	135	2	52	-	-	3	187
Total	14	1,797	2	52	1	16	17	1,865

*Capacities are in Mb/d. The Come by Chance Refinery in Newfoundland and Labrador is being converted into a biofuel refinery.

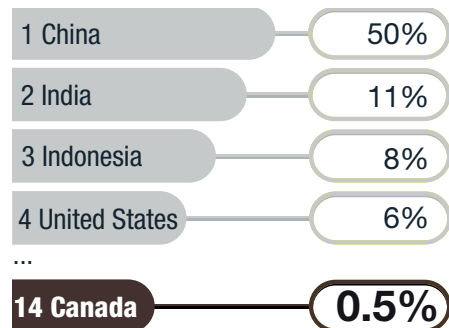
COAL

INTERNATIONAL CONTEXT

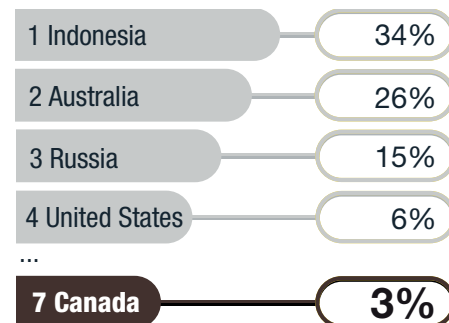
**World proved reserves –
1,074 BILLION TONNES** (2020)



World production – 8.4 BILLION TONNES
(2022)

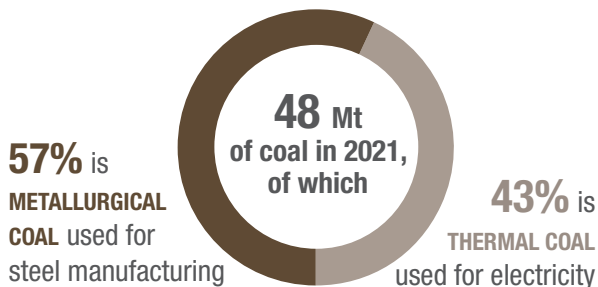


World exports – 1.4 BILLION TONNES
(2022)

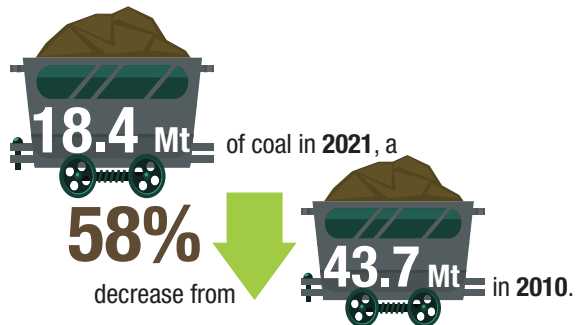


PRODUCTION AND USE

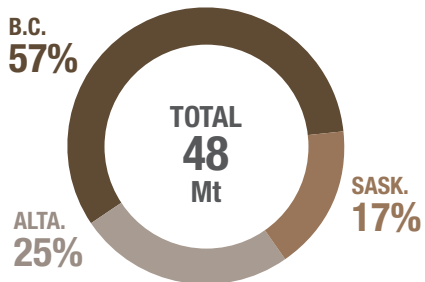
Canada produced



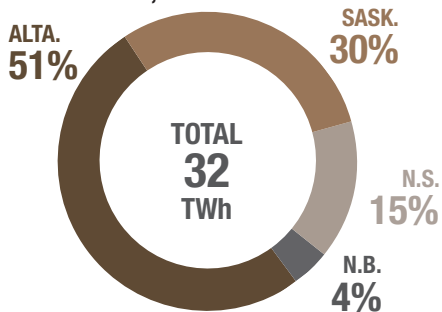
Electricity generation consumed



COAL PRODUCTION BY PROVINCE, 2021



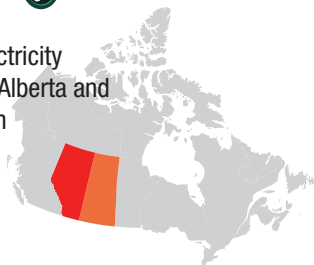
COAL-FIRED ELECTRICITY GENERATION BY PROVINCE, 2021



