ENERGY FACT BOOK
2018–2019
Canada
ENERGY FACT BOOK
2018–2019
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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.

This edition is based on data and information available as of June 2018. 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.rncan@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.

Through Generation Energy, the Government of Canada engaged over 380,000 people in a dialogue on Canada’s energy future. Canadians understand that the energy landscape is changing, with significant implications and potential opportunities. Through the 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 2015 is almost 17% more than in 2005. The world, on average, has increased energy production by 19% in the same period.

TOTAL PRIMARY ENERGY PRODUCTION
TOP ENERGY PRODUCERS, 2015

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>18%</td>
</tr>
<tr>
<td>2</td>
<td>United States</td>
<td>15%</td>
</tr>
<tr>
<td>3</td>
<td>Russia</td>
<td>10%</td>
</tr>
<tr>
<td>4</td>
<td>Saudi Arabia</td>
<td>5%</td>
</tr>
<tr>
<td>5</td>
<td>India</td>
<td>4%</td>
</tr>
<tr>
<td>6</td>
<td>Canada</td>
<td>3%</td>
</tr>
</tbody>
</table>

GLOBAL ENERGY RANKINGS FOR CANADA

<table>
<thead>
<tr>
<th>Proved reserve/capacity</th>
<th>Production</th>
<th>Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude oil</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Uranium</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Hydroelectricity</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Electricity</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Coal</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Natural gas</td>
<td>17</td>
<td>4</td>
</tr>
</tbody>
</table>
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 (2016)

PRIMARY ENERGY PRODUCTION, INCLUDING URANIUM

- Natural Gas: 24%
- Uranium: 32%
- Crude Oil: 31%
- Hydro: 5%
- Coal: 5%
- Other Renewables: 3%
- NGLS: 2%

TOTAL: 29,331 PJ

PRIMARY ENERGY PRODUCTION, EXCLUDING URANIUM

- Natural Gas: 34%
- Crude Oil: 44%
- Coal: 7%
- Hydro: 7%
- Nuclear: 2%
- Other Renewables: 4%
- NGLS: 3%

TOTAL: 20,436 PJ

“Other renewables” includes wind, solar, wood/wood waste, biofuels and municipal waste.
Energy Trade (2017)

Exports
$112.6 billion

- 22% of total Canadian goods exports
- Oil and gas domestic exports totalled over $97 billion
- Of which 97% were to the U.S.

The U.S. accounts for 91% of energy exports by value ($102.2 billion).

Imports
$41.2 billion

- 7% of total Canadian goods imports
- Imported energy products from 114 countries

The U.S. accounts for 65% of energy imports by value ($26.8 billion).
CANADA-U.S. ENERGY TRADE IN 2017

Exports to the U.S. (% of Canadian production)
- Crude oil: 79
- Natural gas: 51
- Uranium: 41
- Petroleum products: 22
- Electricity: 11
- Coal: 1

Exports to the U.S. (% of U.S. consumption)
- Crude oil: 21
- Natural gas: 11
- Uranium: 33
- Petroleum products: 3
- Electricity: 2
- Coal: 0.1

Imports from the U.S. (% of Canadian consumption)
- Crude oil: 20
- Natural gas: 20
- Petroleum products: 11
- Electricity: 2
- Coal: 14

Exports to the U.S. (% of U.S. imports)
- Crude oil: 43
- Natural gas: 97
- Uranium: 25
- Petroleum products: 28
- Electricity: 99
- Coal: 11
NOMINAL GROSS DOMESTIC PRODUCT (2017)
ENERGY’S NOMINAL GDP CONTRIBUTION FOR CANADA

NOMINAL GDP (% OF CURRENT DOLLARS)

10.6%
or$213 billion

CANADIAN GDP
ENERGY DIRECT 7.3% ($146 billion)
CRUDE OIL 2.6%
electricity 1.6%
OTHER 3.1%

ENERGY INDIRECT 3.3% ($67 billion)
CONSTRUCTION 1.4%
OTHER 1.9%
ENERGY’S NOMINAL GDP CONTRIBUTION BY PROVINCE/TERRITORY (2017)

Energy sector nominal GDP* ($ millions)

- Y.T.: 42
- N.W.T.: 109
- Nunavut: 45
- B.C.: 12,947
- Alta.: 79,618
- Sask.: 13,168
- Man.: 3,501
- Ont.: 15,896
- Que.: 14,859
- P.E.I.: 99
- N.B.: 2,259
- N.L.: 6,662
- N.S.: 919

*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, 2012–2016 AVERAGE ($ BILLIONS)

- **Royalties**: $9, 51%
- **Land Sales**: $1.5, 8%
- **Income Taxes**: $4.6, 26%
- **Indirect Taxes**: $2.7, 15%
- **Total**: $17.8

- An important share of government revenues is collected from the oil and gas industry, which averaged **$15.8 billion** over the last five years, including **$12.9 billion** from upstream oil and gas extraction and its support activities.
- Between 2012 and 2016, the energy sector’s share of total taxes paid by all industries was **8.4%** and brought in **over 11%** of all operating revenues earned by the federal and provincial/territorial governments in Canada.
EMPLOYMENT IN CANADA’S ENERGY SECTOR

ENERGY SECTOR DIRECT EMPLOYMENT BY PROVINCE/TERRITORY*
DIRECT: 276,000 JOBS
INDIRECT: 624,000 JOBS
TOTAL: 900,000 JOBS

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

- About 16,700 Indigenous people living off-reserve are directly employed in the energy sector.

SHARE OF TOTAL EMPLOYMENT, 2017

TOTAL EMPLOYMENT
ENERGY DIRECT 1.5%
OIL AND GAS 0.4%
ELECTRICITY 0.4%
OTHER 0.7%
ENERGY INDIRECT 3.4%
CONSTRUCTION 1.4%
OTHER 2%

12 Energy Fact Book
• Capital expenditures in Canada’s energy sector totalled $71 billion in 2017, a decrease of 39% from their peak in 2014.

• Investment recovered slightly in 2017 following two years of declines, driven by a $1 billion increase from 2016 in electric power generation, transmission and distribution spending, and an additional $0.7 billion in pipeline transportation.

*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.

* Stock of foreign direct investment* in Canada and Canadian direct investment abroad in the energy industry

*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 declined 12% in 2017 from the previous year, driven primarily by a $17 billion decrease in oil and gas extraction assets.

• The energy industry’s share of overall FDI in Canada was 22% in 2017, down 3% from 2016.

• The stock of Canadian direct investment abroad (CDIA) was valued at $126 billion in 2017.

• Investment in oil and gas extraction accounted for $59 billion of the CDIA stock in 2017.

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 2016 to $569.3 billion, an increase of almost 6% from $539.2 billion in 2015. In 2016, domestic CEAs totalled $388.5 billion, down 1% from 2015, while Canadian energy assets abroad totalled $180.8 billion, up from $146.3 billion. The increase in assets abroad was driven primarily by a $36.5 billion increase in the U.S. and Mexico.

* 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 2016/17, federal energy RD&D expenditures were **$466 million** and provincial/territorial* (P/T) government energy RD&D expenditures were **$195 million** for a combined total of **$661 million**, down from **$894 million** in 2015/16:

In 2016/17, federal spending was more than double P/T spending. The reduction in total spending relative to 2015/16 was largely driven by a decrease in P/T spending, particularly in the area of carbon capture, utilization and storage (CCUS).

Canadian federal departments, agencies and organizations increased their Mission Innovation-related expenditures to **$438 million** in 2016/17, or **13%** higher than the baseline level in 2014/15.**

Mission Innovation ([mission-innovation.net](http://mission-innovation.net)) is an international initiative of **24 governments** aimed at accelerating global clean energy innovation.

* Provincial and territorial includes utilities and other publicly owned entities.
** Canada’s Mission Innovation baseline of $387 million is a subset of Canada’s federal energy RD&D spending of $416 million in 2014/15 that excludes nuclear activities not directly related to clean energy RD&D.

The Canadian industry spent about **$1.6 billion on energy R&D** in 2015, a decrease from **$2.1 billion** in 2014.
**CANADIAN PUBLIC EXPENDITURES ON ENERGY RD&D**

* Provincial and territorial includes utilities and other publicly owned entities.

** The decrease in P/T spending between 2013/14 and 2014/15 was largely due to a decrease in carbon capture, utilization and storage (CCUS) related spending after construction of a large CCUS project in Saskatchewan was completed in 2014/15.
## EXPENDITURES ON TOTAL ENERGY RD&D BY TECHNOLOGY AREA ($ MILLIONS)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fuels (including CCUS)</td>
<td>91</td>
<td>82</td>
<td>983</td>
</tr>
<tr>
<td>Renewable and clean energy</td>
<td>227</td>
<td>85</td>
<td>361</td>
</tr>
<tr>
<td>Energy end use</td>
<td>148</td>
<td>29</td>
<td>219</td>
</tr>
<tr>
<td><strong>Total</strong>*</td>
<td><strong>466</strong></td>
<td><strong>195</strong></td>
<td><strong>1,563</strong></td>
</tr>
</tbody>
</table>

*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 2016.

