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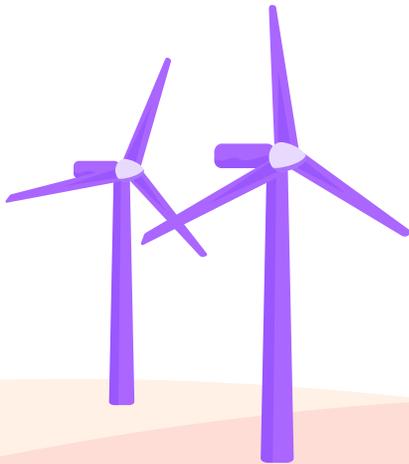
Guiding Canadians through the Electricity Sector



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DAY
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CAN YOU IMAGINE WHAT THE FIRST HOUR OF YOUR DAY WOULD LOOK LIKE WITHOUT ELECTRICITY?

Consider the alarm that wakes you up, the lights that guide you to the bathroom, and the warm water that flows from your shower. Electricity has become such a necessity that it is hard to imagine our daily life without it. **But how was this electricity generated and transmitted to your home?** Behind the scenes, there is a vast network of people, organizations, facilities, and infrastructure that ensure the lights come on when you flick the switch.

ELECTRICITY MANAGEMENT: THE CANADIAN CONTEXT

Canada spans across a wide geographical area that is made up of 13 provinces and territories, each with its own government and responsibilities. **The management of electricity falls under each provincial/territorial government's jurisdiction, and they determine the legislative framework, policy, and development of the electricity industry within their region.** A fragmented decision-making process and the wide variety of energy sources available across Canada make it challenging for renewable electricity to be more widely adopted.

The majority of electricity consumed in each region of Canada is often generated within its borders, with the exception of Nunavut, who relies heavily on imported fuels. In North America, electricity is also imported and exported throughout a grid of networks which spans across Canada, the United States, and Mexico through the North American Electricity System. The Yukon, Northwest Territories, and Nunavut, however, are not connected to this system.

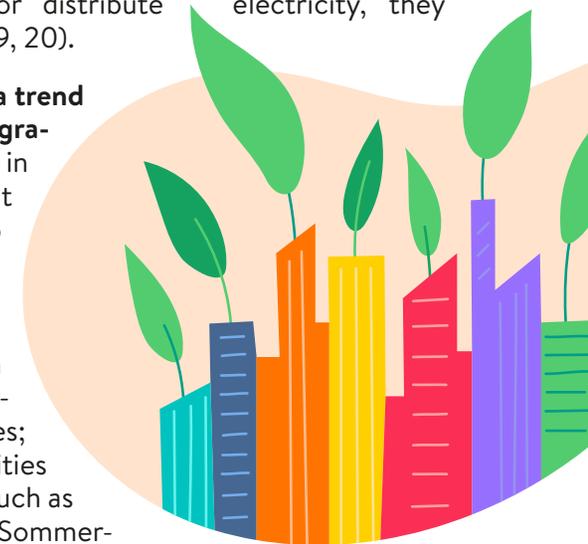
ELECTRICITY MANAGEMENT: VERTICAL INTEGRATION

Each Canadian region has its own independent regulatory body that is responsible for setting rates and monitoring utility companies adherence to legislation. Generally, utility companies in Canada are vertically-integrated, meaning they are responsible for generation, transmission, and distribution of electricity in their province. Specifically, generating the electricity, transmitting it long distances, and then distributing it through local power lines to homes and businesses (23, 20).

While, in many provinces, the vertically-integrated utilities are crown corporations, regions such as the Northwest Territories, Yukon, Ontario, Prince Edward Island, and Newfoundland have both crown and investor-owned utilities. Alberta's electricity market differs from the rest, in that the province does not own any utilities, and, instead, has opted for a competitive market. Comparatively, Ontario operates as a hybrid model, with regulated and non-regulated electricity rates. Unique to both Ontario and Alberta, is the existence of retailers who do not generate, transmit, or distribute electricity, they only sell it to consumers (39, 20).

In Canada, there has been a trend to unbundle vertical integration. This move has resulted in the growth of Independent Power Producers (IPP) who generate electricity and then sell it to utilities. The IPPs include private companies; cooperatives, such as rural solar or wind energy producers; municipalities; and Indigenous communities (39).

Many municipalities, such as Calgary, Toronto, Ottawa, Somerside (PEI), and many in New Brunswick and Nova Scotia, distribute electricity as well as generate it.



