

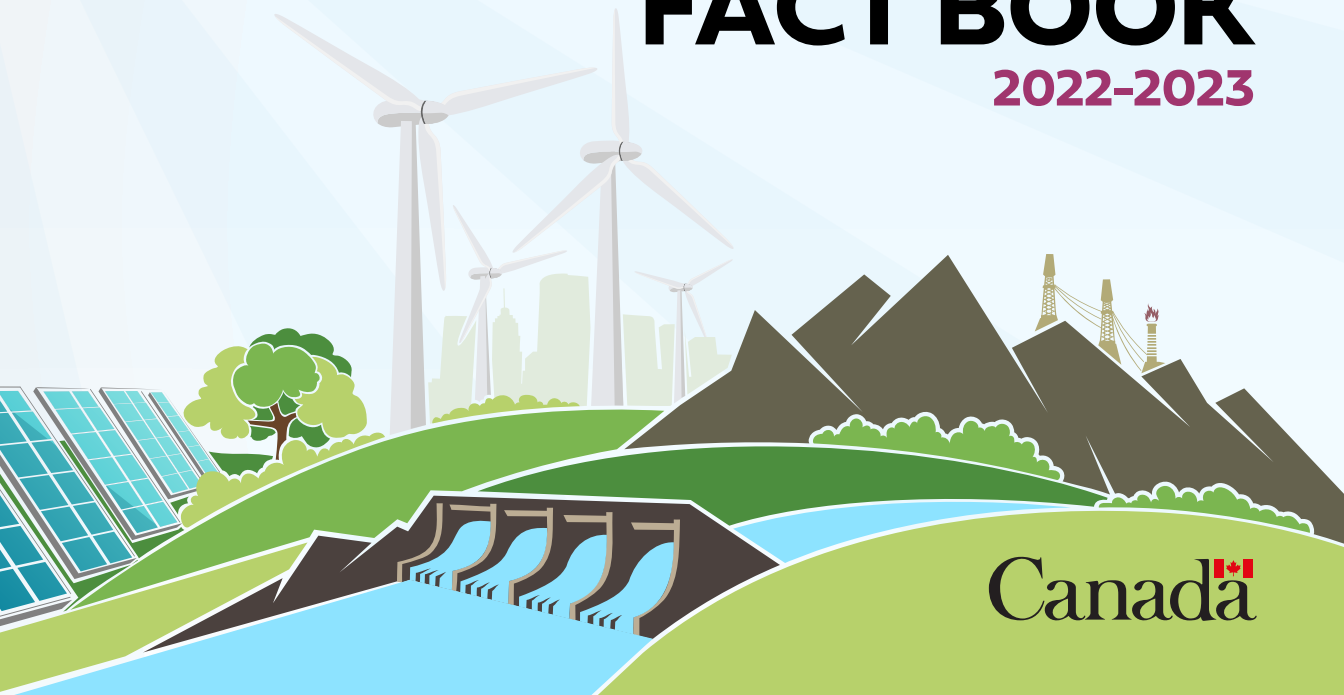


Natural Resources  
Canada

Ressources naturelles  
Canada

# ENERGY FACT BOOK

2022-2023



Canada





Natural Resources  
Canada

Ressources naturelles  
Canada

# ENERGY **FACT BOOK** **2022–2023**

Canada

*Aussi disponible en français sous le titre : Cahier d'information sur l'énergie, 2022-2023*

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## PREFACE

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

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

This publication was assembled by the Energy and Economic Analysis Division of the Energy Policy and International Affairs 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](mailto: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. The petroleum sector is a subset of these industries, and in this publication consists of oil and gas extraction and support activities, pipeline transportation and distribution of oil and gas, and petroleum refineries.

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



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## INTRODUCTION

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

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

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

# Section 6:

## Oil, natural gas and coal

**Crude oil**

**Natural gas**

**Hydrocarbon gas liquids (HGLs)**

**Refined petroleum products (RPPs)**

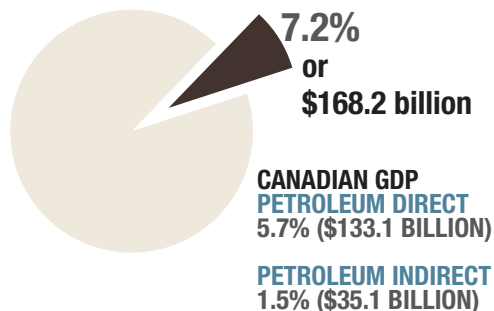
**Coal**

**GHG Emissions from petroleum**

# PETROLEUM AND THE ECONOMY

## NOMINAL GDP CONTRIBUTION FOR CANADA, 2021

NOMINAL GDP (% OF CURRENT DOLLARS)



- Capital Expenditures (2021): **\$42 billion**
- Canada's oil and gas sector represents about **27%** of the country's GHG emissions.
- Exports (2021): **\$140 billion** (29% of total exports)

## EMPLOYMENT, 2021

**DIRECT: 163,700 JOBS**

OIL AND GAS EXTRACTION:	54,400
SUPPORT ACTIVITIES:	58,300
EXPLORATION:	7,700
NATURAL GAS TRANSMISSION AND DISTRIBUTION:	13,100
CRUDE OIL PIPELINES:	4,000
OTHER:	26,100

**INDIRECT: 278,400 JOBS**

**TOTAL: 442,100 JOBS**

Approximately  
**10,400 Indigenous  
people** are employed in  
the oil and gas sector.



**4<sup>TH</sup>** Largest oil producer globally

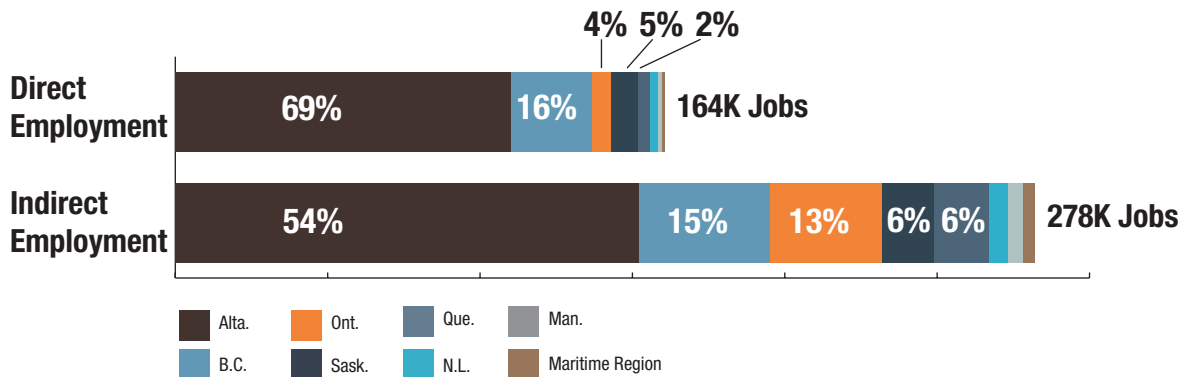
**5<sup>TH</sup>** Largest gas producer globally

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

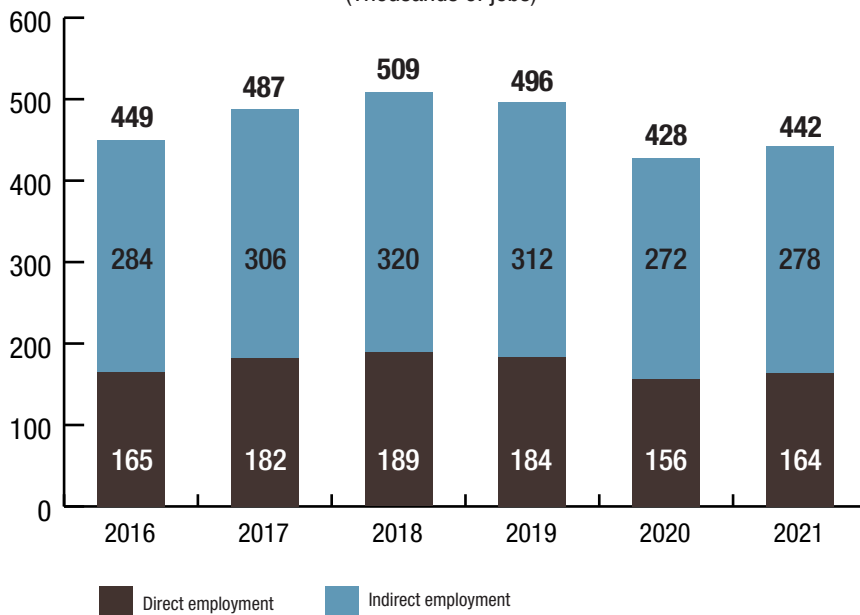
While Canada's petroleum sector **directly employed 163.7K people** in 2021, the sector's use of inputs from other industries created an additional

## 278K indirect jobs in the supply chain.

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



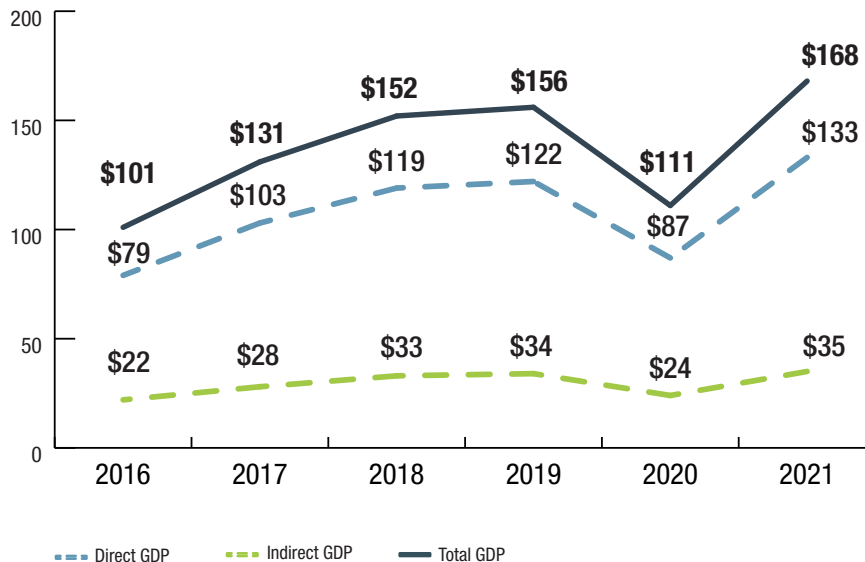
## PETROLEUM EMPLOYMENT (Thousands of jobs)



