

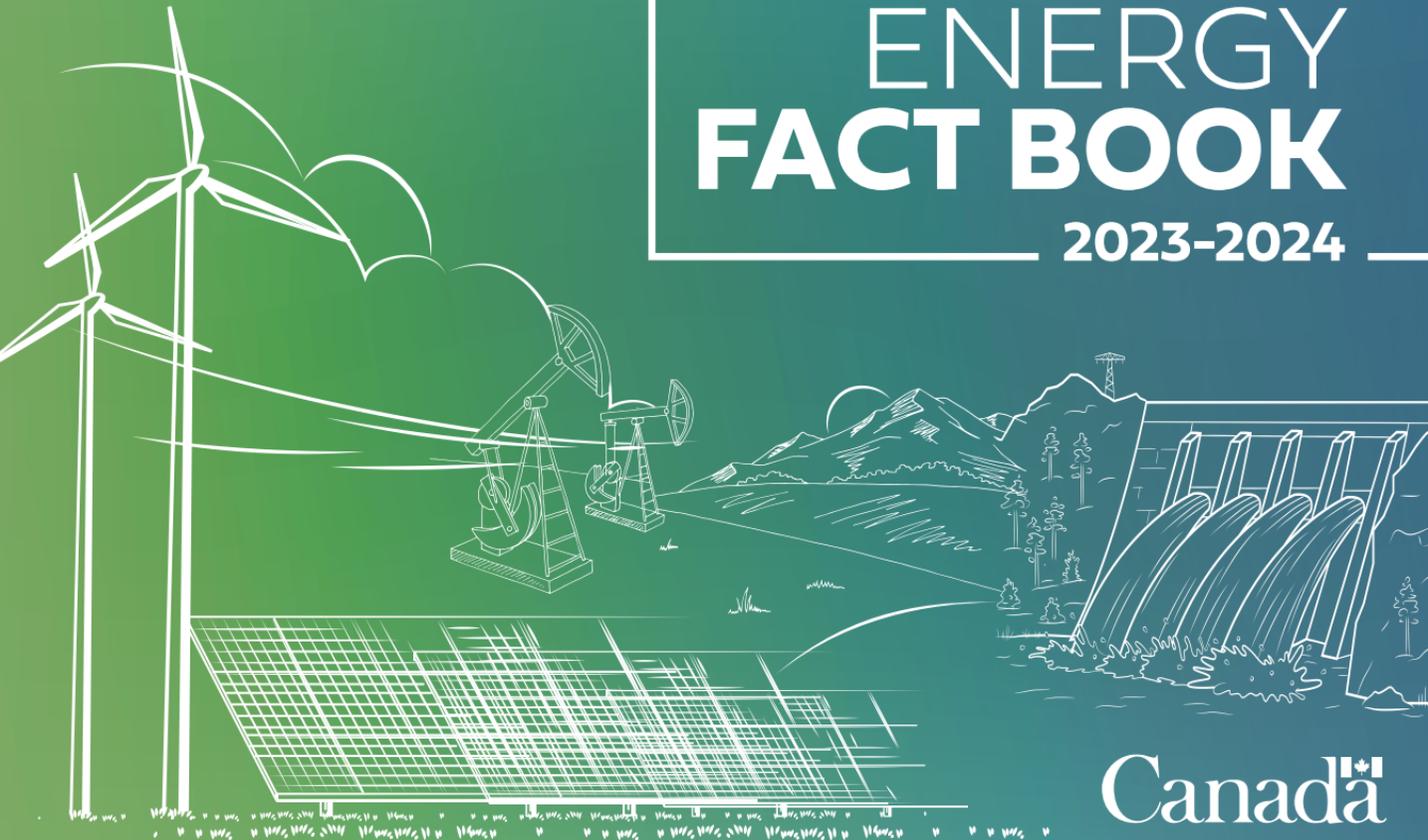


Natural Resources
Canada

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

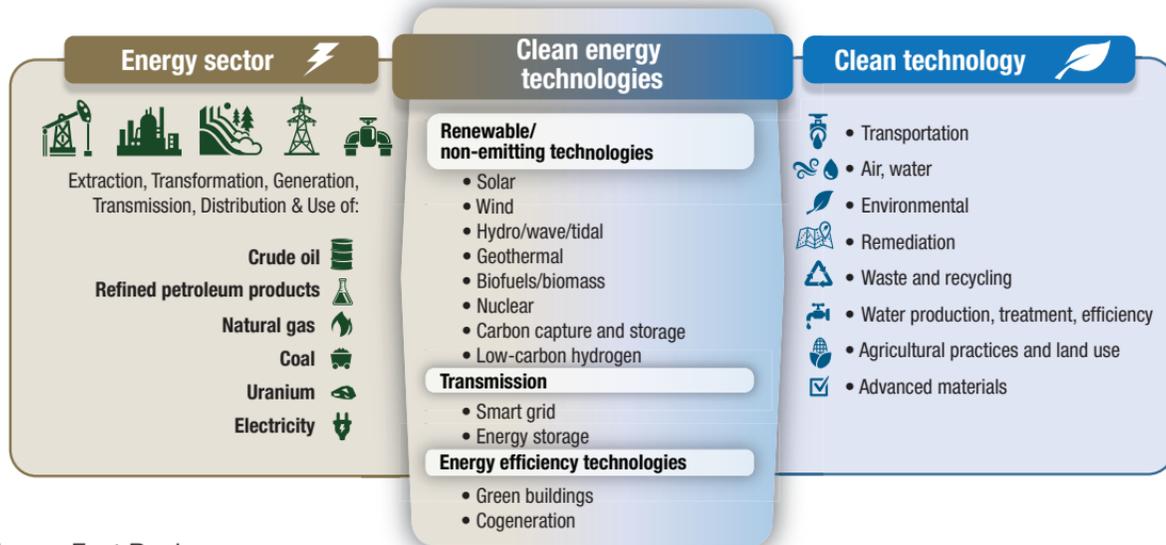
From an energy perspective, Canada is very fortunate. We have a large land mass, small population and one of the largest and most diverse supplies of energy in the world. Our rivers discharge close to 7% of the world's renewable water – a tremendous source of hydroelectric power. We have the fourth-largest 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.

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.

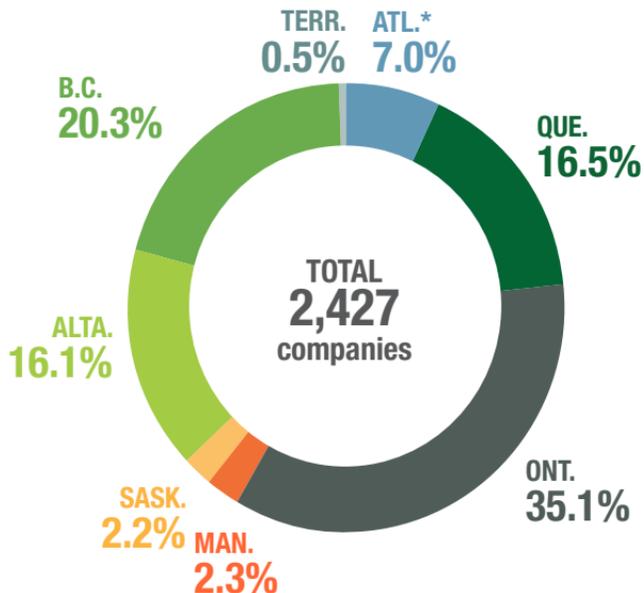


The TSX and TSX-Venture exchanges list **96 companies in the cleantech sector**, with a total market capitalization of **\$56.9 billion**. Of those companies, 83 are headquartered in Canada, with a total market capitalization of **\$48.8 billion** (as of July 31, 2023).

