National Energy Board | Office national de l'énergie

CANADA'S RENEWABLE POWER LANDSCAPE

Energy Market Analysis 2017

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Canada's Renewable Power Landscape – Energy Market Analysis 2017

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Panorama de l'électricité au Canada – Analyse des marchés de l'énergie 2017

ISSN : 2371-5812

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About the NEB

The National Energy Board (NEB or Board) is an independent federal regulator. Its purpose is to promote safety and security, environmental protection, and economic efficiency in the Canadian public interest within the mandate set by Parliament for the regulation of pipelines, energy development, and trade.

The Board's main responsibilities include regulating:

- the construction, operation, and abandonment of pipelines that cross international borders or provincial/territorial boundaries;
- associated pipeline tolls and tariffs;
- the construction and operation of international power lines and designated interprovincial power lines;
- imports of natural gas and exports of crude oil, natural gas, oil, natural gas liquids, refined petroleum products, and electricity; and
- oil and gas exploration and production activities in specified northern and offshore areas.

About this Report

The Board monitors energy markets and assesses Canadian energy requirements and trends to support its regulatory responsibilities. This report, Canada's Renewable Power Landscape, is part of a series of publications on energy supply, demand, and infrastructure that the NEB publishes regularly as part of its ongoing market monitoring.

Contributors to this report include: Ryan Quan (project manager), Christian Vela, Brady Edwards, Michael Nadew and Cassandra Wilde.

Questions or comments? Email renewables@neb-one.gc.ca

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Executive Summary

By adding new renewable capacity and retiring old thermal generation facilities, Canada's total generating capacity increased from 65.6% to 66.4% renewable in 2016, as the electricity sector continued to evolve towards a low-carbon future.

Canada's non-hydro renewable power capacity grew by 8.2% in 2016 with an added 1 293 megawatts (MW) of solar, biomass, and wind. Non-hydro renewables comprised 11.5% of Canada's total capacity. Hydro, Canada's largest source of renewable electricity, comprised a further 54.8% of capacity in 2016.

Wind was the dominant source of new renewable capacity in Canada in 2016. In Ontario, Quebec, and Nova Scotia, wind comprised over half of net capacity additions. This was particularly noteworthy for Quebec, a province that generates 95.2% of its electricity from hydro, where wind capacity additions surpassed those of hydro by 104 MW. Ontario led the country in total wind (467 MW), biomass (188 MW) and solar (172 MW) capacity additions.

On a national scale, natural gas generation decreased by 5.4% in 2016. This was driven by decreases in British Columbia (B.C.), the Northwest Territories (NWT), Manitoba, Ontario, Quebec, and Newfoundland and Labrador.

In Alberta, Saskatchewan, New Brunswick, and Nova Scotia, where coal is a large fuel source for electricity, natural gas generation increased as part a long-term trend away from coal and towards less GHG-emitting sources. Between 2005 and 2016, coal generation decreased from 16.1% to 9.3% of Canada's total generation, while natural gas increased from 6.8% to 9.6%.

B.C. and Manitoba reduced their total generating capacity in 2016 by retiring thermal generation facilities. With these changes, both provinces moved closer to having fully renewable electric generation capacities.

Since 2005, the electricity sector has outpaced all other major industries in Canada in emissions reduction. Emissions from electricity generation fell by 32.6% between 2005 and 2015, while Canada's total emissions fell by only 2.2%. In 2015, the electricity sector accounted for only 10.9% of Canada's emissions, down from 15.8% in 2005.

Generation versus capacity

Capacity is the maximum electric output a facility can produce, and can be measured in MW. Generation is the process of producing electric energy by transforming other forms of energy using this capacity. Generation also describes the amount of electricity produced, and can be measured in gigawatt hours (GW.h). A watt hour is the electricity made or used by a one watt device for one hour.

What is renewable electricity? What is non-emitting electricity?

All methods of generating electricity can have positive and negative consequences. Consistent with many Canadian and international organizations, the NEB considers energy to be renewable if it is derived from natural processes that are replenished at a rate that is equal to or faster than the rate at which they are consumed. In other words, the resource is a sustainable source of energy. For this report, electricity generated from hydro, tidal, wind, biomass and solar are considered renewable.

Electricity is considered non-emitting if the process of generating electricity does not emit GHG emissions. Non-emitting electricity could still have GHG emissions associated with the construction of the facility. This report considers electricity generated from hydro, tidal, wind, biomass solar and nuclear to be non-emitting. Biomass is considered non-emitting because the carbon released from burning biofuels was previously absorbed out of the atmosphere by plants. The net emissions from using biomass fuel can be zero, if biomass is used at the same rate that it regenerates.

New in this report

This update to Canada's Renewable Power Landscape 2016 has several new features.

Non-renewable data

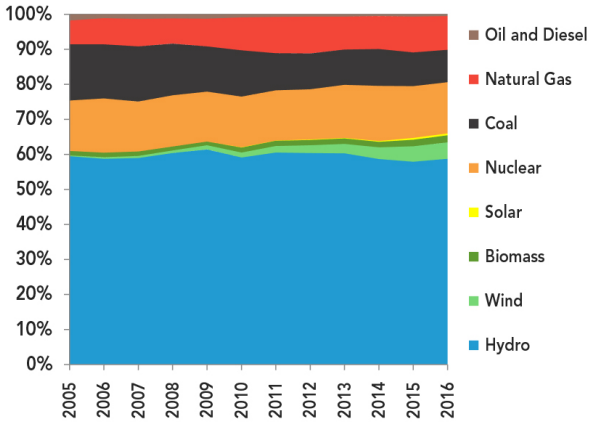
Canada's Renewable Power Landscape 2016 focused on renewables. This report includes data for all individual fuels used for power generation. Data is also presented now for all electricity sources by province and territory, for the years 2005, 2015, and 2016.

TABLE 1
Electric Capacity and Generation in Canada

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	4 795	3 842	3 837	10 608	4 041	3 436
	3.9%	2.7%	2.6%	1.8%	0.6%	0.5%
Natural Gas	13 191	22 006	21 499	40 875	66 060	62 512
	10.8%	15.2%	14.7%	6.8%	10.2%	9.6%
Coal	16 003	9 661	9 661	96 750	62 256	60 374
	13.1%	6.7%	6.6%	16.1%	9.6%	9.3%
Nuclear	12 805	14 273	14 273	86 669	95 682	95 418
	10.5%	9.9%	9.7%	14.4%	14.8%	14.6%
Solar	17	2 135	2 310	0	3 001	3 568
	<0.1%	1.5%	1.6%	0.0%	0.5%	0.5%
Biomass	1 804	2 414	2 702	7 688	12 511	13 214
	1.5%	1.7%	1.8%	1.3%	1.9%	2.0%
Wind	557	11 072	11 902	1 453	28 314	30 462
	0.5%	7.6%	8.1%	0.2%	4.4%	4.7%
Hydro	72 890	79 434	80 403	358 387	374 116	383 392
	59.7%	54.8%	54.8%	59.5%	57.9%	58.8%
All renewable sources	75 268	95 056	97 317	367 528	417 942	430 636
	61.7%	65.6%	66.4%	61.0%	64.7%	66.0%
All sources	122 061	144 838	146 588	602 430	645 981	652 375

Area Graphs

An area graph depicts the percentage share of generation from each source, over the years 2005 to 2016. It shows changes over time in the mix of fuels used for power generation.



Capacity Changes in 2016

This report discusses capacity changes in 2016. It describes the annual, incremental changes made to Canada's power landscape, including the steady growth of renewables.

Data Sources and Methodology

The generation data for the years 2005 to 2016 are historical values based on data from Statistics Canada. Data for oil and diesel, natural gas, coal, nuclear, wind, and hydro generation is derived from Statistics Canada's CANSIM series 127-0007 and 127-0006. These values are also used in *Canada's Energy Future 2017: Energy Supply and Demand Projections to 2040* (EF2017) up to 2015. Generation data for biomass and solar in 2016 is taken from EF2017. Capacity data for the years 2005 to 2015 is based on Statistics Canada data. Capacity in 2016 is a modeled estimate based on the NEB's energy supply and demand model, which is used in EF2017.

GHG data comes from the 2017 release of Canada's National Inventory Report 1990-2015. This contains emissions GHG data for the years from 1990 to 2015.

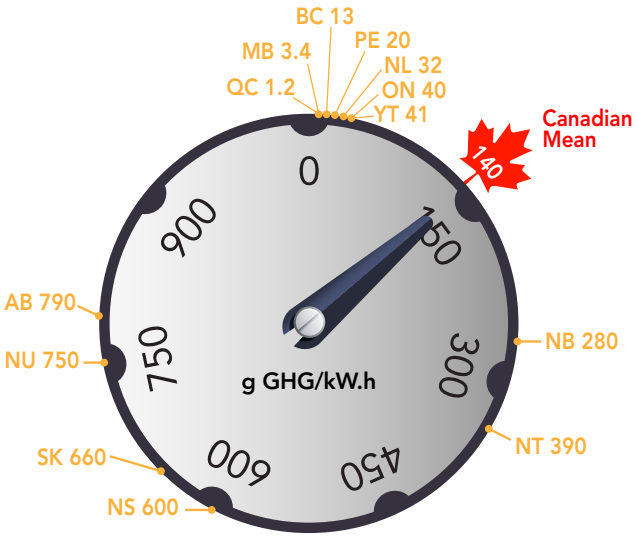
Residential electricity bill data comes from Hydro-Québec. The Canadian average monthly residential bill is the population weighted average of the representative city in each province or territory. The weight is by the population of each province.

GHG intensity dial

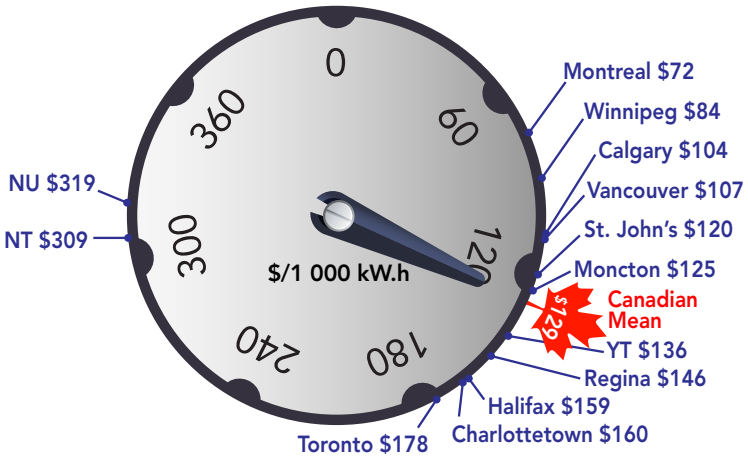
A dial displays the average grams of greenhouse gasses (g GHG) emitted per kilowatt hour (kW.h) of electricity generated in each province and territory. GHG intensity is expressed in grams of GHG emitted per kW.h of electricity generated. It varies greatly by region depending on the sources of electricity.

Electricity price dial

A second dial displays the average monthly residential bill for 1 000 kW.h of electricity in the most populous city[1] in each province and territory. A number of factors, including the local mix of electricity sources and transmission, distribution and administration costs contribute to the total cost of electricity to consumers. Prices also vary throughout each province and territory.



GHG generation intensity g GHG / kW.h



Monthly residential bill for 1 000kW.h

Grams of Greenhouse Gases

In this report emissions from power generation are graphically shown in grams of greenhouse gases per kilowatt hour (g GHG / kW.h). Different greenhouse gases have different global warming potentials compared to CO_2. Greenhouse gases can be measured in terms of CO_2 equivalent, this is the amount of CO_2 that would cause the same amount of warming. Grams of greenhouse gases is the mass of CO_2 equivalent.

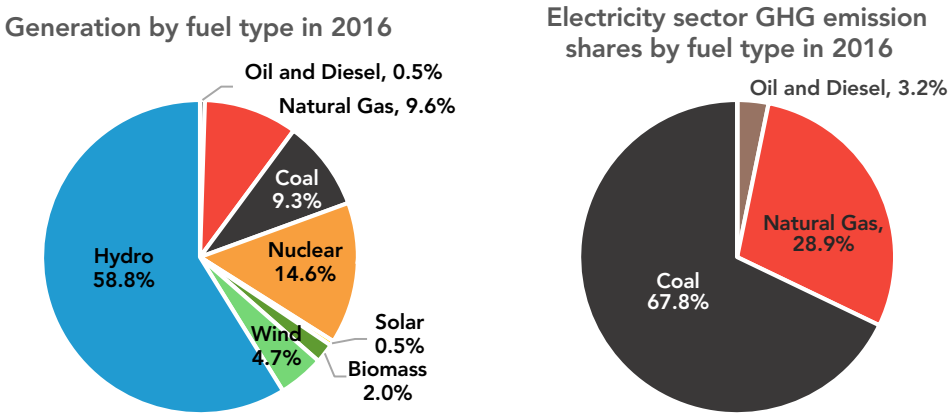
1 The most populous cities in each province are: Vancouver, B.C.; Calgary, Alberta; Winnipeg, Manitoba; Toronto, Ontario; Montreal, Quebec; Moncton, New Brunswick; Charlottetown, PEI; Halifax, Nova Scotia; and St John's, Newfoundland and Labrador. Due to missing price data, Regina was used for Saskatchewan rather than Saskatoon, and the respective territorial utilities (Yukon Energy, Arctic Energy Alliance, Quilliq Energy Corporation) were consulted for a representative price for Yukon, NWT, and Nunavut.

Greenhouse gas (GHG) emissions overview

In 2015, Canada emitted 722 megatons of carbon dioxide equivalent (Mt CO_2 eq). Of these emissions, 10.9% came from electricity generation.

