FIRST NATIONS MAJOR PROJECTS COALITION

Clean Energy Project Types and Opportunities

What First Nations interested in owning or partnering on clean energy projects need to know

FNMPC thanks the British Columbia Clean Energy and Major Projects Office (CEMPO) for funding the preparation of this report.

Prepared by:

Dr. Sue von der Porten, VP Clean Energy Strategy, FNMPC

Emily Nilsen, Independent Consultant

Mark Podlasly *(Nlaka'pamux Nation)*, Chief Sustainability Officer, FNMPC

Angel Ransom *(Nak'azdli Whut'en)*, Senior VP Environmental Services, FNMPC

Thank you for expert review by:

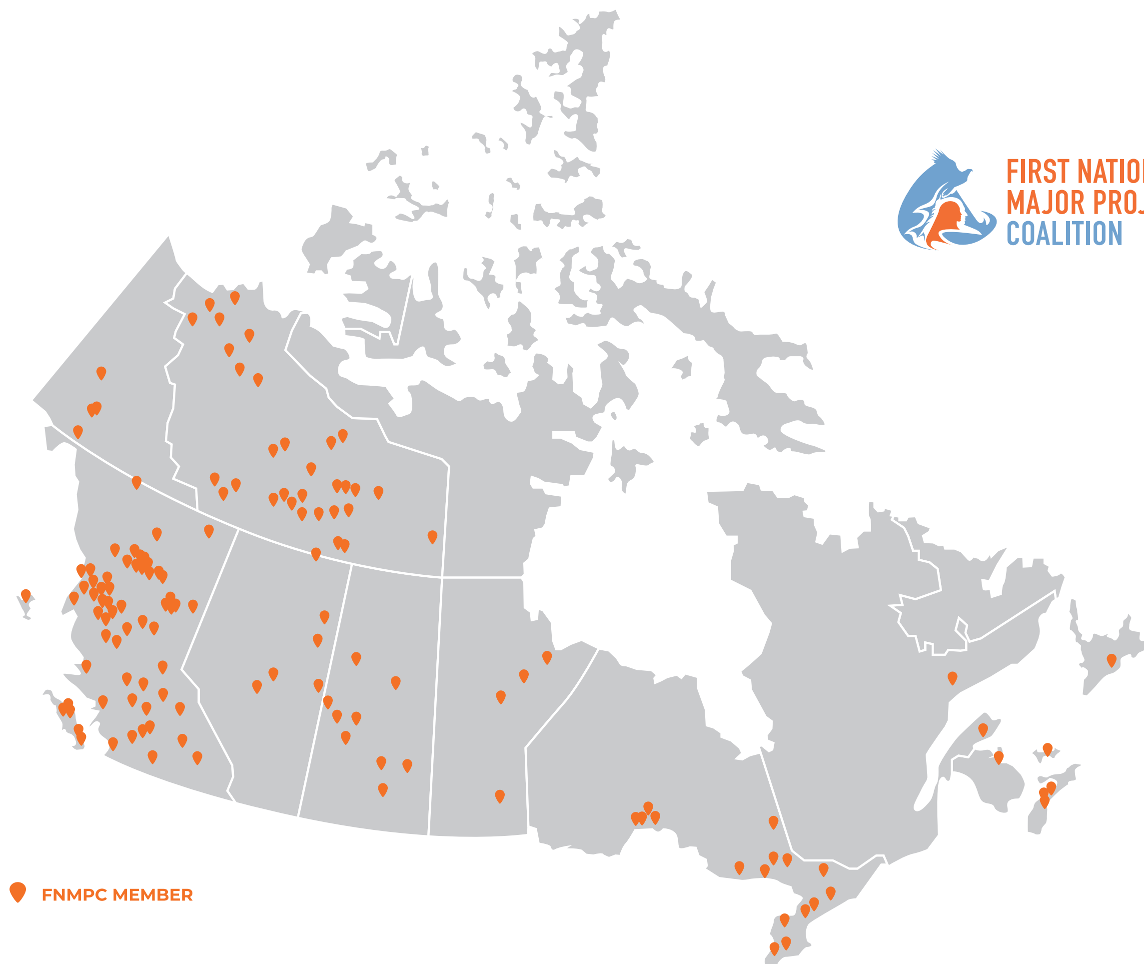
Dan Woynillowicz – Polaris Strategy + Insight

About the First Nations Major Project Coalition (FNMPC)

FNMPC is a national 170+ First Nations non-profit collective working towards the enhancement of the economic well-being of our members, understanding that a strong economy is reliant upon a healthy environment supported by vibrant cultures, languages, and expressions of traditional laws. FNMPC supports its members to:

- Safeguard air, land, water and medicine sources from the impacts of resource development by asserting its members' influence and traditional laws on environmental, regulatory and negotiation processes;
- Receive a fair share of benefits from projects undertaken in the traditional territories of its members; and,
- Explore ownership opportunities of projects proposed in the traditional territories of its members.

FNMPC is currently providing business capacity support to its members on 17 major projects located across Canada, each with a First Nations equity investment component, and a portfolio exceeding a combined total capital cost of over CAD$30-40 billion. FNMPC's business capacity support includes tools that help First Nations to make informed decisions on both the economic and environmental considerations associated with major project development.

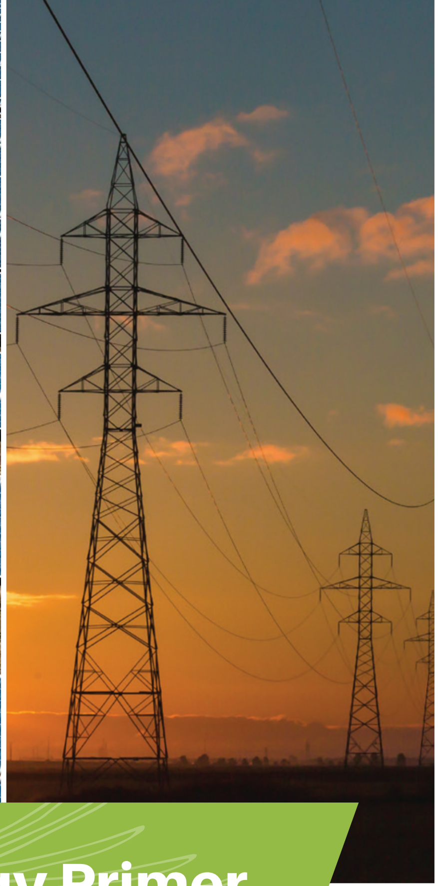


FIRST NATIONS MAJOR PROJECTS COALITION

First Nations Major Projects Coalition | Suite 300, 100 Park Royal | West Vancouver, BC, V7T 1A2 Canada, on the lands of the Sḵwx̱wú7mesh Úxwumixw.

website www.fnmpc.ca | *email* admin@fnmpc.ca

Table of Contents



About This Clean Energy Primer

The transition to a clean energy future is becoming a reality both globally and in Canada. Central to this transition is the collective need to produce more clean energy, to collaboratively create energy systems powered by emissions-free technologies. Within this shift, opportunities for First Nations are on the rise.

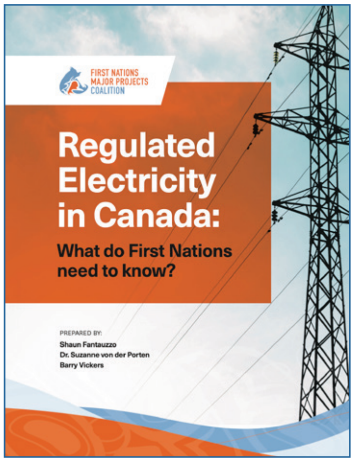
As new clean energy sources become an option for a First Nation—or as prospective projects and partnerships present themselves—this overview may help to paint a general but important big picture of existing and emerging technologies.

The purpose of this primer is (1) to explore mainstream clean energy technologies that are being built, planned, or considered in Canada and around the world, particularly those that are most relevant to First Nations considering, or already entering, the clean energy space; and (2) to present a set of high-level considerations for First Nations wanting to explore a clean energy portfolio.

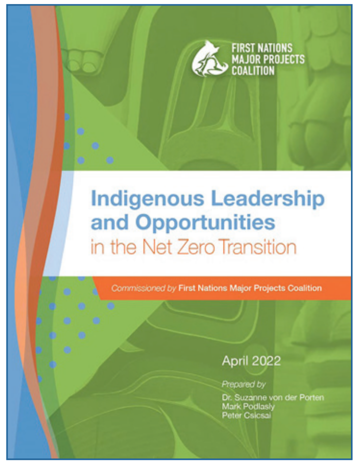
The clean energy landscape is rapidly developing and evolving. It is probable that specific, unique opportunities for First Nations may emerge over the near future that are not covered in the primer. As well, this primer is intended to be a basic introduction to clean energy: it does not cover considerations related to economic viability, legal, capacity, geographic, financial, business risk, rate regulated utilities, impact assessment, and electrification. For deeper reading on these topics and more see the following publications by FNMPC.

National Indigenous Electrification Strategy[1]

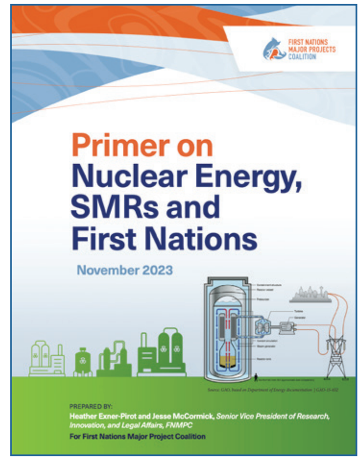
[1] FNMPC and Mokwateh, 2024. National Indigenous Electrification Strategy. April 2024. fnmpc.ca/wp-content/uploads/FNMPC_National_Electrification_digital_final_04222024.pdf.



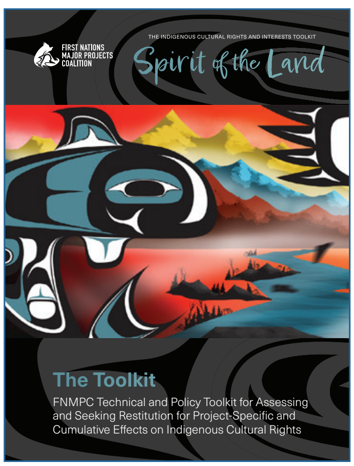
Regulated Electricity in Canada: What do First Nations Need to Know?[2]



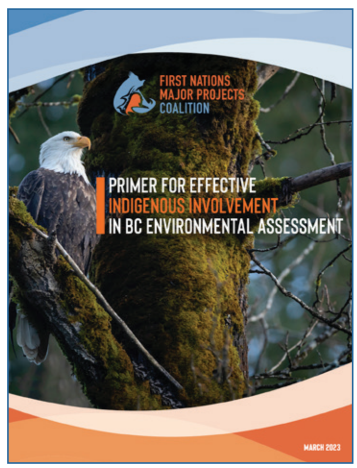
Indigenous Leadership and Opportunities in the Net Zero Transition[3]



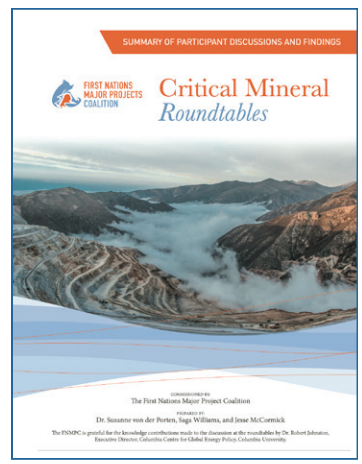
Nuclear Energy, SMRs and First Nations[4]



Spirit of the Land: The Indigenous Cultural Rights and Interests Toolkit[5]



Primer for Effective Indigenous Involvement in BC Environmental Assessment[6]



Critical Mineral Roundtables[7]

---

2 Fantauzzo, S., von der Porten, S., and Vickers, B. February 2024. fnmpc.ca/wp-content/uploads/FNMPC_Elect_Primer_FINAL-Feb-1-2024.pdf.