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



# **PETROLEUM GDP** (Billions of Canadian Dollars)

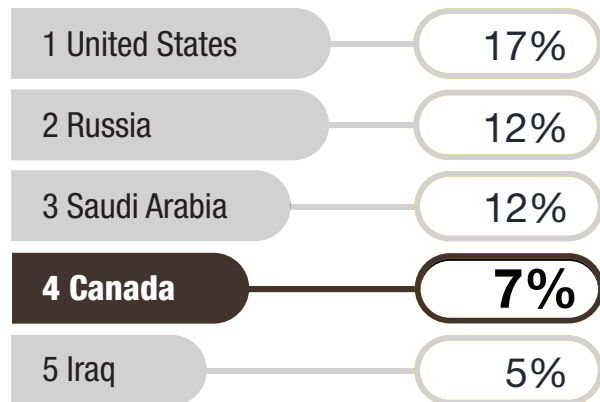


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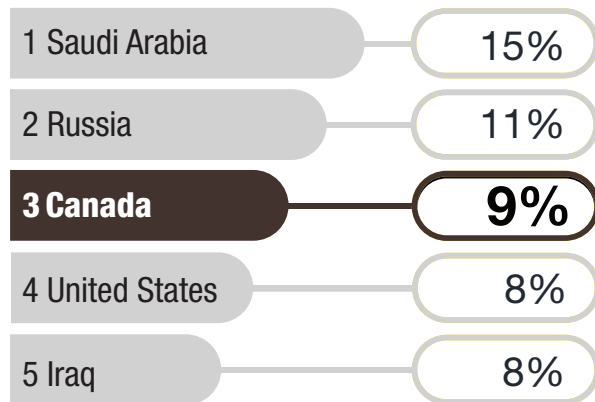
# CRUDE OIL

## INTERNATIONAL CONTEXT

### World production\* – 83.7 MMb/d (2021)



### World exports\* – 43.5 MMb/d (2020)

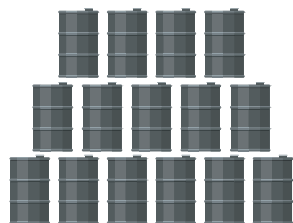


\* includes crude oil, NGLs, additives and other hydrocarbons (including the receipts of additives).

World proved reserves

**1,725.5 billion barrels**

(at the end of 2021)

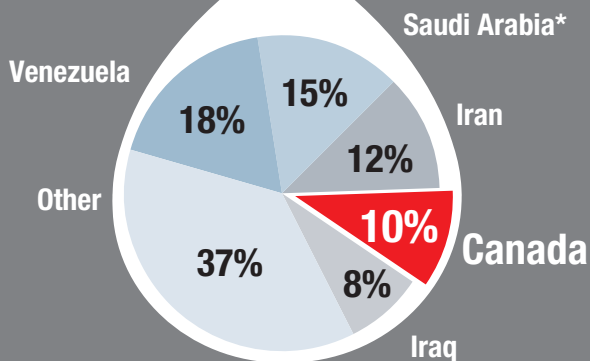


Proved reserves are those reserves expected to be recoverable with a high degree of certainty.



**97%**

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

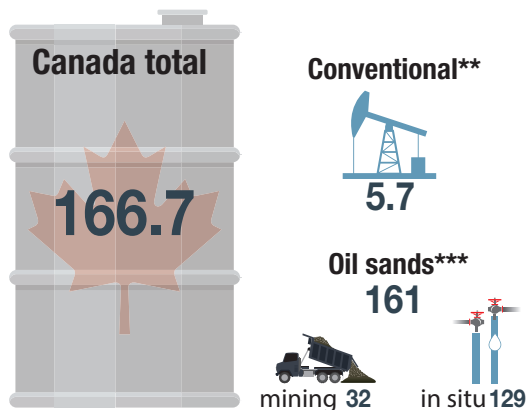


\*Saudi Arabia and Kuwait reserves include the Saudi-Kuwaiti "neutral zone," with total proved reserves of 5 billion barrels.

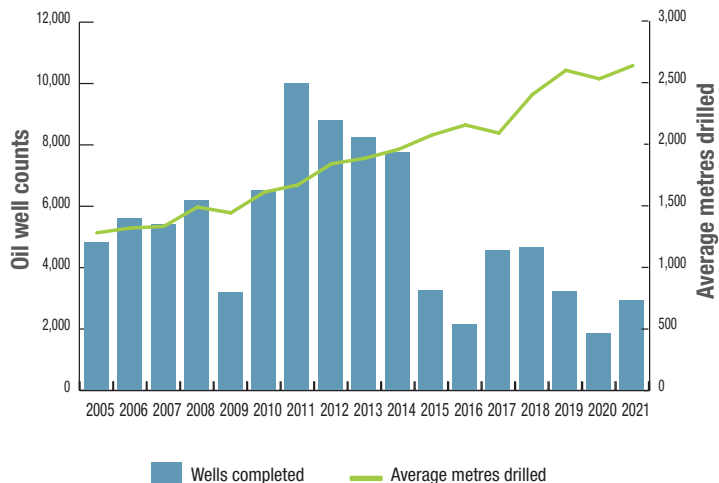
## CANADIAN RESOURCES

### REMAINING ESTABLISHED RESERVES\*

(billion barrels, as of December 2020)



### OIL WELLS COMPLETED AND AVERAGE METRES DRILLED IN WESTERN CANADA



\* Reserves known to exist and 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).

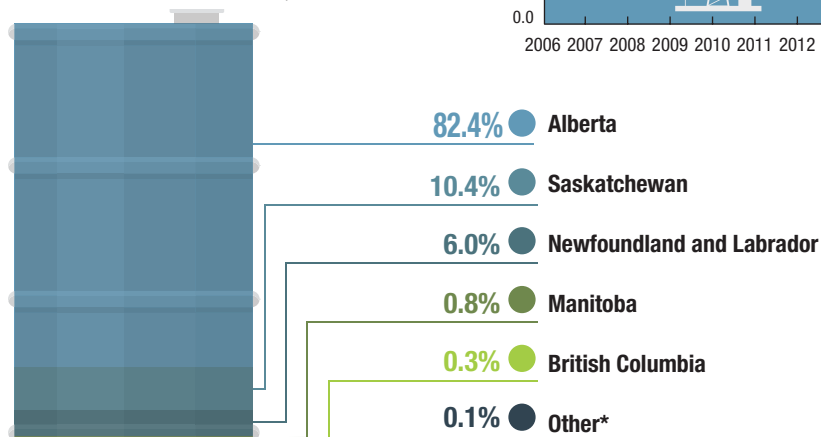
\*\*\*With improved technology, it is estimated that 315 billion barrels are ultimately recoverable from the oil sands.

## CANADIAN PRODUCTION

Oil sands production has exceeded conventional production since 2010.

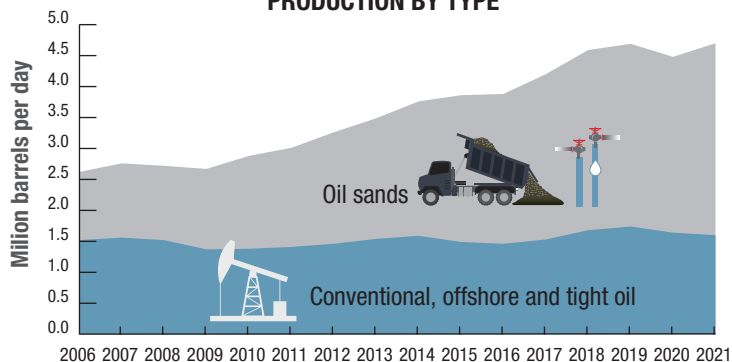
In 2021, oil sands production was **3.1 MMb/d** compared with **1.6 MMb/d** of other oil production.

### PRODUCTION BY PROVINCE, 2021



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

### PRODUCTION BY TYPE



## CANADIAN SUPPLY AND DEMAND\* (2021)

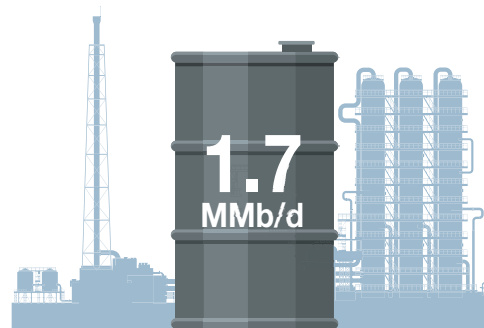
Canadian production



Exports



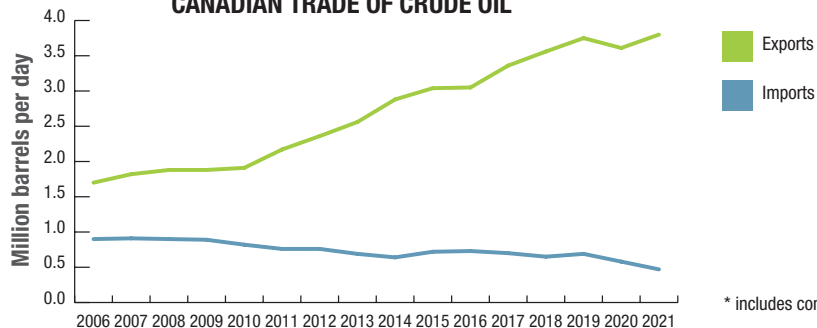
Imports



**CRUDE OIL INPUT TO DOMESTIC REFINERIES**

## TRADE

**CANADIAN TRADE OF CRUDE OIL**



\* includes condensates and pentanes plus.

## OIL SANDS

An estimated **\$340 billion** of capital investment to date, including

**\$7.7 billion** in 2021



**OF CANADA'S PROVED RESERVES**



**OF CANADA'S OIL PRODUCTION IN  
2021 OR 3.1 MMb/d**

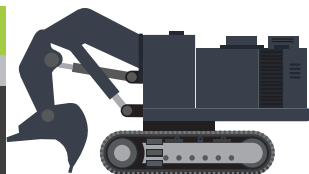
## BITUMEN UPGRADING

- Crude bitumen from oil sands may be transported to upgraders for processing to make it lighter – “synthetic crude oil.”
- In 2021, **39%** of the raw bitumen produced was sent for upgrading in Alberta.
- Major companies with upgrading capacity include Syncrude, Suncor, Shell, Canadian Natural Resources, Husky and Nexen-CNOOC.
- The total upgrading capacity in Canada is **1.15 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 2021, **seven projects in Alberta** produced **1,595 Mb/d**: Syncrude Mining Project (**350 Mb/d**), Suncor Base Mine (**276 Mb/d**), CNRL Horizon Mine (**260 Mb/d**), Athabasca Oil Sands Project – Muskeg River (**183 Mb/d**), Jackpine Mine (**148 Mb/d**), Imperial's Kearl Mine (**281 Mb/d**) and Fort Hills (**97 Mb/d**).



