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INTRODUCING ENERGY IQ

Quebec is known as “la belle province” and with an abundance of lakes, rivers and other water reserves, it’s easy to see why. With such an ample supply of water, Quebec is one of the world’s top producers of hydroelectricity.

Due to its wealth of fresh bodies of water, Quebec produces high volumes of hydroelectricity. It makes enough hydroelectricity to meet its own needs and still have enough left over to export large amounts of power to Ontario, the Maritimes and the northeastern United States.

Wind power in Quebec also accounts for a good-sized portion of its energy sector. Current wind farms are becoming so productive that the province is exploring options to further expand its reach.

This fact book provides a snapshot of Quebec’s energy sector and how it fits into the broader Canadian energy landscape. It covers topics such as

where natural resources are found for energy production, the process through which energy is turned into electricity, how different energy products are used, and how the energy industry impacts Quebec’s unique natural environment.

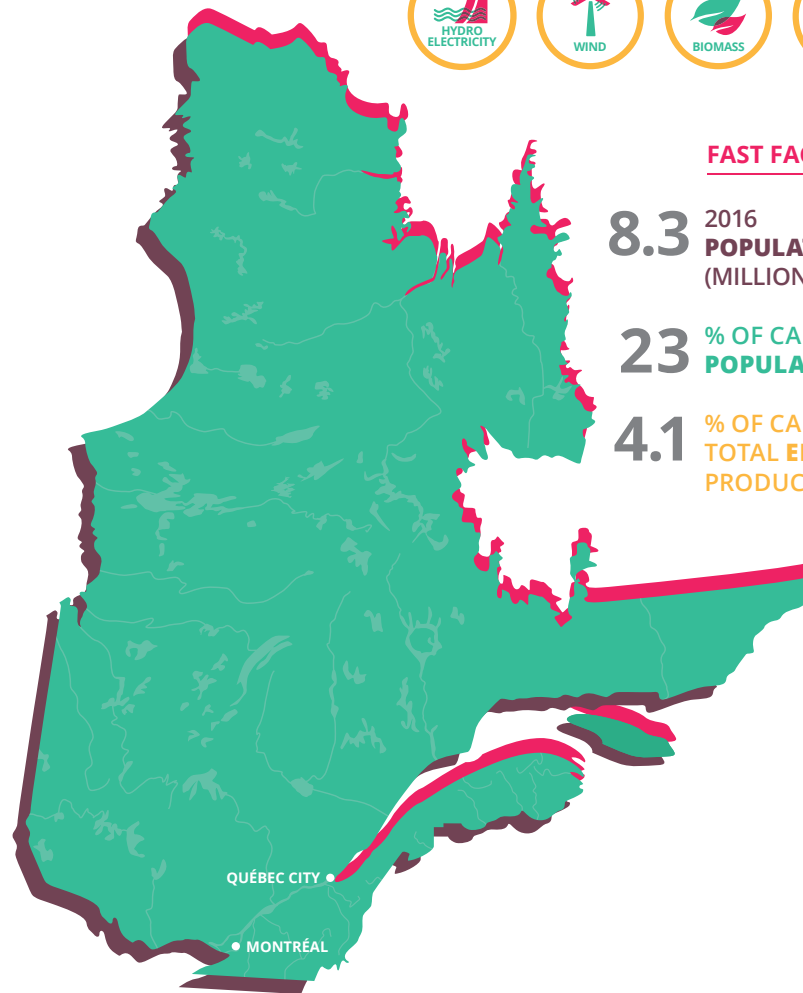
This fact book was produced by Energy IQ, an educational program created and delivered by Canadian Geographic Education. Energy IQ focuses on the demand, production and transmission of various energy sources in Canada today, with the goal of helping to improve energy literacy across the country among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



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

OVERVIEW OF QUEBEC

Quebec produces four main types of energy: hydroelectricity, wind, biomass, and a small percentage of natural gas.



FAST FACTS

8.3 2016
POPULATION
(MILLION)

23 % OF CANADIAN
POPULATION

4.1 % OF CANADA'S
TOTAL ENERGY
PRODUCTION



Learn more about how energy is produced in Quebec and across
the country at energyiq.canadiangeographic.ca/energy_mix

RENEWABLE ENERGY



RENEWABLE ENERGY SOURCES, such as hydroelectricity, wind, biomass, and solar can be found wherever the wind blows, rivers flow, or sun shines.

HYDROELECTRICITY

While having more than one million lakes makes Quebec a beautiful province, its power as an energy supplier mainly comes from its more than 130,000 rivers and streams. In fact, more than 40 per cent of Canada's water reserves are located in Quebec. By tapping into those natural resources, the province has become a leader in clean and renewable energy production. Today, Quebec's energy sector is nearly synonymous with hydroelectricity.

With such a huge natural reserve for the province to draw upon, Quebec has become one of the largest hydroelectricity producers in the world. For the past 75 years, government-owned Hydro-Québec has been managing and operating most of the province's hydroelectricity assets, and is the fourth largest hydroelectricity manager in the world. They operate 62 hydroelectricity facilities across the province, including the James Bay project, located on La Grande Rivière.

But Quebec's electricity doesn't just stay at home. Hydro-Québec also sells their hydroelectricity to other provinces, including Ontario, the Maritimes and the northeastern United States. As a result, the hydroelectric industry contributes billions of dollars to the province's economy each year.

In Quebec, electricity is the most commonly used source of energy, making up 40 per cent of the province's energy consumption. Oil is a close second at 39 per cent.

**QUEBEC HAS
MORE THAN
3 TIMES THE
HYDROELECTRICITY
CAPACITY OF
BRITISH COLUMBIA**

**WATER RESERVES IN THE PROVINCE
(NATURAL LAKES AND RESERVOIRS)
COVER APPROXIMATELY
12% OF ITS TERRITORY**



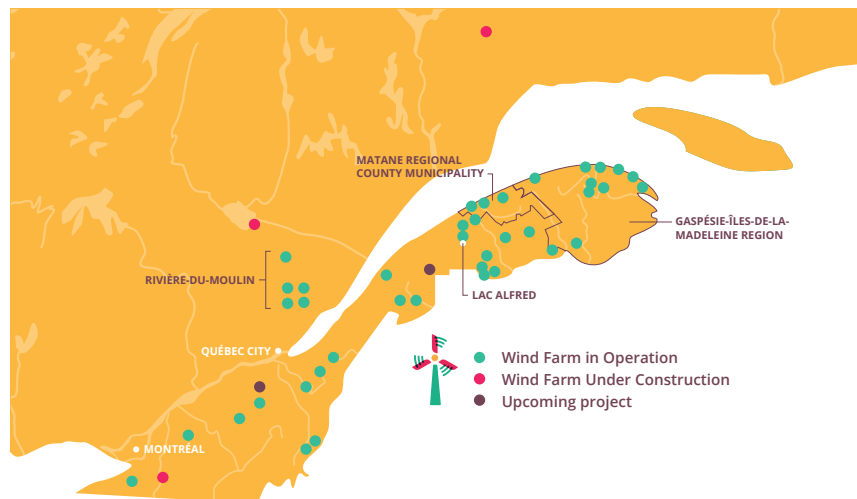


WIND

While hydroelectricity dominates Quebec's energy sector, the province also produces a lot of energy from wind. The wind power industry is so large that the province now ranks second in Canada in terms of installed capacity. It's partially due to the province's 350-megawatt (MW) Rivière-du-Moulin wind farm, the largest in Canada.