3 von der Porten, S., Podlasly, M., and Csicsai, P., April 2022. Indigenous Leadership and Opportunities in the Net Zero Transition, First Nations Major Projects Coalition. https://fnmpc.ca/wp-content/uploads/FNMPC_Primer_04132022_final.pdf.

4 Exner-Pirot, H., and McCormick, J. November 2023. Primer on Nuclear Energy, SMRs and First Nations. https://fnmpc.ca/wp-content/uploads/FNMPC_SMR_PRIMER_for_email.pdf.

5 FNMPC, Spirit of the Land: The Indigenous Cultural Rights and Interests Toolkit. April 2024. fnmpc.ca/wp-content/uploads/FNMPC_SOTL_Toolkit.pdf.

6 First Nations Major Projects Coalition, March 2023. Primer for Effective Indigenous Involvement in BC Environmental Assessment. fnmpc.ca/wp-content/uploads/Sept-13-2023-FNMPC-Primer-for-BC-EA-FINAL.pdf.

7 von der Porten, S., Williams, S., and McCormick, J., July 2023. Critical Mineral Roundtables, First Nations Major Projects Coalition. fnmpc.ca/wp-content/uploads/FNMPC_Critical_RT_Overview_06072023_final.pdf.

What is Clean Energy?

Although the definition can vary, clean energy refers to electricity generation that either does not emit greenhouse gases, air pollution, (e.g., $PM_{2.5}$), or that has very low-carbon emissions. As Canada races to phase-out carbon-intensive power sources, clean energy has become a solution that can both meet energy demands and address provincial, federal and international climate goals. By replacing fossil fuel energy sources with clean electricity—referred to as electrification—energy systems become more sustainable, resilient, and less likely to further drive the impacts of climate change.

According to British Columbia's *Clean Energy Act* (2010), clean energy sources can include "biomass, biogas, geothermal heat, hydro, solar, ocean, wind or any other prescribed resource."[8] The US Department of Energy is mostly aligned, listing solar, wind, water, geothermal, bioenergy and nuclear as clean energy sources.[9]

The focus of this primer is opportunities to harness these clean energy sources to produce clean electricity.

What are Greenhouse Gases?

Greenhouse gas emissions are gases in the atmosphere that insulate the Earth creating the greenhouse effect. When fossils fuels are burned—such as natural gas, oil, or coal—they become a greenhouse gas. The most problematic greenhouse gases include carbon dioxide, nitrous oxide, water vapour, halocarbons, and ozone—all of which contribute to climate change.[10]

Most Problematic Greenhouse Gases

CO_2 = Carbon Dioxide

CH^4 = Methane

H_2O- = Water (Vapour)

O_3 = Ozone

N_2O = Nitrous Oxide

Halocarbons

[8] Clean Energy Act, [SBC 2010] Chapter 22. www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/10022_01.
[9] United States Department of Energy, 2024. Clean Energy. https://www.energy.gov/clean-energy.
[10] Canadian Association of Petroleum Producers (CAPP) "Greenhouse Gas Emissions" capp.ca/explore/greenhouse-gas-emissions/

Why are First Nations Investing in Clean Energy Projects?

Indigenous nations in Canada are, in many respects, at the centre of the net zero transition: Indigenous partnership and electrification in Canada relies on lands and resources to which Indigenous nations are rights-holders. As the required build-out of clean energy infrastructure unfolds, Indigenous nations in Canada—already the third largest collective owners of clean energy assets across the country, after governments and utilities —expect to be full economic beneficiaries of electrification.

Indigenous peoples have long understood the urgency of climate change and have not only been speaking out about those changes for decades,[11] but have been at the forefront of new Indigenous-owned clean energy infrastructure across Canada. In fact, Indigenous nations in Canada are already the third largest collective owners of clean energy assets across the country, after governments and utilities.[12]

Given that any new net zero project will be hosted or built on Indigenous lands, the centering of Indigenous peoples' rights and self-determination must anchor the now quickly unfolding electrification era in Canada. With any project, the balance of risks-benefits needs to be equitable, with Indigenous nations as the key decision-makers.

[11] Watt-Cloutier, S., 2015. The right to be cold: One woman's story of protecting her culture, the arctic and the whole planet. Allen Lane.
[12] Lee, H., 12 July 2021. World's Biggest Green Energy Hub Proposed for Western Australia. Bloomberg. bloomberg.com/news/articles/2021-07-13/world-s-biggest-green-energy-hub-proposed-for-western-australia.

There are **four main drivers** that underpin the central role of Indigenous nations in Canada's clean energy transition:

1 Indigenous Ownership:

Indigenous nations are already acquiring and building significant ownership in clean energy projects.[13] These Indigenous-led, and increasingly Indigenous equity-owned initiatives, are not only at the forefront of the global transition to net zero, but, when set up well, they directly support Indigenous nations by offering financial returns and environmental benefits.

2 Indigenous Lands:

Indigenous peoples, knowledge, identities, and rights are inextricably linked to the homelands and waters of each Indigenous nation. These are the same lands and waters where all net zero projects will be located, and that all net zero policies will directly impact. Indigenous peoples have existed and thrived in their respective environments for millennia. The impact of clean energy projects is of vital importance to Indigenous nations because all associated activities directly impact their lands and waters, the present wellbeing of their Nation, and the future generations who will inherit the same responsibility for the same lands and waters.

3 Free, Prior, and Informed Consent:

Indigenous consent is a legal imperative. Indigenous nations expect to not only be owners of net zero projects, but to also have free, prior, and informed consent as the baseline for any new projects, including those related to net zero. A signatory to the *United Nations Declaration on the Rights of Indigenous Peoples* (UNDRIP), Canada's adherence to the Declaration includes, for example, Article 20(1):

> *Indigenous peoples have the right to maintain and develop their political, economic and social systems or institutions, to be secure in the enjoyment of their own means of subsistence and development, and to engage freely in all their traditional and other economic activities.*

UNDRIP, alongside legal and socio-political precedents, has highlighted the risks (investment, project, and legal) posed to corporations[14] and governments[15] when they fail to secure the free, prior, and informed consent of Indigenous nations or whose lands/waters the project occurs. Without full participation of Indigenous people, clean energy projects are not likely to be completed in time to meet Canada's net zero target timelines.

4 Economic Investment Opportunity

First Nations are keenly aware of the rapidly accelerating economic opportunity being presented as global economies become increasingly ambitious about electrifying local energy supply. Canada is among these economies where the size of the opportunity associated with the electrification is massive (Table 1).

---

[13] White A., Morrison, L. and Warrier, V. JWN Energy, February 28, 2022, "Equity investments by Indigenous communities in energy projects" jwnenergy.com/article/2022/2/28/equity-investments-by-indigenous-communities-in-en/.

[14] Golden, H., 15 Oct 2021, The Guardian, Indigenous tribes tried to block a car battery mine. But the courts stood in the way. www.theguardian.com/.environment/2021/oct/15/indigenous-tribes-block-car-battery-mine-courts.

[15] Friedman, L., 25 March 2020, The New York Times, Standing Rock Sioux Tribe Wins a Victory in Dakota Access Pipeline Case" www.nytimes.com/2020/03/25/climate/dakota-access-pipeline-sioux.html.

Table 1. The size of the electrification opportunity in Canada.

58% GDP growth	"The clean energy sector's GDP is forecast to grow an impressive 58% by 2030—significantly more than fossil fuels, which will grow only 9%. By 2030, clean energy will make up 29% of Canada's total energy GDP, up from 22% in 2020."[16]
2.2 - 3.4x supply	"In its 2023 budget, the Government of Canada forecasted that demand for electricity will double between now and 2050, while supply capacity will have to grow by an astounding 2.2 to 3.4 times today's volume."[17]
$1.1-1.7 trillion	"The Conference Board of Canada has put the cost of the clean electricity transformation before us at $1.7 trillion, nearly the size of the entire Canadian economy in 2023. Université de Montreal's Canada Energy Outlook report estimates the price tag at $1.1 trillion."[18]
$5 billion grants	The Government of Canada has committed approximately $5 billion in grants and contributions for targeted clean electricity programs. Within this $5 billion includes several programs of interest:[19] » $1.5 billion for the Smart Renewables and Electrification Pathways Program; » $250 million for the Clean Electricity Pre-Development Program; » $25 million for the Strategic Intertie Pre-Development Program; » $500 million for the Clean Energy for Rural and Remote Communities Program.

The unprecedented growth in Canada's electricity supply has brought together governments, Indigenous nations, and industry to make electrification happen. Given the land- and water-based impacts these projects will have on Indigenous lands, this growth will need to be matched with investment in Indigenous free, prior, and informed consent.

[16] Clean Energy Canada, October 2018. Batteries Not Included. cleanenergycanada.org/report/batteries-not-included/.
[17] Annesley, J., Campbell, D., Golshan, A., and Greenspon, E., 19 July 2023. Project of the Century: A Blueprint for Growing Canada's Clean Electricity Supply – and Fast https://ppforum.ca/publications/net-zero-electricity-canada-capacity/.
[18] Ibid.
[19] Government of Canada, 2023. Powering Canada Forward. https://natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/electricity-infrastructure/powering-canada-forward-building-clean-affordable-and-reliable-electricity-system-for/25259.

Clean Energy in Canada

Canada's energy system is in flux. Like many countries around the world, Canada has committed to decarbonizing its electricity grid by 2035 and becoming net zero by 2050. Clean energy technologies are what underpin this change, and many are poised to power the rapid expansion of electrification. To make this transition work, not only does the entire energy system need to change, but the economic backbone that supports and benefits from it must change too.

In its recent report **Powering Canada: A Blueprint for Success,** the Canada Electricity Advisory Council stated that the global transition towards electrification is currently being "driven by declining clean technology costs, more robust policy support, and increasing demand from consumers and investors around the world."[20] As Canada moves in step with the rest of the world, the same elements are at work—making the push towards electricity not just possible, but necessary.

The Canada Electricity Advisory Council has provided recommendations on how to better power Canada, through to the future. To read the report, please visit **Powering Canada: A Blueprint for Success**.[21]

[20] Canada Electricity Advisory Council, June 2024. Powering Canada: A Blueprint for Success. natural-resources.canada.ca/sites/nrcan/files/energy/electricity/Canada-Electricity-Advisory-Council-Final-Report-2024.pdf

[21] Ibid.