CLEANTECH COMPANIES

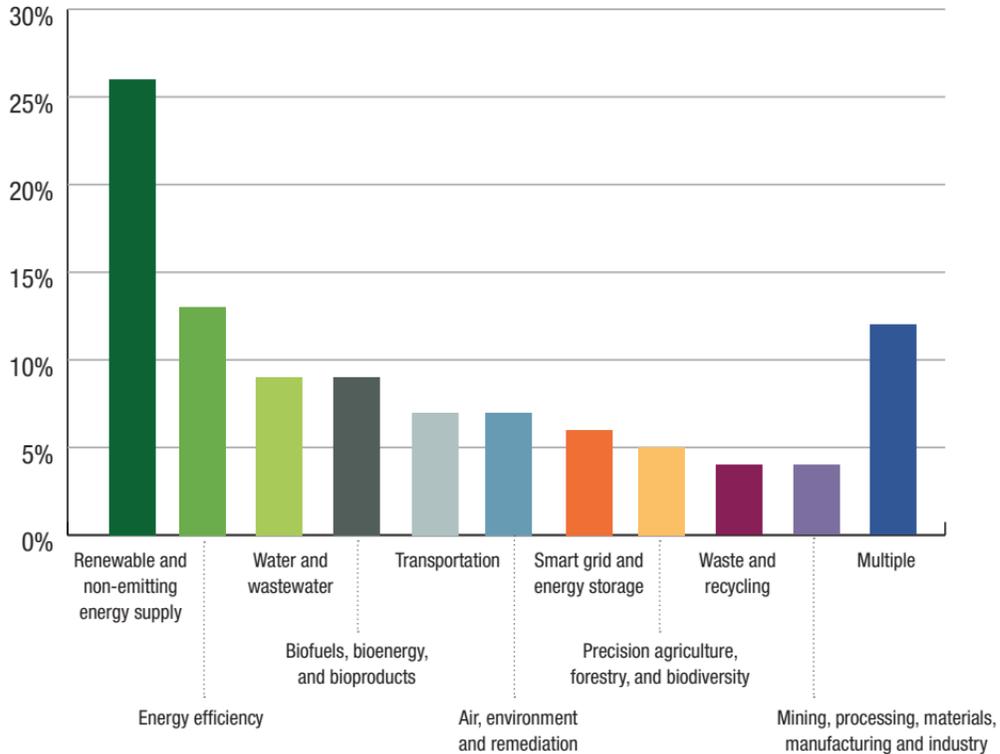
More than half of Canada's 2,427 cleantech companies relate to the energy industry, operating in renewables, energy efficiency, and smart grid technology. They are concentrated in Ontario, British Columbia, Quebec, and Alberta.

CANADIAN CLEANTECH COMPANIES BY PROVINCE, 2022



* Atlantic provinces

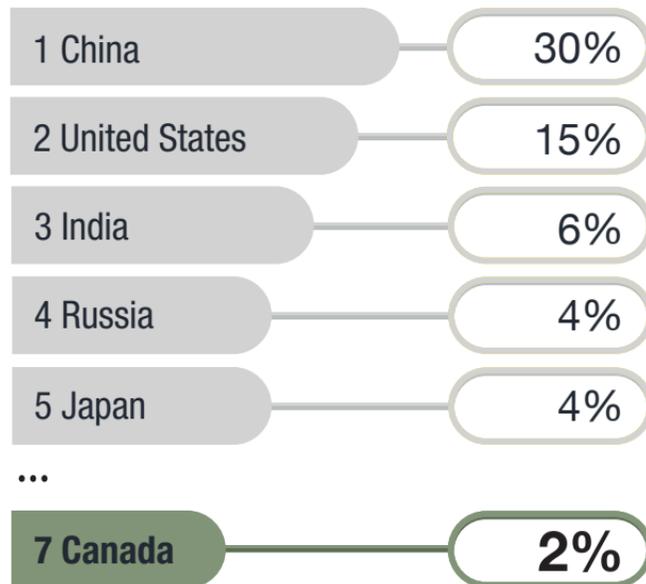
CANADIAN CLEANTECH COMPANIES BY INDUSTRY, 2022



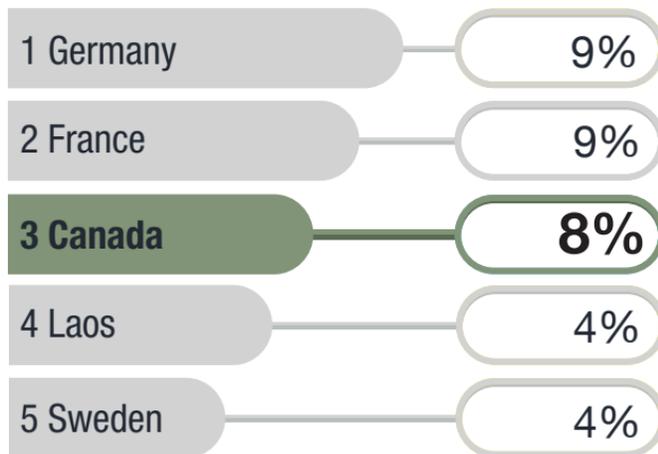
ELECTRICITY

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



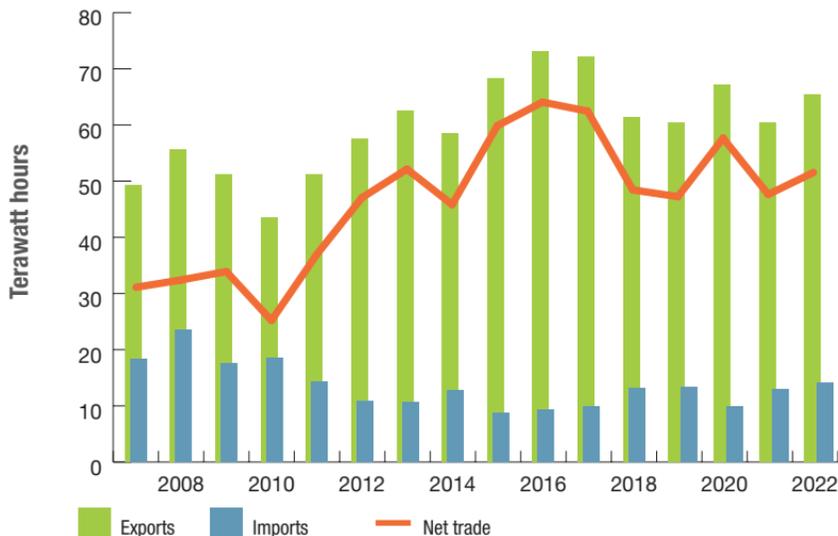
65.4 TWh

IMPORTS



14.1 TWh

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

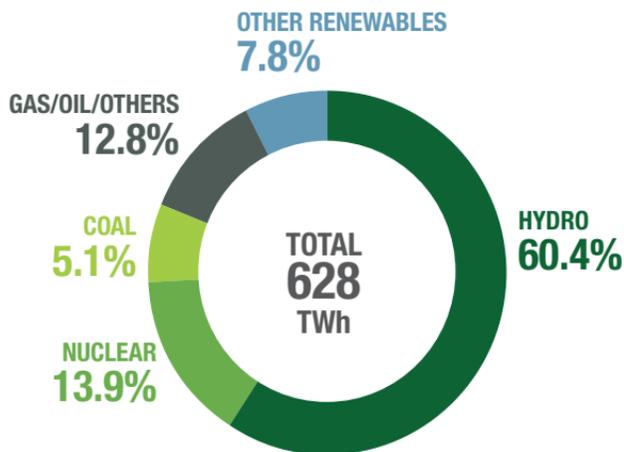


* includes only electricity traded under purchased contracts; excludes electricity transferred under non-financial agreements (e.g. under treaty obligations)