ELECTRICITY MANAGEMENT: FEDERAL GOVERNMENT AND ASSOCIATION INVOLVEMENT

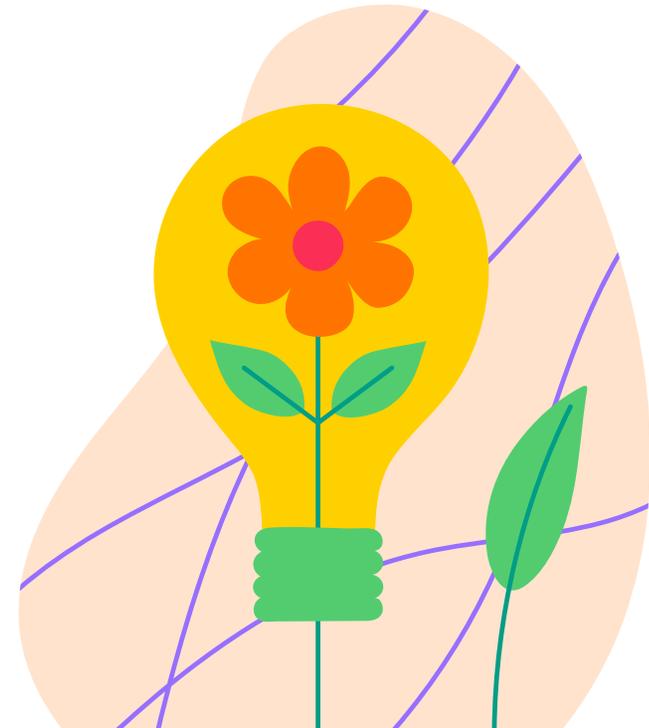
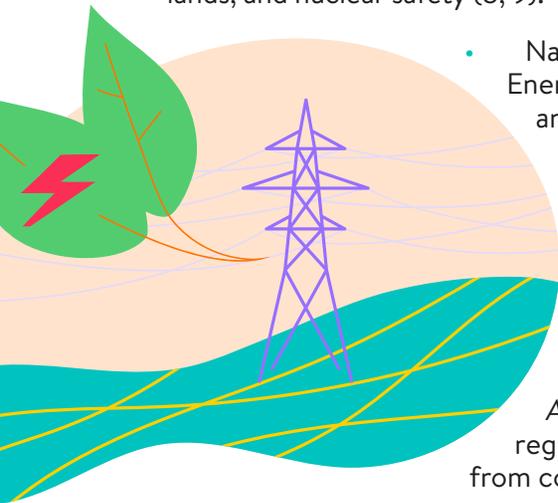
Although the provincial and territorial governments have constitutional authority over the management of electricity, **the federal government still wields significant power over the industry in both direct and indirect ways.**

- The Canada Energy Regulator and Canadian Nuclear Safety Commission are responsible for inter-provincial and international trade of electricity, the development of projects on federal lands, and nuclear safety (5, 9).
- Natural Resources Canada's Energy Sector and Environment and Climate Change Canada's Electricity and Combustion Division lead energy policy and efficiency programs.
- The federal government has also shaped the electricity sector through the *Environmental Protection Act*, where they defined regulations of carbon dioxide from coal-fired electricity facilities.
- Other federal regulations, such as the *Impact Assessment Act*, *Species at Risk Act*, *Migratory Birds Convention Act*, and *Fisheries Act*, play a role in the development and management of generation facilities and transmission lines.
- The federal government also funds a variety of research and development in the electricity sector, which greatly influences the direction of innovation.

There are also many associations across the country who support the electricity industry (eg. Canadian Electricity Association), source specific groups (eg. WaterPower Canada, Canadian

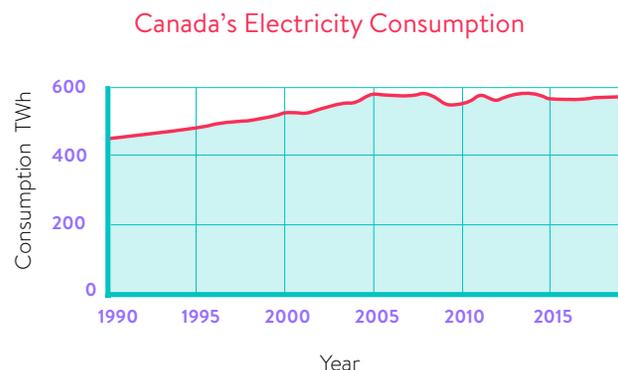
Renewable Energy Association), and regional associations (eg. Independent Power Producers Society of Alberta and Association of Power Producers of Ontario).