Current Energy Mix

Canada currently produces a total of 600 terawatt-hours of electricity each year—the equivalent of providing power for 4.2 million homes, for a full year. Approximately 60% of this electricity is from hydroelectric sources, mostly hydroelectric dams. The remaining 40% of electricity comes from a variety of sources, including biomass, coal, natural gas, nuclear, oil, wind, and solar.[22]

The amount and type of electric power generation being used depends on the jurisdiction. Hydroelectric power accounts for more than 80% of the electricity produced in British Columbia, Manitoba, Quebec, Newfoundland and Labrador, and the Yukon. In comparison, Ontario, New Brunswick, and the Northwest Territories rely on a mix of biomass, coal, hydro, natural gas, nuclear, oil, and wind. Prince Edward Island relies heavily on wind, but it imports a large share of its electricity from New Brunswick. Fossil fuels such as coal, natural gas, and oil are used as the primary source of electric power in Alberta, Saskatchewan, and Nova Scotia. However, these provinces have begun transitioning to clean energy sources such as solar, tidal, and wind (Figure 1).[23]

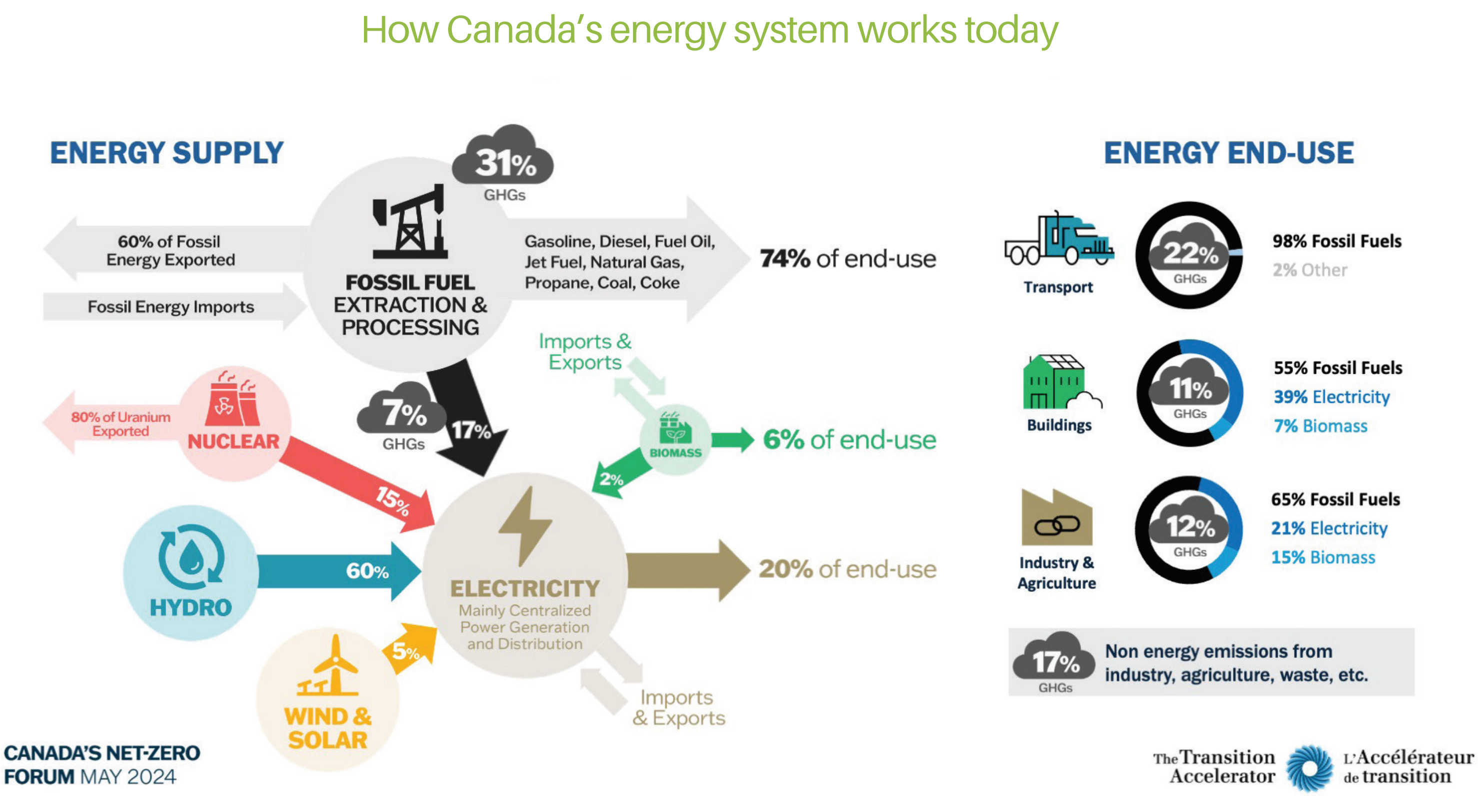


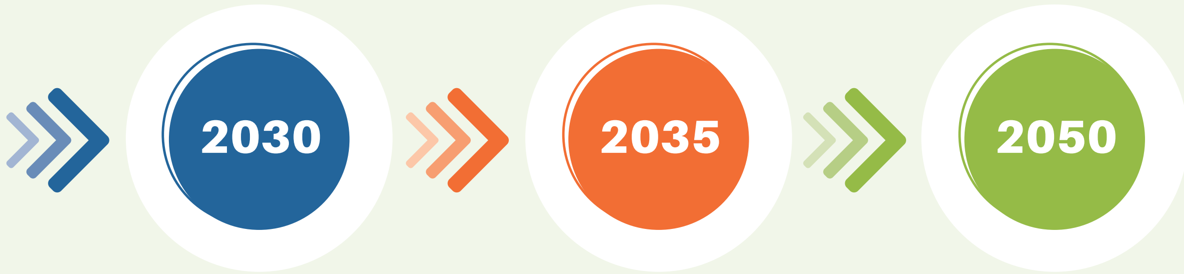
Figure 1. How Canada's Energy System Works Today. Source: Transition Accelerator

[22] Canada Energy Regulator, 2024. https://www.cer-rec.gc.ca/en/index.html
[23] Ibid.

2050 Net Zero Energy System

Canada has committed to net zero total greenhouse gas emissions by 2050.

Figure 2. Canada's major net zero commitments.



2030

- Reduce emissions to 40% below 2005 levels by 2030 – Paris Agreement Targets
- Completed phase out of coal generation

2035

- Net-zero electricity system
- Last year of sales of new internal combustion engine vehicles

2050

- Net zero total greenhouse gas emissions

What will Canada's net zero energy system look like?

By 2050, the Canada Energy Regulator expects that:

- Fossil fuels will be replaced by technologies that use electricity;
- Low-carbon fuels (like hydrogen and biofuels) will accelerate;
- Carbon capture, utilization, and storage (CCUS) will help to reduce emissions in many sectors; and,
- "Global demand for fossil fuels [will fall] steeply, reducing oil and natural gas prices and Canadian production of those commodities".[24]

The Public Policy Forum illustrates a similar picture, where net zero for Canada means getting "back to an abundant system, one built on the back of technology rather than fossil fuels and, therefore, ultimately less susceptible to price shocks, supply interruptions and planned inefficiency".[25]

[24] Canada Energy Regulator, 2023. Canada's Energy Future 2023: Energy Supply and Demand. Projections to 2050. cer-rec.gc.ca/en/data-analysis/canada-energy-future/2023/canada-energy-futures-2023.pdf.

[25] Annesley, J., Campbell, D., Golshan, A., and Greenspon, E., July 2023. Project of the Century: A Blueprint for Growing Canada's Clean Electricity Supply – and Fast https://ppforum.ca/wp-content/uploads/2023/07/Canada%E2%80%99sCleanElectricitySupply-PPF-July2023-EN-1.pdf.

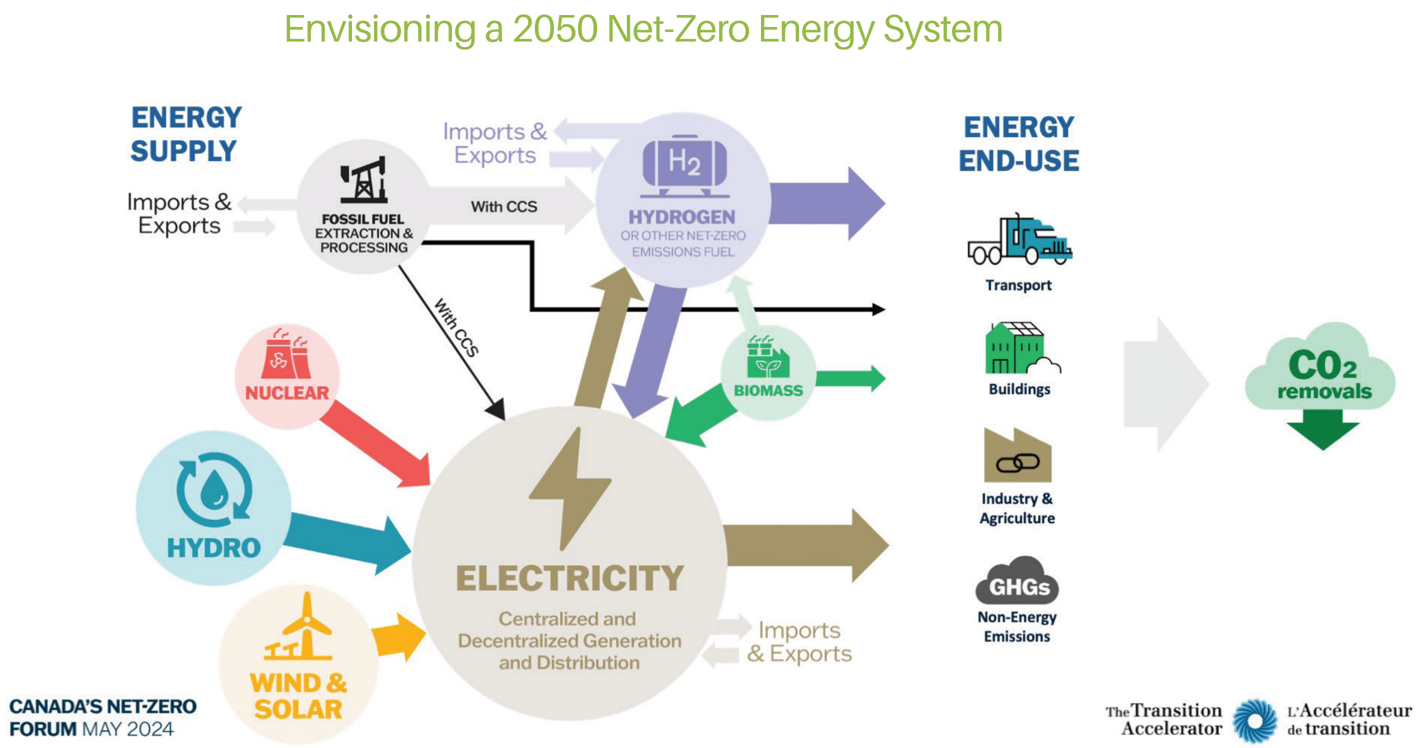


Figure 3. Envisioning a 2050 Net-Zero Energy System. Source: Transition Accelerator

Clean Energy Opportunities for First Nations

Some clean energy technologies have been around for a long time, others are just emerging—their development is moving very quickly. However, as Canada transitions to net zero, the uptake for both is on the rise. This paper provides a quick overview of a handful of clean energy technologies. Although there are many more technologies than what is described here, this introduction to many of them is important so that First Nations interested in owning, investing in, or partnering on projects have a basic understanding of the most common types of clean energy projects.

