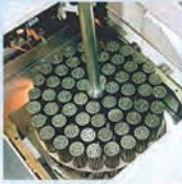




Natural Resources  
Canada

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Canada

# ENERGY MARKETS FACT BOOK



2014-2015

Canada





Natural Resources  
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# **ENERGY MARKETS FACT BOOK**

## **2014–2015**

*Aussi disponible en français sous le titre : Cahier d'information : Les marchés de l'énergie, 2014–2015*

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## Preface

The purpose of the *Energy Markets Fact Book* is to provide key information on energy markets in Canada in a format that is easy to consult.

This edition is based on data and information available as of July 2014. All data are 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 correctly because of 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 the Energy sector and the Minerals and Metals sector of Natural Resources Canada.



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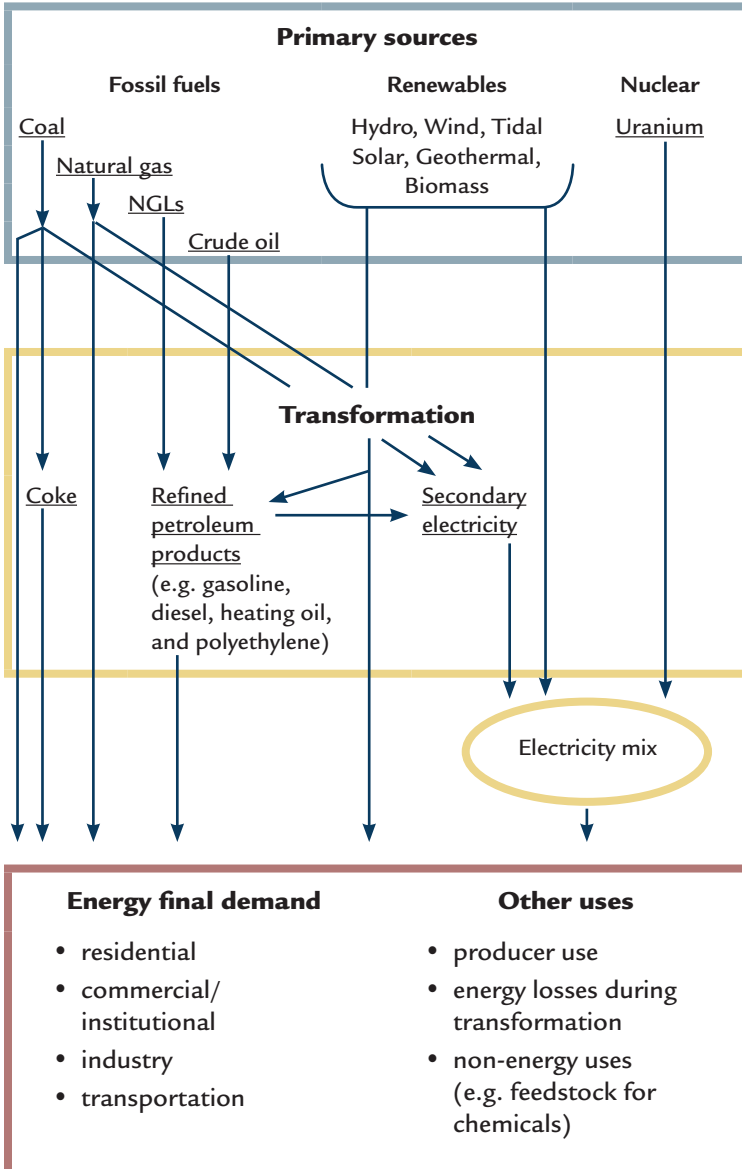
## Definition

In this publication, the following industries are considered to be energy industries:

- oil and gas extraction
- coal mining
- uranium mining
- support activities for oil and gas extraction
- pipeline transportation
- natural gas distribution
- biofuels production
- petroleum refineries
- electric power generation, transmission and distribution

Some energy-related industries (e.g. petroleum product wholesaler-distributors) are excluded because of a lack of data.

## Energy flow



## Canada's position in the world: An overview

Resource	Proved reserve/ capacity	Production	Exports
Crude oil	3rd	5th	4th
Natural gas	19th	5th	4th
Coal	15th	12th	7th
Uranium	4th	2nd	2nd
Electricity	7th	6th	2nd
Renewable energy	-	7th	-
Hydroelectricity	4th	3rd	-
Wind	9th	-	-
Biofuels	-	5th	-

Note: Rankings relate to proved reserves for oil, natural gas, coal and uranium. Other resource rankings relate to capacity.

## Energy and the economy (2013)

### Gross domestic product (in current prices)

Industry	Nominal GDP* (\$ billions)	% of Canadian GDP
Energy (Direct)	175	9.9
· Oil and Gas**	133	7.5
· Electricity	37	2.1
Energy (Indirect)***	62	3.5
Total (Direct + Indirect)	237	13.4

### Employment

Industry	Employment (Jobs)	% of total employment
Energy (Direct)	288,500	1.6
· Oil and Gas**	190,170	1.1
· Electricity	87,250	0.5
Energy (Indirect)***	613,500	3.5
· O&G Construction	170,650	0.9
· Electricity Construction	58,370	0.3
Total (Direct + Indirect)	902,000	5.0

\*NRCan analysis

\*\*Oil and Gas includes oil and gas extraction, support activities for oil and gas extraction, natural gas distribution, petroleum refineries, and pipeline transportation.

\*\*\*NRCan analysis and includes industries (e.g. equipment manufacturing, construction, financial services) that supply goods and services to the energy industry

## Energy and the economy (2013)

### Energy trade

Resource/ product	Exports*			Imports
	% of Canadian production	% to U.S.	% of U.S. Imports/ consumption	% of Canadian consumption
Crude oil	74	97	33/17	35
RPPs	26	92	27/3	12
Natural gas	57	100	97/11	32
Coal	57	3	13/0.1	23
Uranium	85	25	16/14	-
Electricity	10	100	98/2	2

### Exports\*

- \$128 billion
- 29% of Canadian domestic merchandise exports
- 92% (\$118 billion) of total Canadian energy exports are to the U.S.
- Oil and gas domestic exports totalled \$117 billion, of which 98% were to the U.S.

### Imports

- \$55 billion
- 12% of Canadian merchandise imports
- 48% (\$26 billion) of total energy imports are from the U.S.

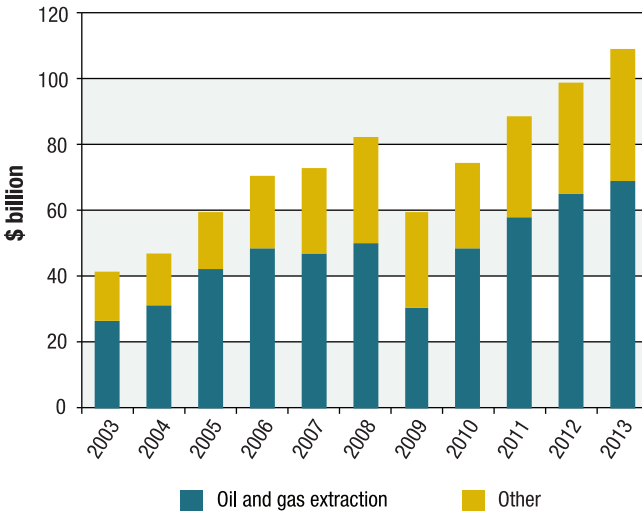
\* Exports refers to domestic exports which exclude the re-exports of goods that have previously entered Canada and exit in the same condition.

## Energy and the economy (2013)

### Capital expenditures

- \$109 billion
- 27% of total public and private investments in Canada
- Oil and gas industries accounted for \$83 billion or 21% of total Canadian capital expenditures

### Capital expenditures in the energy industry



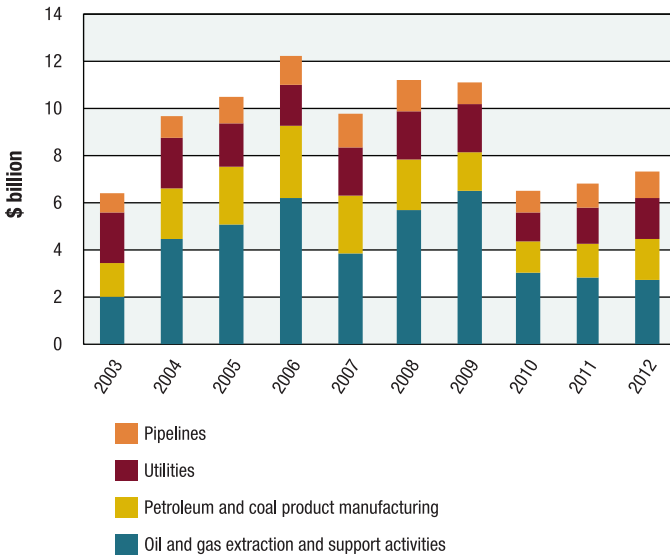
## Government revenues

- Federal and provincial/territorial (P/T) governments in Canada receive direct revenues from energy industries related to
  - corporate income taxes, which are levied on corporations operating in Canada
  - 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
  - crown land sales, which are paid to the Crown in order to acquire the resource rights for specific properties

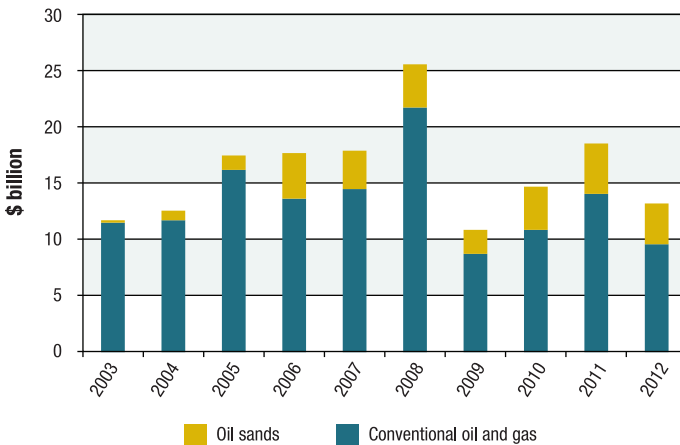
Source	2008–2012 average (\$ billions)
Income tax	6.2
Indirect taxes	2.4
Royalties	12.5
Land sales	4.0
<b>Total</b>	<b>25.1</b>

- The largest share of government revenues is collected from the oil and gas industry, which averaged \$23.3 billion over the last five years, including \$20.7 billion from upstream oil and gas extraction and its support activities.
- Between 2008 and 2012, the energy industries' share of total taxes paid (11.9%) was in line with their share of total operating revenues (13.6%).

**Total taxes paid by energy industries**



**Total oil and gas crown royalties and land sales in Canada**





## Energy research, development and demonstration

Public expenditures\* on energy RD&D for OECD countries - as a % of GDP (2011)

1) Finland .....	0.13%
2) Hungary .....	0.09%
3) Japan.....	0.07%
4) Denmark .....	0.07%
<b>5) Canada .....</b>	<b>0.06%</b>
6) Norway.....	0.06%

\* Expenditures exclude tax incentives.

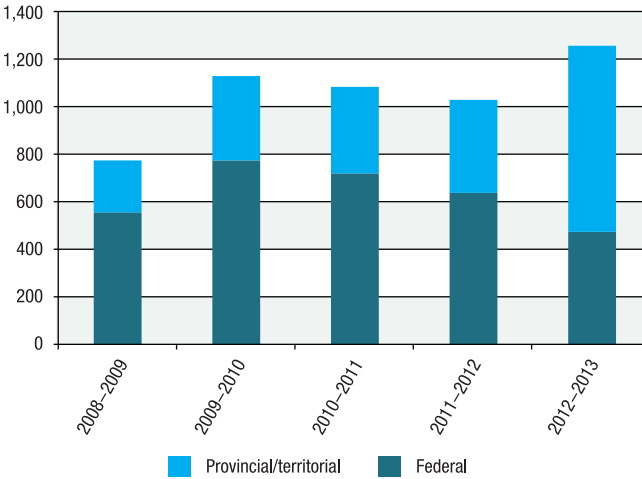
### Canadian public expenditures on energy RD&D

- Federal energy RD&D expenditures of \$472 million in 2012/13
  - key organizations: NRCan (\$148 million), AECL (\$105 million), NSERC (\$80 million) and SDTC (\$67 million)
  - accounted for approximately 8% of federal RD&D expenditures in all economic sectors (\$6 billion)
- P/T energy RD&D expenditures of \$776 million in 2012/13
  - Provincial utilities accounted for \$500 million or 64% of P/T energy RD&D spending.
- Combined federal/provincial/territorial energy RD&D expenditures of about \$1.25 billion in 2012/13, up from \$1 billion in 2011/12
  - The increase was attributed primarily to the construction of the SaskPower Boundary Dam carbon capture and storage project (\$389 million).

## Canadian industry expenditures on energy RD&D

- Canadian industry spent about \$1.67 billion on energy RD&D in 2011.

### Canadian public expenditures on energy RD&D in millions of dollars



\* Provincial/territorial now includes utilities.

### Expenditures on energy RD&D by technology area (\$ millions)

	Federal (2012/13)	Provincial (2012/13)	Industry (2011)
Fossil fuels supply (including CCS)	114	559	1,297
Renewable and clean energy supply	216	147	267
Energy end use	142	70	106
<b>Total</b>	<b>472</b>	<b>776</b>	<b>1,670</b>

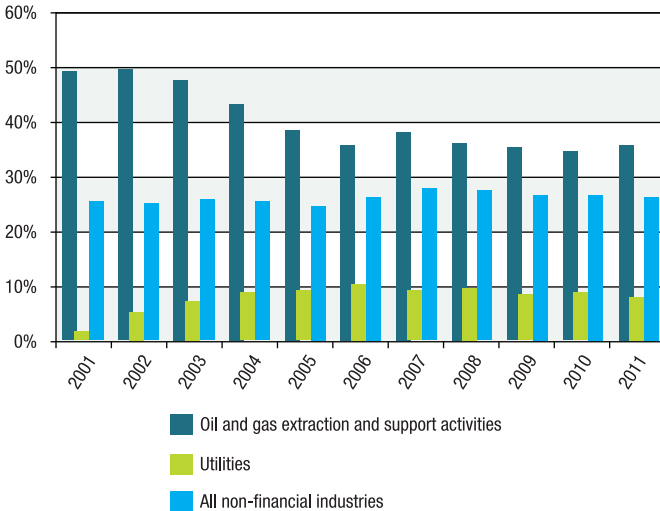
## Investment in Canadian energy industries

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

### 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 the shares are owned by one or more foreign companies.

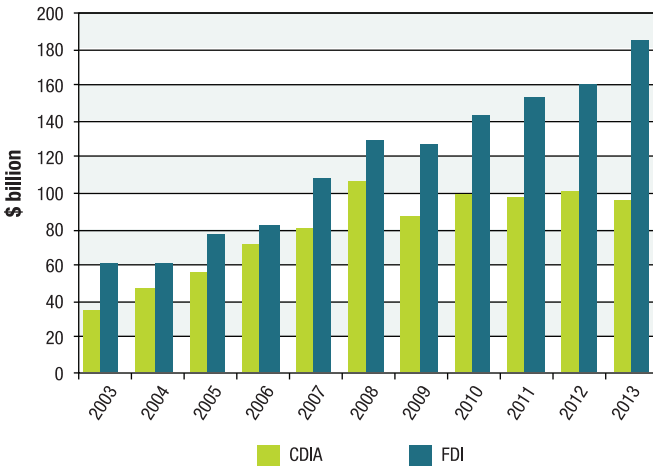
#### Foreign control of Canadian assets



### Direct investment in Canada and abroad

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

**Stock of FDI in Canada and CDIA in the energy industry**



**Stock of foreign direct investment**

- The stock of FDI in the energy sector reached \$182 billion in 2013, up from \$27 billion in 1999.
- The energy industry’s share of overall FDI in Canada has also been steadily increasing, reaching more than 26% in 2013, up from 11% in 1999.
- The stock of FDI from the U.S. in Canada’s oil and gas extraction industry, including support services, more than tripled from \$17.5 billion in 1999 to \$63.1 billion in 2013.