- 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.
The TSX and TSX-Venture exchanges list 90 companies in the cleantech sector, with a total market capitalization of $40.8 billion. Of those companies, 77 are headquartered in Canada, with a total market capitalization of $37.1 billion (as of May 31, 2018).

Environmental and clean technology (2016):

- $59.3 billion of GDP (3.1% of total GDP)
- 274,000 jobs representing 1.5% of jobs in the Canadian economy
- $11.5 billion in exports

Of this, clean energy alone accounted for

- 1.3% of Canada’s GDP
- and employed 56,000 people.
INVESTMENT IN RENEWABLE ENERGY BY TECHNOLOGY IN CANADA FROM 2013 TO 2017

Wind $13.7 BILLION

Small hydro $1.0 BILLION

Solar $6.0 BILLION

Biomass and waste $0.6 BILLION

Biofuels $0.9 BILLION
RENEWABLE ENERGY INVESTMENTS IN CANADA, 2013–2017*

* not including large hydro

<table>
<thead>
<tr>
<th>Year</th>
<th>Wind - onshore</th>
<th>Solar - PV</th>
<th>Hydro - small (up to 50MW)</th>
<th>Biofuels</th>
<th>Biomass and waste</th>
<th>Geothermal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>3.9</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>2.8</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>1.3</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>3.2</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
**HOUSEHOLD EXPENDITURES ON ENERGY**

- Canadian households **spent $4,086** on average on energy in 2016.
- Residential expenditures, including for heating/cooling spaces, lighting and operating appliances, averaged **$2,136**.
- Transportation expenditures averaged **$1,950**.
- Energy accounted for **6.6%** of current household consumption. Lower-income households spend a larger share of their disposable income on energy.

**ENERGY RETAIL PRICES**

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

![CONSUMER PRICE INDEX (2002=100)](chart)
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 2016, Canada’s GHG emissions decreased by 4% while GDP increased 36%. GHG emissions decreased 23% per dollar of GDP and 18% per capita.

Emissions from oil and gas production increased 15% because of a 34% increase in production.

Emissions from buildings have decreased almost 5% despite an increase in floor space of 31% over the same period. This is largely due to higher energy efficiency standards.
SPOTLIGHT: OIL AND GAS

GHG emissions from oil and gas production have gone up 15% between 2000 and 2016, largely from increased oil sands production, particularly in situ extraction.

During this period, oil sands production emissions nearly tripled while conventional oil and natural gas emissions decreased by 19%.

Due to technological and operational efficiency improvements, oil sands emissions per barrel have decreased 29% from 2000 to 2016.
SPOTLIGHT: ELECTRICITY

Total electricity emissions **decreased by 39%** from 2000 to 2016 because of increased generation from non-emitting sources.

Coal-fired electricity generation accounted for **9% of generation** and **75% of electricity-related GHG emissions** in 2016.
Renewable electricity generation has increased 17% between 2010 and 2016, with solar and wind having the largest growth.

In 2016, 81% of electricity in Canada came from non-GHG emitting sources. Hydro made up 59%, nuclear was 15%, and other renewables were the remaining 7%.
SPOTLIGHT: TRANSPORTATION

- **Transportation GHG emissions** have increased 19% from 2000 to 2016. 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.

TRANSPORTATION SECTOR GHG EMISSIONS FOR CANADA, 2000–2016

- Total transportation energy use increased 16% from 2000 to 2015.
- Energy efficiency improvements in the transportation sector saved Canadians 643 PJ of energy and almost $18 billion in energy costs in 2015.
- Passenger transportation contributes 52% to the total emissions, freight emissions are 44%, and off-road emissions are 4%.

* The ethanol proportion is estimated based on production data.
In 2015, electricity powered less than 0.5% of all transportation.

In the first quarter of 2018, electric vehicle (EV) sales made up 1.5% of total vehicle sales.

Almost 19,000 plug-in EVs were sold in 2017, up 56% from 2016. Sales are highest in the provinces of Quebec, Ontario and British Columbia.

To ensure continued uptake, the Government of Canada is partnering with the private sector and is investing $182.5 million to support the demonstration and deployment of new charging stations for EVs as well as refueling stations for alternative fuels such as hydrogen and natural gas and is committed to developing a national strategy for zero emission vehicles in 2018.
A look at Canada’s total primary energy supply (TPES) helps the observer to better understand the impact of energy sources on GHG emissions. The TPES is calculated as:

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

- Fossil fuels made up 74% of Canada’s TPES in 2016.
- Renewable energy sources made up 17.4% of Canada’s TPES in 2016.

Comparatively, the global TPES is made up of:

- **82%** Fossil fuel (oil 32%, coal 28%, natural gas 22%)
- **13%** Renewables
- **5%** Uranium

* 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).
**PRIMARY AND SECONDARY ENERGY USE BY SECTOR (2015)**

- 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 **12,844 PJ**.

<table>
<thead>
<tr>
<th>PRIMARY ENERGY USE</th>
<th>SECONDARY ENERGY USE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDUSTRIAL</td>
<td>28%</td>
</tr>
<tr>
<td>TRANSPORTATION</td>
<td>21%</td>
</tr>
<tr>
<td>RESIDENTIAL</td>
<td>12%</td>
</tr>
<tr>
<td>COMMERCIAL</td>
<td>8%</td>
</tr>
<tr>
<td>AGRICULTURE</td>
<td>2%</td>
</tr>
</tbody>
</table>

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

**ENERGY LOSSES (CONVERSION)**

- **14%**

**NON-ENERGY (FEEDSTOCK)**

- **7%**

**NON-COVERED PRODUCER/CONSUMPTION**

- **7%**

**PIPELINE**

- **1%**

**SECONDARY ENERGY USE**

- **71%**
- 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 2015 was **9,013 PJ**.
- Total secondary energy use increased 11% from 2000 to 2015. Natural gas usage grew the most of all fuel types, increasing by almost 29% during the same period.

* “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 26.5%** between 1990 and 2015.

- **Energy use grew by 30%** between 1990 and 2015. Without energy efficiency improvements, energy use would have grown by 55%.

- **Energy efficiency savings** of **1,766 PJ** in 2015 were equivalent to end-user savings of **$38.2 billion**.

### SECONDARY ENERGY USE WITH AND WITHOUT ENERGY EFFICIENCY EFFECT, 1990–2015

- **Savings from efficiency 1,766 PJ**
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.

• **81%** of residential energy consumption is used for space and water heating.

• Residential energy efficiency improved by **46%** between 1990 and 2015, saving **656 PJ** of energy and **$13.3 billion** in energy costs.
RESIDENTIAL APPLIANCES ENERGY USE (PJ), 2015

TOTAL 1,544 PJ

SPACE COOLING 32 2%

LIGHTING 58 4%

APPLIANCES 201 13%

WATER HEATING 289 19%

SPACE HEATING 964 62%

TOTAL 1,544 PJ

WATER-HEATING ENERGY USE (PJ), 2015

ELECTRICITY 83 29%

HEATING OIL 195 68%

WATER HEATING 289 19%

WOOD 1 0%

OTHER 72 2%

SPACE-HEATING ENERGY USE (PJ), 2015

ELECTRICITY 242 25%

HEATING OIL 486 50%

WATER-HEATING ENERGY USE (PJ), 2015

HEATING OIL 161 17%

WOOD 12 1%

OTHER 63 7%

TOTAL 964 PJ

ELECTRICITY 242 25%

HEATING OIL 486 50%
COMMERCIAL AND INSTITUTIONAL ENERGY USE BY END USE, 2015

- **Space Heating**: 55%
- **Lighting**: 11%
- **Auxiliary Equipment**: 14%
- **Auxiliary Motors**: 6%
- **Water Heating**: 8%
- **Space Cooling**: 5%
- **Street Lighting**: 1%

**Total**: 1,009 PJ

Commercial and institutional energy use increased between 1990 and 2015 35%, but would have increased 58% without energy efficiency improvements.

Energy intensity (GJ/m²) decreased 8%.

Since 1990, energy efficiency in the commercial and institutional sector has improved 23%, saving Canadians 169 PJ of energy and $3.8 billion in energy costs in 2015.
The industrial sector includes all manufacturing, mining (including oil and gas extraction), forestry and construction activities.

From 1990 to 2015, industrial energy use increased 31%. It would have increased 42% without energy efficiency improvements.

As a result of these improvements, the industrial sector’s energy efficiency improved 11%, saving 298 PJ and $3.2 billion in energy costs in 2015.