Established opportunities for First Nations, covered by this primer, include:


Solar Photovoltaic


Onshore Wind


Hydroelectric


Biomass


Traditional Nuclear


Geothermal


Transmission & Distribution


Energy Storage

Emerging clean energy opportunities for First Nations, covered by this primer, include:


Concentrated Solar


Offshore Wind

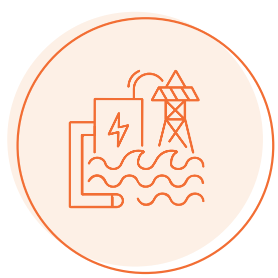

Nuclear Fission: Small Modular Reactors


Nuclear Fusion: Compact

Carbon Capture, Utilization, Storage

Hydrogen


Tidal


Wave

The projects described in this paper are well known, can be utility-scale, and are the most likely projects that First Nations might consider or pursue opportunities to partner on in the near future.

Established Clean Energy Technologies

With the net zero future now on a not-so-distant horizon, investment in clean energy technologies is accelerating. This section gives a brief introduction to each of the clean energy technologies that are relatively established in Canada.

Solar Photovoltaic

At A Glance

Solar photovoltaic power generation—also called solar farms or solar power plants—harnesses the power of the sun to generate electricity. Even on a cloudy day, photovoltaic (PV) cells in solar panels can convert sunlight—or solar energy—directly into electricity. In many cases, this electricity can be sold to the existing power grid.

NOTABLE FACTS

Solar is on the rise.

Solar electricity—from small household grids and microgrids to large-scale solar power farms —is rapidly replacing fossil fuel reliant electricity. In 2021, Canada's solar generation was 19 times more than it was in 2011[26]. In the last decade, solar energy uptake in the US has grown by 25%[27]. Solar electricity capacity around the world has also skyrocketed—going from 100,464 MW to 1,411,129 MW in just ten years[28].

Solar is scalable.

The technology used to convert sunlight into electricity comes in a range of sizes. On-site residential systems have capacity to service a single house or business, whereas solar farms can provide energy to the larger grid. There are many examples of Indigenous nations using solar energy to power a school gym, band office, or homes. As well, a growing number of Indigenous-owned solar projects are selling power back to the grid, generating revenue for the Indigenous nation or corporation while offsetting other sources of power generation[29].

Solar is getting more efficient.

Traditional solar panels capture sunlight using only one side of the panel. Increasingly, installations are using a type of panel that boost energy yield by using both sides known as "bifacial panels". In addition to harnessing direct sunlight from a panel's top surface, bifacial panels also capture light from surrounding surfaces (such as snow or light-coloured roofs) bumping energy production by up to 30%[30]. Bifacial panels are currently more expensive than one-sided panels, and their installation complexities can add to this cost. However, for the right environment, their ability to maximize space and efficiency can make them a solid option. Similarly, solar tracking systems are devices that allow a solar panel array to follow the sun's path, maximizing production throughout the day.

The closely related technology to solar is **concentrated solar power**, an emerging clean energy explored in the Emerging Clean Energy section of this primer.

SPOTLIGHT ON INDIGENOUS PROJECTS

Awasis Solar

Located east of Regina, Saskatchewan, the Awasis Solar project is a 10 MW solar project partnership between Cowessess First Nation (CFN) and Elemental Energy—currently 95% owned by CFN. The power generated is sold to SaskPower as part of a 20-year Power Purchase Agreement. After five years of commercial operation, Indigenous-owned Awasis Nehiyawewini Energy Development Corp (ANEDC) will have the opportunity to become 100% owners.

[26] Natural Resources Canada, 2023. Energy Fact Book. energy-information.canada.ca/sites/default/files/2023-10/energy-factbook-2023-2024.pdf.
[27] Solar Energy Industries Association, 2024. Solar Industry Research Data. seia.org/solar-industry-research-data.
[28] International Renewable Energy Agency, 2024. Solar Energy. irena.org/Energy-Transition/Technology/Solar-energy.
[29] von der Porten, S., Podlasly, M., and Csicsai, P., April 2022. Indigenous Leadership and Opportunities in the Net Zero Transition, First Nations Major Projects Coalition. https://fnmpc.ca/wp-content/uploads/FNMPC_Primer_04132022_final.pdf.
[30] Renogy, 6 August 2024. Bifacial Solar Panels: Everything You Need to Know. https://www.renogy.com/blog/bifacial-solar-panels-disadvantages-and-advantages/?srsltid=AfmBOopSEJuxdo56UaZLOIZRoN_7TgUkAEvcn0VyFfvdDWOvvx4GnrN3.

Chappice Lake

The Chappice Lake Solar-Storage project is located 35 km north of Medicine Hat in Cypress County. This project—a partnership between Elemental Energy and Cold Lake First Nations—combines a 21 MWp solar array co-located with an 8.4 MWh utility-scale vanadium flow battery from Invinity Energy Systems. It is the first utility-scale solar + storage project in Alberta to use a flow battery.

Old Crow / Vuntut Gwitchin First Nation

A 2000-panel, 616kW battery energy storage system and micro-grid controller that generates enough energy to meet 24% of the community's annual power needs (~235 people). This project represents a purchase agreement with ATCO Yukon, who has agreed to sell the solar-generated electricity for 25 years.[31]

[31] Desmarais, A., 28 April 2022. How Old Crow's solar farm is changing green energy projects in Yukon, CBC. www.cbc.ca/news/canada/north/old-crow-solar-farm-changing-green-energy-projects-yukon-1.6434746.

Onshore Wind

At A Glance

Wind can be turned into electricity using wind turbines. When wind passes by a turbine, the air flow turns the blades around a rotor. This rotor is connected to a generator, which turns mechanical power into electricity.[32] Wind farms need to be located in strategic areas with optimal wind patterns and close to existing electrical grids.[33]

NOTABLE FACTS

Wind power technology is growing.

Wind power generation is growing globally at unprecedented rates: the International Energy Agency estimates that both wind and solar are forecast to double by 2028 compared with 2022[34], and will exceed the global power capacity of coal and natural gas by 2025.[35] From 2010 to 2020, onshore wind capacity around the world jumped from 178 GW to 699 GW.[36] Indigenous-led wind projects in both the United States and Canada have multiplied. These projects range from small community wind turbines to large regional-scale projects, where Indigenous nations are selling power to the regional, provincial or state power grid.

[32] United States Wind Energy Technologies Office, 2024. How Do Wind Turbines Work? https://www.energy.gov/eere/wind/how-do-wind-turbines-work.
[33] Government of Canada, 2024. Wind Energy. https://natural-resources.canada.ca/energy/energy-sources-distribution/renewables/wind-energy/7299.
[34] International Energy Agency, 2024. Wind. https://www.iea.org/energy-system/renewables/wind.
[35] International Energy Agency, 2021. Renewable Energy Market Update 2021 - Outlook for 2021 and 2022. www.iea.org/reports/renewableenergy-market-update-2021.
[36] International Renewable Energy Agency, 2024. Wind Energy. https://www.irena.org/Energy-Transition/Technology/Wind-energy.

Wind power is widely deployable.

From single-home wind turbines to massive land-based windfarms, the size and scale of wind generation can greatly vary. Although wind energy projects exist in every province, most of Canada's wind electricity generation is in Ontario, Quebec, and Alberta, and only accounts for approximately 5.7% of the country's total energy demand.[37]

Wind power can be expensive to install, but cost effective to operate.

Although the upfront capital cost of wind power is significant,[38] it can be cost effective to operate. For example, the cost of wind electricity has decreased by over 90% since 1980.[39] This decrease, paired with high-capacity use and scalability, makes wind power a useful addition to Canada's clean energy portfolio, helping the country to meet its net zero targets.

Onshore wind energy is variable, but predictable.

For a number of reasons, wind energy—particularly onshore wind—will likely remain only a part of Canada's energy mix. Due to its intermittent nature, onshore wind does not always provide a consistent, reliable energy source. However, the ability to predict when and how windy it will be has been consistently improving, allowing grid operators to incorporate a growing share of wind power into electricity systems. Wind energy comes with a small environmental footprint that includes some noise and visual pollution, ecological considerations, and turbine wing recycling.[40]

The closely related technology to onshore wind is **offshore wind**, an emerging clean energy (for Canada) explored in the Emerging Clean Energy section of this primer.

SPOTLIGHT ON INDIGENOUS PROJECTS

Uashat Mak Mani-utenam Wind Farm

Built on the traditional territory of the Uashat mak Mani-utenam First Nation, this 200 MW wind farm is a 50-50 partnership between the Innu communities and Boralex, who will equally share the profits generated by the sale of electricity throughout the life of the project. Hydro-Québec Production signed a 30-year contract with Parceolien Apuiat S.E.C. and Boralex to purchase the wind farm's energy.

Henvey Inlet First Nation Wind Energy Centre

Located on HIFN Reserve No. 2 lands on Georgian Bay's northeast shore near Britt, Ontario, this 300 MW wind facility is the largest First Nation wind energy partnership in Canada. This facility is a partnership between Nigig Power Corporation and Pattern Canada, and anticipates generating up to $10 million in annual revenue for Henvey Inlet First Nation[41].

[37] Government of Canada, 2024. Wind Energy. https://natural-resources.canada.ca/energy/energy-sources-distribution/renewables/wind-energy/7299.
[38] Diallo, K., 5 June 2024. How Much a Wind Turbine Costs? Investment and Savings Explained. https://williamkamkwamba.com/how-much-wind-turbine-costs/.
[39] Clean Energy BC, 2024. What is Wind Energy? cleanenergybc.org/sector/wind/#:~:text=Wind%20power%20provides%20a%20continuous,by%20over%20 90%25%20since%201980.
[40] Jacoby, M., 8 August 2022. How can companies recycle wind turbine blades? Chemical & Engineering News. https://cen.acs.org/environment/recycling/companies-recycle-wind-turbine-blades/100/i27.
[41] Pattern Energy, 2024. Henvey Inlet Wind. https://patternenergy.com/projects/henvey-inlet-wind/.

Hydroelectric

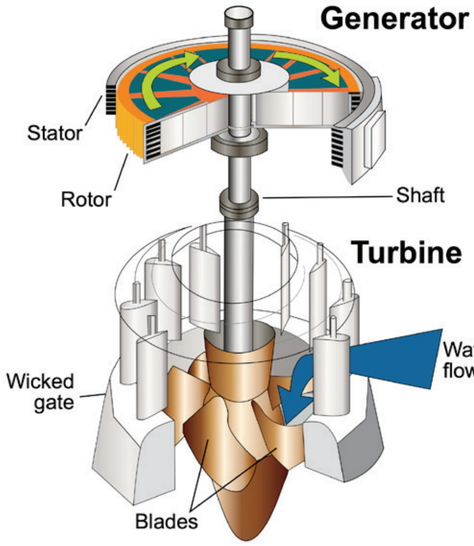
At A Glance

Hydroelectric power is produced by harnessing moving water which flows through a pipe (penstock) and turns blades in a turbine to spin a generator and produce electricity. Typically, hydroelectric facilities use dams as storage systems where water accumulates behind them and is released through when power is needed. There are also run-of-river hydroelectric systems where the flow of the river is diverted, turns the turbine, producing electricity, and returns to the river.

NOTABLE FACTS

Hydroelectricity is currently one of Canada's most common clean energy sources.