Wind power in Quebec is a relatively young venture, only dating back to 1998 and the Le Nordais project, the province's first commercial wind farm. The 133 MW wind farm was built in the Matane region almost 20 years ago and is still operational to this day.

In the past two decades, wind power production has grown significantly. Hydro-Québec has signed contracts with independent power producers for a total of 3,710 MW of wind capacity, installed at several sites concentrated throughout the Gaspésie-Îles-de-la-Madeleine region and the Matane Regional County Municipality. Hydro-Québec buys wind power from independent producers and feeds it into the electricity grid.

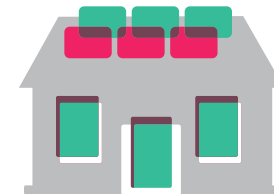


Currently, Quebec's capacity for wind power is 3,510 MW, second only to Ontario, which has a total installed capacity of 4,781 MW. Three of the top 10 largest wind power generators in Canada are located in Quebec, with Lac Alfred ranking as the largest wind farm in the country. In 2015, wind power accounted for 4 per cent of electricity produced in Quebec — a figure which has been steadily on the rise.



SOLAR

Solar power is another source of renewable energy, but in Quebec it is still in the experimental stages for large scale power generation. However, there is some small-scale use of solar power, such as with residential homes having solar panels mounted on their rooftops. This allows users to produce some of their own energy to offset electricity bills.



Of the incredible 63,000,000 watts per square metre of energy the sun emits, only about 547 watts per square metre reaches the earth's surface. As the sun's energy makes its way through the atmosphere, some of it is reflected back into space and the rest is filtered by oxygen, nitrogen, ozone, water vapour and other substances. The energy is then captured by photovoltaic technology through solar cells.

BIOMASS

Only 1.4 per cent of electricity generated in Canada comes from biomass, yet it is the country's third largest renewable source of energy. Today, 4.6 per cent of Canadian households still rely on wood as a primary or secondary source of heating.

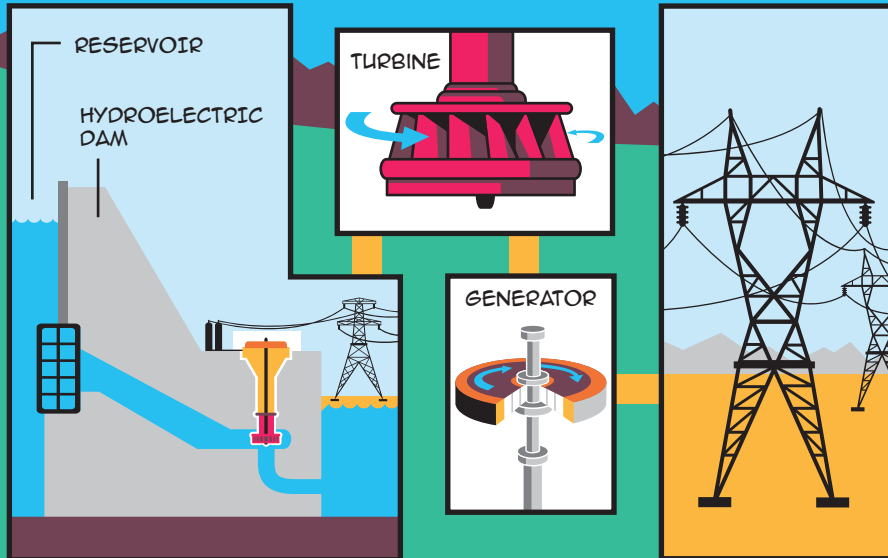
Bioenergy begins with biomass. Industrial wood waste, such as from pulp and paper mills, is the most important biomass. Yearly, more than 400 petajoules (PJ) of bioenergy is used in the industrial sector and another 100 PJ is used in the residential sector.

In Quebec, energy producers are using three different types of biomass: forest, urban and agriculture. These three types of biomass are converted into bioenergy by different means. Forest debris is used in steam generators to produce electricity, methane gas is captured from urban waste at landfills, and agricultural products are distilled into liquid biofuels.

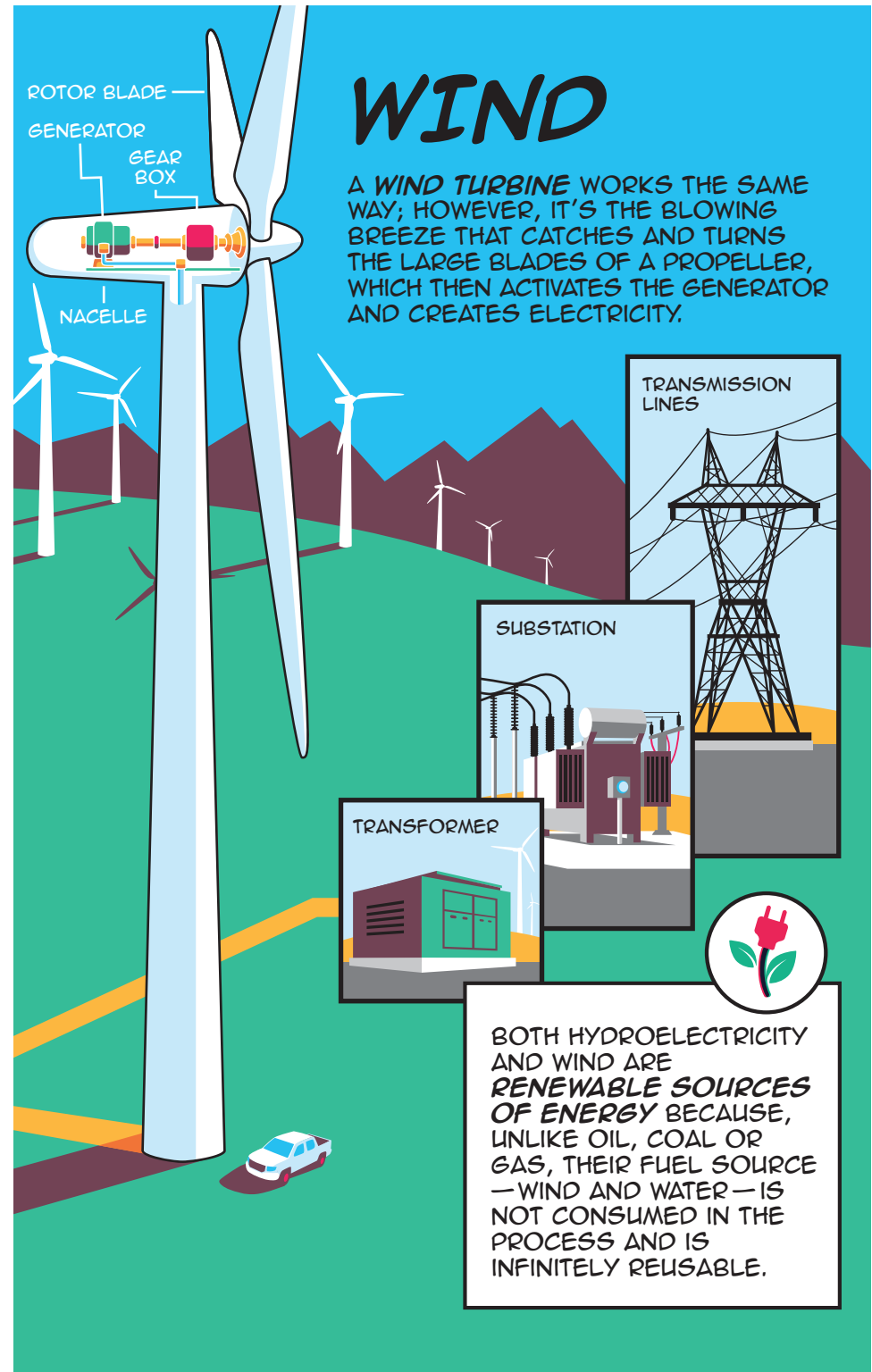
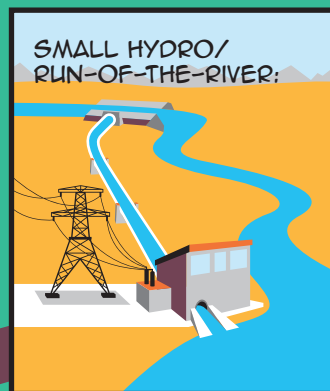
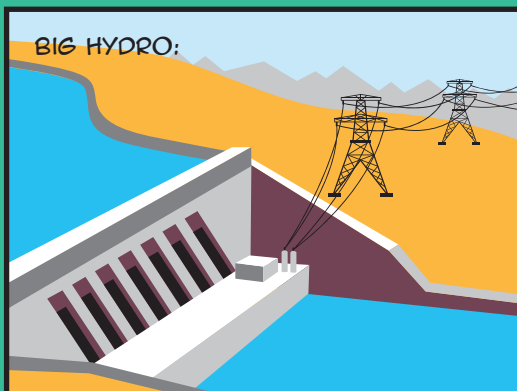
Quebec is densely forested and the province's forest biomass potential was estimated to be at 19.5 million tonnes of dry matter in 2011. About 42 per cent of that biomass energy is already being used for power generation, such as for heating and electricity (although the amount of electricity produced is still very marginal). Biomass accounts for 1 per cent of electricity produced in the province. In Quebec, some companies and businesses use biomass to generate electricity to power their facilities.