↑  
formation of  
75 m or less  
↓

50%

OF CURRENT  
PRODUCTION

20%

OF OIL SANDS  
RESOURCES



## IN SITU METHOD

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

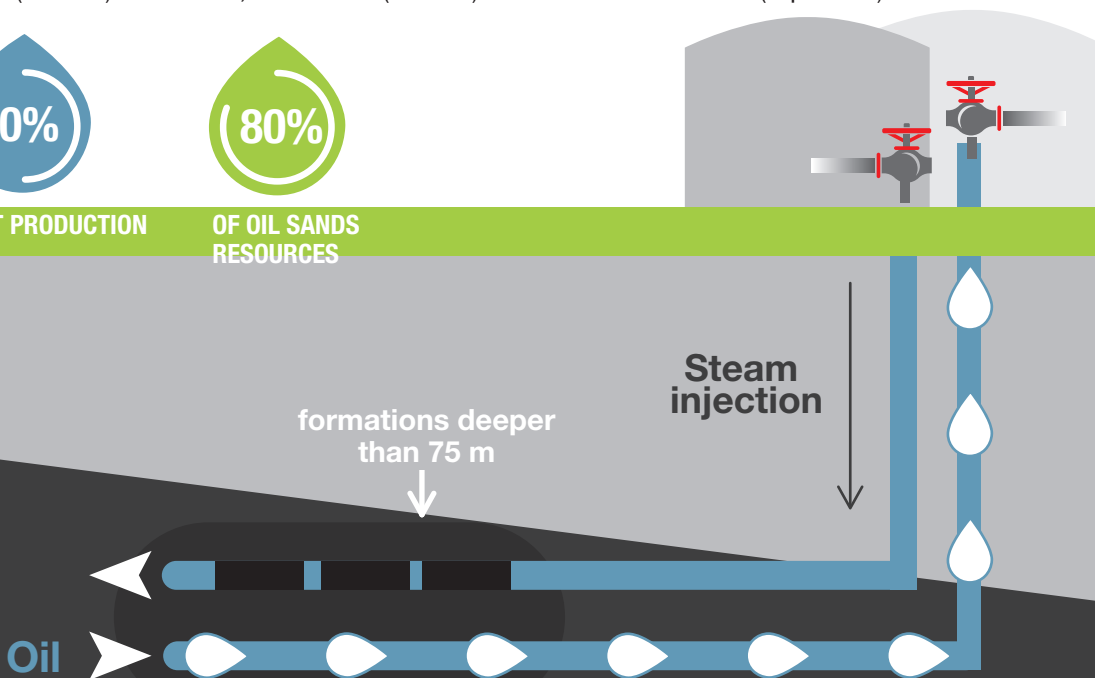
**More than 20 projects in Alberta** – The largest projects in 2021 were Firebag and MacKay River (Suncor) at 242 Mb/d, Christina Lake (Cenovus) at 236 Mb/d, Foster Creek (Cenovus) at 175 Mb/d and Cold Lake (Imperial Oil) at 141 Mb/d.



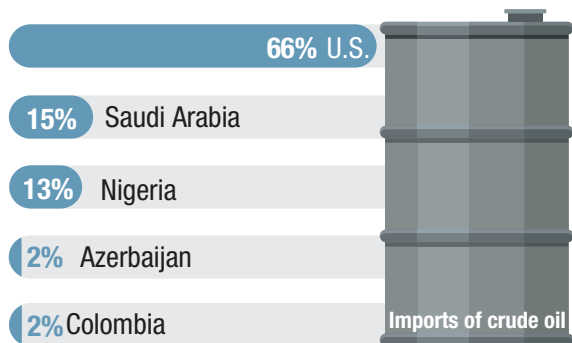
OF CURRENT PRODUCTION



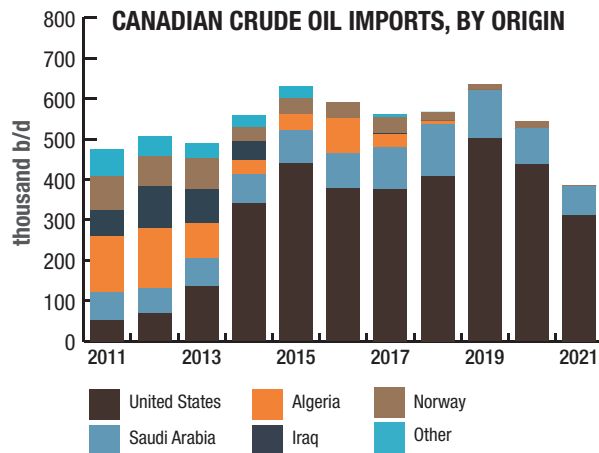
OF OIL SANDS  
RESOURCES



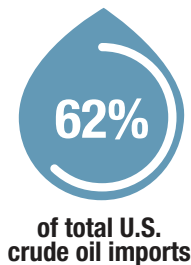
In 2021, imports of crude oil into Canada came from a range of countries including:



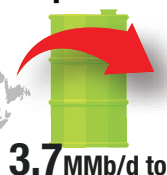
Over recent years, the U.S. has become Canada's primary supplier of imported crude oil.



In 2021, Canada was the **largest foreign supplier of crude oil** to the U.S., accounting for



**exported**



**representing**



## PRICES

### WEST TEXAS INTERMEDIATE (WTI)

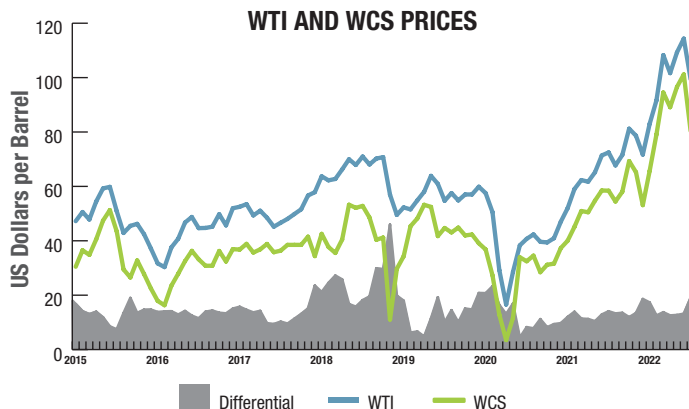
- Reference price for light crude oil delivered at Cushing, Oklahoma (a major pipeline hub)
- Used as the benchmark price for North American crudes and underlies oil futures contracts on the NYMEX

### WESTERN CANADIAN SELECT (WCS)

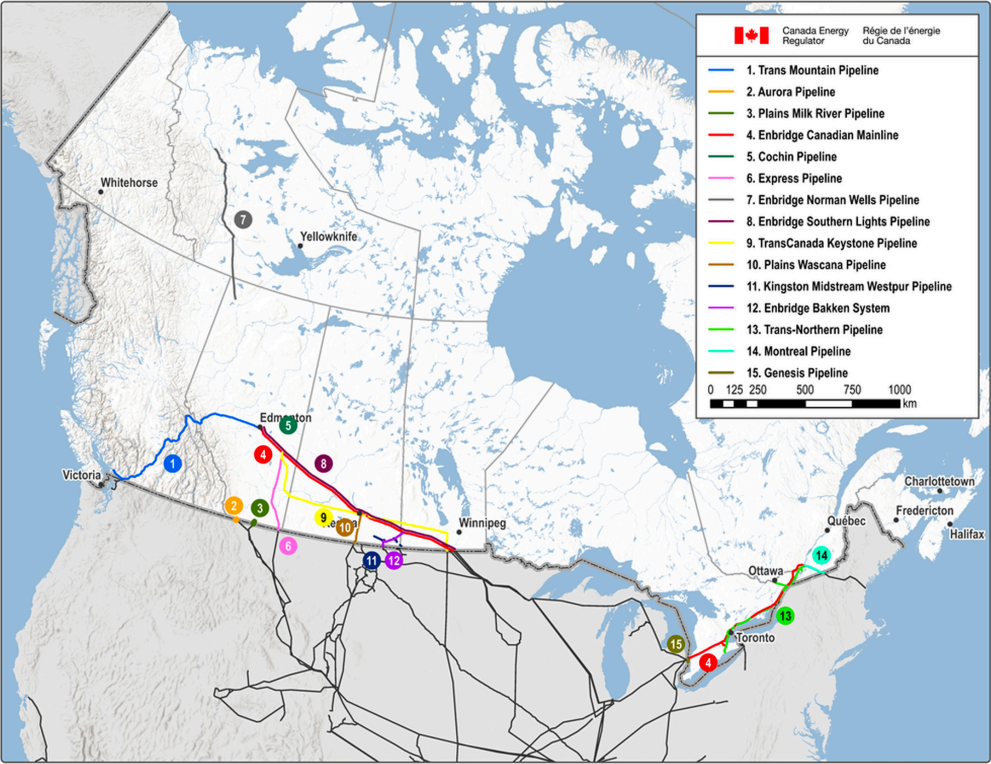
- WCS is the main benchmark price for Canadian heavy crude, specifies delivery at Hardisty, Alberta and is representative of the price of oil from the oil sands.

### WTI-WCS DIFFERENTIAL

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



# MAJOR CER REGULATED OIL PIPELINES



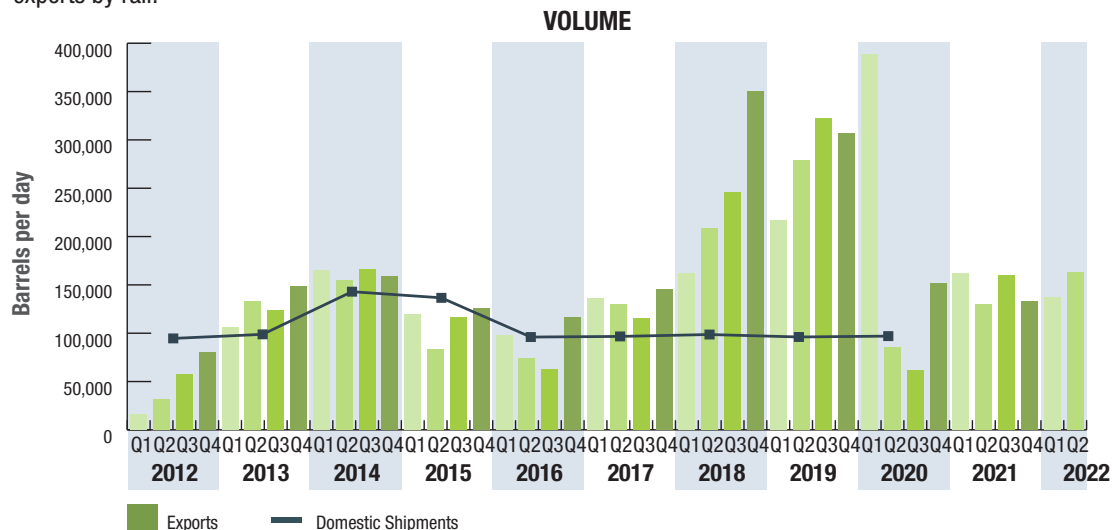
The map is a graphical representation intended for general informational purposes only. Map produced by the CER, June 2021, Last updated on Jun 03