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%**

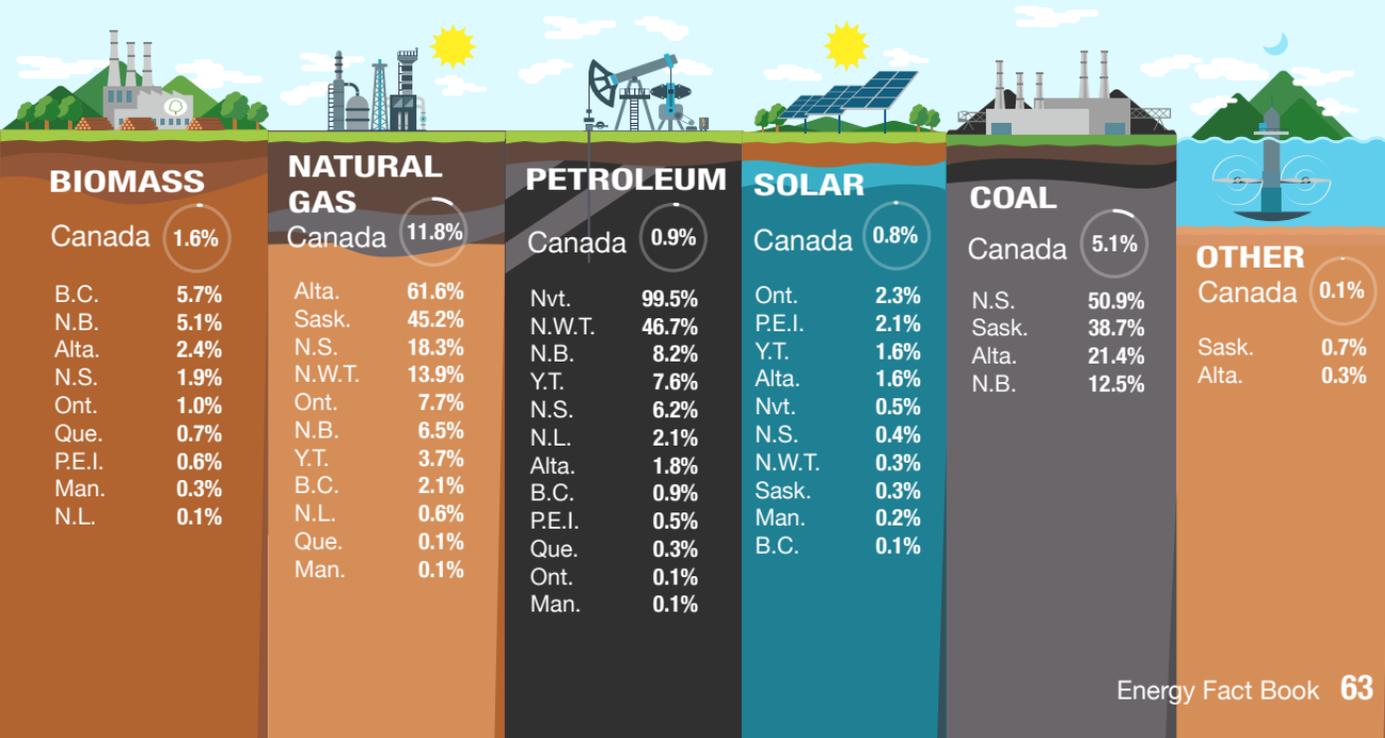
Ont.	57.1%
N.B.	38.3%

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



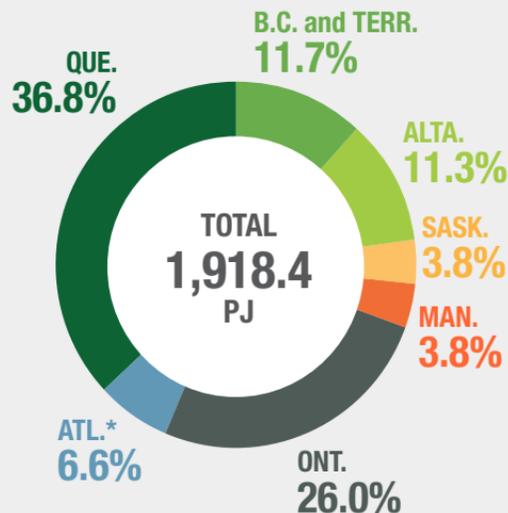
ELECTRICAL ENERGY USE

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

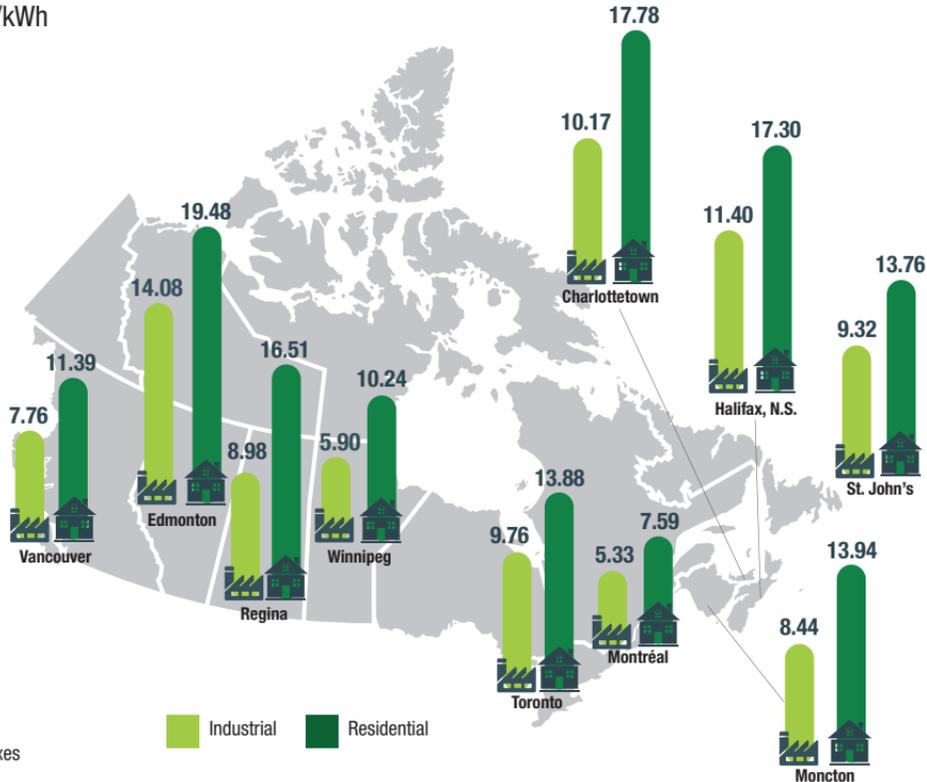


* Atlantic provinces

ELECTRICITY PRICES

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

in cents/kWh

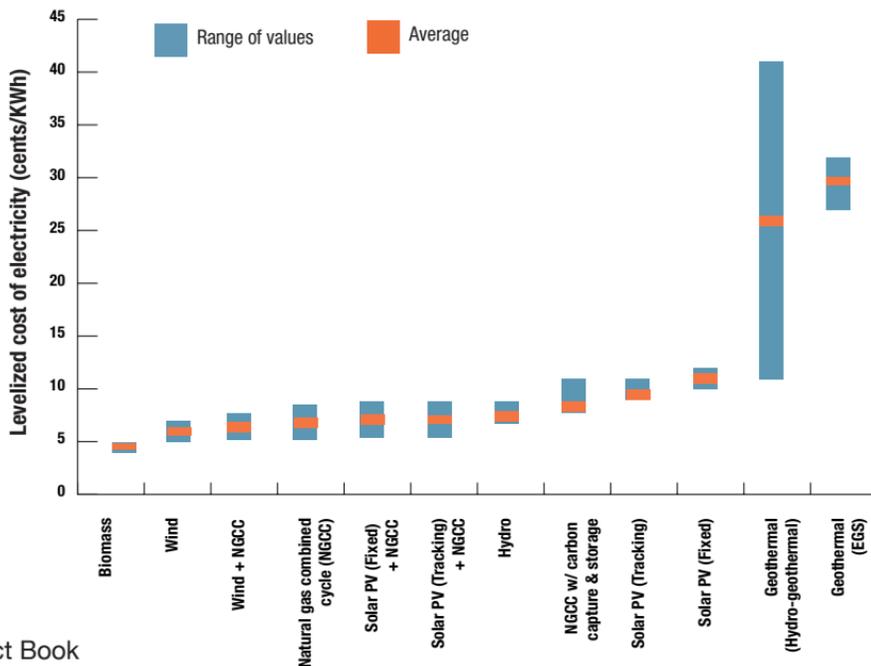


*including taxes

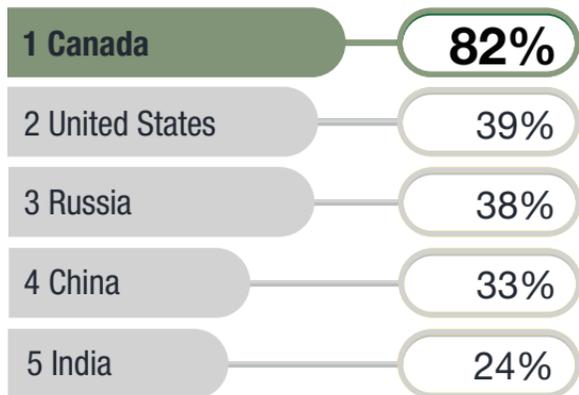
LEVELIZED COST OF ELECTRICITY

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.

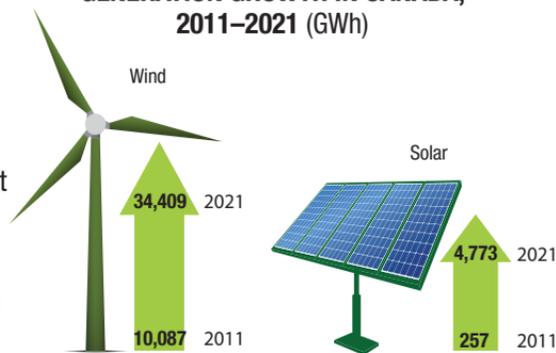


PERCENTAGE OF TOTAL ELECTRICITY FROM NON-EMITTING SOURCES FOR THE TOP FOUR ELECTRICITY-GENERATING COUNTRIES AND CANADA, 2021



- **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%**.