**Stock of Canadian direct investment abroad**

- Investment by Canada’s energy companies in the U.S. accounts for 29% of the stock of energy CDIA and has grown from \$5.5 billion in 1999 to \$27.5 billion in 2013, which is down from a peak of \$47.5 billion in 2008.

## FDI in Canada – major recent deals

### Oil sands

April 2014: PetroChina (China), through its wholly owned subsidiary Phoenix Energy Holdings Limited (China), acquired the remaining 40% stake in Dover Commercial Project from Athabasca Oil Corporation for \$1.23 billion.

August 2013: ExxonMobil Canada (U.S.) and Imperial Oil (U.S.) jointly acquired 100% of ConocoPhillips' Clyden oil sands lease for a combined total of \$751 million.

March 2013: Total S.A. (France) sold its 49% interest in the Voyageur Upgrader Limited Partnership to its partner Suncor Energy for \$515 million.

February 2013: China National Offshore Oil Corporation Ltd. (CNOOC) (China) acquired Nexen Inc. for \$18.4 billion.

March 2012: PetroChina (China), through its wholly owned subsidiary, acquired the remaining 40% percent stake in the MacKay River oil sands project from Athabasca Oil Sands Corporation for \$670 million.

November 2011: CNOOC Limited (China) acquired OPTI Canada Inc. for \$2.2 billion.

January 2011: PTT Exploration and Development (Thailand) acquired a 40% interest in Kai Kos Dehseh oil sands project from Statoil (Norway) for \$2.3 billion.

October 2010: Total S. A. (France) acquired UTS Energy Corporation for \$1.1 billion.

June 2010: Sinopec International Petroleum (China) acquired from ConocoPhillips a 9.03% stake in the Syncrude oil sands project for \$4.75 billion.

## Conventional oil and gas

May 2014: Crescent Point Energy Corp. (U.S.) acquired CanEra Energy Corp. for \$1.1 billion.

April 2014: Canadian Natural Resources Limited (Canada) acquired Devon (Canada) Canadian conventional assets, excluding its Horn River play assets and heavy oil properties, for \$3.1 billion.

March 2014: Progress Energy Resources Corp. (Malaysia) acquired a stake in Montney acreage in northeast British Columbia from Talisman Energy Inc. for \$1.5 billion (\$700 million in cash, \$800 million of drilling costs).

January 2014: Compañía Española de Petroleos (CEPSA) (UAE), acquires Coastal Energy Company for \$2.3 billion.

September 2013: Centrica plc (U.K.) (60%) and Qatar Petroleum International Ltd. (Qatar) (40%) acquired the conventional portion of Suncor Energy Inc.'s natural gas and crude oil assets in western Canada, for \$1 billion.

March 2013: Spectra Energy (U.S.) acquired the Express-Platte crude oil pipeline system from the Ontario Teachers' Pension Plan, Borealis Infrastructure (OMERS) and Kinder Morgan for \$1.5 billion.

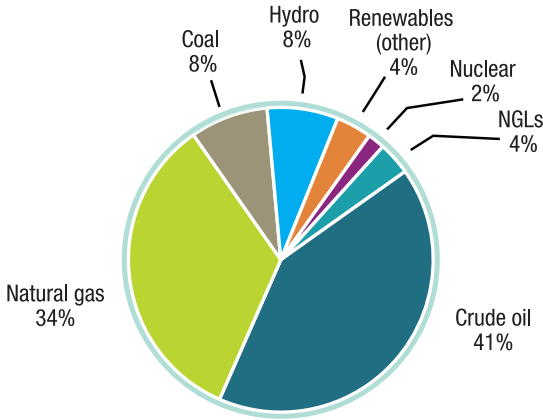
February 2013: Exxon Mobil Corporation (U.S.) agreed to acquire Celtic Exploration Ltd. for \$3.1 billion.

December 2012: PetroChina International Company Limited (China) acquired a 49.9% interest in Encana's Duvernay land holdings in west-central Alberta for \$2.2 billion.

December 2012: PETRONAS (Malaysia) acquired Progress Energy Resources Corp. for \$6 billion.

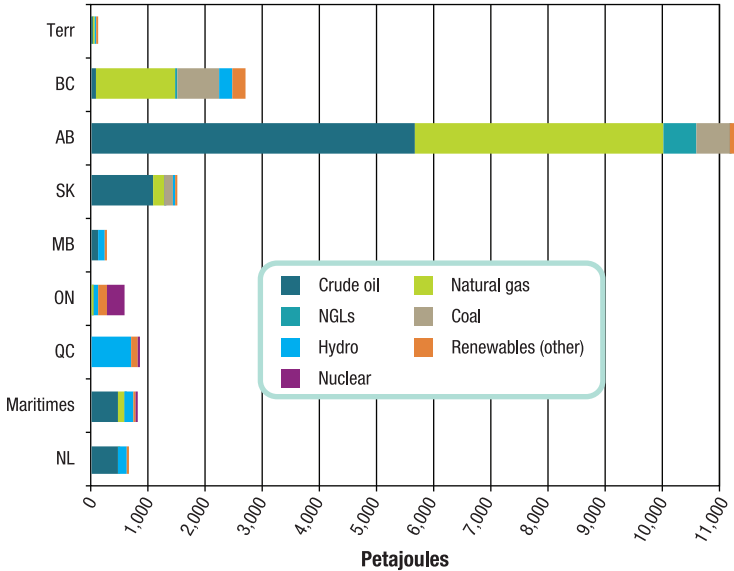
## Canadian energy production

Primary energy production, by source, 2012



“Renewables (other)” includes wind, solar, wood/wood waste, biofuels and municipal waste.

Primary energy production, regional totals, 2012



Terr: Yukon, Northwest Territories and Nunavut

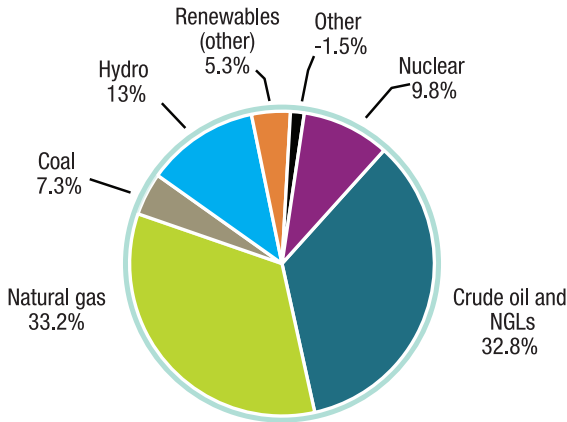
Maritimes: Prince Edward Island, Nova Scotia and New Brunswick

## Canadian primary energy supply

**Total primary energy supply (TPES)** represents Canada’s energy supply which consists of Canada’s own energy production plus imports, less exports, less energy stored in international marine and aviation bunkers and +/- stock changes.

For the purposes of TPES, electricity production and trade are calculated 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 (i.e. 1 TWh =  $(0.086 \div 0.33)$  Mtoe). This conversion factor explains the difference in the share of nuclear energy between primary energy production and TPES.

### Total primary energy supply, by source, 2012



Renewable energy sources make up 18.3% of Canada’s TPES in 2012.

“Renewables (other)” includes wind, solar, wood/wood waste, biofuels and geothermal.

“Other” includes non-renewable industrial and municipal waste and electricity trade.



### **Canadian industry structure**

- The upstream oil and gas industry comprises several hundred companies that engage in activities such as exploration, drilling, production and field processing.
- The 10 largest companies are responsible for more than half of oil and gas production in Canada.
- A variety of firms provide support services to oil and gas extraction operations such as contract drilling and maintenance.
- Oil pipelines, as well as trucks, tanker ships and railways, transport crude oil between production areas, refineries, and export/import border points.

### **Main associations**

- Canadian Association of Petroleum Producers (CAPP)
- Explorers and Producers Association of Canada (EPAC)
- Canadian Association of Oilwell Drilling Contractors (CAODC)
- Canadian Energy Pipeline Association (CEPA)

### **Regulatory authority**

- Primarily with provincial governments, e.g. Alberta Energy Regulator
- Federal jurisdiction over interprovincial and international oil and gas pipelines through the National Energy Board
- The Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board are responsible for the regulation of oil and gas activities in their corresponding offshore areas.

## International context

### World production – 91.5 MMb/d\* (2013, preliminary)

1) Saudi Arabia .....	12%
2) Russia.....	12%
3) United States .....	11%
4) China .....	5%
5) <b>Canada</b> .....	<b>4%</b>

### World exports – 44.3 MMb/d\* (2012)

1) Saudi Arabia .....	17%
2) Russia.....	11%
3) Nigeria .....	6%
4) <b>Canada</b> .....	<b>6%</b>
5) United Arab Emirates.....	6%

### World proved reserves – 1,645 billion barrels (at the end of 2013)

1) Venezuela .....	18%
2) Saudi Arabia** .....	16%
3) <b>Canada</b> .....	<b>11%</b>
(97% of which is oil sands)	
4) Iran .....	10%
5) Iraq .....	9%

\* includes natural gas liquids but excludes biofuels

\*\* includes half of the Saudi-Kuwaiti “neutral zone,” with total proved reserves of 5 billion barrels

## Canadian resources

### Proved reserves (at the end of 2013)

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

**Billion barrels**

**Canada total.....172.5**

- conventional\* ..... 5.3
- oil sands ..... 167.2
  - mining.....33.9
  - in-situ..... 134.2

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

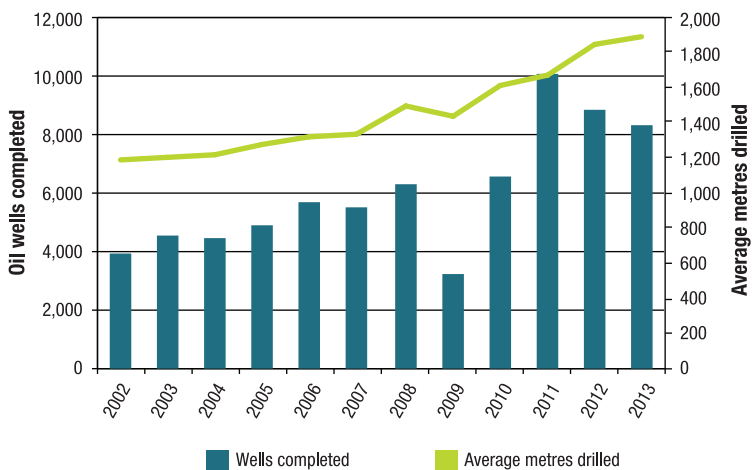
### Oil sands ultimate potential

*oil estimated to be recoverable as technology improves*

Oil sands (Alberta estimate) ..... 315 billion barrels\*

\* includes cumulative production to date

### Oil wells completed and average metres drilled in western Canada

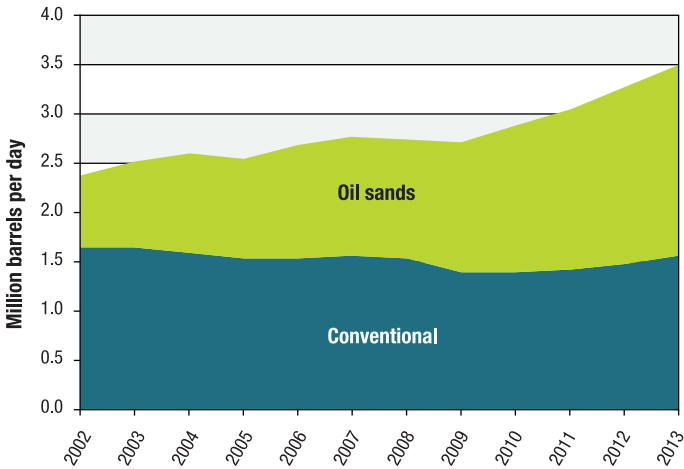


## Canadian production

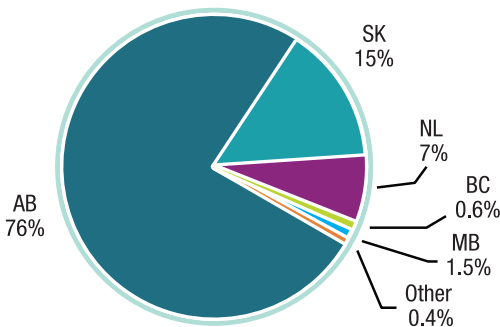
Starting in 2010, oil sands production has exceeded conventional production.

In 2013, oil sands production was 1.9 MMb/d compared to 1.5 MMb/d for conventional oil.

### Production by type



### Production by province, 2013



“Other”: Nova Scotia, Ontario and the Northwest Territories

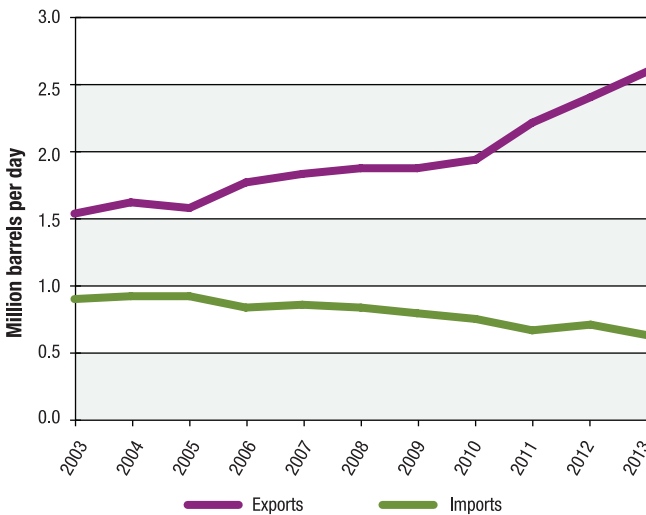
## Canadian supply and demand\* (2013)

Canadian production .....	3.5 MMb/d
Exports .....	2.6 MMb/d
Canadian oil sent to domestic refineries .....	1.1 MMb/d
Imports by domestic refineries .....	0.6 MMb/d

\* includes condensates and pentanes plus

## Trade

### Canadian trade of crude oil



## Key facts (2013)

- 97% of Canadian crude oil exports are to the U.S.
- Canada was the largest foreign supplier of crude oil to the U.S., accounting for 33% of total U.S. crude oil imports and for 17% of U.S. refinery crude oil intake.
- Canadian imports come from a wide range of countries, including the U.S. (20%), Algeria (13%), Iraq (12%) and Norway (11%).

## Prices

### West Texas Intermediate

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

### Brent

- Reference price for light crude oil delivered at the Sullom Voe terminal in the U.K.
- Used as a benchmark price for North Sea crudes, as well as for many other crudes around the world
- During the 2000s, Brent and WTI traded within a few dollars of each other.

### Edmonton Par or Canadian Light Sweet

- Reference price for light crude oil (similar quality to WTI) delivered at Edmonton

### Western Canada Select

- Reference price for heavy crude oil (e.g. blended bitumen) delivered at Hardisty, AB
- It takes more energy to produce refined products (e.g. gasoline) from heavy crudes, therefore WCS trades at a discount compared to lighter crudes.