## CRUDE BY RAIL

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

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

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

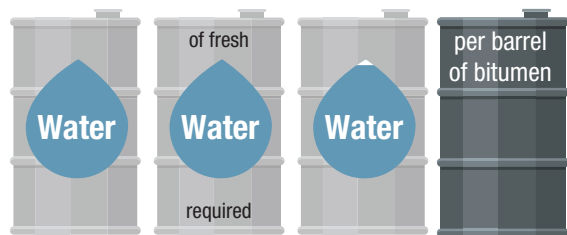


## OIL SANDS: ENVIRONMENTAL CONSIDERATIONS

### WATER

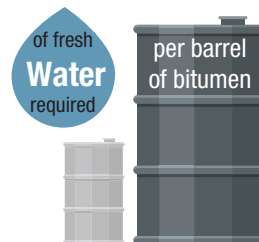
Mining method:

2.9 barrels

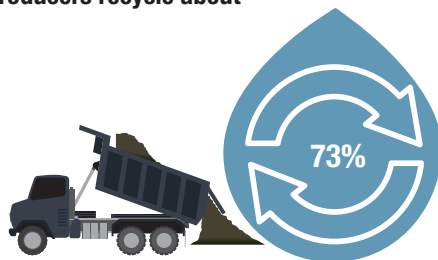


In situ method: an average of

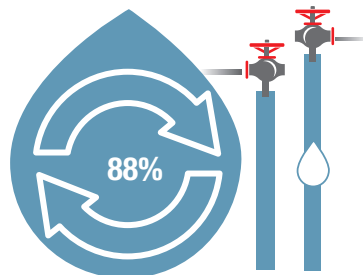
0.2 barrels



Oil sands producers recycle about



OF THE WATER USED FOR  
ESTABLISHED MINES

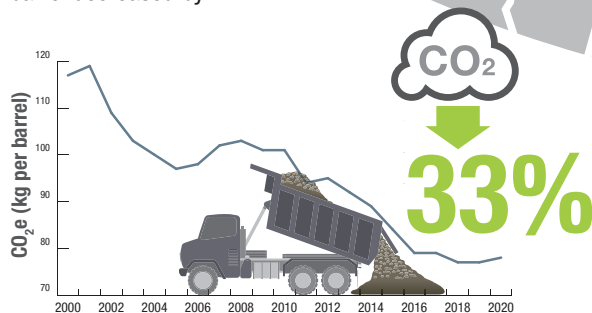


OF THE WATER USED FOR  
IN SITU PRODUCTION

## GREENHOUSE GASES

**12%** of Canada's total **GHG** emissions and **0.17%** of global emissions

From 2000 to 2020, emissions intensity per barrel decreased by



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



### LAND

- area of oil sand resources **142,200 km<sup>2</sup>**
- total mineable area **4,800 km<sup>2</sup>**
- total area being mined **953 km<sup>2</sup>**
- tailings ponds **257 km<sup>2</sup>**

### For comparison:

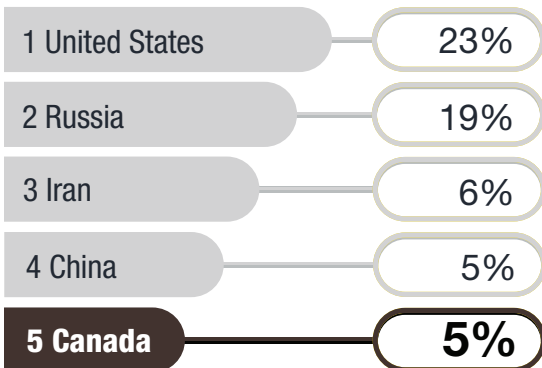
- Canada's area **10,000,000 km<sup>2</sup>**
- Canada's boreal forest **2,700,000 km<sup>2</sup>**

# NATURAL GAS

## INTERNATIONAL CONTEXT

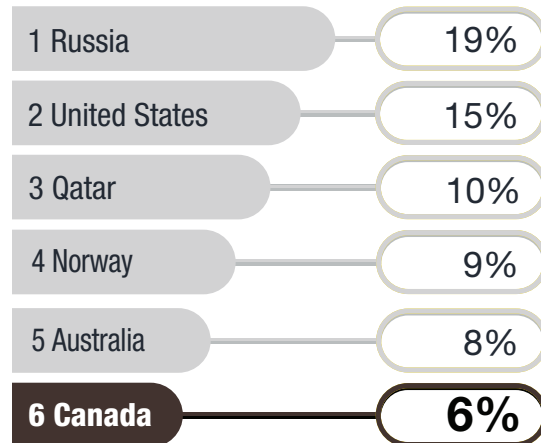
### World production – 401 Bcf/d (11.4 Bcm/d)

(2021, PRELIMINARY)



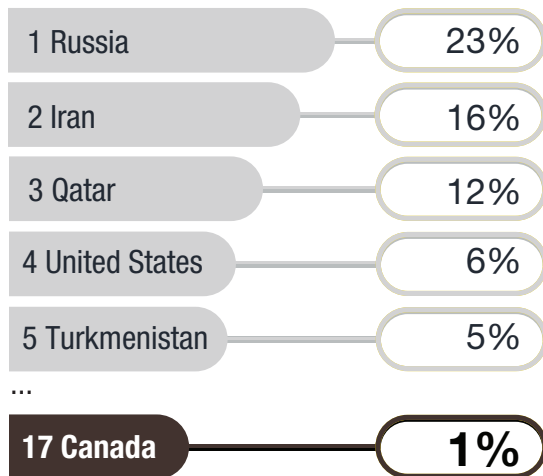
### World exports – 124 Bcf/d (3.5 Bcm/d)

(2021, PRELIMINARY)

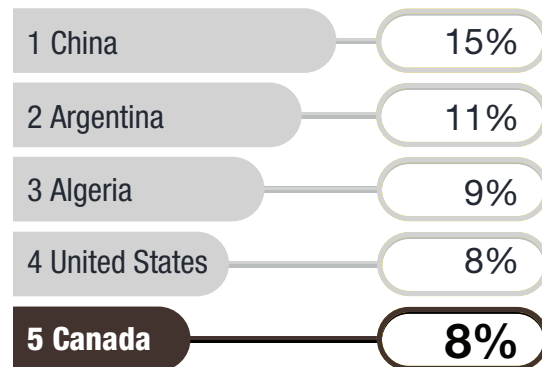




**World proved reserves – 7,291 Tcf**  
**(206 Tcm)** (BEGINNING OF 2021)

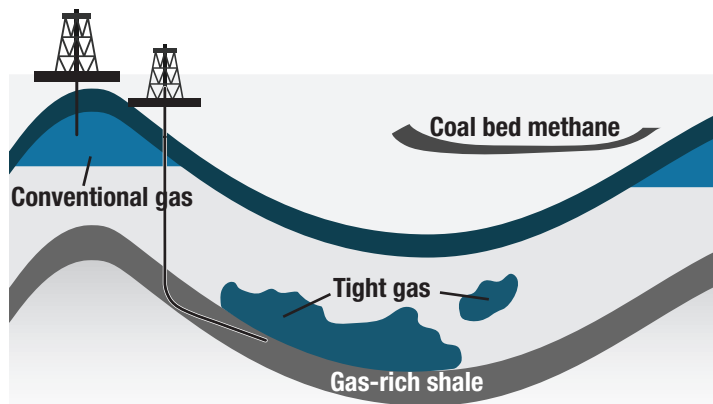
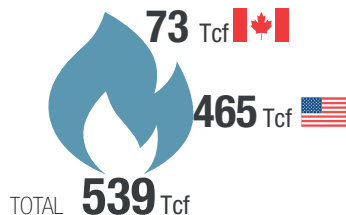


**World unproved technically recoverable**  
**shale resources – 7,577 Tcf** (2015)

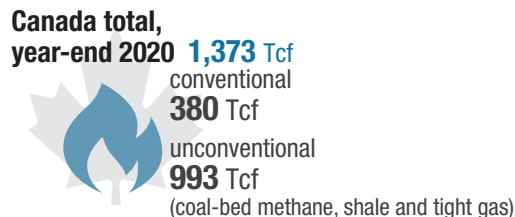


## CANADA-U.S. RESOURCES

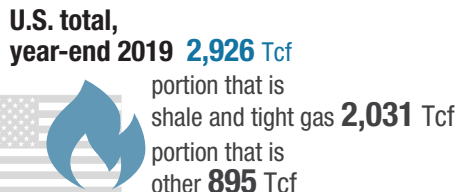
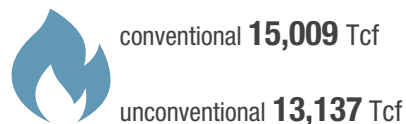
**PROVED RESERVES\*** (End 2020/Beginning 2021)



## MARKETABLE/TECHNICALLY RECOVERABLE RESOURCES\*\*



**World total (year-end 2020) 28,146 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 (2021)

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

**16.8 Bcf/d** (0.48 Bcm/d)



**13%** conventional

**87%** unconventional\*

### U.S. average marketable production

**93.5 Bcf/d** (2.59 Bcm/d)



**11%** conventional

**89%** unconventional\*

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



### Canada-U.S. production

**110.3 Bcf/d** (3.12 Bcm/d)

### LNG imports of North American countries



**0.07 Bcf/d** 

**0.08 Bcf/d** 

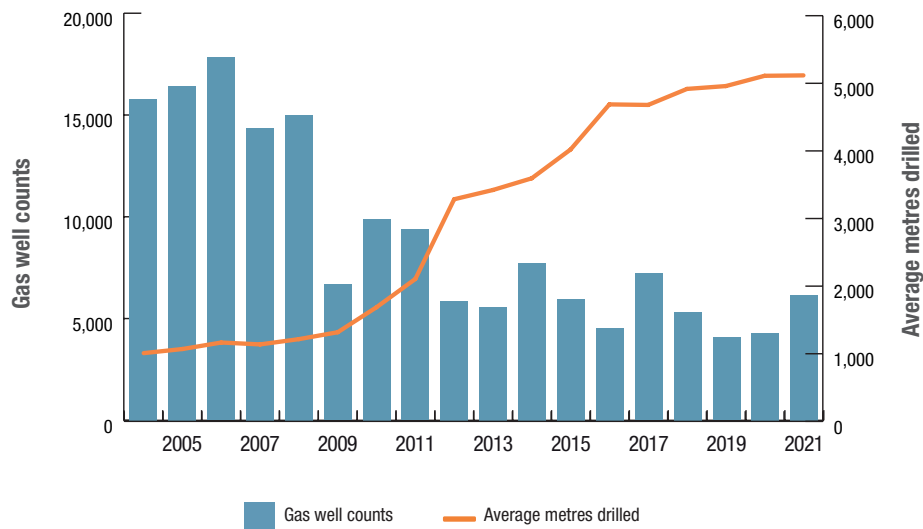
**0.06 Bcf/d** 

### LNG exports of North American countries



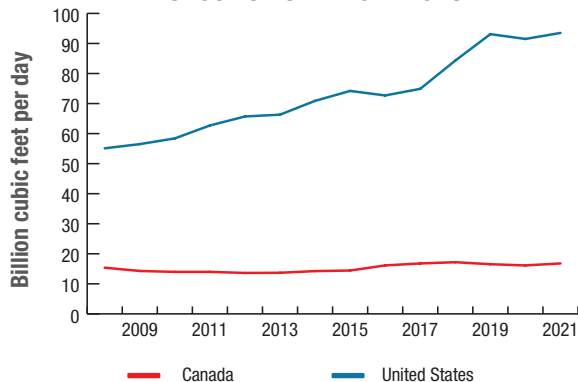
**9.76 Bcf/d** 

## NATURAL GAS WELLS COMPLETED AND AVERAGE METRES DRILLED IN WESTERN CANADA

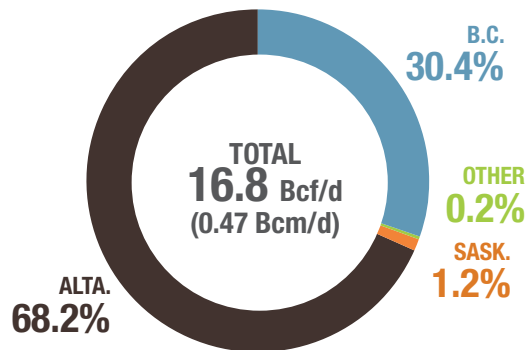


While Canadian natural gas production remained relatively flat and the number of wells drilled declined, the well productivity has increased over time. This reflects the increased use of horizontal drilling and increased well length.

