



Natural Resources
Canada

Ressources naturelles
Canada



ENERGY FACT BOOK 2019–2020



Canada



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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. The abbreviations used throughout this publication are listed in Annex 2.

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 **nrcan.energyfacts-faitsenergetiques.nrcan@canada.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.

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 third-largest global supply of 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, and electric and alternative fuel vehicles have the potential to further transform the energy system.

Canadians understand that the energy landscape is changing, with significant implications and potential opportunities. Following Generation Energy, a council was formed with a mandate to advise on how Canada can transition to a reliable, affordable, low-carbon economy in the future. The council identified four pathways that collectively will lead to an affordable and sustainable energy future: wasting less energy, clean power, renewable fuels, and cleaner oil & gas. These pathways are represented throughout the *Energy Fact Book*.

Through the Generation Energy dialogue, Canadians also highlighted the need for open and accessible energy information. The *Energy Fact Book* provides a solid foundation for Canadians to understand and discuss important developments across the energy sector.

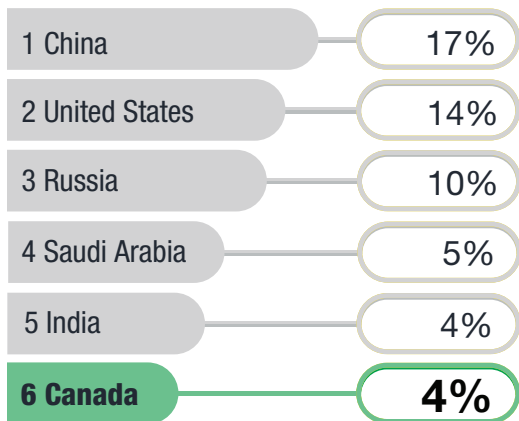
ENERGY AND THE ECONOMY



CANADA: A GLOBAL ENERGY LEADER

The amount of primary energy produced by Canada in 2017 is **27% more** than in 2005. The world, on average, has increased energy production by **21%** in the same period.

WORLD TOTAL PRIMARY ENERGY PRODUCTION TOP ENERGY PRODUCERS, 2017



GLOBAL ENERGY RANKINGS FOR CANADA

| | Proved reserve/ capacity | Production | Exports |
|------------------|-----------------------------|------------|---------|
| Crude oil | 3 | 4 | 4 |
| Uranium | 3 | 2 | 2 |
| Hydroelectricity | 3 | 2 | - |
| Electricity | 8 | 6 | 2 |
| Coal | 16 | 13 | 7 |
| Natural gas | 17 | 4 | 5 |

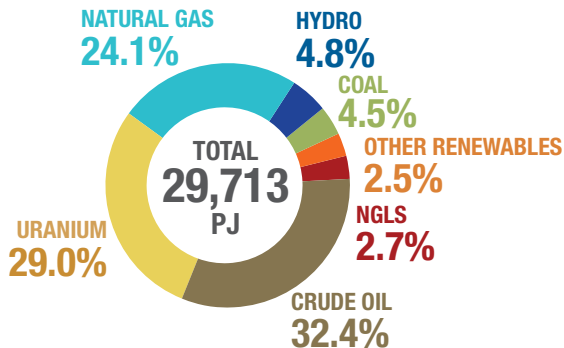
CANADIAN ENERGY PRODUCTION

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.

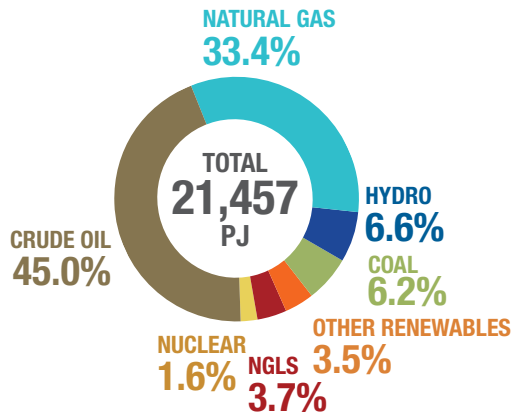
The second method—also employed by the International Energy Agency (IEA), the Energy Information Administration (EIA) and others—treats domestic electricity production from nuclear energy as primary energy, but not uranium itself. Uranium is energy-dense, and Canada exports most of its uranium production,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

PRIMARY ENERGY PRODUCTION BY SOURCE (2017)

PRIMARY ENERGY PRODUCTION, INCLUDING URANIUM



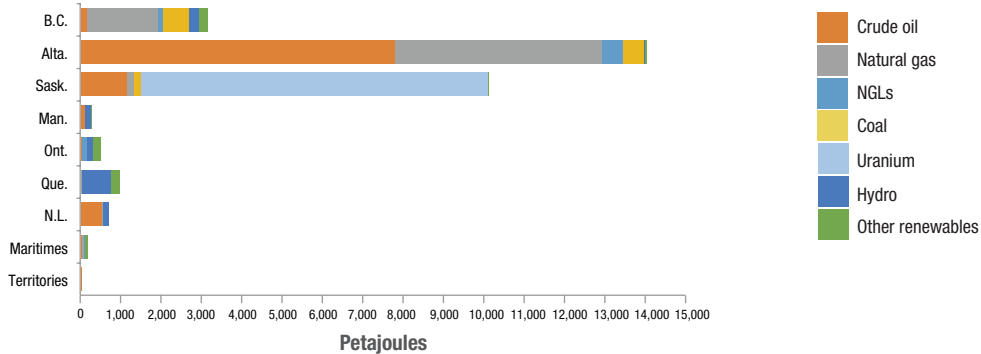
PRIMARY ENERGY PRODUCTION, EXCLUDING URANIUM



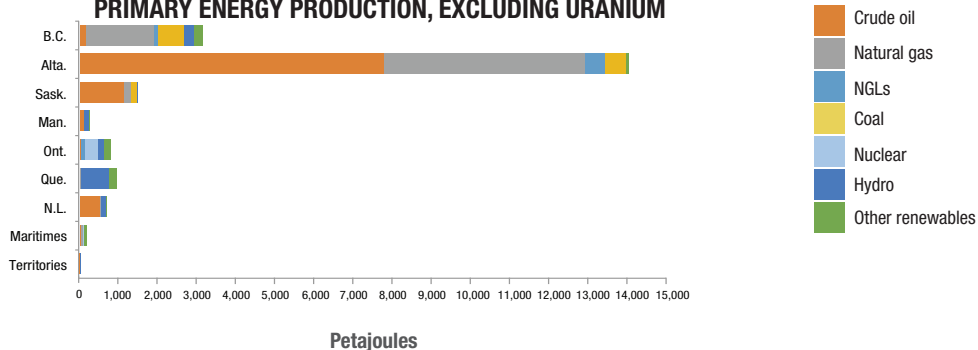
"Other renewables" includes wind, solar, wood/wood waste, biofuels and municipal waste.

PRIMARY ENERGY PRODUCTION BY REGION AND SOURCE (2017)

PRIMARY ENERGY PRODUCTION, INCLUDING URANIUM



PRIMARY ENERGY PRODUCTION, EXCLUDING URANIUM



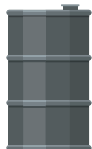
ENERGY TRADE (2018)

Exports

\$132.2 billion



of total Canadian goods exports



Oil and gas domestic exports totalled

over \$119 billion

of which **95%** were to the U.S.



The U.S. accounts for



89%
of energy exports
by value
(\$117.8 billion).

Imports

\$50.5 billion



of total Canadian goods imports



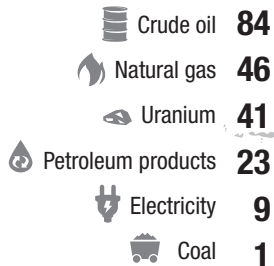
The U.S. accounts for



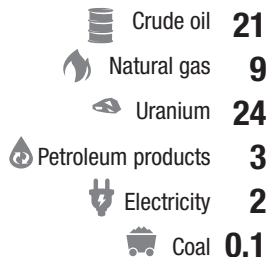
70%
of energy imports
by value
(\$35.5 billion).

CANADA-U.S. ENERGY TRADE IN 2018

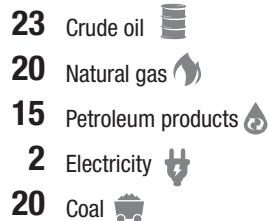
Exports to the U.S. (% of Canadian production)



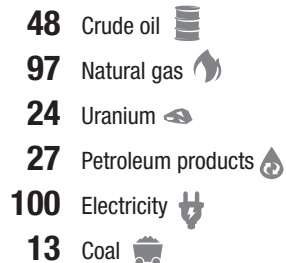
Exports to the U.S. (% of U.S. consumption)



Imports from the U.S. (% of Canadian consumption)



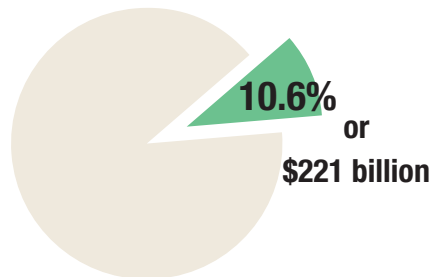
Exports to the U.S. (% of U.S. imports)



NOMINAL GROSS DOMESTIC PRODUCT (2018)

ENERGY'S NOMINAL GDP CONTRIBUTION FOR CANADA

NOMINAL GDP (% OF CURRENT DOLLARS)



CANADIAN GDP

ENERGY DIRECT 7.6% (\$158 billion)

OIL AND GAS 5.6%

ELECTRICITY 1.6%

OTHER 0.4%

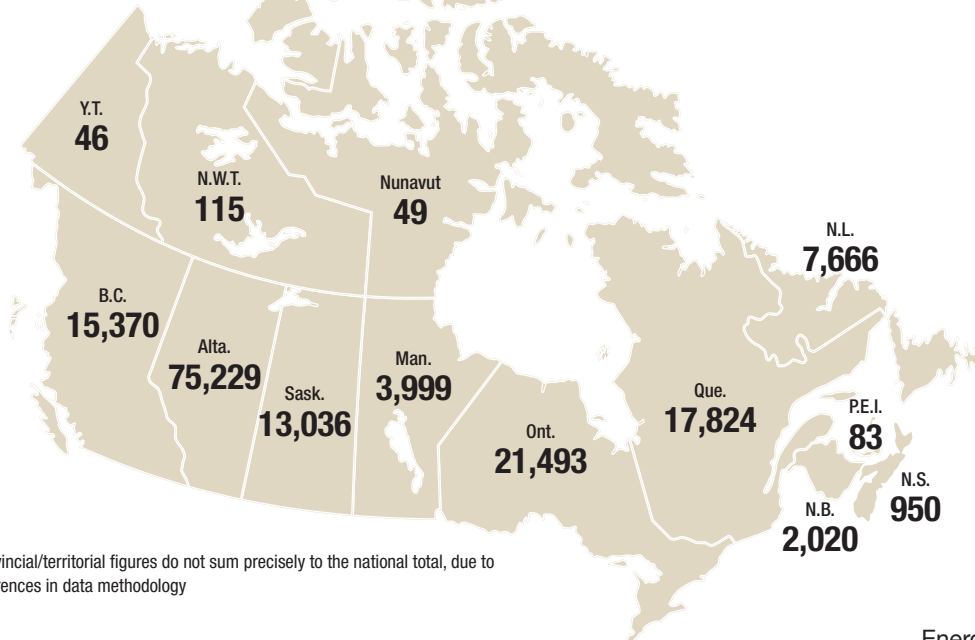
ENERGY INDIRECT 3.0% (\$63 billion)

CONSTRUCTION 1.4%

OTHER 1.6%

ENERGY'S NOMINAL GDP CONTRIBUTION BY PROVINCE/TERRITORY (2018)

Energy sector direct nominal GDP*
(\$ millions)

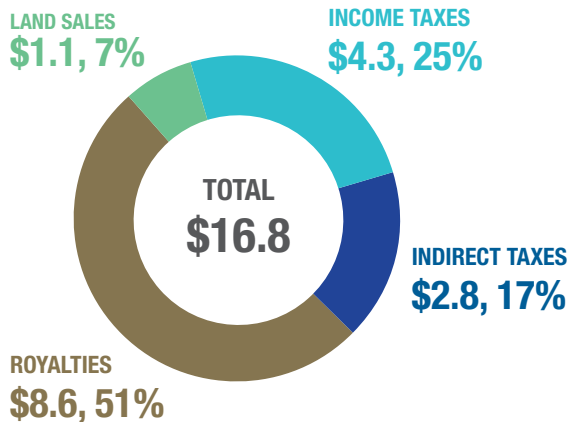


*Provincial/territorial figures do not sum precisely to the national total, due to differences in data methodology

GOVERNMENT REVENUES

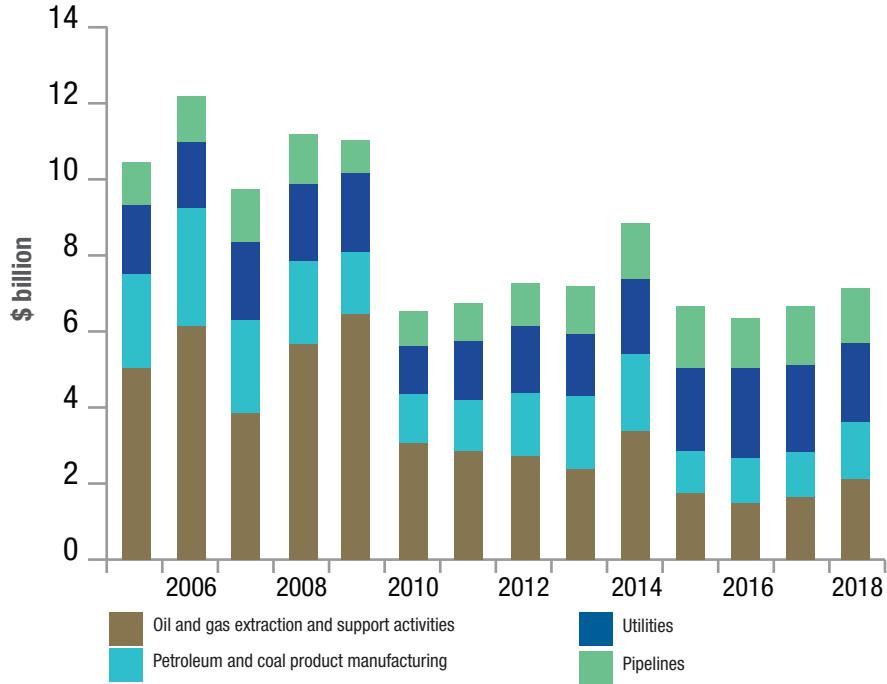
Federal and provincial/territorial governments in Canada receive direct revenues from energy industries through corporate income taxes, indirect taxes (such as sales and payroll taxes), crown royalties, which are the share of the value of oil and gas extracted that is paid to the Crown as the resource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

GOVERNMENT ENERGY REVENUE, 2013-2017 AVERAGE (\$ BILLIONS)



- An important share of government revenues is collected from the oil and gas industry, which averaged **\$14.8 billion** over the last five years, including **\$11.8 billion** from upstream oil and gas extraction and its support activities.
- Between 2013 and 2017, the energy sector's share of taxes paid by all industries was **7.7%**. Operating revenues of the energy sector represented **nearly 11%** of all operating revenues earned by industries in Canada.

TOTAL TAXES PAID BY ENERGY INDUSTRIES



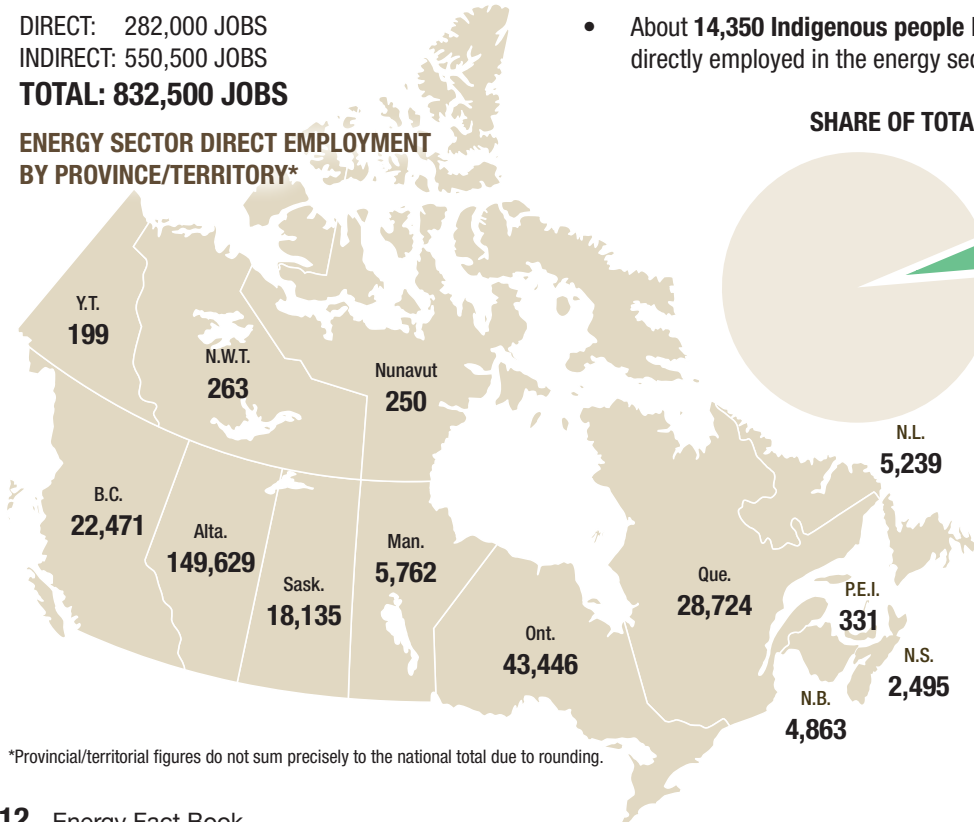
EMPLOYMENT IN CANADA'S ENERGY SECTOR

DIRECT: 282,000 JOBS

INDIRECT: 550,500 JOBS

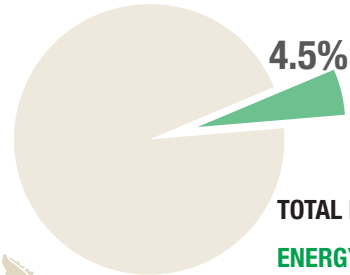
TOTAL: 832,500 JOBS

ENERGY SECTOR DIRECT EMPLOYMENT BY PROVINCE/TERRITORY*



- About **14,350 Indigenous people** living off-reserve are directly employed in the energy sector.

SHARE OF TOTAL EMPLOYMENT, 2018



TOTAL EMPLOYMENT

ENERGY DIRECT 1.5%

OIL AND GAS 0.9%

ELECTRICITY 0.4%

OTHER 0.2%

ENERGY INDIRECT 3.0%

CONSTRUCTION 1.3%

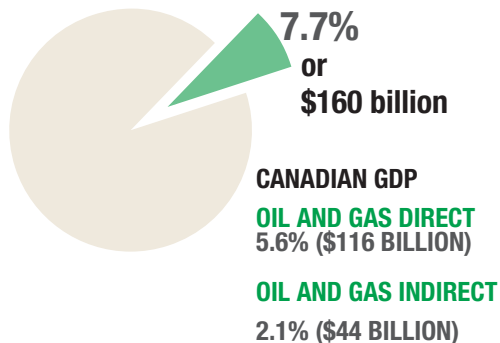
OTHER 1.7%

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

OIL AND GAS AND THE ECONOMY

NOMINAL GDP CONTRIBUTION FOR CANADA, 2018

NOMINAL GDP (% OF CURRENT DOLLARS)



- Capital Expenditures (2018): **\$52 billion**
- Canada's oil and gas sector represents about **25%** of the country's GHG emissions.
- Exports (2018): **\$119 billion** (1/5th of all exports)

EMPLOYMENT

DIRECT: 169,000 JOBS

| | |
|--|--------|
| OIL AND GAS EXTRACTION: | 73,000 |
| SUPPORT ACTIVITIES: | 58,000 |
| EXPLORATION: | 3,000 |
| NATURAL GAS TRANSMISSION AND DISTRIBUTION: | 16,500 |
| CRUDE OIL PIPELINES: | 4,000 |
| OTHER: | 14,500 |

INDIRECT: 407,000 JOBS

TOTAL: 576,000 JOBS

Approximately
10,000 Indigenous people are employed in the oil and gas sector.



4TH IN OIL
(GLOBALLY)

Largest oil producer globally

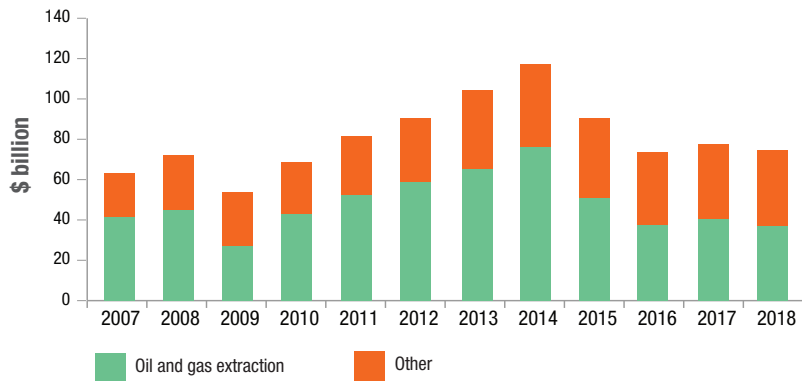
4TH IN GAS
(GLOBALLY)

Largest gas producer globally

INVESTMENT

CAPITAL EXPENDITURES

Capital expenditures* in the energy industry

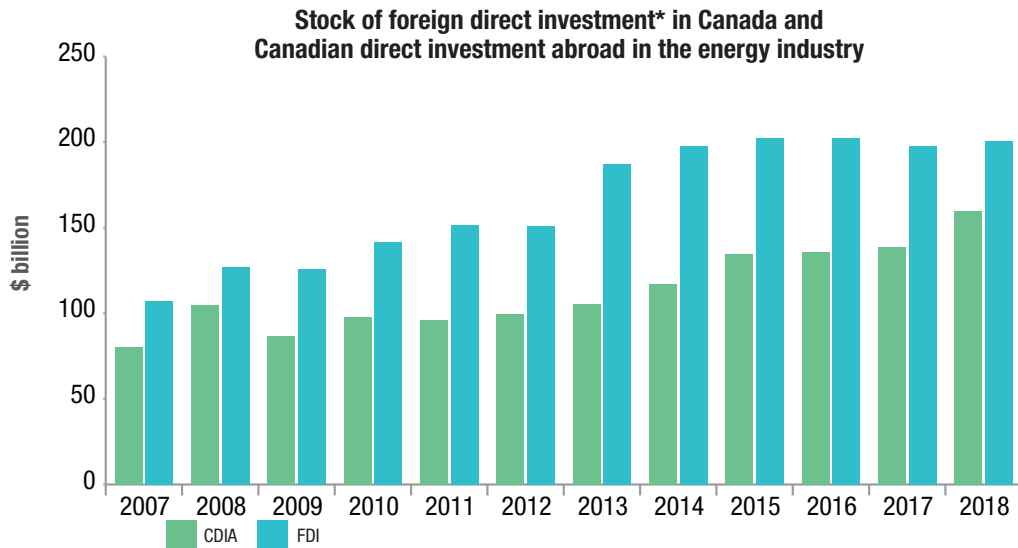


- Capital expenditures in Canada's energy sector totalled **\$73 billion** in 2018, 38% lower from a peak in 2014.
- Investment has been stable over the last three years, with oil and gas extraction being the largest contributor at **\$36.7 billion** in 2018, followed by electric power generation and transmission at **\$20.5 billion**.