DOMESTIC DEMAND (2021)



Mostly for electricity generation in Alberta and Saskatchewan

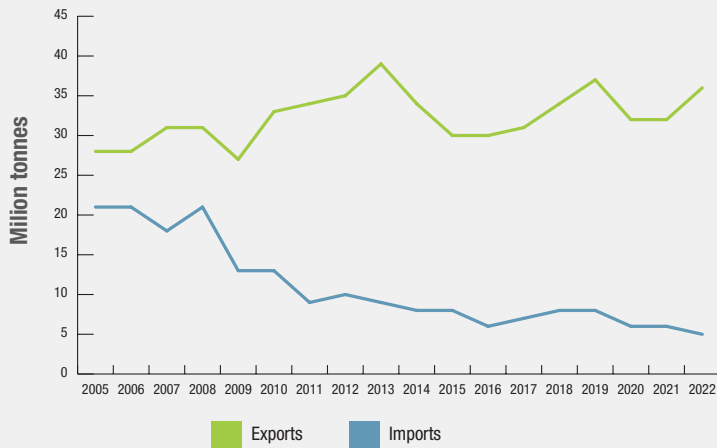


Also for metallurgical applications



TRADE

CANADIAN TRADE OF COAL



Canada's exports are primarily metallurgical coal (**77%** in 2022).

TRADE (2022)

EXPORTS



\$14 billion in coal exports



major export destinations

29% Japan

23% China

17% South Korea

4% of Canadian exports are to the U.S.,



representing **28%** of U.S. coal imports.

IMPORTS



\$1.3 billion in coal imports

75% of Canadian imports are from the U.S.



ANNEXES

ANNEX 1: UNITS AND CONVERSION FACTORS

PREFIXES AND EQUIVALENTS

Prefix				
SI/Metric		Imperial	Equivalent	
k	kilo	M	thousand	10^3
M	mega	MM	million	10^6
G	giga	B	billion	10^9
T	tera	T	trillion	10^{12}
P	peta	-	quadrillion	10^{15}

Notes

- Tonne may be abbreviated to “t” and is not to be confused with “T” for tera or trillion.
- Roman numerals are sometimes used with imperial units (this can create confusion with the metric “M”).

CRUDE OIL

Upstream

- reserves usually in barrels or multiples (million barrels)
- production/capacity often in barrels per day or multiples (thousand barrels/day or Mb/d, million barrels/day or MMb/d)
- metric: 1 cubic metre = 6.2898 barrels
- International Energy Agency: uses weight (tonnes) rather than volume

Downstream (petroleum products)

- volumes of refined products usually in litres
- 1,000 litres = 1 cubic metre
- U.S.: 1 U.S. gallon = 3.785 litres

NATURAL GAS

Volume

- reserves/production usually in cubic feet or multiples (billion cubic feet or Bcf, trillion cubic feet or Tcf)
- production/capacity often in cubic feet per day or multiples (Bcf/d, Tcf/d)
- metric: 1 cubic metre = 35.3147 cubic feet

Density

- 1 million t LNG = 48.0279 billion cubic feet

Pricing

Volume-based:

- cents per cubic metre (¢/m³) (customer level in Canada)
- \$ per hundred cubic feet (\$/CCF) (customer level in the U.S.)

Energy content-based:

- \$ per gigajoule (\$/GJ) (company level in Canada)
- \$ per million British thermal units (\$/MMbtu) (company level in the U.S., LNG)

URANIUM

- 1 metric tonne = 1,000 kilograms of uranium metal (U)
- U.S.: in pounds of uranium oxide (U₃O₈)
- 1 lb. U₃O₈ = 0.84802 lb. U = 0.38465 kg U

COAL

- 1 metric tonne = 1,000 kilograms
- U.S.: 1 short ton = 2,000 pounds
- 1 metric tonne = 1.10231 short tons

ELECTRICITY

Capacity

- maximum rated output that can be supplied at an instant, commonly expressed in megawatts (MW)