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

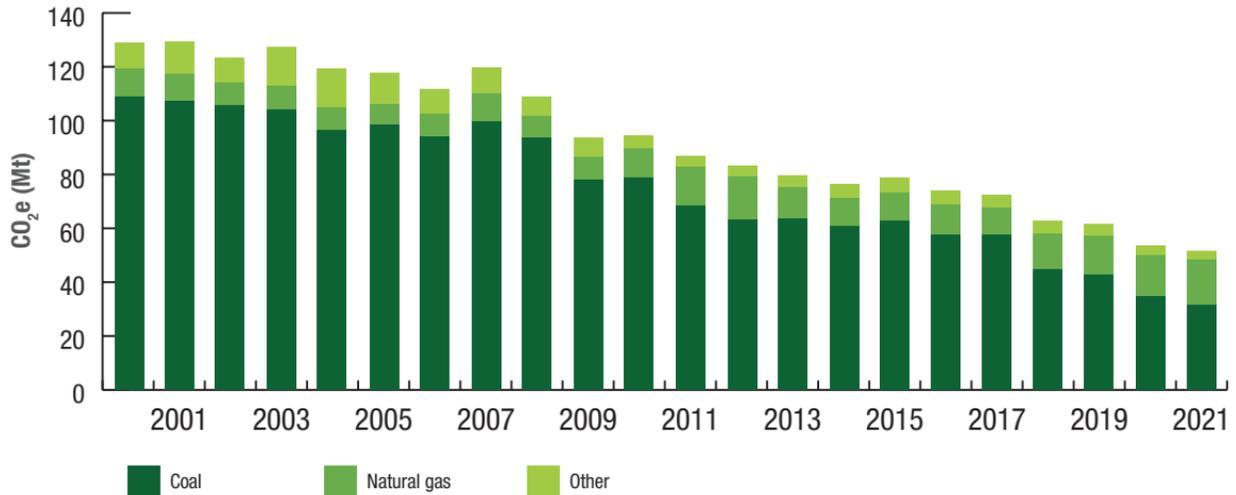


GHG SPOTLIGHT: ELECTRICITY

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.

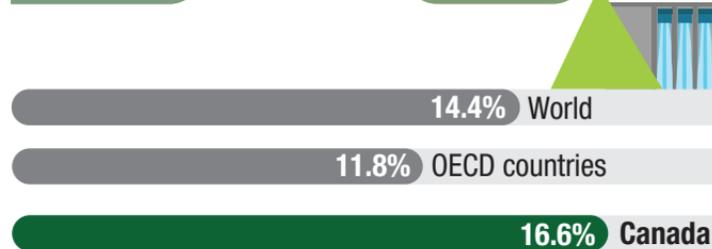
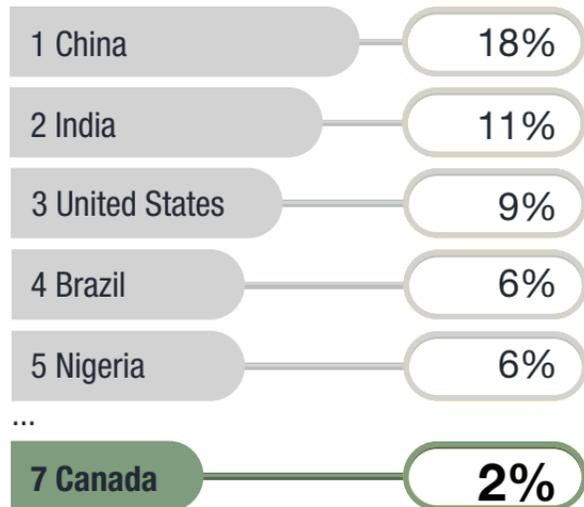
ELECTRICITY SECTOR GHG EMISSIONS FOR CANADA, 2000–2021



RENEWABLE ENERGY

INTERNATIONAL CONTEXT

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

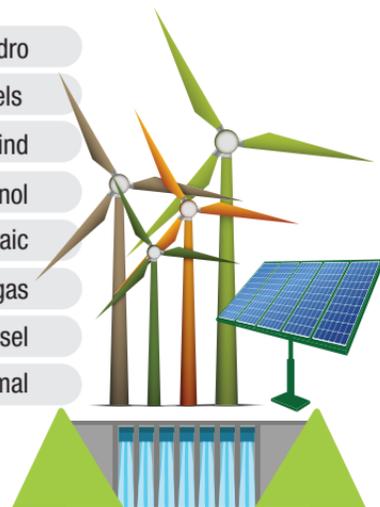
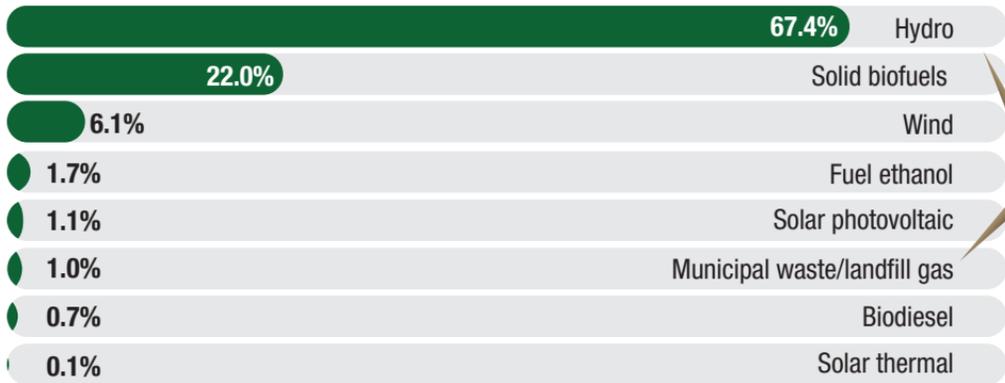


Share of energy supply from renewable sources (2021)



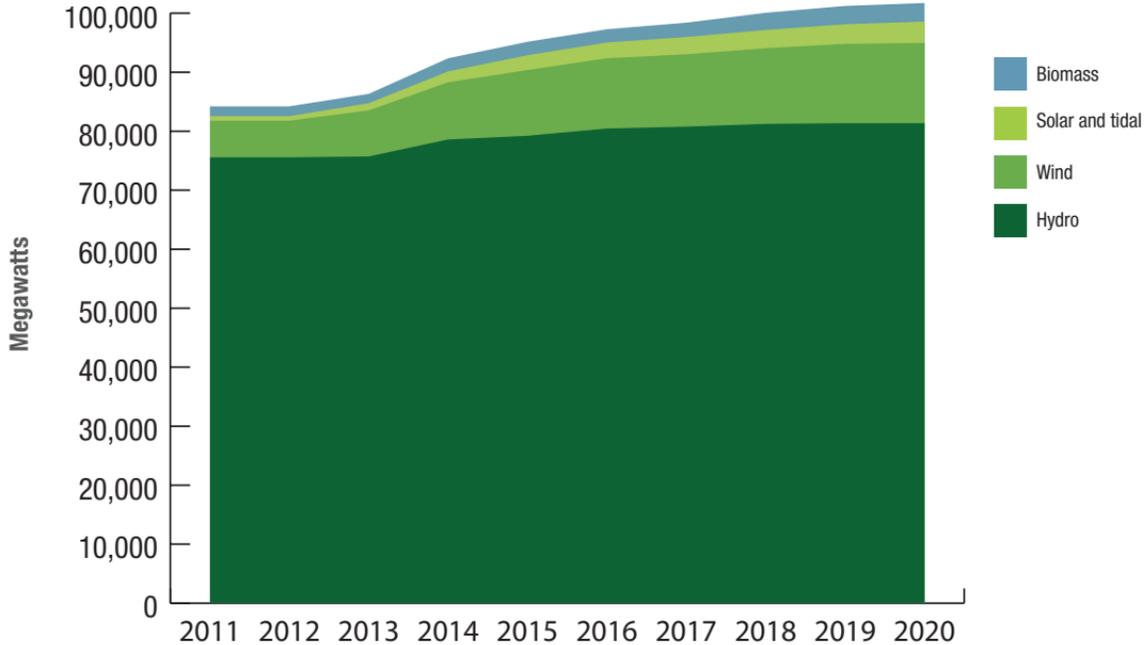
CANADIAN PRODUCTION (2021)

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

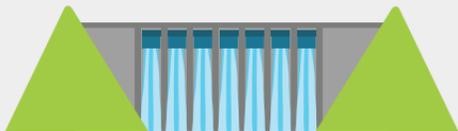


*includes energy consumed for electricity and heat production and for biofuels in the transportation sector

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.