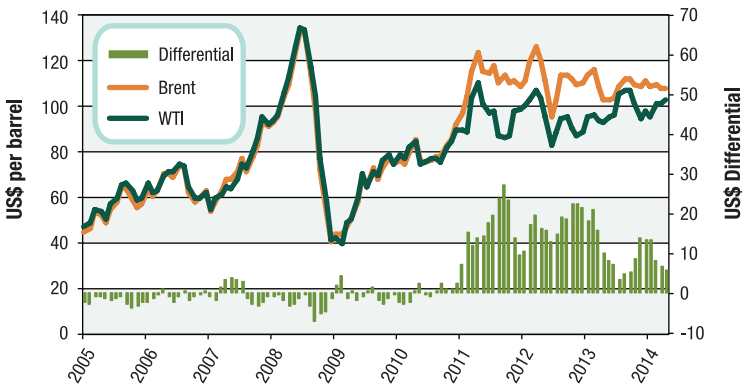
### Maya

- Reference price for heavy oil produced in Mexico (similar quality to WCS)

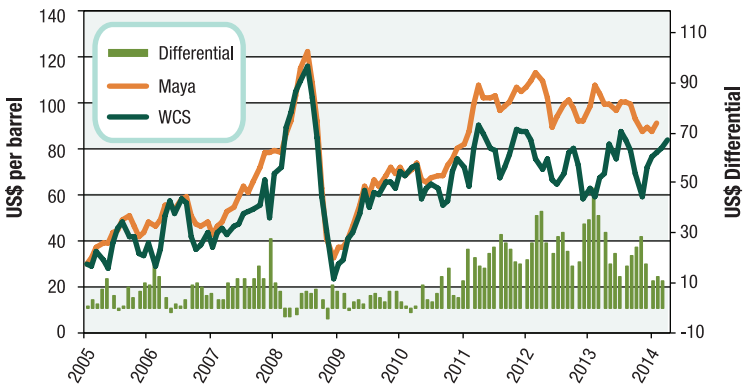
### Highlights for WTI

Average: 1995–2003 .....	US\$23 per barrel
Peak on July 11, 2008 .....	US\$147 per barrel
Average: 2012 .....	US\$94 per barrel
Average: 2013 .....	US\$98 per barrel
Average: 2014 (first 5 months) .....	US\$100 per barrel

## Brent vs. WTI monthly average prices



## Maya vs. WCS monthly average prices



## Oil sands

### Strategic importance

- 97% of Canada's proved reserves
- 56% of Canada's oil production in 2013 or 1.9 MMb/d
- An estimated \$217 billion of capital investment to date, including almost \$33 billion in 2013

### Mining method

- For shallow formations of 75 metres or less
- 47% of current production, 20% of resources
- Process: remove overburden, extract oil sands ore, separate oil from sand using steam, pump tailings into settling basins
- Six large projects in Alberta: Syncrude Mining Project, Suncor Base Mine, CNRL Horizon Mine, Athabasca Oil Sands Project – Muskeg River and Jackpine Mine, and Imperial's Kearl Mine

### In-situ method

- For formations deeper than 75 metres
- 53% of current production, 80% of resources
- Process: drill vertical and/or horizontal wells, inject steam to facilitate the flow of oil
- More than 20 projects in Alberta – largest are Cold Lake (Imperial Oil) and Firebag (Suncor)

### Bitumen upgrading

- Crude bitumen from oil sands may be transported to upgraders for processing to make it lighter – “synthetic crude oil.”
- Bitumen may also be sold directly to refineries capable of processing heavier oils.
- Major companies with upgrading capacity: Syncrude, Suncor, Shell, Canadian Natural Resources, Husky and Nexen-CNOOC
- Total upgrading capacity in Canada of 1,354,000 b/d (facilities are listed in the Petroleum products section)



## Oil sands: environmental challenges

### Water

- mining method: 3 to 4 barrels of water required per barrel of bitumen
- in-situ method:  $\approx$ 1 barrel of water required per barrel of bitumen
- Oil sands producers recycle 70 to 75% of the water used in established mines and approximately 90% for in-situ production.

### Greenhouse gases

- 8.7% of Canada's total GHG emissions and 0.1% globally
- GHG emissions per barrel of oil sands in 2012 were 28% below 1990 levels.

### Land

- area of oil sand resources ..... 142,200 km<sup>2</sup>
- total mineable area ..... 4,800 km<sup>2</sup>
- total area being mined..... 844 km<sup>2</sup>
- tailings ponds ..... 176 km<sup>2</sup>

#### By comparison:

- Canada's total area ..... 10,000,000 km<sup>2</sup>
- Canadian boreal forest ..... 3,200,000 km<sup>2</sup>
- 22% of the Lower Athabasca Region is comprised of conservation areas

## Key existing pipelines

### Enbridge

- World's largest pipeline system for crude oil and petroleum products, serving Canada and the U.S.
  - Mainline: Alberta to the U.S. Midwest and Ontario
  - Northwest: from Northwest Territories to Alberta
  - Line 1: petroleum products from Edmonton to Gretna (Manitoba)
  - Line 9: from Sarnia to Montréal, eastward flow to be finalized by late 2014]
  - Alberta Clipper: from Hardisty (AB) to Superior (Wisconsin)
  - Southern Lights: diluent from Chicago to Edmonton

### Kinder Morgan

- North America's largest pipeline company and largest transporter of refined products
  - Trans Mountain Line: from Edmonton to British Columbia (crude oil and petroleum products) and to Washington State (crude)

### Pembina

- Second-largest oil pipeline system in western Canada
  - 9 pipelines for conventional and unconventional oil
  - Bitumen Line: from Fort McMurray to Edmonton

### Portland-Montreal Pipeline

- Foreign oil – from Portland (Maine) to Montréal

### TransCanada Pipeline

- Keystone Pipeline: from Hardisty (AB) to the U.S. Midwest

### Trans-Northern Pipeline

- Petroleum products – from Montréal to Eastern Ontario, Toronto and Oakville

### Spectra Energy

- Express-Platte: from Hardisty (AB) to U.S. Midwest

## Pipeline expansion proposals

Current Canadian crude oil production is nearing the maximum pipeline capacity out of western Canada of 3.5 million barrels per day. With western Canadian crude oil production projected to grow over the coming years, several pipeline projects are being proposed in order to move new production to markets. Below is a list of some of the largest projects.

### Northern Gateway (Enbridge)

- Two new pipelines from Edmonton to Kitimat (BC)
  - Capacity to export 525,000 b/d of crude oil and import 193,000 b/d of condensate
  - Marine terminal would be constructed

### Trans Mountain Expansion (Kinder Morgan)

- Twinning of existing pipeline from Edmonton to Vancouver
  - Incremental capacity of 590,000 b/d
  - Marine terminal in Burnaby (BC) would be expanded

### Keystone XL (TransCanada)

- New pipeline from Hardisty (AB) to U.S. Gulf Coast
  - Capacity of 830,000 b/d
  - Fifteen Gulf Coast refineries are configured to process heavy crudes.

### Mainline Expansion (Enbridge)

- Expansion of Alberta Clipper from Hardisty (AB) to Gretna (MB), with incremental capacity of 350,000 b/d

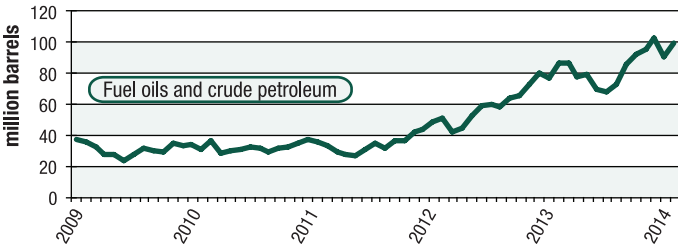
### Energy East (TransCanada)

- Conversion of existing natural gas lines to oil and construction of new oil lines
  - From Hardisty (AB) to Saint John (NB)
  - Capacity of 1.1 MMb/d

## Crude by rail

Given current pipeline constraints, the transportation of crude oil by rail has increased substantially in recent years. The current rail loading capacity out of western Canada is approximately 300,000 b/d but is forecasted to more than double – to 700,000 b/d – by the end of 2016.

### Monthly crude oil volume by rail



## Crude by Rail Facilities

### Conexus (Bruderheim, AB)

- Commenced operations in December 2013
- Guaranteed capacity of up to 100,000 b/d

## Proposed facilities

### Gibsons (Hardisty, AB)

- Rail loading facility with initial capacity of 140,000 b/d

### Kinder Morgan & Imperial Oil (Edmonton, AB)

- The terminal will connect to both the Canadian National and Canadian Pacific main rail lines.
- The initial loading capacity will be 100,000 b/d; that could expand to 250,000 b/d.

### TORQ Transloading (Bromhead, SK)

- Expected to be southeastern Saskatchewan’s largest crude-by-rail terminal, with proposed maximum capacity of 168,000 b/d

## Light tight oil/Shale oil

### Definition

- Light oil found in sedimentary rock characterized by very low permeability – typically shale
- The oil is extracted using horizontal drilling combined with multi-stage hydraulic fracturing – the same techniques used for shale gas extraction.

Note: “Shale oil” should not be confused with “oil shale,” which are shale rocks rich in decomposed matter still in solid state.

### Potential in Canada and the U.S.

- Tight oil resources are largely found in a belt ranging from central Alberta to southern Texas.
- The Bakken (North Dakota, Montana, Saskatchewan, Manitoba) and Eagle Ford (south Texas) tight oil formations are the largest sources of tight oil production in North America.
- Prospective resources have also been identified throughout the Rocky Mountain region, the U.S. Gulf Coast and the northeastern U.S./eastern Canada (including Anticosti Island and western Newfoundland and Labrador).
- The International Energy Agency forecasts that the U.S. will become the world’s largest oil producer by 2020 due to the rapid growth in U.S. tight/shale oil production.

### World technically recoverable shale oil\* resources 345 billion barrels (2012)

1) Russia.....	22%
2) United States .....	17%
3) China .....	9%
4) Argentina.....	8%
5) Libya .....	8%
...	
<b>10) Canada .....</b>	<b>3%</b>

\* Shale formations are a subset of low permeability tight oil formations.

# 3

## Petroleum products

### Canadian industry structure

- Petroleum refineries transform crude oil into a wide range of refined petroleum products (e.g. gasoline, diesel).
- Other plants such as asphalt plants, upgraders and some petrochemical plants also process crude oil to produce a limited range of products.
- A variety of firms distribute refined petroleum products at the wholesale and retail levels.
- Pipelines and tanker ships are commonly used to transport products over long distances; while tanker trucks and trains are more often used for regional and local distribution.

### Main associations

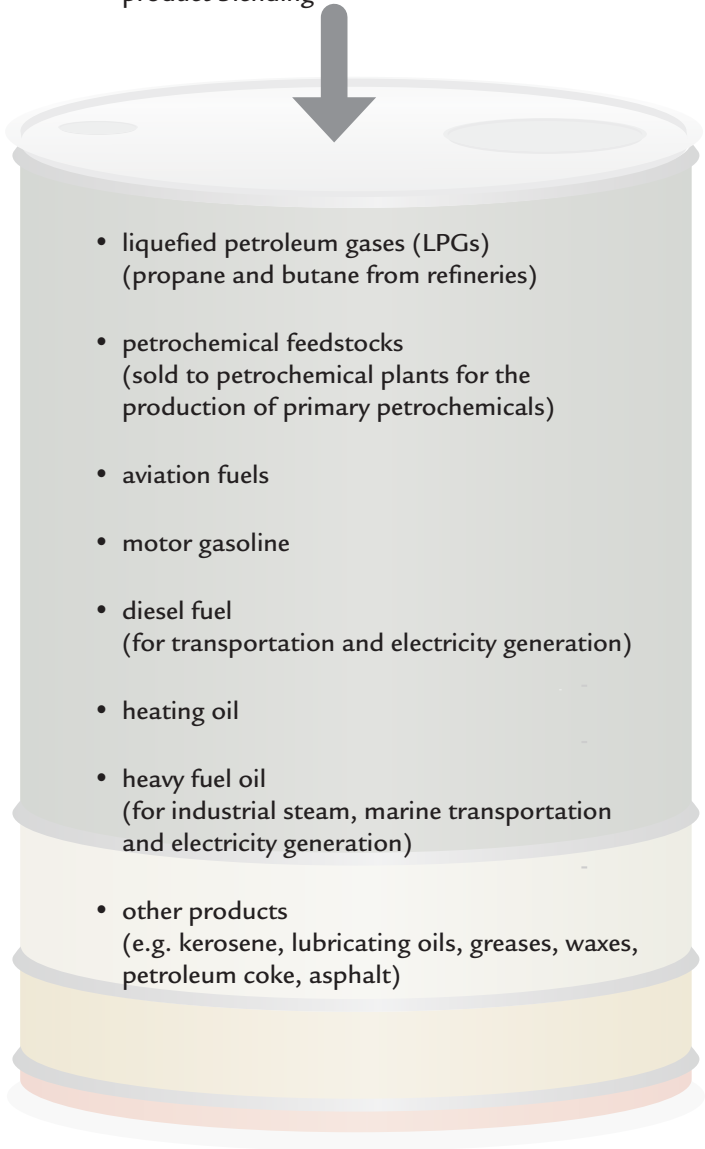
- Canadian Fuels Association (CFA)
- Canadian Independent Petroleum Marketers Association (CIPMA)

### Regulatory authority

- Primarily with provincial governments

## Petroleum refineries

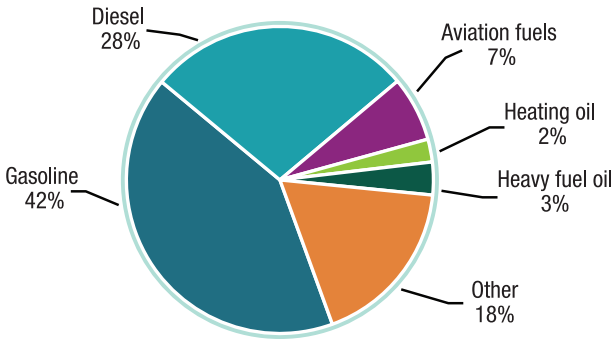
- crude oil distillation
- additional processing (e.g. catalytic cracking and reforming)
- product blending



## Canadian supply and demand (2013)

Crude oil shipped to domestic refineries.....	1.7 MMb/d (99 billion litres)
Canadian production .....	110 billion litres
Imports* .....	13 billion litres (mainly through Montréal)
Exports .....	29 billion litres
Domestic sales* .....	107 billion litres

### Sales by product, 2013\*



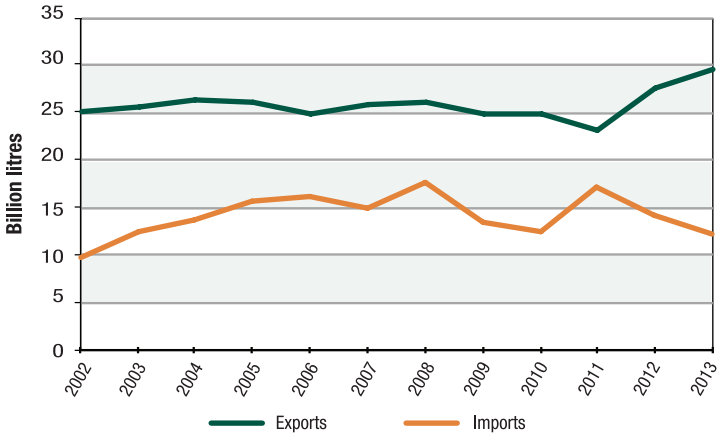
\* Certain product shares are based on NRCAN analysis.

“Other” includes propane, butane, petro-chemical feedstocks, lubricating oils, petroleum coke, and asphalt, etc.



## Trade (2013)

### Canadian exports and imports of refined petroleum products



### Key facts (2013)

- 26% of Canadian production of refined petroleum products is exported:
  - 92% of Canadian refined petroleum product exports are to the U.S.
  - 27% of U.S. imports come from Canada.
- 12% of Canadian consumption of refined petroleum products is imported:
  - 74% of Canadian imports come from the U.S.
  - Other Canadian imports come from a wide range of countries, including the Netherlands (9%), Mexico (3%) and the U.K. (3%).