Total capacity

- installed generator nameplate capacity

Generation/sales

- flow of electricity over time, expressed in watt-hours or multiples:
 - kilowatt-hours or kWh (e.g. customer level)
 - megawatt-hours or MWh (e.g. plant level)
 - gigawatt-hours or GWh (e.g. utility level)
 - terawatt-hours or TWh (e.g. country level)

From capacity to generation

- A 1-MW unit operating at full capacity over one hour generates 1 MWh of electricity.
- Over one year, this unit could generate up to 8,760 MWh (1 MW × 24 hr × 365 days).

- Units are rarely used at full capacity over time because of factors such as maintenance requirements, resource limitations and low demand.
- “Capacity factor” is the ratio of actual generation to full capacity potential.

ENERGY CONTENT

Rather than using “natural” units (e.g. volume, weight), energy sources can be measured according to their energy content – this allows comparison between energy sources.

- metric: joules or multiples (gigajoules or GJ, terajoules or TJ, petajoules or PJ)
- U.S.: 1 British thermal unit (BTU) = 1,055.06 joules
- IEA: energy balances expressed in oil equivalent:
 - thousand tonnes of oil equivalent (ktoe)
 - million tonnes of oil equivalent (Mtoe)

Typical values

- 1 m³ of crude oil = 39.0 GJ
- 1,000 m³ of natural gas = 38.3 GJ
- 1 MWh of electricity = 3.6 GJ
- 1 metric tonne of coal = 29.3 GJ
- 1 metric tonne of wood waste = 18.0 GJ
- 1 metric tonne of uranium = 420,000 GJ to 672,000 GJ

ANNEX 2: ABBREVIATIONS

AECO	Alberta Energy Company	GST	Goods and Services tax
B	billion	GWh	gigawatt hours
b/d	barrels per day	HGL	hydrocarbon gas liquids
Bcf/d	billion cubic feet per day	HST	Harmonized sales tax
Bcm/d	billion cubic metres per day	IEA	International Energy Agency
CANDU	Canada deuterium uranium	IHA	International Hydropower Association
CanREA	Canadian Renewable Energy Association	kg	kilogram
CCS	carbon capture and storage	km	kilometre
CCUS	carbon capture, utilization and storage	km ²	square kilometre
CDIA	Canadian direct investment abroad	kt	kilotonne
CEA	Canadian energy assets	kWh	kilowatt hour
CER	Canada Energy Regulator	lb.	pound
CO ₂ equivalent	carbon dioxide equivalent	L	litre
CPI	consumer price index	LCOE	levelized cost of electricity
CPL	cents per litre	LNG	liquefied natural gas
ECTPEA	Environmental and Clean Technology Products Economic Account	LPG	liquefied petroleum gases
EGS	enhanced geothermal system	LWR	light water reactor
EIA	Energy Information Administration (U.S.)	m	metre
EU	European Union	m ²	square metre
FDI	foreign direct investment	m ³	cubic metre
G7	seven wealthiest major developed nations: Canada, France, Germany, Italy, Japan, U.K. and U.S.	Mb/d	thousand barrels per day
GDP	gross domestic product	MJ	megajoule
GHG	greenhouse gas	MMb/d	million barrels per day
GJ	gigajoule	MMcf/d	million cubic feet per day
		MMbtu	million British thermal units
		Mt	million tonnes; megatonne