* “Other” includes HFO, coke and coke oven gas, coal, LPGs, NGLs, steam and waste.
Per capita energy consumption was 5% lower in 2015 than in 2000. Canada used 17% less energy per dollar of GDP in 2015 than in 2000.
SUMMARY OF FACTORS INFLUENCING THE CHANGE IN ENERGY USE, 1990–2015

- **Activity**: major drivers of energy use in a sector (e.g. floor space area in the commercial/institutional sector)

- **Structure**: refers to change in the makeup of each sector

- **Service level**: increased penetration of auxiliary equipment in commercial/institutional buildings

- **Energy efficiency**: how effectively energy is being used for a given purpose. For example, providing a similar (or better) level of service with less energy consumption on a per unit basis is considered an improvement in energy efficiency.

* “Other” refers to street lighting, non-commercial airline aviation, off-road transportation and agriculture, which are included in the “Total change in energy use” column but are excluded from the factorization analysis.
TRENDS IN ENERGY USE AND INTENSITY BY SECTOR, 1990–2015

RESIDENTIAL
Energy use 8%
Energy intensity -35%

COMMERCIAL
Energy use 36%
Energy intensity -8%

TRANSPORTATION (passenger)
Energy use 19%
Energy intensity -22%

FREIGHT
Energy use 72%
Energy intensity 2%

INDUSTRIAL (forestry, mining, manufacturing, construction)
Energy use 31%
Energy intensity -10%

INDUSTRY (w/o upstream mining)
Energy use -6%
Energy intensity -32%
## INTERNATIONAL CONTEXT

### CRUDE OIL

#### World production* – 95.3 MMb/d (2017)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>14%</td>
</tr>
<tr>
<td>2</td>
<td>Saudi Arabia</td>
<td>12%</td>
</tr>
<tr>
<td>3</td>
<td>Russia</td>
<td>12%</td>
</tr>
<tr>
<td>4</td>
<td>Canada</td>
<td>5%</td>
</tr>
<tr>
<td>5</td>
<td>Iran</td>
<td>5%</td>
</tr>
</tbody>
</table>

#### World exports* – 46.8 MMb/d (2016)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Saudi Arabia</td>
<td>16%</td>
</tr>
<tr>
<td>2</td>
<td>Russia</td>
<td>11%</td>
</tr>
<tr>
<td>3</td>
<td>Iraq</td>
<td>8%</td>
</tr>
<tr>
<td>4</td>
<td>Canada</td>
<td>7%</td>
</tr>
<tr>
<td>5</td>
<td>Iran</td>
<td>5%</td>
</tr>
</tbody>
</table>

* includes crude oil, NGLs, additives and other hydrocarbons (including the receipts of additives).
Of Canada’s proven oil reserves, 98% are located in the oil sands.

World proved reserves
1,662 billion barrels
(at the end of 2017)

Venezuela: 18%
Saudi Arabia*: 16%
Canada: 10%
Iran: 9%
Iraq: 10%
Other: 37%

* 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 2017)

<table>
<thead>
<tr>
<th></th>
<th>Wells completed</th>
<th>Average metres drilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>4,600</td>
<td>1,000</td>
</tr>
<tr>
<td>2006</td>
<td>6,000</td>
<td>1,200</td>
</tr>
<tr>
<td>2007</td>
<td>7,000</td>
<td>1,400</td>
</tr>
<tr>
<td>2008</td>
<td>8,000</td>
<td>1,600</td>
</tr>
<tr>
<td>2009</td>
<td>9,000</td>
<td>1,800</td>
</tr>
<tr>
<td>2010</td>
<td>10,000</td>
<td>2,000</td>
</tr>
<tr>
<td>2011</td>
<td>12,000</td>
<td>2,200</td>
</tr>
<tr>
<td>2012</td>
<td>14,000</td>
<td>2,400</td>
</tr>
<tr>
<td>2013</td>
<td>14,000</td>
<td>2,600</td>
</tr>
<tr>
<td>2014</td>
<td>14,000</td>
<td>2,800</td>
</tr>
<tr>
<td>2015</td>
<td>14,000</td>
<td>3,000</td>
</tr>
<tr>
<td>2016</td>
<td>12,000</td>
<td>3,200</td>
</tr>
<tr>
<td>2017</td>
<td>10,000</td>
<td>3,400</td>
</tr>
</tbody>
</table>

* 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 2017, oil sands production was 2.7 MMb/d compared with 1.5 MMb/d of other oil production.

**PRODUCTION BY TYPE**

- Oil sands
- Conventional, offshore and tight oil

**PRODUCTION BY PROVINCE, 2017**

- **Alberta**: 80.7%
- **Saskatchewan**: 11.7%
- **Newfoundland and Labrador**: 5.3%
- **British Columbia**: 1.4%
- **Manitoba**: 0.9%
- **Other***: 0.1%

*Other: Nova Scotia, Ontario and the Northwest Territories include crude oil, condensates and pentanes plus.
CANADIAN SUPPLY AND DEMAND* (2017)

Canadian production: 4.2 MMb/d
Exports: 3.3 MMb/d
Imports: 0.8 MMb/d

CRUDE OIL SHIPPED TO DOMESTIC REFINERIES: 1.8 MMb/d

TRADE

CANADIAN TRADE OF CRUDE OIL

* includes condensates and pentanes plus.

Exports
Imports

Million barrels per day

**Imports of crude oil** and equivalents into Canada come from a wide range of countries, including:

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>61%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>12%</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>6%</td>
</tr>
<tr>
<td>Norway</td>
<td>5%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>4%</td>
</tr>
</tbody>
</table>

In 2017, Canada was the **largest foreign supplier of crude oil** to the U.S., accounting for

- **43%** of total U.S. crude oil imports
- **21%** of U.S. refinery crude oil intake

**exported** 3.3 MMb/d to the U.S., representing **99%** of all Canadian crude oil and equivalent exports.
PRICES

WEST TEXAS INTERMEDIATE

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

HIGHLIGHTS FOR WTI

<table>
<thead>
<tr>
<th>Year</th>
<th>Average (US$)</th>
<th>Peak or Low (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>$94</td>
<td>$147</td>
</tr>
<tr>
<td>2013</td>
<td>$98</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>$93</td>
<td>$107</td>
</tr>
<tr>
<td>2015</td>
<td>$49</td>
<td>$26</td>
</tr>
<tr>
<td>2016</td>
<td>$43</td>
<td>$43</td>
</tr>
<tr>
<td>2017</td>
<td>$51</td>
<td>$51</td>
</tr>
</tbody>
</table>
| Average: 2018 (first 6 months) | $65 | }
OIL SANDS

An estimated $301 billion of capital investment to date, including $12.8 billion in 2017

BITUMEN UPGRADING

• Crude bitumen from oil sands may be transported to upgraders for processing to make it lighter – “synthetic crude oil.”

• In 2017, 43% 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 1.29 MMb/d (more information on upgrading is in the “Petroleum Products” chapter.)

• 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 2017, seven projects in Alberta produced 1,252 Mb/d: Syncrude Mining Project (301 Mb/d), Suncor Base Mine (300 Mb/d), CNRL Horizon Mine (206 Mb/d), Athabasca Oil Sands Project – Muskeg River (155 Mb/d), Jackpine Mine (100 Mb/d), Imperial’s Kearl Mine (184 Mb/d) and Fort Hills (6 Mb/d).
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 2017 were Christina Lake (Cenovus) at 219 Mb/d, Firebag (Suncor) at 176 Mb/d, Foster Creek (Cenovus) at 165 Mb/d and Cold Lake (Imperial Oil) at 158 Mb/d.

![Diagram](image-url)
OIL SANDS: ENVIRONMENTAL CONSIDERATIONS

WATER

Mining method:

2.5 barrels

In situ method: an average of

0.21 barrels

Oil sands producers recycle about

80–95% of the water used for established mines

85–95% of the water used for in situ production

Water required

Water of fresh

per barrel of bitumen

Water of fresh

per barrel of bitumen

Water of fresh
GREENHOUSE GASES

10% of Canada’s total GHG emissions and 0.1% of global emissions

From 2000 to 2016, the emission intensity of oil sands operations dropped by about 29% 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

1. Enbridge Pipelines (NW) Inc.
2. Enbridge Pipelines Inc.
3. Express Pipeline Ltd.
4. Montreal Pipe Line Limited
5. Trans Mountain Pipeline Inc.
6. Trans-Northern Pipelines Inc.
7. Aurora Pipeline
8. Enbridge Pipelines (Westpur) Inc.
9. Milk River Pipeline
10. Wascana Pipeline
11. Enbridge Southern Lights GP Inc.
12. TransCanada Keystone Pipelines
13. Kinder Morgan Cochin ULC
14. Enbridge Bakken Pipeline Company Inc.

