



CANADA'S ENERGY STORY



ENERGYIQ



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INTRODUCTION

As the world's population and standards of living continue to grow, the global energy demand also continues to rise. For Canada, meeting that energy demand responsibly means making use of all the available options in our energy tool kit and developing our energy systems to be more efficient and flexible. Our country has a wealth of natural resources and is an innovator in the energy sector. From the hydroelectricity produced in provinces such as Ontario, British Columbia and Quebec, to the extraction of crude oil and natural gas in western Canada, our country has a diverse range of energy sources to draw on.

This factbook offers a snapshot of Canada's energy sector. It covers topics such as where natural resources are found for energy production, how energy is transported to where it needs to go, the emerging field of renewable energy, and much more. Broken down by province and territory, this factbook takes you on an energy tour across the country.

The Canada Energy Story was produced by Energy IQ, an educational program created and delivered by Canadian Geographic Education. Energy IQ focuses on the demand, production, and transmission of various energy sources in Canada today, with the goal of helping to improve energy literacy across the country among Canadian students and educators.



For more information and resources, visit energyiq.canadiangeographic.ca

ENERGY TERMS

BIOMASS ENERGY – organic materials such as wood, waste, or pulp are used to produce energy (often to generate electricity); measured in megawatts (MW)

COAL – a mineral rich in carbon that can be burned to generate electricity (there are two types: metallurgical coal is used for making steel, thermal coal is used for energy); measured in tonnes (megatonne: 1,000,000 tonnes)

CRUDE OIL – a naturally occurring mixture of hydrocarbons and organic materials that can be refined into petroleum products such as gasoline, jet fuel and petrochemicals; usually measured in thousand barrels per day (Mb/d)

ELECTRICITY – the flow of an electric charge produced from energy sources such as natural gas, wind, hydropower, nuclear and solar, that powers things like lights, appliances, and electronic devices; measured in watts

ENERGY – the capacity to do work (i.e., natural and physical resources are used to produce energy); measured in joules (J) or petajoules (PJ) for large amounts

FOSSIL FUELS – naturally occurring organic fuel (crude oil, natural gas, and coal) that is produced from plant and animal matter that was transformed through heat and pressure over a long period of time

GDP – the gross domestic product is a measure of economic activity (i.e., goods and services) within a country over a certain time period; expressed as the worth of the output of the country in their local currency

GEOTHERMAL ENERGY – underground reservoirs of steam and hot water that can be trapped to generate electricity or to heat and cool buildings directly; measured in megawatts (MW)

HYDROCARBON – an organic chemical compound that is made up of hydrogen and carbon atoms

HYDROELECTRICITY – electricity produced from kinetic energy captured from moving water (i.e., hydropower); measured in megawatts (MW)

LIQUEFIED NATURAL GAS (LNG) – when natural gas is cooled to -162 C it becomes a liquid that can be easily transported

ENERGY TERMS

NATURAL GAS – a naturally occurring hydrocarbon that is processed and used for heating, cooling, cooking, and electricity generation; measured in cubic feet per day (i.e., MMcf/d is a million cubic feet per day, Bcf/d is a billion cubic feet per day)

NGLs – natural gas liquids are a hydrocarbon in the same family as crude oil and natural gas (e.g., ethane, propane, butane, isobutane, and pentane) produced alongside natural gas or as by-products and are also used as input for petrochemical plants; usually measured in thousand barrels per day (MB/d)

NON-RENEWABLE ENERGY – energy sources that occur naturally and can't be replaced once they run out

NUCLEAR ENERGY – uranium, a radioactive metal, is used as a fuel in a nuclear power plant to generate electricity; measured in megawatts (MW)

REFINED PETROLEUM PRODUCTS (RPPs) – products (e.g., gasoline, diesel, jet fuel) produced from refined crude oil and chemical feedstocks, which are used in manufacturing chemicals, synthetic rubber and a variety of plastics

RENEWABLE ENERGY – energy sources that occur naturally and that can be replenished continually

SOLAR ENERGY – energy derived from the sun's rays that are captured by photovoltaic panels and converted into electricity; measured in megawatts (MW)

TIDAL ENERGY – kinetic energy harnessed from the movement of ocean tides and captured by turbines and converted into electricity; measured in megawatts (MW)

WATT – a unit of power (i.e., how much energy is used over time); 1,000,000 watts in a megawatt (MW); a terawatt hour (TWh: one trillion watts per hour) measures the amount of power produced/consumed

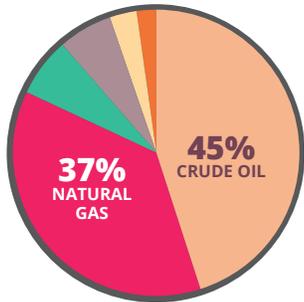
WIND ENERGY – the kinetic energy captured from wind by turbines and converted into electricity; measured in megawatts (MW)

OVERVIEW OF CANADA



ENERGY PRODUCED
21,385 PJ

PRIMARY ENERGY PRODUCTION BY ENERGY SOURCE



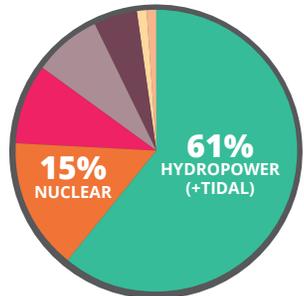
- 7% HYDRO-ELECTRICITY
- 3% RENEWABLES*
- 6% COAL
- 2% NUCLEAR

* Wind, Solar, Biomass and Tidal



ELECTRICITY GENERATED
647.7 Twh

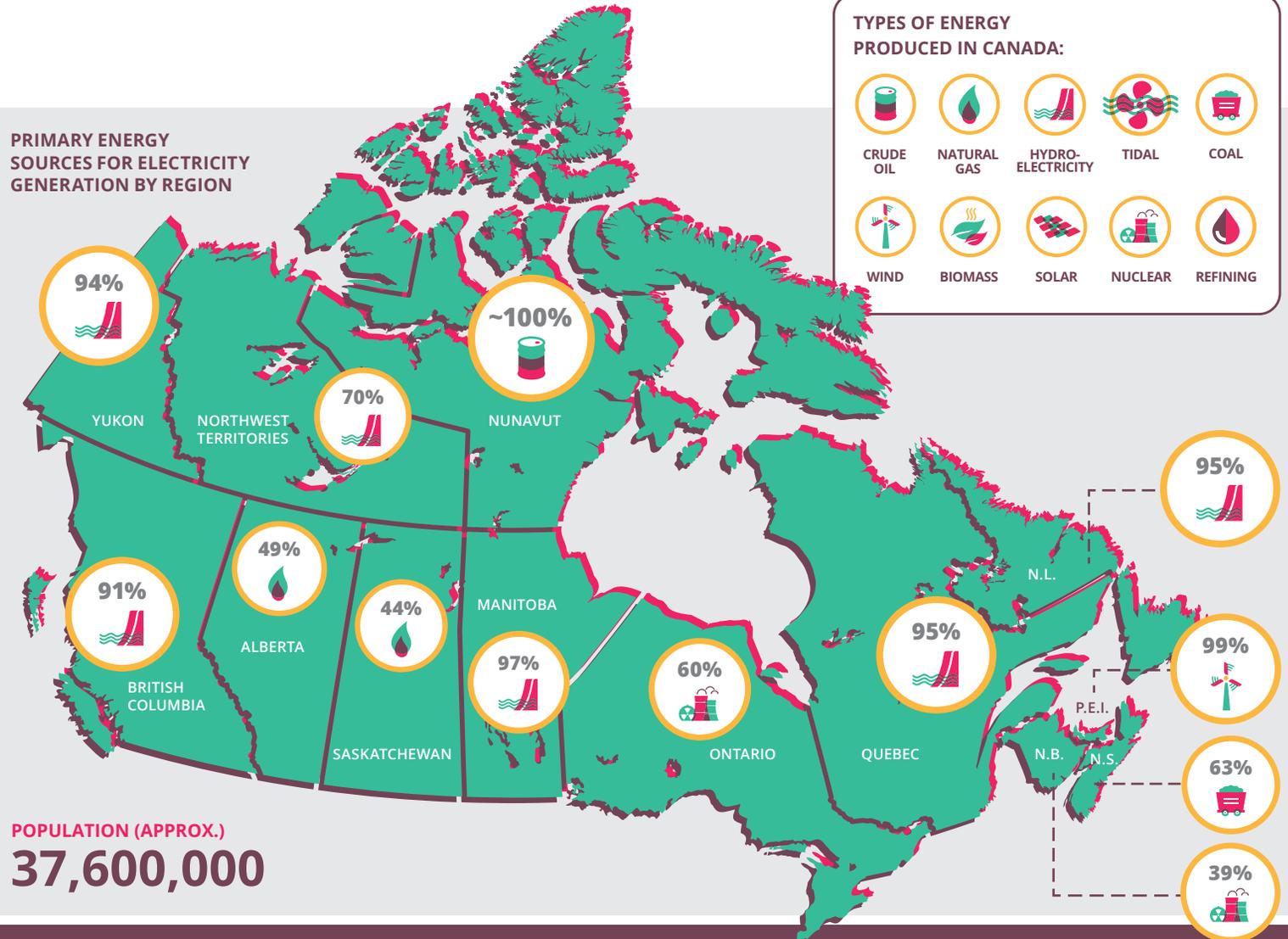
ELECTRICITY GENERATION BY ENERGY SOURCE



- 9% NATURAL GAS
- 1% BIOMASS
- 8% COAL
- 1% RPPs* & SOLAR
- 5% WIND

* Refined petroleum products

PRIMARY ENERGY SOURCES FOR ELECTRICITY GENERATION BY REGION



POPULATION (APPROX.)
37,600,000



ENERGY SECTOR CONTRIBUTION TO NOMINAL GDP

\$230 BILLION
~11% OF TOTAL



EMPLOYMENT IN THE ENERGY SECTOR

TOTAL 4.4% of Canada's total employment

~819,500



DIRECTLY EMPLOYED

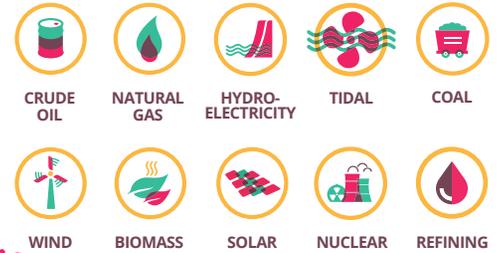
269,000



INDIRECTLY EMPLOYED

550,500

TYPES OF ENERGY PRODUCED IN CANADA:



OVERVIEW OF THE YUKON

ENERGY PRODUCED:



POPULATION (APPROX.)

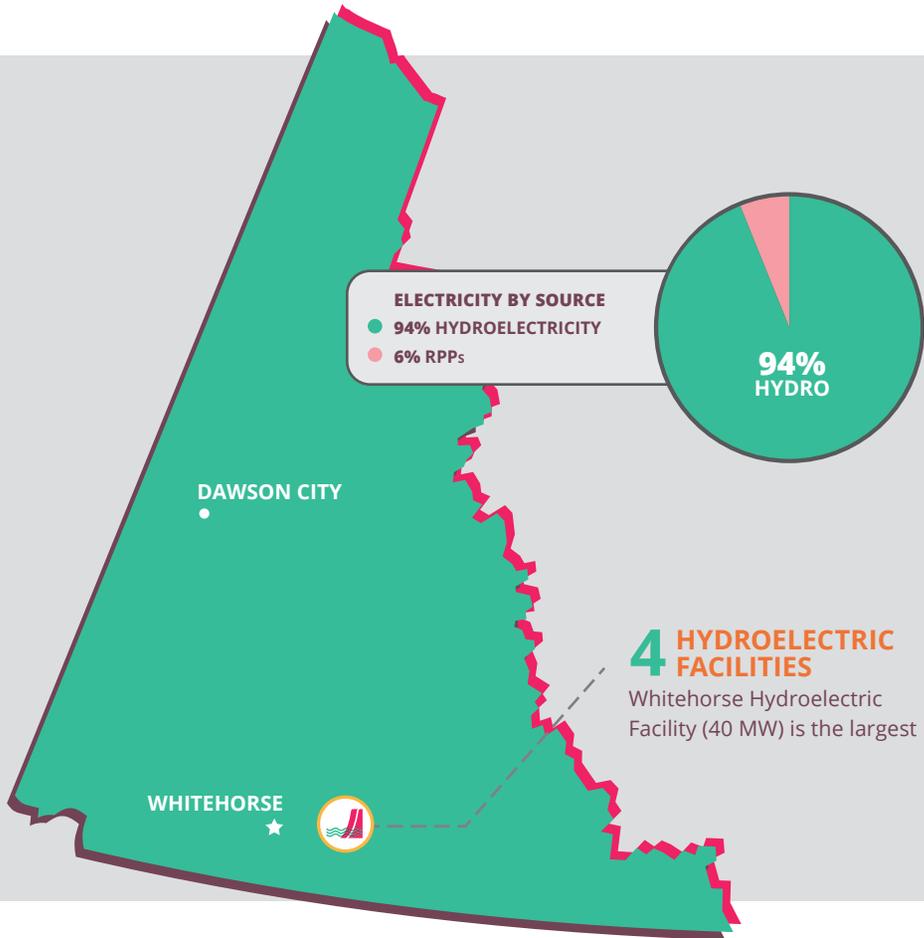
40,900



ELECTRICITY GENERATED

0.5 TWh

~0.1% of Canada's total



YUKON'S ENERGY

- Four hydroelectric facilities.