## Retail prices (in cents per litre)

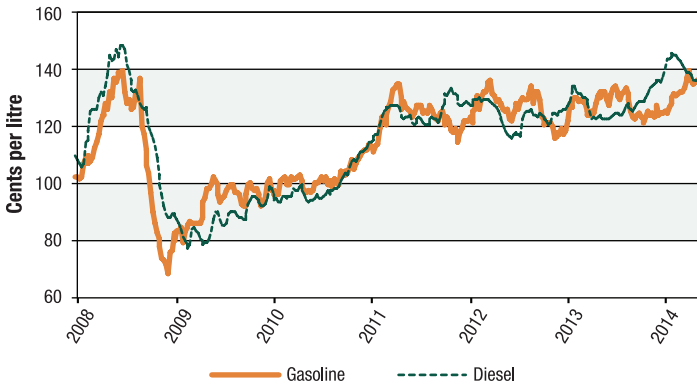
	Gasoline	Diesel
2013		
average Canadian pump price	127.9	128.6
estimated crude cost	63.1	63.1
refining and marketing	25.4	33.6
federal taxes*	15.8	10.1
provincial taxes**	23.6	21.8
2014		
average Canadian pump price (first six months)	133.1	140.0

\* includes the GST and federal excise tax

\*\* includes the provincial portion of the HST

Changes in retail prices for fuel tend to mimic those for crude oil.

### Weekly retail gasoline and diesel prices



## Canadian petroleum refineries

Location	Refinery	Capacity
<b>British Columbia</b>		
Prince George	Husky Energy	12,000 b/d
Burnaby	Chevron Canada	55,000 b/d
<b>Alberta</b>		
Edmonton	Imperial Oil	187,000 b/d
Edmonton	Suncor Energy	142,000 b/d
Edmonton	Shell	100,000 b/d
<b>Saskatchewan</b>		
Regina	Consumer's Co-op	145,000 b/d
<b>Ontario</b>		
Sarnia	Imperial Oil	121,000 b/d
Nanticoke	Imperial Oil	112,000 b/d
Sarnia	Suncor Energy	85,000 b/d
Sarnia	Shell	75,000 b/d
<b>Quebec</b>		
Québec (City)	Valero (formerly Ultramar)	265,000 b/d
Montréal	Suncor Energy	137,000 b/d
<b>New Brunswick</b>		
Saint John	Irving Oil	320,000 b/d
<b>Newfoundland and Labrador</b>		
Come by Chance	North Atlantic	115,000 b/d
<b>Total refining capacity</b>		<b>1,871,000 b/d</b>

## Other plants with crude oil processing

Location	Plant	Capacity
<b>Asphalt plants</b>		
SK		
Lloydminster	Husky Energy	29,000 b/d
Moose Jaw	Moose Jaw Refinery	15,000 b/d
<b>Total processing capacity</b>		<b>44,000 b/d</b>
<b>Petrochemical plants</b> (currently using crude oil as feedstock)		
ON		
Sarnia	Nova Chemicals	80,000 b/d
Mississauga	Suncor Lubricants	16,000 b/d
<b>Total processing capacity</b>		<b>96,000 b/d</b>
<b>Upgraders*</b>		
AB		
Fort McMurray	Syncrude	474,000 b/d
Fort McMurray	Suncor Base U1/U2	267,000 b/d
Fort Sask	Shell Scotford	255,000 b/d
Fort McKay	CNRL Horizon	114,000 b/d
Fort McMurray	Suncor Millenium	90,000 b/d
Wood Buffalo	Nexen-CNOOC	72,000 b/d
SK		
Lloydminster	Husky Energy	82,000 b/d
<b>Total upgrading capacity</b>		<b>1,354,000 b/d</b>

\* Although upgraders primarily transform heavy crudes into lighter crudes, they also produce some refined products, such as diesel.

## Canadian industry structure

- The upstream oil and gas industry comprises several hundred companies that engage in activities such as exploration, drilling, production and field processing.
- The midstream natural gas industry processes raw natural gas and transports it through pipelines from producing areas to transmission pipelines or consuming areas.
- The downstream natural gas industry comprises natural gas utilities that distribute natural gas to end-use consumers by operating extensive networks of local distribution pipelines.

## Main associations

- Canadian Association of Petroleum Producers (CAPP)
- Explorers and Producers Association of Canada (EPAC)
- Canadian Association of Oilwell Drilling Contractors (CAODC)
- Canadian Society for Unconventional Resources (CSUR)
- Canadian Energy Pipeline Association (CEPA)
- Canadian Gas Association (CGA)
- Industrial Gas Users Association (IGUA)

## Regulatory authority

- Primarily with provincial governments
- Federal jurisdiction over interprovincial and international natural gas pipelines through the NEB
- The Canada-Nova Scotia Offshore Petroleum Board and Canada-Newfoundland and Labrador Offshore Petroleum Board are responsible for regulations of oil and gas activities in their corresponding offshore areas.

## International context

**World production** – 336 Bcf/d (9.5 Bcm/d)  
(2013, preliminary)

1) United States .....	20%
2) Russia.....	19%
3) Qatar .....	5%
4) Iran .....	5%
5) <b>Canada</b> .....	<b>4%</b>

**World exports** – 102 Bcf/d (2.9 Bcm/d)  
(2013, preliminary)

1) Russia.....	20%
2) Qatar .....	11%
3) Norway.....	10%
4) <b>Canada</b> .....	<b>8%</b>
5) Netherlands .....	6%

**World proved reserves** – 7,024 Tcf (199 Bcm)  
(at end of 2013)

1) Russia.....	24%
2) Iran .....	17%
3) Qatar .....	13%
4) United States .....	5%
5) Saudi Arabia.....	4%
...	
19) <b>Canada</b> .....	<b>1%</b>

## Canada-U.S. resources

- The natural gas markets in Canada and the U.S. are highly integrated from a supply and demand perspective.
- Together, Canada and the U.S. are estimated to have more than 100 years of supply at current production and consumption rates.

### Proved reserves (at the end of 2012)

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

Canada .....	71 Tcf
U.S. ....	308 Tcf
Total .....	379 Tcf

### Technically recoverable resources

*gas estimated to be recoverable as drilling and infrastructure expands*

Canada total .....	885–1,566 Tcf
Canadian conventional .....	357–436 Tcf
Canadian unconventional.....	528–1,130 Tcf
(coal-bed methane, shale and tight gas)	
U.S. total .....	2,431 Tcf
portion that is shale and tight gas .....	664 Tcf
portion that is other .....	1,766 Tcf
World total .....	28,605 Tcf
portion that is conventional.....	16,527 Tcf
portion that is unconventional.....	12,113 Tcf

## Shale gas

### Features of shale

- Ultra-low permeability sedimentary rock containing natural gas
- Gas is extracted by using horizontal drilling and hydraulic fracturing.

### Hydraulic fracturing (fracking)

- Creates fractures in rock layers by using pressurized water, mixed with small amounts of sand and additives, to release the natural gas

### Potential in Canada

- Shale gas resources are found in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick and Nova Scotia.
- Technological advancements in drilling (long-reach horizontal well bores) and completion techniques (multistage fracking) have allowed commercial production of natural gas from shale.
- These advancements have increased the long-term outlook for the supply of natural gas in North America.

### Global potential

- An updated U.S. Energy Information Administration assessment of 137 shale formation in 41 countries, in addition to the U.S. basins, found a total of 7,299 Tcf of technically recoverable shale gas resources.

### World technically recoverable shale resources –

7,299 Tcf (2012)

1) China .....	15%
2) Argentina.....	11%
3) Algeria.....	10%
4) United States .....	9%
<b>5) Canada .....</b>	<b>8%</b>
6) Mexico.....	7%
7) Australia.....	6%

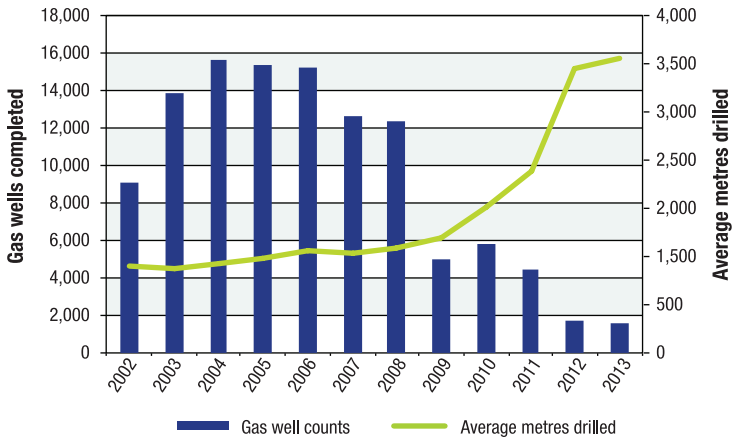


## Canada-U.S. market (2013)

Canada-U.S. market .....	80.6 Bcf/d
	(2.3 Bcm/d)
Canadian average marketable production .....	13.7 Bcf/d
	(0.4 Bcm/d)
conventional* .....	38%
unconventional* .....	62%
U.S. average marketable production.....	66.5 Bcf/d
	(1.9 Bcm/d)
conventional* .....	41%
unconventional* .....	59%
North American LNG imports.....	0.4 Bcf/d
	(0.01 Bcm/d)

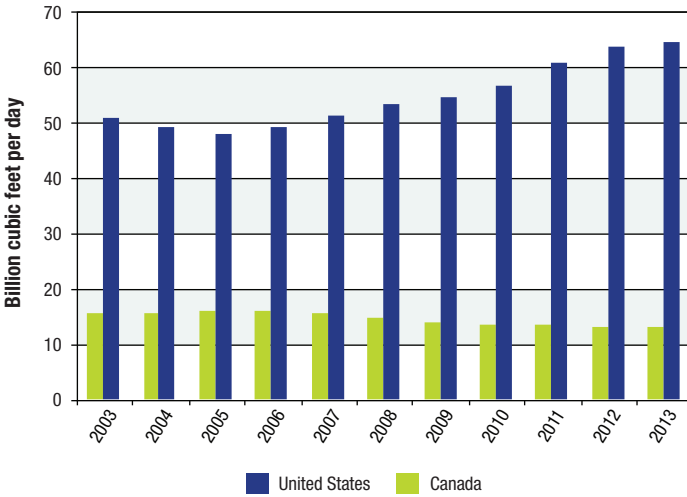
\* Unconventional gas includes tight gas, coalbed methane and shale gas. U.S. percentages by type are based on 2010 data.

## Natural gas wells completed and average metres drilled in western Canada

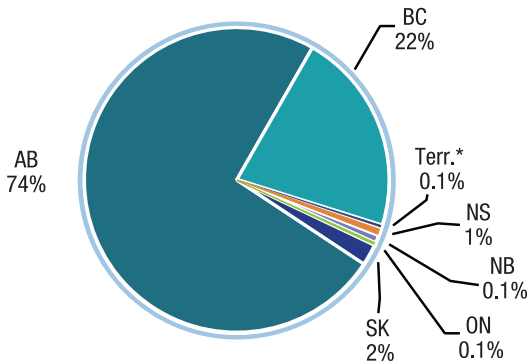


## Canadian production (2013)

Canadian and U.S. marketable production of natural gas



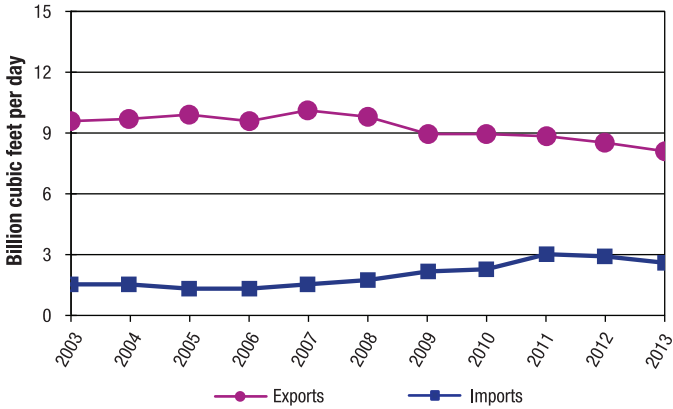
Marketable production by province, 2013



\* Terr.: Northwest Territories and Yukon

## Trade (2013)

### Canadian exports and imports of natural gas



Canadian exports .....	7.8 Bcf/d (0.20 Bcm/d)
Canadian imports .....	2.6 Bcf/d (0.07 Bcm/d)

### Key facts

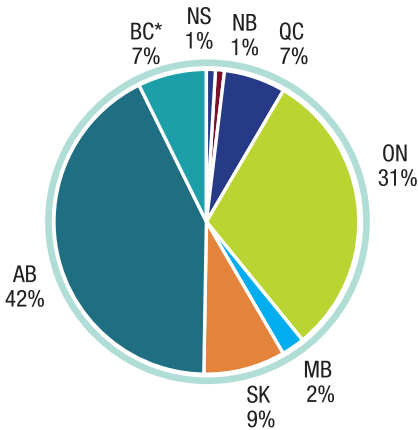
- 57% of Canadian production is exported
  - All Canadian exports go to the U.S.
  - 97% of U.S. imports and 11% of U.S. consumption comes from Canada
- 32% of Canadian consumption, including for non-energy use, is imported from the U.S.
- Since 2009, Canada has also imported small amounts of natural gas from other countries through the Canaport LNG terminal in Saint John, NB.

## Domestic energy demand\* (2012)

Total.....	7.7 Bcf/d
Industrial .....	3.2 Bcf/d (41%)
Residential .....	1.6 Bcf/d (20%)
Electricity generation .....	1.4 Bcf/d (18%)
Commercial/institutional.....	1.2 Bcf/d (15%)
Transportation.....	0.3 Bcf/d (4%)
Agriculture.....	0.1 Bcf/d (1%)

\* excludes field use and non-energy use

## Domestic demand by province, 2013



\* includes Yukon and the Northwest Territories

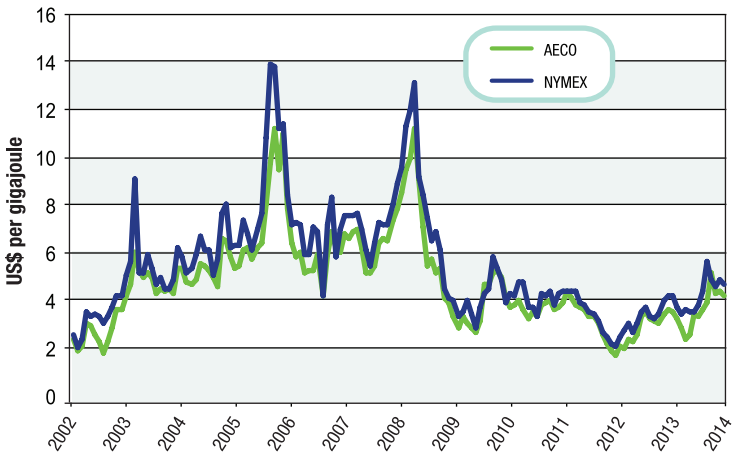
## Upstream prices

(based on Alberta prices at AECO\*)

Average: 2002–2011 .....	C\$5.70/GJ
Average: 2012 .....	C\$2.31/GJ
Average: 2013 .....	C\$3.02/GJ
Average: 2014 .....	C\$4.40/GJ
(first 6 months)	

\* The AECO is the largest trading hub in Canada, and the AECO price serves as a benchmark for Alberta gas transactions.