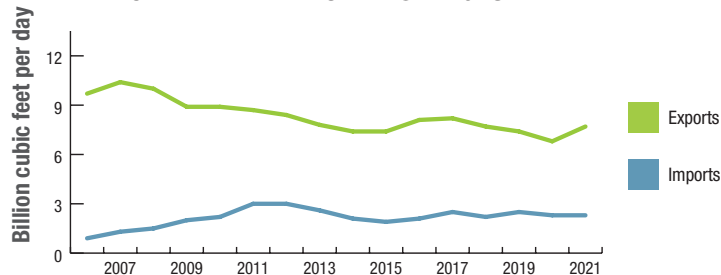
## CANADIAN AND U.S. MARKETABLE PRODUCTION OF NATURAL GAS



## MARKETABLE PRODUCTION BY PROVINCE, 2021



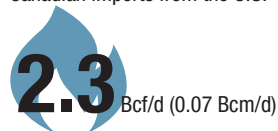
## CANADIAN TRADE OF NATURAL GAS



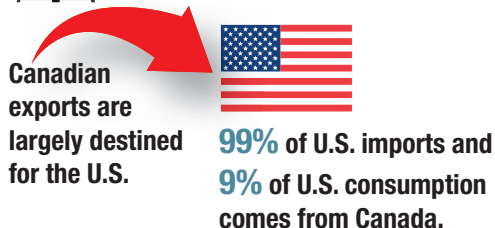
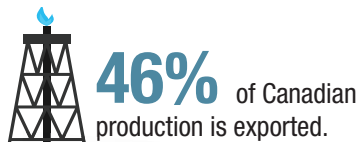
Canadian exports to the U.S.



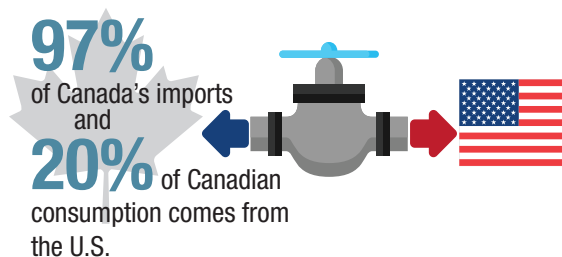
Canadian imports from the U.S.



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



**The value of Canadian net exports**  
(exports minus imports) was  
**\$9.6 billion** in 2021.



## UPSTREAM PRICES

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

### AECO PRICE

Average: 2008–2019 **\$3.39/MMbtu**

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

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

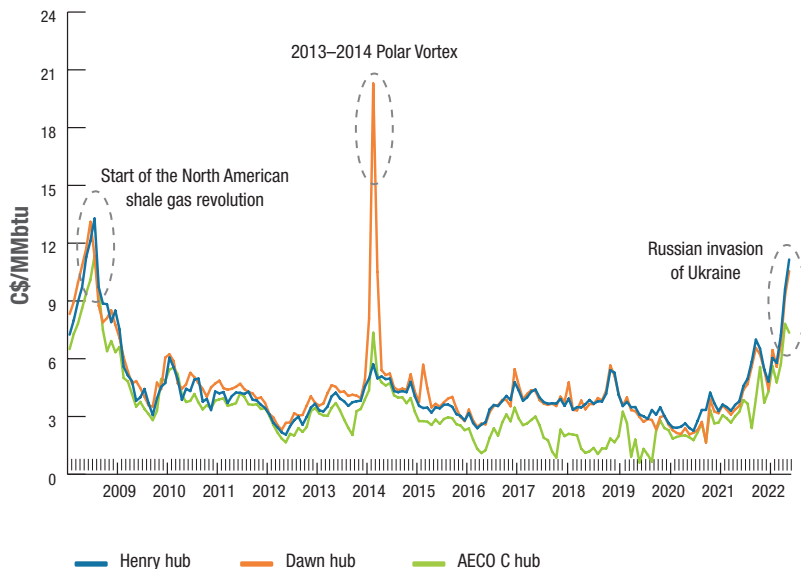
Average: 2018 **\$1.54/MMbtu**

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

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

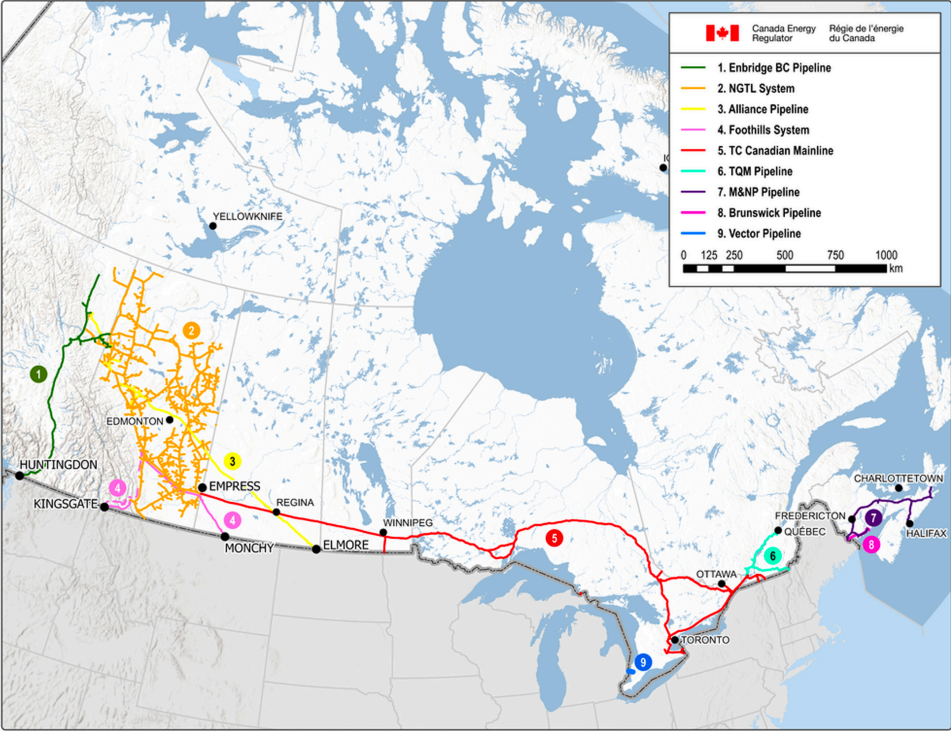
Average: 2021 **\$3.39/MMbtu**

### MONTHLY AVERAGE NATURAL GAS SPOT PRICES



# TRANSPORTATION

## CER REGULATED GAS PIPELINES



The map is a graphical representation intended for general informational purposes only. Map produced by the CER, December 2020. Last updated on Oct 30

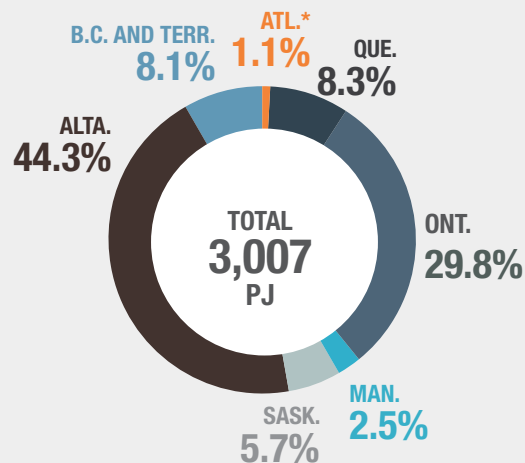


## NATURAL GAS ENERGY USE

### NATURAL GAS END USE BY SECTOR, 2019

Sector	Energy use (PJ)	Energy use (Bcf/d)	% of the total
Residential	731.1	1.81	24.3%
Commercial	599.8	1.49	20.0%
Industrial	1,627.4	4.03	54.1%
Transportation	4.9	0.01	0.2%
Agriculture	43.4	0.11	1.4%
<b>Total</b>	<b>3,006.6</b>	<b>7.45</b>	<b>100%</b>

### NATURAL GAS ENERGY USE BY PROVINCE, 2019



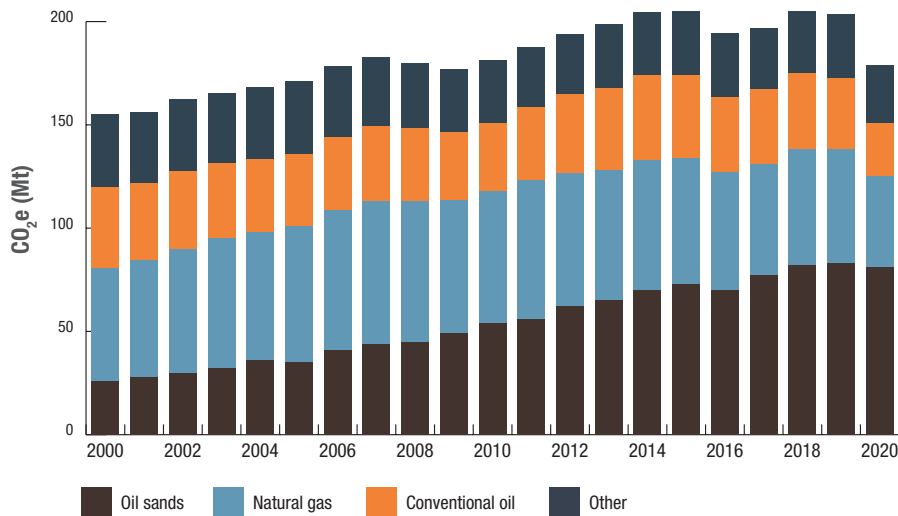
\* Atlantic provinces

## SPOTLIGHT: OIL AND GAS

GHG emissions from oil and gas production **have gone up 15% between 2000 and 2020**, 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 26%**.