In 2016, 80.6% of Canada's electricity was generated from sources that are non-emitting when generating.[2] The remaining generation — from oil and diesel, natural gas, coal, — produced all of the emissions from electricity generation.

FIGURE 1



Source: NEB

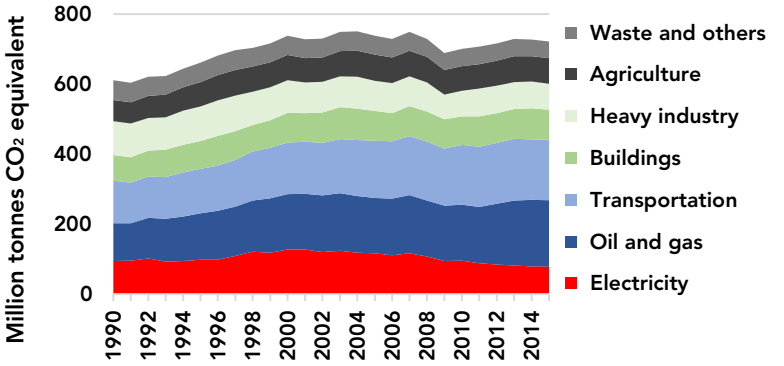
Description: Two pie charts illustrate Canada's electricity generation by fuel type in 2016, and GHG emissions share by fuel type in 2016, respectively. Hydro accounted for 58.8% of electricity generation, followed by 14.6% nuclear, 9.3% coal, 9.6% natural gas, 4.7% wind, 2% biomass, 0.5% oil and diesel, and 0.5% solar.

Coal produced 67.8% of Canada's emissions from electricity generation, followed by 28.9% from natural gas and 3.2% from oil and diesel.

In total, electricity generation emitted 78.7 Mt CO_2 eq in 2015, down from 116.9 Mt CO_2 eq in 2005, when it produced 15.8% of total emissions. The reduced emissions resulted from improvements in technology and a shift towards lower GHG-emitting generation sources in the electricity sector. For more information on the trends in Canadian electricity generation, see the Canadian Overview.

FIGURE 2

Canadian GHG emissions by sector



Source: ECCC Table S-3

Description: This stacked area chart illustrates Canadian GHG emissions from the electricity, oil and gas, transportation, buildings, heavy industry, and agricultural sector. The electricity sector's share of emissions has declined from 15.8% of total emissions in 2005 to 10.9% in 2015.

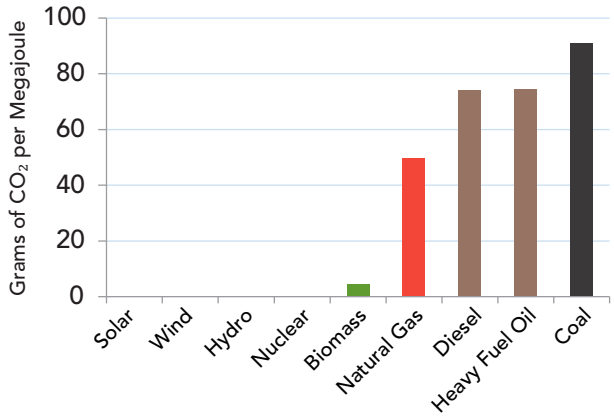
2 Hydro, wind, solar, and nuclear, produce no CO_2 emissions directly during the generation of electricity, although lifecycle emissions are associated with building and decommissioning facilities and related infrastructure, and with maintenance and other generation-related activities.

GHG intensity of electricity generation

Depending on the unique mix of fuels used in electricity generation, each province and territory emits a different quantity of GHGs per unit of electricity generated. This ratio of GHGs per unit of electricity is called the GHG intensity of electricity generation. Regions that rely primarily on hydro, including B.C., Yukon, Manitoba, Quebec, and Newfoundland and Labrador, have some of the lowest GHG intensities in Canada: for example, Quebec emitted only 1.2 grams of carbon dioxide equivalent per kilowatt-hour generated in 2015. In contrast, regions that rely on fossil fuels such as coal and oil products, had GHG intensities as high as 790 grams of CO_2 eq per kW.h.

FIGURE 3

Emissions by fuel type

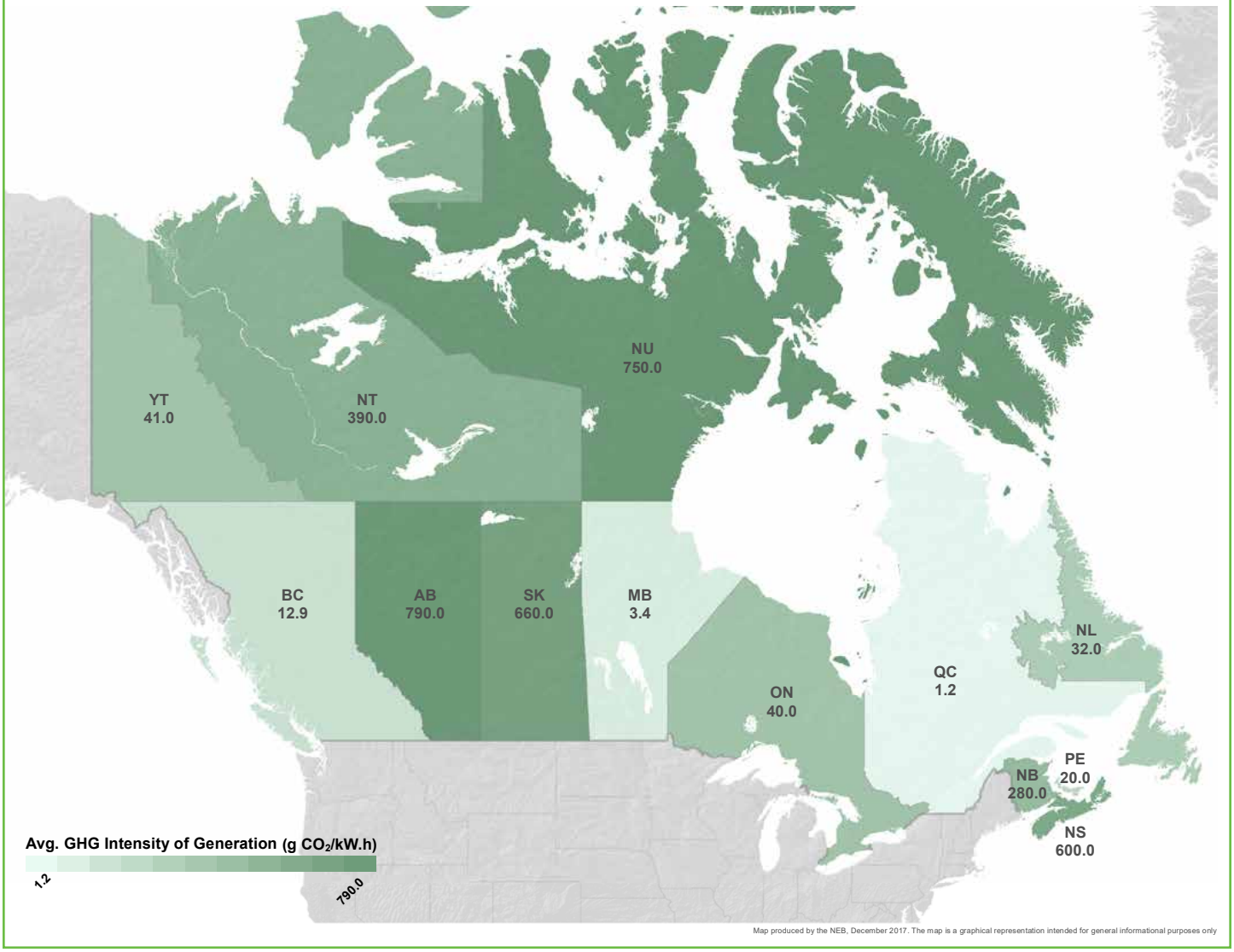


Source: ECCC Table A.6

Description: This chart shows CO_2 emissions by fuel type in grams of CO_2 equivalent per megajoule (g/MJ). There are no emissions during the generation of solar, wind, hydro, or nuclear electricity. Biomass emits 4.59g/MJ, followed by natural gas at 49.88g/MJ, diesel at 74.08g/MJ, heavy fuel oil at 74.58g/MJ, and coal at 90.87g/MJ.

FIGURE 4

Greenhouse gas intensity of electricity generation by province and territory



Source: National Inventory Report 2017

Description: This shaded map shows the relative GHG intensity of each province and territory. Regions shaded lightly have a GHG intensity below the national average of 140 g CO_2/kW.h, while those with dark shading have GHG intensities above the national average. Quebec has the lowest GHG intensity, at 1.2 g CO_2/kW.h, followed by Manitoba (3.4 g CO_2/kW.h), B.C. (12.9 g CO_2/kW.h), PEI (20.0 g CO_2/kW.h), Newfoundland and Labrador (32.0 g CO_2/kW.h), Ontario (40.0 g CO_2/kW.h), Yukon (41.0 g CO_2/kW.h), New Brunswick (280.0 g CO_2/kW.h), NWT (390.0 g CO_2/kW.h), Nova Scotia (600.0 g CO_2/kW.h), Saskatchewan (660.0 g CO_2/kW.h), Nunavut (750.0 g CO_2/kW.h), and Alberta (790.0 g CO_2/kW.h).

Canadian Overview

In 2016, Canada's electricity generation was 66.0% renewable and was 80.6% non-emitting in operation. Since 2005, generation has trended away from coal and towards increased generation from natural gas and wind.

Generation Trends

Hydro is Canada's largest source of electricity, averaging 59.6% of total generation from 2005 to 2016. Hydroelectricity is generated primarily in Yukon, B.C., Manitoba, Ontario, Quebec, and Newfoundland and Labrador. Nuclear, currently located exclusively in Ontario and New Brunswick, supplied on average 14.7% of Canada's electricity from 2005 to 2016, and was the second largest source of total generation. The share of natural gas generation increased from 6.8% to 9.6% between 2005 and 2016, while coal and oil generation declined, mainly due to new emissions-reduction plans, including Ontario's coal phase-out.

Non-hydro renewable generation has grown since 2005, from 1.5% to 7.2% of total generation. Total wind generation grew the most during this period, increasing from just 0.2% to 4.7% of generation. Solar also saw growth, almost exclusively in Ontario, from zero in 2010 to 0.5% of Canadian electricity generation in 2016. Biomass grew from 1.3% to 2.0% of generation between 2005 and 2016.

Capacity Changes in 2016

Net Canadian natural gas, oil and diesel capacity decreased in 2016. This was primarily due to the retirement of the Burrard Thermal Generating Station, among other retirements.

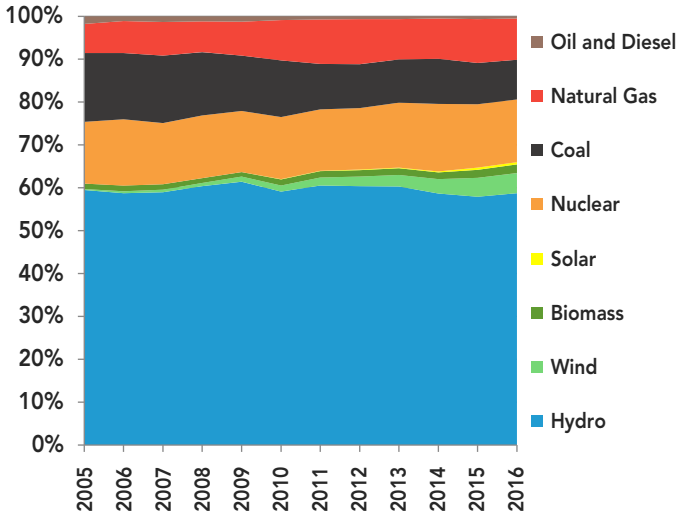
Hydro, wind, biomass, and solar experienced an estimated combined growth of 2 261 MW. Together, renewables' share of total Canadian capacity increased by 0.8% from 2015.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Canada.

FIGURE 5

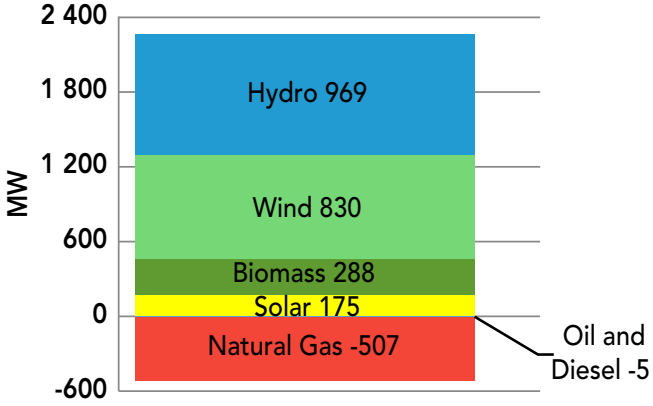
Electricity Generation by Source in Canada



This graph shows the composition of Canada's electricity generation between 2005 and 2016. Hydro averaged 59.6%. Wind increased from 0.2% to 4.7%. Biomass increased from 1.3% to 2.0%. Solar grew from zero to 0.5%. Coal declined from 16.1% to 9.3%. Natural gas increased from 6.8% to 9.6%. Oil and diesel declined from 1.8% to 0.5%.

FIGURE 6

Net Capacity Changes in 2016



This stacked bar chart illustrates estimated net changes to Canada's capacity in 2016. Hydro increased by 969 MW, wind by 830 MW, biomass by 288 MW, and solar by 175 MW. Oil and diesel capacity decreased by 5 MW, and natural gas by 507 MW.