Mtoe	million tons of oil equivalent	P/T	provincial/territorial
MW	megawatt	PV	photovoltaic
NGCC	natural gas combined cycle	RD&D	research, development and demonstration
NGL	natural gas liquids	R&D	research and development
NRCan	Natural Resources Canada	RPP	refined petroleum products
NRSA	Natural Resources Satellite Account	SDTC	Sustainable Development Technology Canada
NSERC	National Science and Engineering Research Council of Canada	Tcf	trillion cubic feet
OECD	Organisation for Economic Co-operation and Development	Tcm	trillion cubic metres
PHWR	pressurized heavy water reactor	Tkm	tonne-kilometre
PJ	petajoule	t	tonnes
Pkm	passenger-kilometre	TPES	total primary energy supply
Provinces	Alta. – Alberta	TWh	terawatt-hour
	B.C. – British Columbia	U.K.	United Kingdom
	Man. – Manitoba	U.S.	United States
	N.B. – New Brunswick	US\$	United States dollars
	N.L. – Newfoundland and Labrador	WTI	West Texas Intermediate
	N.S. – Nova Scotia		
	N.W.T. – Northwest Territories		
	Ont. – Ontario		
	P.E.I. – Prince Edward Island		
	Que. – Quebec		
	Sask. – Saskatchewan		
	Y.T. – Yukon		
	Atl. – Atlantic provinces		
	Terr. – Territories		

ANNEX 3: SOURCES

SECTION 1: KEY ENERGY, ECONOMIC AND ENVIRONMENTAL INDICATORS

- **ENERGY PRODUCTION AND SUPPLY**
 - **Global Primary Energy Production:** IEA Annual Database
 - **Global Energy Rankings:** IEA Annual Database, IHA World Hydropower Outlook
 - **Primary Energy Production by Region & Source:** Statistics Canada tables 25-10-0020-01, 25-10-0029-01, 25-10-0030-01, 25-10-0031-01, and 25-10-0082-01 and NRCan estimates
 - **Canada's energy supply:** IEA Annual Database, World Energy Balances and IEA Standing Group on Long-Term Co-operation questionnaire
 - **Primary and secondary energy use:** Natural Resources Canada's National Energy Use Database
- **ECONOMIC CONTRIBUTION**
 - **GDP:** Statistics Canada tables 38-10-0285-01, 36-10-0221-01, 36-10-0103-01 and 36-10-0400-01 and NRCan estimates
 - **Employment:** Statistics Canada tables 38-10-0285-01, 36-10-0214-01, 36-10-0489-01, 36-10-0480-01, 36-10-0221-01, 36-10-0400-01, 14-10-0023-01, Provincial NRSA and Statistics Canada special tabulations
 - **Energy Trade:** Statistics Canada International Merchandise Trade Database, IEA Annual Database and United States EIA (U.S. Imports by Country of Origin)
 - **Canada-U.S. Energy Trade:** Statistics Canada International Merchandise Trade Database and United States EIA (U.S. Imports by Country of Origin)

- **Government Revenues:** Statistics Canada Table 33-10-0500-01 and Canadian Association of Petroleum Producers, Statistical Handbook, Table 01-01 (Crown land sales Western Canada and Canada lands)

• ENERGY AND GHG EMISSIONS

- **GHG Emissions by Sector:** Environment and Climate Change Canada (National Inventory Report), Climate Watch Data Explorer and Statistics Canada Table 17-10-0134-01

SECTION 2: INVESTMENT

- **Capital expenditures:** Statistics Canada tables 34-10-0035-01, 34-10-0036-01, and 34-10-0040-01
- **Canada's Energy Infrastructure:** StatCan Table: 36-10-0608-01: Infrastructure Economic Accounts, investment and net stock by asset, industry, and asset function
- **Canada's Major Energy Projects:** NRCan Major Project Inventory
- **Foreign Direct Investment and Canadian Direct Investment Abroad:** Statistics Canada Table 36-10-0009-01
- **Foreign Control of Canadian Assets:** Statistics Canada tables 33-10-0033-01, 33-10-0005-01 and 33-10-0006-01
- **Canadian Energy Assets:** Compiled by NRCan from S&P Global Market Intelligence and annual financial statements from publicly traded Canadian energy companies.
- **Research, Development and Demonstration:** compiled by NRCan from internal sources
- **Environmental Protection Expenditures:** StatCan Tables 38-10-0130-01, 38-10-0132-01

SECTION 3: SKILLS, DIVERSITY AND COMMUNITY

- **Energy Sector Demographics:** Statistics Canada Natural Resources Account, special release tables.
- **Energy Affordability:** NRCan estimates based on Statistics Canada special tabulations
- **Household Expenditures on Energy:** Statistics Canada Table 11-10-0222-01
- **Energy Retail Prices:** Statistics Canada tables 18-10-0004-01 and 18-10-0001-01 and IEA Annual Database
- **Energy Reliant Communities:** NRCan analysis based on Statistics Canada 2021 Census Data