### Natural gas prices (AECO/NYMEX)



## Key existing pipelines

### TransCanada Pipelines

- Canada's leading natural gas pipeline company serving markets in Canada, the U.S. and Mexico, tapping into virtually all natural gas basins in North America
- Alberta System (a.k.a. NOVA Gas Transmission Ltd. or NGTL): within Alberta
- Canadian Mainline: several pipelines in the same corridor from Alberta/Saskatchewan border to Québec (city) with several interconnections to the U.S. along the way
- Foothills: from Alberta to Idaho via BC and from Alberta to Montana via Saskatchewan

### Spectra Energy

- Canada's second largest gas pipeline company
- Maritimes & Northeast Pipeline: Nova Scotia and New Brunswick to the U.S.
- Union Gas: gas distribution and transmission in Ontario and the eastern U.S.
- West Coast Energy: pipeline in BC

### Enbridge Inc.

- Third-largest gas pipeline company in Canada
- Largest local gas distribution company in Canada (Enbridge Gas Distribution of Toronto)
- Alliance Line (50% owner): BC through Alberta; and Saskatchewan to Chicago
- Vector Line (60% owner): Chicago to Ontario

### ATCO Pipeline

- Gathering and distribution lines within Alberta

### TransGas Ltd.

- Gathering, transmission and storage facilities in Saskatchewan
- Owned by SaskEnergy Inc. (provincial distributor)

## Pipeline expansion proposals

### Federally regulated

#### Wolverine River Lateral Loop (Carmon Creek Section) (NGTL)

- New pipeline to be located in northwest Alberta
- Capacity of 0.2 Bcf/d

#### North Montney Project (NGTL)

- New pipeline to be located in northeast BC and will connect to the existing Groundbirch Mainline
- Initial capacity of 2.8 Bcf/d

#### Merrick Mainline Pipeline Project (NGTL)

- New pipeline from Dawson Creek, BC, to Summit Lake, BC
- Capacity of 1.9 Bcf/d
- Linked to proposed Kitimat LNG project

#### Eastern Mainline Pipeline Project (TransCanada)

- New pipeline between Markham and Iroquois, Ontario
- This project will enable TransCanada to continue to meet its commercial obligations following the proposed transfer of certain Canadian mainline facilities to the Energy East Oil Pipeline Project.

## Pipeline expansion proposals

### Provincially regulated

#### Coastal Gaslink Pipeline

- New pipeline from Dawson Creek, BC, to Kitimat, BC
- Initial capacity of 1.7 Bcf/d
- Linked to proposed LNG Canada export facility

#### Eagle Mountain - Woodfibre Gas Pipeline Project

- Expansion of existing pipeline between Coquitlam, BC, and Squamish, BC
- Initial capacity of 150 – 220 MMcf/d
- Linked to proposed Woodfibre LNG export facility

#### Pacific Northern Gas Looping Project

- Expansion of existing pipeline between Summit Lake, BC, and Kitimat, BC
- Capacity of 600 MMcf/d
- Linked to proposed Triton LNG export facility

#### Pacific Trail Pipeline

- New pipeline between Summit Lake, BC, and Kitimat, BC
- Capacity of 1.4 Bcf/d
- Linked to proposed Kitimat LNG export facility

#### Prince Rupert Gas Transmission Project

- New pipeline between Hudson's Hope, BC, and Prince Rupert, BC
- Initial capacity of 2.0 Bcf/d
- Linked to proposed Pacific NorthWest LNG export facility

#### Westcoast Connector Gas Transmission Project

- New pipeline between northeastern BC, and Prince Rupert, BC
- Capacity of 4.2 Bcf/d
- Linked to proposed Prince Rupert LNG export facility



## Proposed LNG export projects

Fifteen LNG projects proposed for our west and east coasts have entered the regulatory review process, with a total proposed export capacity of 238 million tonnes per annum (mtpa) of LNG (approximately 32 billion cubic feet per day [Bcf/d] of natural gas).

### Kitimat LNG (Kitimat, BC)

- Proposed by Apache Canada and Chevron Canada
- Maximum capacity of 10 mtpa (1.3 Bcf/d)
- Obtained an export licence in November 2011
- Targeted start date of 2017

### Douglas Channel/BC LNG (Kitimat, BC)

- Proposed by the Douglas Channel Energy Partnership
- Maximum capacity of 1.8 mtpa (0.25 Bcf/d)
- Obtained an export licence in April 2012
- Targeted start date of 2015

### LNG Canada (Kitimat, BC)

- Proposed by Shell Canada, Korea Gas Corp., Mitsubishi Corporation, PetroChina
- Maximum capacity of 24 mtpa (3.2 Bcf/d)
- Obtained an export licence in February 2013
- Targeted start date of 2019/20

### Pacific Northwest LNG (Prince Rupert, BC)

- Proposed by Progress/PETRONAS, Sinopec, Indian Oil Corp., Japan Petroleum Exploration, PetroleumBRUNEI
- Maximum capacity of 19.7 mtpa (2.7 Bcf/d)
- Obtained an export licence in March 2014
- Targeted start date of 2019

### **Prince Rupert LNG (Prince Rupert, BC)**

- Proposed by BG Group
- Maximum capacity of 21.6 mtpa (2.9 Bcf/d)
- Obtained an export licence in March 2014
- Targeted start date of 2022

### **WCC LNG (Kitimat or Prince Rupert, BC)**

- Proposed by ExxonMobil Canada and Imperial Oil
- Maximum capacity of 30 mtpa (4.0 bcf/d)
- Obtained an export licence in March 2014
- Targeted start date of 2021/2023

### **Woodfibre LNG (Squamish, BC)**

- Proposed by Woodfibre Natural Gas, a subsidiary of Pacific Oil & Gas Limited
- Maximum capacity of 2.1 mtpa (0.33 bcf/d)
- Obtained an export licence in March 2014
- Targeted start date of 2017

### **Triton LNG (Kitimat or Prince Rupert, BC)**

- Proposed AltaGas and Idemitsu
- Maximum capacity of 2.3 mtpa (0.32 bcf/d)
- NEB approved an export licence in April 2014
- Licence requires Governor in Council approval
- Targeted start date of 2017

### **Aurora LNG (Prince Rupert, BC)**

- Proposed by Nexen, INPEX and JGC
- Maximum capacity of 24 mtpa (3.1 bcf/d)
- NEB approved an export licence in May 2014
- Licence requires Governor in Council approval
- Targeted start date of 2021/2023

**Kitsault Energy Project (Kitsault, BC)**

- Proposed by Kitsault Energy
- Maximum capacity of 20 mtpa (2.7 bcf/d)
- Export licence application under review by the NEB
- Targeted start date of 2018

**WesPac Marine Terminal/Tilbury LNG (Delta, BC)**

- Marine terminal proposed by WestPac Midstream
- Maximum capacity of 3 mtpa (0.40 bcf/d) following expansion of existing Tilbury LNG (FortisBC) facility
- Export licence application under review by the NEB
- Targeted start date of 2016

**Steelhead LNG (TBD, likely Vancouver Island, BC)**

- Proposed by Steelhead LNG Corp.
- Maximum capacity of 30 mtpa (4.25 Bcf/d)
- Export licence application under review by the NEB
- Targeted start date of 2019

**Grassy Point LNG (Prince Rupert, BC)**

- Proposed by Woodside Energy Holdings Pty Ltd.
- Maximum capacity of 20 mtpa (2.8 Bcf/d)
- Export licence application under review by the NEB
- Targeted start date of 2021

**Discovery LNG (Campbell River, BC)**

- Proposed by Quicksilver Resources Canada Inc.
- Maximum capacity of 20 mtpa (2.63 bcf/d)
- Export licence application under review by the NEB
- Targeted start date of 2021

**Goldboro LNG (Guysborough, NS)**

- Proposed by Pieridae Energy Canada
- Maximum capacity of 10 mtpa (1.4 Bcf/d)
- Targeted start date of 2020

# 5

## Natural gas liquids

### Definition

- Propane, butane and ethane are hydrocarbons obtained from natural gas production and upstream processing.
- These gases can be easily liquefied, and therefore are commonly referred to as “liquids.”
- When these liquids are present in natural gas, it is called “wet” gas; when they are not present, or have been extracted, the natural gas is called “dry” gas.

### Notes

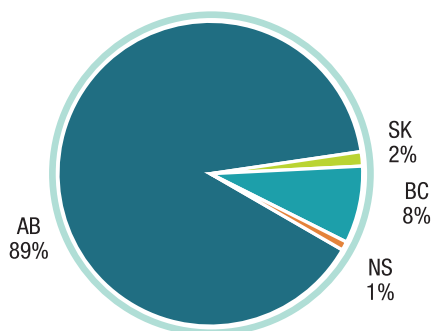
- Condensates and pentanes are also hydrocarbons produced from raw natural gas. However, because they are akin to light crude oil, they are included in the “Crude oil” chapter.
- Propane and butane are also produced from the refining of crude oil. They are referred to as “liquefied petroleum gases” (LPGs).
- Most NGLs (with the exception of ethane) are priced similarly to crude oil and with today’s low natural gas prices, producers have been targeting liquid rich reserves.

## Canadian supply\* (2012)

Canadian production .....	539,000 b/d
- propane .....	192,000 b/d
- butane.....	115,000 b/d
- ethane .....	232,000 b/d
Exports.....	123,000 b/d
Imports.....	12,000 b/d

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

## Natural gas liquids production by province, 2012



**Domestic demand\*** (2012)

Non-energy use .....	64%
(as feedstocks for petrochemicals)	
Other industrial .....	12%
Refinery use .....	11%
Commercial/institutional.....	6%
Residential .....	3%
Transportation.....	2%
Agriculture .....	1%

\* includes liquefied petroleum gases

## Propane

Propane is a natural gas liquid that used for a variety of purposes, from home heating and cooking, to crop drying and fueling vehicles.

Propane is produced through two means in Canada:

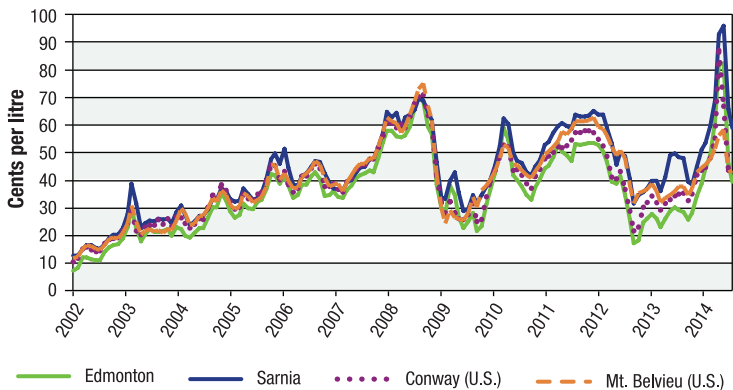
- 85 to 90% of Canadian propane is produced as a result of natural gas processing
- 10 to 15% is produced as a by-product of crude oil refining and upgrading

### Domestic supply and demand (2012)

- More than 192,000 b/d of propane were produced in Canada.
- Approximately 177,000 b/d of propane were consumed in Canada, of which 13,000 b/d or 7% was consumed in residential use.

During the winter of 2013-2014 Canada and US experienced extremely cold weather. As a result of this and a number of other factors (wet harvest season, lower than usual propane inventories, growing North American propane exports) the price of propane in Canada spiked, with adverse consequences for homeowners who rely on propane to heat their homes.

### Monthly average propane price at major Canadian and U.S. hubs



### **Canadian industry structure**

- The Canadian coal industry produces coal for use in
  - metallurgical applications
  - thermal applications (e.g. electricity generation)
- Numerous firms provide services to coal producers such as exploration, equipment supply, engineering services and transportation.
- Some power-generating companies not only use coal for electricity generation but also own coal mines or are involved in coal production. Other companies generate electricity from purchased coal.

### **Main association**

- Coal Association of Canada

### **Regulatory authority**

- primarily with provincial governments



## International context

### World production – 7.7 billion tonnes

(2013, preliminary)

1) China .....	45%
2) United States .....	12%
3) India.....	8%
4) Indonesia.....	6%
5) Australia.....	6%
...	
<b>12) Canada .....</b>	<b>1%</b>

### World exports – 1.3 billion tonnes

(2013, preliminary)

1) Indonesia.....	32%
2) Australia.....	25%
3) Russia .....	11%
4) United States .....	8%
5) Columbia.....	6%
6) South Africa.....	5%
<b>7) Canada .....</b>	<b>3%</b>

### World proved reserves – 892 billion tonnes

(at the end of 2011)

1) United States .....	27%
2) Russia.....	18%
3) China .....	13%
4) Australia.....	9%
5) India.....	7%
...	
<b>15) Canada .....</b>	<b>1%</b>

Above data exclude coal products such as coke.

## Canadian supply and demand (2013)

Canadian production ..... 69 Mt

Exports ..... 39 Mt

- major export destinations (by \$ value):
  - 1) Japan .....28%
  - 2) China .....26%
  - 3) South Korea .....21%
- only 3% of Canadian exports are to the U.S., representing 13% of U.S. coal imports

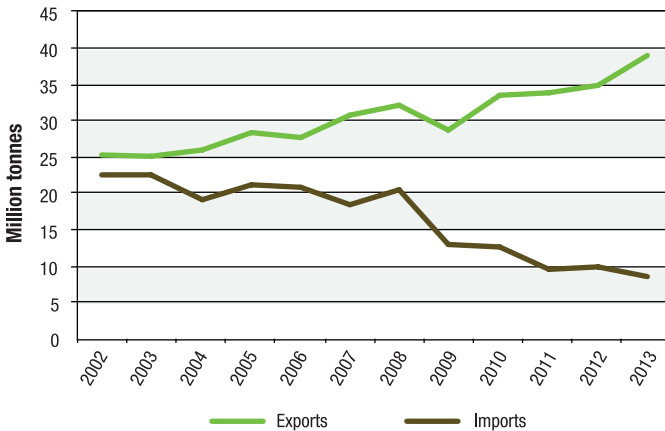
Imports..... 9 Mt

- 77% of Canadian imports are from the U.S.
- close to half of imports are destined for use in steel manufacturing (metallurgical coal), the rest are for electricity generation (thermal coal)

Domestic availability. .... 39 Mt

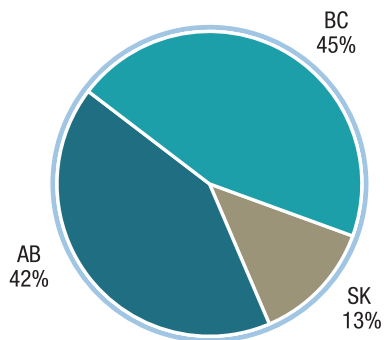
- mostly for electricity generation in AB and SK
- also for metallurgical applications

### Canadian exports and imports of coal

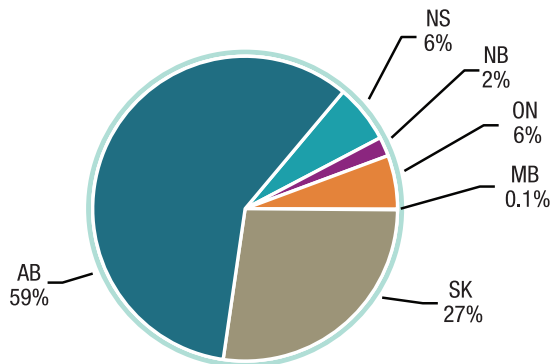


## Production and use, by province

Production by province, 2013



Coal used for electricity generation by province, 2012



## Coal-fuelled power plants in Canada >500 MW (2013)

Facility	Province	Capacity (MW)
Sundance	AB	2,278
Nanticoke*	ON	1,880
Genesee	AB	1,335
Keephills	AB	1,301
Lambton*	ON	950
Boundary Dam	SK	891
Sheerness	AB	816
Battle River	AB	700
Poplar River	SK	630
Lingan	NS	620

\* No longer operational as of December 2013

## Announced retirements of coal-fuelled power plants

- In 2003, Ontario committed to phase out all its coal-fuelled electricity generation. At that time, 36 TWh of electricity were produced at five power plants with a total capacity of 7,555 mw that represented 24% of total electricity generated in the province and 35% of Canada's coal-fired electricity generation.
- The last of the five Ontario coal-fuelled power plants was shut down in April 2014. While some of these facilities have been or will be decommissioned, others will be converted to burn other fuels, such as biomass or natural gas.