HYDROELECTRICITY

HYDROELECTRICITY USES THE KINETIC ENERGY — OR MOTION — OF FALLING WATER, WHILE WIND ENERGY HARNESSES THE SAME KIND OF ENERGY FROM THE NATURAL MOVEMENT OF OUR PLANET'S AIR.

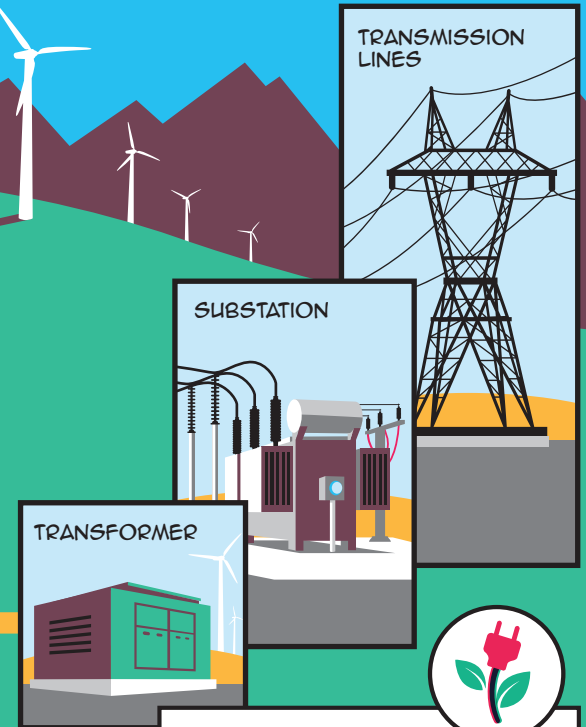


HYDROELECTRICITY IS CREATED WHEN WATER FALLING FROM A RIVER DAM SPINS A TURBINE, WHICH SPINS A GENERATOR THAT TRANSFORMS MECHANICAL ENERGY INTO ELECTRICITY.



WIND

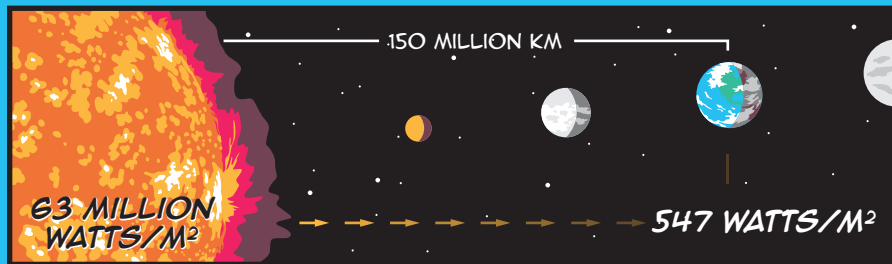
A WIND TURBINE WORKS THE SAME WAY; HOWEVER, IT'S THE BLOWING BREEZE THAT CATCHES AND TURNS THE LARGE BLADES OF A PROPELLER, WHICH THEN ACTIVATES THE GENERATOR AND CREATES ELECTRICITY.



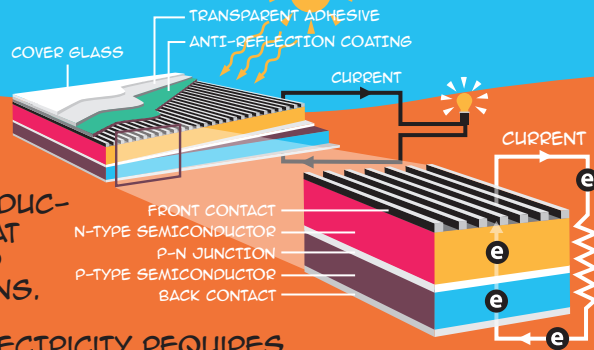
BOTH HYDROELECTRICITY AND WIND ARE **RENEWABLE SOURCES OF ENERGY** BECAUSE, UNLIKE OIL, COAL OR GAS, THEIR FUEL SOURCE — WIND AND WATER — IS NOT CONSUMED IN THE PROCESS AND IS INFINITELY REUSABLE.

SOLAR

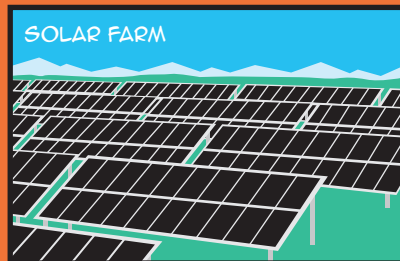
THE SUN CONSTANTLY EMITS AN INCREDIBLE 63,000,000 WATTS PER SQUARE METER OF ENERGY, BUT MOST IS LOST ON THE 150 MILLION KILOMETRE JOURNEY TO EARTH.



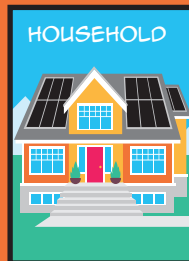
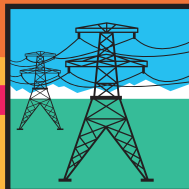
ELECTRICITY IS GENERATED FROM SOLAR ENERGY THROUGH THE USE OF PHOTOVOLTAIC (PV) TECHNOLOGY, MADE OF SEMICONDUCTOR MATERIALS THAT ABSORB LIGHT AND RELEASE ELECTRONS.



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



INVERTER
DC AC



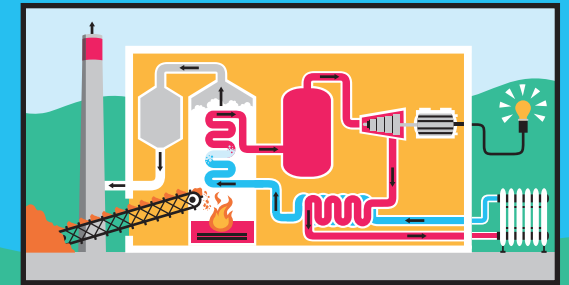
THE ELECTRICITY PRODUCED IN A PV PANEL IS DIRECT CURRENT (DC).