ENERGY TRANSPORTATION

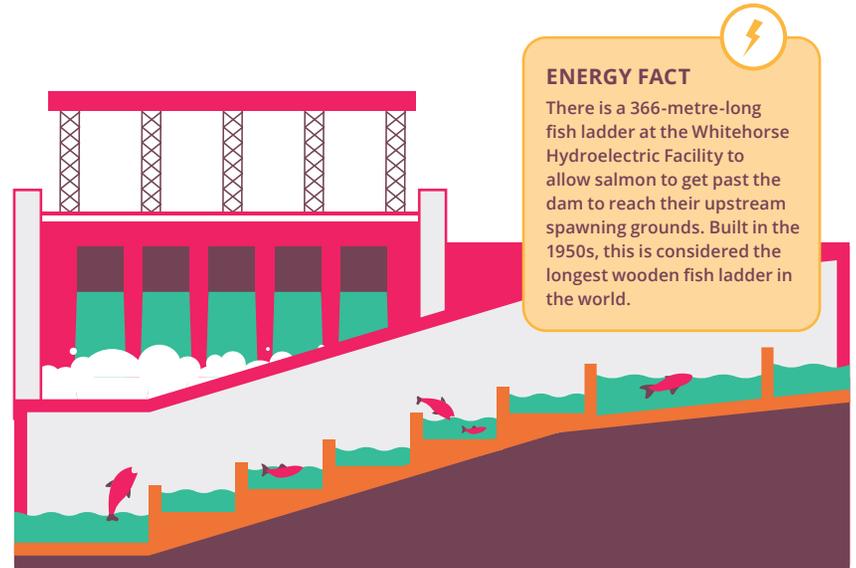
- Petroleum products (e.g., diesel), brought in from British Columbia and Alberta by truck, are used to generate electricity in remote communities.
- Whitehorse also receives some LNG from Tilbury Island, B.C., by truck for electricity generation.

MORE THAN 900 KILOMETRES OF TRANSMISSION POWER LINES

That's like driving from Calgary, Alta., to Vancouver, B.C.

RESERVES AND POTENTIAL

- 8 trillion cubic feet of technically recoverable natural gas.
- Eight areas in Yukon are identified as having a potential of up to 900 million barrels of crude oil.
- There is potential for geothermal energy to be developed near urban areas.
- Coal resources exist in the Yukon but are not being developed.
- The Beaufort Sea on Yukon's northern coast, has oil and natural gas resources estimated to be:
 - 67 trillion cubic feet of natural gas
 - 7 billion barrels of crude oil



OVERVIEW OF THE NORTHWEST TERRITORIES

ENERGY PRODUCED:

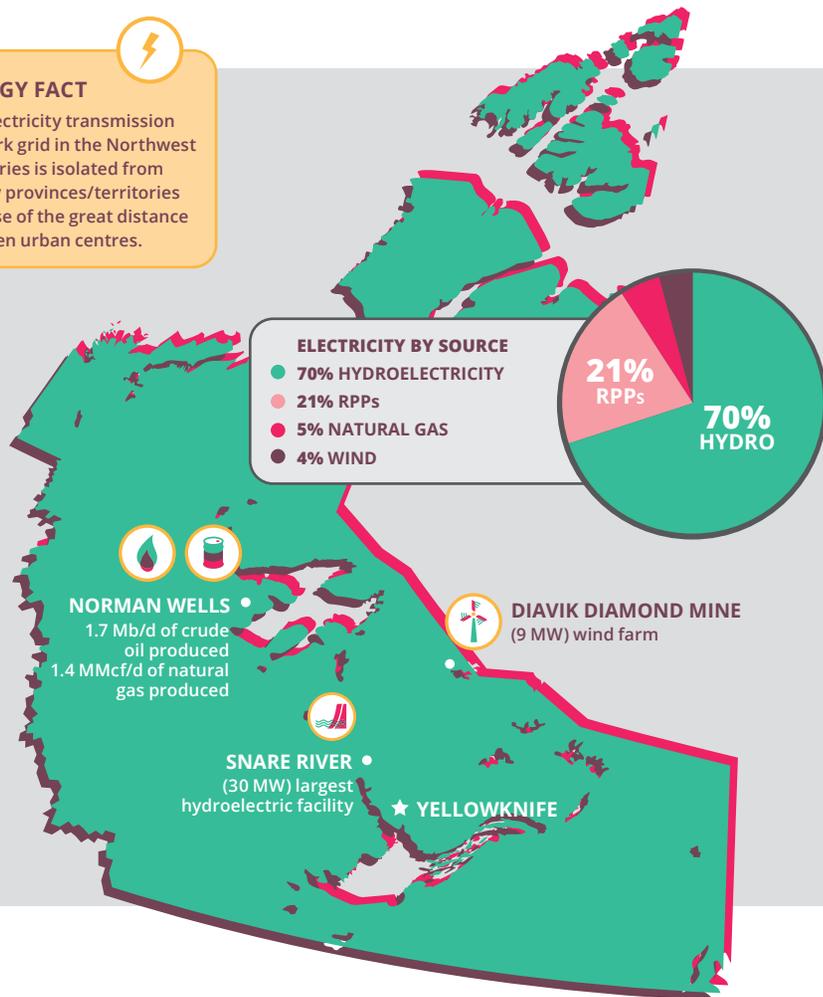


POPULATION (APPROX.)
44,800

ELECTRICITY GENERATED
0.4 TWh
~0.1% of Canada's total

ENERGY FACT

The electricity transmission network grid in the Northwest Territories is isolated from nearby provinces/territories because of the great distance between urban centres.

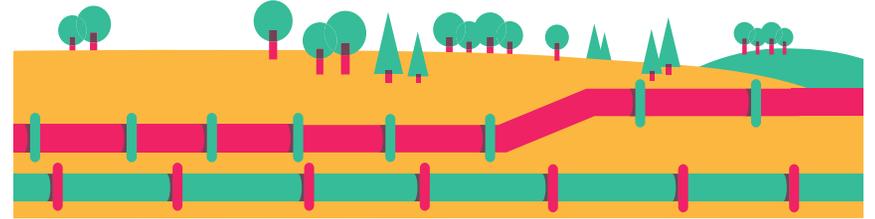


NORTHWEST TERRITORIES' ENERGY

- 1.7 Mb/d of crude oil produced at Norman Wells.
- 1.4 MMcf/d of natural gas produced at Norman Wells (and a small amount at Ikhil).
- Three hydroelectric facilities, with the Snare River system being made up of four power plants.
- One wind farm.

MORE THAN 950 KILOMETRES OF PIPELINE

Crude oil is moved from the Northwest Territories to Alberta via pipeline.



TRUCK AND SHIPPING

- Petroleum products (e.g., diesel), brought in from British Columbia and Alberta by truck and barge, are used to generate electricity in remote communities.
- Inuvik receives LNG from Tilbury Island, B.C., by truck for electricity generation.

RAILWAY

- While crude oil is not transported by rail to the Northwest Territories, there is a rail terminal at Hay River that receives gasoline and diesel from Alberta.

MORE THAN 700 KILOMETRES OF TRANSMISSION POWER LINES

That's like driving from Calgary to Fort McMurray, Alta.

RESERVES AND POTENTIAL

- 16.4 trillion cubic feet of recoverable natural gas reserves.
- 1.2 billion barrels of recoverable crude oil reserves.
- There are offshore oil and natural gas resources in the Northwest Territories that have not been developed.

OVERVIEW OF NUNAVUT

ENERGY PRODUCED:



POPULATION (APPROX.)
38,800

ELECTRICITY GENERATED
0.2 TWh
~0.05% of Canada's total

ENERGY FACT

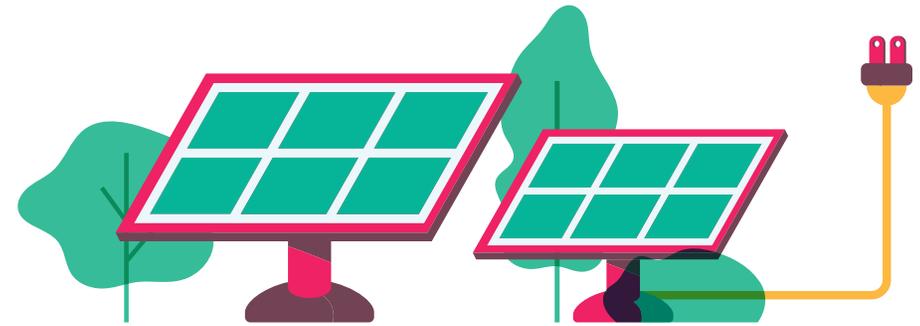
Nunavut doesn't have a shared transmission grid. Each community relies on its own power plant and electricity grid.

ELECTRICITY BY SOURCE

100%
RPPs

BAKER LAKE

IQALUIT



NUNAVUT'S ENERGY

- Solar panels were installed at the Arctic Winter Games Arena and Arctic College in Iqaluit.
- Each community has its own diesel-fired power plant, there are 25 in total. All electricity is generated from diesel. Nunavut is looking to move away from diesel-powered electricity generation and towards LNG or biomass.

TRUCK AND SHIPPING

- Petroleum products are shipped in or transported by truck once a year during the summer, when waterways are clear of sea ice and roads are more accessible.

MORE THAN 350 KILOMETRES OF TRANSMISSION POWER LINES

That's less than the distance from Toronto to Ottawa, Ont.

RESERVES AND POTENTIAL

- 181.43 trillion cubic feet of recoverable natural gas reserves.
- 18.3 billion barrels of recoverable crude oil reserves.
- There is some potential to harness solar energy in southern Nunavut along the Hudson Bay coast, which receives the most sun in the territory.
- Five communities (one of which is Iqaluit) have been identified as having cost-effective wind energy potential.

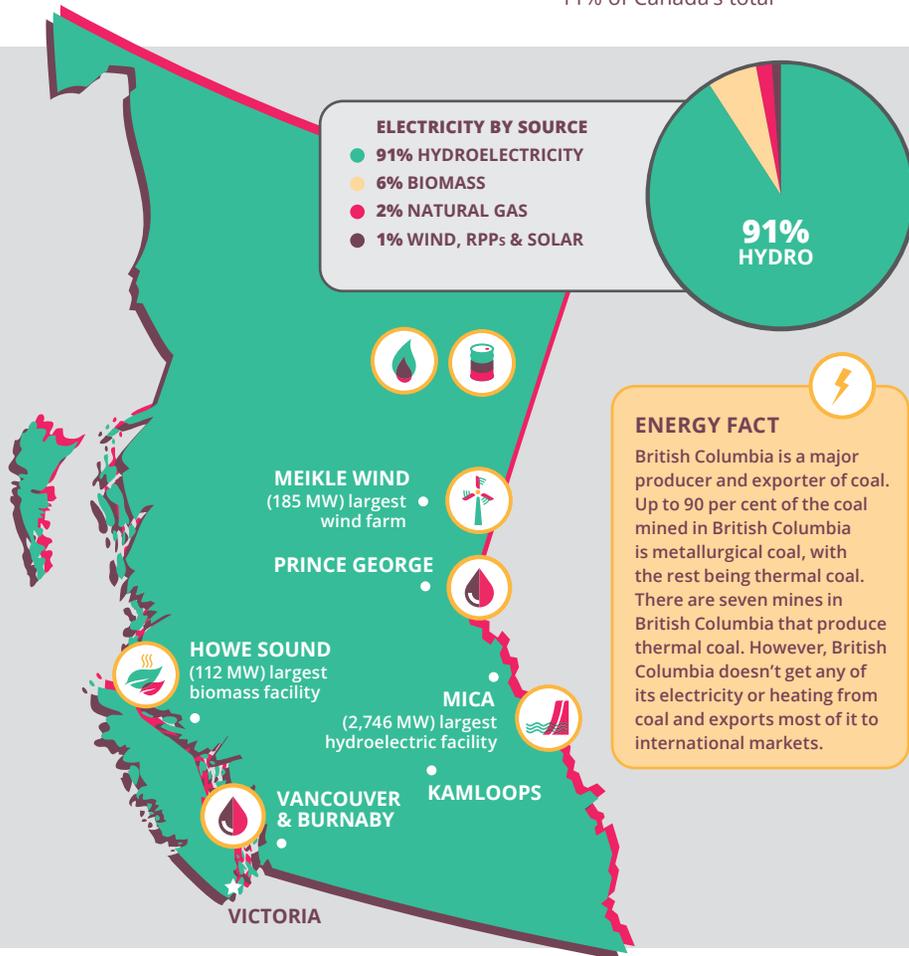
OVERVIEW OF BRITISH COLUMBIA

ENERGY PRODUCED:



POPULATION (APPROX.)
5,071,300

ELECTRICITY GENERATED
74.2 TWh
~11% of Canada's total



Second-largest natural gas producer

Second-largest producer of hydroelectricity

BRITISH COLUMBIA'S ENERGY

- More than 30 hydroelectric facilities.
- 5.1 Bcf/d of natural gas produced in northeastern British Columbia. *That's like 80,000 hot air balloons every day!*
- British Columbia also produces 50 Mb/d of NGLs.
- More than 20 biomass facilities.
- 101.2 Mb/d of light crude oil produced in northeastern British Columbia.
- Nine wind farms – more than 290 wind turbines.

PETROLEUM REFINING

Two refineries, in Burnaby and in Prince George, refine crude oil from western Canada and distribute RPPs throughout British Columbia.

MORE THAN 44,000 KM OF PIPELINE

- Crude oil is transported from Alberta to Kamloops and Burnaby, B.C., via pipeline.
- Natural gas produced in B.C. is transported to other parts of Canada via pipeline. Several B.C. natural gas pipelines connect to U.S. pipelines to export to the United States.
- British Columbia's RPPs are distributed throughout the province via pipeline.

TRUCK

- The Tilbury Island facility, near Vancouver, exports LNG to Yukon and the Northwest Territories by truck.

MORE THAN 18,000 KILOMETRES OF TRANSMISSION POWER LINES

That's two times the length of our border with the United States!

Electricity is exported mainly to the United States, but a small portion also goes to Alberta.



RESERVES AND POTENTIAL

- 349 trillion cubic feet of marketable natural gas reserves.
- 29 million barrels of recoverable crude oil reserves.