## Canadian uranium industry structure

- Canada has a vast supply of uranium in high-concentration deposits, mostly in northern Saskatchewan.
- Key producers are Cameco Corporation and AREVA Resources Canada Inc. - two of the world's largest uranium mining companies.
- Once mined, uranium ore is used to produce a uranium oxide concentrate ( $U_3O_8$ ) commonly known as “yellowcake.”
- Most of the concentrate produced is shipped to a refinery in Blind River, ON, where it is refined into uranium trioxide ( $UO_3$ ); this product is then shipped to a conversion plant in Port Hope, ON, where it is converted into
  - uranium dioxide ( $UO_2$ ) to supply CANDU-type heavy water reactors
  - uranium hexafluoride ( $UF_6$ ), exported to be enriched and used as fuel in light water reactors
- Key users in Canada are power generators with nuclear reactors (e.g. Ontario Power Generation).

## Regulatory authority

- Mining is governed by provincial regulations, but uranium mining falls mainly under federal jurisdiction.
- The Canadian Nuclear Safety Commission regulates mines and mills and all subsequent stages of the nuclear-fuel cycle, including conversion, refining, fuel fabrication, nuclear reactor operation and nuclear fuel waste management.

## Uranium – international context

### World production – 59.6 kt

(2013, preliminary)

1) Kazakhstan .....	38%
<b>2) Canada .....</b>	<b>16%</b>
3) Australia .....	11%
4) Niger .....	8%
5) Namibia .....	7%

### World exports – 49.5 kt

(2013, preliminary)

1) Kazakhstan .....	46%
<b>2) Canada .....</b>	<b>16%</b>
3) Australia .....	13%
4) Niger .....	9%
5) Namibia .....	9%

### World known recoverable resources – 5.3 Mt

(at beginning of 2011)

1) Australia .....	31%
2) Kazakhstan .....	12%
3) Russia .....	9%
<b>4) Canada .....</b>	<b>9%</b>
5) Niger .....	8%

## Uranium – Canadian supply and demand (2013)

Canadian production .....9.3 kt

- all uranium from mines in Saskatchewan
- annual value ≈\$1.0 billion
- Based on long-term contracts, uranium from Canadian mines is generally sent to purchasers in
  - 1) Asia .....40%
  - 2) North America/Latin America .....35%
  - 3) Europe.....25%

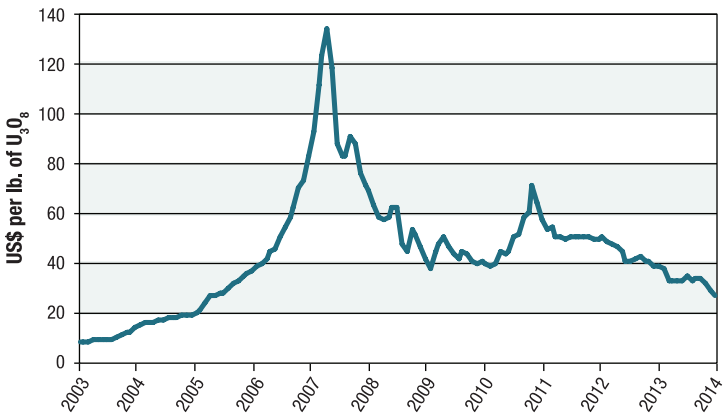
Exports ..... ≈85% of production

- 14% of uranium purchased by U.S. nuclear reactors in 2013 came from Canada, making Canada the second-largest foreign supplier of uranium to U.S. after Russia.

Domestic use ..... ≈15% of production

- to Canada’s CANDU reactors (ON and NB)

### Spot prices



## Nuclear power – international context

### World generation – 2,345 TWh (2012)

1) United States .....	33%
2) France .....	17%
3) Russia.....	7%
4) Japan.....	7%
5) South Korea.....	6%
6) Germany.....	4%
<b>7) Canada .....</b>	<b>4%</b>
8) Ukraine.....	4%

### CANDU nuclear reactors

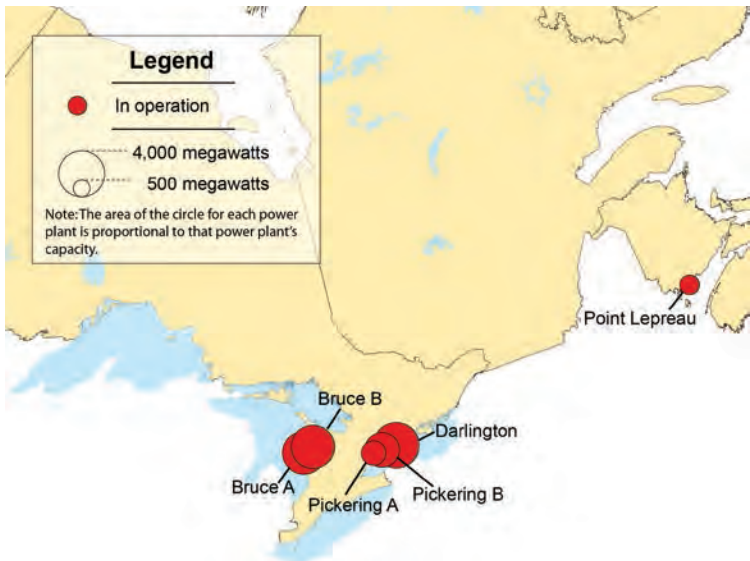
- Canada has developed a unique nuclear reactor called CANDU, for CANada Deuterium Uranium.
- It uses pressurized fuel channels instead of a pressure vessel; natural instead of enriched uranium; and, heavy water as a coolant/moderator instead of light water found in pressurized water reactor designs.
- In addition to Canada, CANDU reactors are found in India, Pakistan, Argentina, South Korea, Romania and China.



## Nuclear power plants in Canada

Facility	Province	Capacity (MW)	Units
Darlington	ON	3,740	4
Bruce B	ON	3,360	4
Bruce A	ON	3,300	4
Pickering B	ON	2,160	4
Pickering A	ON	1,080	2
Point Lepreau	NB	680	1

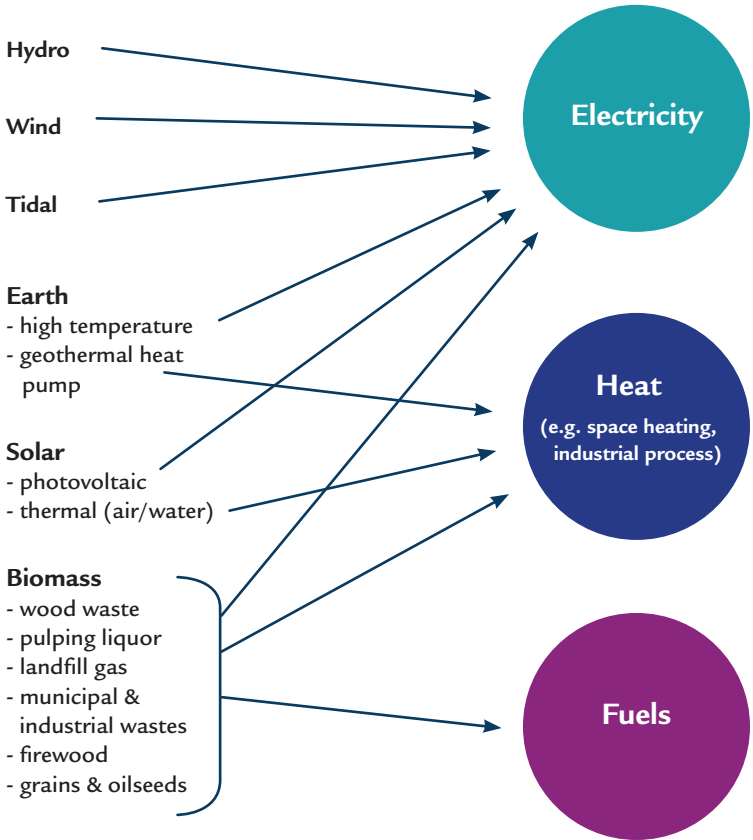
MW: megawatt



## What is renewable energy?

- Renewable energy is obtained from natural resources that can be naturally replenished or renewed within a human lifespan - that is, the resource is a sustainable source of energy.
- Some natural resources, such as moving water, wind and sunshine, are not at risk of depletion.
- Biomass is a renewable resource only if its rate of consumption does not exceed its rate of production.
- A wide range of energy-producing technologies and equipment has been developed over time to take advantage of these natural resources.
- Usable energy can be produced in the form of electricity, industrial heat, thermal energy for space and water conditioning, and transportation fuels.

## Main sources and uses in Canada



## International context

**World production** – 73,766 PJ or 1,762 Mtoe  
(2012)

1) China .....	18%
2) India.....	11%
3) United States .....	7%
4) Brazil.....	7%
5) Nigeria .....	6%
6) Indonesia.....	4%
7) <i>Canada</i> .....	<b>3%</b>

**Share of energy supply from renewable sources**  
(2012)

World .....	13.2%
OECD countries only.....	8.6%
<i>Canada</i> .....	<b>18.3%</b>

**Canadian production**  
(2012)

Total renewable energy – 1,916 PJ or 46 Mtoe

Hydro .....	71.3%
Wood/wood waste.....	23.3%
Wind .....	2.12%
Biogasoline .....	1.90%
Municipal waste/landfill gas .....	0.75%
Industrial and other waste .....	0.31%
Biodiesel .....	0.27%
Solar photovoltaic.....	0.06%
Tidal.....	0.005%

## Hydroelectricity International context

### World generation of hydroelectricity – 3,673 TWh (2012)

1) China .....	23%
2) Brazil .....	11%
<b>3) Canada .....</b>	<b>10%</b>
4) United States .....	8%
5) Russia.....	5%

### Share of hydroelectricity in net electricity generation (2011)

1) Norway.....	96%
2) Brazil.....	80%
3) Venezuela .....	70%
<b>4) Canada .....</b>	<b>60%</b>

By comparison:

China.....	15%
United States .....	8%

## Hydroelectricity

**Hydroelectricity capacity in Canada** – 75,403 MW  
(2011)

### Major hydro facilities in Canada >1,000 MW

Power plant	Province	Capacity (MW)
Robert-Bourassa	QC	5,616
Churchill Falls	NL	5,429
La Grande 4	QC	2,779
Gordon M Shrum	BC	2,730
La Grande 3	QC	2,417
La Grande 2A	QC	2,106
Revelstoke	BC	1,980
Mica	BC	1,805
Beauharnois	QC	1,755
Manic 5	QC	1,528
Sir Adam Beck 2	ON	1,499
La Grande 1	QC	1,436
Limestone	MB	1,349
Manic 3	QC	1,244
Kettle	MB	1,223
Bersimis 1	QC	1,125
Manic 5 PA	QC	1,064
Robert H Saunders	ON	1,045
Manic 2	QC	1,041
Outardes 3	QC	1,026
Long Spruce	MB	1,016
Kemano	BC	1,000

## Hydroelectricity

### Major projects under construction

Project	Province	Size (MW)	Expected in-service
Waneta Expansion	BC	435	2015
La Romaine Complex	QC	1,550	2014–2020
Muskkrat Falls	NL	824	2017
Lower Mattagami	ON	438	2015
<b>Total</b>		<b>3,247</b>	

### Major projects under consideration

Project	Province	Size (MW)
Gull Island	NL	2,250
Keyask	MB	695
Mica 5/6	BC	1,000
Peace River Site C	BC	1,100
<b>Total</b>		<b>5,045</b>
<b>Projects - Grand total</b>		<b>8,292</b>

## Wind power International context

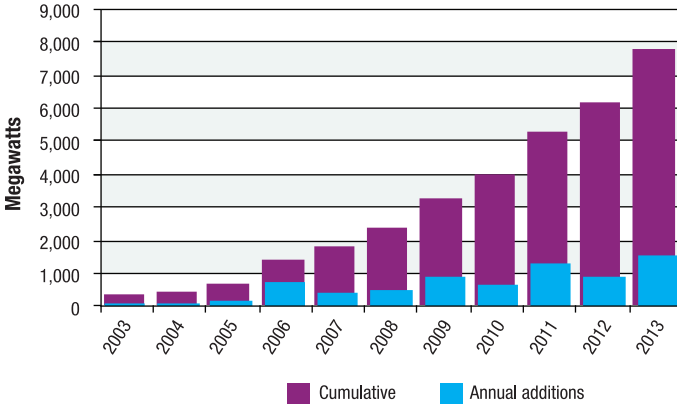
**World capacity of wind power** – 318,105 MW  
(2013)

1) China .....	29%
2) United States .....	19%
3) Germany.....	11%
4) Spain.....	7%
5) India.....	6%
...	
9) <i>Canada</i> .....	<i>2%</i>

## Wind power in Canada

Generation – 11.2 TWh, 1.8% of total electricity (2012)  
Capacity (end of 2013) – 7,803 MW

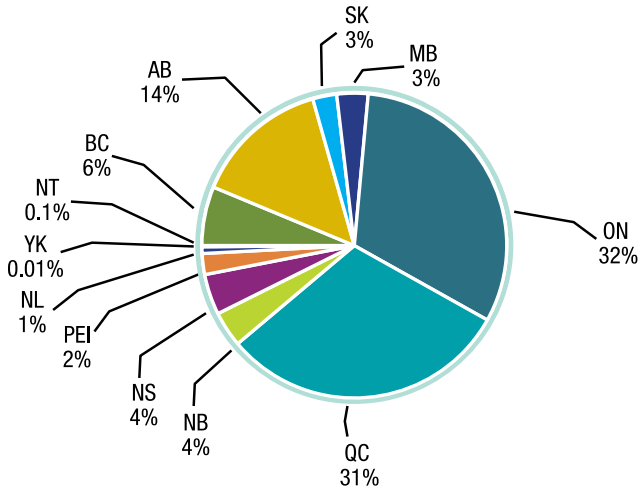
### Installed capacity





## Wind power

Capacity by province, 2013



## Largest wind farms in Canada

Facility	Province	Capacity (MW)
Lac Alfred (I and II)	QC	300
Wolfe Island	ON	198
Prince Project	ON	189
Kincardine	ON	182
Comber	ON	166
Massif du Sud	QC	150
Halkirk Wind Park	AB	149
Dokie Ridge	BC	144
Quality Wind	BC	142
Le Plateau	QC	139
St. Joseph	MB	138

## Solar photovoltaic International context

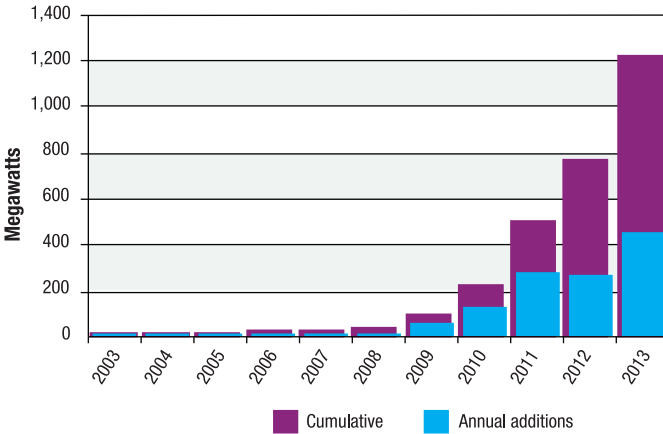
**World capacity of solar PV** – 139,000 MW (2013)

1) Germany.....	26%
2) China .....	14%
3) Italy.....	13%
4) Japan.....	10%
5) United States .....	9%
...	
<b>Canada .....</b>	<b>0.9%</b>

## Solar PV in Canada

Capacity – 1,210 MW (end of 2013)