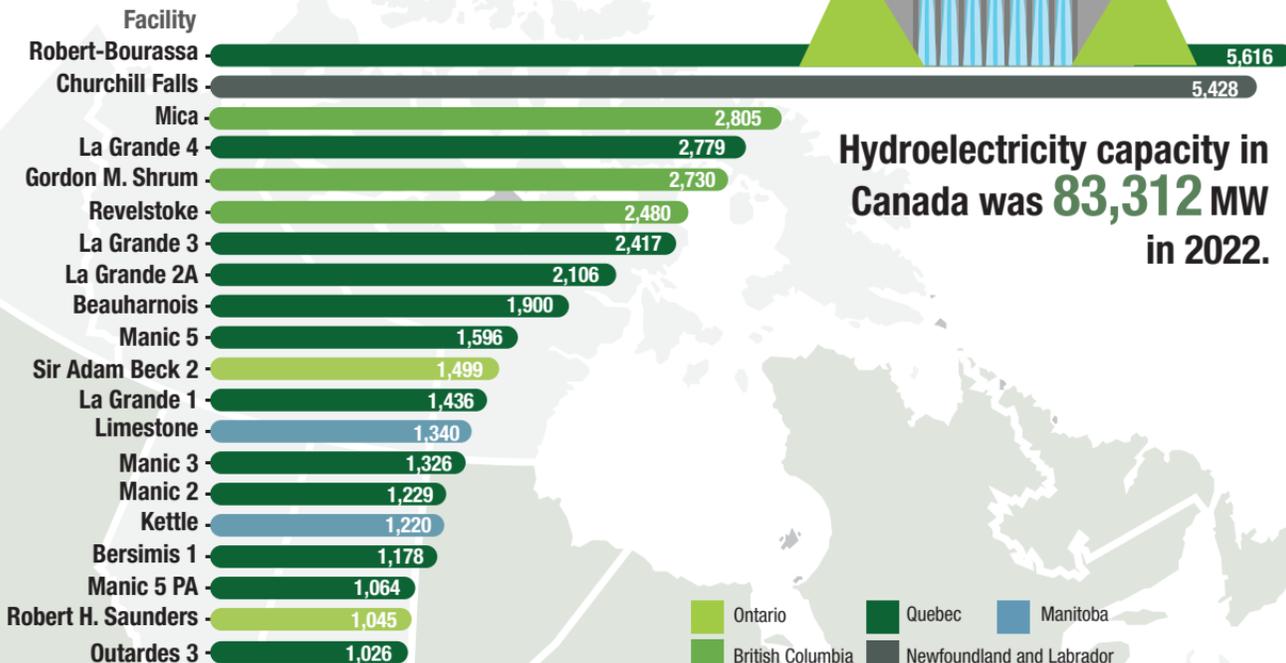
INTERNATIONAL CONTEXT

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.

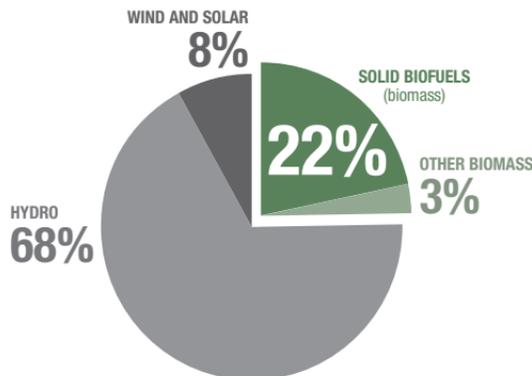
BIOMASS

- 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%**.

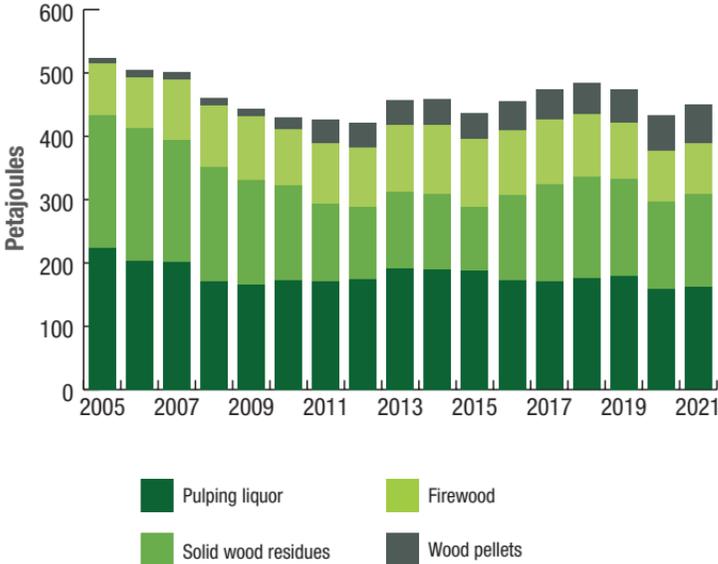


*Includes solid biofuels, liquid biofuels, biogases and renewable municipal waste

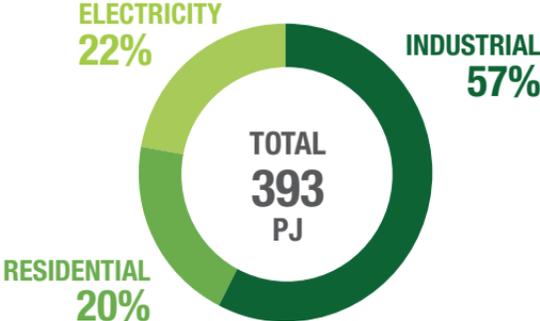
**Organization for Economic Cooperation and Development

CANADIAN PRODUCTION OF SOLID BIOFUELS

CANADIAN PRODUCTION OF SOLID BIOFUELS, 2021



WOOD FUEL USE BY SECTOR, 2021



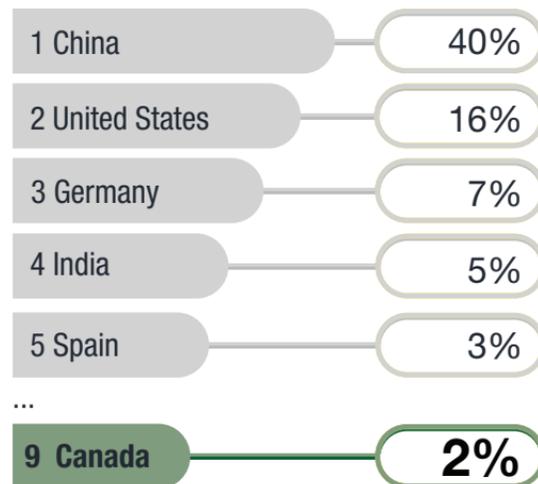
WIND POWER

- 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

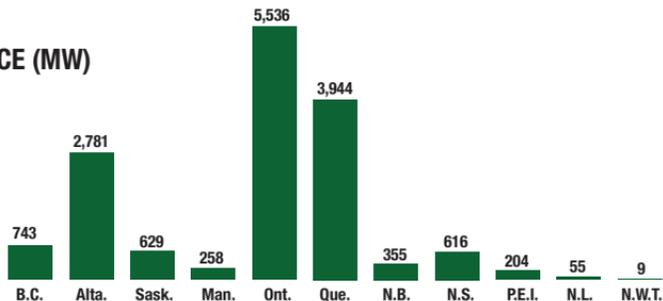
more than
tripled



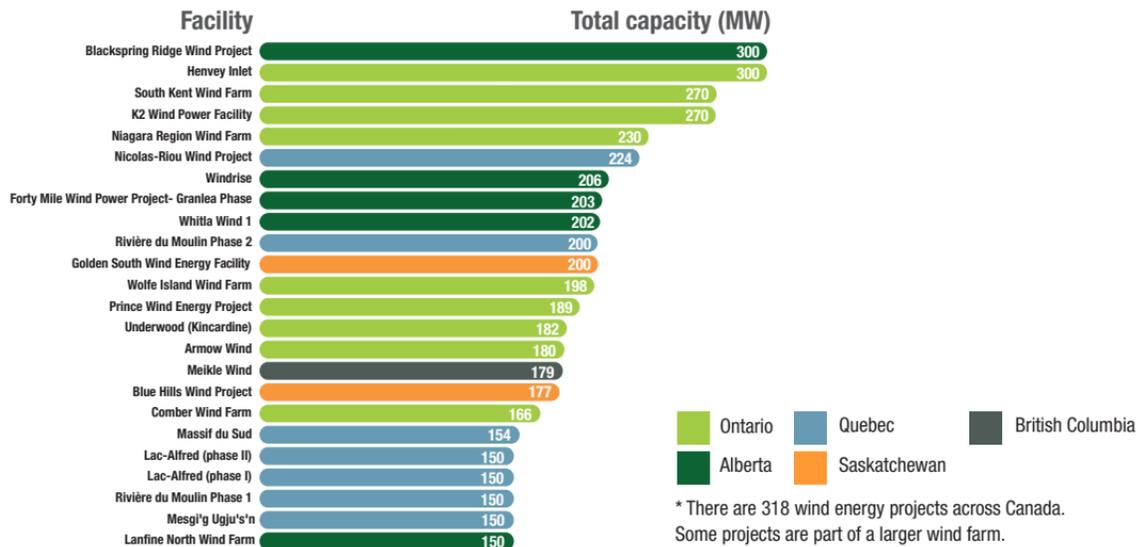
INSTALLED CAPACITY



CAPACITY BY PROVINCE (MW)