Hydroelectric generation is a long-standing electric power source in many provinces and territories in Canada. Quebec accounts for half of Canada's hydroelectric capacity, and British Columbia, Ontario and Manitoba each generate a significant portion of their electricity through hydroelectricity.[42,43]



[42] Natural Resources Canada, 2024. Hydroelectric energy. https://natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/renewable-energy/hydro-electric-energy/25792.

[43] International Hydropower Agency, 2024. North and Central America. https://www.hydropower.org/region-profiles/north-and-central-america.

Hydroelectricity has left a complex legacy.

For Indigenous nations across Canada, hydroelectric development has had a contentious and complex history because of environmental impact through flooding, displacement and the dispossession of Indigenous homelands. This dispossession has, in some cases, resulted in still unreconciled Indigenous nations' loss of lands, waters, homes, hunting, fishing and trapping areas, burial grounds, ceremonial spaces, access to medicinal plants, and ways of life.[44]

The future of hydroelectricity can include opportunity.

Hydroelectric projects may still represent an opportunity for First Nations who wish to seek long-term (and often lucrative) economic partnerships that also embed environmental and cultural protections. Going forward, First Nations may consider factors such as the significant upfront capital cost required for larger hydroelectric dams, and the need to secure a power purchase agreement with the province, territory, or utility to make dams and run-of-river projects economically viable. The closely related technology to onshore wind is offshore wind, an emerging clean energy (for Canada) explored in the Emerging Clean Energy section of this primer.

SPOTLIGHT ON INDIGENOUS PROJECTS

Hupacasath First Nation: China Creek Run-of-River Hydroelectric

A 6.5-megawatt run-of-river hydro project that produces more than enough electricity for the 6,000 homes in Port Alberni. Hupacasath owns the Upnit Power Corporation and retains a 72.5% controlling interest.

Taku River Tlingit First Nation: Atlin Hydro Plant

The Atlin Hydro Plant owned by Taku River Tlingit First Nation is expected to add eight megawatts of dependable capacity to Yukon's grid. When complete, the Atlin Hydro Expansion project will increase the amount of dependable renewable hydroelectricity available in Yukon to meet winter peaks for power and growing demands for clean energy.

Confederated Salish & Kootenai Tribes: Seli'š Ksanka Qlispe' Dam

This project is a 208 megawatt dam that is 100% Indigenous owned by the Confederated Salish & Kootenai Tribes (USA).

[44] Tsay Keh Dene Nation, 2021. DƏNE YI'INJETL - The Scattering of Man. Mesilinka Films.

Bioenergy

At A Glance

Bioenergy is a form of renewable energy that comes from biomass. In energy terms, biomass is organic matter that can be used to make energy, such as wood, agricultural products, waste from municipal and industrial processes, energy crops, and animal manure. When processed, these materials can be used for heat, fuels and electricity.

In its most basic form, bioenergy has been around since humans first started to use wood or plants for fire. Today, processes used to convert biomass into energy include burning, gasification, anaerobic digestion, and pyrolysis (Figure 4).[46]

[46] United States Bioenergy Technologies Office, 2024. Biopower Basics. www.energy.gov/eere/bioenergy/biopower-basics#:~:text=Biomass%20can%20be%20converted%20to,of%20carbon%20monoxide%20and%20hydrogen.

Direct Combustion

Biomass is burned in a boiler to create steam, which is then used to generate electricity.

Gasification

When biomass is exposed to high temperatures it can be converted into synthesis gas, which can be used to generate electricity.

Anaerobic Digestion

Micro-organisms break down organic matter—such as manure or human sewage— to produce biogas which is used for heating, electricity and fuel.

Pyrolysis

Thermal decomposition of biomass can produce bio-oil, gas and bio-char.

Figure 4. Summary of bioenergy technologies.

NOTABLE FACTS

Bioenergy is not fully emission-free.

Although the amount of greenhouse gases released by burning biomass is much lower than burning fossil fuels, they do still exist.[47] However, because bioenergy burns or converts renewable resources rather than pulling new coal, oil or gas out of the ground, it can still support the transition to net zero. In order to be environmentally positive, the biomass that fuels bioenergy needs to come from sustainably-managed sources, as opposed to new deforestation, depleting forests, or other organic sources.[48] Recent research has lent to concern that "burning solid biomass to generate electricity often emits huge amounts of carbon", and there is mounting evidence of significant deforestation related to this form of electricity production.[49]

Bioenergy is unlikely to become Canada's top energy source.

Bioenergy is still a nascent energy source in Canada, with growth potential due to the large scale of biomass produced by the forestry industry. However, due to the lack of scalability, bioenergy is unlikely to become a mainstream energy source.

Like other clean energy sources, bioenergy may provide opportunities for Indigenous nations.

Many Indigenous nations in Canada may be well-positioned to tap into the power of bioenergy. Two opportunities of relevance include:

1. ***Burning biomass for heat and power.*** Indigenous nations who have access to producing or manufacturing forest or other biomass products may consider using these as an energy source. This is particularly relevant for nations who rely on fossil fuels for heat or electricity.
2. ***Producing or using wood products for heat.*** As stewards of their lands, including forests, Indigenous nations have considerable opportunities in the wood pellet sector. This includes equity ownership of wood pellet production plants, contracting, supplying, employment, operation, and procurement.[50]

---

[47] United Nations, 2024. What is renewable energy? https://www.un.org/en/climatechange/what-is-renewable-energy?gad_source=1&gclid=Cj0KCQjwiOy1BhDCARI-sADGvQnCRRTjEtqXU0uS4PT5xo4niyA-8PAsI_oUMQML2ybCkZ8DDuCSNtecaAtl2EALw_wcB.

[48] Drax. 22 December 2021. Forests, net zero and the science behind biomass. https://www.drax.com/sustainable-bioenergy/forests-net-zero-andthe-science-behind-biomass/.

[49] Newsome, M. 20 August 2024. How 'green' electricity from wood harms the planet — and people. Nature. https://www.nature.com/articles/d41586-024-02676-z.

[50] Canadian Biomass. 18 June 2020. Canada's Indigenous communities: a key part of sustainable biomass energy. www.canadianbiomassmagazine.ca/ canadas-indigenous-communities-a-key-part-of-sustainable-biomass-energy/.

SPOTLIGHT ON INDIGENOUS PROJECTS

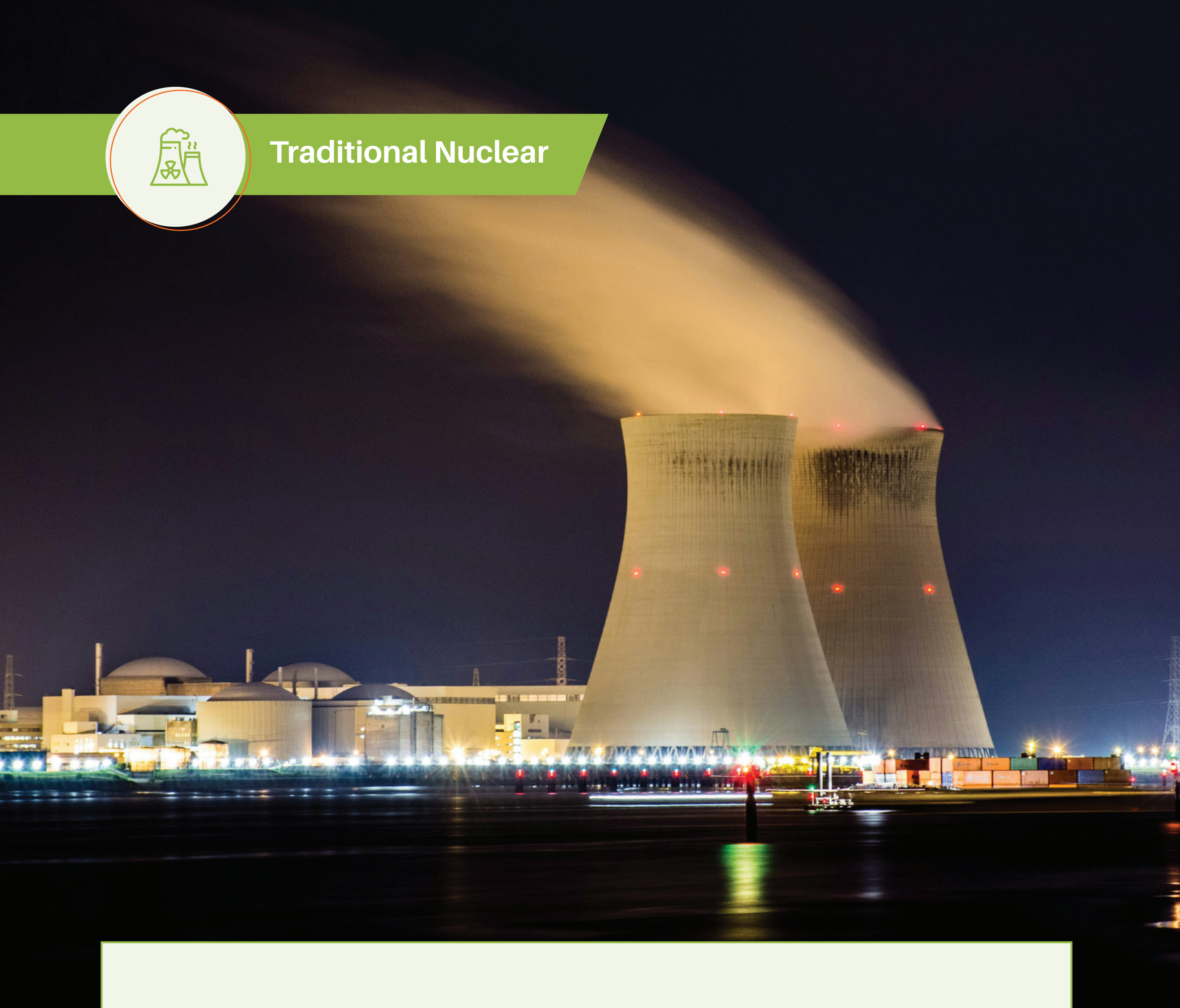
Menominee Biomass Combined Heat & Power

Located in Wisconsin USA, this project is a 50-50 partnership between Menominee Tribal Enterprises and the U.S. Department of Energy. Using a new biomass boiler, this project generates 1,020,217 kilowatt hours per year.

Groupe ADL: Wood Pellet Production

Groupe ADL—a company of Mashteuiatsh First Nation—is the 100% owner of Quebec's largest pellet production facility.

Traditional Nuclear



At A Glance

Nuclear energy is created when energy gets released from the core of an atom, known as the nucleus. This energy is made through fission (splitting the nucleus) and fusion (fusing part of nucleus together). Of these two, nuclear fission is the most common way to create energy. Nuclear fission happens inside a nuclear power reactor, usually using uranium and plutonium atoms. When the atom is split, an enormous amount of energy gets released. This energy turns water into steam, which spins a turbine and generates electricity.[51] Nuclear fusion has yet to be commercialized.

[51] Department of Energy, Office of Nuclear Energy, 2024. https://www.energy.gov/ne/articles/fission-and-fusion-what-difference#:~:text=Fission%20occurs%20when%20a%20neutron,can%20initiate%20a%20chain%20reaction.

NOTABLE FACTS

Nuclear energy has a long history in Canada.