*excludes residential expenditures and intellectual property investments such as exploration expenses

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.



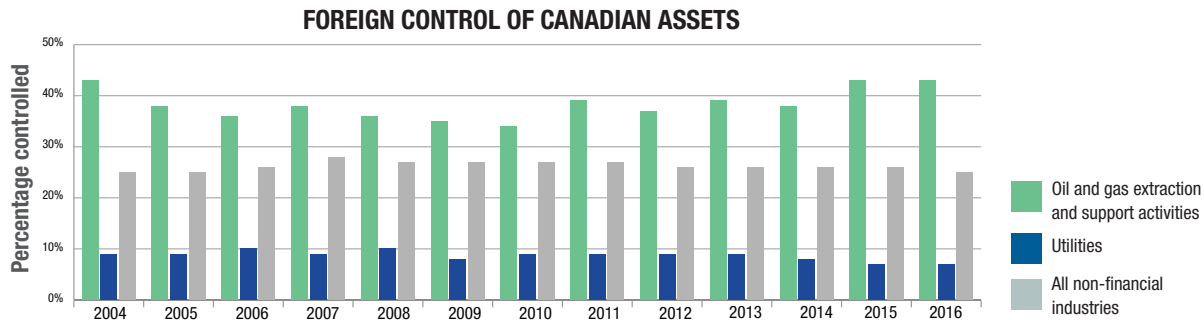
* Direct investment is defined as a company owning a minimum of 10% of voting equity interest in a foreign enterprise and is measured as the total equity value at the time of acquisition.

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

- The stock of **foreign direct investment** (FDI) in the energy sector was up 1% in 2018, with increases reported in oil and gas extraction assets by Asia and Oceania and the United States.
- The energy industry's share of overall FDI in Canada was **23%** in 2018, down **1%** from 2017.
- The stock of **Canadian direct investment abroad** (CDIA) was valued a record high **\$160 billion** in 2018.
- Investment in oil and gas extraction accounted for **\$85 billion** of the CDIA stock in 2018.

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 up in 2018 to **\$685 billion**, an increase of **5%** from **\$654 billion** in 2017. In 2018, domestic CEAs totalled **\$452 billion**, down **0.5%** from 2017, while Canadian energy assets abroad totalled **\$233 billion**, up from **\$200 billion**. The increase in assets abroad was driven primarily by a **\$30.4 billion increase** in the U.S. and Mexico.

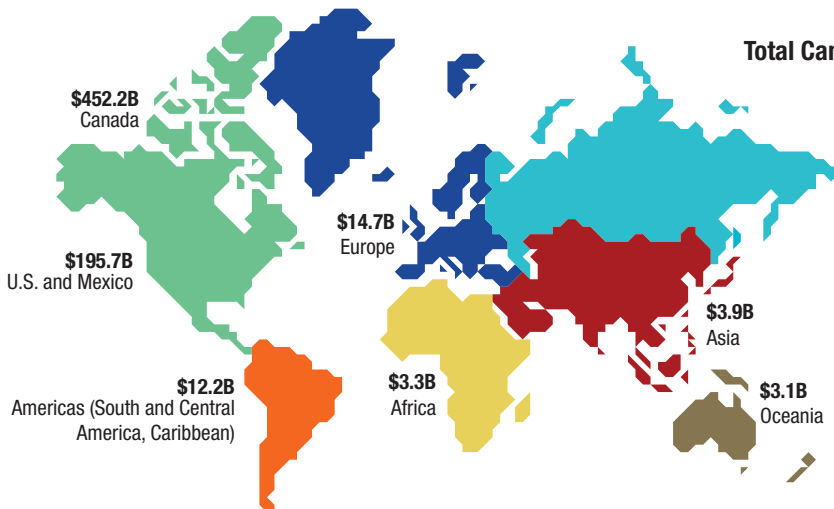
CANADIAN ENERGY ASSETS BY REGION, 2018

Total Canadian energy assets

\$685B

Total Canadian energy assets abroad

\$233B



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

RESEARCH, DEVELOPMENT AND DEMONSTRATION

CANADIAN EXPENDITURES ON TOTAL ENERGY RD&D

In 2017-18, federal energy RD&D expenditures were **\$533 million** and provincial/territorial (P/T) government energy RD&D expenditures were **\$266 million** for a combined total of **\$799 million**, an increase from **\$661 million** in 2016-17.



In 2017-18, federal spending increased by **14% (\$67M)** mostly driven by energy efficiency and hydrocarbon spending including increases in carbon capture, utilization and storage (CCUS). Recent increases in federal spending align with Canada's Mission Innovation objectives.



In 2015, all Mission Innovation members – including Canada – committed to double public investment in clean energy RD&D over five years. Canadian federal departments, agencies, and organizations are well on their way to successfully doubling Canada's annual clean energy RD&D investments from **\$387 million** in 2014-15 to **\$775 million** in 2019-20.



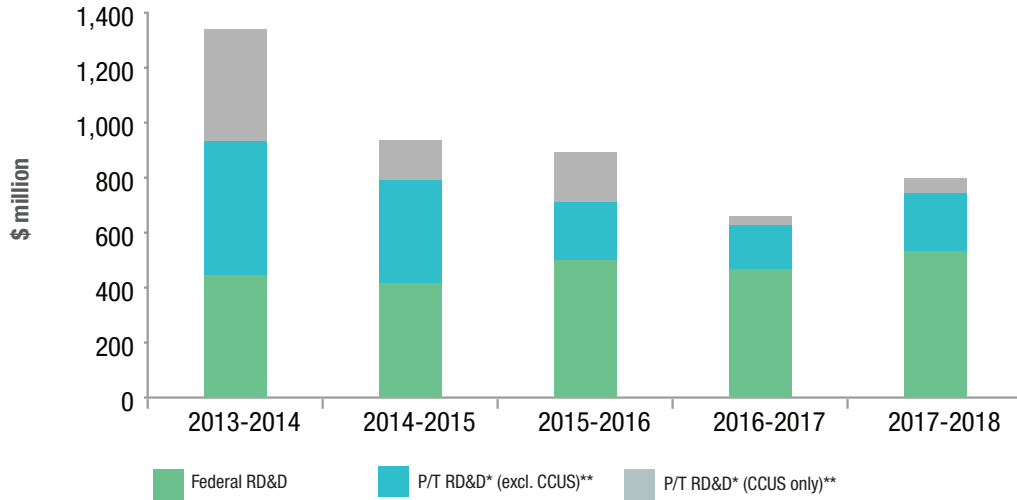
In 2017-18, P/T spending increased by **36% (\$70M)** mostly driven by energy efficiency, CCUS and renewable spending increases.

Energy efficiency saw a significant increase in both federal and P/T spending – federal spending increased by **\$43M** while P/T spending increased by **\$30M**.



The Canadian industry spent about **\$1.6 billion** on energy R&D in 2016, the same as in 2015.

CANADIAN PUBLIC EXPENDITURES ON ENERGY RD&D



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

** P/T spending decreased over the 5 year span (2013-18), mostly due to decreases in spending related to hydrocarbons (including CCUS).

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



Federal
(2017/18)



**Provincial and
territorial**
(2017/18)



Industry
(2016)



Hydrocarbons
(including CCUS)

144

91

727



**Renewable and
clean energy ****

240

113

509



Energy end use***

149

62

354

Total*

533

266

1,590

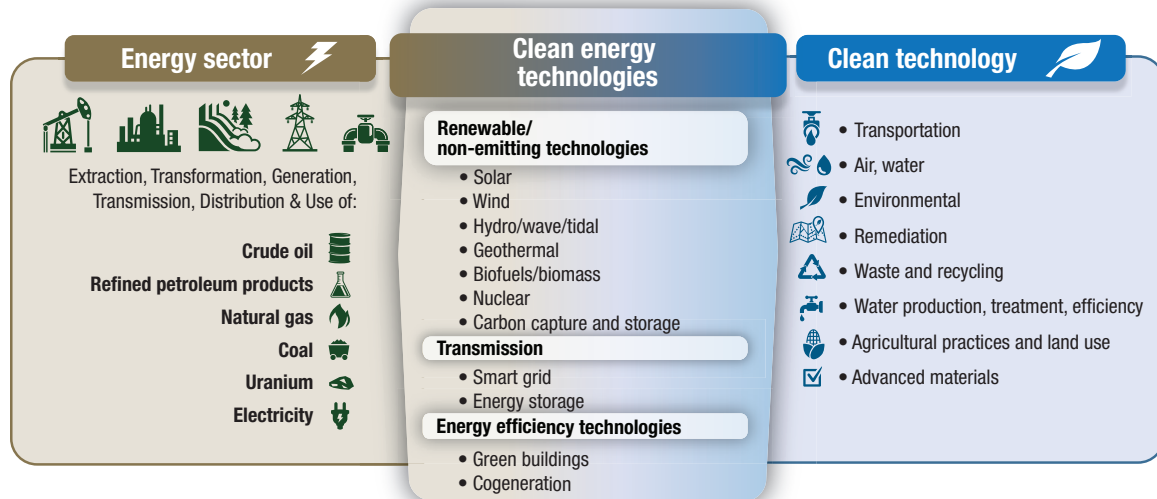
* Totals may not be exact due to rounding.

** Renewable and clean energy supply includes renewable and nuclear energy.

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

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 2017.
- 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 (2017):

\$62 billion of GDP
(3.0% of total GDP)

282,000 jobs representing
1.5% of jobs in the Canadian economy

\$12.4 billion in exports

Of this, clean energy alone accounted for

1.7% of Canada's GDP

and employed

118,200 people.



The TSX and TSX-Venture exchanges list **83 companies in the cleantech sector**, with a total market capitalization of **\$42.8 billion**. Of those companies, 72 are headquartered in Canada, with a total market capitalization of **\$37.8 billion** (as of April 30, 2019).

INVESTMENT IN RENEWABLE ENERGY BY TECHNOLOGY IN CANADA FROM 2014 TO 2018



Wind
\$7.9B



Small hydro
\$0.6B



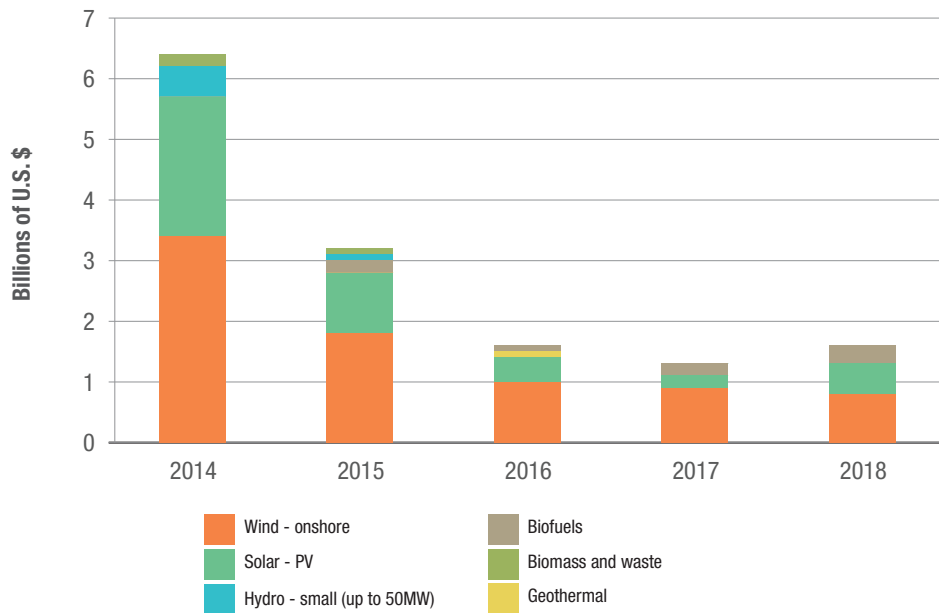
Biomass and waste
\$0.3B

Solar
\$4.4B



Biofuels
\$0.8B

RENEWABLE ENERGY INVESTMENTS IN CANADA, 2014–2018*



* not including large hydro

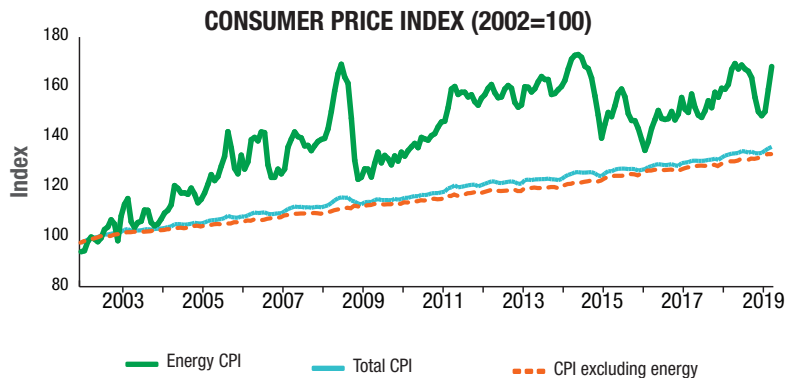
HOUSEHOLD EXPENDITURES ON ENERGY



- Canadian households **spent \$4,281** on average on energy in 2017.
- Residential expenditures, including for heating/cooling spaces, lighting and operating appliances, averaged **\$2,139**.
- Transportation expenditures averaged **\$2,142**.
- Energy accounted for **6.7%** 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.
- This volatility reflects mostly the variations of upstream oil and gas prices and their impact on consumer products such as gasoline.



ENERGY AND GHGS



ENERGY AND GHG EMISSIONS



Globally,

78%

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



This includes activities such as using gasoline for transportation, non-renewable electricity production, oil and gas production, and heating and cooling buildings.



In Canada, **over 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.

Between 2000 and 2017,
Canada's GHG emissions
decreased by

↓ 2%

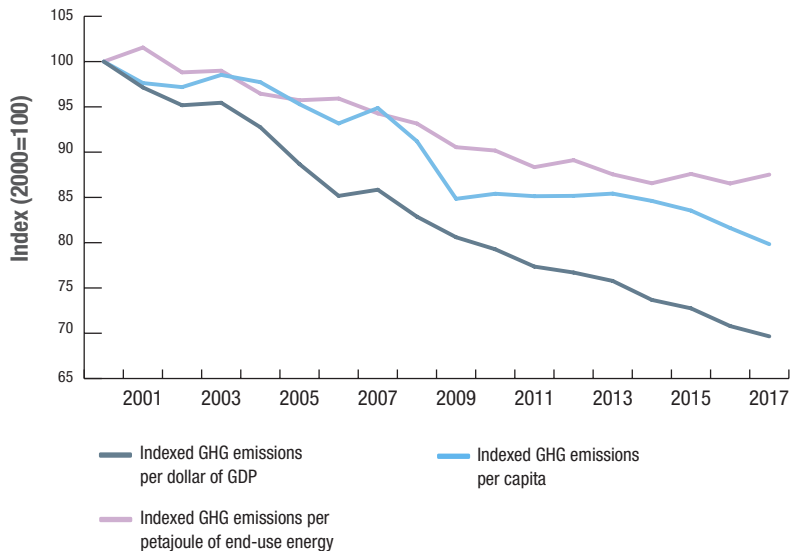
while GDP increased

↑ 40%

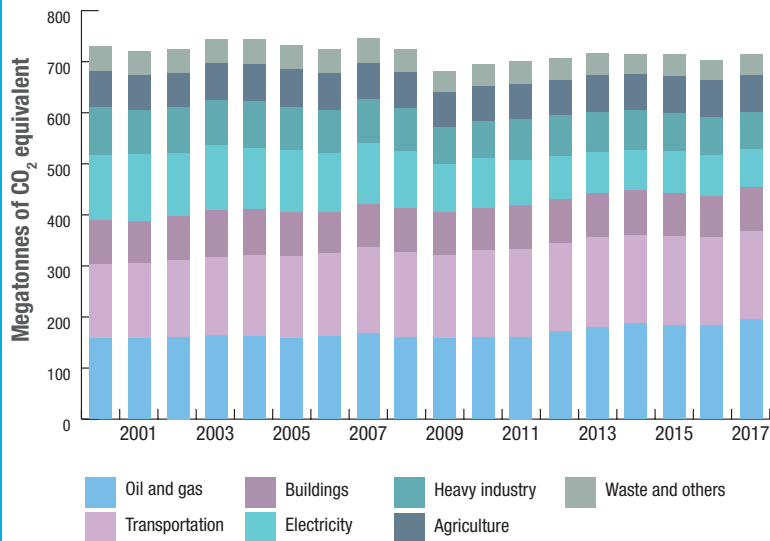
GHG emissions decreased

↓ 30%
per dollar of GDP and
20%
per capita.

INDEXED TREND IN GHG EMISSIONS PER PERSON, PER UNIT OF GDP AND PER UNIT OF ENERGY CONSUMED, 2000–2017



GHG EMISSIONS BY CANADIAN ECONOMIC SECTOR, 2000–2017



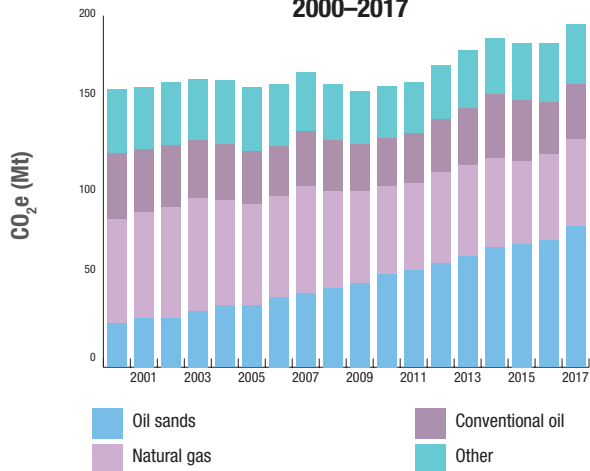
- Between 2000 and 2017, **emissions from electricity production decreased 43%**, largely because of Ontario's successful coal phase-out action plan, which started in 2001.
- **Emissions from oil and gas production increased 23%** because of a **46%** increase in production.
- **Emissions from heavy industry have decreased almost 22%** despite an increase in GDP of **12%** in the industrial sector. This is largely due to higher energy efficiency standards.

SPOTLIGHT: OIL AND GAS

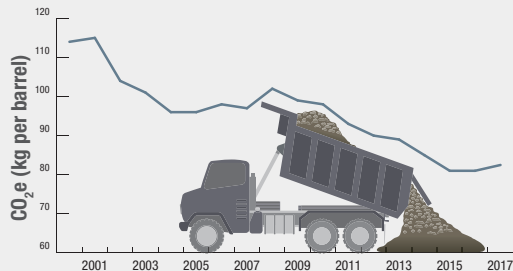
GHG emissions from oil and gas production **have gone up 23% between 2000 and 2017**, largely from increased oil sands production, particularly in situ extraction.

During this period, oil sands production emissions **more than tripled** while conventional oil and natural gas emissions **decreased by 16%**.

OIL AND GAS SECTOR GHG EMISSIONS FOR CANADA, 2000–2017



OIL SANDS EMISSIONS INTENSITY



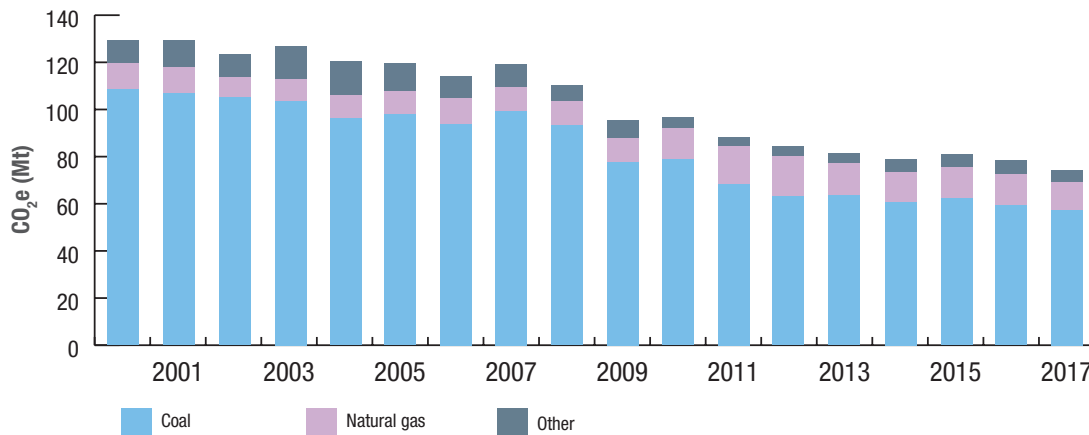
- Due to technological and operational efficiency improvements, oil sands emissions per barrel have **decreased 28%** from 2000 to 2017.

SPOTLIGHT: ELECTRICITY

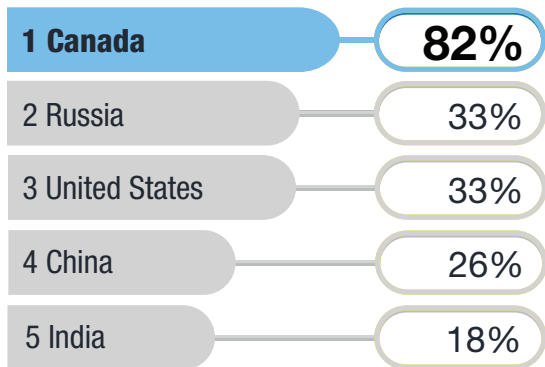
Total electricity emissions **decreased by 42%** from 2000 to 2017 because of increased generation from non-emitting sources.

Coal-fired electricity generation accounted for **9% of generation** and **77% of electricity-related GHG emissions** in 2017.

ELECTRICITY SECTOR GHG EMISSIONS FOR CANADA, 2000–2017

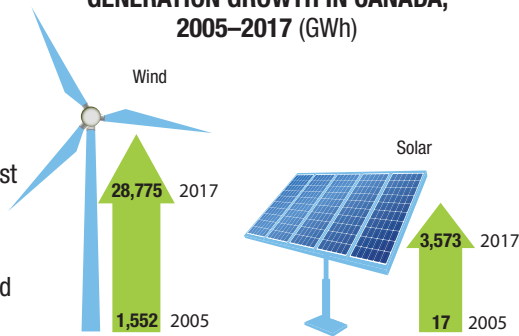


PERCENTAGE OF TOTAL ELECTRICITY FROM NON-EMITTING SOURCES FOR THE TOP FOUR ELECTRICITY-GENERATING COUNTRIES AND CANADA



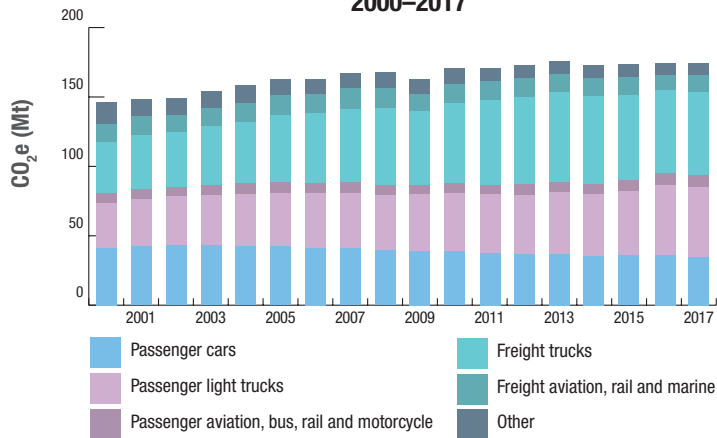
- **Renewable electricity generation has increased 18%** between 2010 and 2017, with solar and wind having the largest growth.
- In 2017, **82% of electricity in Canada** came from non-GHG emitting sources. **Hydro** made up **60%**, **nuclear was 15%**, and other renewables were the remaining **7%**.