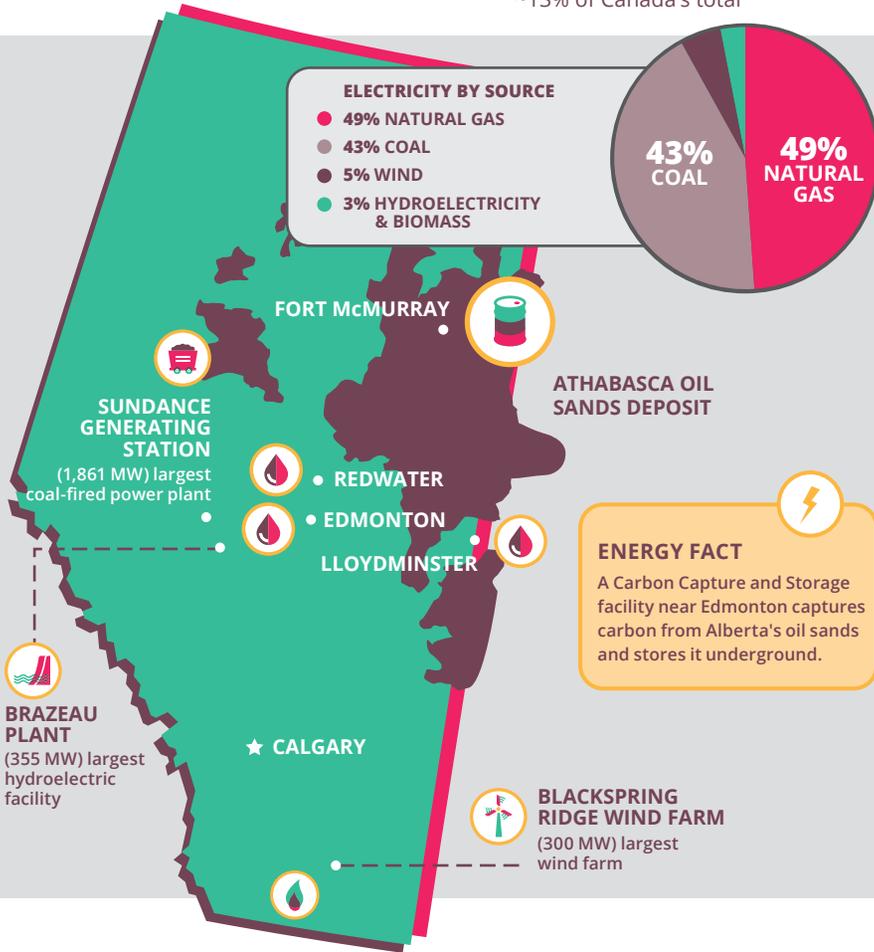
OVERVIEW OF ALBERTA

ENERGY PRODUCED:



POPULATION (APPROX.)
4,371,300

ELECTRICITY GENERATED
81 TWh
~13% of Canada's total



Largest crude oil producer

Largest natural gas producer

Largest for coal-fired generating capacity

ALBERTA'S ENERGY

- 3,910 Mb/d of crude oil produced, mainly in the oil sands region in northern Alberta.
That's enough to fill 245 Olympic-sized swimming pools every day!
- 10.5 Bcf/d of natural gas produced in southeastern plains and southwestern foothills.
Imagine 100,000 hot air balloons filling the sky every day – that's a lot!
- Alberta also produces 515 Mb/d of NGLs.
- Eight coal mines producing 25 megatonnes of coal per year (mainly thermal).
- 18 coal-fired power plants.
- 38 wind farms – more than 950 wind turbines.
- 17 hydroelectric facilities.
- More than 10 biomass facilities primarily supporting the forestry industry.

PETROLEUM REFINING

There are five refineries in Alberta: three in Edmonton, one in Redwater, and one in Lloydminster.

MORE THAN 422,000 KM OF PIPELINE

- Most of the province's crude oil is exported to United States by pipeline.
- Alberta supplies British Columbia, Saskatchewan and Manitoba with RPPs mainly by pipeline.
- Pipelines transport natural gas throughout Alberta, to eastern Canada, and export it to United States (via connections in British Columbia and Saskatchewan).

TRUCK AND RAILWAY

- Alberta has 16 crude oil rail loading facilities.
- The majority of NGLs are transported via rail.
- Within Alberta, RPPs are transported by truck and rail.
- There are two small-scale LNG facilities in Alberta, which mainly supply the transportation sector as well as providing fuel for power generation in Whitehorse, Yukon, and Inuvik, N.W.T. via truck.

MORE THAN **241,000** KILOMETRES OF TRANSMISSION AND DISTRIBUTION POWER LINES
Enough to circle the Earth six times!

RESERVES AND POTENTIAL

- 165.4 billion barrels of proven crude oil reserves in the oil sands.
- 32.4 trillion cubic feet of natural gas reserves.
- Alberta has some of the highest solar energy potential in Canada.

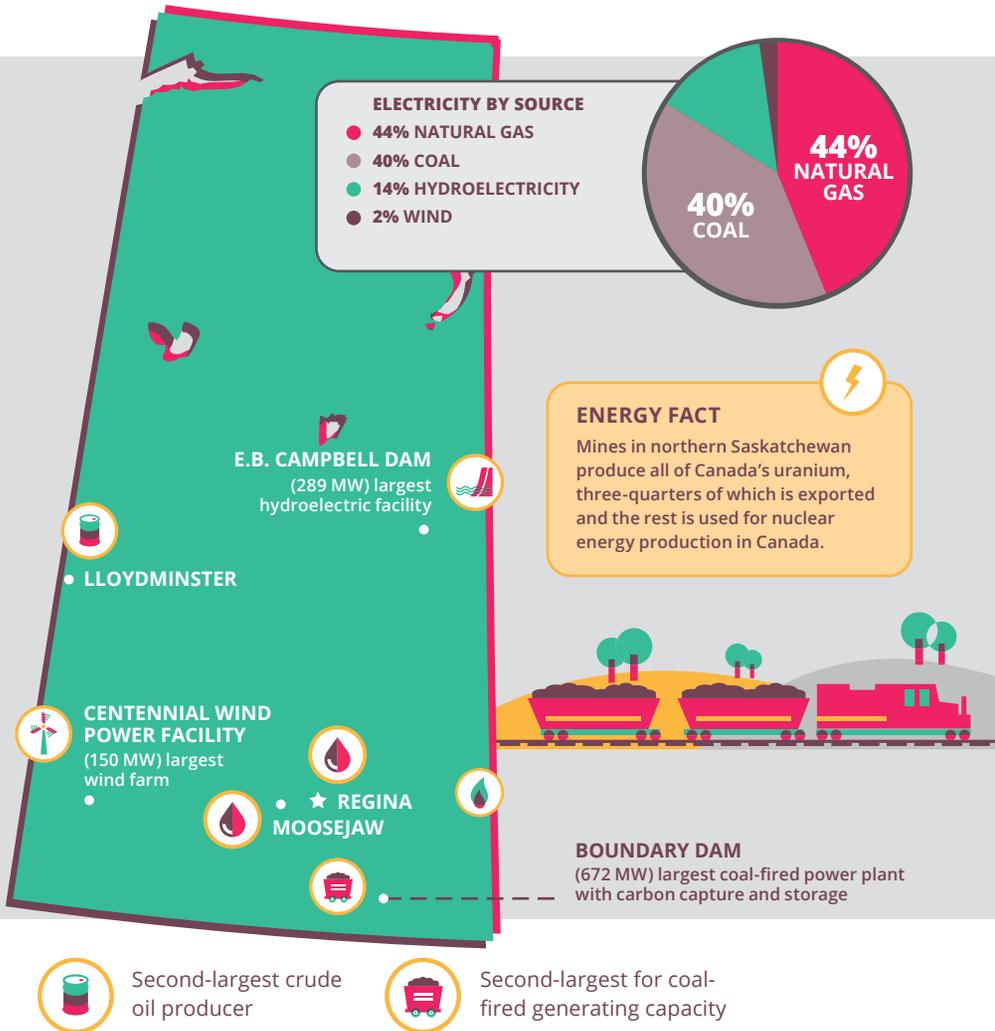
OVERVIEW OF SASKATCHEWAN

ENERGY PRODUCED:



POPULATION (APPROX.)
1,174,500

ELECTRICITY GENERATED
24.3 TWh
~4% of Canada's total



SASKATCHEWAN'S ENERGY

- 489 Mb/d of crude oil produced mainly in western Saskatchewan, near Lloydminster.
That's enough to fill about 31 Olympic-sized swimming pools every day!
- 396 MMcf/d of natural gas produced mainly in southeastern Saskatchewan.
That's more than 6,000 hot air balloons every day!
- Saskatchewan also produces 8.6 Mb/d of NGLs.
- Eight hydroelectric facilities.
- Three coal-fired power plants with associated strip mines - 9.3 megatonnes of coal produced per year (mainly thermal).
- Eight wind farms - more than 150 wind turbines.

PETROLEUM REFINING

The province has two refineries, in Regina and in Moose Jaw, which rely on crude oil from western Canada. They supply Alberta and Manitoba with RPPs and export a small amount to the United States.

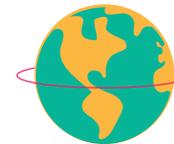
MORE THAN 102,000 KM OF PIPELINE

- Pipelines move crude oil to terminals in the province, to Saskatchewan's two refineries and on to central Canada and the United States.
- Natural gas is transported via pipelines from Saskatchewan and on to central Canada and the United States.

RAILWAY

- Saskatchewan has 13 crude oil rail loading facilities that transport oil to other parts of Canada.

MORE THAN 157,000 KM OF TRANSMISSION AND DISTRIBUTION POWER LINES



THAT'S ENOUGH TO CIRCLE THE EARTH NEARLY FOUR TIMES!

Electricity is exported mainly to the United States, but a small portion also goes to Alberta.

RESERVES AND POTENTIAL

- 725 millions barrels of crude oil reserves.
- 1.3 trillion cubic feet of marketable natural gas reserves.
- Saskatchewan has the highest solar and wind energy potential in Canada.

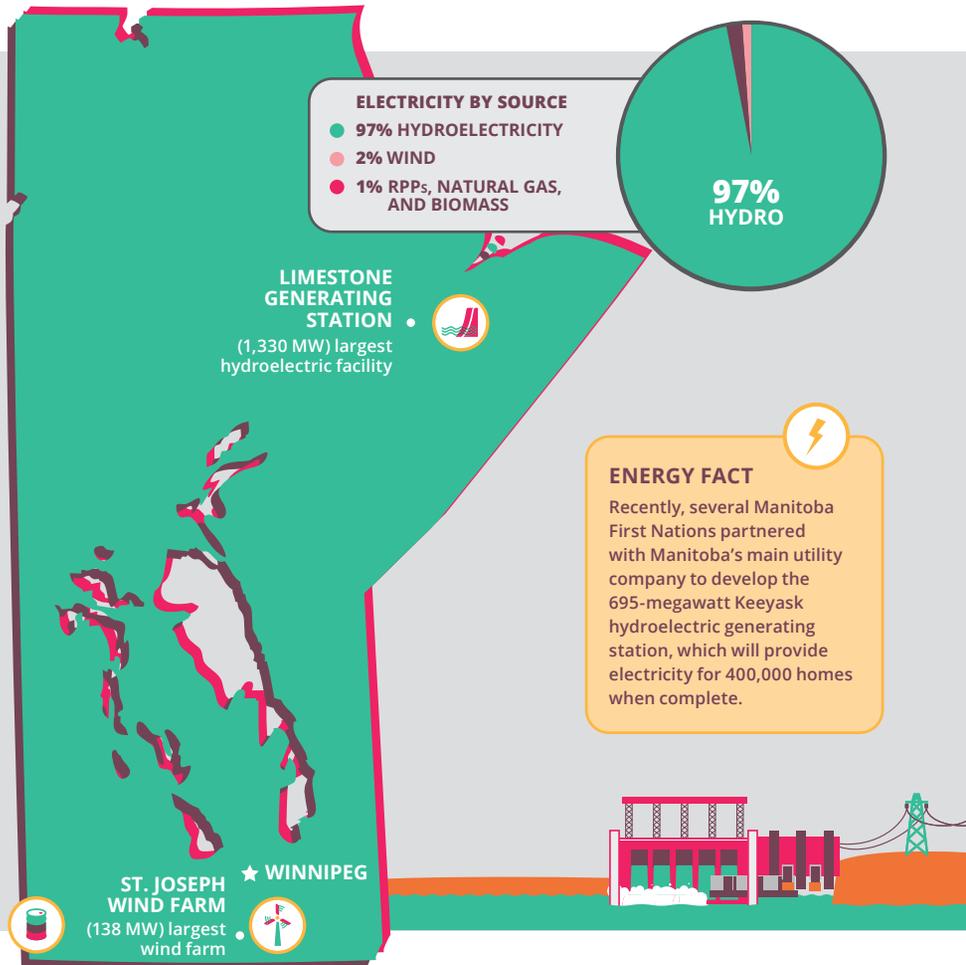
OVERVIEW OF MANITOBA

ENERGY PRODUCED:



POPULATION (APPROX.)
1,369,500

ELECTRICITY GENERATED
36.9 TWh
~6% of Canada's total



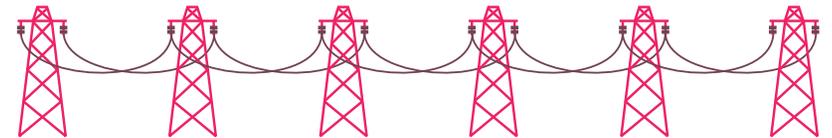
MANITOBA'S ENERGY

- 15 hydroelectric facilities.
- 40 Mb/d of light crude oil produced in the southwestern region of the province.
- Four wind farms – more than 130 wind turbines.

MORE THAN 560 KILOMETRES OF PIPELINE

- Crude oil is transported from western Canada to Manitoba, to central and eastern Canada, and for export to the United States mainly via pipelines.
- RPPs are transported to Manitoba by pipeline from Alberta.
- Natural gas is transported from western Canada to Manitoba, on to eastern Canada, and for export to the United States via pipelines.

MORE THAN **13,800** KILOMETRES OF TRANSMISSION POWER LINES



75,500 KILOMETRES OF DISTRIBUTION LINES

Combined, that's more than twice the circumference of the Earth!

Manitoba exports electricity to the United States, as well as to Ontario and Saskatchewan.

RAILWAY

- Manitoba receives RPPs from Saskatchewan by rail.

RESERVES AND POTENTIAL

- 59 million barrels of potential oil reserves.
- Manitoba has some of the highest solar energy potential in Canada.