### Installed capacity



## Solar photovoltaic

### Largest solar PV farms in Canada

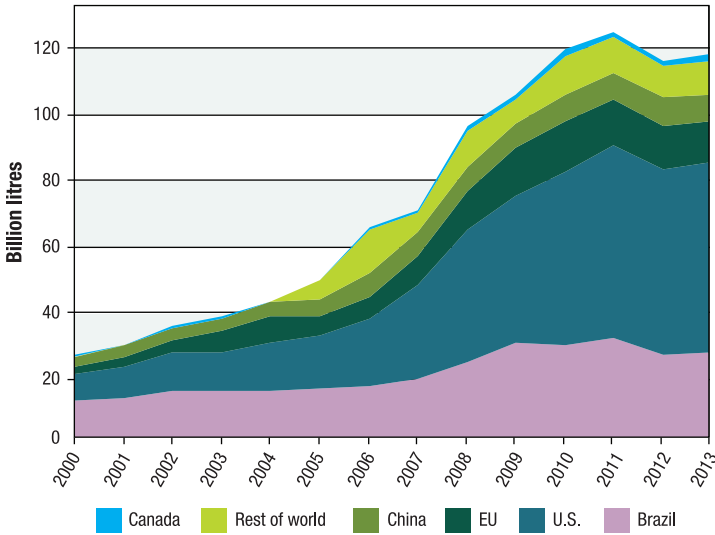
Facility	Province	Capacity (MW)
Sarnia Solar Project 2	ON	60
Sault Ste. Marie 2	ON	34
Stardale	ON	27
Sault Ste. Marie 1	ON	24
Arnprior	ON	23
Sarnia Solar Project 1	ON	20
St Isidore A	ON	12
St Isidore B	ON	12
Sault Ste. Marie 3	ON	11
Lily Lake Solar Farm	ON	10
Rutley Solar	ON	10

## Biofuels International context

### World production of biofuels – 116.1 billion litres (2013)

1) United States .....	49%
2) Brazil .....	23%
3) European Union.....	10%
4) China .....	7%
5) <i>Canada</i> .....	<i>2%</i>

### World biofuels production



## Biofuels

### Canadian supply and demand

	Ethanol (2013)	Biodiesel (2013)
	(million litres)	
Canadian production	1,706	124
Imports	1,080	546
Exports	N/A	123
Domestic use	2,786	547

### CBOT ethanol futures prices



CBOT: Chicago Board of Trade

## Biofuels

### Regulations

	Gasoline	Diesel
	(% of renewable fuels content)	
Canada	5	2
BC	5	4
AB	5	2
SK	7.5	2
MB	8.5	2
ON	5	2**
QC	5*	-

\* Not regulated, target only

\*\* Starting April 1, 2014

## Canadian industry structure

The electricity industry performs three main activities:

- generating electricity by using various energy sources and technologies
- high-voltage transmission of electricity, usually over long distances, from power plants to end-use markets
- distributing electricity to end-users, usually through low-voltage, local power distribution lines

In some provinces, electricity is provided by vertically integrated electric utilities that are often provincial Crown corporations.

## Major associations

- Canadian Electricity Association
- several provincially focused independent power producers' societies
- several source-specific associations (e.g. Canadian Hydropower Association and Canadian Wind Energy Association)

## Regulatory authority

- primarily under provincial jurisdiction
- Provincial governments exercise their jurisdiction through provincial Crown utilities and regulatory agencies.
- NEB regulates international power lines and electricity exports.

## International context

### World generation - 22 752 TWh (2012)

1) China.....	22%
2) United States.....	19%
3) India.....	5%
4) Russia.....	5%
5) Japan.....	5%
<b>6) Canada.....</b>	<b>3%</b>
7) Germany.....	3%
8) France.....	3%

### World exports - 677 TWh (2012)

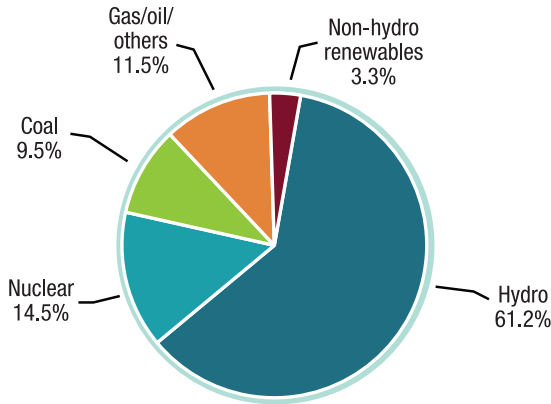
1) Germany.....	10%
<b>2) Canada.....</b>	<b>9%</b>
3) France.....	8%
4) Paraguay.....	7%
5) Switzerland.....	5%
6) Sweden.....	5%



## Canadian supply

### Generation in Canada - 616 TWh (2012)

#### Generation by source, 2012



**Generation from renewable sources:**  
64.5%, first in the G7

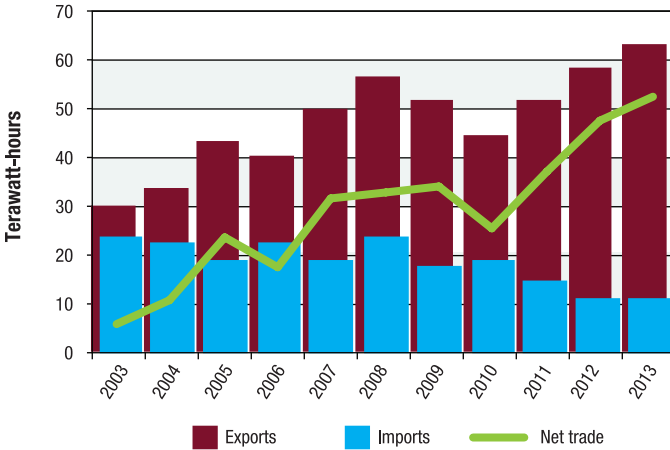
**Generation from non-GHG emitting sources:**  
79%, second in the G7 after France

### Provincial characteristics

- QC, NL, BC and MB – mostly hydro
- AB, NS and SK – more than half from coal
- ON and NB – diversified mix (nuclear, hydro and fossil fuels)
- PE – electricity mostly from NB

## Trade (2013)

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)

Exports ..... 63 TWh

Imports..... 11 TWh

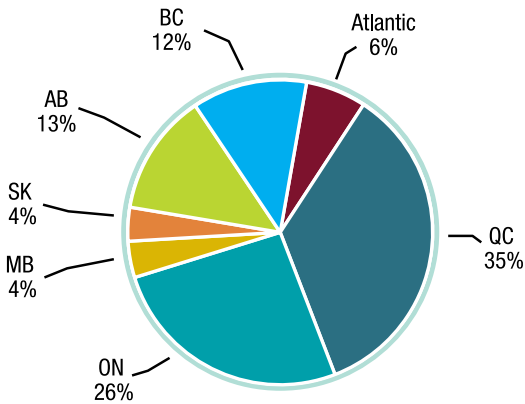
### Key facts (2013)

- All Canadian electricity trade is with the U.S.
- Canada exports about 10% of its electricity to the U.S., which meets 2% of U.S. consumption.

## Domestic demand (2012)

End-use	Use (TWh)	% of Total
Producer consumption	53	9
Mining, oil and gas extraction	31	6
Manufacturing	167	30
Transportation	5	1
Agriculture	9	2
Residential	151	27
Commercial, institutional	148	26
<b>Total</b>	<b>564</b>	<b>100</b>

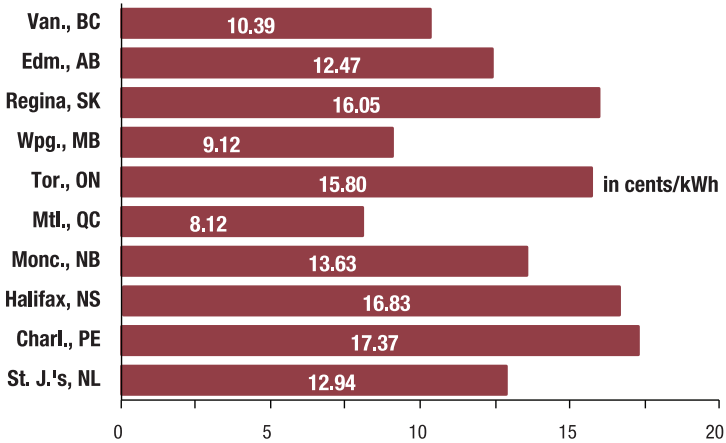
## Electricity demand by province, 2012



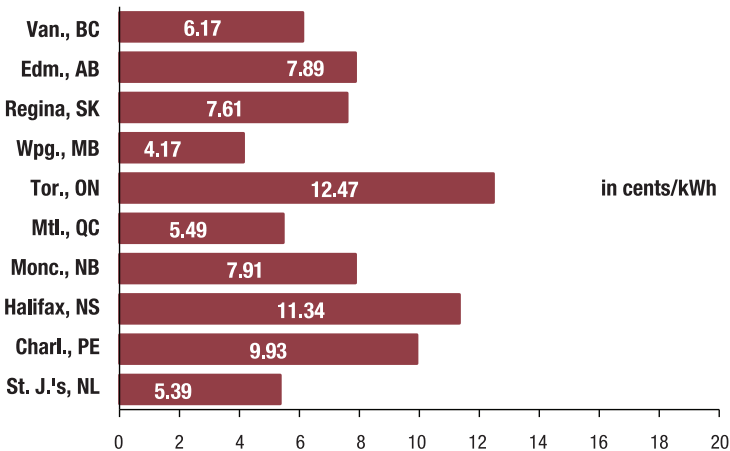
Note: The importance of electricity in Quebec is due to the prevalence of electric space and water heating, as well as the presence of electricity-intensive industries such as aluminum smelting.

## Retail prices

Average residential electricity prices, including taxes, April 2014



Average large industrial electricity prices, including taxes, April 2014



### **Secondary energy use**

- energy used by final consumers in various sectors of the economy
- excludes producer consumption, conversion losses and non-energy uses (e.g. petrochemical feedstocks)

### **Factors affecting energy use**

- level of activity - the number of households and the floor space of residences; short-term variations in industrial output
- sectoral structure (e.g. growth and decline of energy-intensive industries)
- weather - leading to changes in heating and cooling requirements
- service level (i.e. the penetration rate of devices and equipment, such as residential air conditioners)
- capacity utilization rate - the proportion of the installed production capacity that is in use
- energy efficiency

### **Energy efficiency**

- a measure of how effectively energy is used for a given purpose
- providing a similar (or better) level of service with less energy consumption on a per-unit basis is considered an improvement in energy efficiency

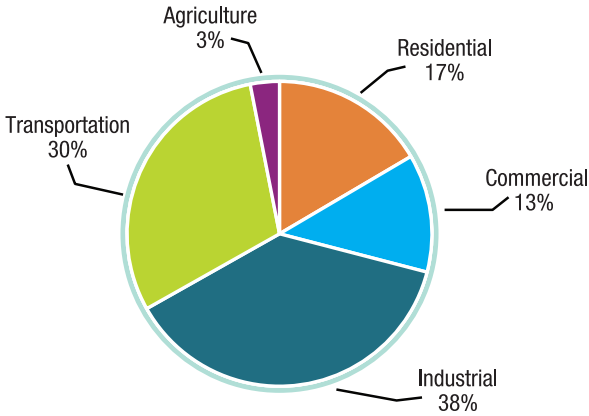
### **Energy intensity**

- the ratio of energy use per unit of activity

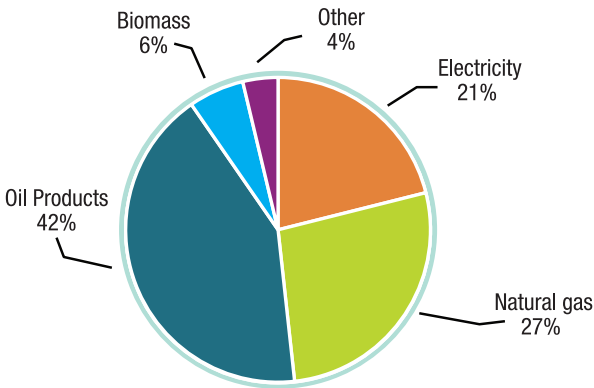
## Canada's secondary energy use

Secondary energy use – 8,808 PJ (2011)

By sector, 2011



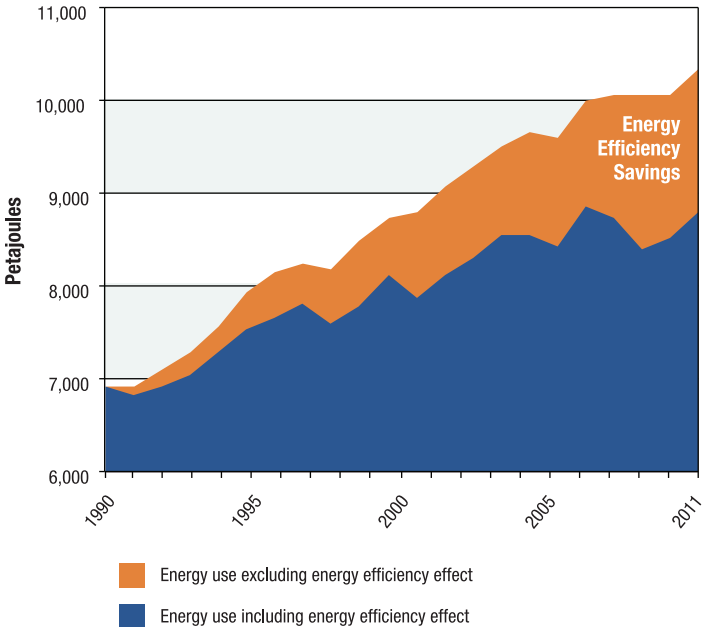
By fuel type, 2011















## Energy efficiency

- Energy efficiency in Canada improved by 1.2% per year or 23.4% overall between 1990 and 2011.
- Efficiency improvements slow the rate of growth in energy use:
  - Energy use grew by 27% between 1990 and 2011.
  - Without energy efficiency improvements, energy use would have grown by 49%.
- Energy efficiency savings of 1,551 PJ in 2011:
  - equivalent to end-user savings of \$34.9 billion

### Secondary energy use with and without energy efficiency improvements 1990–2011



## Trends in energy use and intensity by subsector, 1990–2011

	Energy use <sup>1</sup>	Energy intensity <sup>2</sup>
Residential	 14%	 -29%
Commercial	 27%	 -11%
Transportation (passenger)	 20%	 -21%
Freight	 75%	 15%
Industrial (forestry, mining, manufacturing, construction)	 23%	 -12%
Industry (w/o upstream mining)	 -3%	 -29%

- The lower rate of growth in energy use caused a decline in energy intensities.
- Most industries saw a reduction in their energy intensity due in part to gains in energy efficiency.

<sup>1</sup> energy used by final consumers to deliver energy services in various sectors of the economy (e.g. space heating, process heating and lighting)

<sup>2</sup> the amount of energy used per unit of activity (e.g. floor space – residential, floor space – commercial, passenger-kilometres, tonne kilometres and GDP)



## Canadian households

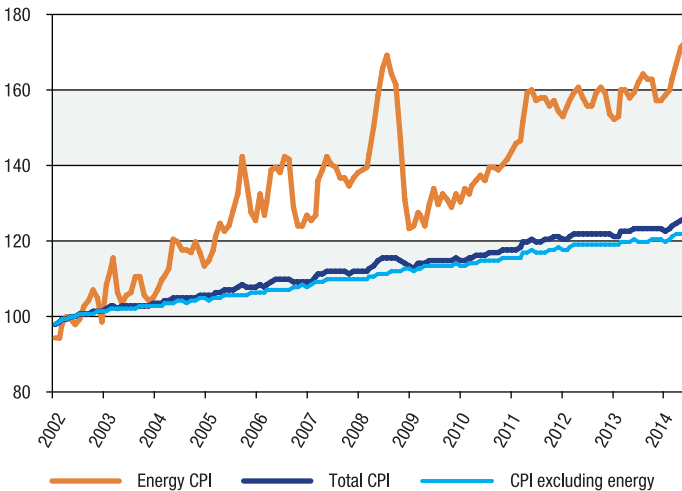
### Household expenditures

- Canadian households spent \$4,434 on average on energy in 2012.
- Energy accounted for 7.9% of total households' expenditures.
- Lower-income households spend a larger share of their disposable income on energy.