TABLE 1

Electric Capacity and Generation in Canada

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	**4 795**	**3 842**	**3 837**	**10 608**	**4 041**	**3 436**
	3.9%	2.7%	2.6%	1.8%	0.6%	0.5%
Natural Gas	**13 191**	**22 006**	**21 499**	**40 875**	**66 060**	**62 512**
	10.8%	15.2%	14.7%	6.8%	10.2%	9.6%
Coal	**16 003**	**9 661**	**9 661**	**96 750**	**62 256**	**60 374**
	13.1%	6.7%	6.6%	16.1%	9.6%	9.3%
Nuclear	**12 805**	**14 273**	**14 273**	**86 669**	**95 682**	**95 418**
	10.5%	9.9%	9.7%	14.4%	14.8%	14.6%
Solar	**17**	**2 135**	**2 310**	**0**	**3 001**	**3 568**
	<0.1%	1.5%	1.6%	0.0%	0.5%	0.5%
Biomass	**1 804**	**2 414**	**2 702**	**7 688**	**12 511**	**13 214**
	1.5%	1.7%	1.8%	1.3%	1.9%	2.0%
Wind	**557**	**11 072**	**11 902**	**1 453**	**28 314**	**30 462**
	0.5%	7.6%	8.1%	0.2%	4.4%	4.7%
Hydro	**72 890**	**79 434**	**80 403**	**358 387**	**374 116**	**383 392**
	59.7%	54.8%	54.8%	59.5%	57.9%	58.8%
All renewable sources	**75 268**	**95 056**	**97 317**	**367 528**	**417 942**	**430 636**
	61.7%	65.6%	66.4%	61.0%	64.7%	66.0%
All sources	**122 061**	**144 838**	**146 588**	**602 430**	**645 981**	**652 375**

British Columbia

B.C. generated 98.4% of its electricity from renewable sources in 2016, up from 95.0% in 2015. Although dominated by hydro, wind capacity has been growing in B.C. since 2009.

Generation Trends

B.C.'s natural geography and public policies have contributed to the establishment of hydro as the province's largest source of electricity. In 2016, over 30 BC Hydro facilities, and over 70 independently-owned hydro facilities, some over 100 years old, generated 88.0% of B.C.'s electricity. Biomass was the second largest source of electricity, mainly consuming wood waste from the forestry, and pulp and paper industries. Biomass generated 6 727 GW.h, or 9.0% of generation, in 2016. This is the highest biomass share of any province or territory.

Total renewable generation grew in relative share due to a significant decrease in natural gas generation, from 3 305 GW.h in 2015 to 1 115 GW.h in 2016, and an increase in hydro generation. Natural gas accounted for only 1.5% of total generation in 2016, down from a ten year average of 4.4%.

Capacity Changes in 2016

B.C. added an estimated 680 MW of hydro capacity in 2016. Major sources of this addition include the Waneta Expansion, the Mica Unit 6 Project, and the new McLymont Creek hydro facility.

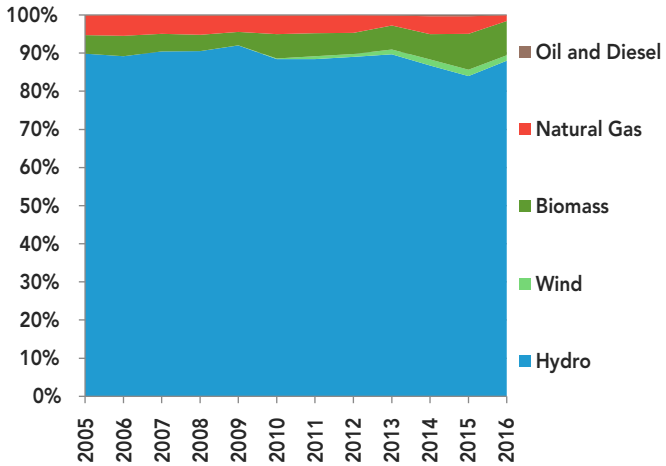
Natural gas capacity decreased by over 900 MW, due to the retirement of the Burrard Thermal Generating Station.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in British Columbia.

FIGURE 7

Electricity Generation by Source in British Columbia



This graph shows the composition of B.C.'s electricity generation between 2005 and 2016. Hydro averaged 88.9% of generation. Wind increased from 0% in 2008 to 1.4% in 2016. Biomass doubled from 4.8% to 9.0%. Natural gas generation declined from 5.1% to 1.5% of generation from 2005 to 2016.

TABLE 2

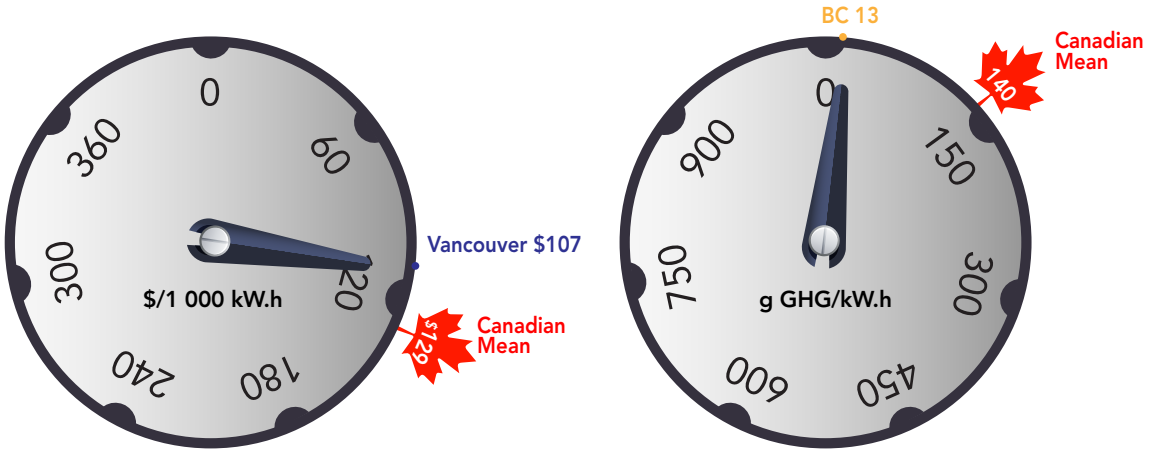
Electric Capacity and Generation in British Columbia

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	82	82	82	88	266	56
	0.5%	0.5%	0.5%	0.1%	0.4%	0.1%
Natural Gas	1 320	1 474	530	3 445	3 305	1 115
	8.8%	8.2%	3.0%	5.1%	4.6%	1.5%
Biomass	811	886	907	3 254	6 738	6 727
	5.4%	4.9%	5.1%	4.8%	9.4%	9.0%
Wind	0	488	488	0	1 206	1 059
	0.0%	2.7%	2.8%	0.0%	1.7%	1.4%
Hydro	12 847	15 029	15 709	60 327	60 344	65 524
	85.3%	83.7%	88.7%	89.9%	84.0%	88.0%
All renewable sources	13 658	16 403	17 104	63 581	68 288	73 310
	90.7%	91.3%	96.5%	94.7%	95.0%	98.4%
All sources	15 060	17 959	17 717	67 114	71 859	74 482

Residential Bills and Greenhouse Gas Generation Intensity

B.C.'s most populous city, Vancouver, has a relatively low residential electricity bill of $107 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. British Columbia's GHG generation intensity is also much lower than most of Canada, emitting 13 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.

FIGURE 8



Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. B.C.'s most populous city, Vancouver, has a relatively low residential electricity bill of $107 for 1 000 kW.h, compared to the Canadian mean of $129 per 1 000 kW.h. British Columbia's GHG generation intensity is also much lower than most of Canada, emitting 13 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.

Alberta

In 2016, Alberta generated 47.4% of its electricity from coal, 40.3% from natural gas, and 12.3% from renewables. Wind was the largest source of renewable power, generating 6.9% of Alberta's electricity.

Generation Trends

Electricity generation in Alberta is dominated by coal and natural gas. Since 2005, generation has trended towards less coal and more natural gas, and this trend is set to continue as Alberta plans to phase out coal by 2030. Currently, coal generates 47.4% of Alberta's electricity.

Wind generation has added more capacity than any other renewable source in Alberta. Since 2005, wind's share of total generation increased from 1.1% to 6.9%. Alberta now has the third highest wind generation in Canada (5 674 GW.h in 2016) after Quebec and Ontario. Most Alberta wind farms are located in the windy southern part of the province.

Biomass and hydro generation have been steady in Alberta. The share of generation for each of these sources fluctuated between 2% and 3% in recent years.

Capacity Changes in 2016

Alberta added an estimated 305 MW of natural gas-fired generation in 2016. Most of this was cogeneration of electricity and steam for oil sands production. The largest addition was the 100 MW Christina Lake cogeneration facility. Electricity from this facility is sold on Alberta's wholesale electricity market while its steam is used for in-situ oil sands production.

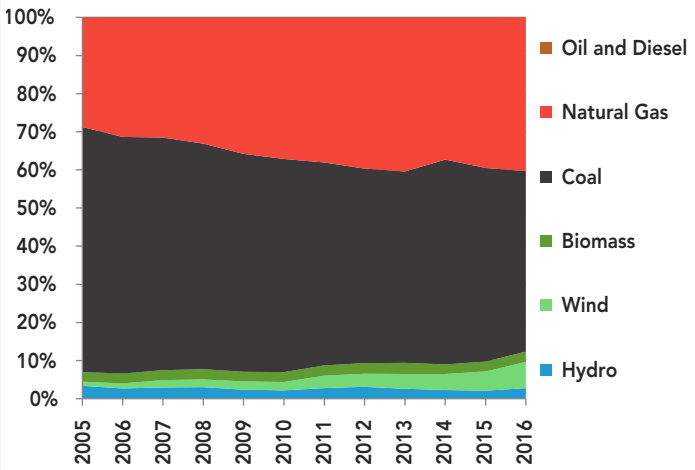
The Cowley Ridge wind facility was Canada's first commercial wind farm. TransAlta retired it in 2016 after 23 years in service. Despite this, Alberta increased wind capacity mainly due to expansions at the Bull Creek Wind Facility.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Alberta.

FIGURE 9

Electricity Generation by Source in Alberta



This graph shows the composition of Alberta's electricity generation between 2005 and 2016. Hydro accounted for 3.4% of generation in 2005 and 2.8% in 2016. Biomass increased from 2.5% to 2.7% over that period. Wind increased from 1.1% in 2005 to 6.9% in 2016. Coal decreased from 64.3% to 47.4%. Natural gas, increased its share from 28.7% to 40.3%.

TABLE 3

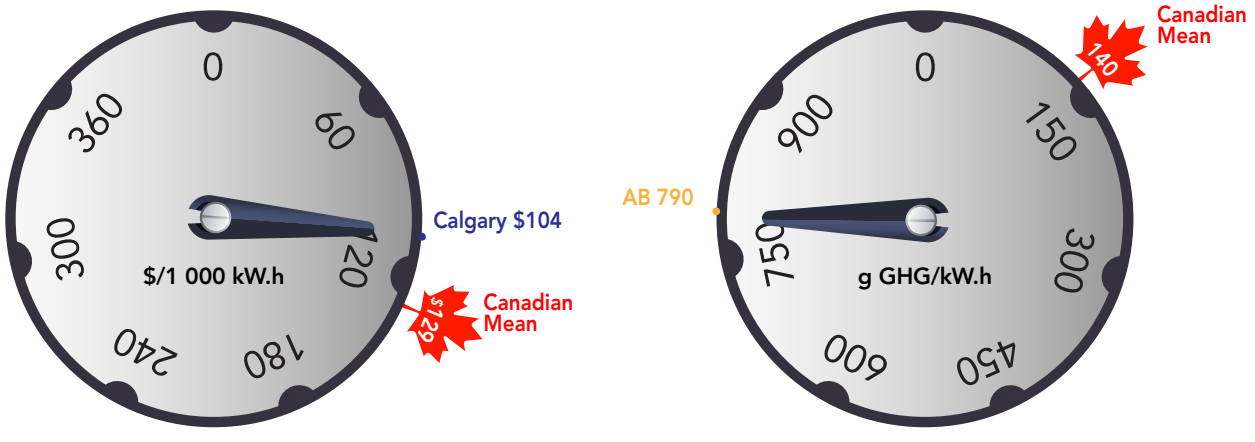
Electric Capacity and Generation in Alberta

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	7	7	7	17	12	0
	0.1%	<0.1%	<0.1%	<0.1%	<0.1%	0.0%
Natural Gas	4 770	7 214	7 519	19 657	32 215	33 184
	39.7%	44.3%	45.3%	28.7%	39.5%	40.3%
Coal	5 840	6 287	6 287	43 986	41 378	39 000
	48.6%	38.6%	37.9%	64.3%	50.7%	47.4%
Biomass	271	428	428	1 725	2 149	2 201
	2.3%	2.6%	2.6%	2.5%	2.6%	2.7%
Wind	251	1 463	1 467	741	4 089	5 674
	2.1%	9.0%	8.8%	1.1%	5.0%	6.9%
Hydro	869	894	894	2 316	1 709	2 282
	7.2%	5.5%	5.4%	3.4%	2.1%	2.8%
All renewable sources	1 391	2 785	2 789	4 782	7 947	10 156
	11.6%	17.1%	16.8%	7.0%	9.7%	12.3%
All sources	12 008	16 293	16 602	68 442	81 552	82 341

Residential Bills and Greenhouse Gas Generation Intensity

Alberta's most populous city, Calgary, has a relatively low residential electricity bill of $104 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Alberta's GHG generation intensity is the highest in Canada, emitting 790 grams of GHGs per kW.h which is nearly six times Canada's mean of 140 g GHG/kW.h.