Nuclear energy has been a part of Canada's energy landscape since 1944, when the country started to research and develop its own line of nuclear power reactors.[52] Today, nuclear energy is the second largest clean energy source in Canada in terms of power produced, providing around 16% of Canada's total electricity.[53] In Ontario, nuclear energy makes up a large portion of the province's energy mix, generating 60% of its power.

Nuclear energy is clean, dense, and firm.

Nuclear energy emits low to no greenhouse gas emissions and displaces 50 million tonnes of greenhouse gas emissions every year.[54] It also has a small land footprint and does not require battery minerals (e.g., lithium or cobalt) that wind and solar installations do. Nuclear energy is highly dense, which means a very small amount of nuclear fuel can create a tremendous amount of power. As well, unlike fluctuating energy sources like solar and wind, nuclear energy can provide a firm source of power, regardless of weather.

Nuclear energy waste needs to be considered.

After nuclear fission takes place, radioactive isotopes need to be disposed of safely. This used nuclear fuel takes 10,000 years to decay and needs long-term containment infrastructure and associated resources to keep this containment safe. However, the amount of waste produced is not very big. For example, if the United States gathered its nuclear waste from the past 60 years it would all fit on a football field, at a depth of less than 30 feet.[55] That said, even a small amount of nuclear waste can create widespread issues. Indigenous nations have often faced the negative consequences of waste disposal on their territory, which includes water table impacts, territorial integrity, and cultural impacts—often without due compensation, land restoration, or redress.[56]

Nuclear energy is one of the safest energy sources.

Nuclear catastrophes around the world have tainted public perception around nuclear safety. However, although malfunctions can be tragically catastrophic, the frequency of these happening is actually very low. In fact, energy from fossil fuels is responsible for far more deaths than nuclear and other renewables, per unit of electricity. For example—including the Chernobyl and Fukushima disasters—nuclear has resulted in 99.8% fewer deaths than coal, with similar statistics for oil and gas.[57]

Nuclear energy is expensive to build.

It takes significant upfront capitol to start a nuclear power plant, estimated at 24.4 cents per kWh.[58] However, once up and running, operational costs are comparable to those of solar and wind power and storage.

Nuclear energy technologies are still emerging.

While traditional nuclear energy continues to power parts of Canada, two emerging nuclear energy types are on the rise: nuclear fusion and small modular reactors (SMRs). More information on each of these technologies can be found in the Emerging Clean Energy Technology section of this primer.

---

[52] World Nuclear Association, 5 March 2024. Nuclear Power in Canada. https://world-nuclear.org/information-library/country-profiles/countries-a-f/canada-nuclear-power.
[53] Government of Canada, 2024. The Canadian Nuclear Energy Technology. https://natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/nuclear-energy-uranium/nuclear-energy/the-canadian-nuclear-energy-technology/7713.
[54] Government of Canada, 2024. Nuclear energy and uranium. https://natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/nuclear-energy-uranium/7691.
[55] Ibid.
[56] Inkstick, 16 August 2022. How Native Land Became a Target for Nuclear Waste. https://inkstickmedia.com/how-native-land-became-a-target-for-nuclear-waste/.
[57] Ritchie, H., 10 February 2020. What are the safest and cleanest sources of energy? https://ourworldindata.org/safest-sources-of-energy.
[58] Ontario Clean Air Alliance, 5 March 2024. Ontario's Electricity Options: A Cost Comparison. https://www.cleanairalliance.org/wp-content/uploads/2024/03/options2024-march.pdf.

SPOTLIGHT ON INDIGENOUS PROJECTS

Nuclear Energy Tribal Working Group (NETWG)

The US-based Nuclear Energy Tribal Working Group (NETWG) engages Tribal nations interested in nuclear energy activities. The mission of NETWG is "to engage federally recognized tribal governments and their representatives in the [Department of Energy's] Office of Nuclear Energy activities." There are currently 12 participating US Tribes, located across 20 states.[59]

Des Nedhe Group, et. al.

In Canada, three Indigenous-owned companies in Saskatchewan (Kitsaki Management, Athabasca Basin Development and Des Nedhe Group) have signed an MOU to explore small modular reactors (see the section on SMRs for more details on this technology). This potential project signals a baseline Indigenous ownership in SMR project exploration.

NuScale Carbon Free Power Project

NuScale's nuclear project was cancelled in 2023. However, while in-progress NuScale stated it was engaged with "native American tribes, working to facilitate an open dialogue as the project progressed." Although no longer active, this project exemplified a process for centering Indigenous peoples with any new nuclear project.

[59] US Office of Nuclear Energy, 28 December 2023. Nuclear Energy Tribal Working Group. www.energy.gov/ne/articles/nuclear-energy-tribal-working-group.

Geothermal

Nesjavellir Power Plant

At A Glance

Geothermal power can come from heat found deep inside of the Earth, or the sun. Utility-scale geothermal power—generated by geothermal power plants—most often originates within the Earth. As rocks inside the Earth's core decay, they produce heat. To access this heat, geothermal power plants drill wells into underground reservoirs and pipe up the hot water and/or steam. Once at the surface, this water or steam drives electric generators to either create electricity or provide direct heating for things like greenhouses, buildings, or swimming pools.[60]

NOTABLE FACTS

Geothermal can come from the sun.

As sun shines down, it heats the ground. This warmth is absorbed by the Earth. In winter months, the below ground temperature is often much higher than surface air. In summer, the temperature is often cooler. It is possible to harness this heat by using geothermal heat pumps: systems that generate enough consistent energy to heat and cool buildings.[61] Although this technology can heat and cool a single house, it can also be scaled to heat/cool at a community level.

[60] National Geographic, 2024. Geothermal Energy. education.nationalgeographic.org/resource/geothermal-energy/.
[61] US Geothermal Technologies Office, 2024. Geothermal Heat Pumps. www.energy.gov/eere/geothermal/geothermal-heat-pumps#:~:text=Geothermal%20heat%20pumps%20use%20the,of%20collector%20and%20connections%20used.

Geothermal can provide baseload power.

Because power usage fluctuates throughout the day and season, an electrical grid needs to have enough electricity to cover high usage times without having too much electricity during low usage times. Due to its reliable nature, geothermal is able to generate the minimum amount of electric power needed, making it a firm electricity source to supply the power grid.

Canada has vast geothermal energy.

Although geothermal energy can be found throughout Canada, the highest temperature geothermal resources are located in British Columbia, Northwest Territories, Yukon, and Alberta.[62] In particular, BC is located on the Pacific Ocean Ring of Fire—a large geological fault identified as having great potential for geothermal energy.[63] Despite these resources, there is currently a huge gap in Canada between the potential for geothermal energy and what has been built.[64]

Geothermal power generation does not need much space.

Geothermal requires relatively little land and water compared to other energy sources. Per gigawatt produced:[65]

» geothermal needs 47 acres
» wind needs 1400 acres
» solar needs 4,300 acres (depends on the type of solar)[66]

Indigenous leadership in geothermal energy is growing.

Several First Nations are taking a leadership role in advancing and developing geothermal as a clean energy source. Given the largely untapped potential of geothermal, this clean energy could offer new opportunities for some Indigenous nations. These opportunities are contingent on access to capital, expertise, and—importantly—being close to a geothermal energy source.

[62] Government of Canada, 2024. Geothermal energy. https://natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/renewable-energy/geothermal-energy/25790.
[63] Ibid.
[64] Richter, A., 1 Apr 2021. Think GeoEnergy. Researchers urge more support for geothermal in BC, Canada. https://www.thinkgeoenergy.com/researchers-urge-more-support-for-geothermal-in-bc-canada/.
[65] Cottrell, C., 26 October 2018. Native Business. From Fear to Favor: Geothermal Energy's Future on the Reservation. nativebusinessmag.com/from-fear-to-favor-geothermal-energys-future-on-the-reservation/.
[66] Ritchie, H., 16 June 2022. How does the land use of different electricity sources compare? https://ourworldindata.org/land-use-per-energy-source.

SPOTLIGHT ON INDIGENOUS PROJECTS

Tu Deh-Kah Geothermal

Tu Deh-Kah Geothermal is 100% owned by Fort Nelson First Nation through their corporation Deh Tai LP. This project will transition existing natural gas production into geothermal production. The goal is to provide up to 15 MW of energy, and will be the first geothermal electricity facility in BC. Tu Deh-Kah is in advanced planning and development stages, and is expected to proceed with appropriate regulatory approvals and completion of technical studies.[67]

Makushin Geothermal Project

Ounalashka Corporation—an Alaska Native Village Corporation—and Chena Power have signed a 30-year power purchase agreement with the City of Unalaska, to develop a 30 MW geothermal facility using geothermal energy from the Makushin Volcano. The project is 51% owned by Ounalashka Corporation.[68]

Kitselas Geothermal

A geothermal project is in development at the M'Deek Reservoir, to harness geothermal power located in the traditional territory of the Gits'ilaasu First Nation. As of summer 2023, Kitselas Geothermal Inc—a partnership between the Kitselas First Nation and Calgary-based Borealis GeoPower—has applied for well authorizations.[69]

[67] Ounalashka Corporation—an Alaska Native Village Corporation—and Chena Power have signed a 30-year power purchase agreement with the City of Unalaska, to develop a 30 MW geothermal facility using geothermal energy from the Makushin Volcano. The project is 51% owned by Ounalashka Corporation.
[68] Chena Power, 2024. A Joint Venture. alaskageothermal.info.
[69] Kitselas Geothermal, 2024. Geothermal Energy as Fuel for Reconciliation. kitselasgeo.ca.

Transmission and Distribution

At A Glance

When electricity is generated it either needs to be stored or delivered to its users—homes, businesses, communities. The process of moving electricity to a region is called transmission. In transmission, power is transported from the generation site through substations and transmission lines until it reaches the distribution system. Once here, electricity moves through substations and distribution wires until it is finally connected with electricity users. This entire system—generation, transmission, distribution and load (or end user)—make up the electrical grid, also known as a transmission grid.[70]

To move electricity from energy source to end user is not a simple process. One complexity is voltage requirements. When electricity is generated, the voltage may be too low to be transported at high speeds. To address this, voltage is increased at the generation site through a step-up transformer. After transmission, voltage is lowered through a step-down transformer, and delivered to end-users through the distribution system.

[70] Transmission Agency of Northern California, 2024. Understanding Transmission. https://www.tanc.us/understanding-transmission/.

NOTABLE FACTS

Electrical grid expansion is critical to Canada's clean energy transition.

To meet its 2050 climate goals, Canada needs to double or triple electrification[71] (electrification refers to clean energy expansion and increased transmission). Integrating clean energy sources into the grid will support smart grid development, high-voltage direct-current technology, efficiency gains and power transmission—all of which are required to reach net zero.

Electrical grids—including transmission and distribution—largely occupy Indigenous lands.

Regardless of its source—whether solar, nuclear, geothermal, hydroelectricity or other—energy needs to be transported through transmission lines to get to its users. These lines traverse great distances, and pass through Indigenous lands. It's important to note that Indigenous support for new (or previously built without Indigenous consent) transmission infrastructure is not universal. Free, prior, and informed consent must be obtained from all impacted Indigenous nations for all types of projects.

Electrical grid expansion requires substantial investment.

Expanding an electrical grid—either to reach more homes or to connect a new clean energy source—is a big investment. This process involves constructing high-voltage power lines, transformers and control systems.[72]

Transmission between regions can help to decarbonize the energy system.