OVERVIEW OF ONTARIO

ENERGY PRODUCED:



POPULATION (APPROX.)
14,566,500

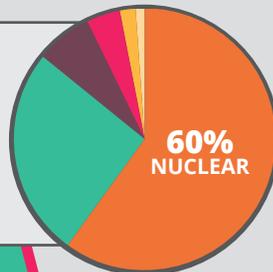
ELECTRICITY GENERATED
151.1 TWh
~23% of Canada's total

ENERGY FACT

Canada's first commercial crude oil was produced in Ontario in 1858 in the communities of Oil Springs and Petrolia in southwestern Ontario, which are still active today.

ELECTRICITY BY SOURCE

- 60% NUCLEAR
- 26% HYDROELECTRICITY
- 7% WIND
- 4% NATURAL GAS
- 2% SOLAR
- 1% BIOMASS AND RPPs



BRUCE POWER
(6,600 MW) largest nuclear power plant

SOL LUCE KINGSTON & GRAND RENEWABLE ENERGY PARK
(100 MW each) largest solar farms

SIR ADAM BECK 2
(1,499 MW) largest hydroelectric facility

SOUTH KENT & K2
(270 MW each) largest wind farms



Largest wind energy producer

Main nuclear energy producer in Canada

Main solar energy producer in Canada (98%)

ONTARIO'S ENERGY

- Three nuclear stations.
- 66 hydroelectric facilities.
- 94 wind farms – more than 2,600 wind turbines.
- 8.4 MMcf/d of natural gas produced in southwestern Ontario.
That's more than 125 hot air balloons every day!
- 0.5 Mb/d of light crude oil produced in southwestern Ontario.
That's could fill 630 bathtubs every day!
- More than a dozen large-scale solar farms in southern Ontario.

PETROLEUM REFINING

Ontario has four refineries, three in Sarnia and one in Nanticoke. They process both western Canadian crude oil and imported oil to produce RPPs for Ontario.

MORE THAN 114,000 KM OF PIPELINE

That's more than two-and-half times the circumference of the Earth!

- Most of the crude oil comes to Ontario's refineries via pipeline.
- RPPs are also transported via pipeline from Quebec to Ontario to meet demand.
- Ontario receives natural gas from western Canada and the United States via pipeline and stores it underground, for regional distribution.

MORE THAN 29,000 KILOMETRES OF TRANSMISSION POWER LINES

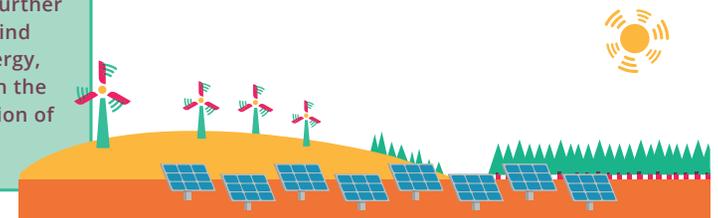
That's more than three times the length of our border with the United States!

- A significant amount of Ontario's electricity is exported to the United States.

RESERVES AND POTENTIAL

- 281 billion cubic feet of potential natural gas reserves.
- 39.7 million barrels of potential crude oil reserves.

Ontario has the potential to further develop its wind and solar energy, particularly in the southern region of the province.



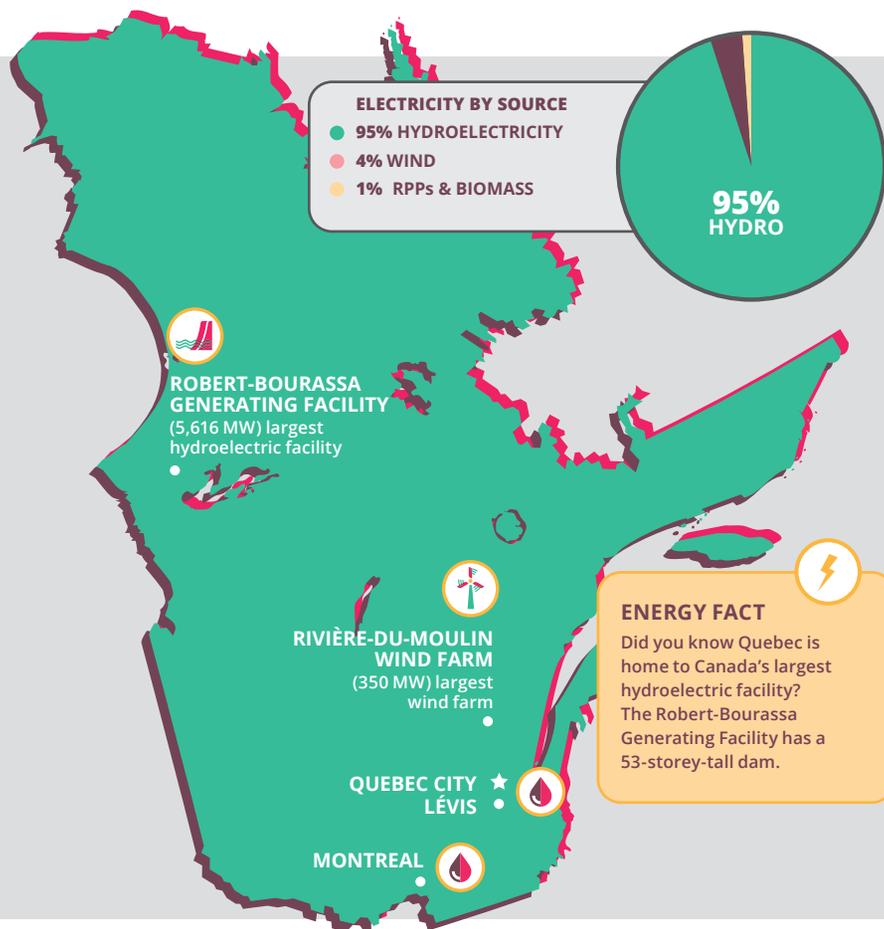
OVERVIEW OF QUEBEC

ENERGY PRODUCED:



POPULATION (APPROX.)
8,485,000

ELECTRICITY GENERATED
213.7 TWh
~1/3 of Canada's total



Largest producer of hydroelectricity

Second-largest wind energy producer

QUEBEC'S ENERGY

- More than 60 hydroelectric facilities.
- 47 wind farms – more than 1,990 wind turbines.

PETROLEUM REFINING

There are two large refineries, in Montreal and Lévis, which mainly receive crude oil from Ontario, western Canada, and the United States. The two refineries in Quebec have a combined refining capacity of 372 thousand barrels per day (Mb/d)

MORE THAN 12,500 KILOMETRES OF PIPELINE

That's more than 15 times the length of the Quebec border with the United States!

- Crude oil is transported by rail and pipeline to Quebec's refineries and then RPPs are distributed throughout Quebec and to Ontario by pipelines, as well as exported to the United States.
- Natural gas is transported via pipeline from western Canada, through Ontario, to Quebec, as well as imported from the United States.

MORE THAN 34,000 KILOMETRES OF TRANSMISSION POWER LINES AND 116,000 KILOMETRES OF DISTRIBUTION LINES

Combined, that's more than three times the circumference of the Earth!

- Electricity is imported from Newfoundland and Labrador. Quebec also exports a significant amount of electricity to the United States, as well as to Ontario and New Brunswick.

SHIPPING



Tankers navigate the Great Lakes St. Lawrence Seaway system to deliver crude oil to Quebec's refineries from the United States and other countries.

RESERVES AND POTENTIAL

- 7 trillion cubic feet of recoverable natural gas reserves.
- Quebec has the potential to grow its wind energy production in regions such as the Gaspésie-Îles-de-la-Madeleine, Moyenne and Basse-Côte-Nord, Bas-Saint-Laurent, and Nord-du-Québec.

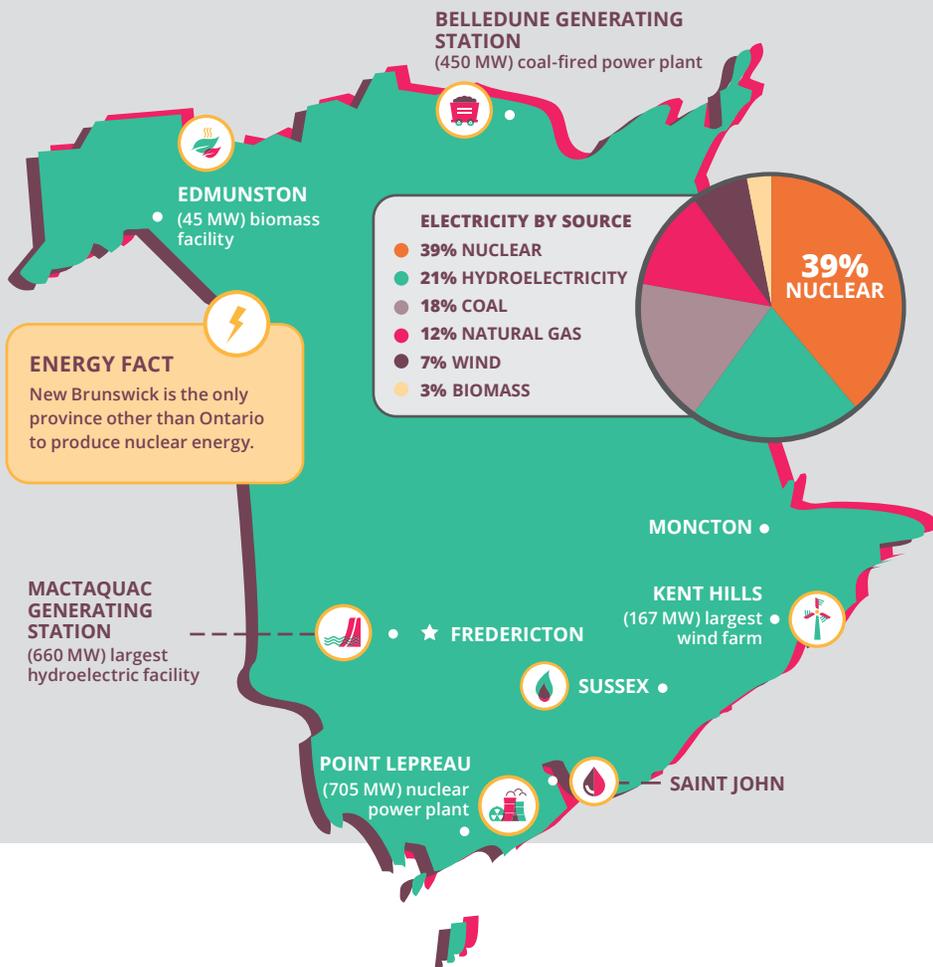
OVERVIEW OF NEW BRUNSWICK

ENERGY PRODUCED:



POPULATION (APPROX.)
776,800

ELECTRICITY GENERATED
12.2 TWh
~2% of Canada's total



NEW BRUNSWICK'S ENERGY

- Point Lepreau is the only nuclear station in New Brunswick.
- Seven hydroelectric facilities.
- 5.4 MMcf/d of natural gas produced at McCully Field, near Sussex. *That's like 83 hot air balloons every day!*
- Six wind farms – more than 110 wind turbines.
- Edmundston is the province's only large-scale biomass power plant.

PETROLEUM REFINING

The largest refinery in Canada is located in Saint John, producing RPPs for export to neighbouring Atlantic provinces and to the United States.

MORE THAN 1,400 KILOMETRES OF PIPELINE

- Natural gas is imported from northeastern United States via pipeline for electricity generation.
- Canaport is a facility in Saint John that imports LNG by tankers from countries in the Caribbean and the Middle East, turns it back into gaseous form, and distributes the natural gas via pipeline to Atlantic provinces and exports to northeastern United States.

MORE THAN 6,500 KILOMETRES OF TRANSMISSION POWER LINES

That's like three-quarters of the length of our border with the United States!

- Electricity is exported to Quebec and United States through connected electricity grids, as well as to Prince Edward Island through underwater cables in the Northumberland Strait.

SHIPPING AND RAILWAY

- Crude oil is imported for refinement by ship from Saudi Arabia, Azerbaijan, Norway, Nigeria, and United States, as well as domestic crude oil from western Canada by rail.
- Belledune Generating Station imports coal from Colombia by ship for electricity generation.



RESERVES AND POTENTIAL

- 2.1 million barrels of recoverable oil reserves.
- 77.9 trillion cubic feet of recoverable natural gas reserves.

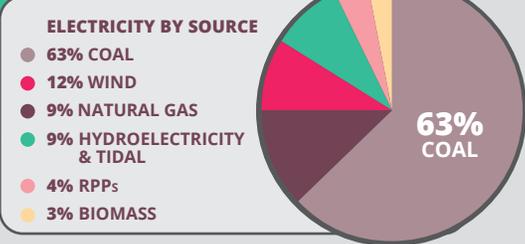
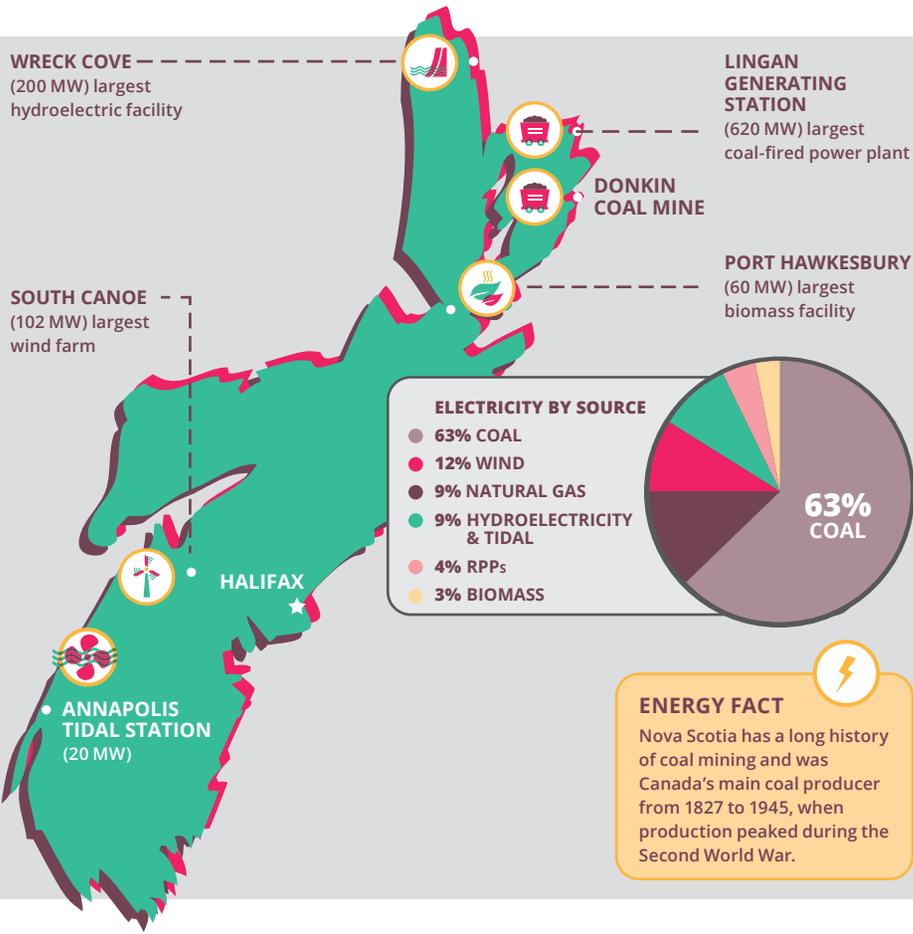
OVERVIEW OF NOVA SCOTIA

ENERGY PRODUCED:



POPULATION (APPROX.)
971,400

ELECTRICITY GENERATED
9.6 TWh
~1% of Canada's total



ENERGY FACT
Nova Scotia has a long history of coal mining and was Canada's main coal producer from 1827 to 1945, when production peaked during the Second World War.