SECTION 4: ENERGY EFFICIENCY

- **ENERGY USE**
 - **Primary and secondary energy use:** Natural Resources Canada's National Energy Use Database
 - **Energy efficiency:** Natural Resources Canada's National Energy Use Database and Natural Resources Canada Energy Efficiency Trends in Canada 2000-2020
 - **Energy intensity:** Natural Resources Canada's National Energy Use Database
 - **Energy in our daily lives:** Natural Resources Canada's Energy Efficiency Trends in Canada 2000-2020
 - **Residential Energy Use, water heating and space heating** Natural Resources Canada's National Energy Use Database and NRCan estimates
 - **Residential, commercial, institutional and industrial sectors:** Natural Resources Canada's National Energy Use Database

• ENERGY TRENDS

- **Trends in Energy use and intensity:** Natural Resources Canada's National Energy Use Database

SECTION 5. CLEAN POWER AND LOW CARBON FUELS

• CLEAN TECHNOLOGY AND THE ECONOMY

- **Environmental and clean technology:** compiled by NRCan from Statistics Canada data and other public sources (Toronto Stock Exchange), NRCan 2022 Cleantech Industry Survey

• ELECTRICITY

- **World production and exports:** IEA database (Electricity Information [note: IEA production/generation data is expressed on a "gross" basis, i.e. before generating station use])
- **Trade:** CER Table (Electricity Exports and Imports Statistics), and Statistics Canada.
- **Canadian and provincial supply:** compiled by Statistics Canada and NRCan's Electricity Division from various sources
- **Prices:** Hydro-Québec (Comparison of Electricity Prices in Major North American Cities)
- **Electricity energy use:** Office of Energy Efficiency Comprehensive Energy Use Database.
- **Levelized cost of electricity:** CER (Canada's Adoption of Renewable Power Sources – Energy Market Analysis)

• RENEWABLES

- **Electricity GHG emissions:** Environment and Climate Change Canada (National Inventory Report)
- **International context – Production:** IEA (Renewables Information)

- **International context – share of energy supply:** IEA (Electricity Information, Energy Balances of OECD Countries, and Energy Balances of Non-OECD Countries) and United States EIA
 - **Domestic production:** IEA (Renewables Information) and NRCan data based on Statistics Canada
 - **Hydro – international generation:** IEA (Electricity Information, Energy Balances of OECD Countries, and Energy Balances of Non-OECD Countries)
 - **Hydro – capacity in Canada:** International Hydropower Association (Hydropower Status Report)
 - **Hydro – facilities and projects:** compiled by NRCan from Statistics Canada and other public sources
 - **Biomass – Renewable balance:** IEA database (Renewables balances)
 - **Biomass – production:** Statistics Canada Table 25-10-0031-01, Statistics Canada International Merchandise Trade Database and NRCan
 - **Biomass – wood fuel use by sector:** IEA (Renewables Information)
 - **Wind – international context:** Global Wind Energy Council (Global Wind Report)
 - **Wind – capacity in Canada:** compiled by NRCan from CanREA data
 - **Wind generation in Canada:** compiled by Statistics Canada and NRCan from various sources
 - **Wind – wind farms:** CanREA data
 - **Solar PV – international context:** Renewable Energy Policy Network for the 21st Century (Renewables 2023 Global Status Report)
 - **Solar PV – capacity in Canada:** compiled by NRCan from CanREA data
 - **Solar PV – generation in Canada:** compiled by Statistics Canada and NRCan from various sources
 - **Solar PV – solar PV farms:** compiled by NRCan from CanREA data
- **URANIUM AND NUCLEAR**
- **Biofuels – regulations:** compiled by Office of Energy Efficiency from various public sources
 - **World uranium production and exports:** World Nuclear Association (World Uranium Mining) and NRCan estimates based on World Nuclear Association production data
 - **World known recoverable resources of uranium:** OECD Nuclear Energy Agency and International Atomic Energy Agency (Uranium: Resource, Production and Demand), World Nuclear Association (Supply of Uranium)
 - **World generation of nuclear power:** International Atomic Energy Agency (Nuclear Power Reactors in the World, 2020 Ed.)
 - **Canadian supply and demand:** World Nuclear Association (Uranium in Canada), Cameco Annual report and estimates compiled by NRCan from company information
 - **Nuclear in Canada infographic:** NRCan website (Nuclear Energy and Uranium)
 - **Purchases by U.S. nuclear reactors:** United States EIA (Uranium Marketing Annual Report) Table 3 (Uranium purchased by owners and operators of U.S. civilian nuclear power reactors by origin country and delivery year)
 - **CANDU nuclear reactors:** Based on figures compiled by NRCan
 - **Nuclear power plants in Canada:** compiled by NRCan from Statistics Canada Table 57-206, International Atomic Energy Agency Power Reactor Information System and other public sources