A great deal of time and resources are needed for many regions to remove fossil fuel emitting energy sources. However, during this transition, if regions can purchase surplus clean energy through an interconnected transmission grid, collective greenhouse gas emissions will be reduced. For this reason, it's important that electrical transmission be shared across adjacent jurisdictions—which includes Indigenous nations, states, provinces, territories and countries.

The transmission and distribution sector holds opportunity for Indigenous nations.

Electrical grid expansion—primarily increased transmission—holds great potential for Indigenous partnerships. Transmission is a rate-regulated industry and presents a low-risk opportunity for Indigenous ownership. For instance, Hydro One has committed to 50% Indigenous ownership for all future transmission assets.[73]

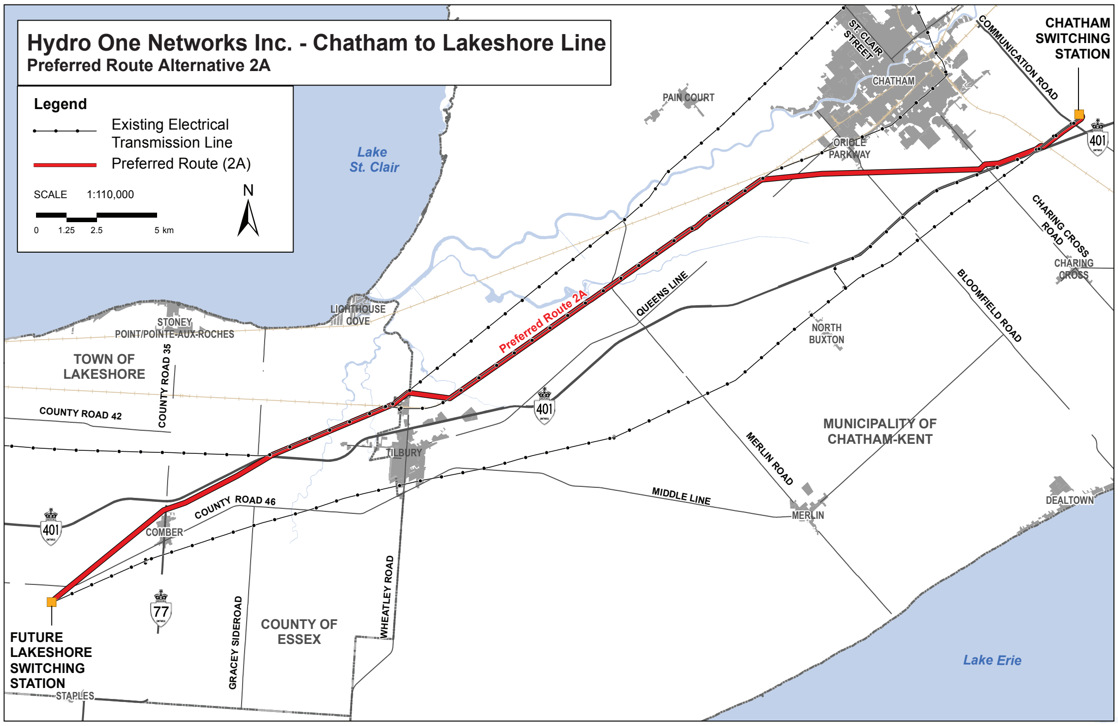
SPOTLIGHT ON INDIGENOUS PROJECTS

Chatham to Lakeshore Transmission Line

In 2023, Hydro One began construction of a new double-circuit 230kV transmission line from Chatham-Kent to Lakeshore, in Southwestern Ontario. It is on track to be completed by the end of 2024—a year ahead of schedule—and will add ~400 MW of clean electricity to the region. As part of Hydro One's First Nations Equity Model, five local First Nations (Chippewas of the Thames, Aamjiwnaang, Walpole Island, Caldwell, and Kettle and Stoney Point First Nations) will have the opportunity to invest in a 50 % equity ownership stake in the transmission line.[74]

---

[71] Annesley, J., Campbell, D., Golshan, A., and Greenspon, E., 19 July 2023. Project of the Century: A Blueprint for Growing Canada's Clean Electricity Supply – and Fast. ppforum.ca/publications/net-zero-electricity-canada-capacity/.
[72] Transmission Agency of Northern California, 2024. Understanding Transmission. https://www.tanc.us/understanding-transmission/.
[73] FNMPC and Mokwateh, 2024. National Indigenous Electrification Strategy. April 2024. fnmpc.ca/wp-content/uploads/FNMPC_National_Electrification_digital_final_04222024.pdf.
[74] Hydro One, 2024. Chatham to Lakeshore Line. hydroone.com/about/corporate-information/major-projects/chatham-to-lakeshore.



Five Nations Energy

First Nations Energy Inc. (FNEI) is the corporation behind the Omushkego Ishkotayo Project (Western James Bay Transmission Line Project), a 270 km long transmission line that services Attawapiskat, Fort Albany, and Kashechewan. "FNEI is one of five licensed electricity transmitters in Ontario; and is also the only Indigenous owned electricity transmission company in Canada, as well as in Ontario."[75]

California Tribes Unite to Test a Controller Microgrid Technology

The Yurok, Valley, and Karuk Tribes in California have come together to build a $177 million microgrid project: three microgrids will "operate independently or together during outages, providing power to critical community institutions—even during broader outages on the circuit." This project will use controller technology to combine renewable energy and backup generators. When the power grid is functioning as normal, the expanded microgrid will add power to the wider electrical circuit. In the case of power outages or problems, "the microgrid can isolate itself—or even send some of its power to an affected area elsewhere on the reservation."[76]

[75] Five Nations Energy Inc., March 2024. Who is FNEI? https://fivenations.ca/index.php/about.
[76] Oxendine, C., 11 August 2024. California tribes unite for $177M microgrid project to combat power outages and boost energy sovereignty, Tribal Business News. https://tribalbusinessnews.com/sections/energy/14801-california-tribes-unite-for-177m-microgrid-project-to-combat-power-outages-and-boost-energy-sovereignty.

Energy Storage

At A Glance

For an electrical grid to do its job—provide power—it needs to supply consistent electricity to all of its users, at all times. To do this, it must constantly balance the supply and demand of electricity. One way to maintain this balance is by storing energy. Utility-scale energy storage technologies are large systems that help offset supply-demand variations by holding on to energy during high generation periods, and distributing energy when user consumption is high. Not only does this process offer grid reliability, but it also lowers economic costs and provides environmental benefits.

Many energy storage solutions are still emerging or being developed. A few known technologies in use today include:

Battery

Utility-scale battery storage works on the same principles as everyday rechargeable batteries. These large batteries may use lithium-ion, lead acid, lithium-iron or other chemicals to store electricity.

Pumped Hydroelectric

An energy storage solution for hydroelectric systems. This storage technology pumps water from a lower reservoir to an upper reservoir (during low demand periods) and releases the water to generate electricity (during high demand periods).

Compressed Air & Flywheel

With compressed air storage, air is compressed and stored in underground caverns. When it is released, it drives turbines and produces electricity. Another technology—flywheel storage—holds onto kinetic energy created by a type of rotor, the flywheel. In demand periods, this energy is activated and turns a generator.[77]

NOTABLE FACTS

Utility-scale energy storage reduces Canada's need for fossil fuel-based power.

By balancing supply and demand, energy storage systems support the addition of renewable energy into the power mix, thereby reducing widespread reliance on fossil fuels.

Utility-scale energy storage is vital for clean energy integration.

Energy storage technologies are especially important when considering renewable energy sources, particularly those that have seasonal or daily fluctuations (such as wind and solar). By storing renewable energy when its abundant, and releasing it when needed, storage technologies can help overcome these intermittent power issues.

Utility-scale energy storage supports energy security.

Utility-scale storage systems can provide backup power during outages and emergencies, enhancing the resilience of the grid against natural disasters or other disruptions.[78]

Energy storage technologies are not without impact.

Although utility-scale energy storage will play an important and ongoing role in lowering the energy sector's overall carbon footprint, there are some things to know. If not disposed of properly, raw materials used in batteries—such as lithium and lead—can be an environmental hazard. However, they can also be recycled, which minimizes the need for new metal and mineral mining and processing.

Energy storage is a fast-growing areas for Indigenous partnerships.

This growth is driven by the increasing need for energy storage solutions to support the addition of clean energy sources into the grid. Indigenous partnership and ownership in energy storage can improve overall infrastructure development, while providing economic returns to participating First Nations.

> *"The Ontario Pumped Storage Project is a long overdue energy initiative with real benefits for the Indigenous people of the land."*
>
> -Conrad Ritchie, Chief, Saugeen First Nation and Gregory Nadjiwon, Chief, Chippewas of Nawash Unceded First Nation[79]

---

[77] US Environmental Protection Agency, 2024. Electricity Storage. https://www.epa.gov/energy/electricity-storage.
[78] Veolia, 2024. Benefits and Applications of Energy Storage Systems. www.veolia.co.uk/benefits-and-applications-energy-storage-systems.
[79] TC Energy, 11 January 2024. Made-in-Ontario Pumped Storage. www.tcenergy.com/announcements/2024/2024-01-11-made-in-ontario-pumped-storage-will-enhance-provinces-energy-supply-mix/.

SPOTLIGHT ON INDIGENOUS PROJECTS

Six Nations of the Grand River: Oneida Battery Storage Project

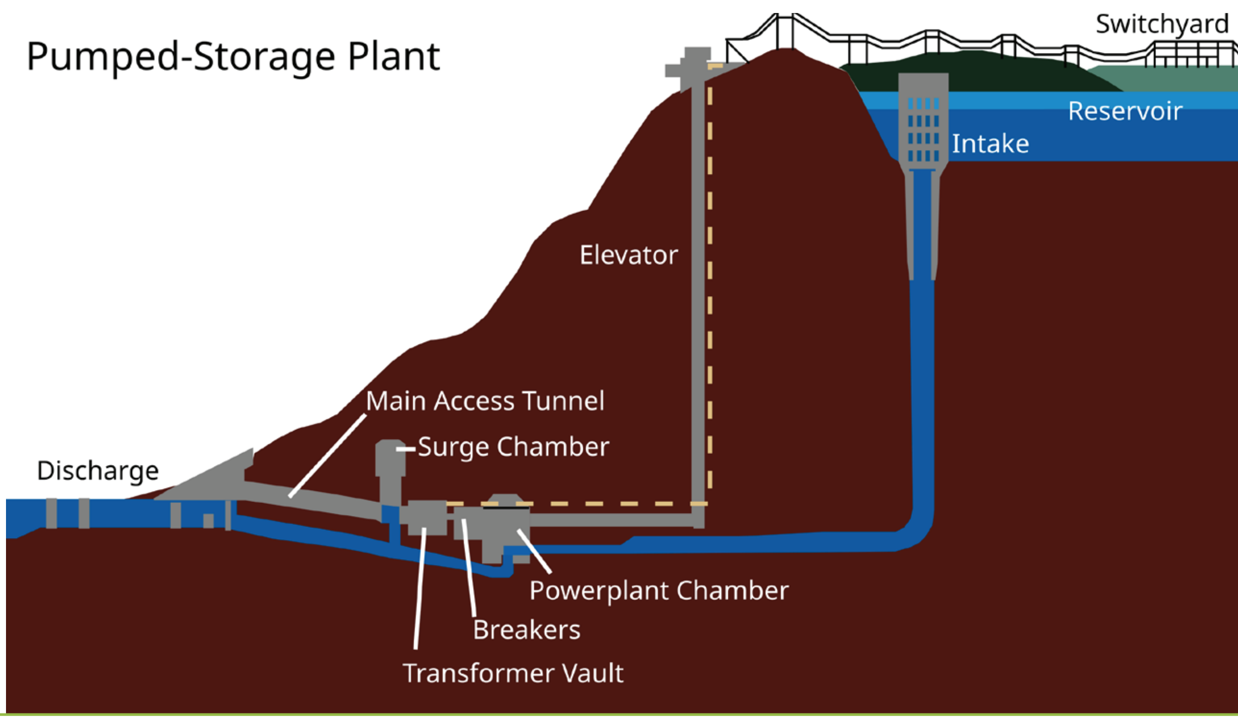
In Southwestern Ontario, the Six Nations of the Grand River Development Corporation have partnered with NRStor Inc. to build a 250 megawatt / 1,000 megawatt-hour energy storage facility.[80]