Visit our [Provinces and Territories profiles](#) to learn more about the specific actors in each province and territory.



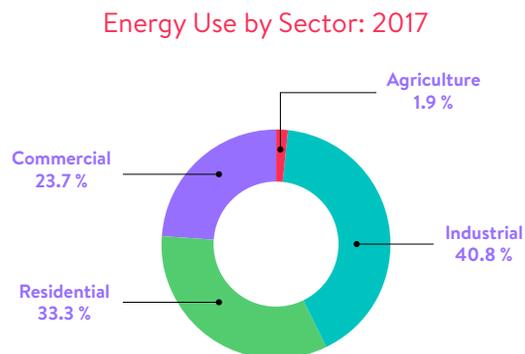
ELECTRICITY CONSUMPTION IN CANADA

Canada's electricity consumption has been increasing steadily over time.



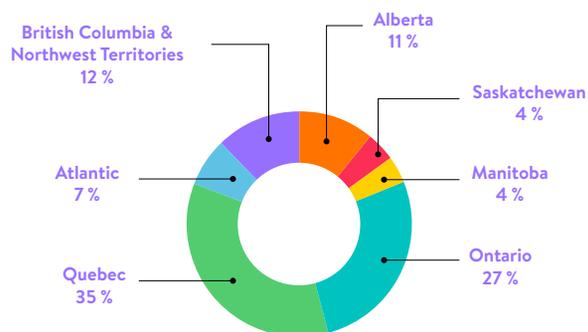
In 2019, Canada consumed over 572 Terawatt-hours (TWh) of electricity. That is 28% higher than what was consumed in 1990 (26).

But who is using all of the electricity in Canada?



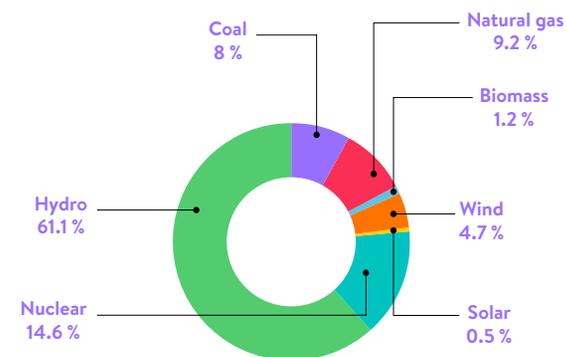
Industrial activities account for just under 50% of our electricity consumption, while the residential and commercial sectors, combined, account for over 55% of the remainder (32).

Electricity Consumption in Canadian Regions: 2017



When looking at Canada by region, Quebec and Ontario account for the largest share of demand at 35% and 27%, respectively (32). High electricity usage in Quebec may be due to their low electricity prices for industrial and residential consumers.

Canada's Energy Generation: 2019



Canada is fortunate to have tremendous potential for generating renewable electricity from a variety of different sources. In fact, around 67% of our electricity generation already comes from renewable sources (2).

SOURCES OF ELECTRICITY

Generally, electricity is produced through the rotation of a turbine from a source of energy (oil, sunlight, coal, etc.).

As a result of Canada's varied landscapes and provincial/territorial policies, several different sources of energy are used across the country to generate electricity.

Hydroelectricity

An illustration showing a stylized dam with a large green leaf in the foreground. The dam is orange and yellow, with water flowing through its spillways. The background is a light orange color.

Hydropower uses the power of flowing water to rotate a turbine, thus generating electricity. This energy source is cost-competitive and reliable, however damming a river changes the surrounding wildlife habitats, blocks fish passage, and may force riverside communities to relocate. In 2019, hydropower accounted for 60% of Canada's total generated electricity, making it the largest source of electricity in Canada (27). British Columbia, Manitoba, Newfoundland and Labrador, Quebec, and Yukon all depend on hydro for over 80% of their electricity demands (21). Because of the specific topography required for hydroelectric dams, it is not a possible source of electricity in all areas of Canada.

Coal

Coal is mined from underground deposits, processed, and then burned to heat water. This, in turn, generates high-pressure steam that rotates a turbine and generates electricity. It is a highly abundant and cheap resource, however it is the most carbon dioxide intensive fuel when combusted and contains other elements that cause pollution and related health and environmental issues. In 2019, coal supplied 8% of Canada's total electricity (2).