The only province that produces tidal energy

NOVA SCOTIA'S ENERGY

- Dunkin Coal Mine is the only underground coal mine in Nova Scotia.
 - 0.62 megatonnes of coal produced per year (thermal and metallurgical).
 - Four coal-fired power plants.
- 77 wind farms – more than 300 wind turbines.
- 33 hydroelectric facilities.
- Annapolis Tidal Station is the only power station of its kind in North America.
- There are a few small, independent biomass facilities.

MORE THAN 120 KILOMETRES OF PIPELINE

- Natural gas is imported from northeastern United States via pipeline for electricity generation.

TRUCK AND SHIPPING

- Donkin Coal Mine supplies some coal by truck for local electricity generation but most is exported.
- The province imports thermal coal from the United States for electricity generation.

MORE THAN 32,000 KILOMETRES OF TRANSMISSION POWER LINES



That's more than three times the length of our border with the United States!
The Maritime Link connects Nova Scotia with Newfoundland and Labrador through underwater cables across the Cabot Strait.

RESERVES AND POTENTIAL

- 120 trillion cubic feet of offshore natural gas resource potential.
- 8 billion barrels of oil in resource potential.

OVERVIEW OF PRINCE EDWARD ISLAND

ENERGY PRODUCED:



POPULATION (APPROX.)

156,900



ELECTRICITY GENERATED

0.7 TWh

~0.1% of Canada's total

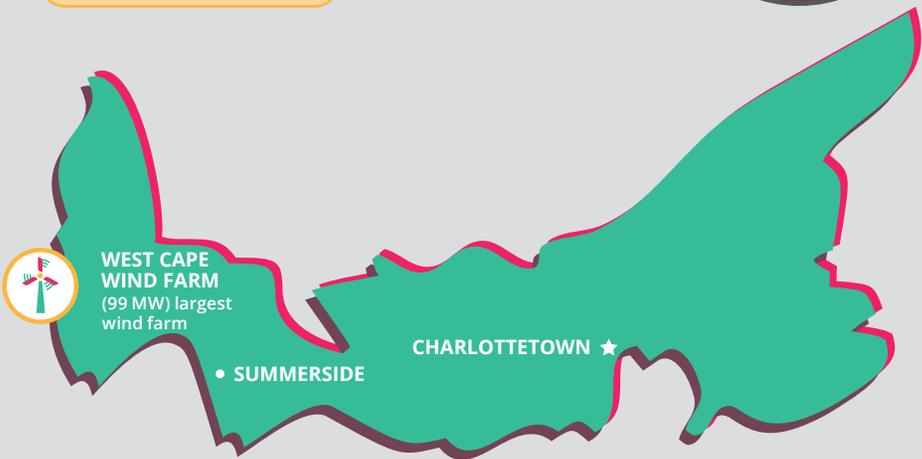
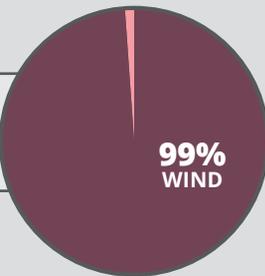


ENERGY FACT

Canada's first offshore oil well was drilled off the coast of Prince Edward Island in 1943.

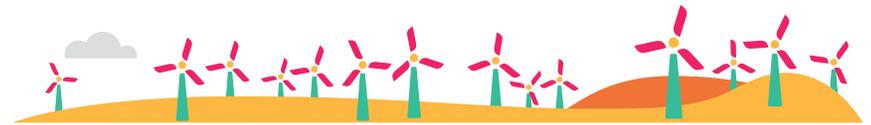
ELECTRICITY BY SOURCE

- 99% WIND
- 1% RPPs



PRINCE EDWARD ISLAND'S ENERGY

- 10 wind farms – more than 100 wind turbines, which power more than 21,000 homes.



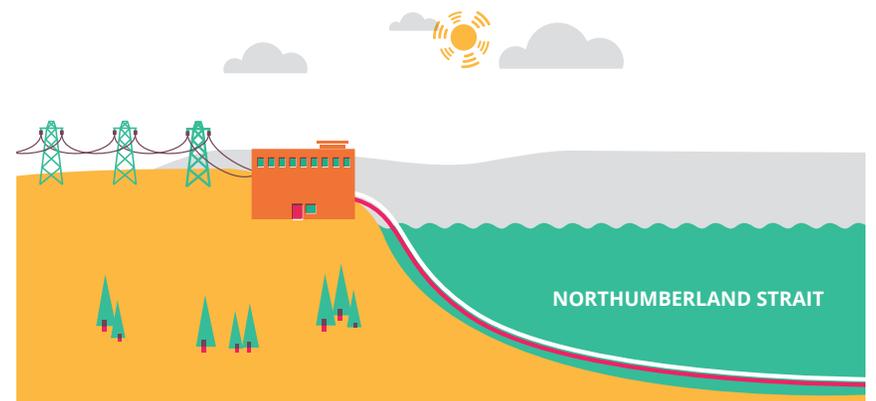
ENERGY TRANSPORTED:

- RPPs are brought in from New Brunswick by ship to Charlottetown and distributed throughout the island by truck. Diesel is used for electricity generation during periods of peak demand or interruptions to the usual supply.

MORE THAN 6,500 KILOMETRES OF TRANSMISSION POWER LINES

That's about two-thirds of the length of our border with the United States!

- Prince Edward Island gets more than half of its electricity from New Brunswick through underwater cables in the Northumberland Strait.



RESERVES AND POTENTIAL

- Prince Edward Island is looking into developing biomass energy production and encouraging the uptake of small-scale solar energy production.
- 0.08 trillion cubic feet of recoverable natural gas.

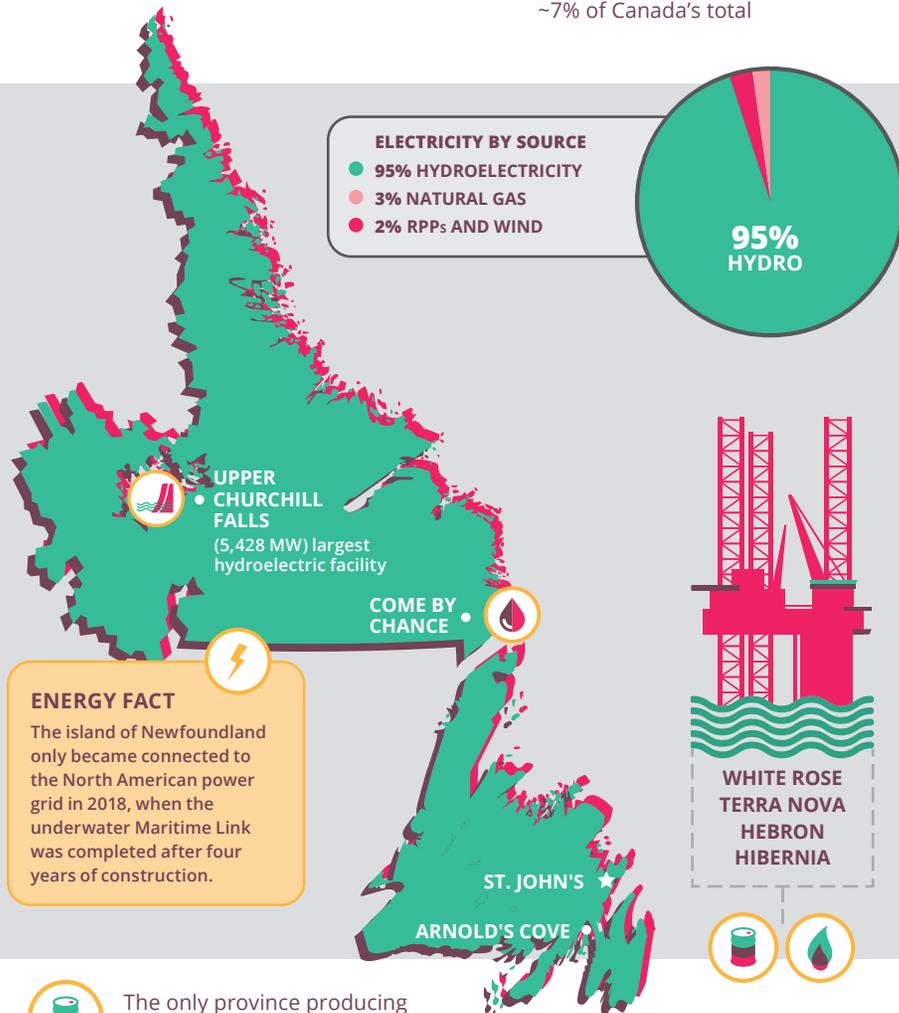
OVERVIEW OF NEWFOUNDLAND AND LABRADOR

ENERGY PRODUCED:



POPULATION (APPROX.)
521,500

ELECTRICITY GENERATED
42.8 TWh
~7% of Canada's total



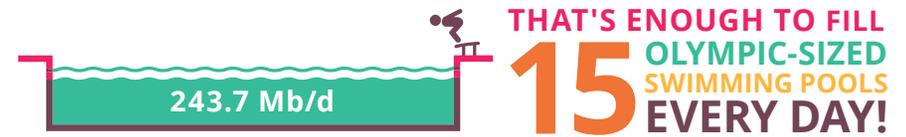
ENERGY FACT

The island of Newfoundland only became connected to the North American power grid in 2018, when the underwater Maritime Link was completed after four years of construction.

The only province producing crude oil offshore

NEWFOUNDLAND AND LABRADOR'S ENERGY

- Nine hydroelectric facilities.
- 243.7 Mb/d of crude oil produced at four offshore facilities: White Rose, Terra Nova, Hebron and Hibernia.



- 549 MMcf/d of natural gas produced to power or support its offshore facilities.
- Four small wind farms – 27 wind turbines.
- There are a few small, independent biomass facilities.

PETROLEUM REFINING

There is one refinery in Come By Chance, which gets crude oil from eastern Canada and imports oil from countries like the United States, United Kingdom, Angola, and Russia to produce RPPs, most of which are exported to the United States.

SHIPPING

DIESEL, THE PRIMARY ENERGY SOURCE IN REMOTE COMMUNITIES IN NORTHERN LABRADOR, IS TRANSPORTED BY SHIP.

- Crude oil is delivered from offshore facilities by ship to Arnold's Cove and then transported by tankers to refineries in Atlantic Canada as well as to the United States.
- There are no crude oil or natural gas pipelines or crude-by-rail facilities in Newfoundland and Labrador.

MORE THAN 6,500 KILOMETRES OF TRANSMISSION POWER LINES

That's about three-quarters of the length of our border with the United States!

- Three-quarters of the province's electricity is exported to Quebec, Nova Scotia, and the United States.

RESERVES AND POTENTIAL

- 3.9 billion barrels of recoverable oil reserves.
- 12.6 trillion cubic feet of recoverable natural gas reserves.

CRUDE OIL

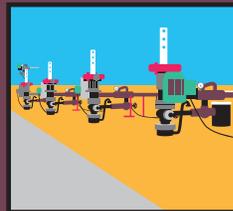
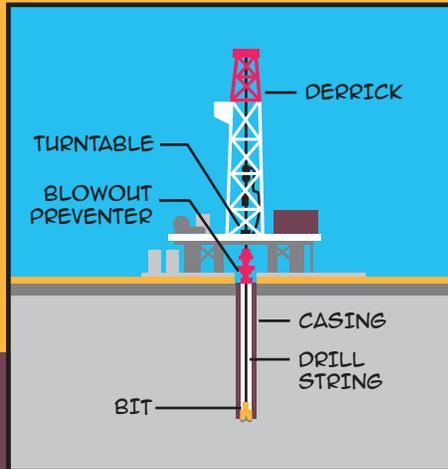
CRUDE OIL IS A YELLOW-TO-BLACK LIQUID, AND REFERS TO LIGHT, MEDIUM, AND HEAVY HYDROCARBONS. IT IS FOUND IN UNDERGROUND RESERVOIRS, OIL SANDS DEPOSITS, OR OFFSHORE RESOURCES.

CONVENTIONAL CRUDE OIL

ONCE OIL IS DISCOVERED IN AN UNDERGROUND RESERVOIR, THE SITE IS PREPARED FOR DRILLING. A DRILLING RIG IS USED TO HOUSE THE TOOLS AND PIPES NEEDED TO DRILL HOLES IN THE EARTH AND BRING OIL TO THE SURFACE.