FIGURE 10



Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Alberta's most populous city, Calgary, has a relatively low residential electricity bill of $104 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Alberta's GHG generation intensity is the highest in Canada, emitting 790 grams of GHGs per kW.h which is nearly six times Canada's mean of 140 g GHG/kW.h.

Saskatchewan

Saskatchewan decreased its generation from coal by 6.5% in just one year. It generated 49.3% of its total electricity from coal in 2016, down from 54.8% in 2015. Natural gas increased its share from 27.7% to 33.7%. Renewables accounted for 17.1% of total generation in 2016.

Generation Trends

Fossil fuels are the primary source of Saskatchewan's electricity due to a relative abundance of coal and natural gas. Coal remains the largest source of generation, but declined from 67.0% to 49.3% between 2005 and 2016. Natural gas generation increased more than four-fold over the same period, due to both lower natural gas prices and a shift towards less GHG intensive generation.

From 2005 to 2016, hydro generation in Saskatchewan fluctuated between 23.2% and 13.4% of total electricity generation. These fluctuations were primarily due to varying annual precipitation and corresponding river flow levels.

Wind, the only non-hydro renewable in Saskatchewan, grew from 0.5% to 3.0% between 2005 and 2016. Saskatchewan is one of the sunniest provinces in Canada; however, they have no utility-scale solar facilities as of 2016.

Capacity Changes in 2016

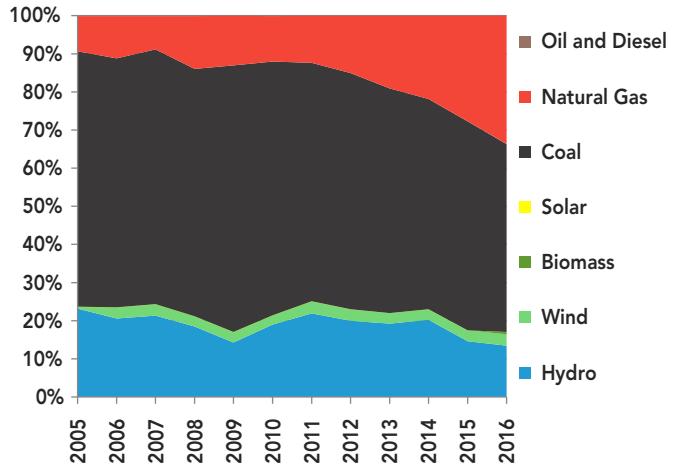
Saskatchewan added an estimated 150 MW of natural gas-fired capacity, primarily from upgrades to the Queen Elizabeth Power Station.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Saskatchewan.

FIGURE 11

Electricity Generation by Source in Saskatchewan



This graph shows the composition of Saskatchewan's electricity generation between 2005 and 2016. Hydro's share fluctuated between 13.4% and 23.2% of generation. Wind averaged 2.7%. Coal decreased from 67.0% in 2005 to 49.3% in 2016. Natural gas' share increased from 9.3% in 2005 to 33.7% in 2016.

TABLE 4

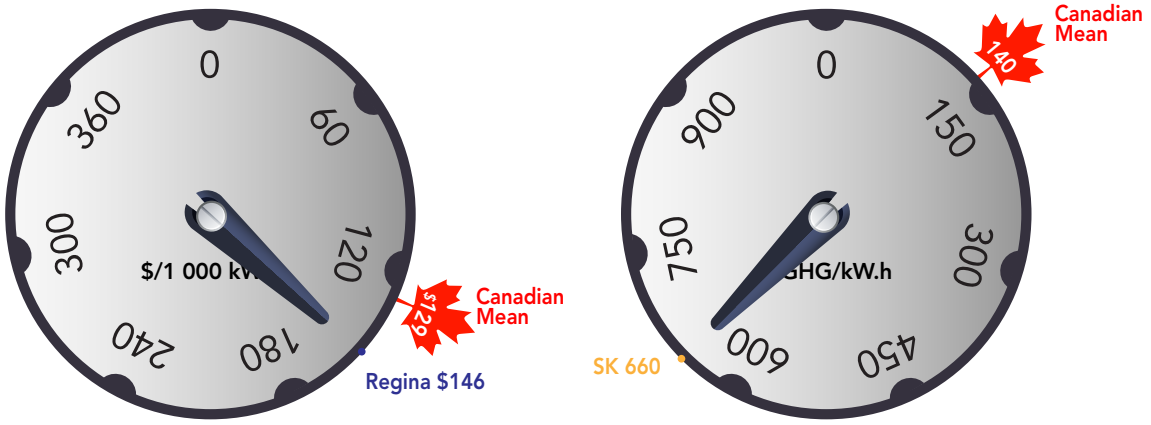
Electric Capacity and Generation in Saskatchewan

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	1	17	17	18	16	0
	<0.1%	0.4%	0.4%	0.1%	0.1%	<0.1%
Natural Gas	1 053	1 710	1 860	1 827	6 498	8 221
	28.2%	39.1%	40.8%	9.3%	27.7%	33.7%
Coal	1 799	1 535	1 535	13 227	12 871	12 040
	48.2%	35.1%	33.6%	67.0%	54.8%	49.3%
Biomass	0	2	36	0	0	152
	0.0%	<0.1%	0.8%	0.0%	0.0%	0.6%
Wind	16	221	221	92	684	730
	0.4%	5.1%	4.8%	0.5%	2.9%	3.0%
Hydro	864	889	889	4 573	3 425	3 285
	23.1%	20.3%	19.5%	23.2%	14.6%	13.4%
All renewable sources	880	1 112	1 146	4 665	4 109	4 167
	23.6%	25.4%	25.1%	23.6%	17.5%	17.1%
All sources	3 733	4 374	4 558	19 737	23 494	24 428

Residential Bills and Greenhouse Gas Generation Intensity

Saskatchewan's capital city, Regina, has a residential electricity bill of $146 for 1 000 kW.h which is slightly higher than the Canadian mean of $129 per 1 000 kW.h. Saskatchewan's GHG generation intensity is almost five times higher than average in Canada, emitting 660 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

FIGURE 12

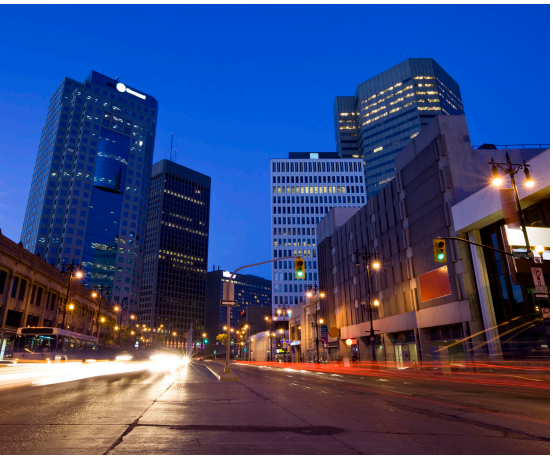


Monthly residential bill for 1 000kW.h

GHG generation intensity g GHG / kW.h

Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Saskatchewan's capital city, Regina, has a residential electricity bill of $146 for 1 000 kW.h, which is slightly higher than the Canadian mean of $129 per 1 000 kW.h. Saskatchewan's GHG generation intensity is almost five times higher than the average in Canada, emitting 660 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.



Manitoba

Manitoba generated 99.6% of its electricity from renewable sources in 2016. This is the second highest share of renewable generation after Quebec. Hydro was the primary source of electricity, accounting for 97.3% of generation.

Generation Trends

The composition of electricity generation from different technologies was relatively stable in Manitoba between 2005 and 2016. The vast majority of the province's electricity was generated from hydro, averaging 97.5% since 2005. Wind generation was the fastest growing electricity source, increasing from 0.1% in 2005 to 2.4% in 2016. In contrast, coal dropped from 1.1% to 0.1% of generation in the same time. Biomass accounted for 0.2% of generation in 2016. Diesel is used in some remote communities, particularly in the northern part of the province.

Capacity Changes in 2016

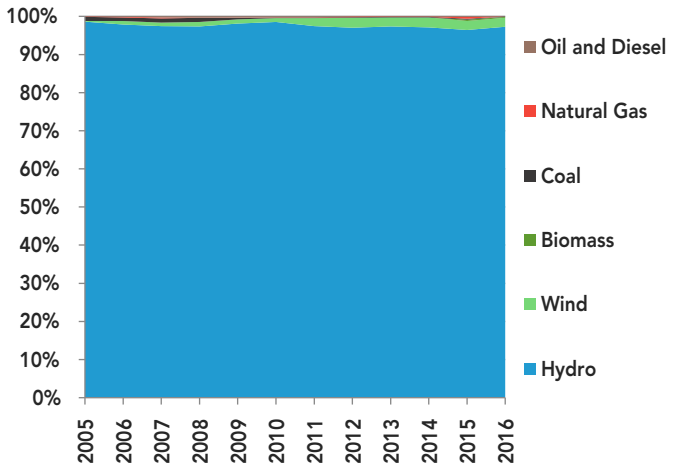
Although accounting for a very small portion of capacity, diesel capacity is estimated to have been halved in 2016, dropping to 5 MW from 10 MW in 2015. The capacity of every other source stayed the same.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Manitoba.

FIGURE 13

Electricity Generation by Source in Manitoba



This graph shows the source of Manitoba's electricity generation between 2005 and 2016. On average, hydro has accounted for about 97.5% of generation. Wind increased from 0.1% in 2005 to 2.4% in 2016. Biomass has remained less than half a percent of generation. Coal, natural gas, oil and diesel each averaged less than half of a percent of generation, and have decreased to shares near zero in 2016.

TABLE 5

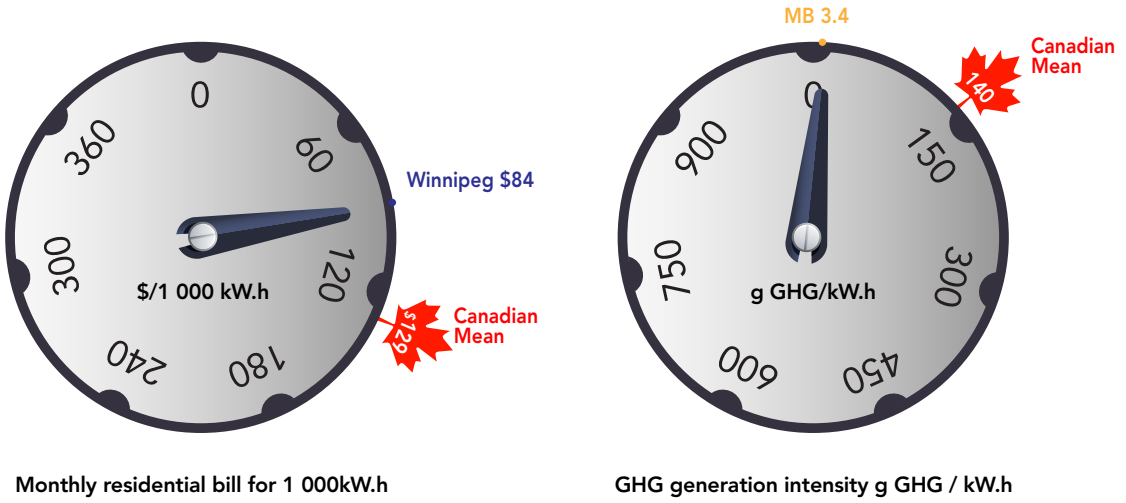
Electric Capacity and Generation in Manitoba

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	32	10	5	32	43	16
	0.6%	0.2%	0.1%	0.1%	0.1%	<0.1%
Natural Gas	368	403	403	11	183	12
	6.6%	6.6%	6.6%	<0.1%	0.5%	0.0%
Coal	98	98	98	421	106	28
	1.7%	1.6%	1.6%	1.1%	0.3%	0.1%
Biomass	22	22	22	Not available	100	78
	0.4%	0.4%	0.4%		0.3%	0.2%
Wind	20	258	258	53	860	863
	0.4%	4.2%	4.2%	0.1%	2.4%	2.4%
Hydro	5 054	5 349	5 349	36 440	34 774	35 599
	90.3%	87.1%	87.1%	98.6%	96.4%	97.3%
All renewable sources	5 074	5 608	5 608	36 493	35 634	36 462
	90.7%	91.3%	91.4%	98.7%	98.8%	99.6%
All sources	5 594	6 140	6 135	36 956	36 067	36 596

Residential Bills and Greenhouse Gas Generation Intensity

Manitoba's largest city, Winnipeg, has a relatively low residential electricity bill of $84 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Manitoba's GHG generation intensity is also much lower than most of Canada, emitting 3.4 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.

FIGURE 14



Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Manitoba's largest city, Winnipeg, has a relatively low residential electricity bill of $84 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Manitoba's GHG generation intensity is also much lower than most of Canada, emitting 3.4 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.

Ontario

In 2016, Ontario generated 33.4% of its electricity from renewable sources and generated 91.7% of its electricity from sources that are non-emitting during operation. Oil and diesel were 0.1% of Ontario's generation in 2016. Natural gas was the only significant fossil fuel source of electricity, accounting for 8.2% of the electricity generated in 2016.

Generation Trends

Ontario generated 58.3% of its electricity from 18 of Canada's 19 CANDU nuclear reactors. (The remaining reactor is in New Brunswick.) Coal, Ontario's third largest source of electricity in 2005, was phased out completely in 2014, and replaced with increased nuclear, wind, solar and natural gas generation.