*Non-NEB regulated pipelines
BY RAIL

Although crude oil is transported primarily by pipeline, some is transported by rail, especially when sufficient pipeline capacity is not available. In 2017, the volume of crude exported by rail increased 18% to an average of 131 Mb/d, up from 87.8 Mb/d in 2016. Crude exports by rail reached a peak of 199 Mb/d in May 2018*.

* This was the latest month of data available at time of publishing.
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** (2017)

- **Canadian production**: 2.0 MMb/d (116 billion L)
- **Exports**: 0.5 MMb/d (29 billion L)
- **Imports**: 0.3 MMb/d (16 billion L)

**Domestic sales**: 1.9 MMb/d (108 billion L)

**SALES BY PRODUCT**

- **GASOLINE**: 44%
- **DIESEL**: 29%
- **AVIATION FUELS**: 7%
- **HEATING OIL**: 2%
- **HEAVY FUEL OIL**: 3%
- **OTHER****: 15%

* Certain product shares are based on Natural Resources Canada estimates.
** “Other” includes LPGs, petrochemical feedstock, lubricating oils, petroleum coke, asphalt, etc.
The Canadian Trade of Refined Petroleum Products

- **Exports**
- **Imports**

### CANADIAN TRADE OF REFINED PETROLEUM PRODUCTS

- **Exports**: United States 88%, Netherlands 74%, United Kingdom 10%, Belgium 4%, Canada 22%
- **Imports**: United States 74%, Netherlands 10%, United Kingdom 4%, Belgium 4%, Canada 22%

### Statistics
- **25%** of Canadian production of refined petroleum products is exported.
- **88%** of United States imports come from Canada.
- **15%** of Canadian consumption of refined petroleum products is imported.
### Average Canadian Gasoline and Diesel Price, 2017

<table>
<thead>
<tr>
<th></th>
<th>Gasoline</th>
<th>Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provincial taxes (include the provincial portion of the HST)</td>
<td>24.8</td>
<td>22.2</td>
</tr>
<tr>
<td>Federal taxes (GST + excise taxes (10.0 cpl for gasoline, 4.0 cpl for diesel))</td>
<td>15.1</td>
<td>10.9</td>
</tr>
<tr>
<td>Refining and marketing costs</td>
<td>31.3</td>
<td>33.5</td>
</tr>
<tr>
<td>Estimated crude cost</td>
<td>43.4</td>
<td>43.4</td>
</tr>
</tbody>
</table>
## REFINERY CAPACITY

CANADIAN PETROLEUM REFINERIES BY COUNT AND CAPACITY*, 2017

<table>
<thead>
<tr>
<th>Province</th>
<th>Petroleum refinery</th>
<th>Asphalt plants</th>
<th>Petrochemical plants (using crude oil as feedstock)</th>
<th>Upgraders**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>Capacity</td>
<td>Count</td>
<td>Capacity</td>
</tr>
<tr>
<td>Alberta</td>
<td>3</td>
<td>429</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>British Columbia</td>
<td>2</td>
<td>69</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>1</td>
<td>318</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Newfoundland and Labrador</td>
<td>1</td>
<td>130</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ontario</td>
<td>4</td>
<td>392</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Quebec</td>
<td>2</td>
<td>402</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>1</td>
<td>130</td>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
<td>1,870</td>
<td>2</td>
<td>48</td>
</tr>
</tbody>
</table>

*Capacities are in Mb/d.
**Capacities reported are for inputs of heavy crude oil or bitumen.
HYDROCARBON

GAS LIQUIDS
SUPPLY AND DEMAND* (2017)

Canadian production

<table>
<thead>
<tr>
<th></th>
<th>Propane</th>
<th>Butane</th>
<th>Ethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>672.4 Mb/d</td>
<td>252.9 Mb/d</td>
<td>176.2 Mb/d</td>
</tr>
<tr>
<td>Imports</td>
<td>73.3 Mb/d</td>
<td>73.3 Mb/d</td>
<td>73.3 Mb/d</td>
</tr>
</tbody>
</table>

GAS PROCESSING PLANT PRODUCTION OF NGLS BY PROVINCE

- ALTA. 86%
- B.C. 10.1%
- SASK. 3.4%
- N.S. 0.4%

*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 127.7 PJ IN 2015.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Energy use* (PJ)</th>
<th>% of the total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>14.0</td>
<td>11.0%</td>
</tr>
<tr>
<td>Commercial</td>
<td>34.1</td>
<td>26.7%</td>
</tr>
<tr>
<td>Industrial</td>
<td>60.0</td>
<td>47.0%</td>
</tr>
<tr>
<td>Transportation</td>
<td>10.6</td>
<td>8.3%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>8.9</td>
<td>7.0%</td>
</tr>
<tr>
<td>Total</td>
<td>127.7</td>
<td>100%</td>
</tr>
</tbody>
</table>

*secondary energy use

NATURAL GAS LIQUIDS ENERGY USE BY PROVINCE, 2015

- ALTA. 39%
- B.C. AND TERR. 6%
- ATL. 4%
- QUE. 13%
- ONT. 28%
- SASK. 7%
- MAN. 3%

TOTAL 128 PJ
Uranium is a silvery-white metal containing energy. After being mined, milled, refined and converted, uranium fuels nuclear power generation.
### INTERNATIONAL CONTEXT

#### NATURAL GAS

**World production – 365 Bcf/d (10.3 Bcm/d)**
(2017, PRELIMINARY)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>Russia</td>
<td>18%</td>
</tr>
<tr>
<td>3</td>
<td>Iran</td>
<td>6%</td>
</tr>
<tr>
<td>4</td>
<td>Canada</td>
<td>5%</td>
</tr>
<tr>
<td>5</td>
<td>Qatar</td>
<td>4%</td>
</tr>
</tbody>
</table>

**World exports – 117 Bcf/d (3.3 Bcm/d)**
(2017, PRELIMINARY)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Russia</td>
<td>19%</td>
</tr>
<tr>
<td>2</td>
<td>Norway</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>Qatar</td>
<td>10%</td>
</tr>
<tr>
<td>4</td>
<td>United States</td>
<td>7%</td>
</tr>
<tr>
<td>5</td>
<td>Canada</td>
<td>7%</td>
</tr>
</tbody>
</table>
### World proved reserves – 6,955 Tcf (197 Tcm) (BEGINNING OF 2018)

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>24%</td>
</tr>
<tr>
<td>Iran</td>
<td>17%</td>
</tr>
<tr>
<td>Qatar</td>
<td>12%</td>
</tr>
<tr>
<td>United States</td>
<td>5%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>4%</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td><strong>17 Canada</strong></td>
<td><strong>1%</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>15%</td>
</tr>
<tr>
<td>Argentina</td>
<td>11%</td>
</tr>
<tr>
<td>Algeria</td>
<td>9%</td>
</tr>
<tr>
<td>United States</td>
<td>8%</td>
</tr>
<tr>
<td><strong>5 Canada</strong></td>
<td><strong>8%</strong></td>
</tr>
</tbody>
</table>
**CANADA-U.S. RESOURCES**

**PROVED RESERVES** (AT THE END OF 2016)

<table>
<thead>
<tr>
<th>Country</th>
<th>Conventional</th>
<th>Tight gas</th>
<th>Gas-rich shale</th>
<th>Coal bed methane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>73 Tcf</td>
<td>341 Tcf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td>341 Tcf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>414 Tcf</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MARKETABLE/TECHNICALLY RECOVERABLE RESOURCES**

**Canada total, year-end 2016**

- **Conventional**: 228–234 Tcf
- **Unconventional**: 632–1,534 Tcf
  - **Shale and tight gas**: 1,396 Tcf
  - **Other**: 1,067 Tcf

**U.S. total, year-end 2015**

- **Conventional**: 15,256 Tcf
- **Unconventional**: 12,890 Tcf

**World total**: 28,146 Tcf

- **Conventional**: 15,256 Tcf
- **Unconventional**: 12,890 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’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**

16.1 Bcf/d (0.5 Bcm/d)

- **20%** conventional
- **80%** unconventional*

**U.S. average marketable production**

73.6 Bcf/d (2.1 Bcm/d)

- **23%** conventional
- **77%** unconventional*

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

**Canada-U.S. production**

90.3 Bcf/d (2.6 Bcm/d)

**LNG imports of North American countries**

- **0.04** Bcf/d (Canada)
- **0.66** Bcf/d (Mexico)
- **0.21** Bcf/d (United States)

**LNG exports of North American countries**

- **1.74** Bcf/d (United States)
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.
**MARKETABLE PRODUCTION BY PROVINCE, 2017**

- **B.C.:** 25%
- **N.S.:** 1%
- **SASK.:** 2%
- **ALTA.:** 72%
- **TOTAL:** 16 Bcf/d (0.44 Bcm/d)