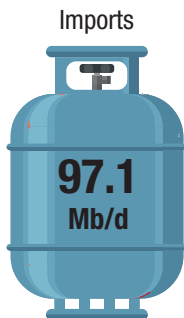
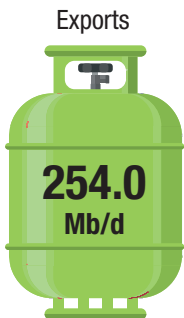
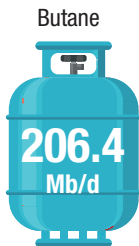
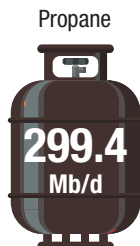
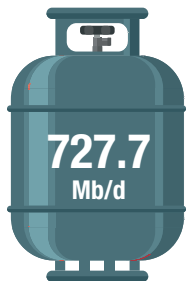
OIL AND GAS SECTOR GHG EMISSIONS FOR CANADA, 2000–2020



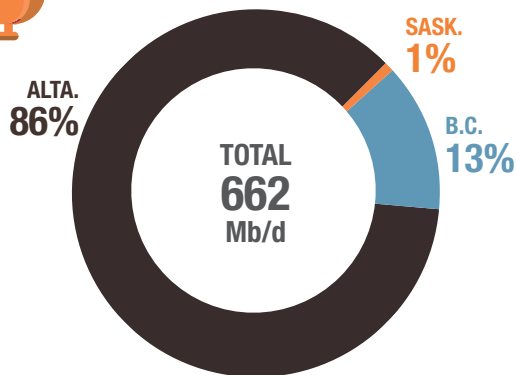
# HYDROCARBON GAS LIQUIDS (HGLs)

## SUPPLY AND DEMAND\* (2021)

Canadian production



GAS PROCESSING PLANT PRODUCTION  
OF NGLS BY PROVINCE (2020)



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

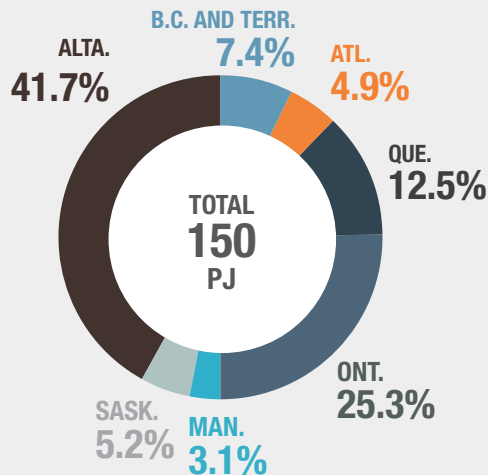
## NATURAL GAS LIQUIDS ENERGY USE

**TOTAL NATURAL GAS LIQUIDS ENERGY USE  
WAS 149.5 PJ IN 2019.**

Sector	Energy use* (PJ)	% of the total
Residential	16.3	10.9%
Commercial	38.8	25.6%
Industrial	72.9	48.8%
Transportation	11.6	7.8%
Agriculture	10.5	7.0%
<b>Total</b>	<b>149.5</b>	<b>100%</b>

\*secondary energy use

**NATURAL GAS LIQUIDS ENERGY USE  
BY PROVINCE, 2019**



# REFINED PETROLEUM PRODUCTS (RPPs)

## PETROLEUM REFINERIES

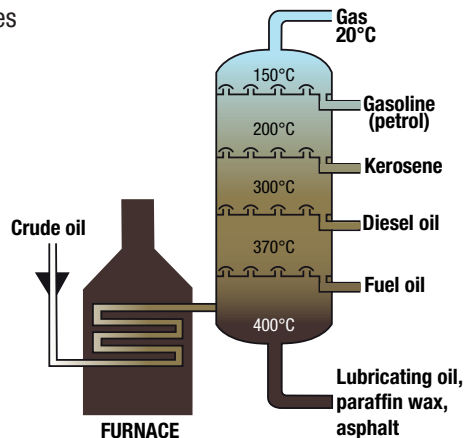
Petroleum refineries transform crude oil into a wide range of refined petroleum products (RPPs, e.g. gasoline, diesel). Other facilities such as asphalt plants, lubricant plants, upgraders and some petrochemical plants also process crude oil to produce a limited range of products.

### REFINERY ACTIVITIES

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

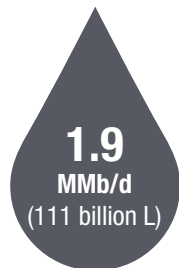
### REFINERY OUTPUTS

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

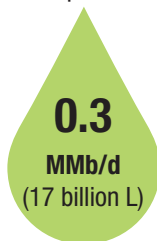


## SUPPLY AND DEMAND\* (2021)

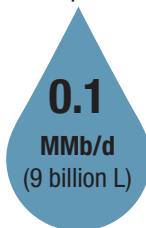
Canadian net production



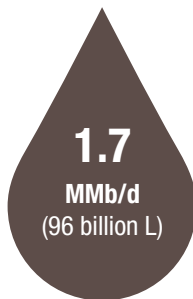
Exports



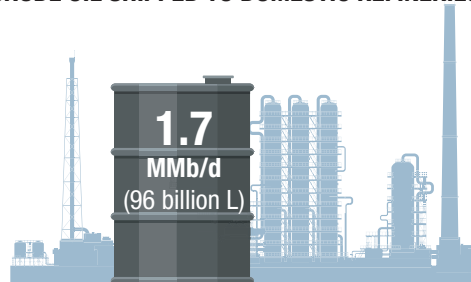
Imports



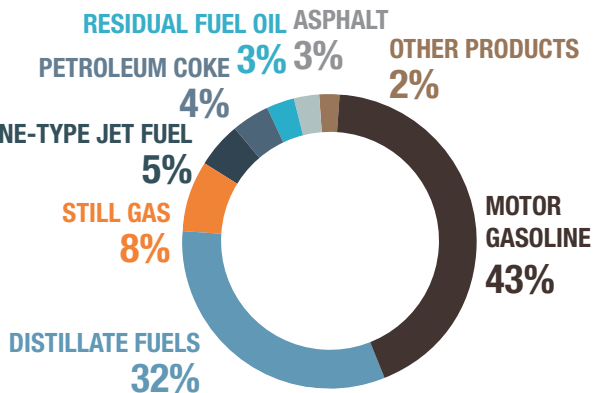
Domestic Consumption



## CRUDE OIL SHIPPED TO DOMESTIC REFINERIES



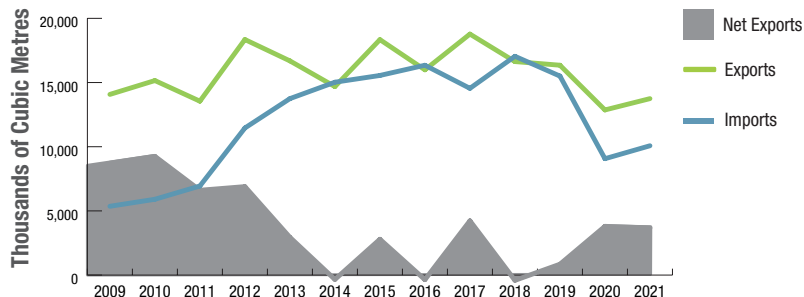
## DOMESTIC CONSUMPTION BY PRODUCT\*



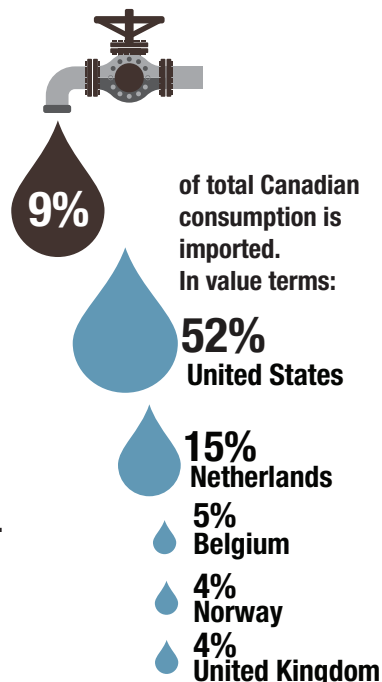
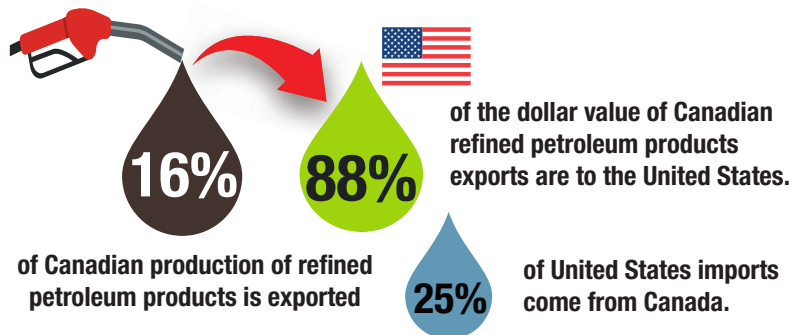
\* Certain product shares are based on Natural Resources Canada estimates.