- **Spot prices:** United States EIA Annual Uranium Market Report
- **BIOFUELS AND TRANSPORTATION**
 - **Biofuels – regulations:** compiled by Office of Energy Efficiency from various public sources
 - **Biofuels – international context:** IEA (Renewables Information)
 - **Biofuels – production, supply and demand :** Compiled by NRCan from a variety of sources
 - **Transportation – Electric vehicle sales:** Statistics Canada Table: 20-10-0021-01
 - **Transportation – GHG emissions:** Environment and Climate Change Canada (National Inventory Report)
 - **Hydrogen – NRCan Hydrogen Strategy for Canada,** EIA Global Hydrogen Review

SECTION 6: PETROLEUM, GAS AND COAL

- **CRUDE OIL**
 - **World production and exports:** IEA Online Data Services (Crude Oil Information)
 - **World proved reserves:** Oil and Gas Journal (Worldwide Look at Reserves and Production)
 - **Canadian Resources:** CER (Canada’s Energy Future Data Appendices) and Oil & Gas Journal (World proved reserves)
 - **Wells completed and metres drilled in western Canada:** Canadian Association of Petroleum Producers, Statistical Handbook, Wells and Metres Drilled in Western Canada (2021 Drilling Activity)
 - **Canadian and provincial production:** Statistics Canada Table 25-10-0063-01 and NRCan analysis
- **Canadian Supply and Demand:** Statistics Canada Table 25-10-0063-01 and Statistics Canada International Merchandise Trade Database, United States EIA (Imports by Country of Origin, Refining and Processing, total crude oil and products, consumption/sales)
- **Trade:** Statistics Canada table 25-10-0063-01 and Statistics Canada International Merchandise Trade Database, U.S. EIA (Imports by Country of Origin, Refining and Processing, total crude oil and products, consumption/sales)
- **Oil Sands:** Canadian Association of Petroleum Producers, Statistical Handbook, Table 04-14 (Canada Oil Sands Expenditures), Statistics Canada tables 34-10-0036-01 and 25-10-0063-01, Alberta Energy Regulator ST98 (Alberta’s Energy Reserves and Supply/Demand Outlook) table S3.1 (Crude bitumen production) and NRCan analysis
- **Prices:** United States EIA tables (Spot Prices for Crude Oil) and Sproule
- **Pipelines:** CER (Crude Oil Pipeline Transportation System)
- **Transportation by Rail:** CER (Canadian Crude Oil Exports by Rail – Monthly Data) , Statistics Canada table 23-10-0062-01 and various sources
- **Oil Sands Environmental Considerations:** NRCan compiled using Environment and Climate Change Canada (National Inventory Report 1990 to 2021: Greenhouse Gas Sources and Sinks in Canada), World Resources Institute (CAIT - Country Greenhouse Gas Emissions Data), Alberta Government (Oil Sands Information Portal), Alberta Energy Regulator, Statistics Canada, NRCan Boreal forest website, Alberta Government Lower Athabasca Regional Plan and Canadian Association of Petroleum Producers (Frequently used statistics)