LARGEST WIND PROJECTS* (≥150 MW)



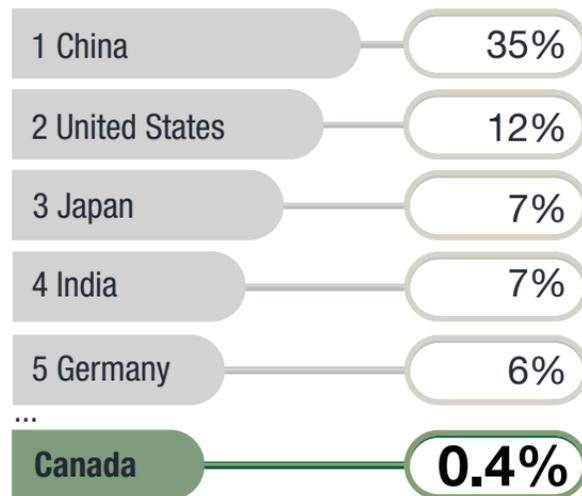
* There are 318 wind energy projects across Canada. Some projects are part of a larger wind farm.

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):

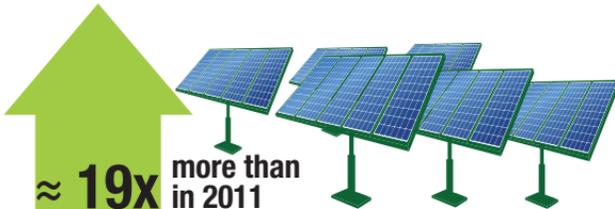
4,554 MW



≈ **8X** more than 2011

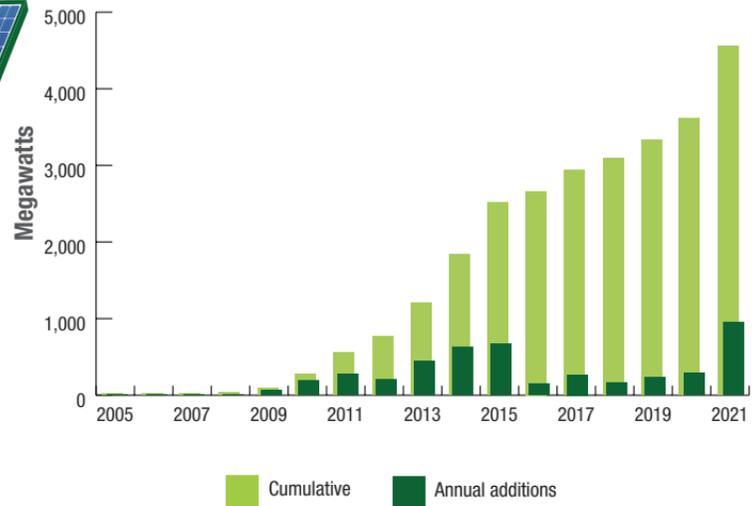
Generation (2021):

4.8 TWh



≈ **19X** more than in 2011

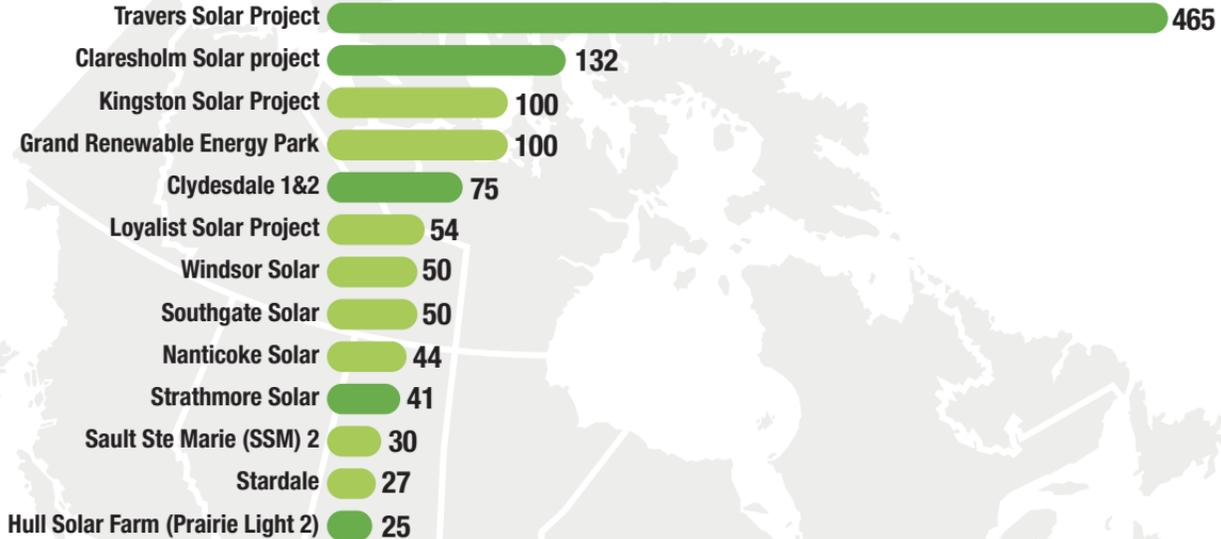
INSTALLED CAPACITY



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.

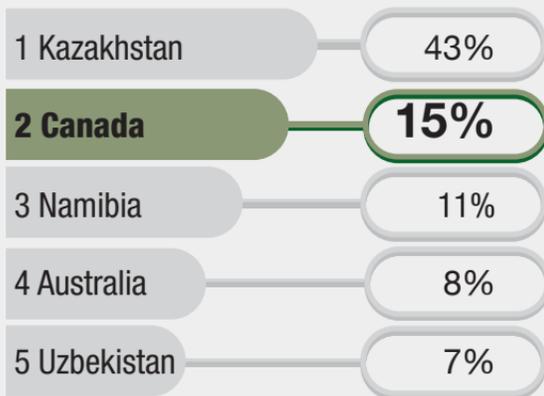
Alberta Ontario

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)