WIND AND SOLAR NET ELECTRICITY GENERATION GROWTH IN CANADA, 2005–2017 (GWh)



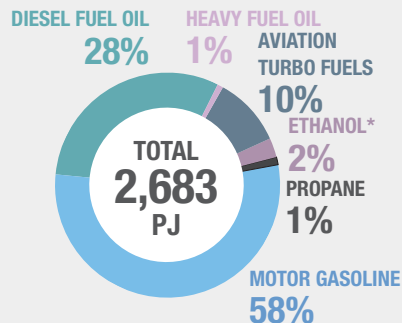
SPOTLIGHT: TRANSPORTATION

TRANSPORTATION SECTOR GHG EMISSIONS FOR CANADA, 2000–2017



- **Transportation GHG emissions** have **increased 19%** from 2000 to 2017. Emissions from passenger light trucks and freight trucks have continued rise because of an increased number of vehicles (especially light trucks and SUVs). Freight emissions have increased because of many factors including increasing trade and globalization and on-line shopping.

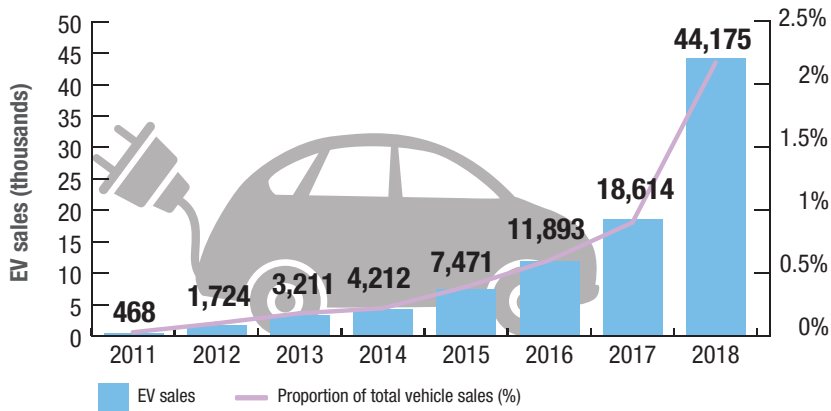
FUEL MIX OF THE TRANSPORTATION SECTOR, 2016



- Total transportation energy use **increased 16%** from 2000 to 2016.
- Energy efficiency improvements in the transportation sector saved Canadians **763 PJ** of energy and almost **\$21 billion** in energy costs in 2016.
- Passenger transportation contributes **54%** to the total emissions, freight emissions are **41%**, and off-road emissions are **5%**.

* The ethanol proportion is estimated based on production data.

PLUG-IN ELECTRIC VEHICLE SALES PORTION OF TOTAL VEHICLE SALES



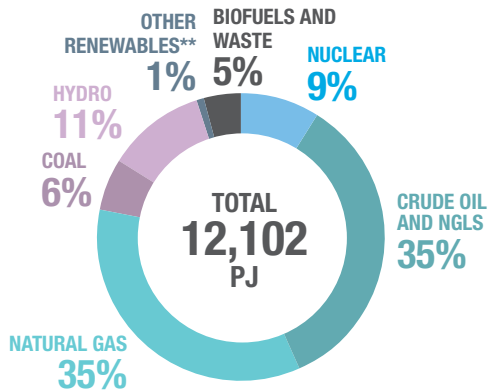
- In 2018, electric vehicle (EV) sales made up **2.2% of total vehicle sales**.
- Almost **44,000 plug-in EVs** were **sold** in 2018, more than double the sales in 2017. Sales are highest in the provinces of Quebec, Ontario and British Columbia.
- To ensure continued uptake, the federal government is undertaking a series of measures. It includes a **\$300 million** investment in the creation of a new federal purchase incentive to buy zero-emission vehicles, a **\$130 million** investment in new zero-emission vehicle infrastructure deployment, and a \$5 million fund to work with automakers to secure ZEV sale targets.

CANADA'S ENERGY PRODUCTION AND USE

A look at Canada's total primary energy supply (TPES) helps to better understand the impact of energy sources on GHG emissions. The TPES¹ is calculated as:

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

CANADA TOTAL PRIMARY ENERGY SUPPLY,* BY SOURCE, 2017



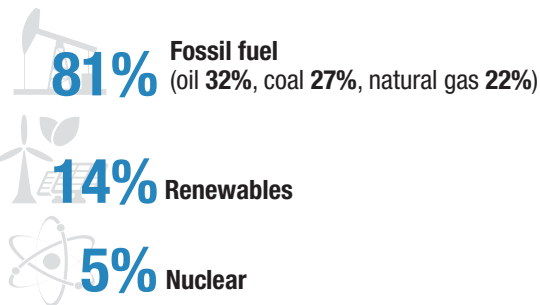
* not including electricity trade

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

¹ For the purposes of TPES, 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 TPES in 2017.
- Renewable energy sources made up **17.3%** of Canada's TPES in 2017.

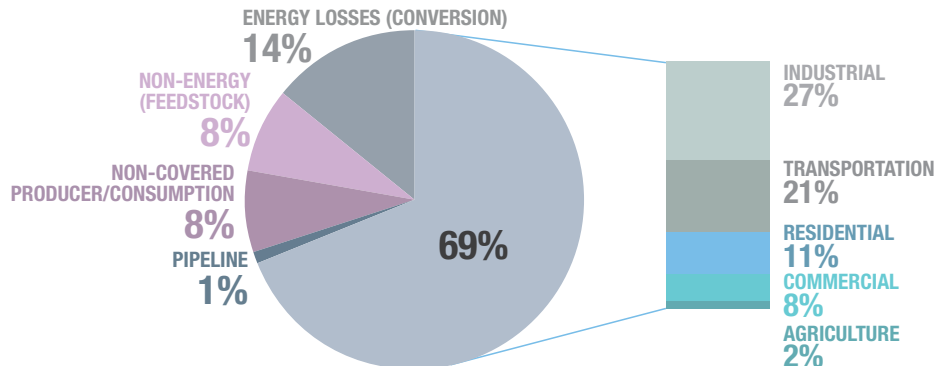
Comparatively, the global TPES is made up of



PRIMARY AND SECONDARY ENERGY USE BY SECTOR (2016)

- 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 **12,713 PJ**.

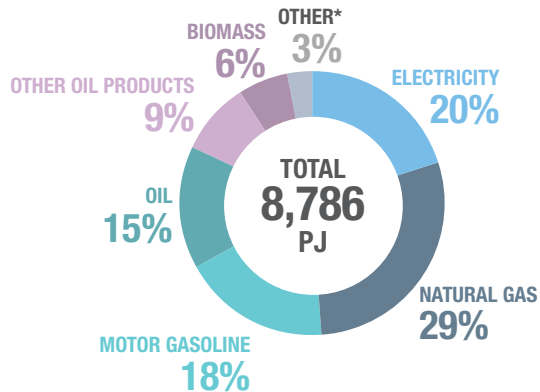
TOTAL ENERGY USE AND FINAL ENERGY DEMAND BY SECTOR, 2016



*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 2016 was **8,786 PJ**.
- Total secondary energy use **increased 9%** from 2000 to 2016. Natural gas usage grew by **almost 18%** during the same period.

CANADA'S SECONDARY ENERGY USE BY FUEL TYPE, 2016

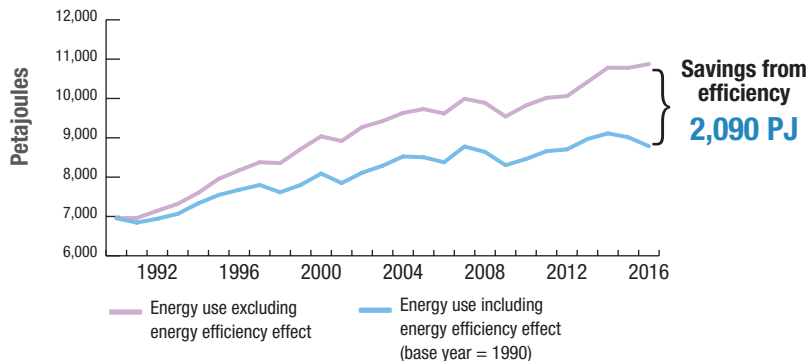


* "Other" includes coal, coke, coke oven gas, NGLs and steam and waste.

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 31%** between 1990 and 2016.
- **Energy use grew by 26%** between 1990 and 2016. Without energy efficiency improvements, energy use would have **grown by 56%**.
- **Energy efficiency savings** of **2,090 PJ** in 2016 were equivalent to end-user savings of **\$45 billion**.

SECONDARY ENERGY USE WITH AND WITHOUT ENERGY EFFICIENCY EFFECT, 1990–2016

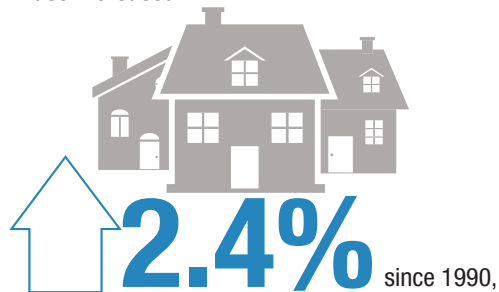


ENERGY IN OUR DAILY LIVES

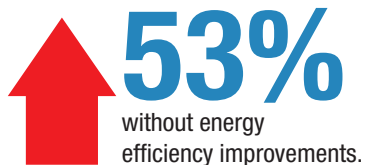
Canadian households use energy every day – to power lights and appliances, heat or cool spaces, run personal vehicles, recharge electronics and more.

- **80%** of residential energy consumption is used for space and water heating.
- Residential energy efficiency improved by **51%** between 1990 and 2016, **saving 721 PJ** of energy and **\$15 billion in energy costs**.

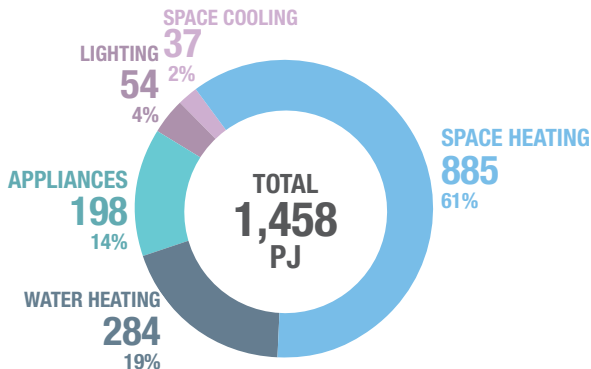
Residential energy use increased



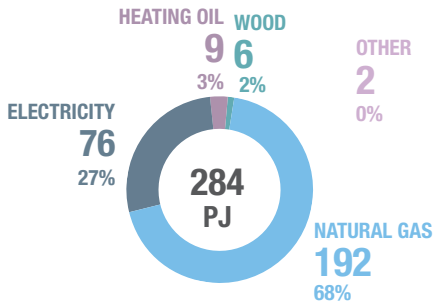
but would have increased by



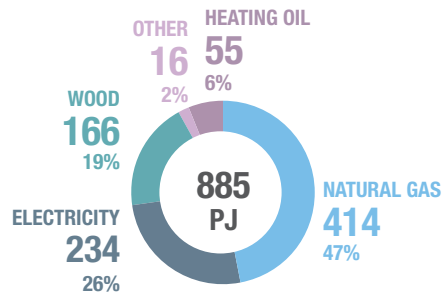
RESIDENTIAL APPLIANCES ENERGY USE (PJ), 2016



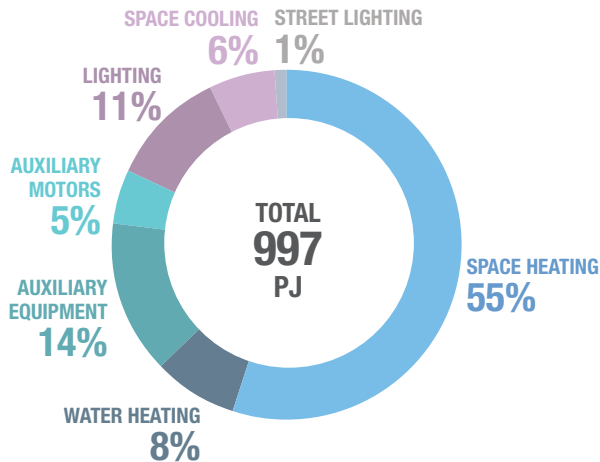
WATER-HEATING ENERGY USE (PJ), 2016



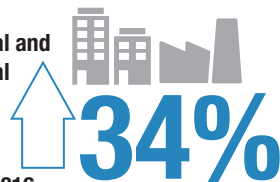
SPACE-HEATING ENERGY USE (PJ), 2016



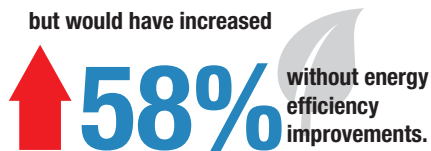
COMMERCIAL AND INSTITUTIONAL ENERGY USE BY END USE, 2016



Commercial and institutional energy use increased between 1990 and 2016



but would have increased

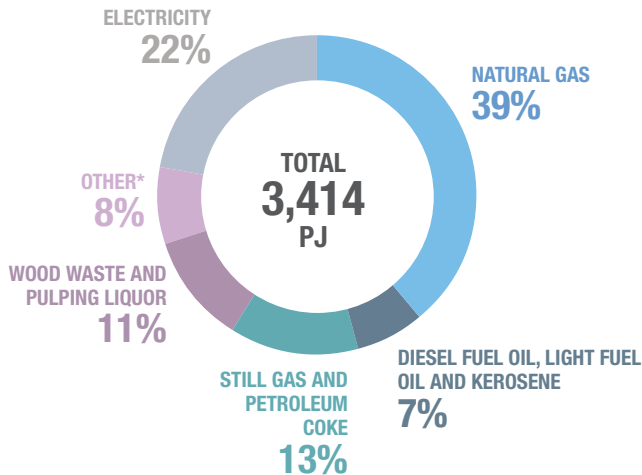


Energy intensity (GJ/m²) decreased



Since 1990, energy efficiency in the commercial and institutional sector has **improved 24%**, saving 180 PJ of energy and **\$4.3 billion** in energy costs in 2016.

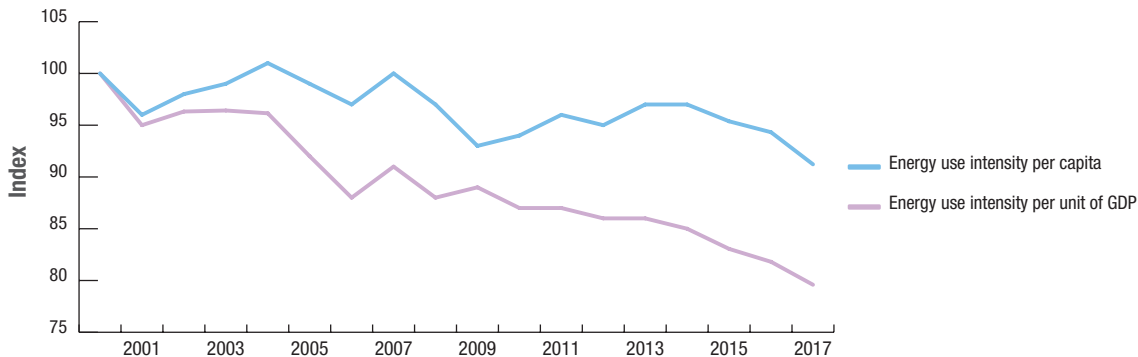
INDUSTRIAL SECTOR ENERGY USE BY FUEL TYPE, 2016



- The **industrial sector** includes all manufacturing, mining (including oil and gas extraction), forestry and construction activities.
- From 1990 to 2016, **industrial energy use increased 26%**. It would have **increased 42%** without energy efficiency improvements.
- As a result of these improvements, the industrial sector's **energy efficiency improved 16%**, **saving 426 PJ** and **\$4.9 billion** in energy costs in 2016.

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

INDEXED TOTAL SECONDARY ENERGY USE INTENSITY PER CAPITA AND PER UNIT OF GDP, 2000–2017 (2000=100)



Per capita energy consumption was

9%



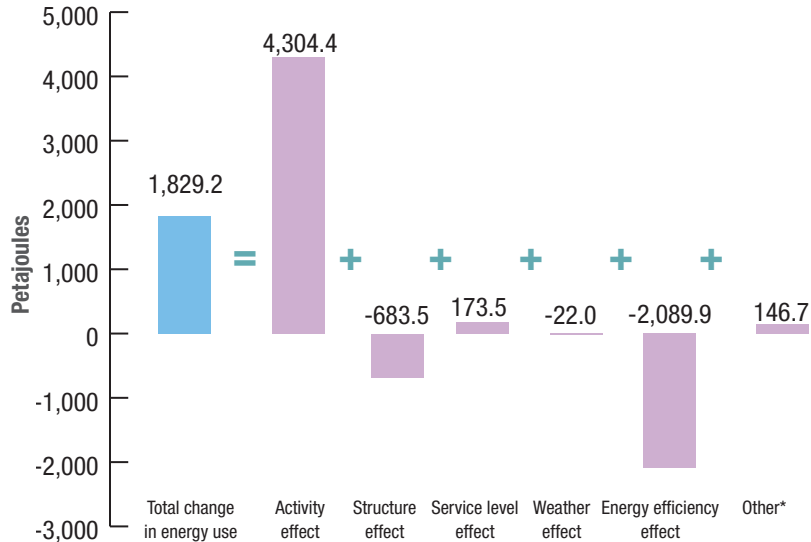
lower in 2017 than in 2000.

Canada used

20%

less energy per dollar of GDP in 2017 than in 2000.

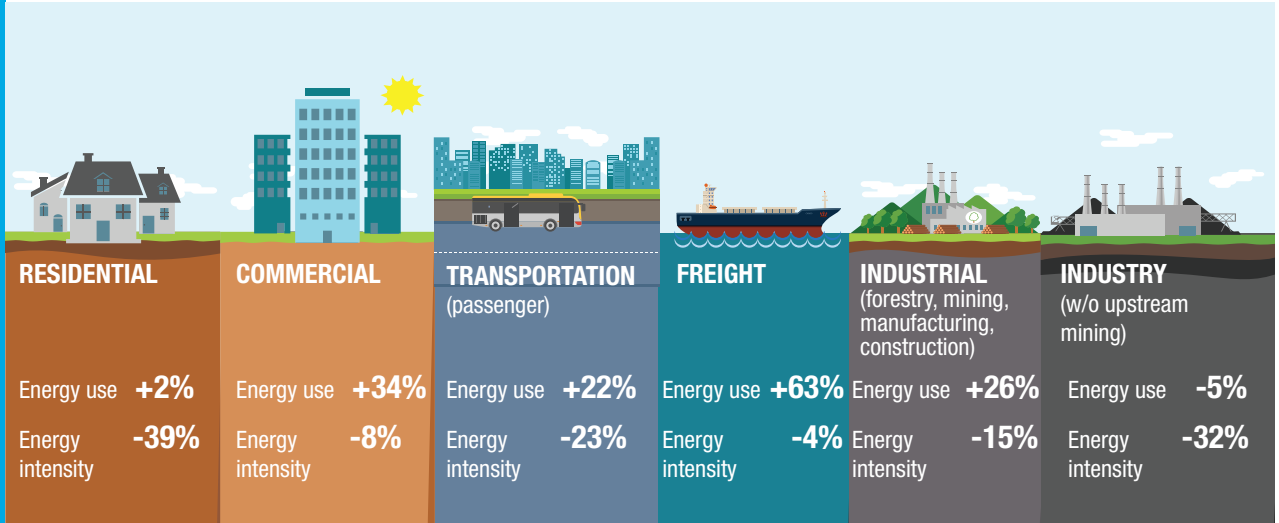
SUMMARY OF FACTORS INFLUENCING THE CHANGE IN ENERGY USE, 1990–2016



* "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.

- **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.

TRENDS IN ENERGY USE AND INTENSITY BY SECTOR, 1990–2016





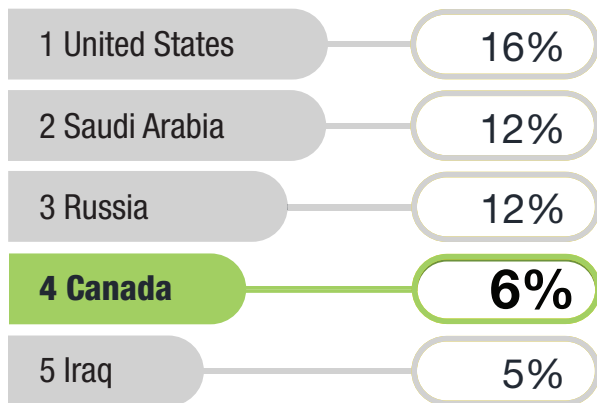
CRUDE OIL



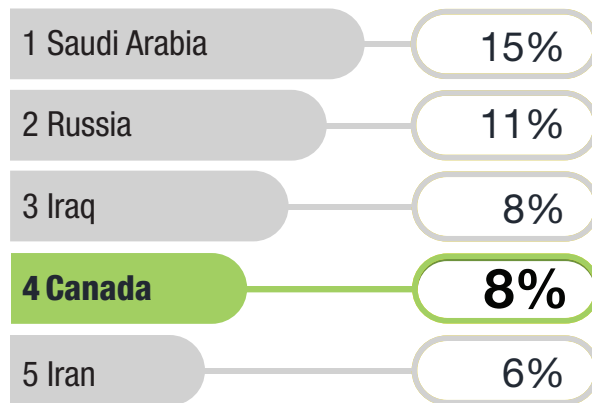
INTERNATIONAL CONTEXT

CRUDE OIL

World production* – 98.3 MMb/d (2018)



World exports* – 47.5 MMb/d (2017)

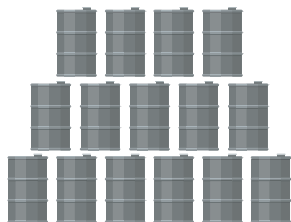


* includes crude oil, NGLs, additives and other hydrocarbons (including the receipts of additives).

World proved reserves

1,672 billion barrels

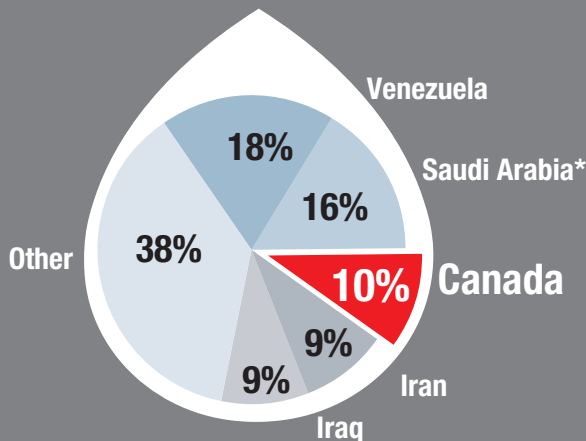
(at the end of 2018)



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.

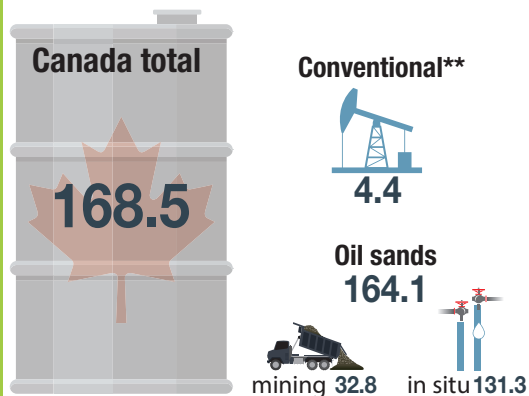


*Saudi Arabia and Kuwait reserves include the Saudi-Kuwaiti "neutral zone," with total proved reserves of 5 billion barrels.