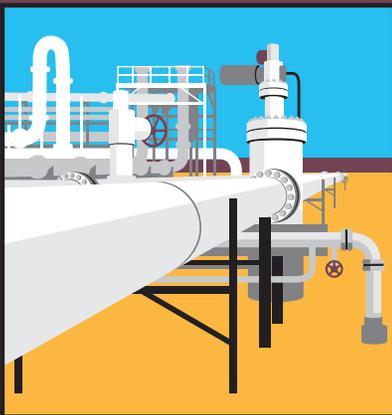
AFTER THE RIG IS REMOVED, THE CREW PUTS A PUMP ON THE WELL HEAD, WHICH PULLS OIL UP THROUGH THE WELL. WHEN COMPLETED, THE WELL BRINGS A STEADY FLOW OF OIL TO THE SURFACE.

DRILLING RIGS ARE FITTED WITH BLOWOUT PREVENTERS (BOP) TO HELP PREVENT ACCIDENTAL RELEASES OF OIL.



THE CRUDE OIL IS THEN KEPT IN STORAGE TANKS OR TAKEN TO REFINERIES TO BE PROCESSED INTO VARIOUS PETROLEUM PRODUCTS.

OIL IS PRIMARILY TRANSPORTED BY PIPELINES—CANADA HAS A PIPELINE NETWORK OF MORE THAN 840,000 KILOMETRES. IT IS ALSO TRANSPORTED BY RAIL, TRUCKS, OR TANKER SHIPS TO WHERE IT NEEDS TO GO.

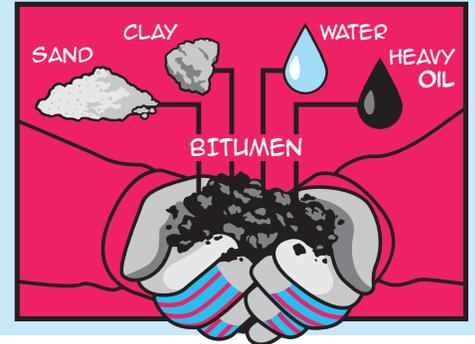


UNCONVENTIONAL CRUDE OIL

THIS HEAVY OIL MIXTURE IS **TOO THICK AND HEAVY TO FLOW** AND IS USUALLY EXTRACTED FROM THE GROUND USING EITHER **MINING** OR **IN SITU** METHODS.

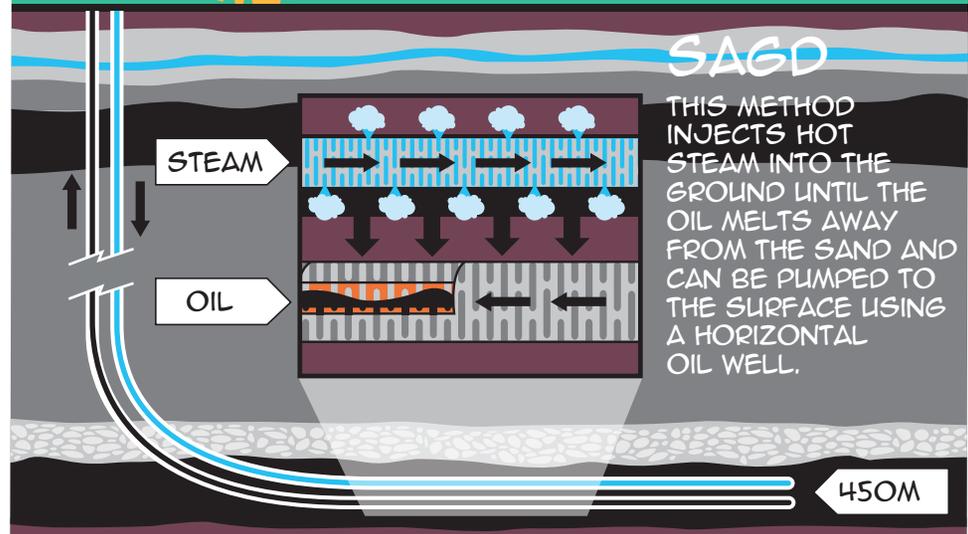


MINING IS USED WHEN OIL SANDS ARE CLOSE ENOUGH TO THE SURFACE TO BE DUG UP USING EXCAVATORS, WHICH LOAD IT ONTO LARGE TRUCKS. THE **OIL SANDS** ARE TAKEN TO A PROCESSING PLANT WHERE IT IS MIXED WITH HOT WATER TO REMOVE THE SAND AND CLAY.



IN SITU

IF THE **HEAVY OIL** CANNOT BE MINED, THEN **IN SITU** METHODS ARE USED, INCLUDING **STEAM-ASSISTED GRAVITY DRAINAGE (SAGD)**.



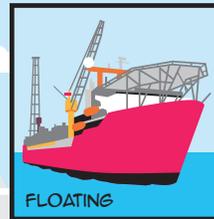
SAGD

THIS METHOD INJECTS HOT STEAM INTO THE GROUND UNTIL THE OIL MELTS AWAY FROM THE SAND AND CAN BE PUMPED TO THE SURFACE USING A HORIZONTAL OIL WELL.

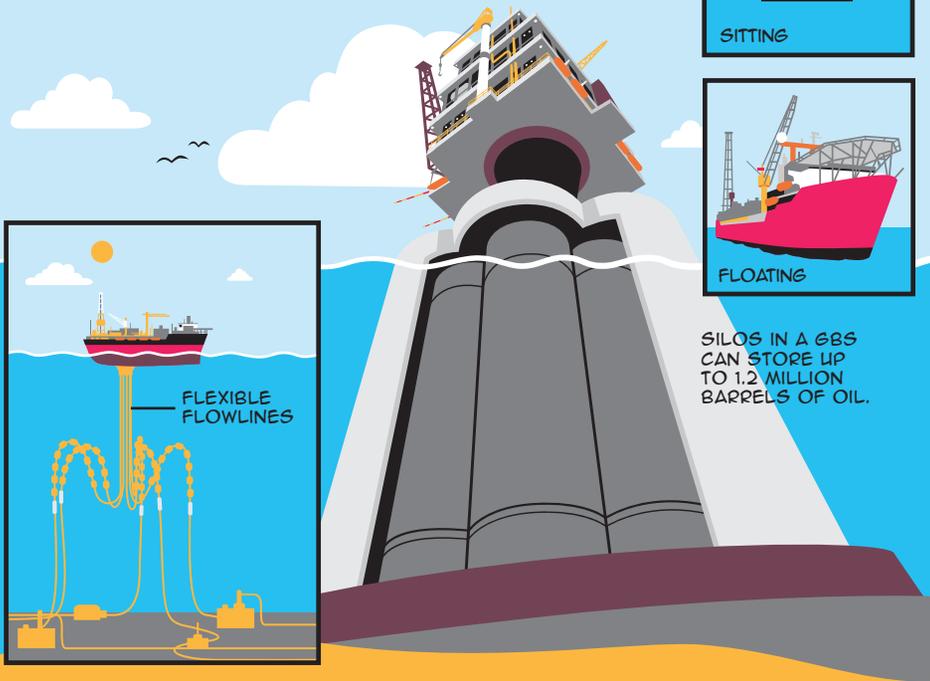
OFFSHORE PRODUCTION

ALL OFFSHORE OIL PRODUCTION FACILITIES CONSIST OF TWO PARTS. THERE IS A PLATFORM, WHICH SITS ON THE SEAFLOOR OR FLOATS ON THE OCEAN SURFACE, AND A TOPSIDE, WHERE THE PRODUCTION OPERATIONS TAKE PLACE.

MOBILE OFFSHORE DRILLING UNITS (MODUS) ARE USED TO ACCESS OIL BENEATH THE OCEAN FLOOR. THEN EITHER OFFSHORE PLATFORMS OR FLOATING PRODUCTION STORAGE AND OFFLOADING (FPSO) VESSELS ARE USED TO EXTRACT AND STORE THE OIL.



SILOS IN A GBS CAN STORE UP TO 1.2 MILLION BARRELS OF OIL.



IN A FPSO VESSEL SYSTEM, FLEXIBLE FLOWLINES ATTACH TO WELLHEADS IN THE SEAFLOOR, WHICH ALLOWS FOR THE VESSEL TO MOVE AROUND TO ADAPT TO WEATHER CONDITIONS. THE EXTRACTED OIL IS THEN SHIPPED TO SHORE BY SHUTTLE TANKERS.

IN A GRAVITY-BASED STRUCTURE (GBS), A PLATFORM IS BUILT ON STEEL AND CONCRETE PILLARS THAT ATTACH TO THE SEAFLOOR AND CONTAIN OIL STORAGE TANKS. THESE TYPES OF STRUCTURES ARE BUILT TO WITHSTAND COLLISIONS WITH ICEBERGS AND STORMS.

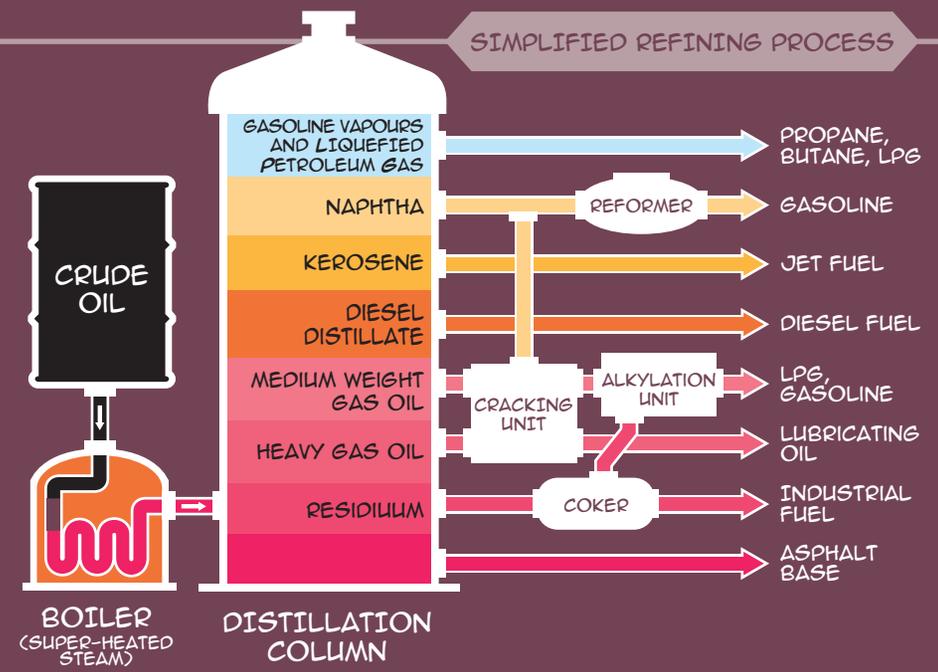
DRILL RIGS AND WELLHEADS ARE FITTED WITH BLOWOUT PREVENTERS TO PREVENT ACCIDENTAL RELEASES OF OIL.

REFINING CRUDE OIL

CRUDE OIL IS TRANSFORMED INTO REFINED PETROLEUM PRODUCTS (RPPS), SUCH AS GASOLINE AND JET FUEL, THROUGH A PROCESS CALLED REFINEMENT. REFINERIES ARE LARGE AND COMPLEX INDUSTRIAL STRUCTURES COMPRISING MANY DIFFERENT PARTS AND PROCESSES THAT PRODUCE DIFFERENT RPPS.



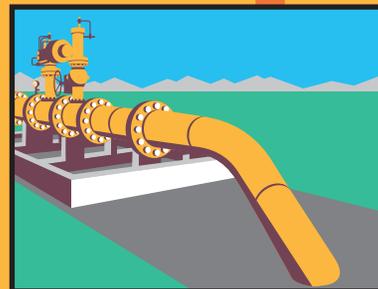
THE COMPONENTS MAKING UP CRUDE OIL EVAPORATE AT DIFFERENT TEMPERATURES, ALLOWING THEM TO BE SEPARATED AND REFINED INTO VARIOUS END PRODUCTS.



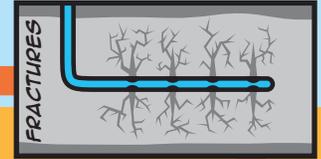
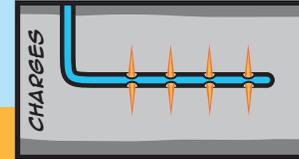
NATURAL GAS

NATURAL GAS IS FOUND IN RESERVOIRS DEEP UNDERGROUND, USUALLY TRAPPED BENEATH, AND SOMETIMES WITHIN, LAYERS OF ROCK.

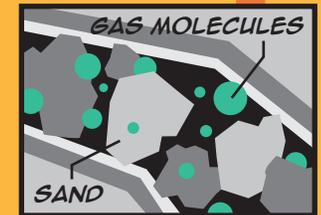
TO EXTRACT **CONVENTIONAL NATURAL GAS**—GAS TRAPPED IN POROUS SANDSTONE AND LIMESTONE FORMATIONS—WELLS ARE DRILLED INTO THE EARTH, AND THE GAS FLOWS TO THE SURFACE THROUGH THE WELL.



TO EXTRACT **UNCONVENTIONAL NATURAL GAS**—LOCKED WITHIN SHALE ROCK FORMATIONS—HORIZONTAL WELLS ARE DRILLED DEEP INTO THE EARTH AND A SERIES OF CHARGES ARE SENT DOWN THE WELL TO MAKE SMALL FRACTURES IN THE ROCK IN A PROCESS KNOWN AS HYDRAULIC FRACTURING.



NEXT, A PRESSURIZED MIXTURE OF WATER, SAND AND CHEMICALS IS SENT DOWN THE WELL TO HOLD OPEN THE CRACKS IN THE ROCK.

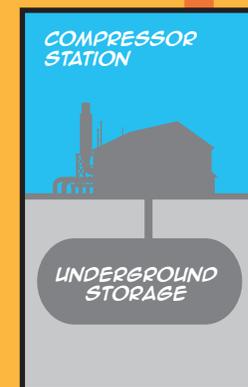


THEN THE GAS, WHICH IS LIGHTER THAN THE FLUID MIXTURE, RISES UP THROUGH THE WELL TO THE SURFACE.



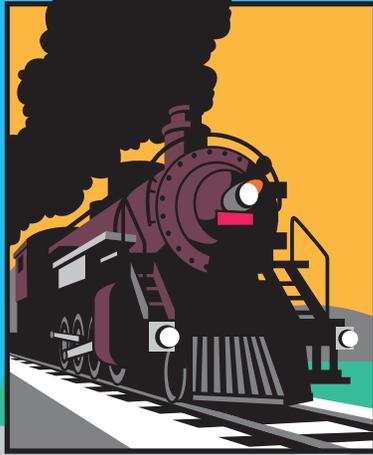
2KM DEEP!