In 2016, hydro was Ontario's second largest source of electricity. Hydro has accounted for an average of 23.1% of generation since 2005. Non-hydro renewables experienced strong growth under the feed-in-tariff program, an incentive implemented in 2006. Wind, solar, and biomass increased from 0.7% in 2005 to 10.8% combined in 2016. Ontario produced the most wind and solar electricity of any province or territory in 2016, at 12 123 GW.h and 3 566 GW.h, respectively.

Capacity Changes in 2016

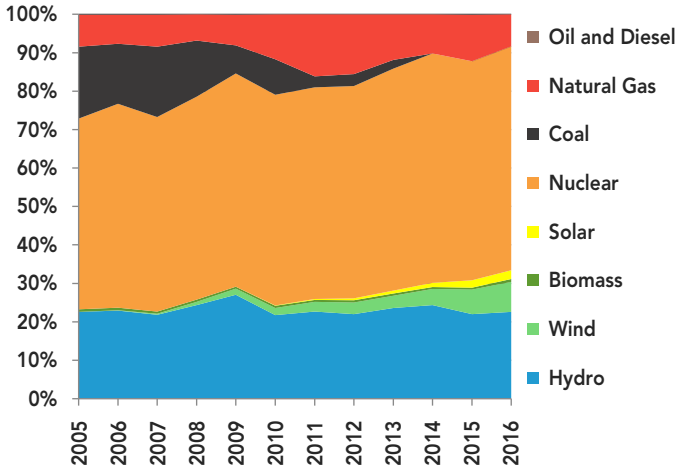
Ontario added an estimated 932 MW of capacity in 2016, all from renewable sources. As much new capacity came from wind as from all other sources combined. The Armow, and Grand Bend wind projects were the largest capacity additions at 180 MW and 100 MW respectively.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Ontario.

FIGURE 15

Electricity Generation by Source in Ontario



This graph shows the composition of Ontario's electricity generation between 2005 and 2016. On average, hydro accounted for 23.1% of generation. Wind's share grew from zero to 7.8%, solar from zero to 2.3%, and biomass remained at 0.7%. Nuclear grew from 49.6% to 58.3% of generation. Coal decreased from 18.7% in 2005 to 0% in 2014. Natural gas peaked at 16.1% in 2011 before falling to 8.2% in 2016.

TABLE 6

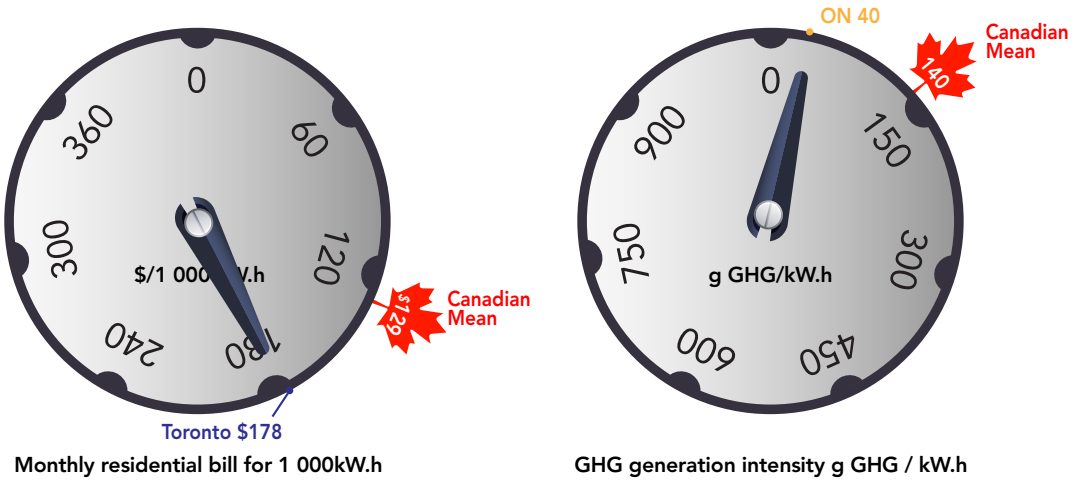
Electric Capacity and Generation in Ontario

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	116	250	250	184	237	109
	0.4%	0.6%	0.6%	0.1%	0.1%	0.1%
Natural Gas	4 789	9 648	9 630	13 082	19 403	12 859
	15.2%	24.5%	23.9%	8.3%	12.1%	8.2%
Coal	6 437	0	0	29 431	0	0
	20.4%	0.0%	0.0%	18.7%	0.0%	0.0%
Nuclear	11 450	13 568	13 568	77 969	91 405	90 873
	36.3%	34.5%	33.7%	49.6%	57.0%	58.3%
Solar	17	2 119	2 291	0	3 001	3 566
	0.1%	5.4%	5.7%	0.0%	1.9%	2.3%
Biomass	209	574	762	1 108	818	1 128
	0.7%	1.5%	1.9%	0.7%	0.5%	0.7%
Wind	15	4 374	4 841	26	10 200	12 123
	<0.1%	11.1%	12.0%	<0.1%	6.4%	7.8%
Hydro	8 505	8 768	8 872	35 480	35 359	35 288
	27.0%	22.3%	22.1%	22.6%	22.0%	22.6%
All renewable sources	8 746	15 835	16 767	36 614	49 378	52 105
	27.7%	40.3%	41.7%	23.3%	30.8%	33.4%
All sources	31 538	39 302	40 215	157 280	160 422	155 946

Residential Bills and Greenhouse Gas Generation Intensity

Ontario's largest city, Toronto, has a relatively high residential electricity bill of $178 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Ontario's GHG generation intensity is relatively low, emitting 40 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

FIGURE 16



Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Ontario's largest city, Toronto, has a relatively high residential electricity bill of $178 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Ontario's GHG generation intensity is relatively low, emitting 40 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.

Quebec

Quebec generated 99.8% of its electricity from renewable sources in 2016, and had the highest percentage of renewable generation in Canada. Hydro was the primary source of Quebec's electricity, accounting for 95.2% of generation. Wind and biomass were Quebec's next largest electricity sources.

Generation Trends

Quebec produced 95.2% of its electricity from hydro in 2016, similar to generation shares in 2005. Wind generation increased significantly, from 0.2% in 2005 to 3.6% in 2016. With 7 360 GW.h of wind generation in 2016, Quebec had the second highest wind generation in Canada, after Ontario.

Rural communities in northern Quebec that are not connected to the grid rely on diesel and oil for power generation. This accounted for about 0.2% of generation in 2016. Quebec ceased nuclear generation in 2012 when the Gentilly-2 Nuclear Generating Station was shut down.

Capacity Changes in 2016

Quebec added wind, hydro, and biomass capacity totaling an estimated 502 MW in 2016. The largest wind farms were the Rivière du Moulin and the Mont-Rothery farms.

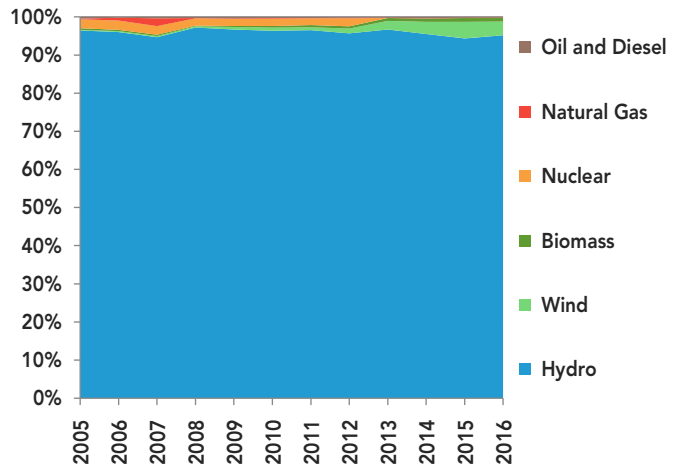
Hydro-Québec added approximately 185 MW of hydro capacity in 2016 with the completion of Romaine 1. This is the first in a series of hydro facilities constituting the Romaine Complex on the St. Lawrence River.

More Information

Canada's Renewable Power Landscape – Energy Market Analysis provides additional information on renewable power in Quebec.

FIGURE 17

Electricity Generation by Source in Quebec



This graph shows the composition of Quebec's electricity generation between 2005 and 2016. On average, hydro accounted for 95.9% of generation. Wind increased from 0.2% in 2005 to 3.6% in 2016. Biomass increased from 0.4% to 1.0%. Nuclear power dropped from 2.4% to zero in 2012. Natural gas, oil and diesel accounted for about 0.2% in 2016.

TABLE 7

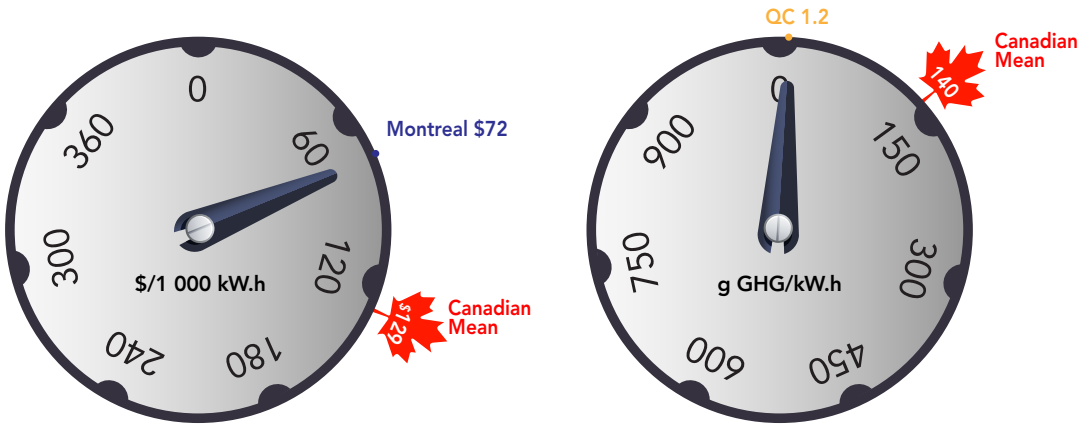
Electric Capacity and Generation in Quebec

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	1 595	589	589	824	518	424
	4.1%	1.3%	1.3%	0.5%	0.3%	0.2%
Natural Gas	31	591	591	269	100	65
	0.1%	1.3%	1.3%	0.1%	<0.1%	<0.1%
Nuclear	675	0	0	4 322	0	0
	1.7%	0.0%	0.0%	2.4%	0.0%	0.0%
Biomass	278	245	275	646	2 053	2 093
	0.7%	0.5%	0.6%	0.4%	1.0%	1.0%
Wind	207	3 262	3 549	416	8 938	7 360
	0.5%	7.3%	7.8%	0.2%	4.3%	3.6%
Hydro	36 473	40 212	40 397	173 356	194 540	197 243
	92.9%	89.6%	89.0%	96.4%	94.4%	95.2%
All renewable sources	36 958	43 719	44 222	174 418	205 531	206 696
	94.1%	97.4%	97.4%	97.0%	99.7%	99.8%
All sources	39 259	44 899	45 402	179 832	206 149	207 184

Residential Bills and Greenhouse Gas Generation Intensity

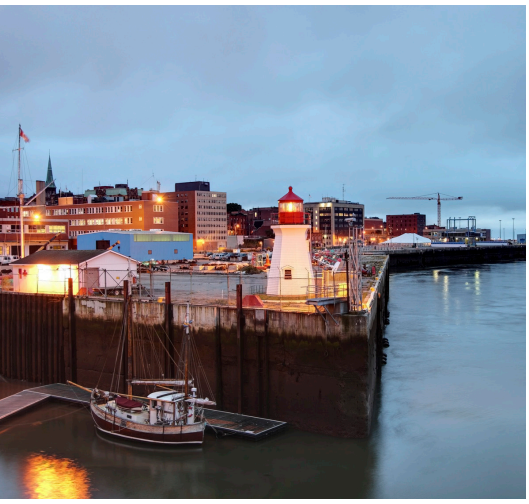
Quebec's largest city, Montreal, has the lowest residential electricity bill in Canada, at $72 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Quebec's GHG generation intensity is also the lowest in Canada, emitting 1.2 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.

FIGURE 18



Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Quebec's largest city, Montreal, has the lowest residential electricity bill in Canada, at $72 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Quebec's GHG generation intensity is also the lowest in Canada, emitting 1.2 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.



New Brunswick

New Brunswick generated its electricity from a mix of sources, which was 29.9% renewable in 2016. Nuclear was the primary source of electricity, also accounting for 29.9% of generation, followed by hydro and coal, producing 20.6% and 20.7% of generation, respectively.

Generation Trends

Nuclear, hydro, coal, and natural gas all provide a significant portion of New Brunswick's electricity. Nuclear was the largest source in 2016, accounting for 29.9% of the province's total generation. The Point Lepreau Nuclear Generating Station is the only nuclear power station in Canada outside of Ontario. It was refurbished between 2009 and 2011.

Coal and natural gas power generation have remained stable, supplying 20.7% and 15.5% of total generation in 2016. Oil and diesel generation decreased significantly, from 34.7% to 3.9% since 2005, due to provincial emissions policies that helped New Brunswick meet its 2030 GHG emissions targets 15 years early.

Hydro was the main source of renewable energy in New Brunswick, accounting for 20.6% of generation in 2016. Most of the province's wind power facilities were installed during the refurbishment of Point Lepreau. In 2016, wind accounted for 5.6% of generation. Biomass averaged 4.0% of generation between 2005 and 2016.