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.

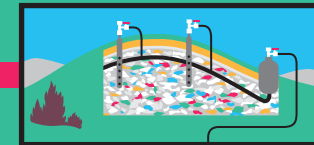
BIOMASS



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.



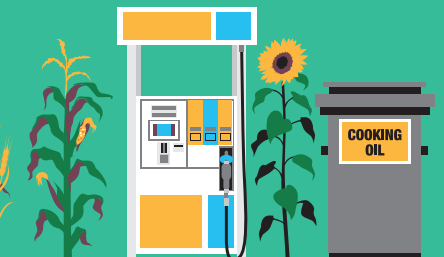
ELECTRICITY: WOODCHIPS, SAWDUST, OR OTHER ORGANIC MATERIALS, ARE COLLECTED AND COMPRESSED INTO PELLETS. THE PELLETS FUEL A BOILER USED TO PRODUCE STEAM. IT TURNS TURBINES, WHICH SPIN MAGNETS IN A GENERATOR, CONVERTING MECHANICAL ENERGY INTO ELECTRICITY.



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.



NATURAL GAS



Natural gas in Quebec is found in the Utica Shale, which is located along the St. Lawrence Valley between Québec City and Montréal.

The natural gas reserve is so large that some estimates suggest that it may contain as much as 20 trillion cubic feet of recoverable natural gas — enough to supply Quebec's energy needs for over a century and reduce the need to import natural gas from western Canada.

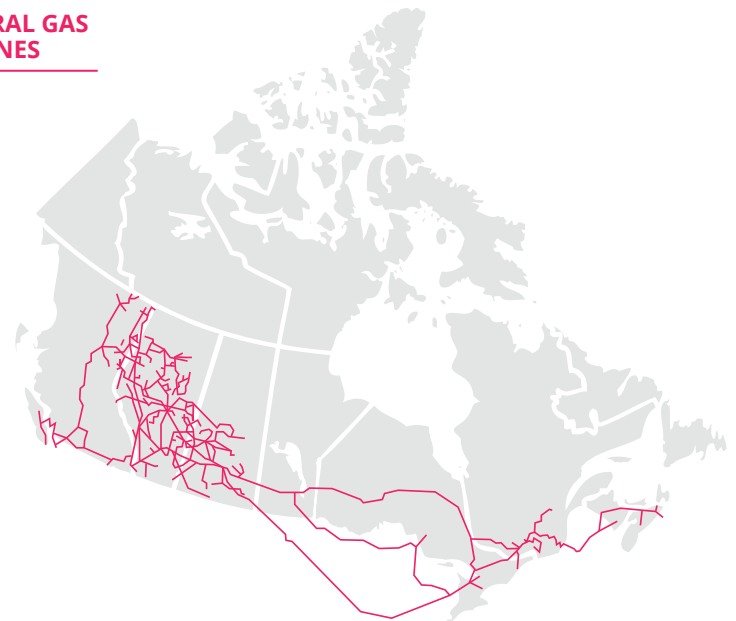


Currently, Quebec produces a very small amount of its own natural gas (0.04 per cent of Canada's total of natural gas production). It gets its majority of natural gas from western Canada, through Gaz Métro, which is the province's main distributor. In 2009, natural gas made up 13 per cent of energy use in Quebec. Natural gas can be used to generate electricity and, in 2009, it accounted for 0.7 per cent of electricity produced in Quebec. In addition, Gaz Métro has been liquefying natural gas at its Liquefaction, Storage and Regasification (LSR) Plant in Montréal East since 1969.

Quebec consumes about \$2 billion worth of natural gas per year. Across Quebec, approximately 130,000 households use natural gas for things like heating and cooking. In addition, natural gas accounts for about half the energy used by Quebec's industrial sector.

NATURAL GAS IS THE CLEANEST-BURNING FOSSIL FUEL AND EMITS LOW LEVELS OF GHGS

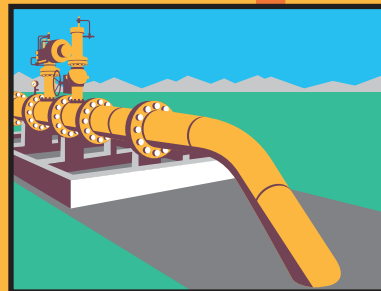
NATURAL GAS PIPELINES



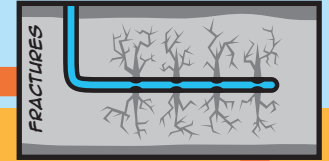
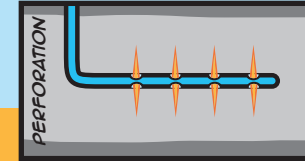
NATURAL GAS

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

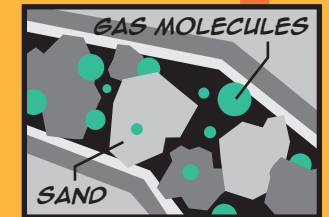
TO EXTRACT **CONVENTIONAL NATURAL GAS** — GAS TRAPPED IN POROUS SANDSTONE AND LIMESTONE FORMATIONS — ENERGY COMPANIES DRILL WELLS INTO THE EARTH, AND THE GAS FLOWS TO THE SURFACE THROUGH THE WELL.



TO EXTRACT **UNCONVENTIONAL NATURAL GAS** — GAS LOCKED WITHIN DEEP ROCK FORMATIONS — ENERGY COMPANIES DRILL HORIZONTAL WELLS 2-3 KILOMETRES INTO THE EARTH.



NEXT, A PRESSURIZED MIXTURE OF WATER, CHEMICALS, AND SAND IS SENT DOWN THE WELL TO OPEN THE CRACKS IN THE ROCK IN A PROCESS KNOWN AS "FRACKING".

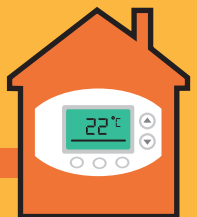
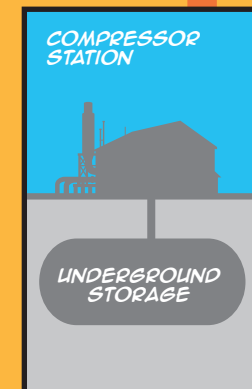
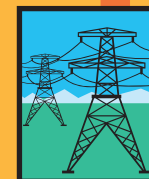
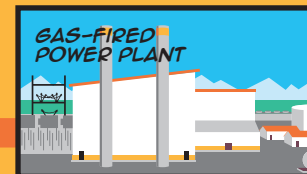


THE GAS IS THEN ABLE TO RISE UP THROUGH THE WELL TO THE SURFACE.



2KM DEEP!