### Energy retail prices

- The “energy” component of the consumer price index 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)



## Canadian GHG emissions (2012)

Total..... 699 Mt CO<sub>2</sub> equivalent

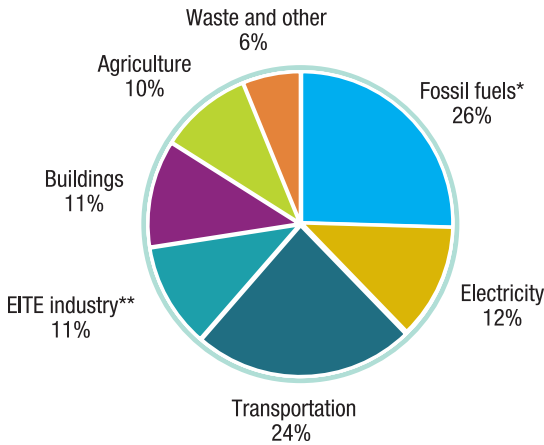
Canada's emissions constitute less than 2% of global emissions.

Between 2005 and 2012, GHG emissions decreased by 5.1% while the economy grew by 10.6%.

Over that same period, GHG emissions from the production of fossil fuels (including coal) increased by 10% and emissions from electricity production decreased by 29%.

\*See page 25 for information on GHG emissions from the oil sands.

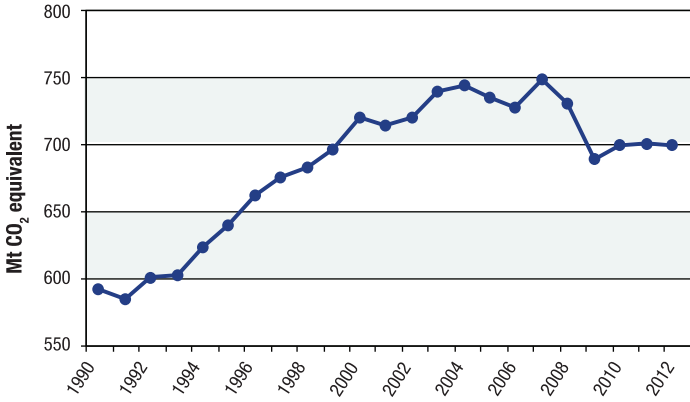
## Canada's 2012 emissions by economic sector



\*includes coal production

\*\*EITE: emissions intensive, trade exposed

Canada's GHG emissions, 1990–2012



# Annex 1: Units and conversion factors

## Prefixes and abbreviations

### Metric

kilo	=	k	=	thousand
mega	=	M	=	million
giga	=	G	=	billion
tera	=	T	=	trillion
peta	=	P	=	10 <sup>15</sup>

### Notes

- Tonne may be abbreviated to “t”
- Roman numerals are sometimes used with imperial units (this can create confusion with the metric “M”):
  - M = thousand
  - MM = million

## Crude oil

### Upstream

- reserves/production 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

- 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 tonnes LNG = 48.0 billion cubic feet

### Pricing

volume based:

- cents per cubic metre ( $\text{\$/m}^3$ ) (customer level in Canada)
- \$ per hundred cubic feet ( $\text{\$/CCF}$ ) (customer level in U.S.)

energy content based:

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

## Coal

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

## Uranium

- 1 metric tonne = 1,000 kilograms of uranium metal (U)
- U.S.: in pounds of uranium oxide ( $\text{U}_3\text{O}_8$ )
- 1 lb.  $\text{U}_3\text{O}_8$  = 0.84802 lb. U = 0.38465 kg U

### Electricity

#### Capacity

- maximum rated output at an instant, expressed in watts or multiples (megawatts or MW, gigawatt or GW)

#### 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 ( $1 \text{ MW} \times 24 \text{ hr} \times 365 \text{ d}$ ).
- 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) = 1 054.6 joules
- IEA: energy balances expressed in oil equivalent
  - thousand tonnes of oil equivalent (ktoe)
  - million tonnes of oil equivalent (Mtoe)

## Typical values

- 1 m<sup>3</sup> of crude oil = 39.0 GJ
- 1,000 m<sup>3</sup> of natural gas = 38.3 GJ
- 1 MWh of electricity = 3.6 GJ
- 1 metric tonne of coal = 29.3 GJ
- 1 metric tonne of wood waste = 18.0 GJ
- 1 metric tonne of uranium = 420,000 GJ to 672,000 GJ

## Annex 2: Glossary

b/d	barrels per day
Bcf/d	billion cubic feet per day
Bcm	billion cubic metres
Bcm/d	billion cubic metres per day
C\$	Canadian dollars
CCS	carbon capture and storage
CDIA	Canadian direct investment abroad
CO <sub>2</sub>	equivalent carbon dioxide equivalent
EIA	Energy Information Administration (U.S.)
FDI	foreign direct investment
G7	Seven wealthiest major developed nations: Canada, France, Germany, Italy, Japan, U.K. and U.S.
GDP	gross domestic product
GHG	greenhouse gas
GJ	gigajoule
GST	Goods and Services tax
HST	Harmonized Sales tax
IEA	International Energy Agency
kg	kilogram
km <sup>2</sup>	square kilometre
kt	kilotonne
lb.	pound
LNG	liquefied natural gas
LPG	liquefied petroleum gases
m	metre
m <sup>3</sup>	cubic metre
Mb/d	thousand barrels per day
MMb/d	million barrels per day
MMcf/d	million cubic feet per day
Mt	million tonnes; megatonne
Mtoe	million tons of oil equivalent
mtpa	million tonnes per annum
MW	megawatt
NEB	National Energy Board



NGL	natural gas liquids
NRCan	Natural Resources Canada
NSERC	National Science and Engineering Research Council of Canada
OECD	Organisation for Economic Co-operation and Development
PJ	petajoule
Provinces	AB - Alberta, BC - British Columbia, MB - Manitoba, NB - New Brunswick, NL - Newfoundland and Labrador, NS - Nova Scotia, ON - Ontario, PE - Prince Edward Island, QC - Quebec, SK - Saskatchewan
P/T	provincial/territorial
PV	photovoltaic
RD&D	research, development and demonstration
RPP	refined petroleum products
SDTC	Sustainable Development Technology Canada
Tcf	trillion cubic feet
Tcm	trillion cubic metres
TPES	total primary energy supply
TWh	terawatt-hour
UAE	United Arab Emirates
U.K.	United Kingdom
U.S.	United States
US\$	United States dollars
WCS	Western Canada Select
WTI	West Texas Intermediate

# Annex 3: Sources

## 1. Energy industry

**Canada's position in the world:** electricity capacity from the United Nations; for other data, see relevant chapters

**Gross domestic product:** StatCan CANSIM Table 379-0029, nominal values for recent years estimated by NRCan

**Employment:** CANSIM Table 383-0031

**Capital expenditures:** StatCan CANSIM Tables 0029-0005 to 0029-0012, StatCan special tabulation for support activities for oil and gas extraction

**Exports/imports:** StatCan International Merchandise Trade Database (TRAGS Database)

**Government revenues:** StatCan CANSIM Table 180-0003, StatCan special tabulation (royalties), Canadian Association of Petroleum Producers, *Statistical Handbook*, Table 01-01C

**Expenditure on energy RD&D:** IEA RD&D Budget database; StatCan survey of industry expenditures; and data compiled by NRCan

**Foreign control:** StatCan CANSIM Tables 179-0004, 179-0005, 180-0003 and StatCan document 61-220-X

**Investment:** StatCan CANSIM Table 376-0052

**Major recent deals:** S&P Capital IQ, Canoils, Bloomberg (based on closing dates when available)

**Canadian production:** StatCan CANSIM Tables 127-007, 128-0016, 128-0007, and NRCan estimates

**Total primary energy supply:** IEA Annual Database, World Energy Balances and IEA SLT questionnaire

## 2. Crude oil

**World production and exports:** International Energy Agency (IEA *Oil Market Report*)

**World proved reserves:** *Oil and Gas Journal*, Table World's Top Oil Reserves

**Canadian resources:** CAPP, *Statistical Handbook for Canada's Upstream Petroleum Industry*, Table 02-01A; Alberta Energy Regulator (AER) Supply/Demand Outlook; and National Energy Board, *Canada's Energy Future 2013*

**Wells completed and metres drilled in western Canada:** June Warren-Nickles Energy Group and Canadian Association of Oilwell Drilling Contractors (CAODC)

**Canadian production:** StatCan CANSIM Table 126-0001

**Canadian supply and demand:** StatCan CANSIM Table 126-0001

**Trade:** StatCan CANSIM Table 126-0001 and StatCan International Merchandise Trade Database (TRAGS Database), U.S. Energy Information Administration, U.S. Imports by Country of Origin for Crude Oil, Refinery and Blender Net Imports for Petroleum and Other Liquids, calculations by NRCan

**Prices:** U.S. EIA Tables on Spot Prices for Petroleum and Other Liquids and Sproule Worldwide Petroleum Consultants

**Pipelines:** compiled by NRCan

**Oil sands:** CAPP, *Statistical Handbook for Canada's Upstream Petroleum Industry*, Tables 04-16B and 07-03B, and StatCan CANSIM Table 029-0007, compiled by NRCan

**Light tight Oil/Shale Oil:** U.S. EIA, Technically Recoverable Shale Oil Resources

**Environmental challenges:** compiled by NRCan

**Crude by rail:** StatCan CANSIM Table 404-0021 and CAPP, *Transporting Crude Oil by Rail in Canada*

### 3. Petroleum products

**Canadian refineries:** compiled by NRCan from company information and Conference Board of Canada, Canada's *Petroleum Refining Sector*, and other published sources

**Canadian supply and demand:** StatCan CANSIM Table 134-0004

**Trade:** StatCan CANSIM Table 134-0004, U.S. EIA, U.S. Imports by Country of Origin for Petroleum and Other Liquids, and StatCan International Merchandise Trade Database (TRAGS Database)

**Gasoline prices:** Fuel Focus, average retail prices for regular gasoline and diesel fuel, and data compiled by NRCan

**Canadian petroleum refineries:** compiled by NRCan

### 4. Natural gas

**World production and exports:** International Energy Agency, *IEA Natural Gas Information*

**World proved reserves:** *Oil and Gas Journal*

**Canada reserves:** *CAPP Statistical Handbook*, Table 02-13B

**Canada resources:** NEB, *Canada's Energy Future 2013*

**U.S. reserves:** U.S. EIA, *Natural Gas Reserves Summary*, dry gas

**U.S. resources:** Potential Gas Committee, *Report of Potential Supply of Natural Gas in the United States, 2013* and U.S. EIA, *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States, June 2013*

**World resources:** International Energy Agency, *World Energy Outlook 2013*, Table 3.3

**Shale gas:** U.S. EIA, *Technically Recoverable Shale Gas Resources, June 2013*, Table 6

**Canada-U.S. market:** compiled by NRCan from StatCan, U.S. EIA, US Natural Gas Imports by Country, National Energy Board, Natural Gas Imports, Exports and Liquefied Natural Gas Statistics, Commodity Statistics for LNG imports, LNG Shipment Details

**Wells completed and metres drilled in western Canada:**

June Warren-Nickles Energy Group and CAODC

**Canadian production:** StatCan CANSIM Table 131-0001

**U.S production:** U.S. EIA Table Natural Gas Gross Withdrawals and Production

**Trade:** NEB, Natural Gas Imports, Exports and Liquefied Natural Gas Statistics, Commodity Statistics for pipeline trade, Gas Monthly Summary for the Year, U.S. EIA, Natural Gas Consumption by End Use and calculations by NRCan

**Canadian domestic demand:** StatCan CANSIM Tables 128-0017 and 129-0002

**Prices:** GLJ Energy Publications, *Canadian National Gas Focus*, 2002-2014

**Pipelines:** compiled by NRCan

**LNG export applications:** compiled by NRCan

## 5. Natural gas liquids

**Canadian supply:** StatCan CANSIM Table 128-0012

**Production by province:** *CAPP Statistical Handbook*, Table 03-07E

**Domestic demand:** StatCan CANSIM Table 128-0012

## 6. Coal

**World production and exports:** International Energy Agency, *IEA Coal Information*

**World proved reserves:** World Energy Council

**Canadian supply and demand:** StatCan CANSIM Table 135-0002 and StatCan International Merchandise Trade Database (TRAGS Database)

**Coal-fuelled power plants:** compiled by NRCan from StatCan and other sources

## 7. Uranium and nuclear power

**World production and exports:** World Nuclear Association

**World known recoverable resources:** Organisation for Economic Co-operation and Development, Nuclear Energy Agency, International Atomic Energy Agency

**Canadian supply and demand:** compiled by NRCan from company information; also published by the World Nuclear Association

**Purchases by U.S. nuclear reactors:** U.S. EIA Table Uranium Purchases by Owners and Operators of Civilian Nuclear Power Reactors

**Spot prices:** Ux Consulting Company

**Nuclear power world generation:** U.S. EIA Table Nuclear Electricity Net Generation

**Nuclear power plants in Canada:** compiled by NRCan from StatCan and other sources

## 8. Renewable energy

**International context:** International Energy Agency (*IEA Renewables Information*)

**Domestic production:** International Energy Agency (*IEA Renewables Information*), based on StatCan and NRCan data

**Hydro – international context:** International Energy Agency (*IEA Electricity Information, Energy Balances of OECD Countries, and Energy Balances of Non-OECD Countries*) and the U.S. EIA, Table International Energy Statistics, Hydroelectricity net generation

**Hydro – capacity in Canada:** StatCan CANSIM Table 127-0009 and compiled by NRCan

**Hydro – facilities and projects:** compiled by NRCan

**Wind – international context:** Global Wind Energy Council

**Wind – generation in Canada:** StatCan CANSIM Table 127-0007

**Wind – capacity in Canada:** compiled by NRCAN from multiple sources (e.g. Canadian Wind Energy Association, StatCan, NRCAN)

**Solar PV – international context:** *Renewable Energy Policy Network for the 21st Century*

**Solar PV – capacity in Canada:** *Canada’s Annual Report to the IEA Implementing Agreement on PV* and compiled by NRCAN

**Biofuels – Canadian production of biofuels:** compiled by NRCAN; World production of biofuels (with the exception of Canada): Bloomberg New Energy Finance and F.O. Licht

**Biofuels – supply and demand:** production: NRCAN, ecoENERGY for Biofuels program; imports/exports: StatCan International Merchandise Trade Database; domestic demand: estimation based on production plus imports minus exports

**Biofuels – ethanol prices:** Haver Analytics

**Biofuels – regulations:** compiled by NRCAN

## 9. Electricity

**World generation and exports:** International Energy Agency, IEA *Electricity Information*, note: IEA production/generation data are expressed on a “gross” basis, i.e. before generating station use

**Canadian supply:** compiled by StatCan and NRCAN

**Trade:** National Energy Board Table *Electricity Exports and Imports Statistics*, StatCan, and U.S. EIA Table *Retail Sales of Electricity to Ultimate Customers*

**Domestic demand:** StatCan CANSIM Table 128-0017

**Prices:** Hydro-Québec report *Comparison of Electricity Prices in Major North American Cities*

## 10. Energy demand

**Canada's secondary energy use:** compiled by NRCan from StatCan

**Energy efficiency:** compiled by NRCan

**Household expenditures:** StatCan CANSIM Tables 203-0001, -0003, -0007, -0010, -0021, and 326-0020

**Consumer prices:** StatCan CANSIM Table 326-0020

## 11. Greenhouse gas emissions

Environment Canada *National Inventory Report*