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

- **Canada:**
  - 2003-2005: 10 Bcf/d (0.28 Bcm/d)
  - 2007-2009: 12 Bcf/d (0.34 Bcm/d)
  - 2011-2013: 15 Bcf/d (0.42 Bcm/d)
  - 2015-2017: 16 Bcf/d (0.44 Bcm/d)

- **United States:**
  - 2003-2005: 33 Bcf/d (0.93 Bcm/d)
  - 2007-2009: 20 Bcf/d (0.56 Bcm/d)
  - 2011-2013: 30 Bcf/d (0.83 Bcm/d)
  - 2015-2017: 40 Bcf/d (1.1 Bcm/d)

**CANADA TRADE OF NATURAL GAS**

- **Exports:**
  - 2003-2005: 0 Bcf/d
  - 2007-2009: 6 Bcf/d (0.17 Bcm/d)
  - 2011-2013: 9 Bcf/d (0.25 Bcm/d)
  - 2015-2017: 12 Bcf/d (0.33 Bcm/d)

- **Imports:**
  - 2003-2005: 3 Bcf/d (0.08 Bcm/d)
  - 2007-2009: 4 Bcf/d (0.11 Bcm/d)
  - 2011-2013: 7 Bcf/d (0.19 Bcm/d)
  - 2015-2017: 10 Bcf/d (0.27 Bcm/d)

- **Canadian exports to the U.S.:** 8.2 Bcf/d (0.23 Bcm/d)
- **Canadian imports from the U.S.:** 2.4 Bcf/d (0.07 Bcm/d)
• 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.

51% of Canadian production is exported.

All Canadian exports go to the U.S.

97% of U.S. imports and 11% of U.S. consumption comes from Canada.

The value of Canadian net exports (exports minus imports) was $6.7 billion in 2017.

98% of Canada’s imports and 20% of Canadian consumption comes from the U.S.
UPSTREAM PRICES

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

AECO PRICE

<table>
<thead>
<tr>
<th>Average Year</th>
<th>Price ($) Per MMbtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007–2016</td>
<td>4.18</td>
</tr>
<tr>
<td>2015</td>
<td>2.70</td>
</tr>
<tr>
<td>2016</td>
<td>2.18</td>
</tr>
<tr>
<td>2017</td>
<td>2.20</td>
</tr>
<tr>
<td>2018*</td>
<td>1.88</td>
</tr>
</tbody>
</table>

* First four months
TRANSPORTATION

BY PIPELINE

1. Alliance Pipeline
2. Sable Offshore Energy Project
3. TransCanada Foothills System (B.C. and SK)
4. Maritimes and Northeast Pipeline
5. Trans Quebec and Maritimes Pipeline
6. TransCanada Mainline
7. Westcoast Pipeline
8. NGTL System
9. Emera Brunswick Pipeline Company Ltd.
NATURAL GAS ENERGY USE

TOTAL NATURAL GAS ENERGY USE* WAS 2,754 PJ IN 2015.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Energy use (PJ)</th>
<th>Energy use (Bcf/d)</th>
<th>% of the total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>689.8</td>
<td>1.71</td>
<td>25%</td>
</tr>
<tr>
<td>Commercial</td>
<td>512.9</td>
<td>1.27</td>
<td>18.6%</td>
</tr>
<tr>
<td>Industrial</td>
<td>1,508.1</td>
<td>3.74</td>
<td>54.8%</td>
</tr>
<tr>
<td>Transportation</td>
<td>3.9</td>
<td>0.01</td>
<td>0.1%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>39.1</td>
<td>0.10</td>
<td>1.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,753.8</strong></td>
<td><strong>6.83</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*secondary energy use

TOTAL NATURAL GAS ENERGY USE BY PROVINCE, 2015

- ALTA. 42%
- B.C. AND TERR. 8%
- ATL.* 1%
- QUE. 10%
- SASK. 5%
- MAN. 2%
- ONT. 32%

* Atlantic provinces
### INTERNATIONAL CONTEXT

#### ELECTRICITY

**World production – 25,082 TWh (2016)**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>25%</td>
</tr>
<tr>
<td>2</td>
<td>United States</td>
<td>17%</td>
</tr>
<tr>
<td>3</td>
<td>India</td>
<td>6%</td>
</tr>
<tr>
<td>4</td>
<td>Russia</td>
<td>4%</td>
</tr>
<tr>
<td>5</td>
<td>Japan</td>
<td>4%</td>
</tr>
<tr>
<td>6</td>
<td>Canada</td>
<td>3%</td>
</tr>
</tbody>
</table>

**World exports – 724 TWh (2016)**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Germany</td>
<td>11%</td>
</tr>
<tr>
<td>2</td>
<td>Canada</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>France</td>
<td>8%</td>
</tr>
<tr>
<td>4</td>
<td>Paraguay</td>
<td>7%</td>
</tr>
<tr>
<td>5</td>
<td>Switzerland</td>
<td>4%</td>
</tr>
</tbody>
</table>
TRADE (2017)

All Canadian electricity trade is with the U.S.

EXPORTS

72 TWh

IMPORTS

10 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 – 648.4 TWh

GENERATION BY SOURCE, 2016

- **Hydro**: 59% (Canada 59.1%)
- **Non-Hydro Renewables**: 7%
- **Coal**: 9%
- **Gas/Oil/Others**: 10%
- **Nuclear**: 15% (Canada 9.2%)

**HYDRO**
- Canada: 59.1%
- Man.: 97.0%
- Que.: 95.3%
- N.L.: 94.3%
- Y.T.: 93.7%
- B.C.: 89.4%
- N.W.T.: 37.4%
- Ont.: 22.3%
- N.B.: 21.5%
- Sask: 13.3%
- N.S.: 8.7%
- Alta.: 2.8%

**NUCLEAR**
- Canada: 14.7%
- Ont.: 57.5%
- N.B.: 31.2%
- P.E.I.: 98.1%
- N.S.: 10.4%
- Alta.: 7.0%
- N.B.: 5.9%
- Que.: 3.6%
- Sask: 3.0%
- Man.: 2.4%
- N.W.T.: 2.1%
- B.C.: 1.4%
- N.L.: 0.5%
- Y.T.: 0.1%

**WIND**
- Canada: 4.7%
PROVINCIAL ELECTRICITY GENERATION BY SOURCE, 2016

BIOMASS
- Canada 1.7%
  - B.C. 7.1%
  - N.S. 4.5%
  - N.B. 3.6%
  - Alta. 1.6%
  - Ont. 1.3%
  - Que. 0.8%
  - P.E.I. 0.7%
  - Man. 0.2%

NATURAL GAS
- Canada 9.2%
  - Alta. 38.6%
  - Sask 34.8%
  - N.B. 16.3%
  - N.S. 12.6%
  - Ont. 9.3%
  - N.W.T. 2.2%
  - B.C. 2.0%
  - Y.T. 0.7%
  - N.L. 0.6%
  - Man. 0.2%

PETROLEUM
- Canada 1%
  - Nunavut 100%
  - N.W.T. 58.3%
  - N.S. 15.1%
  - N.B. 6.7%
  - Y.T. 5.3%
  - N.L. 4.6%
  - Alta. 1.3%
  - P.E.I 1.0%
  - Que. 0.2%
  - B.C. 0.1%
  - Man. 0.1%
  - Ont. 0.1%

SOLAR
- Canada 0.5%
  - Ont. 1.9%
  - N.S. 0.2%
  - P.E.I 0.2%
  - N.W.T. 0.1%
  - Y.T. 0.1%

COAL
- Canada 9%
  - Sask. 48.9%
  - Alta. 48.5%
  - N.S. 48.5%
  - N.B. 14.8%
  - Man. 0.1%

OTHER
- Canada 0.2%
  - Alta. 0.2%
  - Ont. 0.1%

TIDAL
- N.S. 0.2%
ELECTRICITY PRICES

AVERAGE LARGE INDUSTRIAL AND RESIDENTIAL ELECTRICITY PRICES* (AS OF APRIL 2017) in cents/kWh

*including taxes

- Vancouver: 7.05 cents/kWh
- Edmonton: 5.55 cents/kWh
- Regina: 8.88 cents/kWh
- Winnipeg: 4.83 cents/kWh
- Montréal: 5.64 cents/kWh
- Toronto: 7.19 cents/kWh
- Charlottetown: 10.71 cents/kWh
- Halifax, N.S.: 18.88 cents/kWh
- St. John’s: 11.66 cents/kWh
- Moncton: 14.92 cents/kWh
- Vancouver: 11.83 cents/kWh
- Edmonton: 10.86 cents/kWh
- Regina: 18.33 cents/kWh
- Winnipeg: 10.07 cents/kWh
- Montréal: 10.07 cents/kWh
- Toronto: 18.62 cents/kWh
- Charlottetown: 11.66 cents/kWh
- Halifax, N.S.: 18.88 cents/kWh
- St. John’s: 12.83 cents/kWh