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

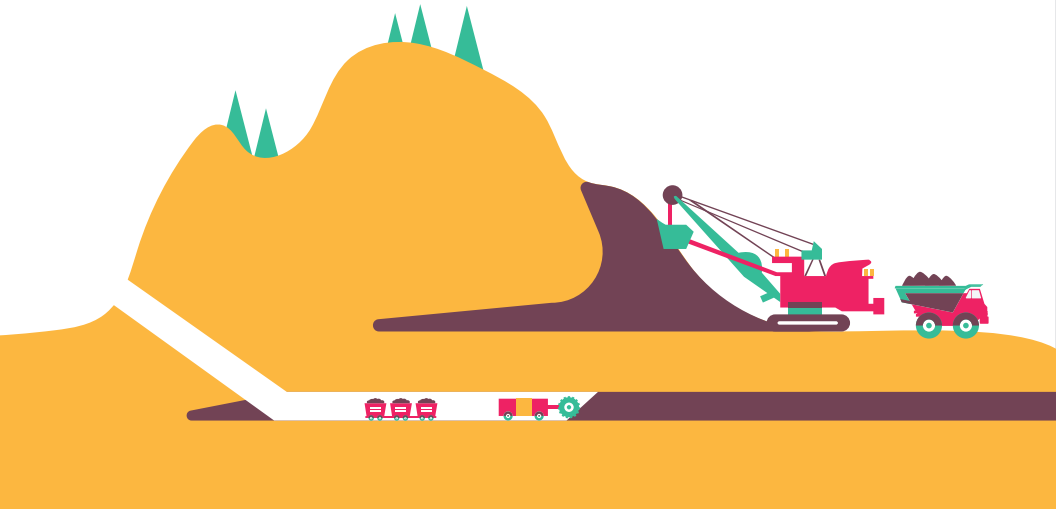


COAL

Coal is the world's most plentiful fossil fuel and a well-used fuel source in Canada. There are about 6.6 billion tonnes of recoverable coal reserves in the country, with the majority of them located in western Canada. This large supply provides an advantage for the country as it allows for the shipping of coal to international markets, such as Japan, China and South Korea.

In Quebec, however, the coal industry is almost non-existent. Less than one per cent of Quebec's energy comes from coal. There are currently 24 coal mines in Canada, with British Columbia home to 10 coal mines, closely followed by Alberta's nine mines. Quebec currently has no active mines.

Mining and open pit-mining are used to remove coal near the surface of flatter terrains, and surface and underground mining is used in the Rocky Mountains and foothills of western Canada. The largest open-pit coal mine in Canada is the Highvale Mine, covering more than 125 square kilometres west of Edmonton near Wabamun.



In terms of energy consumption, Quebec plans to eliminate coal use entirely by 2030 and intends to invest \$4 billion to pursue that goal.

CRUDE OIL

Quebec's capacity for oil and gas was discovered long before industrial resource exploration ever began. In the early days of the province's history, explorer Jacques Cartier was said to have used tar seeping from the mouth of the St. Lawrence River to repair his ship during his travels.

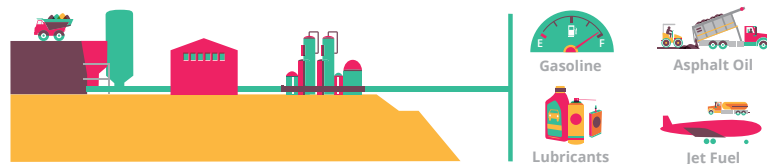
Although Quebec doesn't have any oil production, crude oil plays a huge role in the province's energy economy. Quebec relies heavily on petroleum products, both for its industrial and everyday needs.

While Quebec is considered a clean producer of energy, the province is not necessarily a clean user of energy. While Quebec does purchase some crude oil from western Canada, most of the province's crude oil comes from abroad. Quebec imports over 200 thousand barrels per day (Mbpd) from places like the United States, Algeria, Kazakhstan, and Nigeria. In 2012, Quebec's oil imports amounted to \$13 billion.

Other than the cost of importing crude oil, one also must consider the broader implications of importing crude oil from foreign markets, where oil production may not be regulated by the same strict environmental guidelines as in Canada. The greenhouse gas emission from the production of crude oil, the protection of these natural resources, and the transportation of petroleum products across the Atlantic Ocean to Quebec also leave a large carbon footprint on the environment.

Crude oil needs to be refined and there is a significant refining industry in Quebec. Quebec has two refineries— one in Montreal and another in Lévis — with a total refining capacity of more than 367,000 barrels per day (b/d). Quebec's \$9 billion petro-chemical industry depends on raw materials such as oil to manufacture many products for key Quebec industries, such as aerospace, plastics, and pulp and paper.

Crude oil can be acquired through conventional drilling, mining or extracted from the ground using steam-assisted gravity drainage (SAGD), which breaks up the heavy mixture found in oil sands into something that can be pumped using an oil well. In the west, oil sands account for about 80 per cent of crude oil production in Alberta alone.

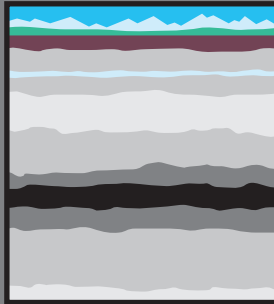


COAL

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



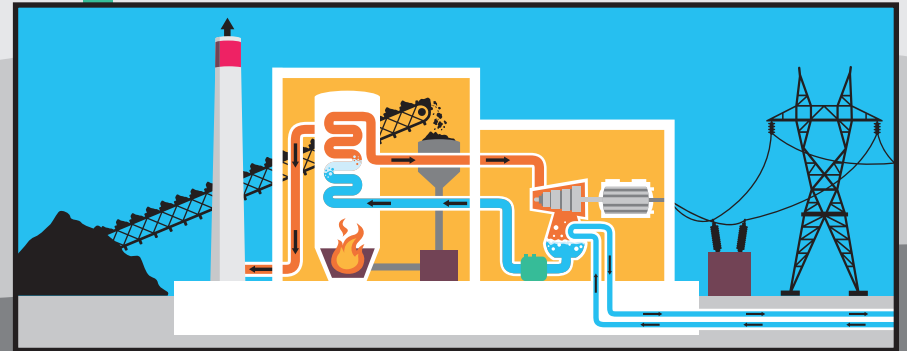
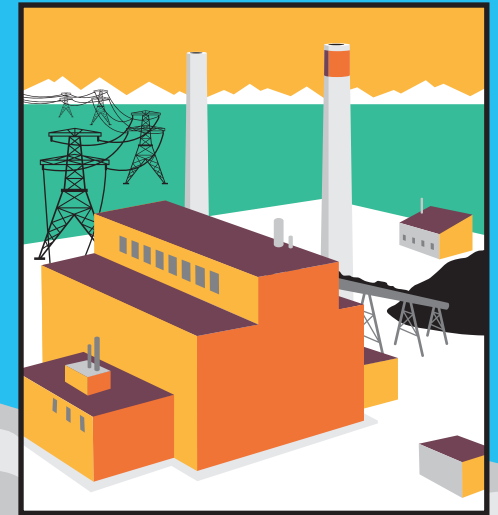
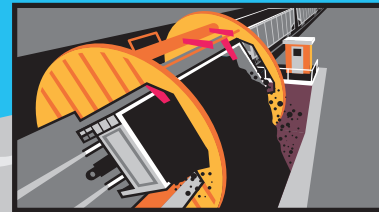
LIKE OIL SANDS MINING, COAL CAN BE STRIPPED FROM THE SURFACE OF THE EARTH BY MACHINE, CALLED STRIP-MINING...



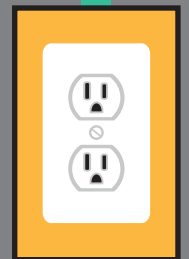
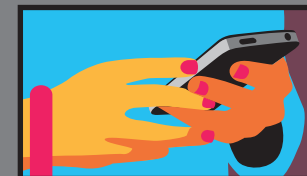
...OR DUG UP BY MINERS WHO BLAST AND BURROW DEEP UNDERGROUND INTO BURIED COAL DEPOSITS OR "SEAMS."



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.