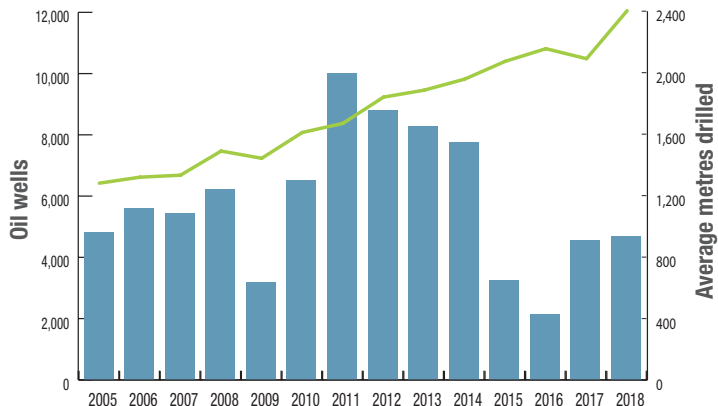
CANADIAN RESOURCES

REMAINING ESTABLISHED RESERVES*

(billion barrels, as of December 2018)



OIL WELLS COMPLETED AND AVERAGE METRES DRILLED IN WESTERN CANADA



■ Wells completed — Average metres drilled

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

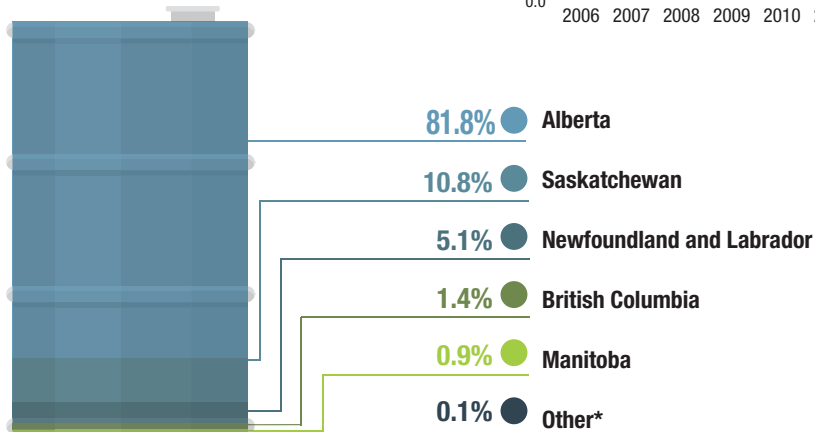
** Reserves also include proved reserves of pentanes plus (a crude-oil equivalent that is associated with oil production).

CANADIAN PRODUCTION

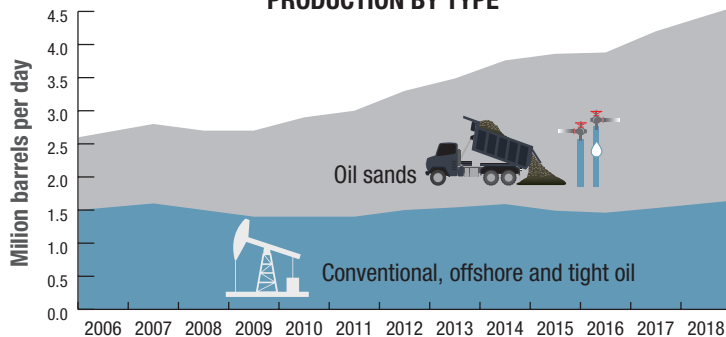
Oil sands production has exceeded conventional production since 2010.

In 2018, oil sands production was **2.9 MMb/d** compared with **1.6 MMb/d** of other oil production.

PRODUCTION BY PROVINCE, 2018



PRODUCTION BY TYPE



*Other: Nova Scotia, Ontario and the Northwest Territories include crude oil, condensates and pentanes plus.

CANADIAN SUPPLY AND DEMAND* (2018)

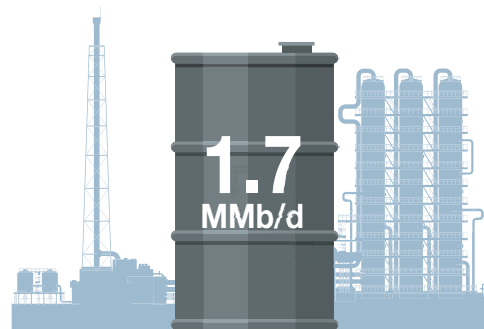
Canadian production



Exports

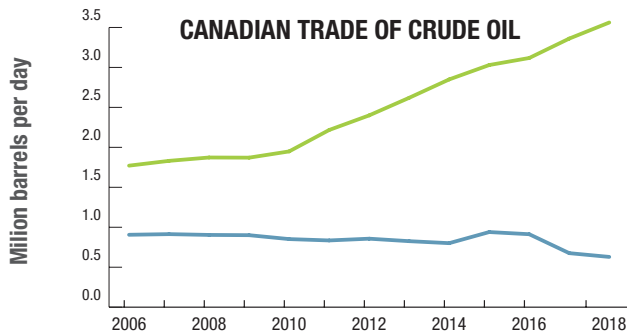


Imports



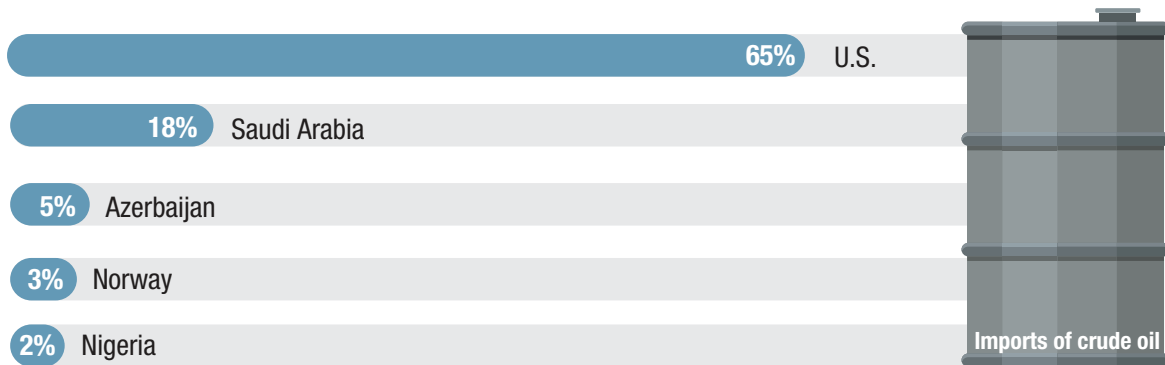
CRUDE OIL INPUT TO DOMESTIC REFINERIES

TRADE

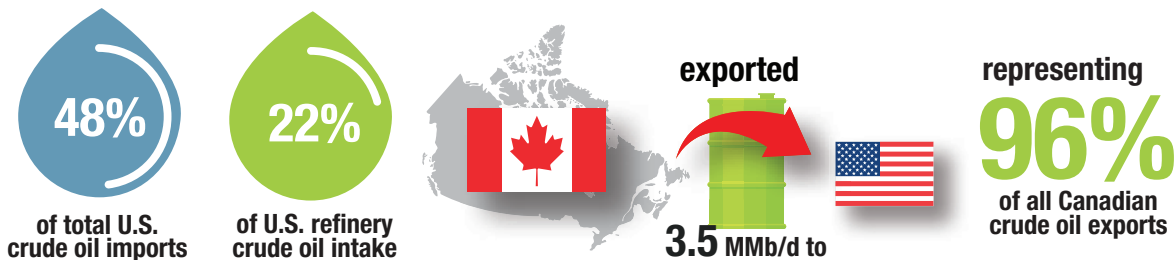


* includes condensates and pentanes plus.

Imports of crude oil into Canada come from a wide range of countries, including



In 2018, 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

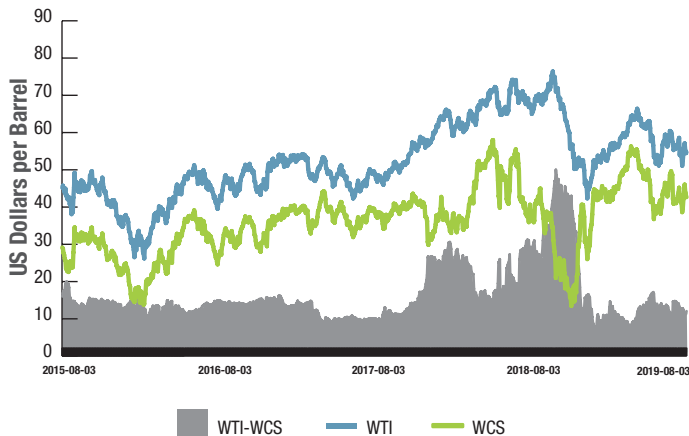
WESTERN CANADIAN SELECT (WCS)

- WCS is the main benchmark price for Canadian heavy crude and 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.
- In early 2019 as U.S. refineries returned to normal operations following heavy maintenance, and production in Alberta was curtailed, the differential narrowed back to 2017 levels.

WTI AND WCS PRICES



OIL SANDS

An estimated **\$313 billion** of capital investment to date, including **\$10.6 billion** in 2018



OF CANADA'S PROVED RESERVES



**OF CANADA'S OIL PRODUCTION IN
2018 OR 2.9 MMb/d**

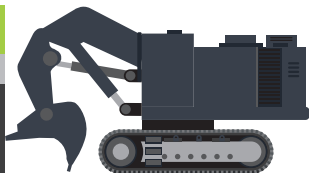
BITUMEN UPGRADING

- Crude bitumen from oil sands may be transported to upgraders for processing to make it lighter – “synthetic crude oil.”
- In 2018, **41%** 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 **1.33 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 2018, **seven projects in Alberta** produced **1,468 Mb/d**: Syncrude Mining Project (**302 Mb/d**), Suncor Base Mine (**259 Mb/d**), CNRL Horizon Mine (**264 Mb/d**), Athabasca Oil Sands Project – Muskeg River (**163 Mb/d**), Jackpine Mine (**132 Mb/d**), Imperial's Kearl Mine (**223 Mb/d**) and Fort Hills (**125 Mb/d**).



↑
formation of
75 m or less
↓

47%

OF CURRENT
PRODUCTION

19%

OF OIL SANDS
RESOURCES

IN SITU METHOD

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

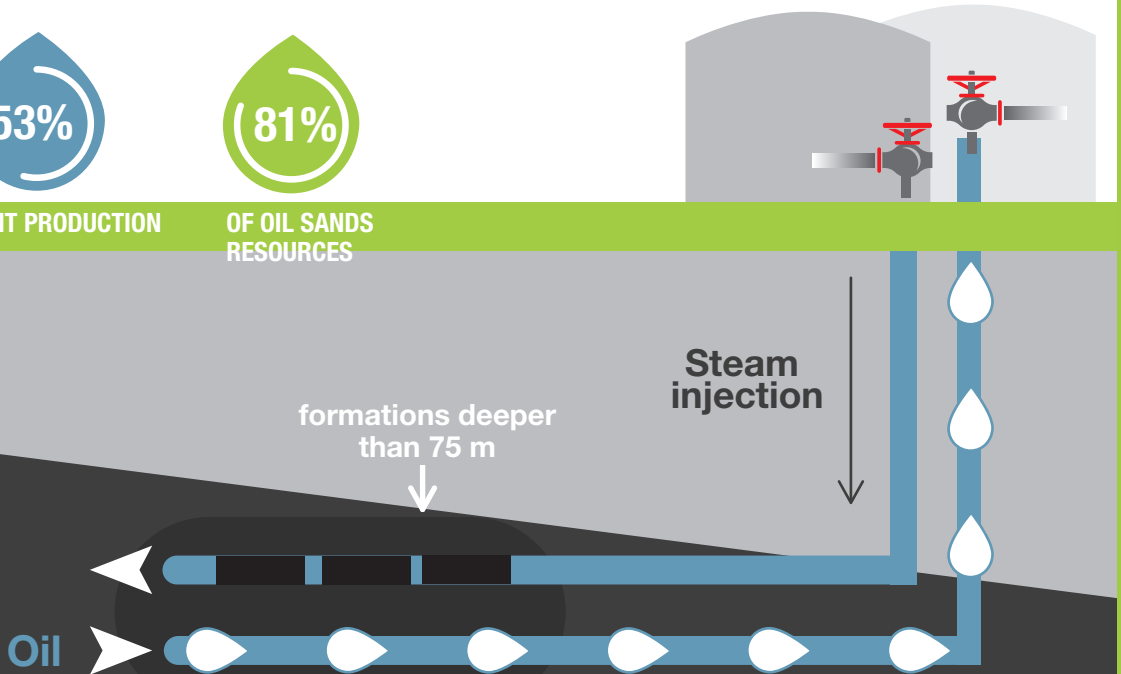
More than 20 projects in Alberta – The largest projects in 2018 were Firebag and MacKay River (Suncor) at 242 Mb/d, Christina Lake (Cenovus) at 201 Mb/d, Foster Creek (Cenovus) at 162 Mb/d and Cold Lake (Imperial Oil) at 148 Mb/d.



OF CURRENT PRODUCTION



OF OIL SANDS
RESOURCES

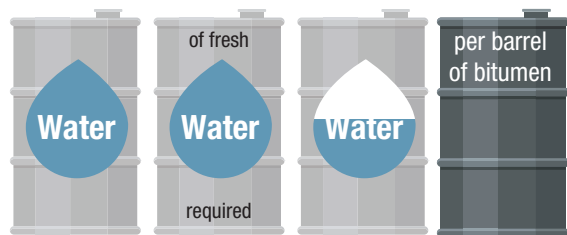


OIL SANDS: ENVIRONMENTAL CONSIDERATIONS

WATER

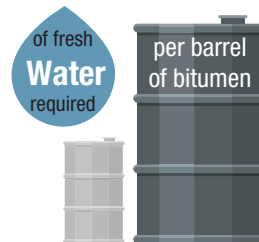
Mining method:

2.5 barrels

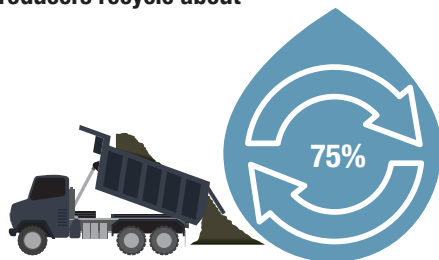


In situ method: an average of

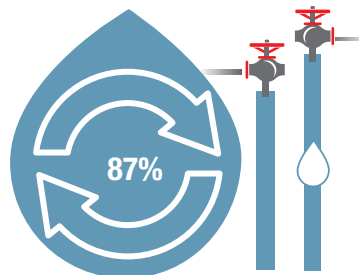
0.2 barrels



Oil sands producers recycle about



**OF THE WATER USED FOR
ESTABLISHED MINES**



**OF THE WATER USED FOR
IN SITU PRODUCTION**

GREENHOUSE GASES

11% of Canada's total **GHG emissions** and **0.1%** of **global emissions**

From 2000 to 2017, the **emission intensity** of oil sands operations **dropped** by about



28%



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.



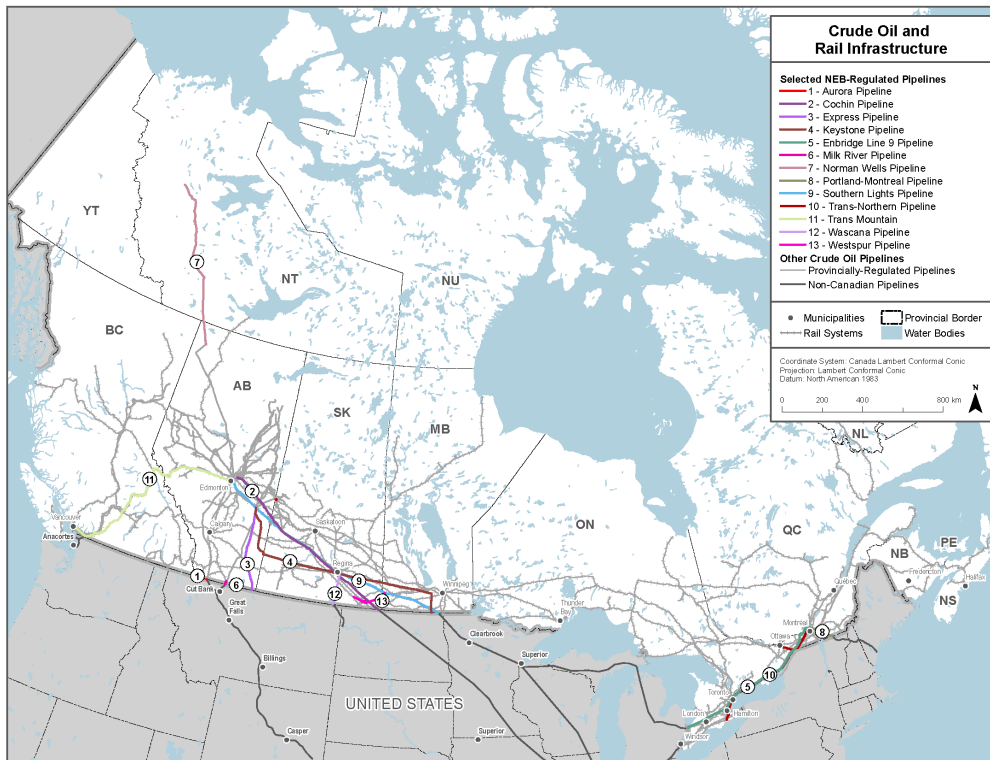
LAND

- area of oil sand resources **142,200 km²**
- total mineable area **4,800 km²**
- total area being mined **901 km²**
tailings ponds **220 km²**

For comparison:

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

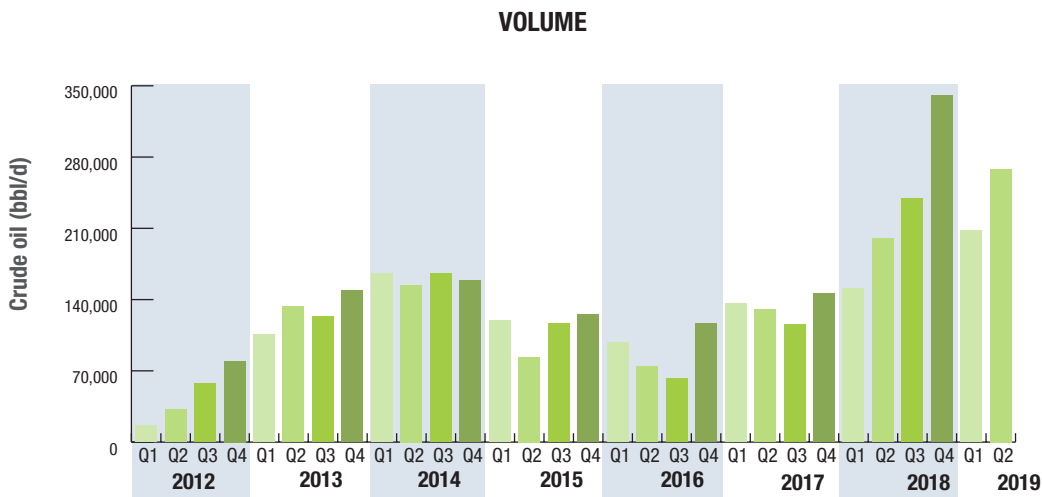
TRANSPORTATION BY PIPELINE AND RAIL



BY RAIL

As production increases in Western Canada have outpaced increases in pipeline capacity, shipments of crude oil by rail have increased to fill the gap. Exports of crude oil by rail more than doubled in 2018, from **146 Mb/d** in January 2018, to **354 Mb/d** in December 2018.

As oil production limits in Alberta have eased over 2019, rail exports are trending back up following the drop in the first quarter.





PETROLEUM PRODUCTS

PETROLEUM REFINERIES

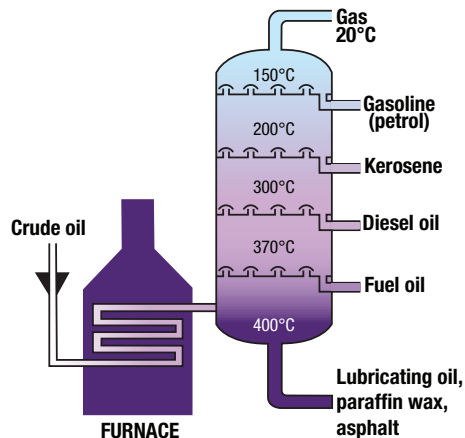
Petroleum refineries transform crude oil into a wide range of refined petroleum products (e.g. gasoline, diesel). Other facilities such as asphalt plants, lubricant plants, upgraders and some petrochemical plants also process crude oil to produce a limited range of products.

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

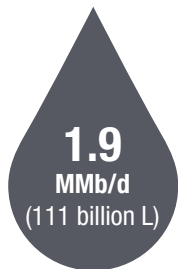
REFINERY OUTPUTS

- 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

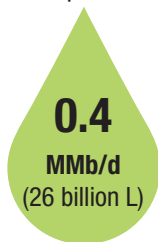


SUPPLY AND DEMAND* (2018)

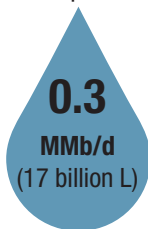
Canadian production



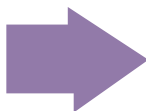
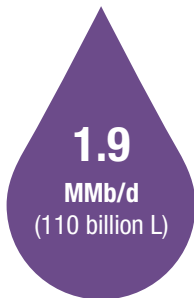
Exports



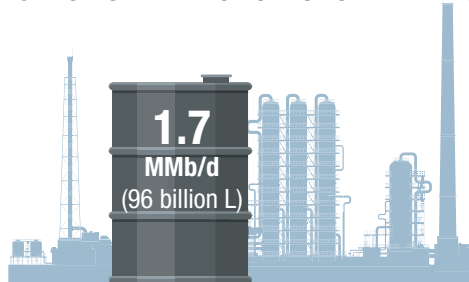
Imports



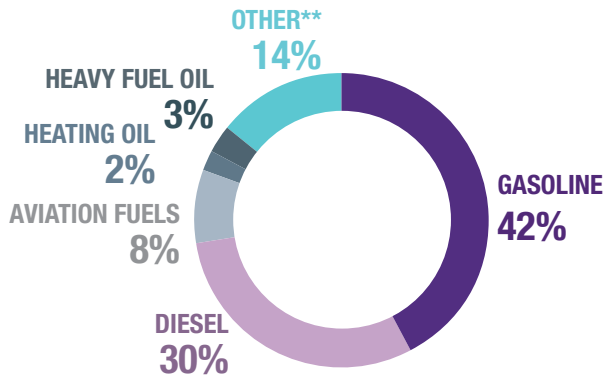
Domestic sales



CRUDE OIL SHIPPED TO DOMESTIC REFINERIES



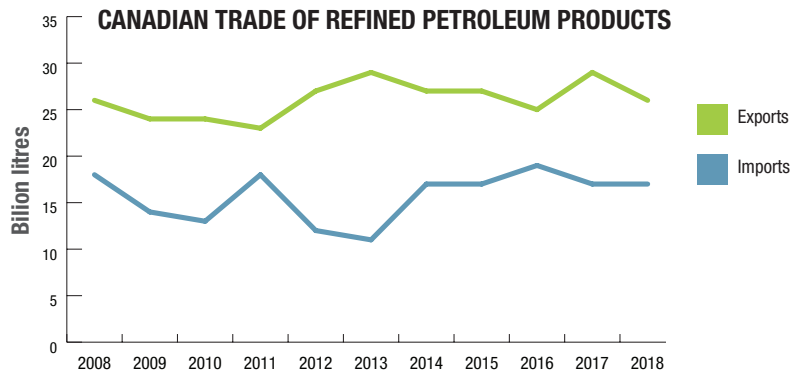
SALES BY PRODUCT*



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

** "Other" includes propane, butane, petro-chemical feedstocks, asphalt, petroleum coke, lubricating oils, etc.

TRADE (2018)



23%

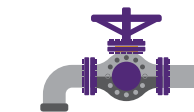
of Canadian production of refined petroleum products is exported

92%

of Canadian refined petroleum product exports are to the United States.