Natural Gas

Natural gas is extracted from deposits found between rock layers underground, processed, and burned either to produce pressurized gas or to heat water to generate high-pressure steam, both of which result in the rotation of a turbine. When burned, natural gas emits less greenhouse gases than coal, however, it is still a source of carbon dioxide and methane (a highly potent greenhouse gas that can escape during the extraction process). Natural gas is the most common combustible fuel used accounting for 9% of total electricity generation in 2019 (2).

Oil

Oil is extracted from underground reservoirs, processed, and burned to heat water. This, in turn, generates high-pressure steam that rotates a turbine and generates electricity. Rather than being used to generate electricity, oil is primarily used to power Canada's transportation system and to create materials, such as plastics, that we use in our daily life. Oil emits greenhouse gases when burned and its extraction can cause land-disturbances. As well, exportation of oil between regions is risky and can result in oil spills, thus damaging nearby environments and communities. Oil accounted for less than 1% of Canada's total electricity generation in 2019 (2).

Biomass

Utilizing biomass as an electricity source involves processing and burning organic materials, such as wood, living plants, and waste to produce high-pressure steam that rotates a turbine and generates electricity. Biomass can be an environmentally friendly source



of electricity or it can have high greenhouse gas emissions, depending on the technology and organic materials being used. Biomass accounted for 1% of Canada's electricity generation in 2019 (2).

Nuclear

Nuclear energy uses the energy from splitting atoms to generate heat. This heat is then used to generate high-pressure steam that rotates a turbine and generates electricity. Nuclear power plants can generate a lot of electricity and nuclear power itself does not emit greenhouse gases, however nuclear production generates radioactive waste that can remain hazardous to humans and the environment for thousands of years. Nuclear energy accounted for 15% of the total Canadian electricity supply in 2019, generated at power plants in Ontario and New Brunswick (2).

Wind

Wind energy simply uses the energy of wind to rotate a turbine and generate electricity. The production of wind energy does not directly emit greenhouse gases, however wind is not constant and so it cannot be relied upon as a constant source of electricity. Furthermore, concerns around noise, land use, and bird disruption due to erection of wind turbines have been raised in some areas of the country. Wind accounted for 5% of Canada's electricity generation in 2019 (2). Canada's vast open landscapes allow for great potential to harness wind power, making it one of Canada's fastest growing sources of electricity.

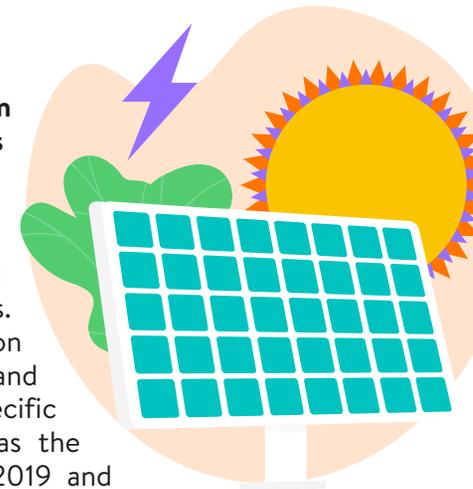
Solar

Solar energy converts the energy of the sun into direct current electricity using a material called semiconductors. Solar energy production does not directly emit greenhouse gases,

however, much like wind energy, it cannot be relied upon as a constant source of electricity and achieving high efficiency can be a challenge depending on the location, season, and time of day. Solar accounted for less than 1% of Canada's electricity generation in 2019, but is one of the fastest growing generation sources (2).

Tidal

Tidal energy uses the power from the natural rise and fall of the tides to rotate a turbine and generate electricity. Tidal power has low environmental impacts compared to most generating sources and has predictable generation patterns. However, the periods of generation may not match periods of demand and tidal projects require very specific site requirements. Nova Scotia was the sole producer of tidal energy in 2019 and generated 0.01% of its electricity supply from tidal power (2).



To learn more about how the different sources of electricity work, visit electricity.ca.



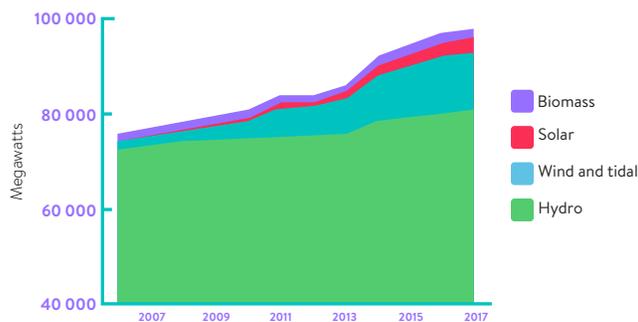
CANADIAN ELECTRICITY AND CLIMATE CHANGE

Canada's electricity sector was responsible for 9% of the country's total greenhouse gas emissions in 2018 (24).