CRUDE OIL

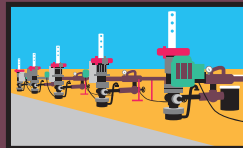
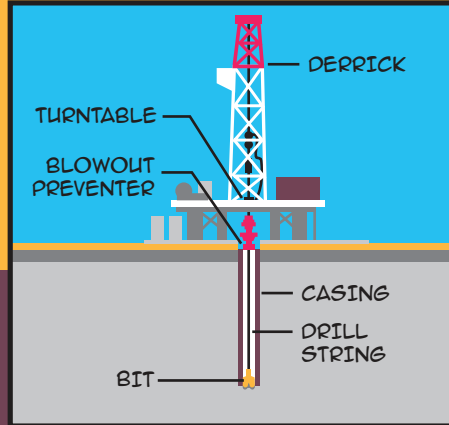
CRUDE OIL IS A YELLOW-TO-BLACK LIQUID, AND REFERS TO LIGHT, MEDIUM, AND HEAVY HYDROCARBONS. IT IS FOUND IN UNDERGROUND RESERVOIRS, OR OIL SANDS DEPOSITS.

CONVENTIONAL CRUDE OIL

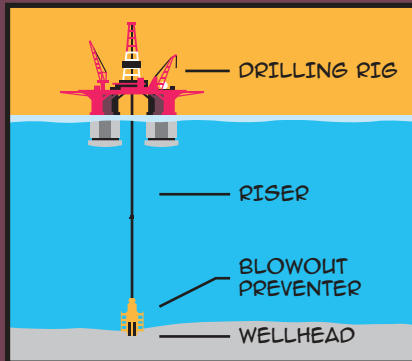
ONCE OIL IS DISCOVERED IN AN UNDERGROUND RESERVOIR, THE SITE IS PREPARED FOR DRILLING. AN OIL RIG IS BUILT TO HOUSE THE TOOLS AND PIPES NEEDED TO DRILL HOLES IN THE EARTH AND BRING OIL UP TO THE SURFACE.

AFTER THE RIG IS REMOVED, THE CREW PUTS A PUMP ON THE WELL HEAD, WHICH PULLS OIL UP THROUGH THE WELL.

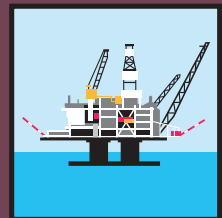
WHEN FINISHED, THE DRILLED WELL BRINGS A STEADY FLOW OF OIL TO THE SURFACE.



SIMILARLY, MOBILE OFFSHORE DRILLING UNITS (MODU) ARE USED TO ACCESS OIL BENEATH THE OCEAN FLOOR. THEN EITHER OFFSHORE PLATFORMS, OR FLOATING PRODUCTION STORAGE AND OFFLOADING (FPSO) VESSELS EXTRACT AND STORE OIL BEFORE IT IS MOVED ASHORE.



BOTH DRILL RIGS AND PRODUCING WELLS ARE FITTED WITH **BLOWOUT PREVENTERS (BOP)** TO HELP PREVENT ACCIDENTAL RELEASES OF OIL.

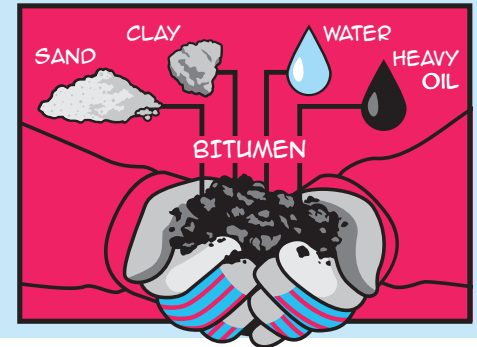


UNCONVENTIONAL CRUDE OIL

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.

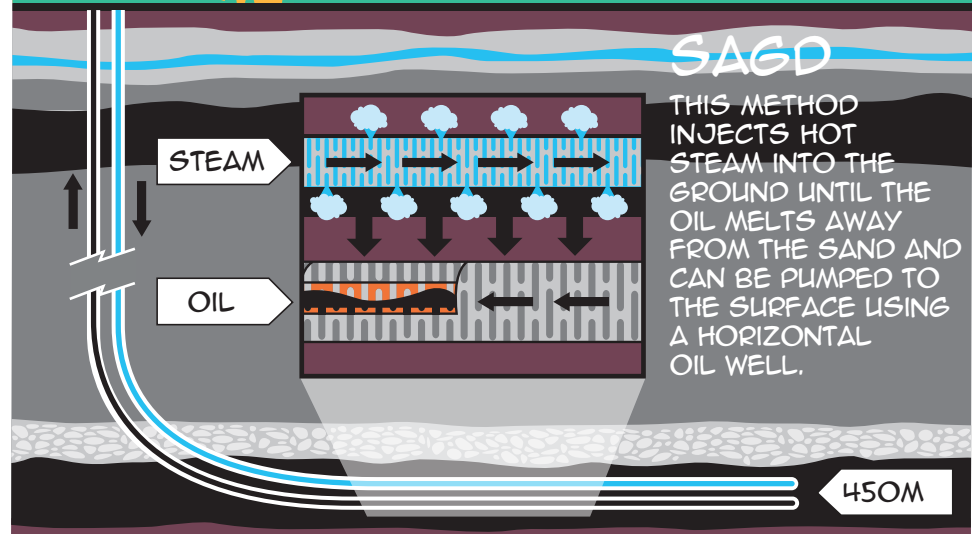


MINING IS USED WHEN OIL SANDS ARE CLOSE ENOUGH TO THE SURFACE TO BE DUG UP USING EXCAVATORS, WHICH LOAD IT ONTO LARGE TRUCKS. THE **OIL SANDS** ARE TAKEN TO A PROCESSING PLANT WHERE IT IS MIXED WITH HOT WATER TO REMOVE THE SAND AND CLAY.



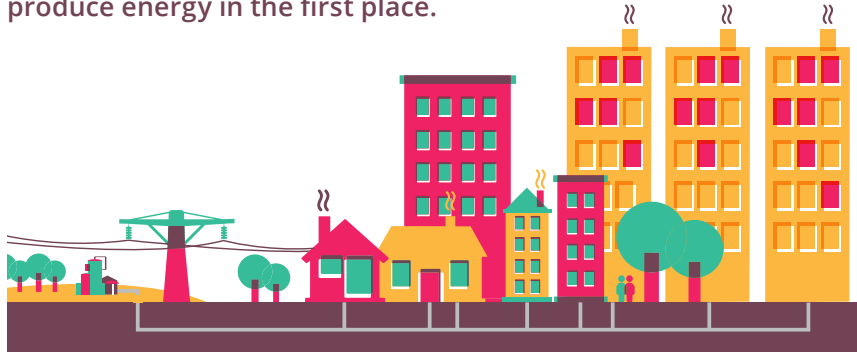
IN SITU

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



ENERGY SUPPLY CHAIN

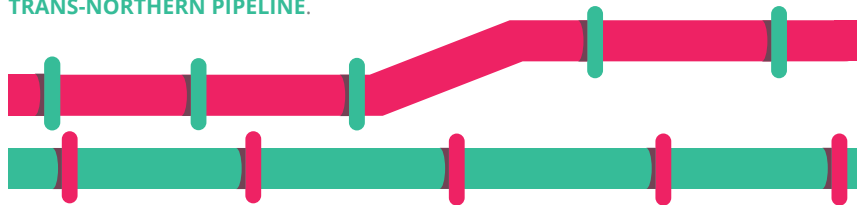
Whether it's hydroelectricity, natural gas or crude oil, the sources of energy that heat our homes, fuel our vehicles, and power our devices often travel huge distances. This means that how we transport energy is almost as important as how we produce energy in the first place.