20%

of United States imports come from Canada.



16%

of Canadian consumption of refined petroleum products is imported:

71%

United States

8%

Netherlands

3%

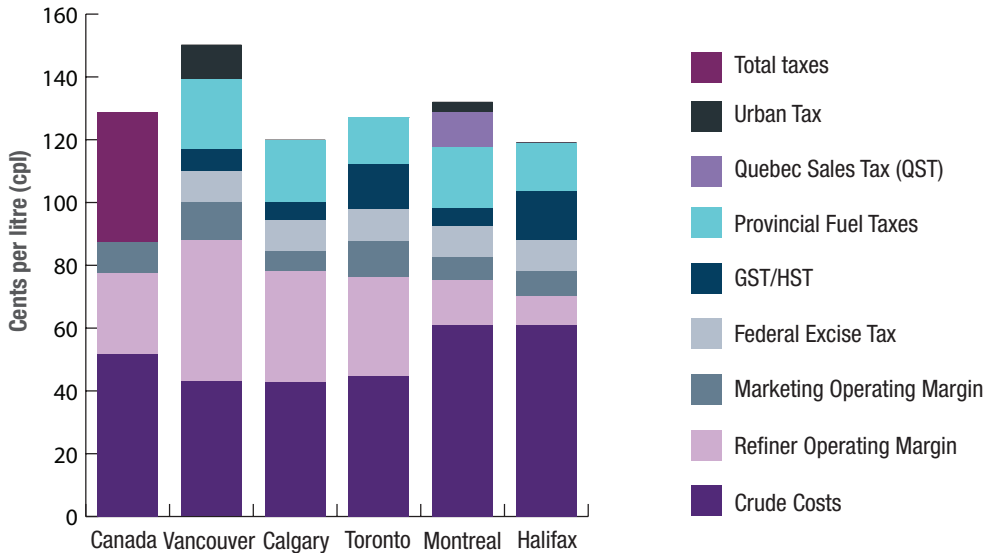
United Kingdom

2%

Belgium

RETAIL PRICES

AVERAGE CANADIAN REGULAR GASOLINE PRICES, 2018



REFINERY CAPACITY

CANADIAN PETROLEUM REFINERIES BY COUNT AND CAPACITY*, 2018

| Province | Petroleum refinery | | Asphalt plants | | Lubricant plants (using crude oil as feedstock) | |
|---------------------------|--------------------|--------------|----------------|-----------|--|-----------|
| | Count | Capacity | Count | Capacity | Count | Capacity |
| Alberta | 4 | 479 | - | - | - | - |
| British Columbia | 2 | 67 | - | - | - | - |
| New Brunswick | 1 | 318 | - | - | - | - |
| Newfoundland and Labrador | 1 | 130 | - | - | - | - |
| Ontario | 4 | 392 | - | - | 1 | 16 |
| Quebec | 2 | 402 | - | - | - | - |
| Saskatchewan | 1 | 130 | 2 | 48 | - | - |
| Total | 15 | 1,918 | 2 | 48 | 1 | 16 |

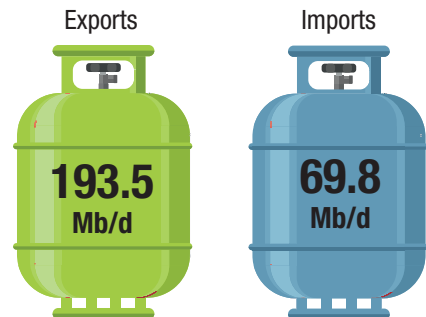
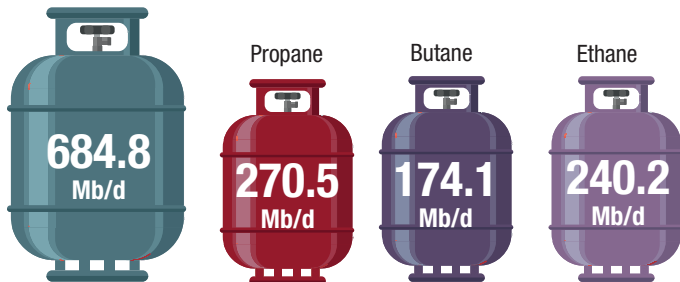
*Capacities are in Mb/d.

HYDROCARBON GAS LIQUIDS

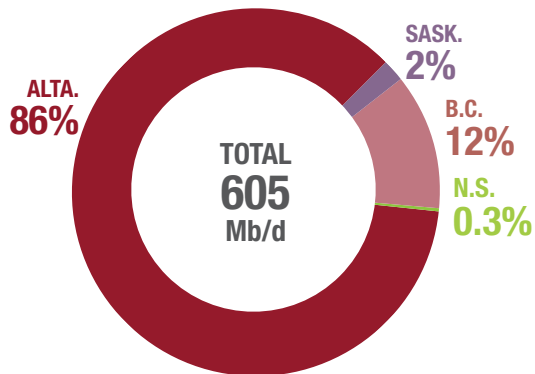


SUPPLY AND DEMAND* (2018)

Canadian production



GAS PROCESSING PLANT PRODUCTION OF NGLS BY PROVINCE



* excludes condensates and pentanes plus, which are included as part of crude oil, and includes refinery-produced LPGs. Some refinery production was estimated due to confidentiality.

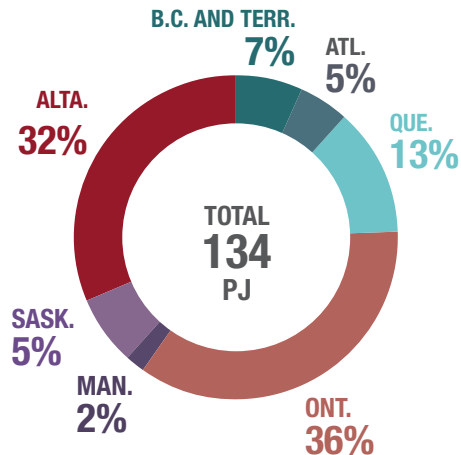
NATURAL GAS LIQUIDS ENERGY USE

TOTAL NATURAL GAS LIQUIDS ENERGY USE
WAS 134.2 PJ IN 2016.

| Sector | Energy use* (PJ) | % of the total |
|----------------|------------------|----------------|
| Residential | 17.1 | 12.7% |
| Commercial | 38.3 | 28.5% |
| Industrial | 56.5 | 42.1% |
| Transportation | 12.1 | 9.0% |
| Agriculture | 10.3 | 7.7% |
| Total | 134.2 | 100% |

*secondary energy use

NATURAL GAS LIQUIDS ENERGY USE
BY PROVINCE, 2016



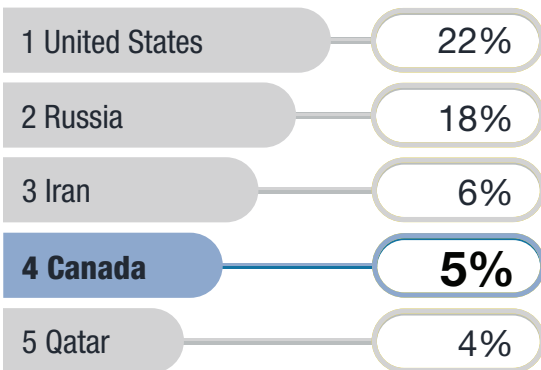
NATURAL GAS



NATURAL GAS

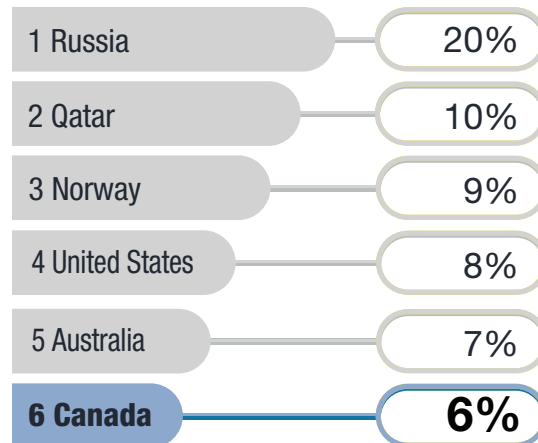
World production – 381 Bcf/d (10.8 Bcm/d)

(2018, PRELIMINARY)

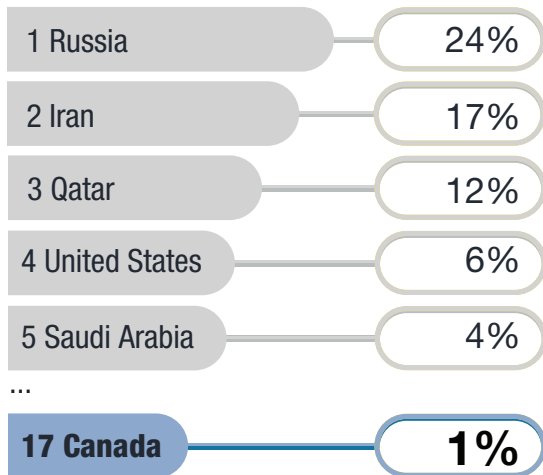


World exports – 121 Bcf/d (3.4 Bcm/d)

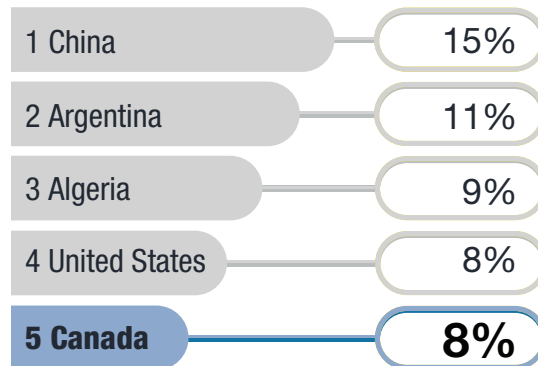
(2018, PRELIMINARY)



World proved reserves – 7,125 Tcf (202 Tcm) (BEGINNING OF 2019)

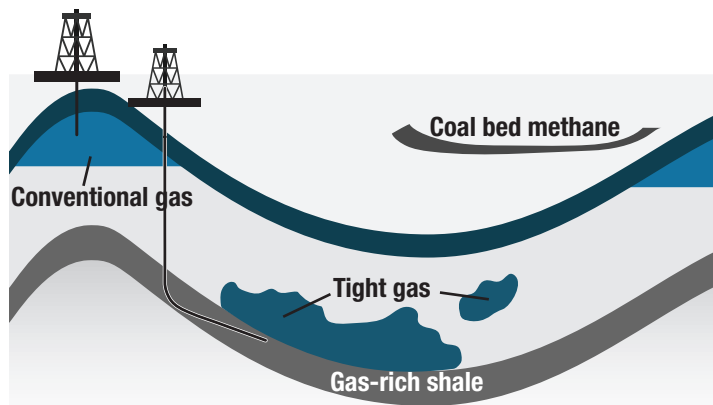
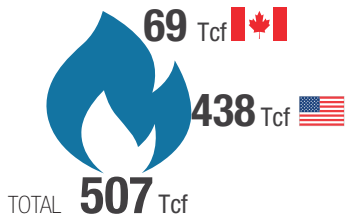


World technically recoverable shale resources – 7,577 Tcf (2015)



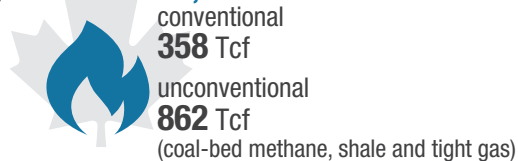
CANADA-U.S. RESOURCES

PROVED RESERVES* (AT THE END OF 2017)

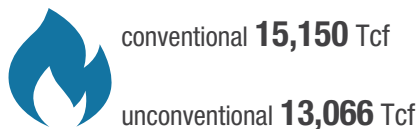


MARKETABLE/TECHNICALLY RECOVERABLE RESOURCES**

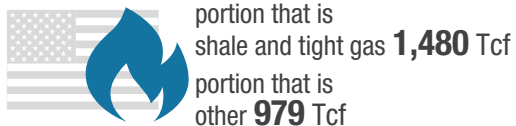
Canada total,
year-end 2017 **1,220 Tcf**



World total **28,216 Tcf**



U.S. total,
year-end 2016 **2,459 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 (2018)

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

16.7 Bcf/d (0.5 Bcm/d)



29% conventional

71% unconventional*

U.S. average marketable production

83.4 Bcf/d (2.4 Bcm/d)



20% conventional

80% unconventional*

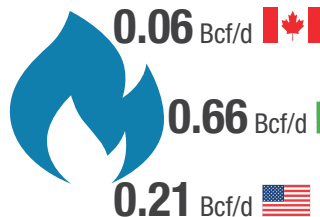
* Unconventional gas includes tight gas, coal bed methane and shale gas.



Canada-U.S. production

100.1 Bcf/d (2.8 Bcm/d)

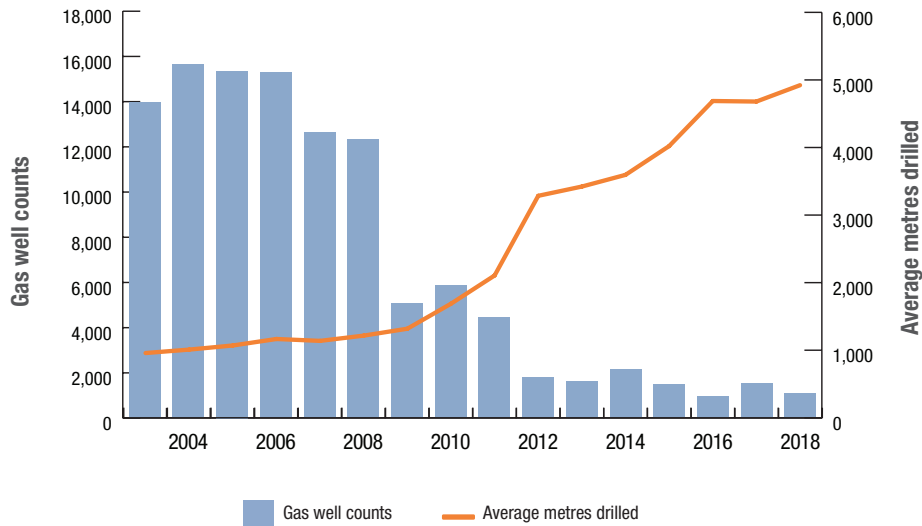
LNG imports of North American countries



LNG exports of North American countries

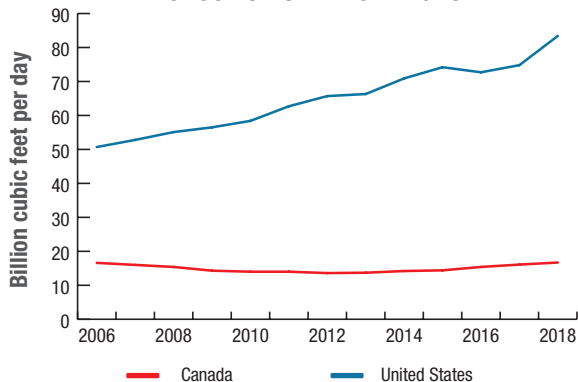


NATURAL GAS WELLS COMPLETED AND AVERAGE METRES DRILLED IN WESTERN CANADA

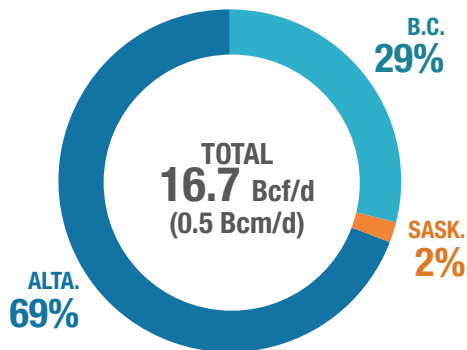


While Canadian natural gas production remained relatively flat and the number of wells drilled declined, the well productivity has increased over time. This reflects the increased use of horizontal drilling and increased well length.

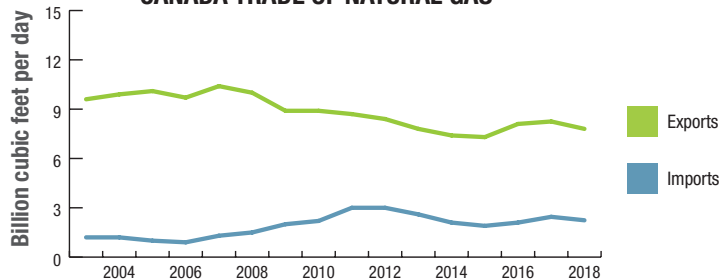
CANADIAN AND U.S. MARKETABLE PRODUCTION OF NATURAL GAS



MARKETABLE PRODUCTION BY PROVINCE, 2018



CANADA TRADE OF NATURAL GAS



Canadian exports to the U.S.



Canadian imports from the U.S.



- While the share of exports is declining, more Canadian gas was exported than consumed domestically.
- 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.

All Canadian exports go to the U.S.

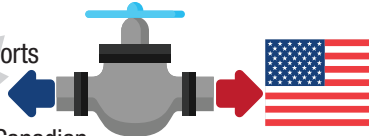


97% of U.S. imports and **9%** of U.S. consumption comes from Canada.

The value of Canadian net exports (exports minus imports) was **\$6.1 billion** in 2018.

98% of Canada's imports and

17% 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

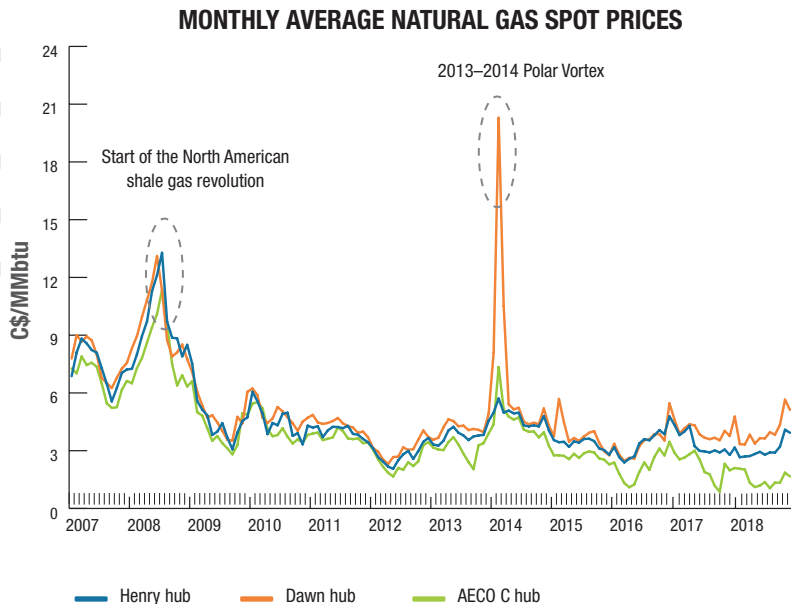
Average: 2007–2016 **\$4.18/MMbtu**

Average: 2015 **\$2.70/MMbtu**

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

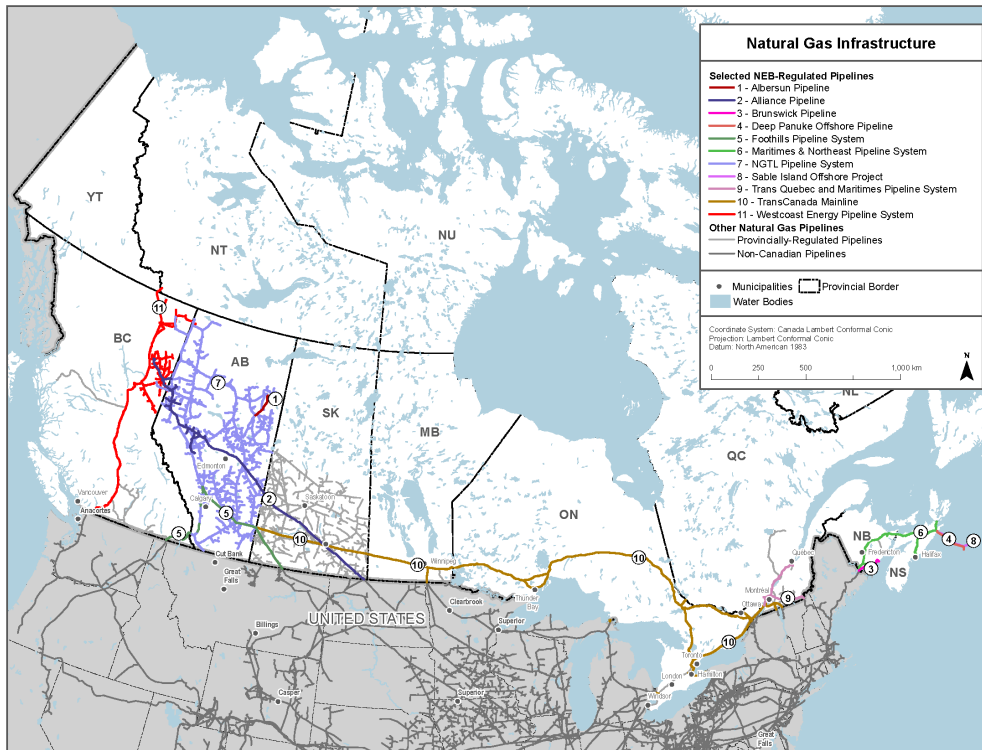
Average: 2017 **\$2.20/MMbtu**

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



TRANSPORTATION

BY PIPELINE

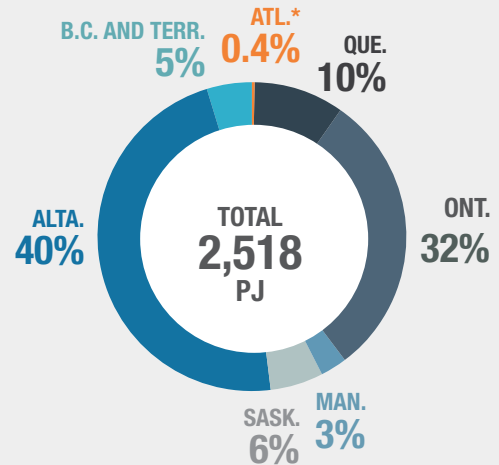


NATURAL GAS ENERGY USE

NATURAL GAS END USE BY SECTOR, 2016

| Sector | Energy use (PJ) | Energy use (Bcf/d) | % of the total |
|----------------|-----------------|--------------------|----------------|
| Residential | 613.9 | 1.52 | 24.4% |
| Commercial | 513.9 | 1.27 | 20.4% |
| Industrial | 1,348.1 | 3.34 | 53.5% |
| Transportation | 4.1 | 0.01 | 0.2% |
| Agriculture | 38.2 | 0.09 | 1.5% |
| Total | 2,518.1 | 6.24 | 100% |

NATURAL GAS ENERGY USE BY PROVINCE, 2016



* Atlantic provinces

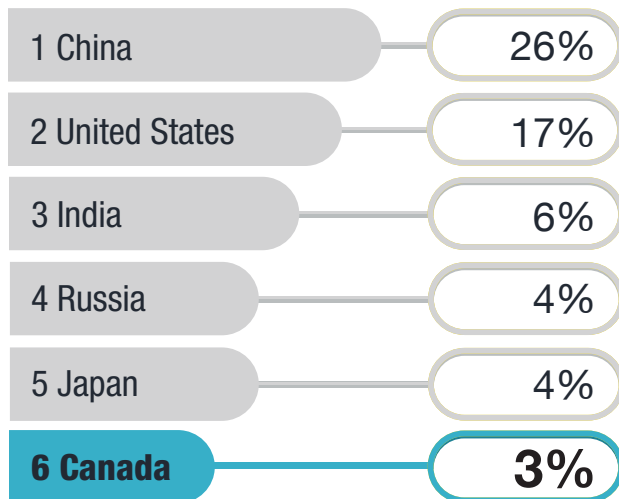
ELECTRICITY



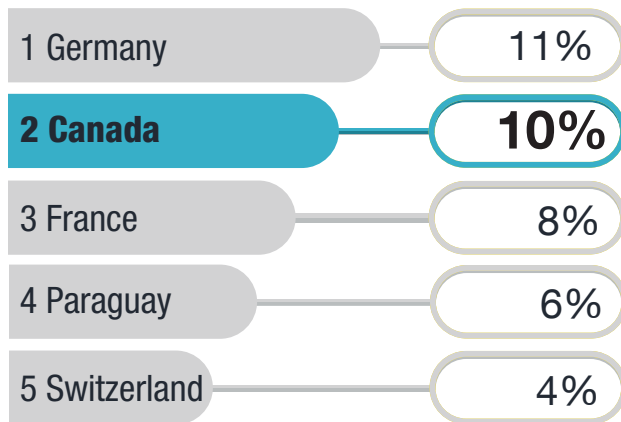
INTERNATIONAL CONTEXT

ELECTRICITY

World production – 25,721 TWh (2017)



World exports – 730 TWh (2017)



TRADE (2018)

All Canadian electricity trade is with the U.S.