The majority (63%) of these emissions coming from coal-fired electricity (22). As electricity consumption increases, **transitioning away from emission-heavy sources and increasing renewable electricity generation is crucial and would lead to significant reductions in Canada's total emissions.**

The good news is that renewable energy sources, such as wind and solar power, are becoming less expensive with technological advances, making future projects increasingly viable. In 2005, Canada had zero generation of solar power. Now, although solar power only contributes roughly 0.5% (in 2015) of Canada's electricity generation, **the production of solar energy has increased by 4,361% since 2011 (5)!** Continued innovation, investments, and support for these projects are necessary to allow us to continue moving forward on this path.

Canadian Renewable Electricity Generating Capacity



Source: [Natural Resources Canada Renewable Energy Facts](#)

THE FUTURE OF RENEWABLE ELECTRICITY

The shift away from traditional energy production is occurring across the globe, with countries continuously looking to renewable energy sources to deliver services, such as heating and transportation (7).

In Canada, our demand for electricity is expected to grow 1% per year between now and 2040 (20). This increase means that investing in new infrastructure is crucial, not only to replace our current non-renewable sources and aging infrastructure, but also to meet our future electricity demand. **The Government of Canada has set a goal to have 90% of the country's electricity produced by non-emitting sources by 2030 (22).** As part of this initiative, they have introduced regulations to phase-out traditional coal fire electricity across the country by 2030 (18). Four provinces have also established their own goals or targets relating to renewable energy (11). The specifics of each of these provinces can be viewed in the table below.

Renewable energy goals and targets from Canadian provinces (11)

British Columbia <i>Clean Energy Act (2010)</i>	Goal to have 93% of electricity generated from clean or renewable energy sources and electricity demand reduced by at least 66% by 2020.
Alberta <i>Renewable Electricity Act (2017)</i>	By 2030, Alberta has the target to have 30% of the electricity produced in the province produced through renewable sources.
Saskatchewan SaskPower (Government owned Utility)	Goal to increase renewable electricity generation from 25% to 50% by 2030.
New Brunswick Electricity from Renewable Resources Regulation	Target to have 50% of the province's electricity sales come from renewable energy by 2020.

Alberta recently terminated their Renewable Energy Procurement program that would have ensured an additional 3600 MW of renewable generation. Similarly, Ontario recently terminated feed-in-tariff and procurements of large renewable projects. Although the loss of these policy decisions are indeed setbacks in these regions, renewable electricity projects remain viable (2).

INSPIRING INITIATIVES ACROSS THE COUNTRY

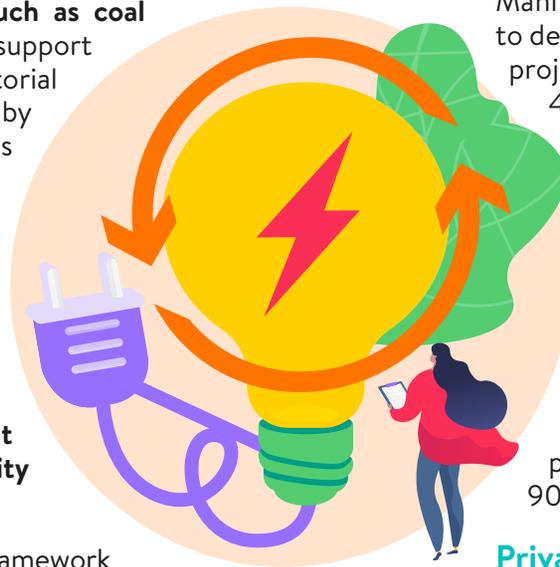
Increases in renewable energy and natural gas are expected to be the major drivers in meeting Canada's future electricity demand and replace retiring sources, such as coal (2,17).

These developments will require support from federal, provincial, and territorial governments, and will be undertaken by utilities, private-sector players, Indigenous Peoples, and communities. Across the country, there are many exciting projects and initiatives being led by all of these actors.

Governments

The federal, provincial, and territorial governments will all play an important role in promoting renewable electricity development in Canada.