# TRADE

## CANADIAN TRADE OF MAJOR REFINED PETROLEUM PRODUCTS

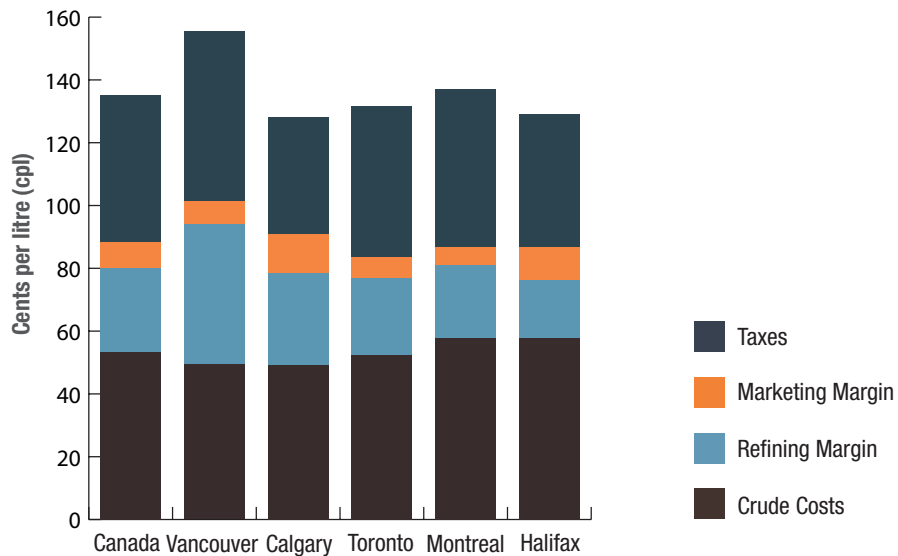


*Primarily motor gasoline, diesel, jet fuel, fuel oil, and kerosene*



## RETAIL PRICES

AVERAGE CANADIAN REGULAR GASOLINE PRICES, 2021





## REFINERY CAPACITY

### CANADIAN PETROLEUM REFINERIES BY COUNT AND CAPACITY\*, 2021

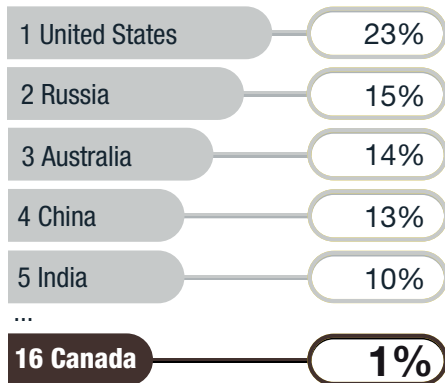
Province	Petroleum refinery		Asphalt plants		Lubricant plants (using crude oil as feedstock)		Total	
	Count	Capacity	Count	Capacity	Count	Capacity	Count	Capacity
Alberta	4	530	-	-	-	-	4	530
British Columbia	2	67	-	-	-	-	2	67
New Brunswick	1	300	-	-	-	-	1	300
Newfoundland and Labrador	1	130	-	-	-	-	1	130
Ontario	4	393	-	-	1	16	5	409
Quebec	2	372	-	-	-	-	2	372
Saskatchewan	1	135	2	52	-	-	3	187
<b>Total</b>	<b>15</b>	<b>1,927</b>	<b>2</b>	<b>52</b>	<b>1</b>	<b>16</b>	<b>18</b>	<b>1,995</b>

\*Capacities are in Mb/d.

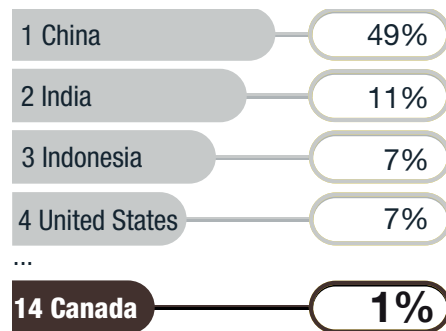
# COAL

## INTERNATIONAL CONTEXT

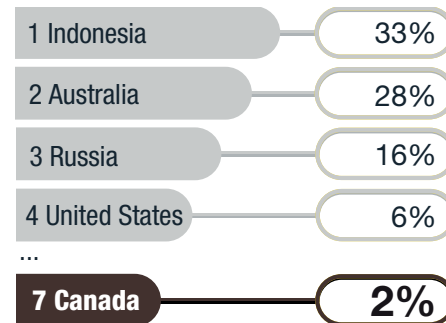
**World proved reserves –  
1,074 BILLION TONNES** (2020)



**World production – 7.7 BILLION TONNES**  
(2021)

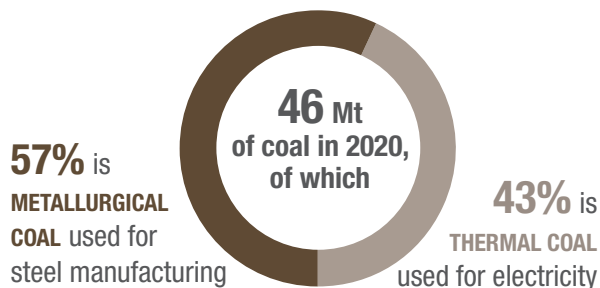


**World exports – 1.3 BILLION TONNES**  
(2021)

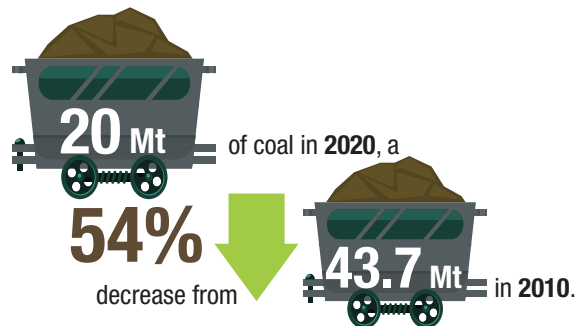


## PRODUCTION AND USE

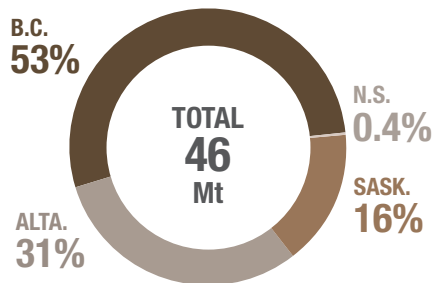
### Canada produced



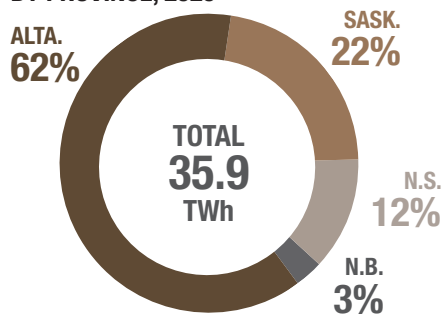
### Electricity generation consumed



### COAL PRODUCTION BY PROVINCE, 2020



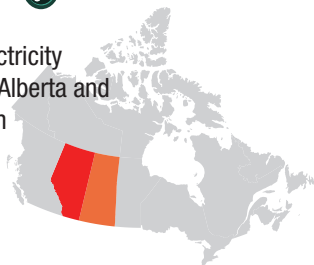
### COAL-FIRED ELECTRICITY GENERATION BY PROVINCE, 2020



## DOMESTIC DEMAND



Mostly for electricity generation in Alberta and Saskatchewan

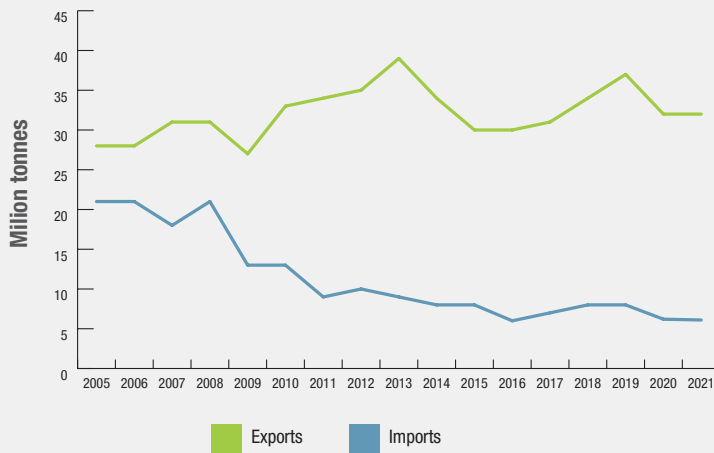


Also for metallurgical applications



## TRADE

### CANADIAN TRADE OF COAL



Canada's exports are primarily metallurgical coal (**88%** in 2020).

## TRADE (2021)

### EXPORTS

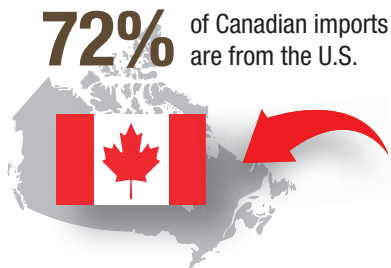


**46% China**  
**15% South Korea**  
**15% Japan**

**3%** of Canadian exports are to the U.S.,  
representing **19%** of  
**U.S. coal imports.**



### IMPORTS





# 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 (¢/m<sup>3</sup>) (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 (U<sub>3</sub>O<sub>8</sub>)
- 1 lb. U<sub>3</sub>O<sub>8</sub> = 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 m<sup>3</sup> of crude oil = 39.0 GJ
- 1,000 m<sup>3</sup> 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	HGL	hydrocarbon gas liquids
B	billion	HST	Harmonized sales tax
b/d	barrels per day	IEA	International Energy Agency
Bcf/d	billion cubic feet per day	kg	kilogram
Bcm/d	billion cubic metres per day	km	kilometre
CANDU	Canada deuterium uranium	km <sup>2</sup>	square kilometre
CCS	carbon capture and storage	kt	kilotonne
CCUS	carbon capture, utilization and storage	kWh	kilowatt hour
CDIA	Canadian direct investment abroad	lb.	pound
CEA	Canadian energy assets	L	litre
CER	Canada Energy Regulator	LCOE	levelized cost of electricity
CO <sub>2</sub> 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 <sup>2</sup>	square metre
EU	European Union	m <sup>3</sup>	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
		MW	megawatt
		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

### SECTION 1: KEY ENERGY, ECONOMIC AND ENVIRONMENTAL INDICATORS

#### • ENERGY PRODUCTION AND SUPPLY

- **Global Primary Energy Production:** IEA Annual Database
- **Global Energy Rankings:** IEA Annual Database
- **Primary Energy Production by Region & Source:**  
Statistics Canada tables 25-10-0020-01, 25-10-0029-01 and 25-10-0007-01 and NRCan estimates
- **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:** Natural Resources Canada's National Energy Use Database

#### • ECONOMIC CONTRIBUTION

- **GDP:** Statistics Canada tables 38-10-0285-01, 36-10-0221-01, 36-10-0103-01 and 36-10-0400-01 and NRCan estimates
- **Employment:** Statistics Canada tables 38-10-0285-01, 36-10-0214-01, 36-10-0489-01, 36-10-0480-01, 36-10-0221-01, 36-10-0400-01, 14-10-0023-01, Provincial NRSA and Statistics Canada special tabulations
- **Energy Trade:** Statistics Canada International Merchandise Trade Database, IEA Annual Database and United States EIA (U.S. Imports by Country of Origin)
- **Canada-U.S. Energy Trade:** Statistics Canada International Merchandise Trade Database and United States EIA (U.S. Imports by Country of Origin)
- **Government Revenues:** Statistics Canada Table 33-10-0006-01, Statistics Canada special tabulation

(royalties) and Canadian Association of Petroleum Producers, Statistical Handbook, Table 01-01C (Crown land sales Western Canada and Canada lands)

#### • ENERGY AND GHG EMISSIONS

- **GHG Emissions by Sector:** Environment and Climate Change Canada (National Inventory Report)