Capacity Changes in 2016

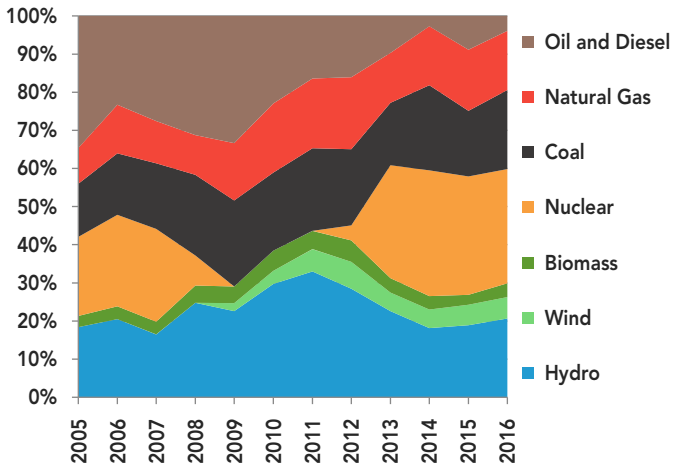
New Brunswick's capacity was the same in 2016 as it was in 2015.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in New Brunswick.

FIGURE 19

Electricity Generation by Source in New Brunswick



This graph shows the composition of New Brunswick's electricity generation between 2005 and 2016. Hydro fluctuated from 18.4% in 2005, to 33.0% in 2011, then decreased to 20.6% in 2016. Wind's share increased from zero to 5.6%. Biomass remained stable at around 4.0%. Nuclear dropped to zero between 2009 and 2011 then increased to 29.9% in 2016. Coal fluctuated from 13.9% in 2005, to an average of 21.6% between 2009 and 2011, and was 20.7% in 2016. Natural gas increased from 9.4% in 2005 to 15.5% in 2016, while oil and diesel dropped from 34.7% to 3.9% over these years.

TABLE 8

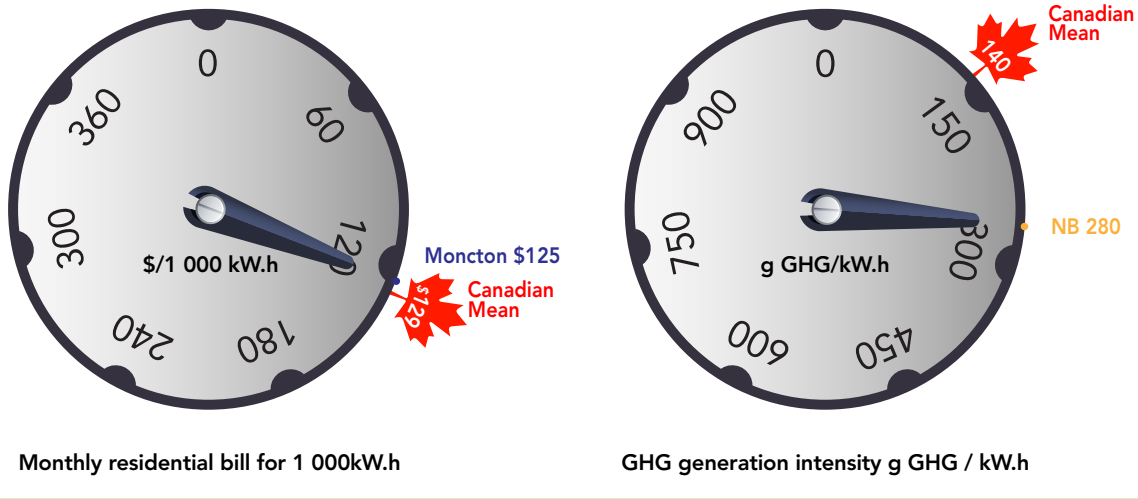
Electric Capacity and Generation in New Brunswick

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	1 593	1 593	1 593	7 300	1 223	591
	37.6%	35.2%	35.2%	34.7%	8.9%	3.9%
Natural Gas	340	350	350	1 980	2 212	2 359
	8.0%	7.7%	7.7%	9.4%	16.0%	15.5%
Coal	541	490	490	2 922	2 373	3 148
	12.8%	10.8%	10.8%	13.9%	17.2%	20.7%
Nuclear	680	705	705	4 378	4 277	4 545
	16.1%	15.6%	15.6%	20.8%	31.0%	29.9%
Biomass	127	127	127	610	361	548
	3.0%	2.8%	2.8%	2.9%	2.6%	3.6%
Wind	0	294	294	0	737	856
	0.0%	6.5%	6.5%	0.0%	5.3%	5.6%
Hydro	953	961	961	3 875	2 612	3 134
	22.5%	21.3%	21.3%	18.4%	18.9%	20.6%
All renewable sources	1 080	1 382	1 382	4 485	3 710	4 538
	25.5%	30.6%	30.6%	21.3%	26.9%	29.9%
All sources	4 235	4 520	4 520	21 064	13 796	15 181

Residential Bills and Greenhouse Gas Generation Intensity

New Brunswick's largest city, Moncton, has a residential electricity bill of $125 for 1 000 kW.h close to the Canadian mean of $129 per 1 000 kW.h. New Brunswick's GHG generation intensity is relatively high, emitting 280 grams of GHGs per kW.h double the Canadian mean of 140 g GHG/kW.h.

FIGURE 20



Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. New Brunswick's largest city, Moncton, has a residential electricity bill of $125 for 1 000 kW.h close to the Canadian mean of $129 per 1 000 kW.h. New Brunswick's GHG generation intensity is relatively high, emitting 280 grams of GHGs per kW.h double the Canadian average of 140 g GHG/kW.h.

Nova Scotia

Nova Scotia generated 63.7% of its electricity from coal in 2016. Natural gas was the second largest source of electricity in the province, followed by wind and hydro.

Generation Trends

Coal generation comprised 63.7% of electricity production in 2016 in Nova Scotia, this is a decrease from 77.9% in 2005. Natural gas's share increased from 2.1% to 12.9% from 2005 to 2016.

Hydro, wind, and biomass supplied Nova Scotia's renewable power in 2016. At 10.6%, wind was the largest renewable source, up from 1.0% in 2005. Hydro was the second largest renewable source in Nova Scotia, accounting for 9.1% of total generation in 2016. The Annapolis Tidal Station, on Nova Scotia's Annapolis River, is the only tidal generation station in Canada. It generates roughly 33 GW.h per year. Biomass averaged 3.0% from 2005 to 2016. Oil and diesel generation averaged 3.4%.

Capacity Changes in 2016

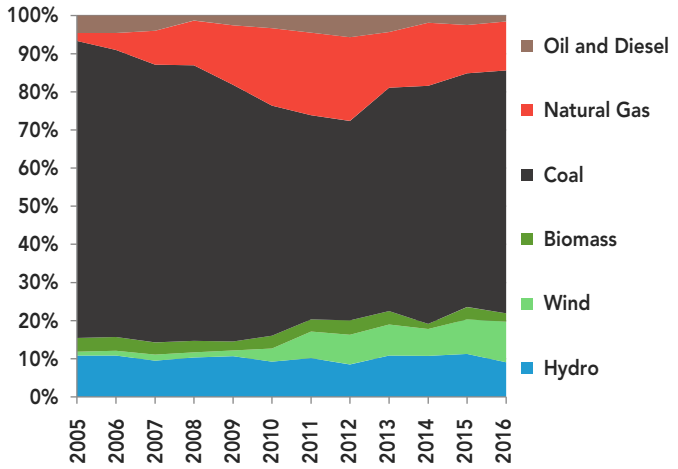
Nova Scotia added new wind and biomass capacity in 2016 totaling an estimated 86 MW.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Nova Scotia.

FIGURE 21

Electricity Generation by Source in Nova Scotia



This graph shows the composition of Nova Scotia's electricity generation between 2005 and 2016. On average, hydro accounted for 10.2% of generation. Wind grew from 1.0% to 10.6%. Biomass generation averaged 3.0%. Coal fell from 77.9% to 63.7%. Natural gas fluctuated from 2.1% in 2005 to a high of 21.9% in 2012 before falling to 12.9% in 2016. Oil and diesel decreased from 4.6% to 1.6%.

TABLE 9

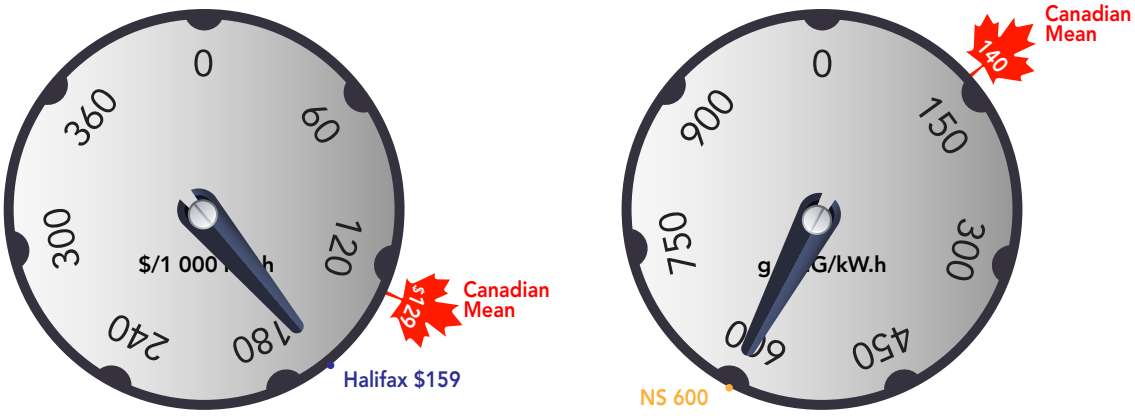
Electric Capacity and Generation in Nova Scotia

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	**222**	**222**	**222**	**397**	**226**	**151**
	9.3%	7.7%	7.4%	4.6%	2.5%	1.6%
Natural Gas	**381**	**482**	**482**	**181**	**1 137**	**1 244**
	15.9%	16.6%	16.1%	2.1%	12.6%	12.9%
Coal	**1 288**	**1 252**	**1 252**	**6 764**	**5 528**	**6 158**
	53.8%	43.2%	41.9%	77.9%	61.3%	63.7%
Biomass	**69**	**113**	**128**	**318**	**289**	**212**
	2.9%	3.9%	4.3%	3.7%	3.2%	2.2%
Wind	**35**	**444**	**515**	**85**	**818**	**1 027**
	1.4%	15.3%	17.2%	1.0%	9.1%	10.6%
Hydro	**401**	**388**	**388**	**941**	**1 016**	**880**
	16.7%	13.4%	13.0%	10.8%	11.3%	9.1%
All renewable sources	**505**	**945**	**1 031**	**1 344**	**2 123**	**2 119**
	21.1%	32.6%	34.5%	15.5%	23.6%	21.9%
All sources	**2 396**	**2 901**	**2 987**	**8 686**	**9 014**	**9 672**

Residential Bills and Greenhouse Gas Generation Intensity

Nova Scotia's largest city, Halifax, has a residential electricity bill of $159 for 1 000 kW.h somewhat higher than the Canadian mean of $129 per 1 000 kW.h. Nova Scotia's GHG generation intensity is more than four times higher than most of Canada, emitting 600 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

FIGURE 22



Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Nova Scotia's largest city, Halifax, has a residential electricity bill of $159 for 1 000 kW.h somewhat higher than the Canadian mean of $129 per 1 000 kW.h. Nova Scotia's GHG generation intensity is more than four times higher than most of Canada, emitting 600 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

Newfoundland and Labrador

Newfoundland and Labrador generated 94.3% of its electricity from renewable sources, almost entirely from hydro. The remaining generation was mainly from oil, diesel, and natural gas.

Generation Trends

Newfoundland and Labrador generated 93.9% of its electricity from hydro in 2016. The Churchill Falls Generating Station in Labrador is the second largest hydro plant in Canada, with an installed capacity of 5 428 MW, and annual generation of about 34 000 GW.h. Under an agreement with Hydro-Québec, a significant portion of generation at the facility is exported to Quebec. Wind and biomass account for a small share of generation, at only 0.7% combined in 2016.

Hydro generation in Newfoundland and Labrador is supplemented with diesel generation at the 500 MW Holyrood Thermal Generating Station, among other facilities. Natural gas is used for electricity generation on offshore oil drilling rigs, and accounts for an estimated 1.2% of the province's generation.

Capacity Changes in 2016

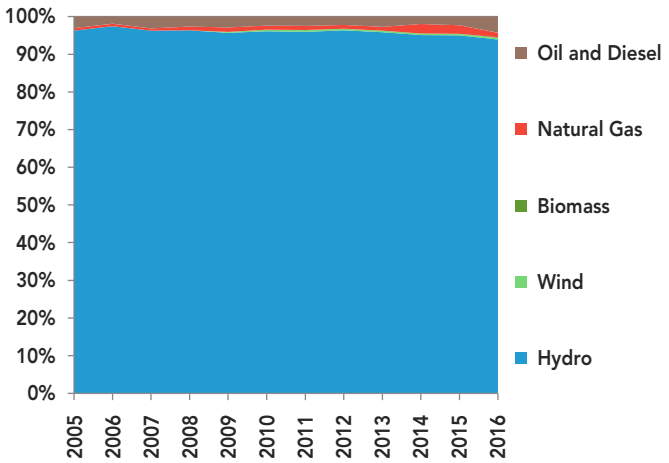
Newfoundland and Labrador's capacity in 2016 was the same as in 2015.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Newfoundland and Labrador.

FIGURE 23

Electricity Generation by Source in Newfoundland and Labrador



This graph shows the composition of Newfoundland and Labrador's electricity generation between 2005 and 2016. On average, hydro accounted for 95.8% of generation. Wind and biomass generated less than 1% combined. Natural gas averaged 1.2%. Oil and diesel averaged 2.7% of generation.