EXPORTS



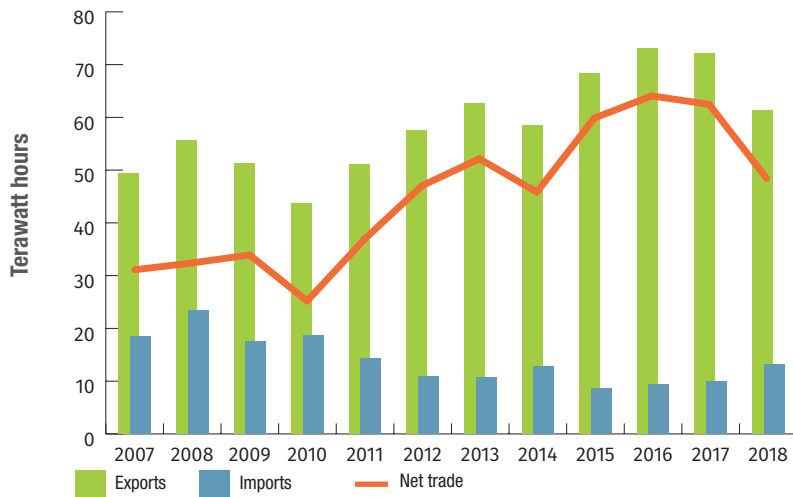
61.4 TWh

IMPORTS



13.2 TWh

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

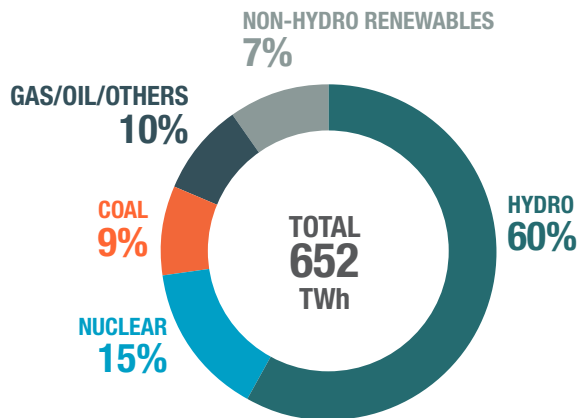


* includes only electricity traded under purchased contracts; excludes electricity transferred under non-financial agreements (e.g. under treaty obligations)

CANADIAN SUPPLY

GENERATION IN CANADA – 652.3 TWh

GENERATION BY SOURCE, 2017



HYDRO

Canada 60.2%

| | |
|--------|-------|
| Man. | 96.8% |
| Que. | 95.0% |
| N.L. | 93.7% |
| Y.T. | 92.2% |
| B.C. | 90.5% |
| N.W.T. | 38.5% |
| Ont. | 25.9% |
| N.B. | 19.6% |
| Sask | 13.7% |
| N.S. | 8.8% |
| Alta. | 2.5% |

NUCLEAR

Canada 14.6%

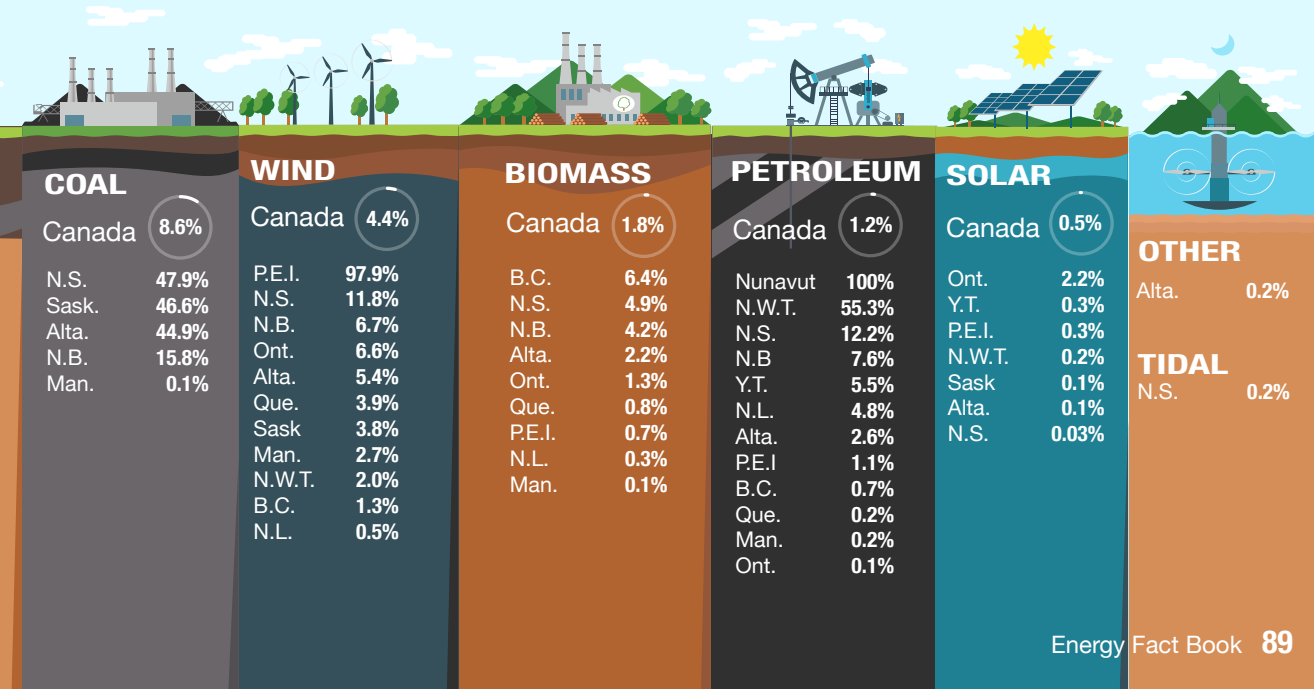
| | |
|------|-------|
| Ont. | 58.6% |
| N.B. | 36.1% |

NATURAL GAS

Canada 8.6%

| | |
|--------|-------|
| Alta. | 42.2% |
| Sask | 35.7% |
| N.S. | 14.3% |
| N.B. | 9.9% |
| Ont. | 5.2% |
| N.W.T. | 4.0% |
| Y.T. | 2.0% |
| B.C. | 1.1% |
| N.L. | 0.7% |
| Que. | 0.1% |

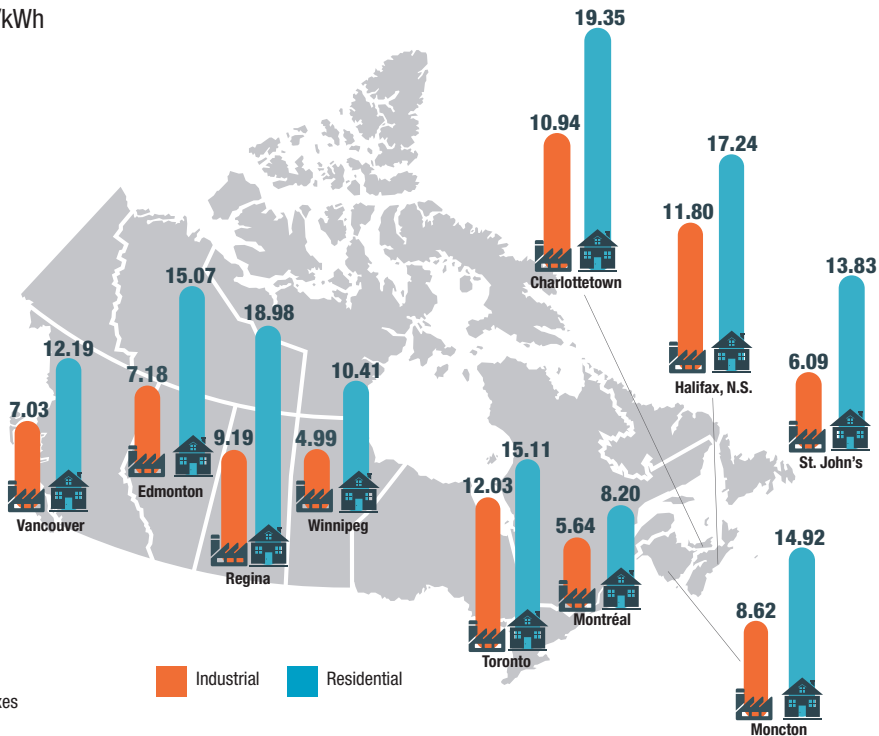
PROVINCIAL ELECTRICITY GENERATION BY SOURCE, 2017



ELECTRICITY PRICES

AVERAGE LARGE INDUSTRIAL AND RESIDENTIAL ELECTRICITY PRICES* (AS OF APRIL 2018)

in cents/kWh



*including taxes

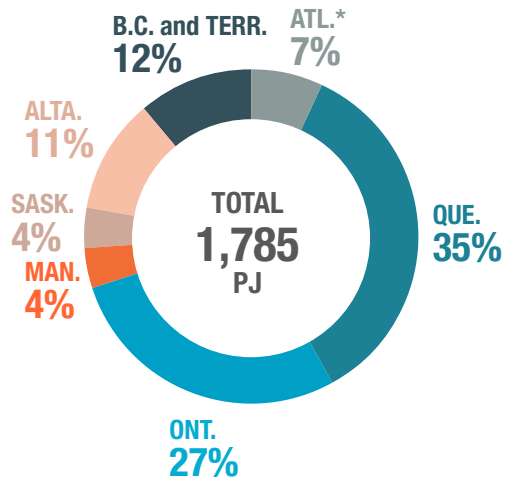
ELECTRICAL ENERGY USE

TOTAL ELECTRICAL ENERGY USE* WAS 1,785 PJ
IN 2016

| Sector | Energy use (PJ) | % of the total |
|----------------|-----------------|----------------|
| Residential | 591.0 | 33.1% |
| Commercial | 416.5 | 23.3% |
| Industrial | 738.4 | 41.4% |
| Transportation | 3.0 | 0.2% |
| Agriculture | 36.1 | 2.1% |
| Total | 1,785.0 | 100% |

*secondary energy use

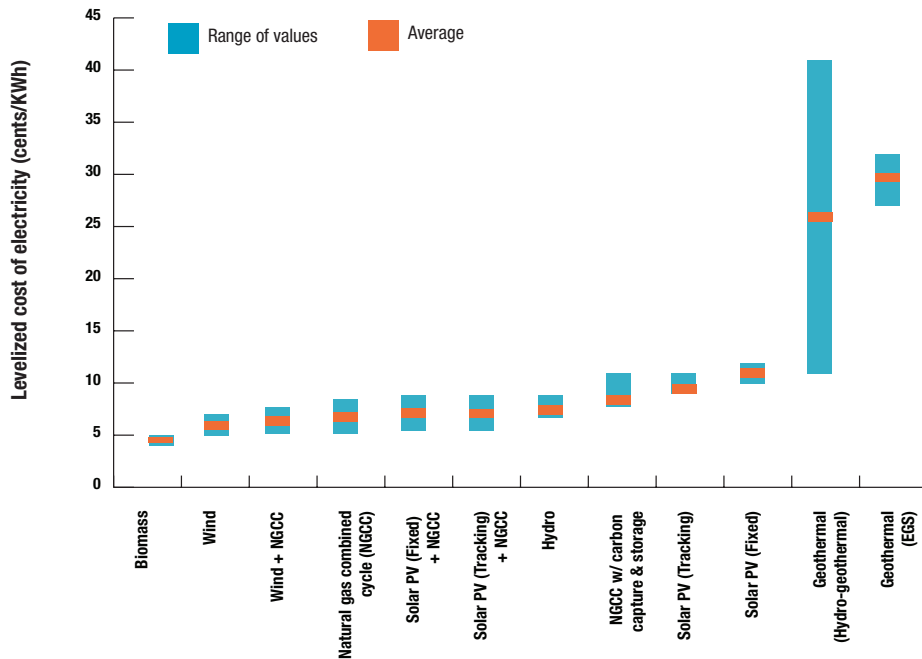
ELECTRICAL ENERGY USE BY PROVINCE, 2016



* Atlantic provinces

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. In 2018, the Canadian Energy Research Institute estimated the LCOE for different electricity generation technologies in Canada.



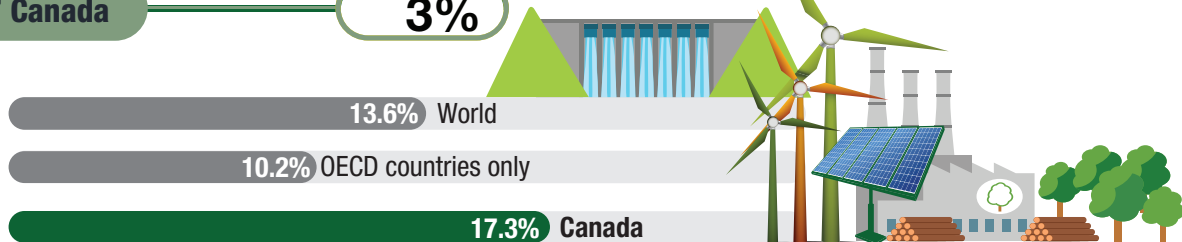
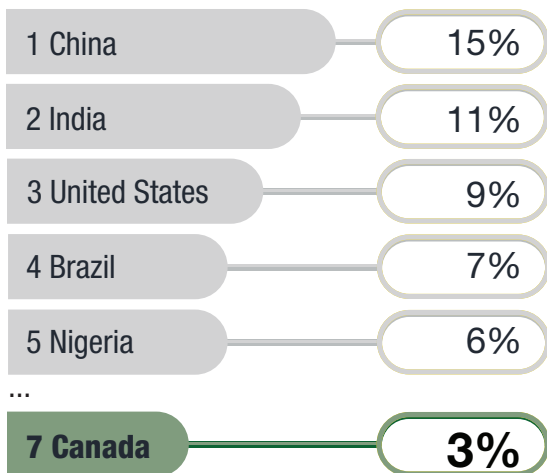
RENEWABLE ENERGY



INTERNATIONAL CONTEXT

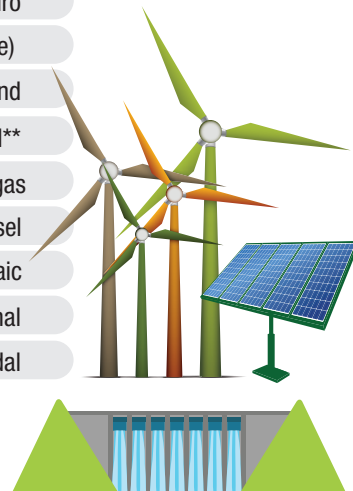
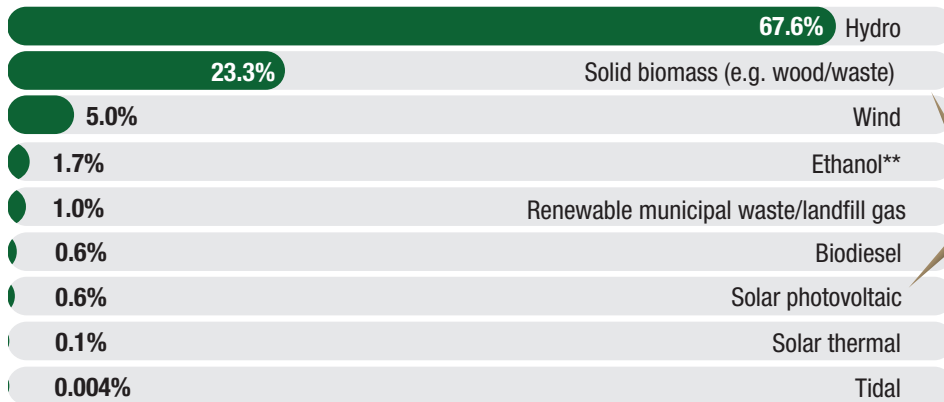
RENEWABLE ENERGY

World production – 79,092 PJ or 1,889 MTOE (2017)



CANADIAN PRODUCTION (2017)

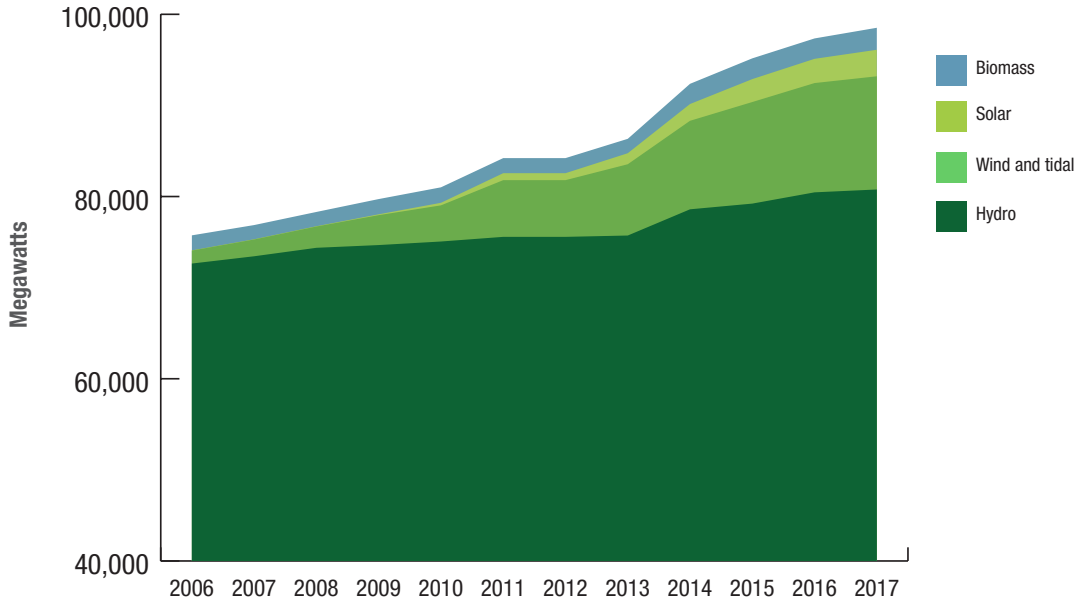
Total renewable energy* – 2,090 PJ or 49.9 MTOE



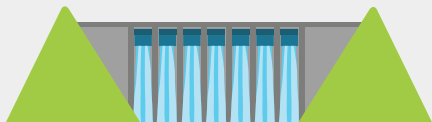
*includes energy consumed for electricity and heat production and for biofuels in the transportation sector

**is a biogasoline

CANADIAN RENEWABLE ELECTRICITY GENERATING CAPACITY



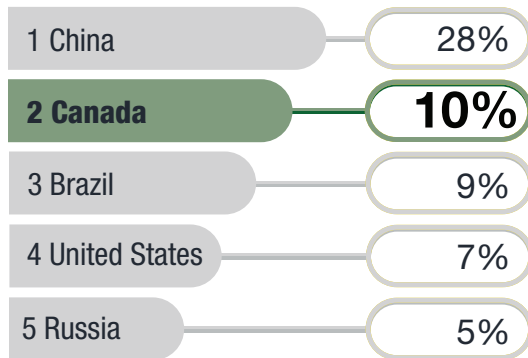
HYDROELECTRICITY



Moving water is the most important renewable energy source in Canada, providing **60%** of Canada's electricity generation. In fact, in 2017, Canada was the second-largest producer of hydroelectricity in the world.

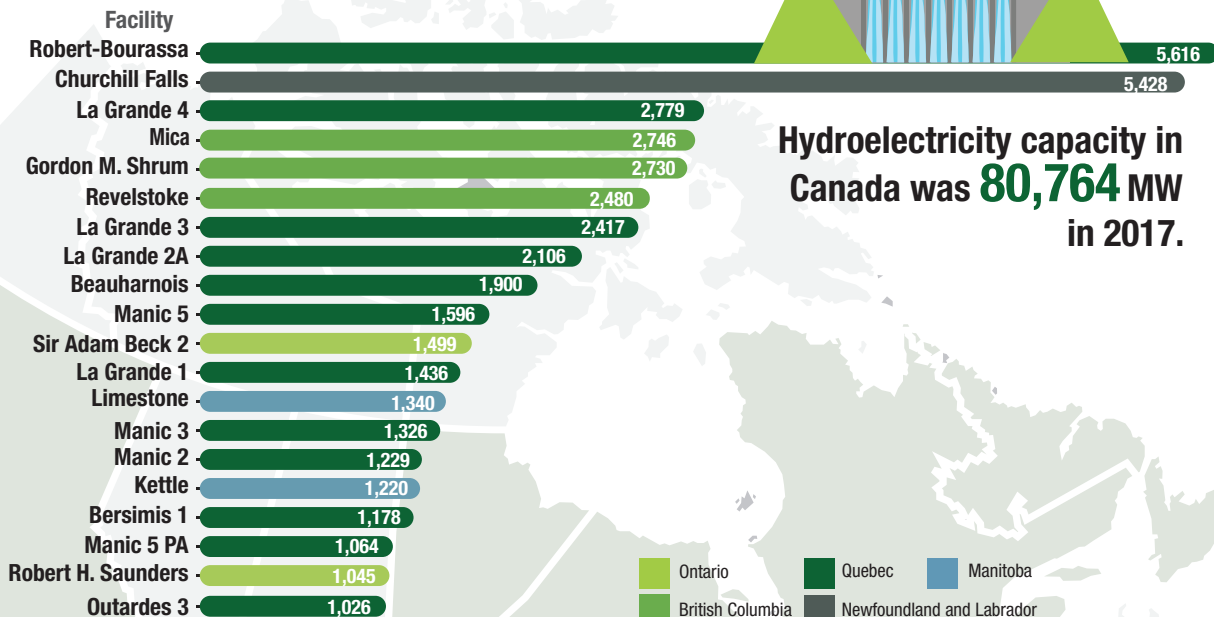
INTERNATIONAL CONTEXT HYDROELECTRICITY

World generation of hydroelectricity – 4,082 TWh
(2017)



HYDROELECTRICITY CAPACITY IN CANADA

MAJOR HYDRO FACILITIES IN CANADA* ($\geq 1,000$ MW)



*There are 518 facilities with a capacity of at least 1 MW and 45 facilities with less than 1 MW of capacity, for a total of 563 facilities.