*including taxes
ELECTRICAL ENERGY USE

TOTAL ELECTRICAL ENERGY USE* WAS 1,784 PJ IN 2015

<table>
<thead>
<tr>
<th>Sector</th>
<th>Energy use (PJ)</th>
<th>% of the total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>608.5</td>
<td>34.1%</td>
</tr>
<tr>
<td>Commercial</td>
<td>425.2</td>
<td>23.8%</td>
</tr>
<tr>
<td>Industrial</td>
<td>711.3</td>
<td>39.9%</td>
</tr>
<tr>
<td>Transportation</td>
<td>3.8</td>
<td>0.2%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>35</td>
<td>2.0%</td>
</tr>
<tr>
<td>Total</td>
<td>1,783.8</td>
<td>100%</td>
</tr>
</tbody>
</table>

*secondary energy use

ELECTRICAL ENERGY USE BY PROVINCE, 2015

- QUE. 35%
- ONT. 28%
- MAN. 4%
- SASK. 4%
- ALTA. 11%
- ATL.* 7%
- B.C. and TERR. 11%

* 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 2017, the National Energy Board estimated the LCOE for different electricity generation technologies in Canada.
Uranium is a silvery-white metal containing energy. After being mined, milled, refined and converted, uranium fuels nuclear power generation.
INTERNATIONAL CONTEXT

RENEWABLE ENERGY

World production – 78,616 PJ or 1,878 MTOE (2016)

1 China 14%
2 India 11%
3 United States 8%
4 Brazil 6%
5 Nigeria 6%
...
7 Canada 3%

Share of energy supply from renewable sources (2016)

13.4% World
9.9% OECD countries only
17.4% Canada
### CANADIAN PRODUCTION (2016)

**Total renewable energy** – 2,055 PJ or 49.3 MTOE

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>67.5%</td>
</tr>
<tr>
<td>Solid biomass (e.g. wood/waste)</td>
<td>22.6%</td>
</tr>
<tr>
<td>Wind</td>
<td>5.4%</td>
</tr>
<tr>
<td>Ethanol**</td>
<td>1.7%</td>
</tr>
<tr>
<td>Municipal waste/landfill gas</td>
<td>1.2%</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>0.7%</td>
</tr>
<tr>
<td>Solar photovoltaic</td>
<td>0.5%</td>
</tr>
<tr>
<td>Industrial and other waste</td>
<td>0.3%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0.1%</td>
</tr>
<tr>
<td>Tidal</td>
<td>0.003%</td>
</tr>
</tbody>
</table>

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

**is a biogasoline
CANADIAN RENEWABLE ELECTRICITY GENERATING CAPACITY

<table>
<thead>
<tr>
<th>Year</th>
<th>Biomass</th>
<th>Solar and tidal</th>
<th>Wind</th>
<th>Hydro</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td>77,000</td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
<td>77,500</td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td>78,000</td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td></td>
<td>78,500</td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td>79,000</td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td>79,500</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td>80,000</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td>80,500</td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td></td>
<td>81,000</td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td>81,500</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td></td>
<td>82,000</td>
</tr>
</tbody>
</table>
Moving water is the most important renewable energy source in Canada, providing 59% of Canada’s electricity generation. In fact, in 2016, Canada was the second-largest producer of hydroelectricity in the world.

**INTERNATIONAL CONTEXT**

**HYDROELECTRICITY**

World generation of hydroelectricity – 4,061 TWh (2016)

1. China 29%
2. Canada 10%
3. Brazil 9%
4. United States 7%
5. Russia 5%
### HYDROELECTRICITY CAPACITY IN CANADA

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

<table>
<thead>
<tr>
<th>Facility</th>
<th>Total capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert-Bourassa</td>
<td>5,616</td>
</tr>
<tr>
<td>Churchill Falls</td>
<td>5,428</td>
</tr>
<tr>
<td>La Grande 4</td>
<td>2,779</td>
</tr>
<tr>
<td>Mica</td>
<td>2,746</td>
</tr>
<tr>
<td>Gordon M. Shrum</td>
<td>2,730</td>
</tr>
<tr>
<td>Revelstoke</td>
<td>2,480</td>
</tr>
<tr>
<td>La Grande 3</td>
<td>2,417</td>
</tr>
<tr>
<td>La Grande 2A</td>
<td>2,106</td>
</tr>
<tr>
<td>Beauharnois</td>
<td>1,900</td>
</tr>
<tr>
<td>Manic 5</td>
<td>1,596</td>
</tr>
<tr>
<td>Sir Adam Beck 2</td>
<td>1,499</td>
</tr>
<tr>
<td>La Grande 1</td>
<td>1,436</td>
</tr>
<tr>
<td>Limestone</td>
<td>1,340</td>
</tr>
<tr>
<td>Manic 3</td>
<td>1,326</td>
</tr>
<tr>
<td>Manic 2</td>
<td>1,229</td>
</tr>
<tr>
<td>Kettle</td>
<td>1,220</td>
</tr>
<tr>
<td>Bersimis 1</td>
<td>1,178</td>
</tr>
<tr>
<td>Manic 5 PA</td>
<td>1,064</td>
</tr>
<tr>
<td>Robert H. Saunders</td>
<td>1,045</td>
</tr>
<tr>
<td>Outardes 3</td>
<td>1,026</td>
</tr>
<tr>
<td>Mica</td>
<td>1,026</td>
</tr>
<tr>
<td>La Grande 3</td>
<td>1,026</td>
</tr>
<tr>
<td>Manic 5</td>
<td>1,026</td>
</tr>
<tr>
<td>Sir Adam Beck 2</td>
<td>1,046</td>
</tr>
<tr>
<td>La Grande 1</td>
<td>1,046</td>
</tr>
<tr>
<td>Limestone</td>
<td>1,046</td>
</tr>
<tr>
<td>Manic 3</td>
<td>1,046</td>
</tr>
<tr>
<td>Manic 2</td>
<td>1,046</td>
</tr>
<tr>
<td>Kettle</td>
<td>1,046</td>
</tr>
<tr>
<td>Bersimis 1</td>
<td>1,046</td>
</tr>
<tr>
<td>Manic 5 PA</td>
<td>1,046</td>
</tr>
<tr>
<td>Robert H. Saunders</td>
<td>1,046</td>
</tr>
<tr>
<td>Outardes 3</td>
<td>1,046</td>
</tr>
</tbody>
</table>

Hydroelectricity capacity in Canada was **80,859 MW** in 2016.

*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.

- There are 111 electricity and co-generation facilities with capacity of at least 1 MW using biomass in Canada.

- Together, these facilities have an aggregate capacity of about 2,475 MW.

- 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 36%.

In Canada, that share is 23%.
CANADIAN PRODUCTION OF BIOMASS, 2016

- **Solid wood waste**
- **Firewood**
- **Liquid wood waste**
- **Wood pellets**

**WOOD FUEL USE BY SECTOR, 2016**

- **Total** 432 PJ
- **Industrial** 45%
- **Residential** 29%
- **Electricity** 26%

**TOP CONTRIBUTORS TO CANADIAN PRODUCTION, 2016**

- Solid wood waste
- Firewood
- Liquid wood waste
- Wood pellets
WIND POWER

• Electricity from wind energy is one of the fastest growing sources of electricity in the world and in Canada.

• Wind accounts for 5% of electricity generation in Canada.

INTERNATIONAL CONTEXT

WIND POWER

World capacity of wind power – 539,581 MW (2017)

1. China 35%
2. United States 17%
3. Germany 10%
4. India 6%
5. Spain 4%
...
9. Canada 2%
WIND POWER IN CANADA

Capacity (2017):
12,239 MW
more than doubled

Generation (2016):
30.5 TWh
more than tripled

INSTALLED CAPACITY

<table>
<thead>
<tr>
<th>Year</th>
<th>Megawatts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>4,000</td>
</tr>
<tr>
<td>2012</td>
<td>5,000</td>
</tr>
<tr>
<td>2013</td>
<td>6,000</td>
</tr>
<tr>
<td>2014</td>
<td>7,000</td>
</tr>
<tr>
<td>2015</td>
<td>8,000</td>
</tr>
<tr>
<td>2016</td>
<td>9,000</td>
</tr>
<tr>
<td>2017</td>
<td>10,000</td>
</tr>
</tbody>
</table>

Cumulative

Annual additions
**CAPACITY BY PROVINCE (MW)**

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total capacity (MW)</td>
<td>698</td>
<td>1,479</td>
<td>221</td>
<td>258</td>
<td>4,900</td>
<td>3,510</td>
<td>294</td>
<td>610</td>
<td>204</td>
<td>55</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