EITHER WAY, NATURAL GAS CAN BE USED TO GENERATE ELECTRICITY, AND HEAT HOMES.

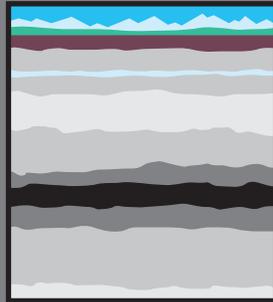


COAL

COMMERCIAL MINING IN CANADA DATES BACK TO THE EARLY 1800S.



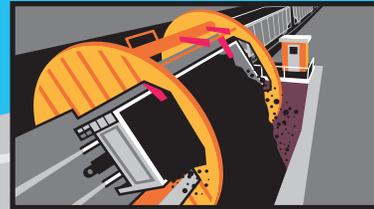
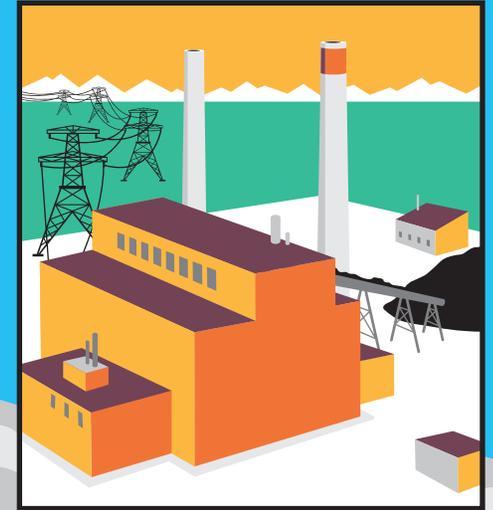
LIKE OIL SANDS MINING, COAL CAN BE STRIPPED FROM THE SURFACE OF THE EARTH BY MACHINE, CALLED STRIP-MINING...



...OR DUG UP BY MINERS WHO BLAST AND BURROW DEEP UNDERGROUND INTO BURIED COAL DEPOSITS OR "SEAMS."



ONCE OUT OF THE GROUND, COAL IS TAKEN TO A POWER PLANT WHERE IT IS BURNED TO HEAT WATER TO MAKE STEAM. THE PRESSURE CREATED BY THAT STEAM SPINS A TURBINE, WHICH IN TURN SPINS MAGNETS INSIDE A GENERATOR.



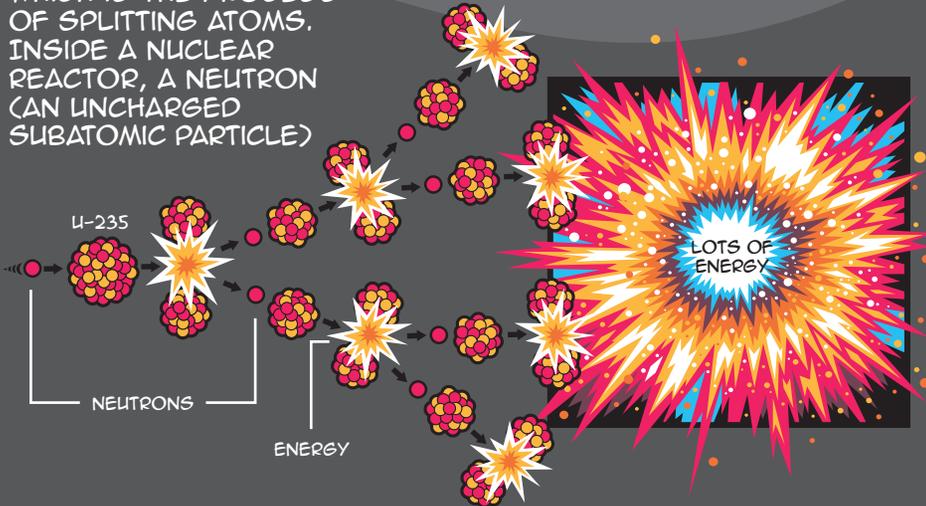
THIS GENERATOR CONVERTS THAT MECHANICAL ENERGY INTO THE KIND OF ELECTRICAL ENERGY WE USE EVERY DAY.



NUCLEAR

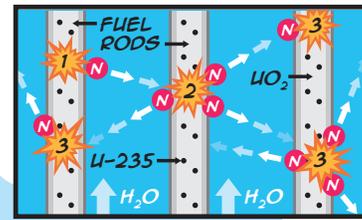
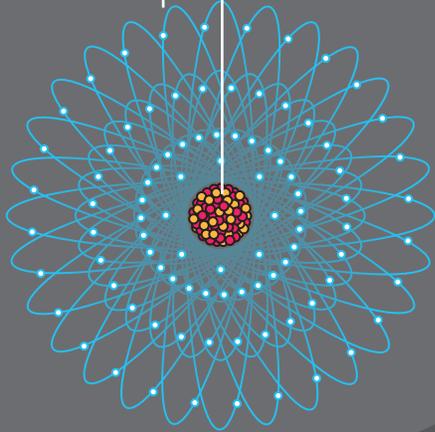
URANIUM IS A HEAVY METAL THAT IS MINED AND PROCESSED TO SERVE AS FUEL FOR NUCLEAR REACTORS. IT IS A RADIOACTIVE ELEMENT AND THE ISOTOPE URANIUM -235 CAN BE USED TO PRODUCE NUCLEAR ENERGY. ISOTOPES ARE VARIATIONS OF THE SAME ELEMENT, WITH AN ATOM HAVING A DIFFERENT ATOMIC WEIGHT DEPENDING ON THE NUMBER OF NEUTRONS IN ITS NUCLEUS.

NUCLEAR ENERGY IS CREATED THROUGH NUCLEAR FISSION, WHICH IS THE PROCESS OF SPLITTING ATOMS. INSIDE A NUCLEAR REACTOR, A NEUTRON (AN UNCHARGED SUBATOMIC PARTICLE)



IS FIRED AT THE NUCLEUS OF THE ISOTOPE U-235. THIS EXTRA NEUTRON IN THE NUCLEUS MAKES THE ISOTOPE HEAVIER AND HIGHLY UNSTABLE. TO RELEASE THAT ENERGY, THE ISOTOPE SPLITS INTO TWO SMALLER ELEMENTS. IT ALSO RELEASES A FEW NEUTRONS IN THE PROCESS. THESE NEUTRONS GO ON TO COLLIDE INTO OTHER U-235 ISOTOPES, CAUSING A CHAIN REACTION (I.E., A NUCLEAR REACTION).

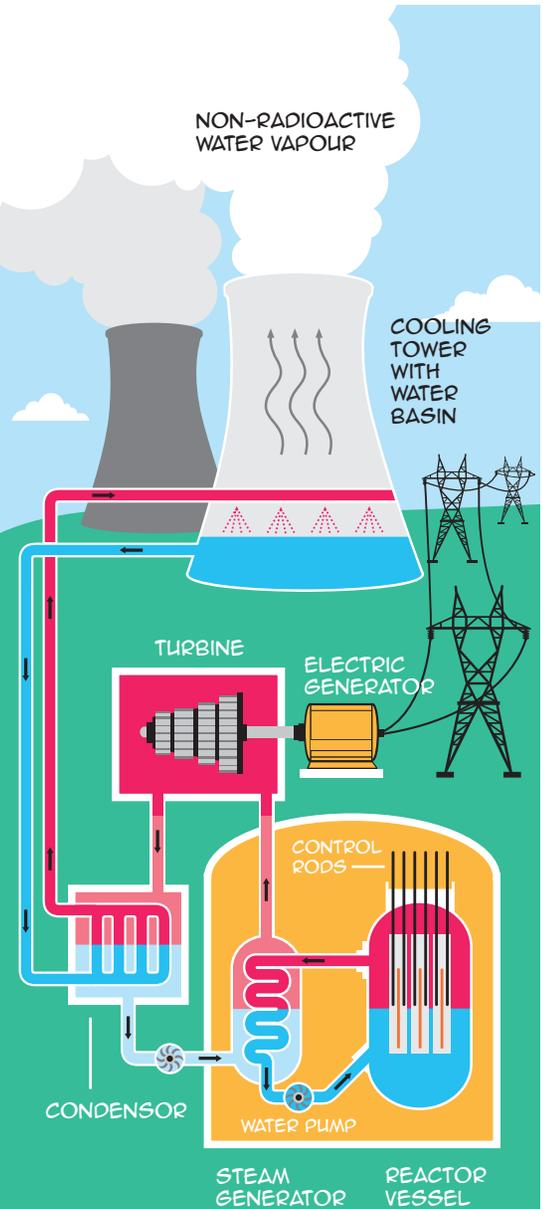
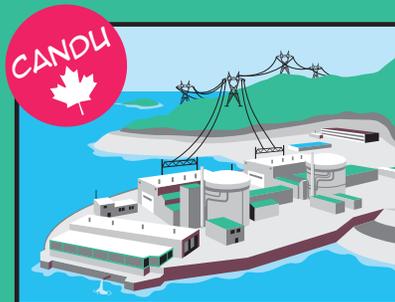
U-235
92 PROTONS
143 NEUTRONS



THE NEUTRONS RELEASED IN THE REACTION MOVE AT SPEEDS THAT MAKE IT DIFFICULT FOR THEM TO HIT OTHER ISOTOPES. TO MAKE SURE THE NUCLEAR REACTION CAN CONTINUE, THE NEUTRONS NEED TO BE SLOWED DOWN, OR "MODERATED." WATER IS USED AS A MODERATOR.

NEUTRONS BOUNCE OFF OF WATER'S HYDROGEN NUCLEI AND LOSE ENERGY WITH EACH COLLISION.

NUCLEAR REACTORS ALLOW FOR CONTROLLED NUCLEAR FISSION. CONTROL RODS, MADE FROM A MATERIAL THAT ABSORBS NEUTRONS, ARE RAISED OR LOWERED INTO THE NUCLEAR REACTOR TO CONTROL THE RATE OF FISSION. NUCLEAR FISSION PRODUCES A LARGE AMOUNT OF ENERGY, WHICH IS DISSIPATED AS HEAT.

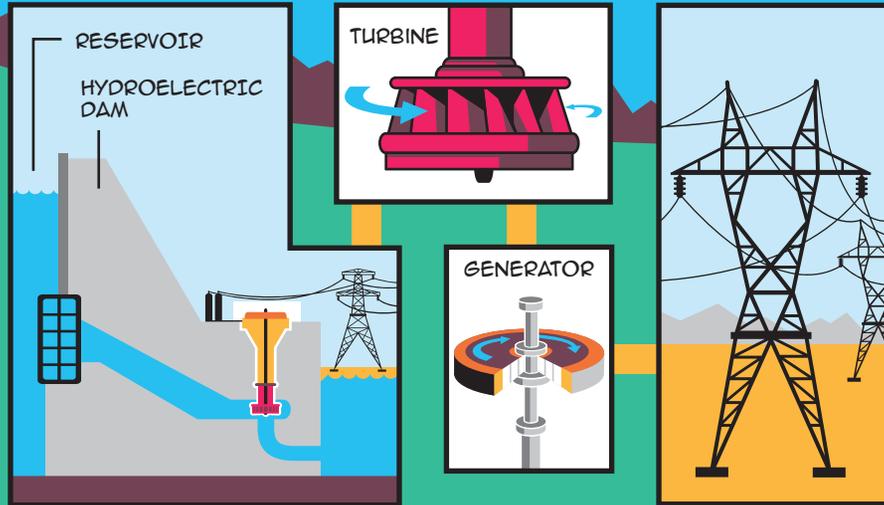


THIS HEAT BOILS WATER AND CREATES STEAM TO POWER THE GENERATORS THAT PRODUCE ELECTRICITY.

CANADA HAS DEVELOPED ITS OWN UNIQUE NUCLEAR REACTOR TECHNOLOGY, CALLED CANDU, WHICH IT HAS EXPORTED TO THE WORLD.

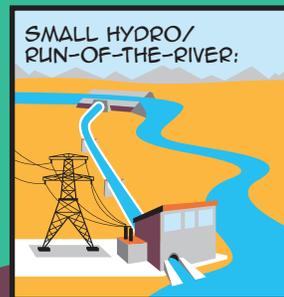
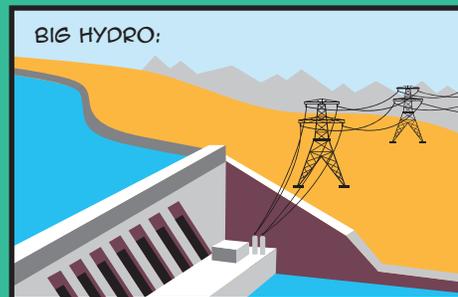
HYDROELECTRICITY

FOR BIG HYDRO PROJECTS, A DAM IS BUILT ON A RIVER TO STORE WATER IN A RESERVOIR. WHEN THE WATER IS RELEASED, ITS KINETIC ENERGY PASSES THROUGH A PENSTOCK (A SET OF CHANNELS OR PIPES). THE WATER TURNS THE BLADES OF A TURBINE, CREATING MECHANICAL ENERGY, WHICH IS THEN CONVERTED INTO ELECTRICITY BY A GENERATOR.



IN A PUMPED STORAGE SYSTEM, WATER IS RELEASED WHEN THERE IS PEAK DEMAND. WHEN DEMAND IS LOW, THE WATER IS PUMPED BACK UP TO THE RESERVOIR USING ELECTRICITY FROM OTHER ENERGY SOURCES. IN RUN-OF-THE-RIVER INSTALLATIONS, THE NATURAL FLOW OF THE RIVER PROVIDES THE NECESSARY KINETIC ENERGY.

HYDROELECTRICITY IS A RENEWABLE SOURCE OF ENERGY BECAUSE WATER IS NOT USED UP IN THE ENERGY PRODUCTION PROCESS.