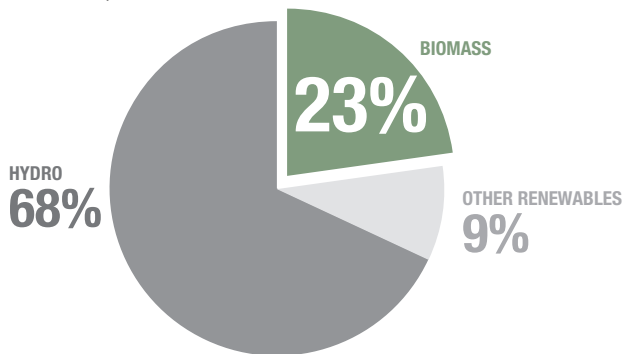
BIOMASS

- Biomass is a renewable energy resource derived from living organisms and/or their by-products.
- In 2017 there were **36 operational** co-generation units at pulp and paper mills and **41 Independent Power Providers (IPP)** using biomass.
- Electrical capacity of pulp and paper co-generation was **3,427 MW**, while heat capacity was **1,384 MW**. IPP capacity for electricity and heat was **794 MW** and **400 MW**, respectively.
- There are also **364 bioheat projects**, of which **70%** are less than **1 MW**. Institutions, including schools and hospitals, are the strongest market for bioheat in Canada.

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

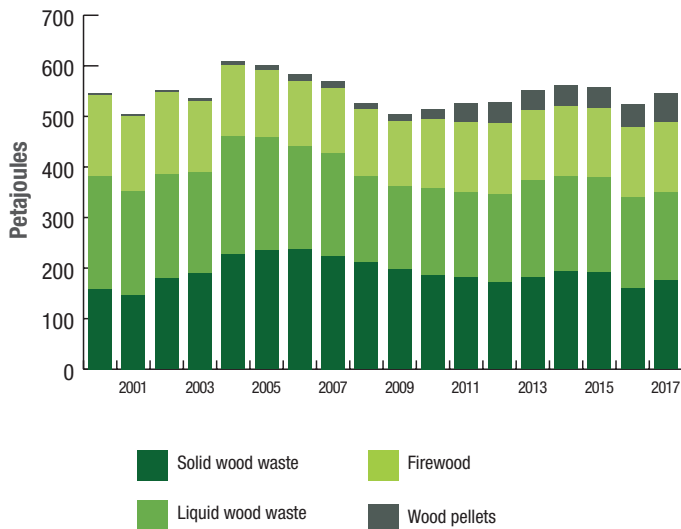


In Canada, that share is

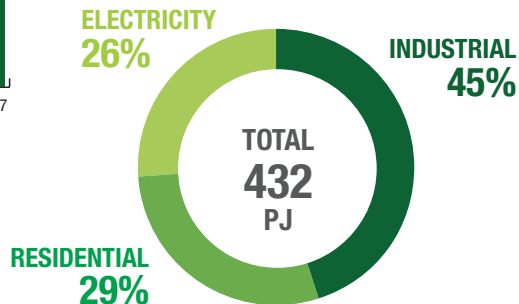


CANADIAN PRODUCTION

CANADIAN PRODUCTION OF BIOMASS, 2017



WOOD FUEL USE BY SECTOR, 2016

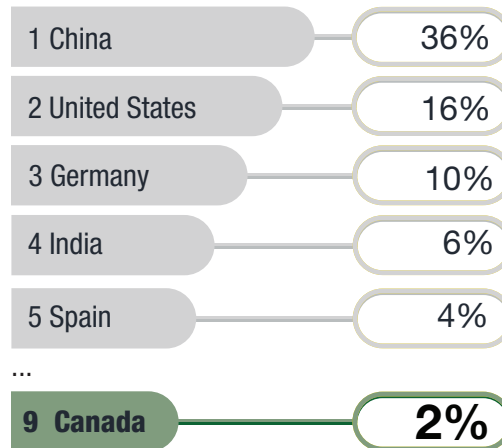


WIND POWER

- Electricity from wind energy is one of the **fastest growing sources** of electricity in the world and in Canada.
- Wind accounts for **4%** of electricity generation in Canada.

INTERNATIONAL CONTEXT WIND POWER

World capacity of wind power – 591,549 MW
(2018)



WIND POWER IN CANADA

Capacity (2018):

12,817 MW

more than
tripled



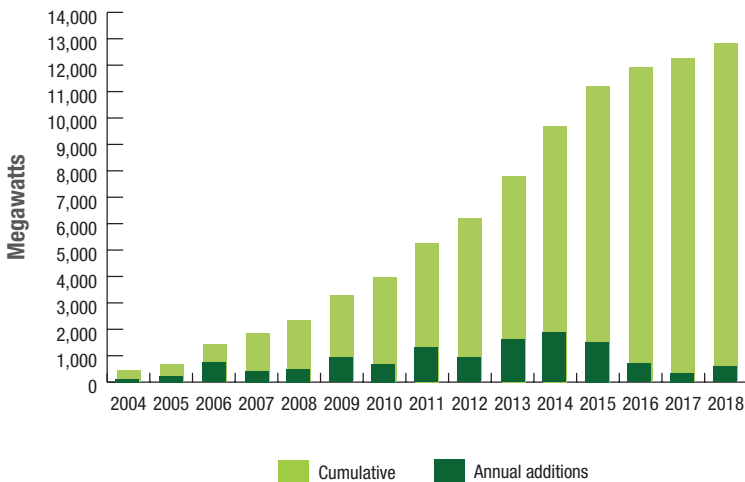
Generation (2017):

28.8 TWh

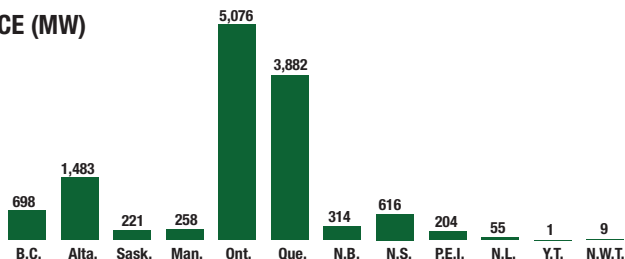
more than
tripled



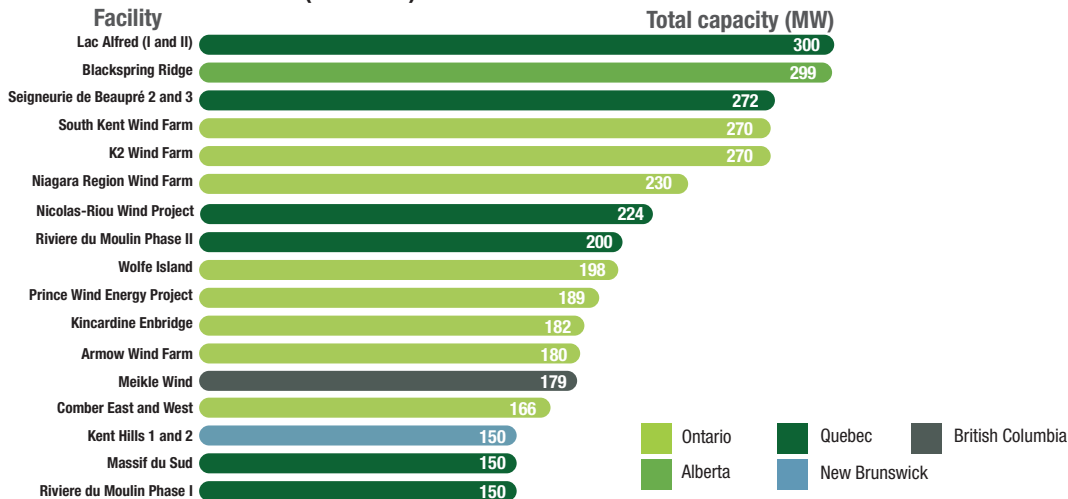
INSTALLED CAPACITY



CAPACITY BY PROVINCE (MW)



LARGEST WIND FARMS IN CANADA* (≥150 MW)



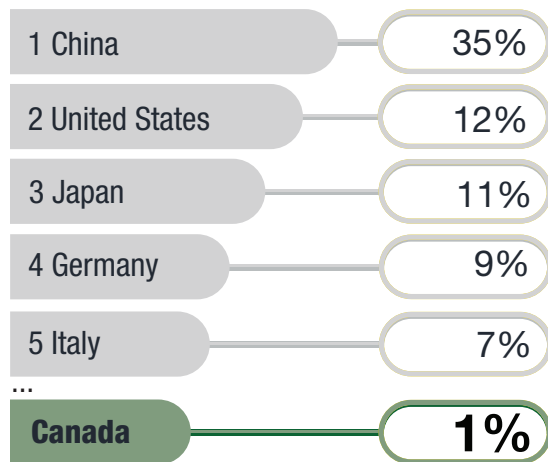
*There are 246 facilities in Canada with a capacity of at least 1 MW and 16 facilities with less than 1 MW of capacity, for a total 273 wind facilities.

SOLAR PHOTOVOLTAIC

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

INTERNATIONAL CONTEXT SOLAR PHOTOVOLTAIC

World capacity of solar PV – 505 GW (2018)

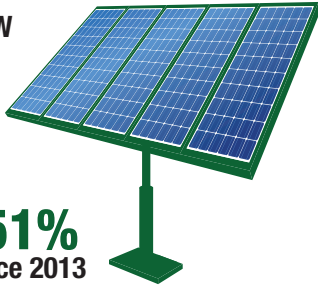


SOLAR PV IN CANADA

Capacity (2018):

3,040 MW

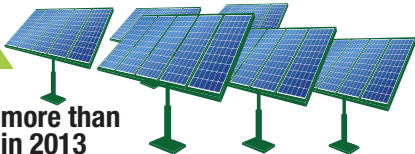
up **151%**
since 2013



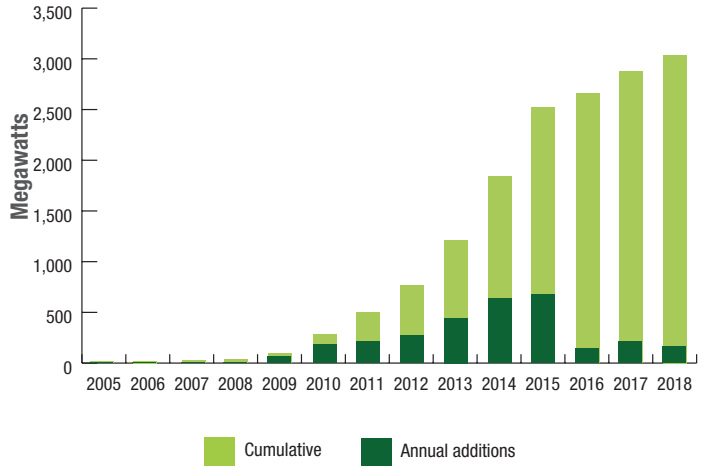
Generation (2017):

2.9 TWh

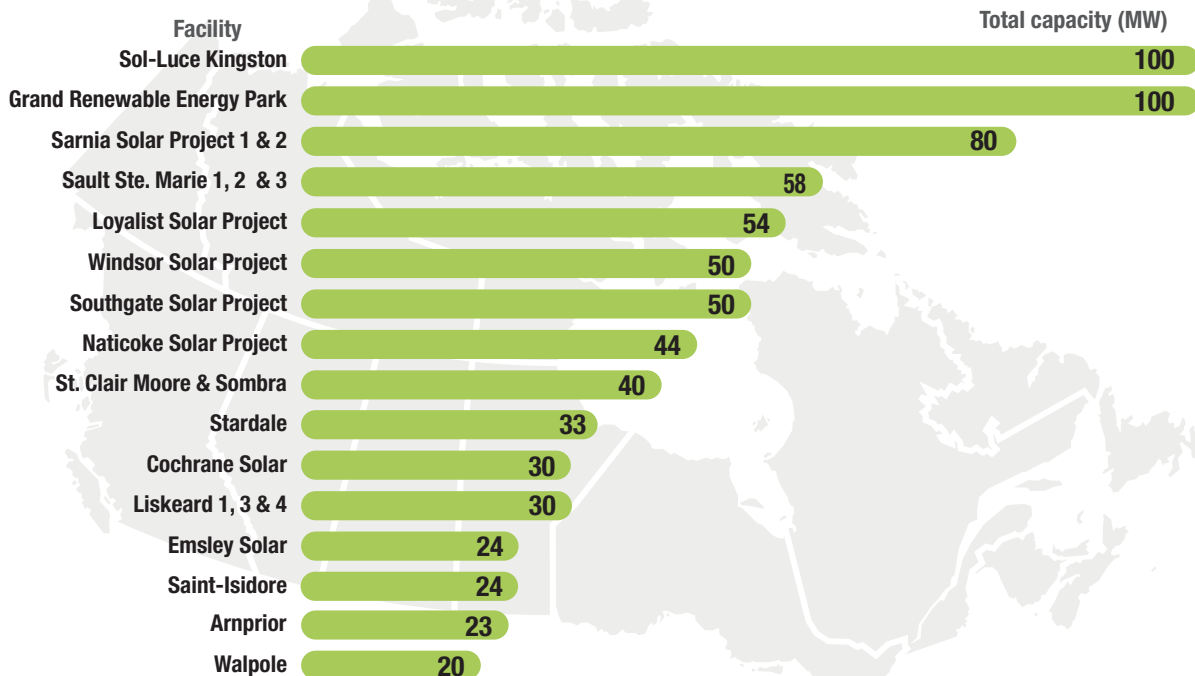
8x
more than
in 2013



INSTALLED CAPACITY



SOME OF THE LARGEST SOLAR PV FARMS IN CANADA* (≥ 20 MW)



* There are 138 solar PV farms in Canada with a capacity of at least 1 MW, totaling over 1,700 MW.

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.*

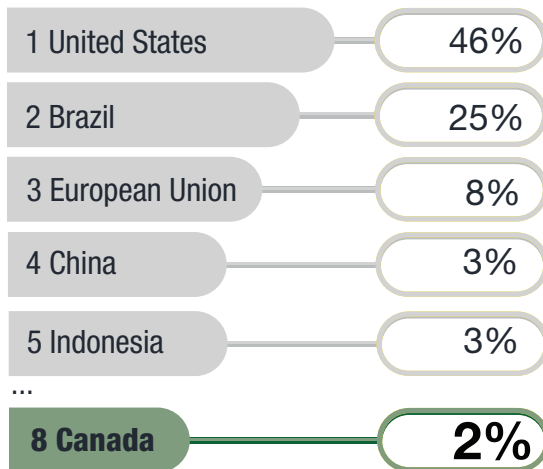
* Heating distillate oil volumes for space-heating purposes are excluded from the diesel regulations.

INTERNATIONAL CONTEXT

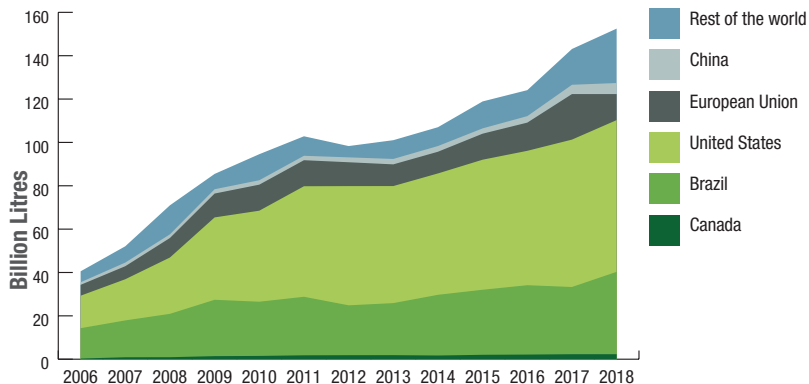
LIQUID BIOFUELS

World capacity of biofuels – 153.2 billion litres

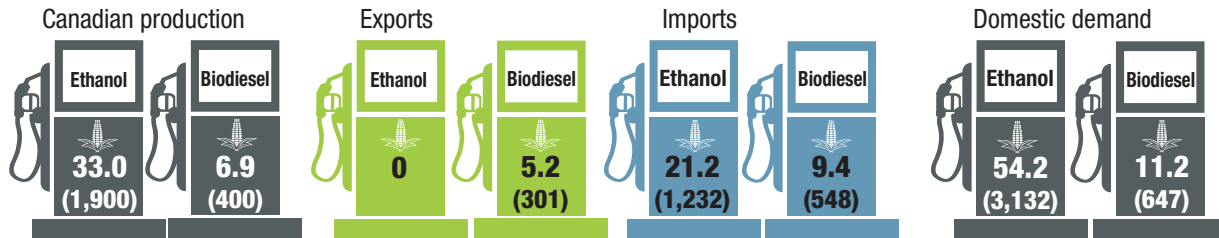
(2018)



WORLD BIOFUELS PRODUCTION



CANADIAN SUPPLY AND DEMAND (2018) (Mb/d [million L])

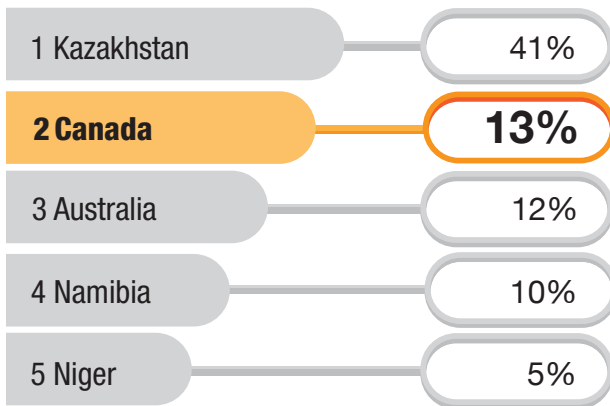




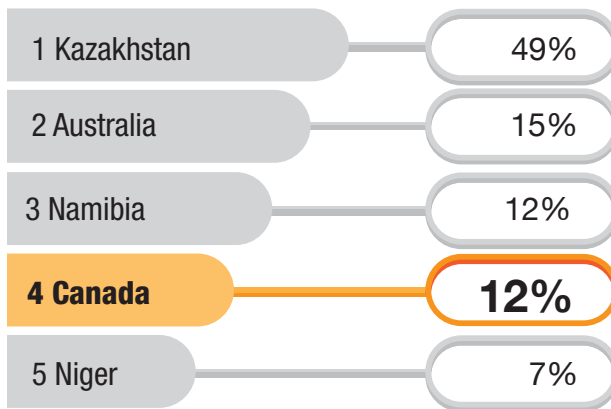
URANIUM AND NUCLEAR POWER

URANIUM

World production – 53.5 kt (2018)



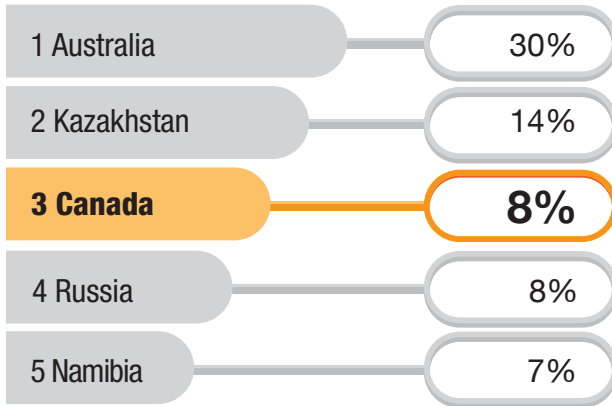
World exports – 44.4 kt (2018)



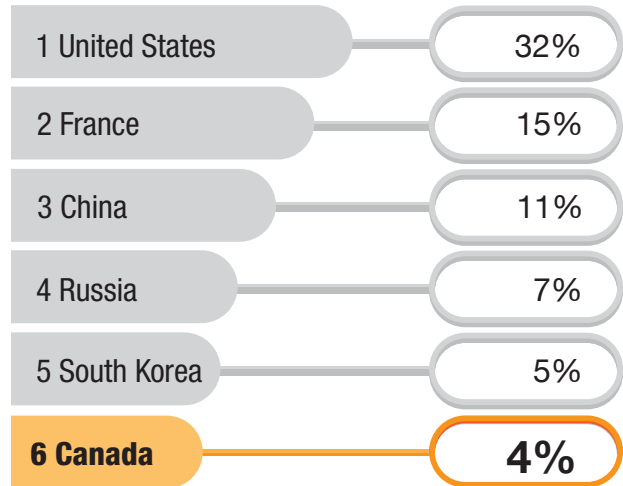
INTERNATIONAL CONTEXT

NUCLEAR POWER

World known recoverable resources – 6.1 Mt (2017)



World generation – 2,563 TWh (2018)



CANADIAN SUPPLY AND DEMAND (2018)

URANIUM

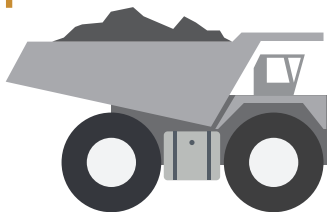
Canadian production **7.0 kt**

All uranium comes from mines in Saskatchewan.

ANNUAL VALUE

about

\$900 million



EXPORTS: 76% of production

Based on long-term contracts*, uranium from Canadian mines is generally sold in

- 1) Asia **42%**
- 2) North America/Latin America **41%**
- 3) Europe **16%**

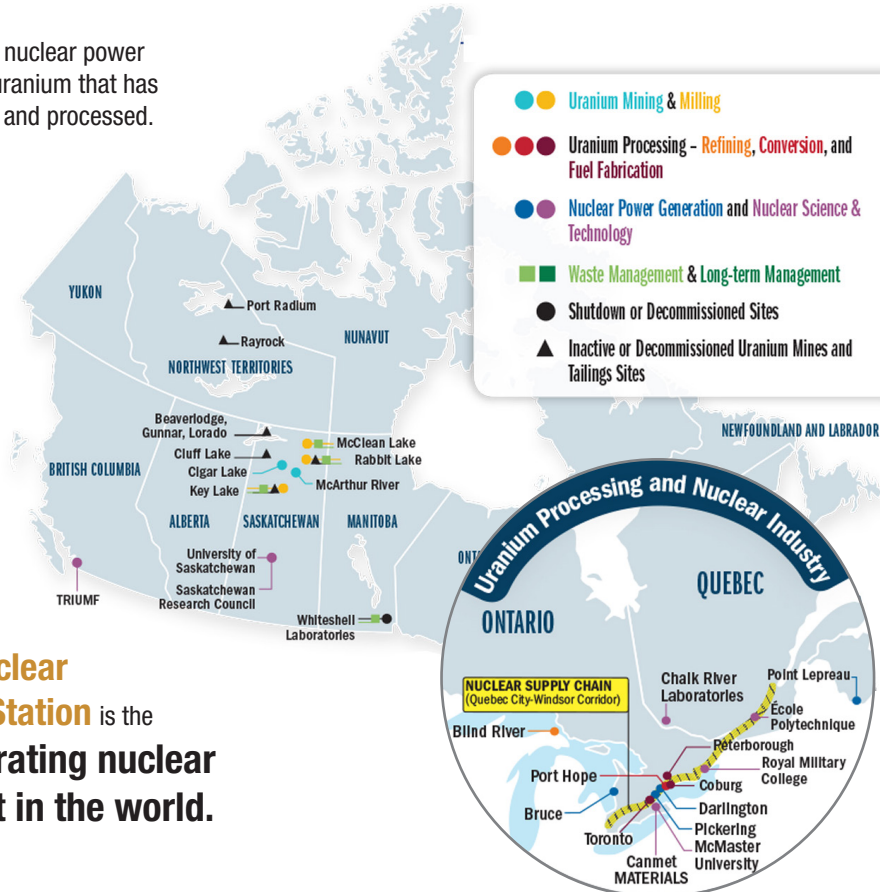
* These values can vary based on changes in regional demand.