### SECTION 2: INVESTMENT

- **Capital expenditures:** Statistics Canada tables 34-10-0035-01, 34-10-0036-01, and 34-10-0040-01
- **Canada's Energy Infrastructure:** StatCan Table: 36-10-0608-01: Infrastructure Economic Accounts, investment and net stock by asset, industry, and asset function
- **Canada's Major Energy Projects:** NRCan Major Project Inventory
- **Foreign Direct Investment and Canadian Direct Investment Abroad:** Statistics Canada Table 36-10-0009-01
- **Foreign Control of Canadian Assets:** Statistics Canada tables 33-10-0033-01, 33-10-0005-01 and 33-10-0006-01
- **Canadian Energy Assets:** Compiled by NRCan from S&P Global Market Intelligence and annual financial statements from publicly traded Canadian energy companies.
- **Research, Development and Demonstration**
- **Environmental Protection Expenditures:** StatCan Environmental protection expenditures by businesses, 2018 (Tables 38-10-0130-01, 38-10-0132-01)

## SECTION 3: SKILLS, DIVERSITY AND COMMUNITY

- **Energy Sector Demographics:** Statistics Canada Natural Resources Account, special release tables.
- **Household Expenditures on Energy:** Statistics Canada Table 11-10-0222-01
- **Energy Retail Prices:** Statistics Canada tables 18-10-0004-01 and 18-10-0001-01
- **Energy Reliant Communities:** NRCan analysis based on Statistics Canada 2016 Census Data

## SECTION 4: ENERGY EFFICIENCY

### • ENERGY USE

- **Primary and secondary energy use:** Natural Resources Canada's National Energy Use Database
- **Energy efficiency:** Natural Resources Canada's National Energy Use Database and Natural Resources Canada Energy Efficiency Trends in Canada 2000-2018
- **Energy intensity:** Natural Resources Canada's National Energy Use Database
- **Energy in our daily lives:** Natural Resources Canada's Energy Efficiency Trends in Canada 2000-2018
- **Residential Energy Use, water heating and space heating** Natural Resources Canada's National Energy Use Database and NRCan estimates
- **Residential, commercial, institutional and industrial sectors:** Natural Resources Canada's National Energy Use Database

### • ENERGY TRENDS

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

## SECTION 5. CLEAN POWER AND LOW CARBON FUELS

### • CLEAN TECHNOLOGY AND THE ECONOMY

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

### • ELECTRICITY

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

### • RENEWABLES

- **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
- **Biomass – Renewable balance:** IEA database (Renewables balances)
- **Biomass – production:** Statistics Canada Table 25-10-0031-01, Statistics Canada International Merchandise Trade Database and NRCan
- **Biomass – wood fuel use by sector:** IEA (Renewables Information)
- **Wind – international context:** Global Wind Energy Council (Global Wind Report)
- **Wind – capacity in Canada:** compiled by NRCan from 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 2020 Global Status Report)
- **Solar PV – capacity in Canada:** IEA and compiled by NRCan
- **Solar PV – generation in Canada:** Statistics Canada Table 25-10-0020-01
- **Solar PV – solar PV farms:** compiled by NRCan from Statistics Canada data and various public sources
- **URANIUM AND NUCLEAR**
  - **Biofuels – regulations:** compiled by Office of Energy Efficiency from various public sources
  - **World uranium production and exports:** World Nuclear Association (World Uranium Mining) and NRCan estimates based on World Nuclear Association production data
  - **World known recoverable resources of uranium:** OECD Nuclear Energy Agency and International Atomic Energy Agency (Uranium: Resource, Production and Demand), World Nuclear Association (Supply of Uranium)
  - **World generation of nuclear power:** International Atomic Energy Agency (Nuclear Power Reactors in the World, 2020 Ed.)
  - **Canadian supply and demand:** World Nuclear Association (Uranium in Canada), Cameco Annual report and estimates compiled by NRCan from company information
  - **Nuclear in Canada infographic:** NRCan website (Nuclear Energy and Uranium)
  - **Purchases by U.S. nuclear reactors:** United States EIA (Uranium Marketing Annual Report) Table 3 (Uranium purchased by owners and operators of U.S. civilian nuclear power reactors by origin country and delivery year)
  - **CANDU nuclear reactors:** Based on figures compiled by NRCan
  - **Nuclear power plants in Canada:** Compiled by NRCan from Statistics Canada Table 57-206, International Atomic Energy Agency Power Reactor Information System and other public sources
  - **Spot prices:** United States EIA Annual Uranium Market Report
- **BIOFUELS AND TRANSPORTATION**
  - **Biofuels – regulations:** compiled by Office of Energy Efficiency from various public sources

- **Biofuels – international context:** IEA (Renewables Information)
- **Biofuels – production, supply and demand :** Compiled by NRCan from a variety of sources
- **Transportation – Electric vehicle sales:** Statistics Canada Table: 20-10-0021-01
- **Transportation – GHG emissions:** Environment and Climate Change Canada
- **Hydrogen – Hydrogen Strategy For Canada,** <https://www.nrcan.gc.ca/climate-change/canadas-green-future/the-hydrogen-strategy/23080>

## SECTION 6: PETROLEUM, GAS AND COAL

### • CRUDE OIL

- **World production and exports:** IEA Online Data Services (Crude Oil Information)
- **World proved reserves:** Oil and Gas Journal (Worldwide Look at Reserves and Production)
- **Canadian Resources:** 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), R4.1 (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, Wells and Metres Drilled in Western Canada (2020 Drilling Activity)
- **Canadian and provincial production:** Statistics Canada Table 25-10-0063-01 and NRCan analysis
- **Canadian Supply and Demand:** Statistics Canada Table 25-10-0063-01 and Statistics Canada International Merchandise Trade Database, United States EIA (Imports by Country of Origin, Refining and Processing, total crude oil and products, consumption/sales)
- **Trade:** Statistics Canada table 25-10-0063-01 and Statistics Canada International Merchandise Trade Database, U.S. EIA (Imports by Country of Origin, Refining and Processing, total crude oil and products, consumption/sales)
- **Oil Sands:** Canadian Association of Petroleum Producers, Statistical Handbook, Table 04-14 (Canada Oil Sands Expenditures), Statistics Canada tables 34-10-0036-01 and 25-10-0063-01, Alberta Energy Regulator ST98 (Alberta's Energy Reserves and Supply/Demand Outlook) table S3.1 (Crude bitumen production), Canada's Oil Sands Innovation Alliance, CanOils Database and NRCan analysis
- **Prices:** United States EIA tables (Spot Prices for Crude Oil) and Sproule
- **Pipelines:** compiled by NRCan
- **Transportation by Rail:** CER (Canadian Crude Oil Exports by Rail – Quarterly Data) , Statistics Canada table 23-10-0062-01 and various sources
- **Oil Sands Environmental Considerations:** NRCan compiled using Environment and Climate Change Canada (National Inventory Report 1990 to 2020: Greenhouse Gas Sources and Sinks in Canada), World Resources Institute (CAIT - Country Greenhouse Gas Emissions Data), Alberta Government (Oil Sands Information Portal), Alberta Energy Regulator, Statistics



Canada, NRCan Boreal forest website, Alberta Government Lower Athabasca Regional Plan and Canadian Association of Petroleum Producers (Frequently used statistics)

## • NATURAL GAS

- **World production and exports:** IEA (Natural Gas Information)
- **World proved reserves:** U.S. EIA, International Data Browser
- **World unproved technically recoverable shale resources:** U.S. EIA, World Shale Resource Assessments
- **World resources and technically recoverable resources:** IEA (World Energy Outlook 2017, 2014 and 2013) tables 5.3 (Remaining technically recoverable natural gas resources by type and region), 8.2 (Remaining technically recoverable natural gas resources by type) and 3.3 (Remaining technically recoverable natural gas resources by type and region) and Oil and Gas Journal (Worldwide Look at Reserves and Production)
- **Canada and US proved reserves:** U.S. EIA and O&G Journal, extracted from EIA International Data Browser
- **Marketable and technically recoverable resources:** CER Energy Future Report, EIA Annual Energy Outlook, Assumptions to AEO - Oil and Gas Supply Module, EIA Shale gas proved reserves, IEA World Energy Outlook
- **Canadian production and share of conventional versus unconventional production:** StatCan Table: 25-10-0055-01 Natural gas supply and disposition and CER Energy Futures, Natural Gas Production by Type
- **US production and share of conventional versus unconventional production:** U.S. EIA, Dry Natural Gas Production, Annual and US EIA Annual Energy Outlook
- **LNG Imports of North American countries:** CER LNG Imports and Exports, U.S. EIA Liquefied Natural Gas Imports and Exports, Annual, and IGU World LNG Report

- **Natural gas wells completed and average metres drilled:** CAPP, Statistical Handbook
  - **Canadian trade of natural gas:** CER Exports and Imports of Natural Gas
  - **Marketable Production by Province:** StatCan Table: 25-10-0055-01 Natural gas supply and disposition
  - **Prices:** Sproule Price Forecast
  - **Pipelines:** Canada Energy Regulator
  - **Natural gas energy use:** NRCan Office of Energy Efficiency, National Energy Use Database
  - **Consumption:** Statistics Canada Table 25-10-0030-01 and IEA Annual Mini-Questionnaire
- ## • HGLs
- **Processing plant production:** StatCan Table 25-10-0036-01 - Supply of natural gas liquids and sulphur products from processing plants
  - **Refinery production:** Gross production of HGLs from StatCan Monthly Refined Petroleum Product Survey
  - **Shares of NGL Production by province:** CAPP Statistical Handbook
  - **NGLs end use:** NRCan Office of Energy Efficiency, National Energy Use Database
- ## • RPPs
- **Canadian refineries:** compiled by NRCan (from company information, Conference Board of Canada, Canada's Petroleum Refining Sector Canadian Fuels Association, Canadian Association of Petroleum Producers, Oil Sands magazine and CanOils Database)
  - **Supply and Demand:** Statistics Canada Tables, 25-10-0063-01 and 25-10-0081-01 and NRCan Analysis

- **Crude oil shipped to domestic refineries:** Statistics Canada table 25-10-0063-01
- **Domestic consumption by product:** Statistics Canada table 25-10-0081-01 and analysis by NRCan
- **Trade:** Statistics Canada Table 25-10-0081-01, United States EIA (U.S. Imports by Country of Origin for Petroleum and Other Liquids) and Statistics Canada International Merchandise Trade Database
- **Gasoline prices:** Kalibrate Technologies Ltd (average retail prices for regular gasoline and diesel fuel) and data compiled by NRCan
- **Refinery capacity:** Oil sands magazine and estimates compiled by NRCan
- **COAL**
  - **World proved reserved:** World Energy Council (BP Statistical Review of World Energy)
  - **World production and exports:** IEA (Coal Information)
  - **Canadian supply and demand:** Public provincial data sources, Statistics Canada table 25-10-0017-01, Statistics Canada International Merchandise Trade Database, public sources and NRCan estimations
- **GHG EMISSIONS FROM PETROLEUM**
  - **GHG Emissions by Sector:** Environment and Climate Change Canada (National Inventory Report)



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