• NATURAL GAS

- **World production and exports:** IEA (Natural Gas Information)
 - **World proved reserves:** U.S. EIA, International Data Browser
 - **World unproved technically recoverable shale resources:** U.S. EIA, World Shale Resource Assessments
 - **World resources and technically recoverable resources:** IEA (World Energy Outlook 2017, 2014 and 2013) tables 5.3 (Remaining technically recoverable natural gas resources by type and region), 8.2 (Remaining technically recoverable natural gas resources by type) and 3.3 (Remaining technically recoverable natural gas resources by type and region) and Oil and Gas Journal (Worldwide Look at Reserves and Production)
 - **Canada and US proved reserves:** U.S. EIA and O&G Journal, extracted from EIA International Data Browser
 - **Marketable and technically recoverable resources:** CER Energy Future Report, EIA Annual Energy Outlook, Assumptions to AEO - Oil and Gas Supply Module, EIA Shale gas proved reserves, IEA World Energy Outlook
 - **Canadian production and share of conventional versus unconventional production:** StatCan Table: 25-10-0055-01 Natural gas supply and disposition and CER Energy Futures, Natural Gas Production by Type
 - **US production and share of conventional versus unconventional production:** U.S. EIA, Dry Natural Gas Production, Annual and US EIA Annual Energy Outlook
 - **LNG Imports of North American countries:** CER LNG Imports and Exports, U.S. EIA Liquefied Natural Gas Imports and Exports, Annual, and IGU World LNG Report
 - **Natural gas wells completed and average metres drilled:** CAPP, Statistical Handbook
 - **Canadian trade of natural gas:** CER Exports and Imports of Natural Gas
 - **Marketable Production by Province:** StatCan Table: 25-10-0055-01 Natural gas supply and disposition
 - **Prices:** Sproule Price Forecast
 - **Pipelines:** Canada Energy Regulator
 - **Natural gas energy use:** NRCAN Office of Energy Efficiency, National Energy Use Database
 - **Consumption:** Statistics Canada Table 25-10-0030-01 and IEA Annual Mini-Questionnaire
- ## • HGLs
- **Processing plant production:** StatCan Table 25-10-0036-01 - Supply of natural gas liquids and sulphur products from processing plants
 - **Refinery production:** Gross production of HGLs from StatCan Monthly Refined Petroleum Product Survey
 - **Shares of NGL Production by province:** CAPP Statistical Handbook
 - **NGLs end use:** NRCAN Office of Energy Efficiency, National Energy Use Database
- ## • RPPs
- **Canadian refineries:** compiled by NRCAN (from company information, Conference Board of Canada, Canada's Petroleum Refining Sector Canadian Fuels Association, Canadian Association of Petroleum Producers, Oil Sands magazine and CanOils Database)
 - **Supply and Demand:** Statistics Canada Tables, 25-10-0063-01 and 25-10-0081-01 and NRCAN Analysis

- **Crude oil shipped to domestic refineries:** Statistics Canada table 25-10-0063-01
 - **Domestic consumption by product:** Statistics Canada table 25-10-0081-01 and analysis by NRCan
 - **Trade:** Statistics Canada Table 25-10-0081-01, United States EIA (U.S. Imports by Country of Origin for Petroleum and Other Liquids) and Statistics Canada International Merchandise Trade Database
 - **Gasoline prices:** Kalibrate Technologies Ltd (average retail prices for regular gasoline and diesel fuel) and data compiled by NRCan
 - **Refinery capacity:** Oil sands magazine and estimates compiled by NRCan
- **COAL**
 - **World proved reserves:** Energy Institute (Statistical Review of World Energy)
 - **World production and exports:** IEA (Coal Information)
 - **Canadian supply and demand:** IEA (Coal Information), Statistics Canada International Merchandise Trade Database, and NRCan estimations
- **GHG EMISSIONS FROM PETROLEUM**
 - **GHG Emissions by Sector:** Environment and Climate Change Canada (National Inventory Report)

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<https://energy-information.canada.ca/index-eng.htm>