TABLE 10

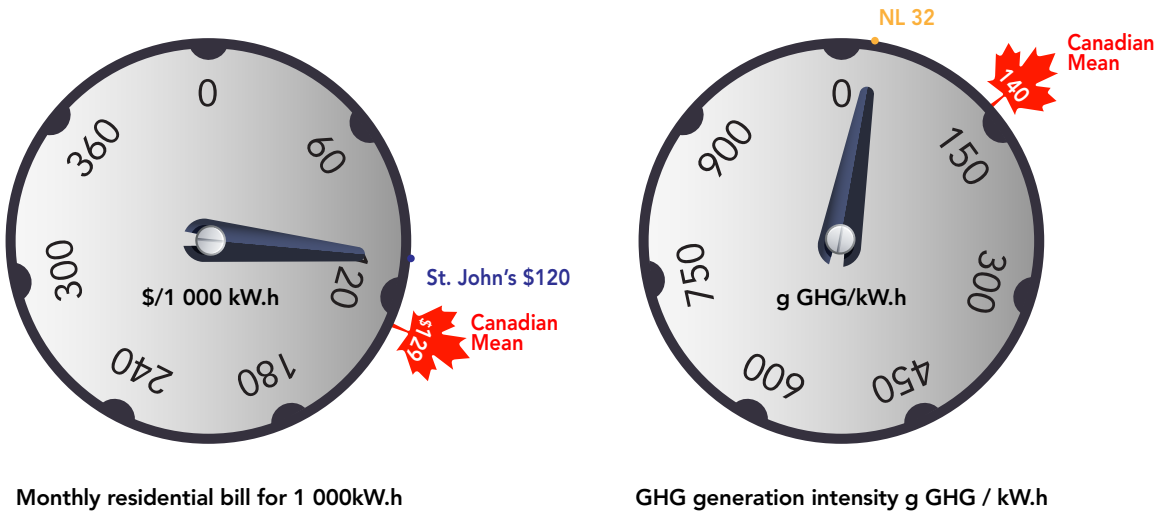
Electric Capacity and Generation in Newfoundland and Labrador

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	**784**	**737**	**737**	**1 304**	**974**	**1 805**
	10.2%	9.6%	9.6%	3.1%	2.3%	4.3%
Natural Gas	**103**	**103**	**103**	**269**	**922**	**506**
	1.3%	1.3%	1.3%	0.6%	2.2%	1.2%
Biomass	**15**	**15**	**15**	**0**	**0**	**70**
	0.2%	0.2%	0.2%	0.0%	0.0%	0.2%
Wind	**0**	**54**	**54**	**0**	**189**	**190**
	0.0%	0.7%	0.7%	0.0%	0.5%	0.5%
Hydro	**6 791**	**6 794**	**6 794**	**40 498**	**39 687**	**39 483**
	88.3%	88.2%	88.2%	96.3%	95.0%	93.9%
All renewable sources	**6 791**	**6 848**	**6 848**	**40 498**	**39 876**	**39 673**
	88.3%	88.9%	88.9%	96.3%	95.5%	94.3%
All sources	**7 692**	**7 703**	**7 703**	**42 071**	**41 772**	**42 053**

Residential Bills and Greenhouse Gas Generation Intensity

Newfoundland and Labrador's largest city, St. John's, has a residential electricity bill of $120 for 1 000 kW.h which is slightly lower than the Canadian mean of $129 per 1 000 kW.h. Newfoundland and Labrador's GHG generation intensity is much lower than most of Canada, emitting 32 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

FIGURE 24



Monthly residential bill for 1 000kW.h

GHG generation intensity g GHG / kW.h

Sources: Hydro-Québec, National Inventory Report

Description: Two semicircular dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Newfoundland and Labrador's largest city, St. John's, has a residential electricity bill of $120 for 1 000 kW.h which is slightly lower than the Canadian mean of $129 per 1 000 kW.h. Newfoundland and Labrador's GHG generation intensity is much lower than most of Canada, emitting 32 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

Prince Edward Island

In 2016, 99.0% of electricity generated in Prince Edward Island (PEI) was renewable, almost all of it from wind. PEI has the highest percentage of wind generation of any province or territory. Oil and diesel accounted for the rest of the generation in PEI.

Generation Trends

Wind generation in PEI has remained fairly stable. Wind accounted for 97.8% of generation in 2005 and 98.1% in 2016. Biomass supplied 0.9% of generation in 2016, and oil and diesel generators produced only 1.0% of the province's electricity. PEI is the only province that does not generate hydroelectricity.

PEI imports a large percentage of its consumed electricity from New Brunswick while exporting a significant portion of its locally produced renewable electricity. (See New Brunswick's generation by source.) The two submarine cables that connect PEI and New Brunswick are vital to the operation and reliability of PEI's electricity grid.

Capacity Changes in 2016

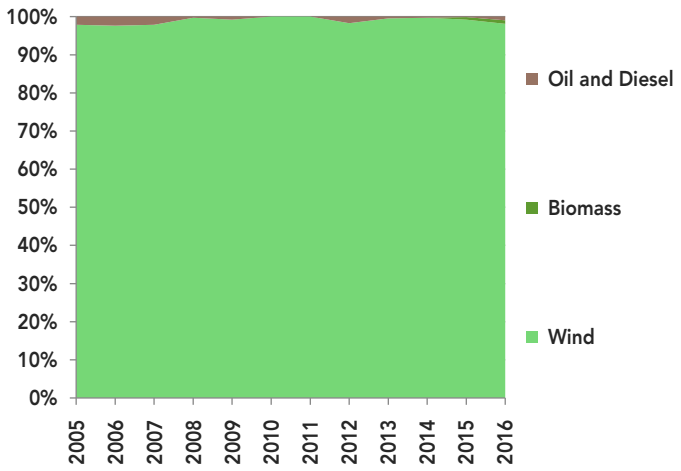
PEI did not have any new facilities enter into service during 2016. Although oil and diesel generators comprise 43.9% of available capacity, this capacity continued to be rarely used.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in PEI.

FIGURE 25

Electricity Generation by Source in Prince Edward Island



This graph shows the composition of PEI's electricity generation between 2005 and 2016. Wind increased from 97.8% to 98.1% of generation. Biomass generated 0.9% in 2016. Oil and diesel fell from 2.2% to 1.0%.

TABLE 11

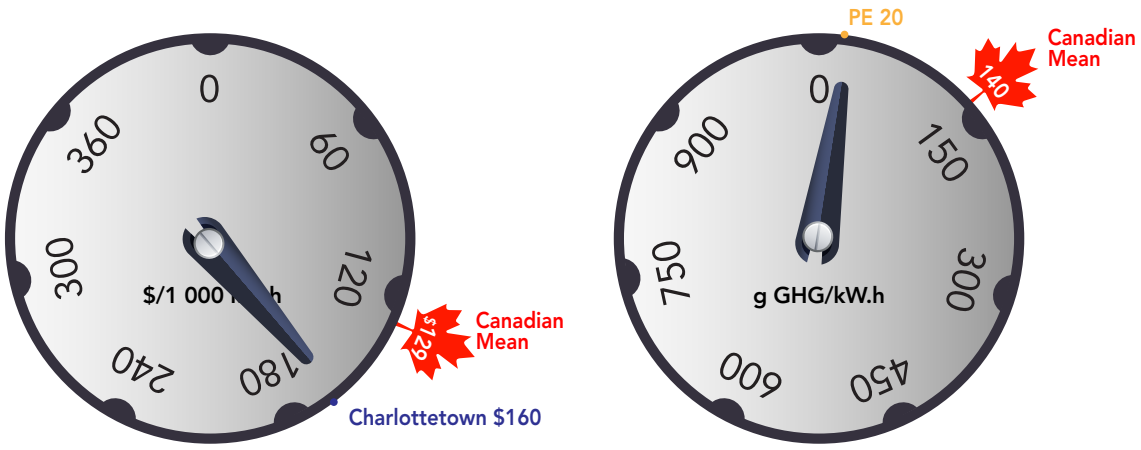
Electric Capacity and Generation in Prince Edward Island

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	**161**	**160**	**160**	**1**	**1**	**6**
	91.4%	43.9%	43.9%	2.2%	0.2%	1.0%
Biomass	**2**	**2**	**2**	**Not available**	**4**	**5**
	1.2%	0.6%	0.6%		0.7%	0.9%
Wind	**13**	**203**	**203**	**40**	**587**	**565**
	7.4%	55.6%	55.6%	97.8%	99.2%	98.1%
All renewable sources	**15**	**205**	**205**	**40**	**591**	**570**
	8.6%	56.1%	56.1%	97.8%	99.8%	99.0%
All sources	**176**	**366**	**366**	**41**	**592**	**576**

Residential Bills and Greenhouse Gas Generation Intensity

PEI's largest city, Charlottetown, has a relatively high residential electricity bill of $160 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. PEI's GHG generation intensity is much lower than most of Canada, emitting 20 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.

FIGURE 26



Monthly residential bill for 1 000kW.h

GHG generation intensity g GHG / kW.h

Sources: Hydro-Québec, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. PEI's largest city, Charlottetown, has a relatively high residential electricity bill of $160 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. PEI's GHG generation intensity is much lower than most of Canada, emitting 20 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h, although this only includes power that is generated in the province.

Yukon

Yukon generates over 94.0% of its electricity from renewable sources, almost entirely from hydro. Diesel generators are used in remote communities, and for backup power.

Generation Trends

In 2016, Yukon generated 93.8% of its electricity from hydro. However, Yukon faces unique challenges in ensuring a reliable, year-round supply of electricity. The second largest plant, located at Aishihik, stores water in the summer when demand is lower, and releases it during the winter and at other times when demand is higher. This energy storage is crucial because Yukon's largest hydro plant, Whitehorse Hydro Plant, loses nearly half of its generation potential in the winter due to flow reductions on the Yukon River.

Occasionally, when hydro supply is disrupted or when electricity demand exceeds hydro generation, diesel powered generators produce electricity to meet demand. Remote communities rely on diesel generation year-round. In 2016, diesel was used for 5.3% of the territory's electricity generation.

Capacity Changes in 2016

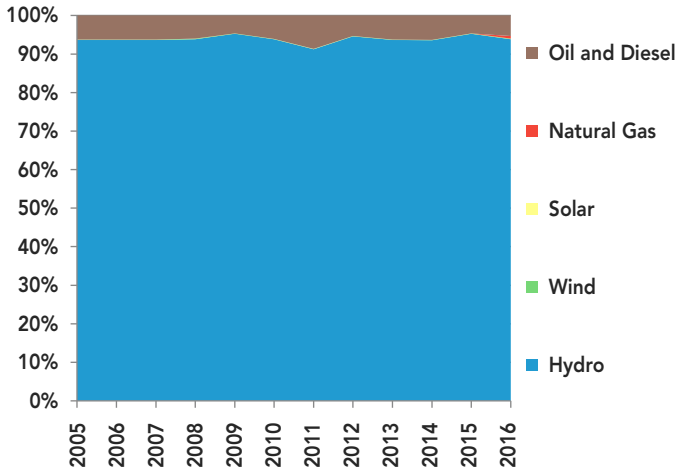
The territorial government is currently looking to transition Yukon's diesel generators to cleaner-burning liquefied natural gas (LNG). However, no new facilities went into service during 2016.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Yukon.

FIGURE 27

Electricity Generation by Source in Yukon



This graph shows the composition of Yukon's electricity generation between 2005 and 2016. Hydro generation averaged 93.8% from 2005 to 2016. Oil and diesel generation accounting for an average of 6.0%. Wind, solar and natural gas generated about 0.8% combined in 2016.

Data Challenges for Northern Territories

The data in this report was derived from Canada's Energy Future 2017. Its electricity generation and capacity numbers are based on a model that uses historical Statistics Canada data along with forecasted and estimated values. Accurate and detailed data is especially difficult to obtain for Canada's northern territories.

TABLE 12

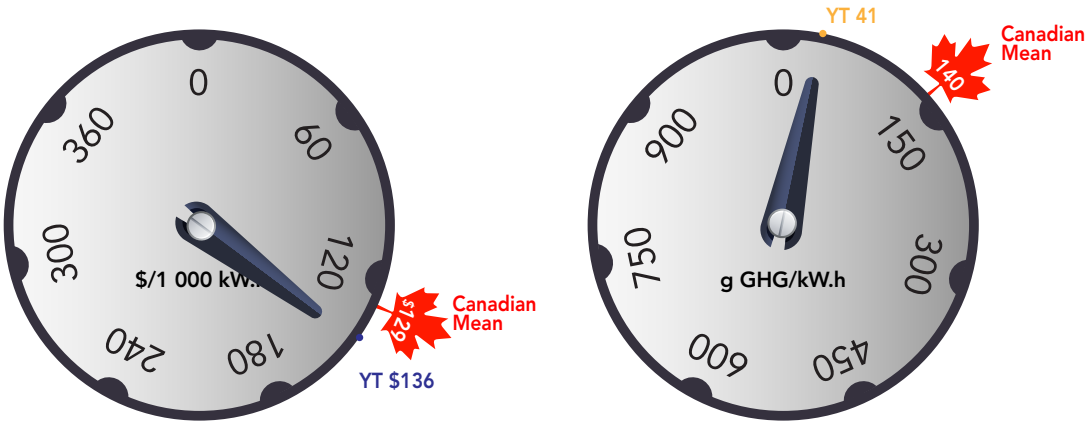
Electric Capacity and Generation in Yukon

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	33	25	25	22	21	24
	29.8%	19.8%	19.7%	6.3%	4.7%	5.3%
Natural Gas	0	4	4	0	0	3
	0.0%	3.5%	3.5%	0.0%	0.0%	0.7%
Wind	1	1	1	0.4	0.3	0.5
	0.7%	0.7%	0.7%	0.1%	0.1%	0.1%
Solar	0	<0.1	0.1	0	<0.1	<0.1
	0.0%	<0.1%	0.1%	0.0%	<0.1%	<0.1%
Hydro	78	95	95	331	422	419
	69.5%	76.0%	75.9%	93.6%	95.3%	93.8%
All renewable sources	79	95	95	331	422	420
	70.2%	76.7%	76.6%	93.7%	95.3%	94.0%
All sources	112	124	124	353	443	447

Residential Bills and Greenhouse Gas Generation Intensity

Yukon Energy has a residential electricity bill of $136 for 1 000 kW.h which is slightly higher than the Canadian mean of $129 per 1 000 kW.h. Yukon's GHG generation intensity is relatively low, emitting 41 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

FIGURE 28



Monthly residential bill for 1 000kW.h

GHG generation intensity g GHG / kW.h

Sources: Yukon Energy, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Yukon Energy has a residential electricity bill of $136 for 1 000 kW.h which is slightly higher than the Canadian mean of $129 per 1 000 kW.h. Yukon's GHG generation intensity is relatively low, emitting 41 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

Northwest Territories

NWT generated 69.8% of its electricity from hydro in 2016. Renewables comprised 73.7% of all generation, mostly from hydro, but also solar and wind.