**LARGEST WIND FARMS IN CANADA* (≥150 MW)**

<table>
<thead>
<tr>
<th>Facility</th>
<th>Total capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lac Alfred (I and II)</td>
<td>300</td>
</tr>
<tr>
<td>Blackspring Ridge</td>
<td>299</td>
</tr>
<tr>
<td>Seigneurie de Beaupré 2 and 3</td>
<td>272</td>
</tr>
<tr>
<td>South Kent Wind Farm</td>
<td>270</td>
</tr>
<tr>
<td>K2 Wind Farm</td>
<td>270</td>
</tr>
<tr>
<td>Niagara Region Wind Farm</td>
<td>230</td>
</tr>
<tr>
<td>Riviere du Moulin Phase II</td>
<td>200</td>
</tr>
<tr>
<td>Wolfe Island</td>
<td>198</td>
</tr>
<tr>
<td>Prince Wind Energy Project</td>
<td>189</td>
</tr>
<tr>
<td>Kincardine Enbridge</td>
<td>182</td>
</tr>
<tr>
<td>Armow Wind Farm</td>
<td>180</td>
</tr>
<tr>
<td>Meikle Wind</td>
<td>179</td>
</tr>
<tr>
<td>Comber East and West</td>
<td>166</td>
</tr>
<tr>
<td>Kent Hills 1 and 2</td>
<td>150</td>
</tr>
<tr>
<td>Massif du Sud</td>
<td>150</td>
</tr>
<tr>
<td>Riviere du Moulin Phase I</td>
<td>150</td>
</tr>
</tbody>
</table>

*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 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 – 402 GW (2017)*

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Capacity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>33%</td>
</tr>
<tr>
<td>2</td>
<td>United States</td>
<td>13%</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>12%</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>11%</td>
</tr>
<tr>
<td>5</td>
<td>Italy</td>
<td>5%</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>1%</td>
</tr>
</tbody>
</table>
SOLAR PV IN CANADA

Capacity (2017): 2,911 MW

Generation (2016): 3 TWh

Up 137% since 2013

More than 6x in 2014

INSTALLED CAPACITY

Megawatts


0 500 1,000 1,500 2,000 2,500 3,000

Cumulative

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

<table>
<thead>
<tr>
<th>Facility</th>
<th>Total capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sol-Luce Kingston</td>
<td>100</td>
</tr>
<tr>
<td>Grand Renewable Energy Park</td>
<td>100</td>
</tr>
<tr>
<td>Sarnia Solar Project 1 &amp; 2</td>
<td>80</td>
</tr>
<tr>
<td>Sault Ste. Marie 1, 2 &amp; 3</td>
<td>58</td>
</tr>
<tr>
<td>Loyalist Solar Project</td>
<td>54</td>
</tr>
<tr>
<td>Windsor Solar Project</td>
<td>50</td>
</tr>
<tr>
<td>Southgate Solar Project</td>
<td>50</td>
</tr>
<tr>
<td>Naticoke Solar Project</td>
<td>44</td>
</tr>
<tr>
<td>St. Clair Moore &amp; Sombra</td>
<td>40</td>
</tr>
<tr>
<td>Stardale</td>
<td>33</td>
</tr>
<tr>
<td>Cochrane Solar</td>
<td>30</td>
</tr>
<tr>
<td>Liskeard 1, 3 &amp; 4</td>
<td>30</td>
</tr>
<tr>
<td>Emsley Solar</td>
<td>24</td>
</tr>
<tr>
<td>Saint-Isidore</td>
<td>24</td>
</tr>
<tr>
<td>Arnprior</td>
<td>23</td>
</tr>
<tr>
<td>Walpole</td>
<td>20</td>
</tr>
</tbody>
</table>

* 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.*

---

**INTERNATIONAL CONTEXT**

**LIQUID BIOFUELS**

**World capacity of biofuels – 142.7 billion litres**

(2017)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>47%</td>
</tr>
<tr>
<td>2</td>
<td>Brazil</td>
<td>22%</td>
</tr>
<tr>
<td>3</td>
<td>European Union</td>
<td>14%</td>
</tr>
<tr>
<td>4</td>
<td>Argentina</td>
<td>3%</td>
</tr>
<tr>
<td>5</td>
<td>China</td>
<td>3%</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Canada</td>
<td>2%</td>
</tr>
</tbody>
</table>

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

CANADIAN SUPPLY AND DEMAND (2017) (Mb/d [million L])

Canadian production

<table>
<thead>
<tr>
<th>Ethanol</th>
<th>Biodiesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.0 (1,800)</td>
<td>8.6 (500)</td>
</tr>
</tbody>
</table>

Exports

<table>
<thead>
<tr>
<th>Ethanol</th>
<th>Biodiesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.6 (324)</td>
</tr>
</tbody>
</table>

Imports

<table>
<thead>
<tr>
<th>Ethanol</th>
<th>Biodiesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.0 (1,216)</td>
<td>7.9 (461)</td>
</tr>
</tbody>
</table>

Domestic demand

<table>
<thead>
<tr>
<th>Ethanol</th>
<th>Biodiesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.0 (3,016)</td>
<td>11.0 (637)</td>
</tr>
</tbody>
</table>
Uranium is a silvery-white metal containing energy. After being mined, milled, refined and converted, uranium fuels nuclear power generation.
### INTERNATIONAL CONTEXT

#### URANIUM

**World production – 59.5 kt (2017)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kazakhstan</td>
<td>39%</td>
</tr>
<tr>
<td>Canada</td>
<td>22%</td>
</tr>
<tr>
<td>Australia</td>
<td>10%</td>
</tr>
<tr>
<td>Namibia</td>
<td>7%</td>
</tr>
<tr>
<td>Niger</td>
<td>6%</td>
</tr>
</tbody>
</table>

**World exports – 54.1 kt (2017)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kazakhstan</td>
<td>43%</td>
</tr>
<tr>
<td>Canada</td>
<td>21%</td>
</tr>
<tr>
<td>Australia</td>
<td>11%</td>
</tr>
<tr>
<td>Niger</td>
<td>8%</td>
</tr>
<tr>
<td>Russia</td>
<td>5%</td>
</tr>
</tbody>
</table>
### World known recoverable resources – 5.7 Mt (2015)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Australia</td>
<td>29%</td>
</tr>
<tr>
<td>2</td>
<td>Kazakhstan</td>
<td>13%</td>
</tr>
<tr>
<td>3</td>
<td>Canada</td>
<td>9%</td>
</tr>
<tr>
<td>4</td>
<td>Russia</td>
<td>9%</td>
</tr>
<tr>
<td>5</td>
<td>South Africa</td>
<td>6%</td>
</tr>
</tbody>
</table>

### World generation – 2,503 TWh (2017)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>32%</td>
</tr>
<tr>
<td>2</td>
<td>France</td>
<td>15%</td>
</tr>
<tr>
<td>3</td>
<td>China</td>
<td>9%</td>
</tr>
<tr>
<td>4</td>
<td>Russia</td>
<td>8%</td>
</tr>
<tr>
<td>5</td>
<td>South Korea</td>
<td>6%</td>
</tr>
<tr>
<td>6</td>
<td>Canada</td>
<td>4%</td>
</tr>
</tbody>
</table>
CANADIAN SUPPLY AND DEMAND (2017)

URALNIUM

Canadian production 13.1 kt

All uranium comes from mines in Saskatchewan.

ANNUAL VALUE

about $1.6 billion

EXPORTS: 88% of production

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

1) North America/Latin America 41%
2) Asia 39%
3) Europe 20%

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

33% of uranium purchased by U.S. nuclear reactors in 2017 came from Canada, making Canada the largest foreign supplier of uranium to the U.S.

DOMESTIC USE: 12% of production

Used in Canada’s CANDU reactors (Ontario and New Brunswick), including the Bruce Generating Station, the world’s largest operating nuclear facility.
The Bruce Nuclear Generating Station is the largest operating nuclear power plant in the world.