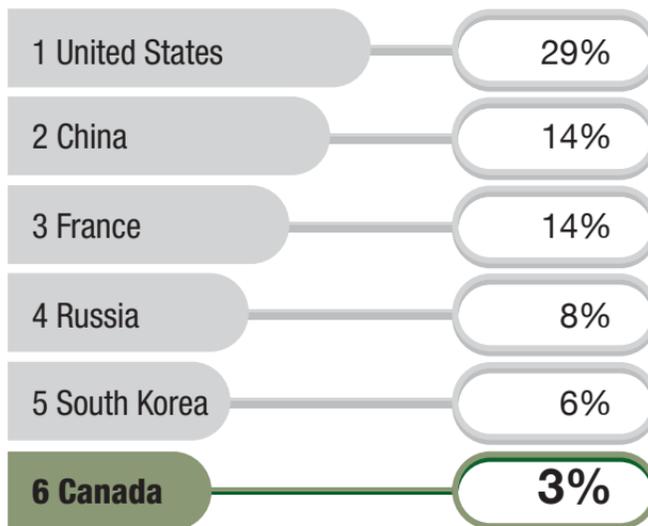
NUCLEAR POWER

- 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%**

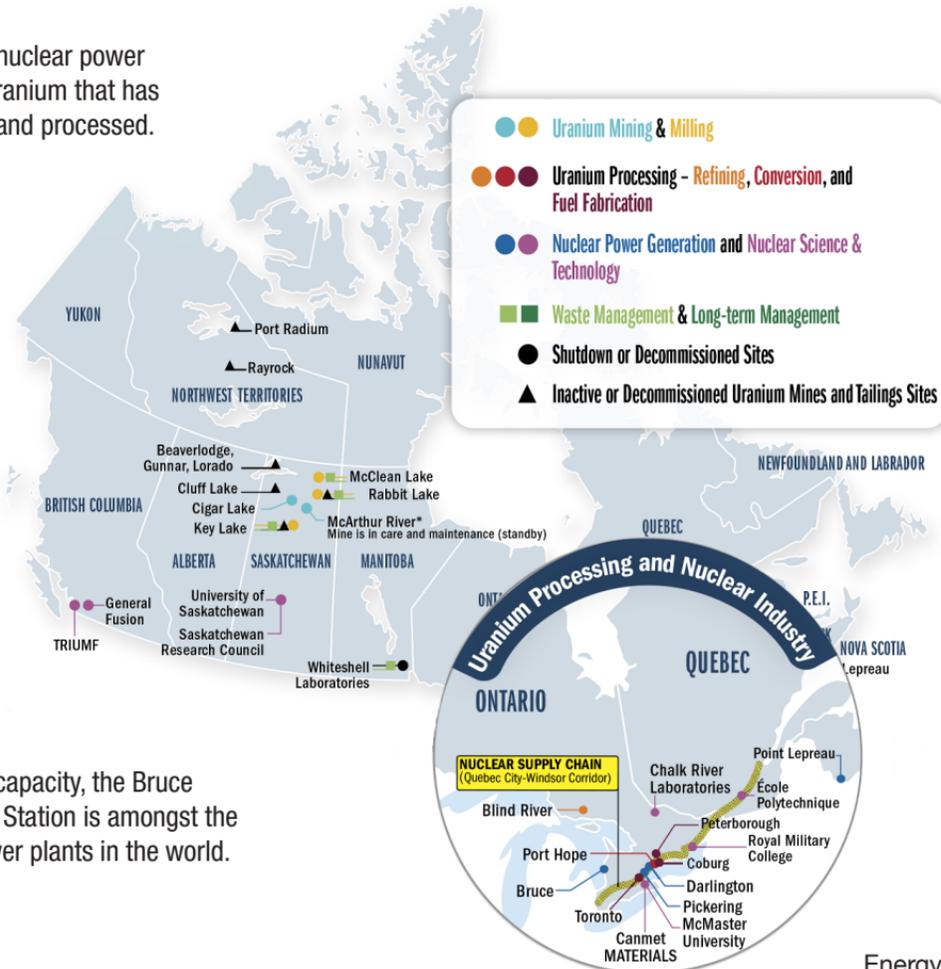
* These values can vary based on changes in regional demand.

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.

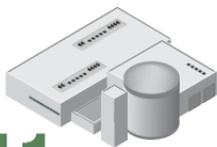
Across the country, nuclear power is generated from uranium that has been mined, milled and processed.



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.



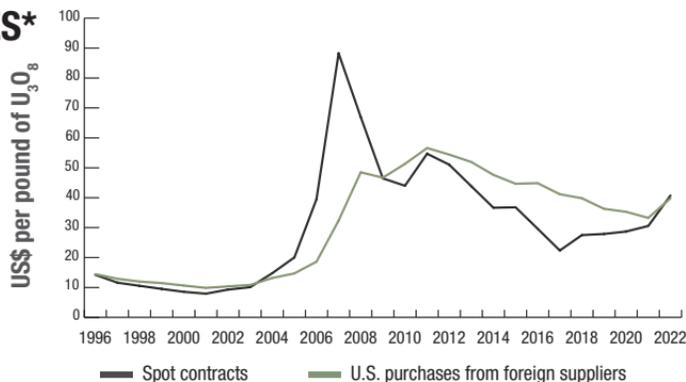
11 CANDU reactors
are in operation outside of Canada.



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

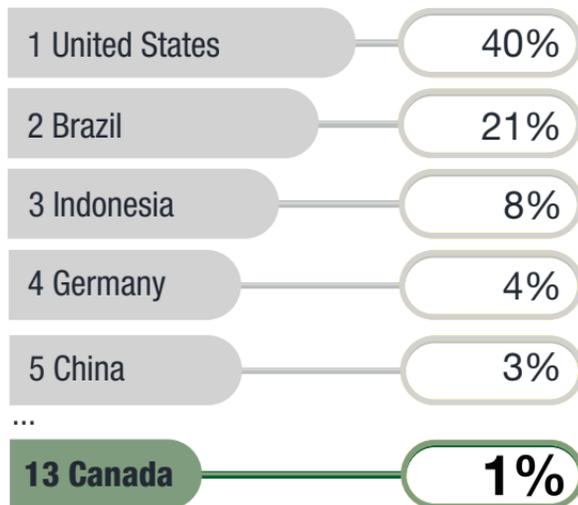
LIQUID BIOFUELS

- 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.*

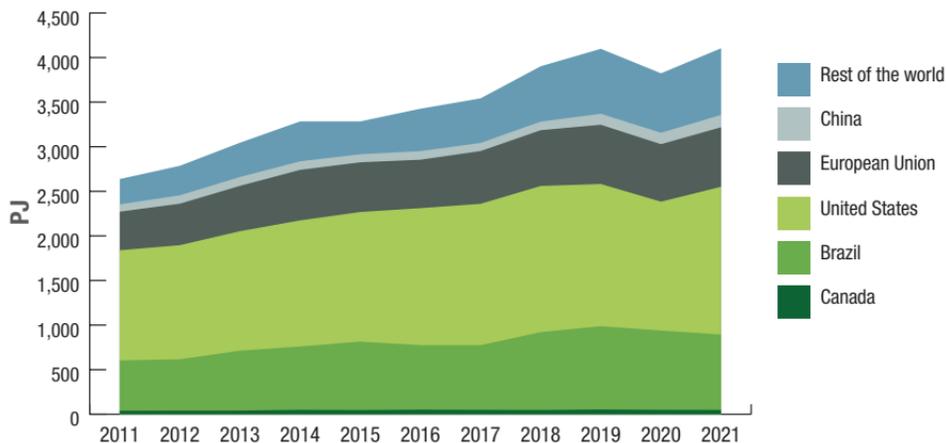
* Heating distillate oil volumes for space-heating purposes are excluded from the diesel regulations.*

INTERNATIONAL CONTEXT

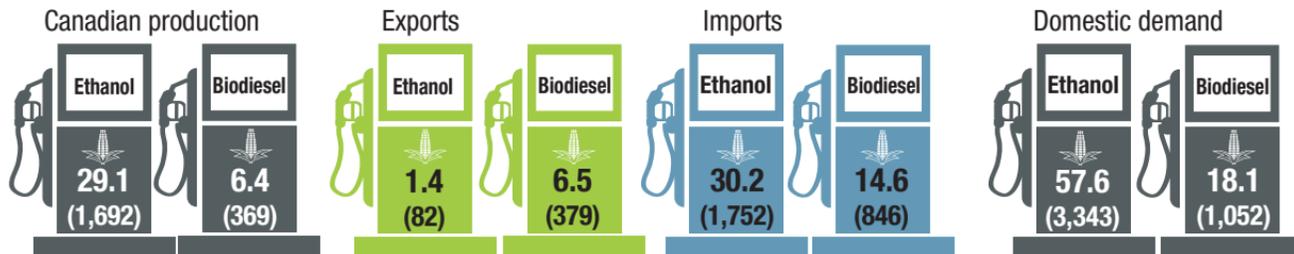
World production of biofuels – 4103 PJ (2021)



WORLD BIOFUELS PRODUCTION

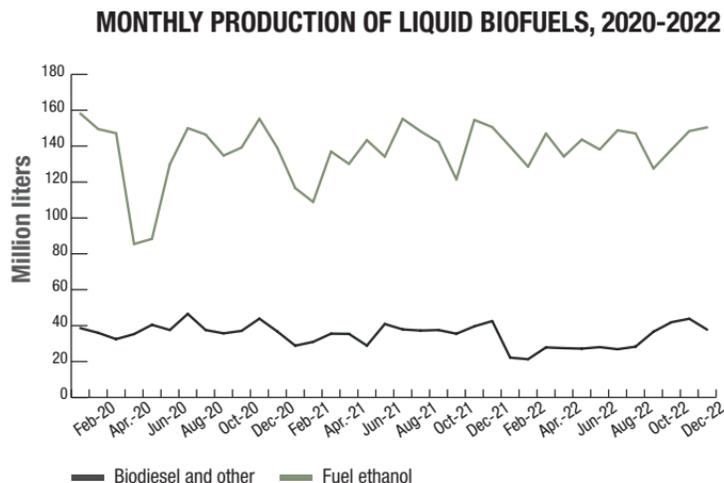


CANADIAN SUPPLY AND DEMAND (2022) - MB/D (MILLION LITRES)