Generation Trends

Hydroelectric generation fluctuates significantly between years in NWT, and comprised 69.8% of total generation in 2016. The Snare, Bluefish, and Taltson hydro plants supply the areas around Great Slave Lake, while more remote communities rely primarily on local diesel generators. Inuvik relies on one natural gas generator in addition to a diesel generator. The natural gas is in the form of LNG and is imported by truck. Of Inuvik's power generation in 2016, 11.7% came from LNG. Natural gas use has been falling in northern communities since 2005, partly because natural gas production in NWT has declined. Diesel generation is used to meet the demand not met by hydro, so it varies by year. Diesel accounted for 22.4% of generation in NWT in 2016.

In 2012, four wind turbines were constructed at the Diavik Diamond Mine, which produced 1.0% of total NWT electricity generation in 2016.

Capacity Changes in 2016

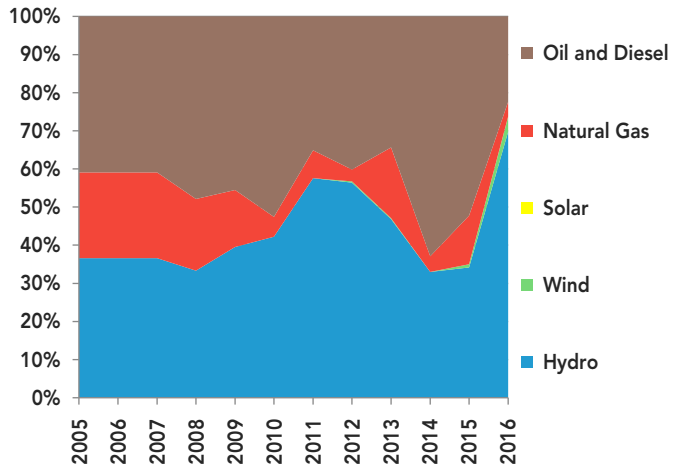
In 2016, NWT added an estimated 0.4 MW of solar capacity from multiple photovoltaic projects.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in NWT.

FIGURE 29

Electricity Generation by Source in Northwest Territories



This graph shows the composition of NWT's electricity generation between 2005 and 2016. Hydro's share fluctuated from 36.6% in 2005 to a high of 69.8% in 2016. Wind grew from zero to 3.9% from 2012 to 2016. Natural gas generally decreased from 22.5% to 3.9%, with fluctuations year to year. Oil and diesel generation averaged 43.0% from 2005 to 2016, but fell to 22.4% in 2016.

Data Challenges for Northern Territories

The data in this report was derived from Canada's Energy Future 2017. Its electricity generation and capacity numbers are based on a model that uses historical Statistics Canada data along with forecasted and estimated values. Accurate and detailed data is especially difficult to obtain for Canada's northern territories.

TABLE 13

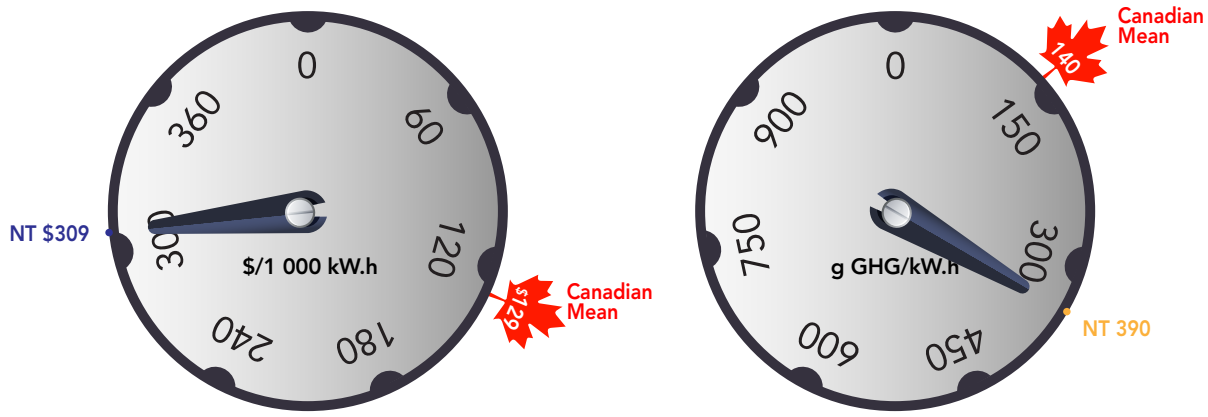
Electric Capacity and Generation in Northwest Territories

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	**114**	**94**	**94**	**280**	**348**	**82**
	55.8%	50.3%	50.3%	40.9%	52.3%	22.4%
Natural Gas	**35**	**27**	**27**	**154**	**85**	**14**
	17.1%	14.6%	14.5%	22.5%	12.8%	3.9%
Solar	**0**	**0.8**	**1. 2**	**0**	**<0.1**	**0.3**
	0.0%	0.4%	0.6%	0.0%	<0.1%	0.1%
Wind	**0**	**9**	**9**	**0**	**5**	**14**
	0.0%	4.9%	4.9%	0.0%	0.8%	3.9%
Hydro	**55**	**55**	**55**	**250**	**228**	**255**
	27.1%	29.7%	29.6%	36.6%	34.2%	69.8%
All renewable sources	**55**	**65**	**65**	**250**	**233**	**269**
	27.1%	34.6%	34.6%	36.6%	35.0%	73.7%
All sources	**204**	**187**	**187**	**684**	**666**	**366**

Residential Bills and Greenhouse Gas Generation Intensity

Northwest Territories Power Corporation has a very high residential electricity bill of $309 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. NWT's GHG generation intensity is also higher than most of Canada, emitting 390 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

FIGURE 30



Sources: Arctic Energy Alliance, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Northwest Territories Power Corporation has a very high residential electricity bill of $309 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. NWT's GHG generation intensity is also higher than most of Canada, emitting 390 grams of GHGs per kW.h compared to the mean of 140 g GHG/kW.h.

Nunavut

Nunavut relies on diesel and other oil products for electricity generation. Its remoteness and small population make the adoption of other technologies challenging. However it is piloting wind and solar projects.

Generation Trends

Nunavut faces many challenges supplying its communities with electricity. Due to its cold climate and sparse population, each community relies on local diesel generators for electricity. Diesel fuel for these generators is imported from outside the territory during summer and then stored for use throughout the year.

Qulliq Energy Corporation (QEC), Nunavut's energy utility, is seeking ways to increase renewable generation in the territory; however, these initiatives are currently in the developmental stages.

Capacity Changes in 2016

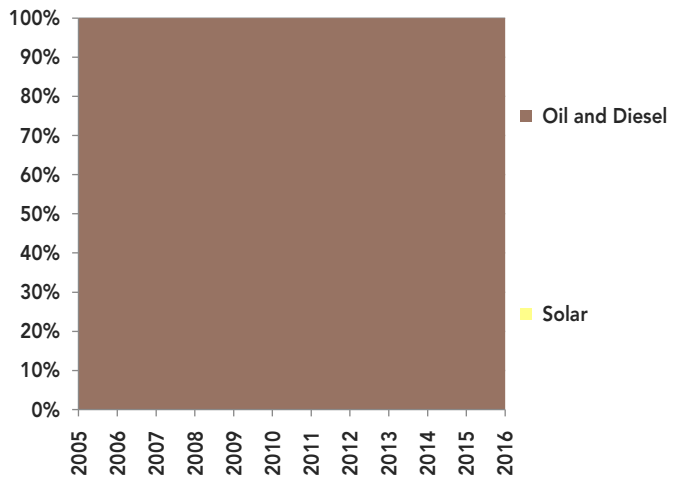
In 2016, QEC installed 11 solar panels at one of its power plants in Iqaluit as a pilot project to research the viability of larger solar applications. A QEC study assessed the viability of wind power across Nunavut and shortlisted five communities with potential for future wind power sites.

More Information

Canada's Renewable Power Landscape 2016 – Energy Market Analysis provides additional information on renewable power in Nunavut.

FIGURE 31

Electricity Generation by Source in Nunavut



This graph shows the composition of Nunavut's electricity generation between 2005 and 2016. Oil and diesel accounted for almost all of generation since 2005. Nunavut's solar generation is estimated to be less than 0.1 GW.h per year. It is too small to be visible on the graph.

Data Challenges for Northern Territories

The data in this report was derived from Canada's Energy Future 2017. Its electricity generation and capacity numbers are based on a model that uses historical Statistics Canada data along with forecasted and estimated values. Accurate and detailed data is especially difficult to obtain for Canada's northern territories.

TABLE 14

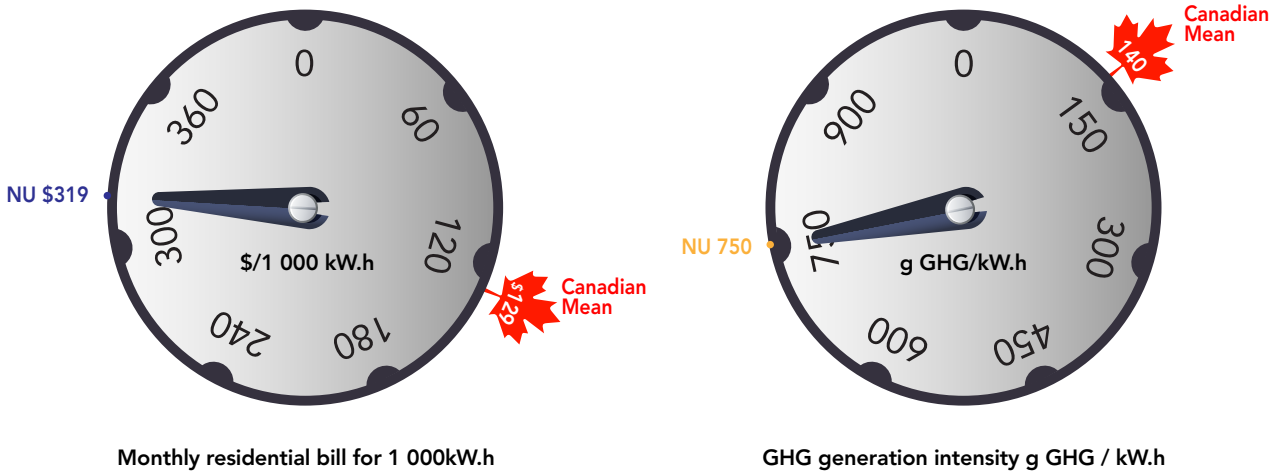
Electric Capacity and Generation in Nunavut

	Capacity in MW and %			Generation in GW.h and %		
	2005	2015	2016	2005	2015	2016
Oil and Diesel	**54**	**54**	**54**	**142**	**156**	**173**
	100.0%	99.9%	99.8%	100.0%	100.0%	100.0%
Solar	**0**	**<0.1**	**0.1**	**0**	**<0.1**	**<0.1**
	0.0%	0.1%	0.2%	0.0%	<0.1%	<0.1%
All renewable sources	**0**	**<0.1**	**0.1**	**0**	**<0.1**	**<0.1**
	0.0%	0.1%	0.2%	0.0%	<0.1%	<0.1%
All sources	**54**	**54**	**54**	**142**	**156**	**173**

Residential Bills and Greenhouse Gas Generation Intensity

Qulliq Energy Corporation in Nunavut has the highest residential electricity bill in Canada, at $319 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h. Nunavut's GHG generation intensity is also much higher than most of Canada, second only to Alberta, emitting 750 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.

FIGURE 32



Monthly residential bill for 1 000kW.h

GHG generation intensity g GHG / kW.h

Sources: Quilliq Energy Corporation, National Inventory Report

Description: Two dials indicate the monthly residential electricity bill for 1 000 kW.h and the GHG generation intensity in grams of GHG per kW.h. Qulliq Energy Corporation in Nunavut has the highest residential electricity bill in Canada, at $319 for 1 000 kW.h compared to the Canadian mean of $129 per 1 000 kW.h Nunavut's GHG generation intensity is also much higher than most of Canada, second only to Alberta, emitting 750 grams of GHGs per kW.h compared to the Canadian mean of 140 g GHG/kW.h.