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

12 CANDU reactors are in operation outside of Canada.
# GROSS CAPACITY OF NUCLEAR POWER PLANTS IN CANADA

<table>
<thead>
<tr>
<th>Facility</th>
<th>Province</th>
<th>Total capacity (MW)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darlington</td>
<td>Ontario</td>
<td>3,512</td>
<td>4</td>
</tr>
<tr>
<td>Bruce A</td>
<td>Ontario</td>
<td>3,220</td>
<td>4</td>
</tr>
<tr>
<td>Bruce B</td>
<td>Ontario</td>
<td>3,390</td>
<td>4</td>
</tr>
<tr>
<td>Pickering A</td>
<td>Ontario</td>
<td>1,084</td>
<td>2</td>
</tr>
<tr>
<td>Pickering B</td>
<td>Ontario</td>
<td>2,160</td>
<td>4</td>
</tr>
<tr>
<td>Point Lepreau</td>
<td>New Brunswick</td>
<td>705</td>
<td>1</td>
</tr>
</tbody>
</table>

# URANIUM - PRICES

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

---

*SPOT PRICES*

![Graph showing uranium prices](image)
COAL
### INTERNATIONAL CONTEXT

#### COAL

**World proved reserves – 1,035 BILLION TONNES (2017)**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>24%</td>
</tr>
<tr>
<td>2</td>
<td>Russia</td>
<td>15%</td>
</tr>
<tr>
<td>3</td>
<td>Australia</td>
<td>14%</td>
</tr>
<tr>
<td>4</td>
<td>China</td>
<td>13%</td>
</tr>
<tr>
<td>5</td>
<td>India</td>
<td>9%</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Canada</td>
<td>1%</td>
</tr>
</tbody>
</table>

**World production – 7.3 BILLION TONNES (2017, PRELIMINARY)**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>43%</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>United States</td>
<td>10%</td>
</tr>
<tr>
<td>4</td>
<td>Australia</td>
<td>7%</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Canada</td>
<td>1%</td>
</tr>
</tbody>
</table>

**World exports – 1.4 BILLION TONNES (2017, PRELIMINARY)**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Indonesia</td>
<td>29%</td>
</tr>
<tr>
<td>2</td>
<td>Australia</td>
<td>28%</td>
</tr>
<tr>
<td>3</td>
<td>Russia</td>
<td>14%</td>
</tr>
<tr>
<td>4</td>
<td>United States</td>
<td>6%</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Canada</td>
<td>2%</td>
</tr>
</tbody>
</table>
PRODUCTION AND USE

Canada produced

61 Mt of coal in 2017, of which

56% is METALLURGICAL COAL used for steel manufacturing

44% is THERMAL COAL used for electricity

COAL PRODUCTION BY PROVINCE, 2017

B.C. 49%

ALTA. 34%

SASK. 16%

N.S. 1%

TOTAL 61 Mt

Electricity generation consumed

34.4 Mt of coal in 2016, a 5% decrease from 36.2 Mt in 2015.

THERMAL COAL used for electricity

44% is

56% is METALLURGICAL COAL used for steel manufacturing

COAL-FIRED GENERATING CAPACITY* BY PROVINCE, 2017

ALTA. 19%

SASK. 15%

N.B. 6%

N.S. 15%

MAN. 1%

TOTAL 8,159 MW

*does not include currently deactivated capacity

Canada produced

56% is METALLURGICAL COAL used for steel manufacturing

44% is THERMAL COAL used for electricity

61 Mt of coal in 2017, of which

TOTAL 61 Mt

Electricity generation consumed

34.4 Mt of coal in 2016, a 5% decrease from 36.2 Mt in 2015.

THERMAL COAL used for electricity

44% is

56% is METALLURGICAL COAL used for steel manufacturing

61 Mt of coal in 2017, of which

TOTAL 61 Mt

Electricity generation consumed

34.4 Mt of coal in 2016, a 5% decrease from 36.2 Mt in 2015.

THERMAL COAL used for electricity

44% is

56% is METALLURGICAL COAL used for steel manufacturing

61 Mt of coal in 2017, of which
Canada’s exports are primarily metallurgical coal (93% in 2017). In 2017 the U.S. increased coal exports by **61% to 97 Mt** as exports to Asia more than doubled. Metallurgical coal accounted for **57%** of U.S. exports.
TRADE (2017)

**EXPORTS**
- **31 Mt**
- **$6.8 billion**
- **major export destinations (by % value):**
  - 23% Japan
  - 20% South Korea
  - 15% China

**IMPORTS**
- **7.5 Mt**
- **74%** of Canadian imports are from the U.S.

3% of Canadian exports are to the U.S., representing 11% of U.S. coal imports.
## ANNEX 1: UNITS AND CONVERSION FACTORS
### PREFIXES AND EQUIVALENTS

<table>
<thead>
<tr>
<th>Prefix</th>
<th>SI/Metric</th>
<th>Imperial</th>
<th>Equivalent</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>k</td>
<td>kilo</td>
<td>M</td>
<td>thousand</td>
<td>$10^3$</td>
</tr>
<tr>
<td>M</td>
<td>mega</td>
<td>MM</td>
<td>million</td>
<td>$10^6$</td>
</tr>
<tr>
<td>G</td>
<td>giga</td>
<td>B</td>
<td>billion</td>
<td>$10^9$</td>
</tr>
<tr>
<td>T</td>
<td>tera</td>
<td>T</td>
<td>trillion</td>
<td>$10^{12}$</td>
</tr>
<tr>
<td>P</td>
<td>peta</td>
<td>-</td>
<td>quadrillion</td>
<td>$10^{15}$</td>
</tr>
</tbody>
</table>

**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
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AECO</td>
<td>Alberta Energy Company</td>
</tr>
<tr>
<td>B</td>
<td>billion</td>
</tr>
<tr>
<td>b/d</td>
<td>barrels per day</td>
</tr>
<tr>
<td>Bcf/d</td>
<td>billion cubic feet per day</td>
</tr>
<tr>
<td>Bcm/d</td>
<td>billion cubic metres per day</td>
</tr>
<tr>
<td>CANDU</td>
<td>Canada deuterium uranium</td>
</tr>
<tr>
<td>CCS</td>
<td>carbon capture and storage</td>
</tr>
<tr>
<td>CCUS</td>
<td>carbon capture, utilization and storage</td>
</tr>
<tr>
<td>CDIA</td>
<td>Canadian direct investment abroad</td>
</tr>
<tr>
<td>CEA</td>
<td>Canadian energy assets</td>
</tr>
<tr>
<td>CO₂ equivalent</td>
<td>carbon dioxide equivalent</td>
</tr>
<tr>
<td>CPI</td>
<td>consumer price index</td>
</tr>
<tr>
<td>CPL</td>
<td>cents per litre</td>
</tr>
<tr>
<td>ECTPEA</td>
<td>Environmental and Clean Technology Products</td>
</tr>
<tr>
<td>EIA</td>
<td>Energy Information Administration (U.S.)</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FDI</td>
<td>foreign direct investment</td>
</tr>
<tr>
<td>G7</td>
<td>seven wealthiest major developed nations: Canada, France, Germany, Italy, Japan, U.K. and U.S.</td>
</tr>
<tr>
<td>GDP</td>
<td>gross domestic product</td>
</tr>
<tr>
<td>GHG</td>
<td>greenhouse gas</td>
</tr>
<tr>
<td>GJ</td>
<td>gigajoule</td>
</tr>
<tr>
<td>GST</td>
<td>Goods and Services tax</td>
</tr>
<tr>
<td>GWh</td>
<td>gigawatt hours</td>
</tr>
<tr>
<td>HGL</td>
<td>hydrocarbon gas liquids</td>
</tr>
<tr>
<td>HST</td>
<td>Harmonized sales tax</td>
</tr>
<tr>
<td>IEA</td>
<td>International Energy Agency</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
</tr>
<tr>
<td>km</td>
<td>kilometre</td>
</tr>
<tr>
<td>km²</td>
<td>square kilometre</td>
</tr>
<tr>
<td>kt</td>
<td>kilotonne</td>
</tr>
<tr>
<td>kWh</td>
<td>kilowatt hour</td>
</tr>
<tr>
<td>lb.</td>
<td>pound</td>
</tr>
<tr>
<td>L</td>
<td>litre</td>
</tr>
<tr>
<td>LCOE</td>
<td>levelized cost of electricity</td>
</tr>
<tr>
<td>LNG</td>
<td>liquefied natural gas</td>
</tr>
<tr>
<td>LPG</td>
<td>liquefied petroleum gases</td>
</tr>
<tr>
<td>LWR</td>
<td>light water reactor</td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
</tr>
<tr>
<td>m²</td>
<td>square metre</td>
</tr>
<tr>
<td>m³</td>
<td>cubic metre</td>
</tr>
<tr>
<td>Mb/d</td>
<td>thousand barrels per day</td>
</tr>
<tr>
<td>MJ</td>
<td>megajoule</td>
</tr>
<tr>
<td>MMb/d</td>
<td>million barrels per day</td>
</tr>
<tr>
<td>MMcf/d</td>
<td>million cubic feet per day</td>
</tr>
<tr>
<td>MMbtu</td>
<td>million British thermal units</td>
</tr>
<tr>
<td>Mt</td>
<td>million tonnes; megatonne</td>
</tr>
<tr>
<td>Mtoe</td>
<td>million tons of oil equivalent</td>
</tr>
<tr>
<td>MW</td>
<td>megawatt</td>
</tr>
<tr>
<td>NEB</td>
<td>National Energy Board</td>
</tr>
<tr>
<td>NGL</td>
<td>natural gas liquids</td>
</tr>
</tbody>
</table>
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)
- **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 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 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 Merceandise 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 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
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**: NEB (Canada’s Adoption of Renewable Power Sources – Energy Market Analysis)
- **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 – 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