At the federal level, the Pan-Canadian Framework on Clean Growth and Climate Change (2016) establishes a plan to increase renewable generation, connect clean power with places in need, and upgrade electricity systems to facilitate the integration and expansion of renewables (22). The federal government recently established the Canada Infrastructure Bank that will invest \$2.5 billion to support renewable electricity generation, storage, and transmission between provinces and territories. As well, they will invest \$1.5 billion in the acceleration of zero-emission buses and charging infrastructure adoption (8).



Meanwhile, provinces and territories are collaborating through the Canadian Energy Strategy (2015) to improve energy conservation and efficiency, clean energy technology and innovation, and the deployment of energy to people and global markets (37).

Utilities

Canadian utility companies will continue to be some of the biggest players in the future of renewable electricity development.

Manitoba Hydro is partnering with four Manitoba First Nations to develop the Keeyask Hydroelectric Project. This \$8.7 billion project, currently under construction, will contribute roughly 4,400 GWh of renewable electricity to the province's total generation. That's enough to power 400,000 homes (29)!

In jurisdictions where the potential to generate hydroelectricity is limited, forecasts show significant increases in wind and solar generation. For Example, SaskPower, the principal electric utility company in Saskatchewan, has contracted Potentia Renewables to build, own, and manage the Golden South Wind Energy Facility. The facility will produce 200 MW of wind-produced electricity, enough to power approximately 90,000 homes (34).

Private sector

The private sector is leading some of the most exciting projects in Canada, including the deployment of smart grids.

These projects modernize the electrical grid, allowing for the integration of renewable sources, supporting the transition towards electric vehicles, and allowing the grid to be more efficient and reliable.

The Sault Smart Grid Project in Sault Ste. Marie, Ontario is one

great example. PUC Services Inc. is establishing a community-scale smart grid that will incorporate several smart grid technologies into the electrical system.

The project has several advantages:

- Will reduce electricity costs to customers,
- Increase reliability and power quality,
- Allow for the integration of renewable electricity.
- It will even create 140 new jobs (19)!

Communities

Canada has a variety of community-owned renewable electricity projects, though the number of these types of projects is significantly less compared to other countries (38).

When a community has ownership over a project, it often ensures that the goals of the project align with the goals of the community and it allows for the project to be designed to provide local economic and social benefits. Community-owned projects can provide meaningful employment, support energy independence, and empower citizens (38).

The Skinners Pond Wind Energy Centre is a community-driven project that started with a group of forward-thinking landowners in PEI. Recognizing their region had large wind power potential and that wind turbines were compatible with local farming practices, they decided to take action. After soliciting bids, Invenergy was selected to construct a 30 MW wind farm.

In addition to generating renewable electricity and delivering benefits to the landowners, the project established a community benefit fund that will contribute \$500/MW to local institutions for the benefit of all residents (35).

Indigenous peoples

Canada's relationship with Indigenous peoples is important for the future of renewable electricity.

With the right approach, renewable electricity projects have

the potential to contribute to reconciliation and nation-to-nation relationships (15). Supporting Indigenous-led projects allows communities to produce electricity rather than depend on large corporations or utilities, become more autonomous, and secure long-term financial benefits (33).

First Nations, Inuit and Metis peoples are currently participating in or leading more than 150 large-scale clean energy projects (31). When Indigenous communities lead these projects, they are able to achieve their own vision for environmental sustainability and build capacity for building and managing electricity infrastructure (33).

Indigenous communities in action

Following an oil spill on the Lubicon Lake Band's traditional territory in Alberta, the Band decided to lead a transition towards a greener future. Together with their partner, Bullfrog Power, the Band built the Piitapan Solar Project, an 80-panel project that provides renewable electricity into the community's health centre.

THE TIME FOR ACTION

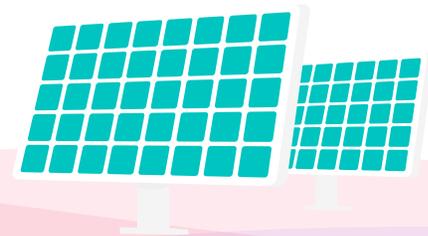
All Canadians have a role to play in securing a future with reliable and sustainable electricity. As a homeowner, business, or municipality, **there are exciting opportunities and incentives to support renewable electricity generation.**

Visit our website switchtorenewable.ca to learn how you can join the energy transition and adopt renewables.



REFERENCES

To view the references we utilized to obtain information for both switchtorenewable.ca and this guide, please [click here](#).





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