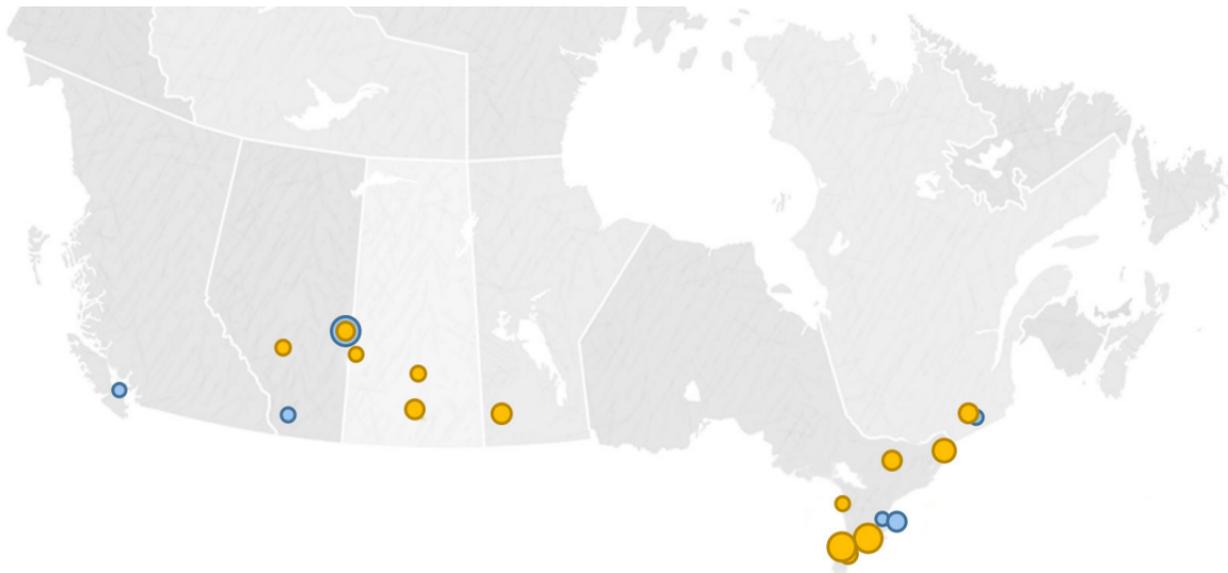
CANADIAN BIOFUEL PRODUCTION

- 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

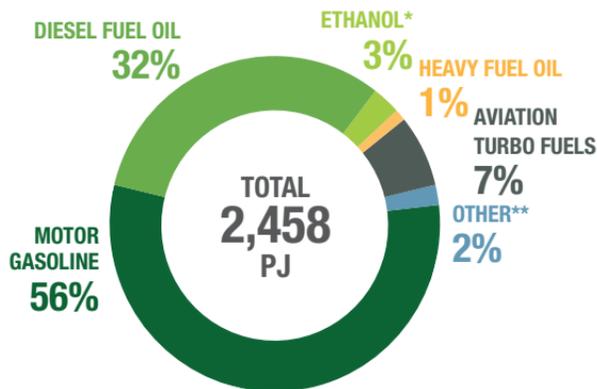
100 – 200
Medium

200 – 300
Large

300+
Giga



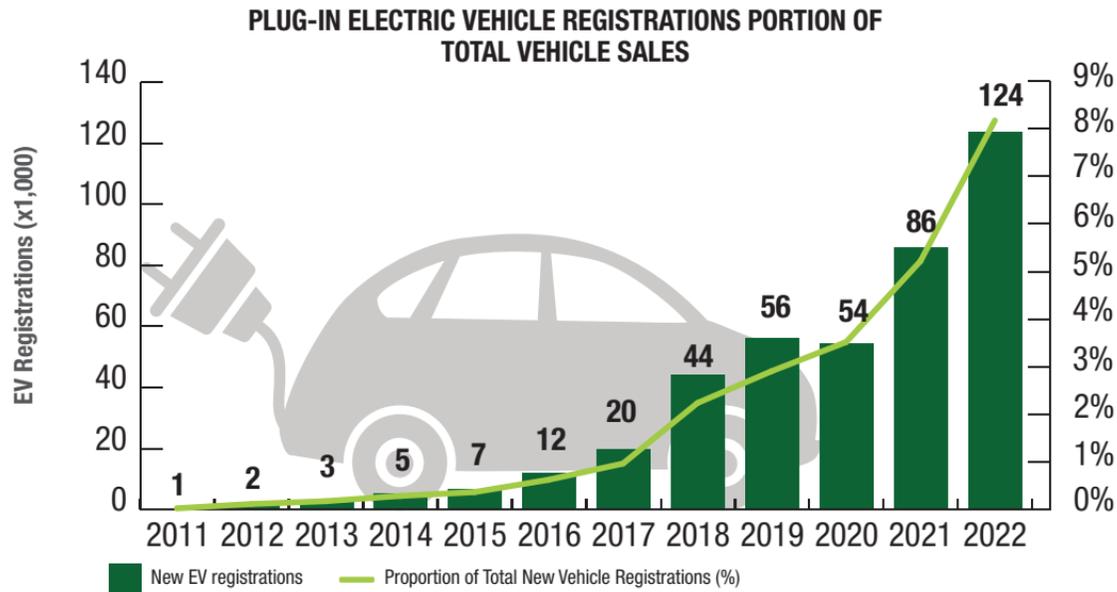
FUEL MIX OF THE TRANSPORTATION SECTOR, 2020



- 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%**.

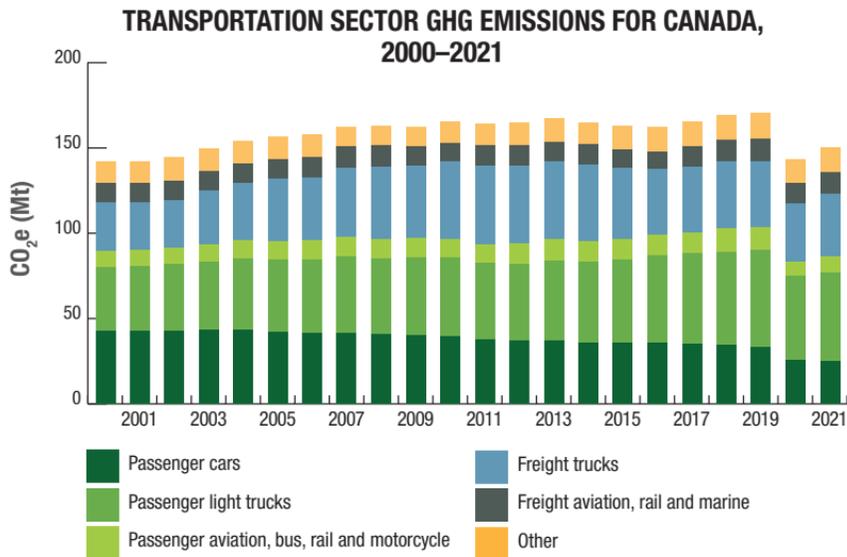
* The ethanol proportion is estimated based on production data.

** 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**



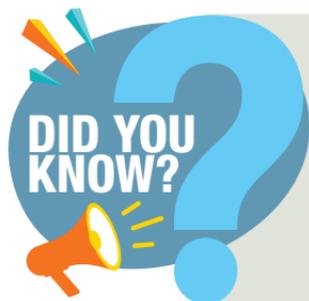
**Can be produced
from variety of
feedstocks**



**Can be
transported
long distances**



**Highest energy
per mass of
any fuel**



The energy in

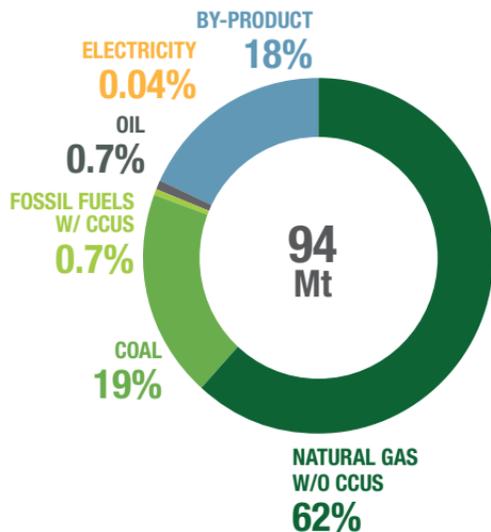
1 kg of hydrogen

is the same as approximately

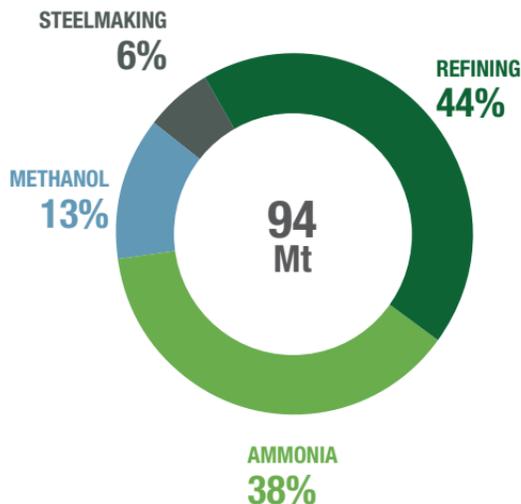
2.8 kg of gasoline.

- 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.



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)

CANADIAN CENTRE FOR ENERGY INFORMATION

CCEI

Canadian Centre for Energy Information

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