WIND

A WIND TURBINE CATCHES THE KINETIC ENERGY FROM A BLOWING BREEZE, CAUSING THE PROPELLER BLADES TO TURN AND CREATE MECHANICAL ENERGY. THE TURBINE IS CONNECTED TO A GENERATOR, WHICH CONVERTS THE MECHANICAL ENERGY INTO ELECTRICITY.

The diagram shows a cross-section of a wind turbine. The 'ROTOR BLADE' is the large, white, curved blade. It is attached to the 'NACELLE', which houses the 'GENERATOR' and 'GEAR BOX'. The nacelle is mounted on a tall tower. In the background, several other wind turbines are shown in a field, with a 'SUBSTATION' and 'TRANSMISSION LINES' nearby. A car is shown on a road in the foreground.

TRANSMISSION LINES

SUBSTATION

TRANSFORMER

A TRANSFORMER INCREASES THE ELECTRICITY TO A HIGHER VOLTAGE, TRANSMITTING IT TO A SUBSTATION THAT INCREASES THE VOLTAGE AGAIN SO THAT IT CAN TRAVEL OVER LONGER DISTANCES THROUGH THE ELECTRICITY GRID.

WIND ENERGY IS RENEWABLE, BUT IT IS ALSO INTERMITTENT, MEANING THAT IT IS NOT ALWAYS AVAILABLE.

A small circular icon in the bottom right corner features a red electrical plug with a green leaf growing from its base, symbolizing clean or renewable energy.

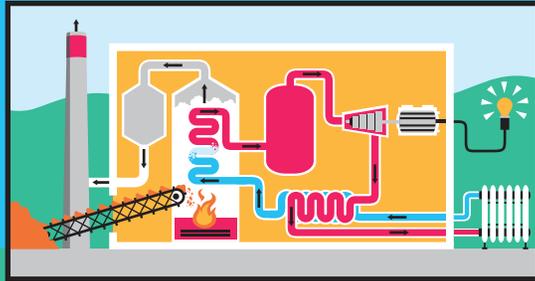
BIOMASS



BIOENERGY BEGINS WITH BIOMASS, WHICH IS ANY ORGANIC MATERIAL THAT HAS STORED ENERGY FROM THE SUN IN A CHEMICAL FORM, SUCH AS TREES, HAY, AND EVEN HOUSEHOLD GARBAGE.



ELECTRICITY: WOODCHIPS, SAWDUST OR OTHER ORGANIC MATERIALS ARE COLLECTED AND COMPRESSED INTO PELLETS. THE PELLETS FUEL A BOILER USED TO PRODUCE STEAM. IT TURNS TURBINES, WHICH SPIN MAGNETS IN A GENERATOR, CONVERTING MECHANICAL ENERGY INTO ELECTRICITY.



LANDFILL GAS CAPTURE: METHANE FROM CAPPED LANDFILLS IS COLLECTED, PROCESSED AND UPGRADED, THEN TRANSMITTED BY PIPELINE TO HOMES AND BUSINESSES.

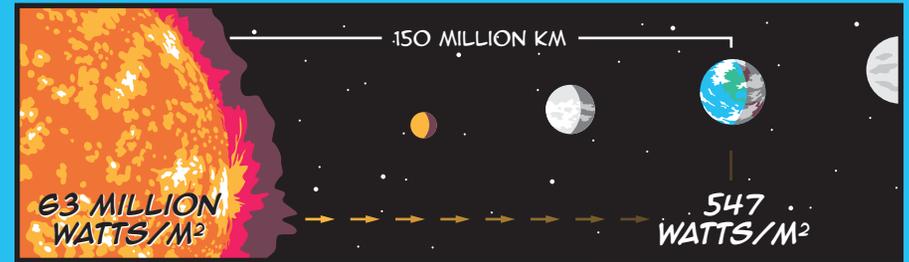


LIQUID BIOFUELS: BIOETHANOL IS CREATED BY FERMENTING AND DISTILLING BIOMASS SUCH AS STRAW, CORN OR GRAINS. BIODIESEL IS DERIVED FROM VEGETABLE AND ANIMAL FATS, INCLUDING USED OIL FROM RESTAURANTS.

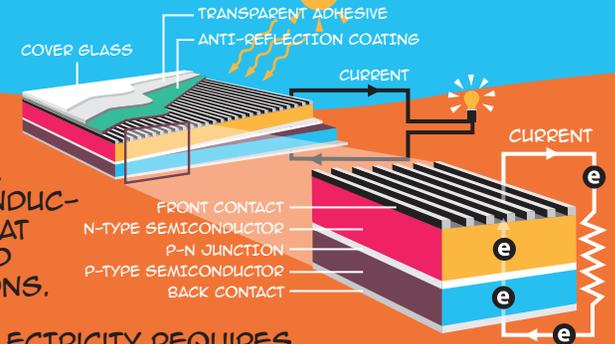


SOLAR

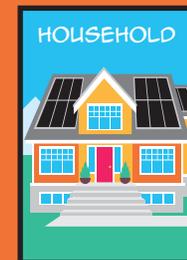
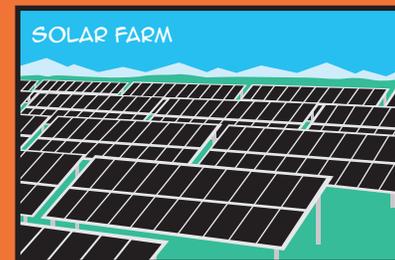
THE SUN CONSTANTLY EMITS AN INCREDIBLE 63,000,000 WATTS PER SQUARE METRE OF ENERGY, BUT MOST IS LOST ON THE 150 MILLION KILOMETRE JOURNEY TO EARTH.



ELECTRICITY IS GENERATED FROM SOLAR ENERGY THROUGH THE USE OF PHOTOVOLTAIC (PV) TECHNOLOGY, MADE OF SEMICONDUCTOR MATERIALS THAT ABSORB LIGHT AND RELEASE ELECTRONS.

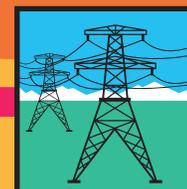


GENERATION OF ELECTRICITY REQUIRES CURRENT AND VOLTAGE. IN A SOLAR CELL, THE FLOW OF ELECTRONS CREATES THE CURRENT AND THE ELECTRIC FIELD CAUSES VOLTAGE.



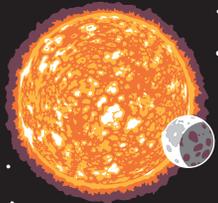
THE ELECTRICITY PRODUCED IN A PV PANEL IS DIRECT CURRENT (DC).

SINCE THE NORTH AMERICAN POWER GRID - AND MOST HOMES AND BUILDINGS - WORKS ON ALTERNATING CURRENT (AC), AN INVERTER IS REQUIRED TO CHANGE THE POWER FROM DC TO AC.

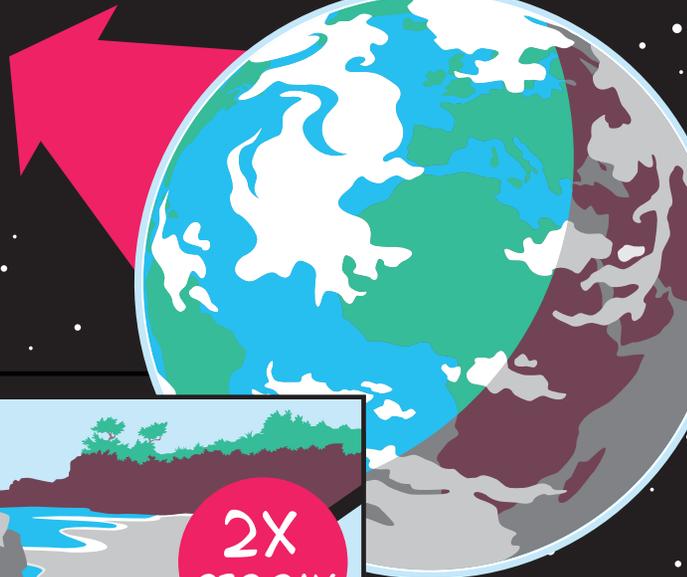


TIDAL

TIDAL ENERGY HARNESSES THE POWER OF OCEAN TIDES, WHICH ARE CAUSED BY THE GRAVITATIONAL PULL OF THE MOON AND SUN, AS WELL AS THE ROTATION OF THE EARTH. TIDAL ENERGY IS RENEWABLE, MEANING THAT THE WATER USED FOR ENERGY PRODUCTION IS NOT USED UP IN THE PROCESS.



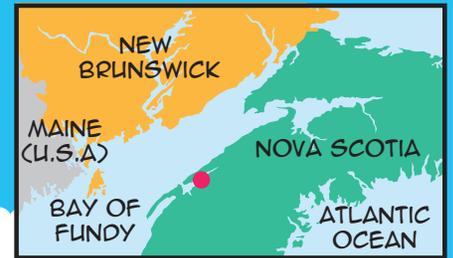
GRAVITATIONAL
PULL



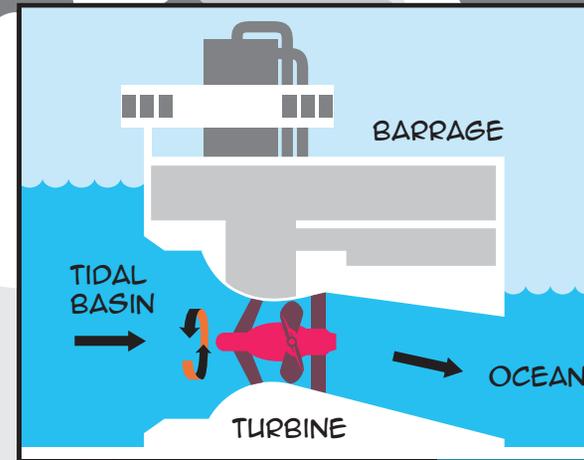
2X
PER DAY

TIDAL POWER STATIONS ARE INSTALLED ALONG COASTLINES IN AREAS WITH A LARGE TIDAL RANGE. TIDAL ENERGY IS RELIABLE BECAUSE TIDES HAPPEN TWICE A DAY — TWO LOW TIDES AND TWO HIGH TIDES WITHIN ABOUT 24 HOURS.

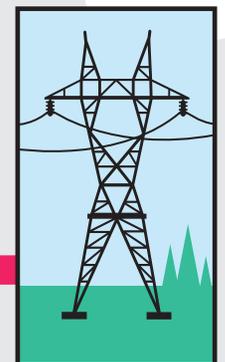
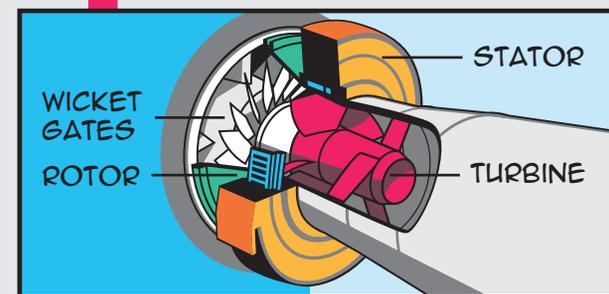
ANNAPOLIS
TIDAL STATION



ELECTRICITY IS GENERATED FROM OCEAN TIDES WHEN WATER PASSES THROUGH A BARRAGE OR DAM.



THE CHANGE BETWEEN LOW TIDE AND HIGH TIDE CAUSES WATER TO FLOW THROUGH A TURBINE. THIS KINETIC ENERGY TURNS THE TURBINE, WHICH IN TURN POWERS A GENERATOR, CONVERTING MECHANICAL ENERGY INTO ELECTRICITY.



COOL ENERGY FACTS



Two-thirds of Canada's crude oil is exported, mostly to the United States, who is our biggest trading partner.

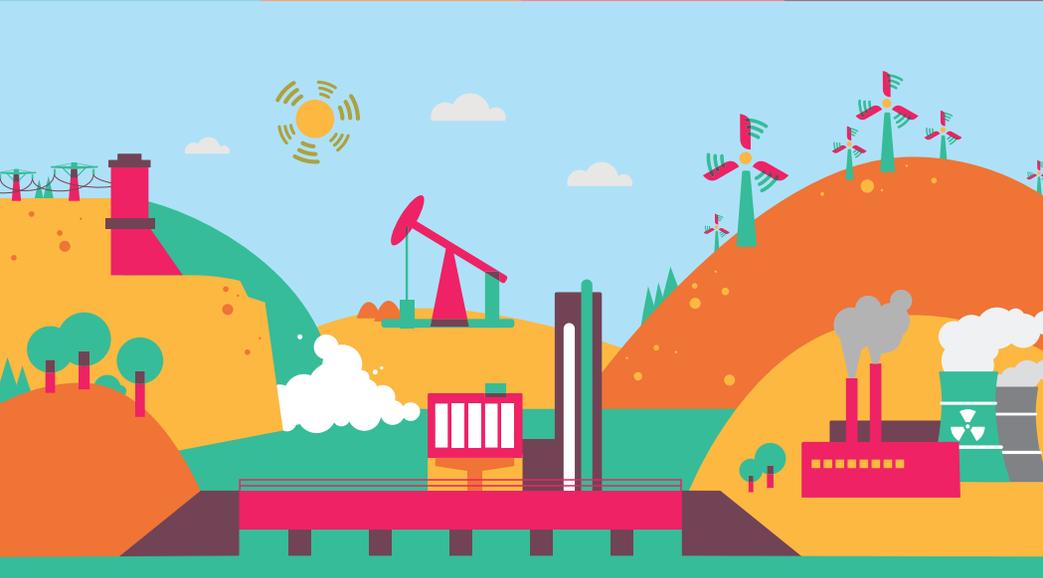


Canada is the fourth-largest producer and sixth-largest exporter of natural gas in the world. The majority of Canadian natural gas is exported to the United States.

CANADA IS THE **FOURTH -LARGEST OIL PRODUCER IN THE WORLD!**



Canada is the second-largest producer of hydroelectricity in the world, and ranks ninth in the world for wind and solar power installations.



With about 170 billion barrels, Canada has the third-largest global supply of proven oil reserves.

THERE ARE **17** REFINERIES IN CANADA.



Canada has the third-largest reserves of uranium and ranks second worldwide in uranium production and export.

Canada is the sixth-largest producer of electricity in the world. Canada exports more electricity than it imports.

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