Quebec is a major player in the supply chain. It may be known for its hydroelectricity and wind power, but Quebec also has an important role in the distribution of petroleum products. In Canada, there are three distinct regions for the distribution of petroleum products: Western Canada, Ontario, and Quebec/Atlantic Canada.

In the Quebec/Atlantic Canada region, ships transport petroleum products from regional refineries to wherever they need to go. Quebec also has two major pipelines: the **TRANS QUEBEC AND MARITIMES PIPELINE** and the **TRANS-NORTHERN PIPELINE**.

QUEBEC HAS AN IMPORTANT ROLE IN THE DISTRIBUTION OF PETROLEUM PRODUCTS

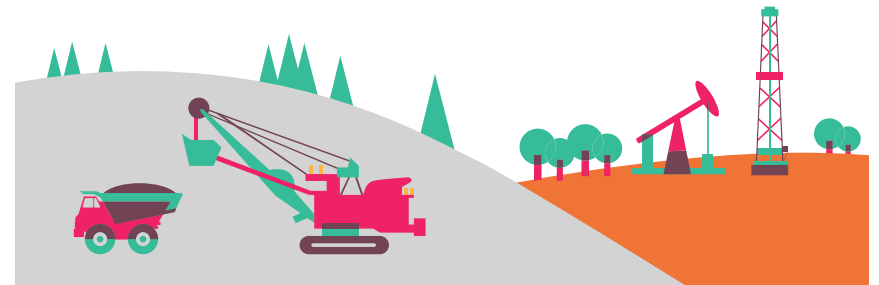


The **TRANS QUEBEC AND MARITIMES PIPELINE** connects Montréal to Québec City, carrying natural gas. It is part of the larger TransCanada 60,000 km market across North America. The **TRANS-NORTHERN PIPELINE** links Montréal, Quebec to Nanticoke, Ontario. This pipeline transports approximately 172,900 barrels of refined fuel products daily.

Most of the refineries in the Quebec/Atlantic Canada region get their crude oil from other countries. Over half of the oil used in the region comes from countries such as Saudi Arabia and the United States.

It's a give and take relationship. Quebec in turn exports electricity to the northeastern United States thanks to the province's substantial supply of hydroelectricity.

THE OIL SANDS INDUSTRY EMPLOYS OVER 16,000 QUEBECERS



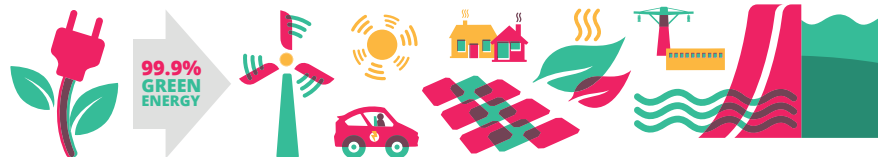
Quebec also benefits from Canada's oil sands. The goods, materials and services used to construct and operate oil sands projects come from across Canada. Quebec plays an important role in the industry, providing some of these goods, materials and services. In Quebec, between 2014 and 2015, the oil sands industry was responsible for creating or maintaining over 16,000 jobs. The oil sands sector also purchased about \$1.2 billion in contracts for transportation, manufacturing and services.

ENVIRONMENTAL IMPACTS

All energy sources impact the environment in various ways, but not all these impacts are equal. Fossil fuels emit greenhouse gases (GHGs), which cause climate change. The infrastructure for hydroelectricity requires large swathes of land and can alter ecosystems. Wind power installations can be harmful to wildlife, such as birds.

And yet, the environmental impact of renewable resources on the environment is far lesser than that of fossil fuels. Quebec's focus on renewable energy means that the province produces low GHG emissions. The province is one of only a few places in the world that produces primarily clean energy, with 99.9 per cent of all energy produced considered green energy. "Green" or "clean energy" is energy that is renewable and produces low GHG emissions.

Although renewable energy sources such as wind and hydroelectricity emit little to no GHGs when operating, their infrastructure requires the use of other GHG-emitting fossil fuels for their construction and maintenance.



This chart compares Canada's major energy sources and their effects on the environment. It looks at four main criteria: average weight in kilograms of carbon dioxide (CO₂ is the most commonly measured GHG) per million British Thermal Units (BTUs is a measure of energy) emitted when using the energy source for fuel, the infrastructure needed to produce the energy resource, the impact on the landscape of developing these resources, and how long it takes the land to return to its previous, or similar, productivity.



To learn more about how energy sources contribute to climate change, visit energyiq.canadiangeographic.ca/learning_centre

CANADA'S MAJOR ENERGY SOURCES AND THEIR IMPACTS ON THE ENVIRONMENT



COAL



CRUDE OIL



NATURAL GAS



RENEWABLES

TYPE FOUND IN CANADA

Bituminous & sub-bituminous coal

Mostly oil sands, a mixture of sand, clay, water, and oil; some conventional crude oil

Mostly conventional; some unconventional

Hydroelectric, wind, solar, and biomass

AVERAGE KGS OF CO₂/MILLION BTU

95.25

75.57

53.00

Little to no GHGs

INFRASTRUCTURE NEEDED

Excavators, trucks, processors, coal-fired power plants, transmission lines

Excavators, trucks, drilling rigs, upgraders, refineries and pipelines

Drilling rigs, processors, gas-burning power plants, transmission lines

Wind turbines, biomass feedstocks and generating plants, hydro-electric dams, transformers, transmission lines

IMPACT ON LANDSCAPE

Vast areas of land are disturbed and removed entirely

For mining, areas of land are stripped and tailings ponds remain for several years. For conventional drilling, very little land is used

Minimal clearing of trees around a well site, if necessary. Fracking requires significant quantities of water

Wind farms can harm local avian populations. Hydroelectric dams can harm aquaculture. Biomass can include crops, and generating facilities can produce some GHGs. Solar uses farm land, and the panels can be hazardous to birds

TIME FOR LAND TO RETURN TO PREVIOUS PRODUCTIVITY

Many years, though often the landscape is forever changed

For oil sands, many years of reclamation are necessary. In the case of conventional oil, there is often no disruption to previous productivity

No disruption to previous productivity on the surface. Impacts of fracking are still being measured

Immediately, though hydroelectric dams can cause long-term changes to river ecosystems

ENERGY ECONOMY

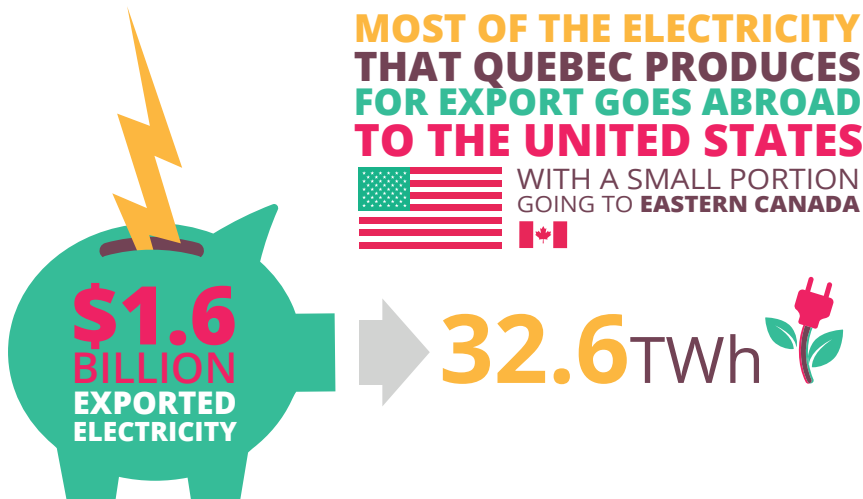


Quebec has always been known for its renewable natural resources, which have allowed the province to maintain a strong position in the energy sector, both in Canada and on a global scale.