24% of uranium purchased by U.S. nuclear reactors in 2018 came from Canada, making Canada the largest foreign supplier of uranium to the U.S.

DOMESTIC USE: 24% of production

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

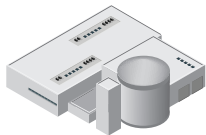
Across the country, nuclear power is generated from uranium that has been mined, milled and processed.



The **Bruce Nuclear Generating Station** is the largest operating nuclear power plant 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.



10 CANDU reactors are in operation outside of Canada.



GROSS CAPACITY OF NUCLEAR POWER PLANTS IN CANADA

| Facility | Province | Total capacity (MW) | Units |
|---------------|---------------|---------------------|-------|
| Darlington | Ontario | 3,512 | 4 |
| Bruce A | Ontario | 3,220 | 4 |
| Bruce B | Ontario | 3,390 | 4 |
| Pickering A | Ontario | 1,084 | 2 |
| Pickering B | Ontario | 2,160 | 4 |
| Point Lepreau | New Brunswick | 705 | 1 |

URANIUM - PRICES



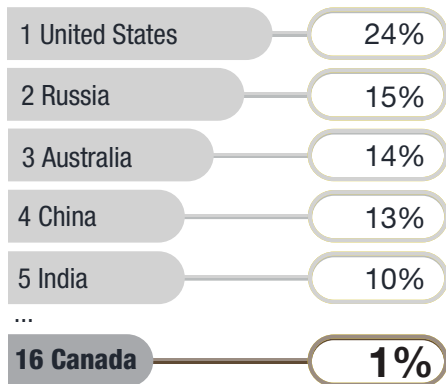
* The majority of Canadian uranium production is sold by long-term contract, as opposed to the on the spot market.



COAL

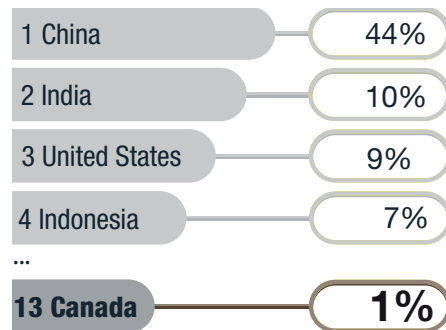
COAL

World proved reserves – 1,055 BILLION TONNES (2018)



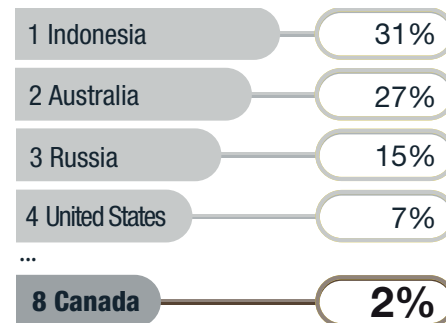
World production – 7.6 BILLION TONNES

(2018, PRELIMINARY)



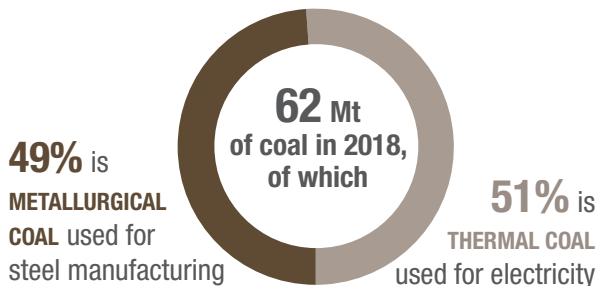
World exports – 1.4 BILLION TONNES

(2018, PRELIMINARY)

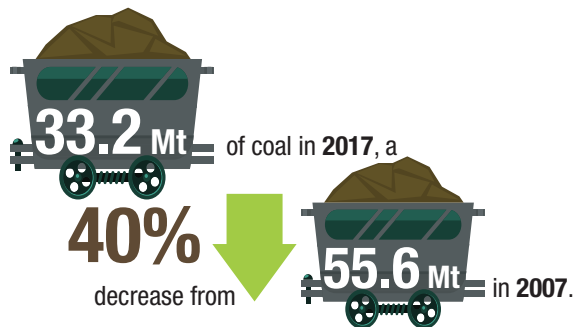


PRODUCTION AND USE

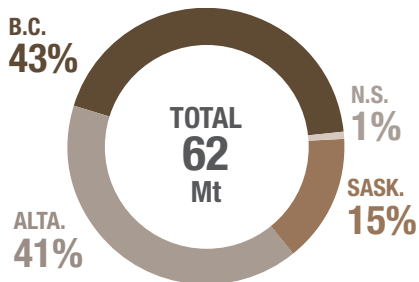
Canada produced



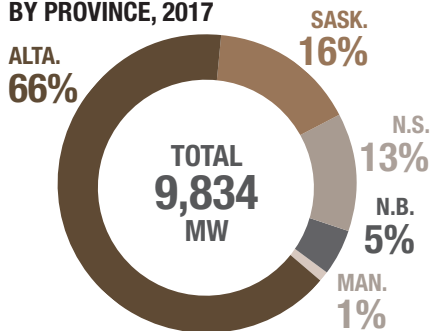
Electricity generation consumed



COAL PRODUCTION BY PROVINCE, 2018



COAL-FIRED GENERATING CAPACITY BY PROVINCE, 2017



DOMESTIC DEMAND



Mostly for electricity generation in Alberta and Saskatchewan



Also for metallurgical applications



TRADE

CANADIAN TRADE OF COAL



Canada's exports are primarily metallurgical coal (**97%** in 2018).

U.S. coal exports have increased **92%** over the last two years, reaching **115.6 Mt** in 2018. Metallurgical coal accounted for **53%** of U.S. exports.

TRADE (2018)

EXPORTS



26% South Korea
22% Japan
13% India

3% of Canadian exports are to the U.S.,



representing **13%** of U.S. coal imports.

IMPORTS



69% 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 | HST | Harmonized sales tax |
| B | billion | IEA | International Energy Agency |
| b/d | barrels per day | kg | kilogram |
| Bcf/d | billion cubic feet per day | km | kilometre |
| Bcm/d | billion cubic metres per day | km ² | square kilometre |
| CANDU | Canada deuterium uranium | kt | kilotonne |
| CCS | carbon capture and storage | kWh | kilowatt hour |
| CCUS | carbon capture, utilization and storage | lb. | pound |
| CDIA | Canadian direct investment abroad | L | litre |
| CEA | Canadian energy assets | LCOE | levelized cost of electricity |
| CO ₂ equivalent | carbon dioxide equivalent | LNG | liquefied natural gas |
| CPI | consumer price index | LPG | liquefied petroleum gases |
| CPL | cents per litre | LWR | light water reactor |
| ECTPEA | Environmental and Clean Technology Products Economic Account | m | metre |
| EIA | Energy Information Administration (U.S.) | m ² | square metre |
| EU | European Union | m ³ | cubic metre |
| FDI | foreign direct investment | Mb/d | thousand barrels per day |
| G7 | seven wealthiest major developed nations: Canada, France, Germany, Italy, Japan, U.K. and U.S. | MJ | megajoule |
| GDP | gross domestic product | MMb/d | million barrels per day |
| GHG | greenhouse gas | MMcf/d | million cubic feet per day |
| GJ | gigajoule | MMbtu | million British thermal units |
| GST | Goods and Services tax | Mt | million tonnes; megatonne |
| GWh | gigawatt hours | Mtoe | million tons of oil equivalent |
| HGL | hydrocarbon gas liquids | MW | megawatt |
| | | NEB | National Energy Board |
| | | NGL | natural gas liquids |

| | | | |
|-----------|---|------|---|
| 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 | | |
| P/T | provincial/territorial | | |
| PV | photovoltaic | | |
| RD&D | research, development and demonstration | | |
| R&D | research and development | | |

ANNEX 3: SOURCES

1. ENERGY AND THE ECONOMY

- **Global Primary Energy Production:** IEA Annual Database
- **Global Energy Rankings:** IEA Annual Database
- **Canadian Energy Production:** Statistics Canada tables 25-10-0020-01, 25-10-0029-01 and 25-10-0007-01 and NRCan estimates
- **Global Trade:** Statistics Canada International Merchandise Trade Database and IEA Annual Database
- **Canada-United States Trade:** Statistics Canada International Merchandise Trade Database and United States EIA (U.S. Imports by Country of Origin)
- **GDP:** Statistics Canada tables 38-10-0285-01, 36-10-0221-01, 36-10-0103-01 and 36-10-0400-01 and NRCan estimates
- **Government Revenue:** Statistics Canada Table 33-10-0006-01, Statistics Canada special tabulation (royalties) and Canadian Association of Petroleum Producers, *Statistical Handbook*, Table 01-01C (Crown land sales Western Canada and Canada lands)
- **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 special tabulation and NRCan estimates
- **Capital expenditures:** Statistics Canada tables 34-10-0035-01, 34-10-0036-01 and 34-10-0040-01
- **Foreign Direct Investment and Canadian Direct Investment Abroad:** Statistics Canada Table 36-10-0009-01
- **Foreign control:** Statistics Canada tables 33-10-0033-01, 33-10-0005-01 and 33-10-0006-01
- **Canadian Energy Assets:** compiled by NRCan from the S&P Capital IQ

- **Canadian Expenditures on Energy RD&D:** IEA Data Services (Data analysis performed by NRCan using the IEA Energy RD&D survey results for public expenditures) and Statistics Canada (Annual Survey of R&D in Canadian Industry, energy-related R&D by area of technology for industry expenditures, data analysis performed by NRCan using internal data provided by Statistics Canada)
- **Clean Energy and Tech Investment:** Bloomberg New Energy Finance, TSX and TYSX-V, Statistics Canada, Environmental and Clean Technology Products Economic Account and The Market Intelligence Group report
- **Household expenditures:** Statistics Canada Table 11-10-0222-01
- **Consumer prices:** Statistics Canada tables 18-10-0004-01 and 18-10-0001-01

2. ENERGY AND GHGS

- **Global Emission Sources:** Environment and Climate Change Canada (National Inventory Report), Statistics Canada Table 36-10-0434-01 and World Resources Institute (CAIT - Country Greenhouse Gas Emissions Data)
- **GHG Overview:** Environment and Climate Change Canada (National Inventory Report) and World Resources Institute (CAIT - Country Greenhouse Gas Emissions Data)
- **Coal Phase Out:** IEA World Annual Balances
- **Oil and Gas emissions intensity:** Environment and Climate Change Canada (National Inventory Report)

- **Electricity GHG:** Environment and Climate Change Canada (Environmental Indicators: Greenhouse Gas Emissions by Canadian Economic Sector 1990 to 2016)
- **Non-emitting electricity share:** World Bank (Sustainable Energy for All database Global Tracking Framework)
- **Solar and Wind Generation:** IEA Annual Database
- **Transportation GHG:** Environment and Climate Change Canada (Environmental Indicators: Greenhouse Gas Emissions by Canadian Economic Sector 1990 to 2016)
- **Transportation Fuel Mix:** Office of Energy Efficiency's National Energy Use Database
- **Electric Vehicle Sales:** Green Car Reports and Bloomberg New Energy Finance
- **Province and Territory GHG Emissions:** Environment and Climate Change Canada (Environmental Indicators: Greenhouse Gas Emissions by Province and territory 1990 to 2016) and Statistics Canada Table 17-10-0005-01
- **Total primary energy supply:** IEA Annual Database, World Energy Balances and IEA Standing Group on Long-Term Co-operation questionnaire
- **Primary and secondary energy use:** Office of Energy Efficiency's National Energy Use Database
- **Energy efficiency:** Office of Energy Efficiency's National Energy Use Database and NRCan (*Energy Efficiency Trends in Canada 1990 to 2015*)
- **Energy intensity:** Office of Energy Efficiency's National Energy Use Database
- **Energy in our daily lives:** NRCan (*Energy Efficiency Trends in Canada 1990 to 2015*)

- **Residential Energy Use, water heating and space heating:** Office of Energy Efficiency's National Energy Use Database and NRCan estimates
- **Residential, commercial and institutional sector:** Office of Energy Efficiency's National Energy Use Database
- **Trends in Energy Use and Intensity:** Office of Energy Efficiency National Energy Use Database (Efficiency Trends Analysis tables)
- **Transition to a low-carbon future:** Pan-Canadian Framework on Clean Growth and Climate Change and Environment and Climate Change Canada (National Inventory Report)
- **Carbon Price:** The World Bank Carbon Pricing Dashboard

3. CRUDE OIL

- **World production and exports:** IEA Online Data Services
- **World proved reserves:** *Oil and Gas Journal* (Worldwide Look at Reserves and Production)
- **Canadian resources:** Canadian Association of Petroleum Producers *Statistical Handbook* tables 2.6 (Crude Oil Remaining Established Reserves) and 2.1a (Crude Reserves) Alberta Energy Regulator ST98 (Alberta's Energy Reserves and Supply/Demand Outlook), tables R4.5 (Conventional crude oil reserves as of each year-end), R3.2 (Reserve and production change highlights) and 1 (Resources, reserves and production summary)
- **Wells completed and metres drilled in western Canada:** Canadian Association of Petroleum Producers, *Statistical Handbook*, Table 1.2 (2017 Drilling activity)
- **Canadian & provincial production:** Statistics Canada tables 25-10-0014-01 and 25-10-0063-01 and NRCan analysis

- **Canadian supply and demand:** Statistics Canada tables 25-10-0014-01, 25-10-0063-01, 25-10-0041-01 and 25-10-0039-01 and Statistics Canada International Merchandise Trade Database
- **Trade:** Statistics Canada tables 25-10-0014-01 and 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)
- **Prices:** United States EIA tables (Spot Prices for Crude Oil) and Sproule
- **Oil sands:** Canadian Association of Petroleum Producers, *Statistical Handbook*, Table 4-16B (Canada Oil Sands Expenditures), Statistics Canada tables 34-10-0036-01, 25-10-0014-01 and 25-10-0063-01, Alberta Energy Regulator ST98 (Alberta's Energy Reserves and Supply/Demand Outlook) table S3.1 (Crude bitumen production), Canada's Oil Sands Innovation Alliance, CanOils Database and NRCan analysis
- **Light tight Oil/Shale Oil:** United States EIA (World Shale Gas Resources, Technically Recoverable Shale Oil Resources)
- **Reserves by provinces:** Alberta Energy Regulator ST98 (Alberta's Energy Reserves and Supply/Demand Outlook) tables R4.1 (Reserves and production changes in crude oil) and R4.5 (Conventional crude oil reserves as of each year-end), Canadian Association of Petroleum Producers, *Statistical Handbook*, Table 2.1a (Crude Reserves) and NEB
- **Environmental considerations:** NRCan compiled using Environment and Climate Change Canada (National Inventory Report 1990 to 2016: 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)

- **Pipelines:** compiled by NRCan
- **Transportation:** Statistics Canada table 23-10-0216-01, Canadian Association of Petroleum Producers (Crude Oil Forecast, Markets & Transportation), Oil Sands Magazine (Crude-By-Rail Loading & Offloading Terminals), NEB (Featured articles, Canadian Crude Oil Exports by Rail – Quarterly Data) and various sources
- **Key Facts:** CanOils Database

4. PETROLEUM PRODUCTS

- **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)
- **Canadian supply and demand:** Statistics Canada tables 25-10-0042-01 and 25-10-0044-01 and NRCan analysis
- **Refineries crude supply:** Statistics Canada table 25-10-0063-01
- **Sales by Product:** Statistics Canada table 25-10-0044-01 and NRCan analysis
- **Trade:** Statistics Canada table 25-10-0044-01, United States EIA (U.S. Imports by Country of Origin for Petroleum and Other Liquids) and Statistics Canada International Merchandise Trade Database
- **Gasoline prices:** Kent Group Ltd (average retail prices for regular gasoline and diesel fuel) and data compiled by NRCan
- **Refinery capacity:** compiled by NRCan

5. HYDROCARBON GAS LIQUIDS

- **Canadian supply and demand:** Statistics Canada tables 25-10-0044-01 and 25-10-0036-01, NEB (Exports) and Statistics Canada International Merchandise Trade Database (Imports)
- **Production by province:** Canadian Association of Petroleum Producers, *Statistical Handbook*, tables 3.5 (Canadian Propane Production), 3.6 (Canadian Butane Production), and 3.14 (Canadian Ethane Production) and Statistics Canada table 25-10-0042-01
- **Natural gas liquids energy use:** Office of Energy Efficiency's National Energy Use Database

6. NATURAL GAS

- **World production and exports:** IEA (Natural Gas Information)
- **World proved reserves:** *Oil and Gas Journal*
- **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 reserves:** Canadian Association of Petroleum Producers *Statistical Handbook* table 2-13b (Marketable Natural Gas Remaining Established Reserves in Canada at Year End)
- **United States reserves:** United States EIA (Natural Gas Reserves Summary, dry gas)
- **Canada resources and technically recoverable resources:** NEB (Short-term Canadian natural gas deliverability 2014 to 2016 and *Canada's Energy Future 2017: Energy Supply and Demand Projections to 2040*)
- **United States resources and technically recoverable resources:** United States EIA (Technically Recoverable Shale Oil and Shale Gas Resources, June 2013, US total)
- **Shale gas and Tight Gas:** United States EIA (World Shale Resource Assessments, Technically Recoverable Shale Gas Resources) Table 6 (Technically Recoverable Shale Gas Resources) and NEB (*Canada's Energy Future 2017: Energy Supply and Demand Projections to 2040*)
- **Canada-United States market:** compiled by NRCan from Statistics Canada, United States EIA (US Natural Gas Imports by Country), NEB (Natural Gas Imports, Exports and Liquefied Natural Gas Statistics, Commodity Statistics for LNG imports, LNG Shipment Details)
- **Wells completed and metres drilled in Canada:** Daily Oil Bulletin (Wells Completions – Annual Breakdown by Province and Wells Counts and Metres Drilled – Western Canada) and Canadian Association of Petroleum Producers, *Statistical Handbook*, Table 1.2 (Drilling activity)
- **Canadian and provincial production:** Statistics Canada tables 25-10-0047-01 and 25-10-0055-01, NEB (Short term Canadian Natural Gas Deliverability 2014 to 2016)
- **United States production:** United States EIA (Annual energy Outlook) tables (Natural Gas Gross Withdrawals and Production, Natural Gas by Country Imports, Exports & LNG Statistics)
- **North American LNG imports:** International Gas Union (IGU World Gas LNG Report, 2018 edition) Table 3.2 (LNG Trade Volumes Between Countries)
- **Trade:** NEB (Natural Gas Imports, Exports and Liquefied Natural Gas Statistics, Commodity Statistics for Pipeline Trade Gas Monthly Summary for the Year), United States EIA (Natural Gas Consumption by End Use), Statistics Canada International Merchandise Trade Database and calculations by NRCan

- **Prices:** Sproule Price Forecast
- **Pipelines:** compiled by NRCan
- **Natural gas energy use:** Office of Energy Efficiency
- **Consumption:** Statistics Canada Table 25-10-0030-01 and IEA Annual Mini-Questionnaire

7. 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:** NEB Table (Electricity Exports and Imports Statistics), Statistics Canada and United States EIA Table 5.1 (Retail Sales of Electricity to Ultimate Customers)
- **Canadian and provincial supply:** compiled by Statistics Canada and NRCan’s Electricity Division from various sources
- **Domestic demand:** Statistics Canada Table 25-10-0030-01
- **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:** Canadian Energy Research Institute, Study No. 168. A Comprehensive Guide to Electricity Generation Options in Canada.
- **World capacity:** United Nations *Energy Statistics Yearbook*, Table 32 (Net installed capacity of electric generating plants)

8. RENEWABLE ENERGY

- **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:** Statistics Canada Table 25-10-0022-01 and compiled by NRCan
- **Hydro – facilities and projects:** compiled by NRCan from Statistics Canada and other public sources
- **Wood and wood waste – Renewable balance:** IEA database (Renewables balances)
- **Wood and wood waste – production:** Statistics Canada Table 25-10-0031-01, Statistics Canada International Merchandise Trade Database and NRCan
- **Wood and wood waste – wood fuel use by sector:** IEA (Renewables Information)
- **Wood and wood waste – trade:** Statistics Canada International Merchandise Trade Database
- **Wind – international context:** Global Wind Energy Council (Global Wind Report)
- **Wind – capacity in Canada:** compiled by NRCan from multiple sources (Canadian Wind Energy Association, Statistics Canada and NRCan)
- **Wind – generation in Canada:** Statistics Canada Table 25-10-0020-01
- **Wind – wind farms:** compiled by NRCan from Statistics Canada data and other public sources (including Canadian Wind Energy Association)
- **Solar PV – international context:** Renewable Energy Policy Network for the 21st Century (*Renewables 2018 Global Status Report*)

- **Solar PV – capacity in Canada:** IEA (Canada's Annual Report to the IEA Implementing Agreement on PV and 2018 Snapshot of Global Photovoltaic Markets) and compiled by NRCan
- **Solar PV – solar PV farms:** compiled by NRCan from Statistics Canada data and various public sources
- **Solar PV – generation in Canada:** Statistics Canada Table 25-10-0020-01
- **Biofuels – production:** Bloomberg New Energy Finance, F.O. Licht, Food and Agricultural Policy Research Institute, NRCan, United States EIA and Environment and Climate Change Canada
- **Ethanol – production:** United States EIA and Bloomberg New Energy Finance
- **Biofuels – supply and demand :** Data compiled by NRCan from various public sources (Bloomberg New Energy Finance, F.O. Licht, Food and Agricultural Policy Research Institute, Environment and Climate Change Canada [2016 Biodiesel Production from Industry Representatives])
- **Biofuels/ethanol – imports/exports:** Statistics Canada data and Statistics Canada International Merchandise Trade Database
- **Biofuels – ethanol prices:** Haver Analytics, Office of Energy Efficiency and Chicago Ethanol Market Price
- **Biofuels – regulations:** compiled by Office of Energy Efficiency from various public sources

9. URANIUM AND NUCLEAR POWER

- **World production and exports:** World Nuclear Association (World Uranium Mining) and NRCan estimate based on World Nuclear Association production data
- **World known recoverable resources of uranium:** World Nuclear Association (Supply of Uranium) and OECD Nuclear Energy Agency and International Atomic Energy Agency
- **Nuclear power world generation:** United States EIA (International Energy Statistics) table (Nuclear Electricity Net Generation), International Atomic Energy Agency, OECD, and Nuclear energy agency
- **Canadian supply and demand:** World Nuclear Association (Uranium in Canada), Cameco Annual report and compiled by NRCan from company information
- **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)
- **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:** UX Consulting Company provided by NRCan Uranium and Radioactive Waste Division

10. COAL

- **World proved reserves:** World Energy Council (BP statistical review of world energy)
- **World production and exports:** IEA (Coal Information and world energy balances)
- **Canadian supply and demand:** Statistics Canada International Merchandise Trade Database
- **Coal by province:** Statistics Canada tables 25-10-0046-01 and 25-10-0017-01 and NRCan estimates
- **Coal-fueled power plants:** compiled by NRCan from Statistics Canada Table 57-206 and other public sources

CANADIAN CENTRE FOR ENERGY INFORMATION

CCEI

Canadian Centre for Energy Information



The purpose of the Canadian Centre for Energy Information (CCEI) is to provide a convenient one-stop shop for information on Canada's energy future. The CCEI will present energy information in a way that is easy for a wide range of data users to understand. It will integrate data from federal, provincial and territorial sources across Canada.

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