In 2016, Quebec's net electricity exports totalled over \$1.6 billion, which accounted for a total of 32.6 TWh of electricity. Most of the electricity that Quebec produces for export goes abroad to the United States, with a small portion going to Eastern Canada. In 2016, Quebec sold 48 per cent of its electricity to New England and 26 per cent to New York.

There are currently close to 52,000 people employed in the energy sector in Quebec. Interest in green renewable energy continues to grow in the face of climate change, creating more jobs and opening new markets. With its hydroelectricity plants and wind power installations, Quebec is well positioned as a green energy industry leader.

Other facts of Quebec's economy, beyond the energy sector, are fueled by Canadian energy production. For example, the province's \$9 billion petrochemical industry depends on raw materials such as oil to manufacture many products for key Quebec industries, such as aerospace, plastics, and pulp and paper.



ENERGY FUTURE

In Quebec, electric vehicles are becoming more and more common. Quebec accounts for nearly half of all electric vehicle sales in Canada. In fact, a region just north of Montréal, called Lanaudière, has even earned the nickname "electric car capital of Canada". It boasts the highest electric car ownership per person in Quebec.



Several factors have helped make electric vehicles popular in Quebec: the province offers rebates for electric vehicles, there is new legislation in place for automakers that encourages the sale of electric vehicles and hybrids, and electricity in Quebec is cheaper than in the rest of the country.

Electric vehicles aren't without environmental impacts, but those impacts come mainly from their manufacturing. The amount of energy it takes to make an electric car is about twice as much as for a conventional car, which is in part because of battery issues and lower lifetime mileage for electric cars. When it comes to driving, electric cars can be more environmentally friendly than conventional vehicles that use gasoline or diesel if they are powered by clean energy. This is especially true in Quebec, where the energy used to charge electric cars comes mainly from hydroelectricity, a relatively clean renewable source of energy.

In Quebec, liquid natural gas (LNG) has also made an appearance in transportation. Natural gas is the cleanest-burning fossil fuel and produces less GHG emissions than crude oil. Since 2011, some heavy trucks have been running on LNG, supported by three different refueling stations in Quebec. As for marine transport, Quebec's MV F.-A.-Gauthier has become the first ship in Canada to be fuelled by natural gas.

ENERGY QUIZ



For more fun and interactive energy quizzes, visit
energyiq.canadiangeographic.ca/main/quizzes

Test your knowledge of Quebec's energy resources.

1) WHICH OF THE FOLLOWING ARE THE MAIN SOURCES OF ENERGY PRODUCED IN QUEBEC?

- A) Hydro, Coal, Solar B) Nuclear, Wind, Solar
C) Hydro, Wind, Biomass D) Hydro, Nuclear, Coal

2) TRUE OR FALSE: QUEBEC HOLDS OVER 80 PER CENT OF CANADA'S WATER RESERVES.

- A) True B) False

3) HOW LONG HAS HYDRO-QUÉBEC BEEN IN OPERATION?

- A) 60 years B) 50 years
C) 40 years D) 75 years

4) WHERE IS THE JAMES BAY PROJECT LOCATED?

- A) St. Lawrence River B) La Grande Rivière
C) Saguenay River D) Rivière Chaudière

5) TRUE OR FALSE: HYDROELECTRICITY IS A RENEWABLE TYPE OF ENERGY.

- A) True B) False

6) QUEBEC HAS ____ OUT OF CANADA'S TOP 10 WIND FARMS.

- A) 2 B) 3
C) 5 D) 7

7) THE UTICA SHALE IS ____ METRES DEEP.

- A) 2,500 B) 7,000
C) 5,200 D) 3,300

8) WHICH FAMED EXPLORER USED TAR FROM QUEBEC'S OIL AND GAS RESERVES TO REPAIR HIS SHIPS?

- A) Alexander Mackenzie B) Jacques Cartier
C) William Cormack D) David Thompson

9) HOW MANY QUEBECERS ARE EMPLOYED BY THE OIL SANDS INDUSTRY?

- A) Less than 10,000 B) 12,000
C) 5,000 D) More than 16,000

10) TRUE OR FALSE: QUEBEC IMPORTS ALL NATURAL RESOURCES NECESSARY TO MAKE PETROLEUM PRODUCTS.

- A) True B) False

WORDSEARCH PUZZLE

Y F I U V P D R B W S T O R L S
E T T R N A M V I P A Q E W H R
A L I Q J V U S O G K U N O W H
P E D C G T L Y M B L E E Y N O
O N T C I M X G A S H B R I R S
D O A F S R B N S W M E G D A W
U R V U L I T M S A O C Y F X O
M D X E E B B C R F N H E O R O
D A M L A G O R E S T N M I E D
C I A K M A G I H L R Y Q Y T S
A S C Q L R U Q O O E V S B A E
S R I M P A N G J C A O Z D W E
E Z T U N P O W E R N I R I J Q
M A U S K L R F Z E B L O D N Y
A S R I V I E R E N F R F A Y G
J A G L E Q T M H O Z P I S L H

Questions

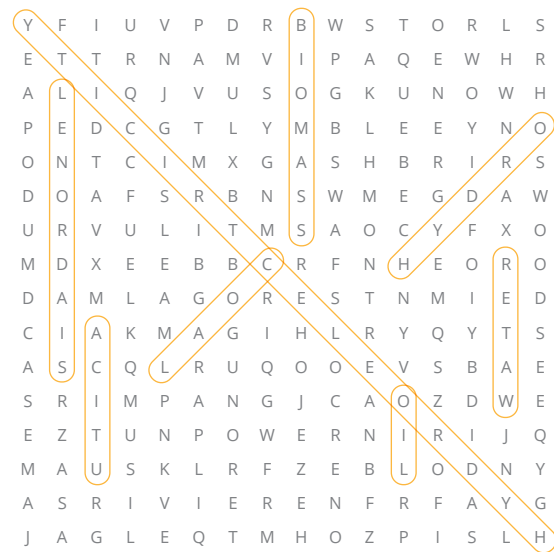
- 1) What is the term for industrial wood waste used in energy production? (7 letters)
- 2) What is the most prevalent type of energy produced in Quebec? (5 letters)
- 3) What is needed to make hydroelectricity? (5 letters)
- 4) This energy resource is black and lumpy in form. (4 letters)
- 5) What was Quebec's first commercial wind farm? (9 letters)
- 6) After hydroelectricity, what is the second most common energy source used in Quebec? (3 letters)
- 7) What is Quebec's main energy export? (16 letters)
- 8) What is the name of the natural gas reserve found in Quebec? (5 letters)

ANSWER KEY

ANSWERS TO ENERGY QUIZ (PG 28):

- 1) Hydro, Wind, Biomass
- 2) False — It holds just over 40%.
- 3) 75 years
- 4) La Grande Rivière
- 5) True
- 6) 3
- 7) 3,300
- 8) Jacques Cartier
- 9) More than 16,000
- 10) True

ANSWERS TO WORDSEARCH (PG 29):



- | | | |
|------------|---------------|---------------------|
| 1) Biomass | 4) Coal | 7) Hydroelectricity |
| 2) Hydro | 5) Le Nordais | 8) Utica |
| 3) Water | 6) Oil | |

NOTES

[illegible]

NOTES

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