Makwa-Cahill

Makwa Development Corporation (owned by Chippewas of Nawash Unceded First Nation) and The Cahill Group have partnered to create Mahill-Cahill LP. In 2022, they announced they were selected to review TC Energy's pumped storage project in Meaford, Onatrio.[81]

Saugeen Ojibway Nation & TC Energy

In the beginning of 2024, TC Energy Corporation announced it would continue to advance a pumped storage project in prospective partnership with Saugeen Ojibway Nation. If approved, the project would begin service in the early 2030s.[82]



[80] NRStor, 10 February 2023. NRStor and Partners Execute Major Agreements for 1000 MWh Oneida Energy Storage Project. http://nrstor.com/2023/02/09/nrstor-and-partners-execute-major-agreements-for-1000-mwh-oneida-energy-storage-project/.
[81] Makwa Development, 18 June 2024. Our Work. www.makwadevelopment.ca/our-work.
[82] TC Energy, 11 January 2024. Made-in-Ontario Pumped Storage. www.tcenergy.com/announcements/2024/2024-01-11-made-in-ontario-pumped-storage-will-enhance-provinces-energy-supply-mix/.

Emerging Clean Energy Technology

Over the next decade or two, the energy sector will experience a big shift. Part of this will include the integration of established clean energy technologies described earlier. On top of this, a number of solutions are emerging in Canada and around the world. This section gives a brief introduction to each of the clean energy technologies that currently show considerable promise.

Concentrated Solar Power

At A Glance

Concentrated solar power (CSP) generates electricity from the sun without using traditional solar photovoltaic panels. Instead, CSP power plants use mirrors or lenses to magnify sunlight on a single point—the receiver. The receiver then passes this energy to a fluid produces steam to drive a turbine.[83] Unlike solar photovoltaic power plants, CSP plants take up less land and are able to concentrate sunlight and generate solar energy at a higher efficiency rate. They can also store thermal capacity to provide a degree of baseload electricity and can be scaled up to utility-scale power plants.[84]

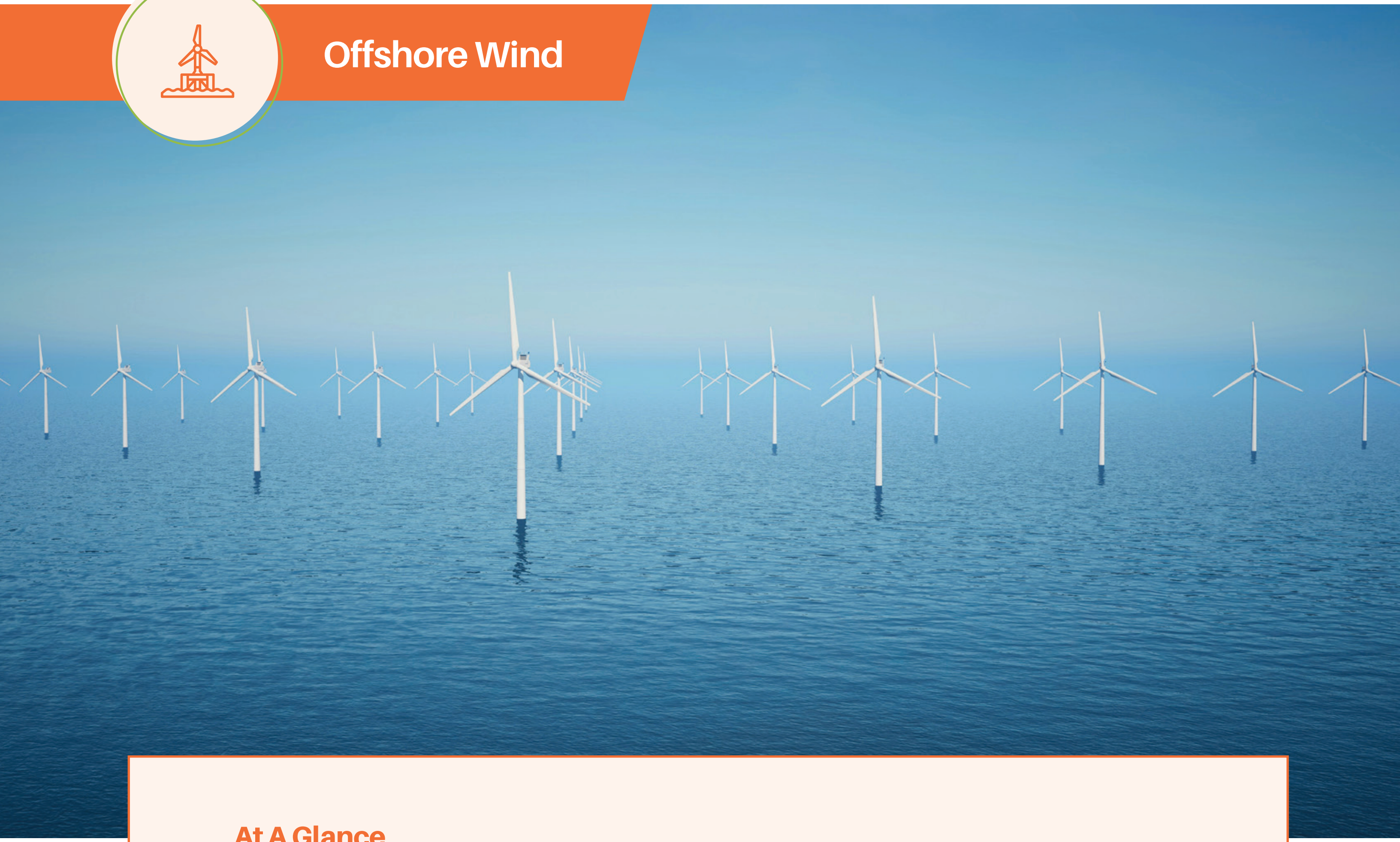
[83] Clean Energy Ideas, 15 November 2019. What Are Concentrated Solar Thermal Power Plants? https://www.clean-energy-ideas.com/solar/concentrated-solar-power/what-are-concentrated-solar-thermal-power-plants/.

[84] US Department of Energy, Solar Energy Technologies Office, 2024. Concentrating Solar-Thermal Power Basics. https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-basics.

CURRENT STATUS

While CSP power plants are producing electricity around they world,[85] in Canada they are only in the research and development phases. Although not at commercial-scale yet in Canada, CSP research and development may be of interest to First Nations located in sunnier areas, such as Medicine Hat which is currently piloting a concentrated solar thermal plant.[86]

Offshore Wind



At A Glance

Offshore wind works in a similar way to onshore wind, the difference is where the turbines are located, strategically positioned in the ocean where wind is mostly more reliable and usually blows at greater force than onshore wind, allowing for larger turbines that can generate considerably more power. The open space of the ocean allows wind to travel unrestrained without hitting land: this abundance of energy gets harnessed by wind turbines, which create electricity.[87]

[85] SolarPaces, 2024. CSP Projects Around the World. solarpaces.org/worldwide-csp/csp-projects-around-the-world/.
[86] Pembina Institute, 18 November 2014. Welcome to Canada's first concentrated solar thermal plant. https://www.pembina.org/blog/welcome-canadas-first-concentrated-solar-thermal-plant .
[87] National Grid, 2024. Onshore vs offshore wind energy: what's the difference? https://www.nationalgrid.com/stories/energy-explained/onshore-vs-offshore-wind-energy.

CURRENT STATUS

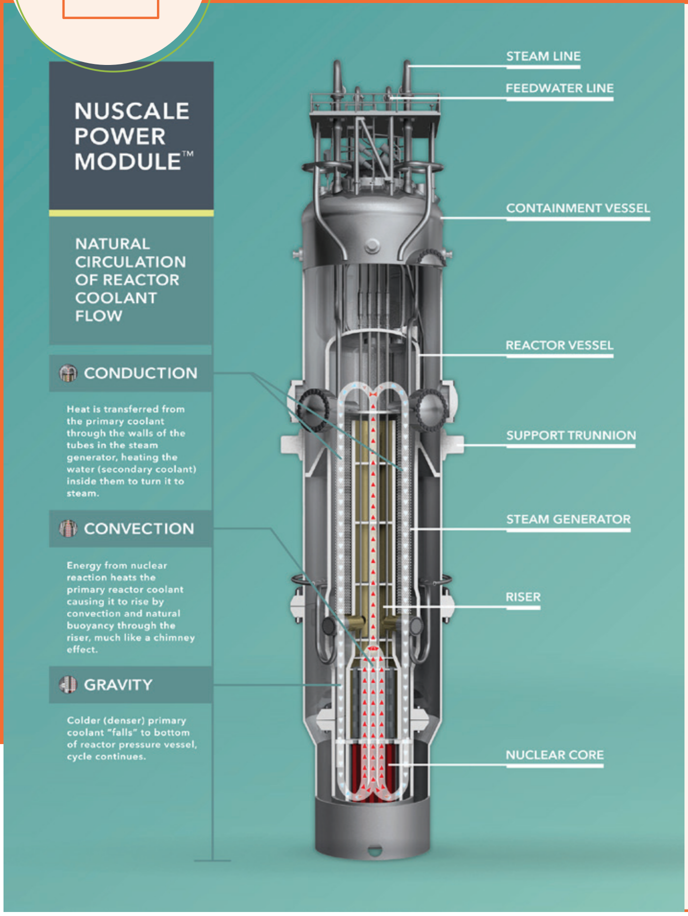
Offshore wind has been an important source of energy for many countries around the world, for many years.[88] Canada, with its long coastlines near population centres in the Pacific, Atlantic, and Great Lakes, has great potential to develop offshore wind resources. However, no offshore wind projects have been built yet.[89]

A few barriers to offshore wind development include:

» High capital costs;
» Newly emerging regulatory and policy developments;
» Technical difficulties with building and operating offshore wind turbines.

For First Nations, navigating territorial impacts and jurisdiction over offshore wind resources may be challenging: there may be more overlapping claims, or uncertain territorial claims, on water than on land. However, as Canada begins to build out its offshore wind market, opportunities for First Nations involvement may arise to solve these very jurisdictional challenges. In Nova Scotia, the country's first offshore wind farm is expected to near completion by the end of 2030.[90]

Nuclear Fission: Small Modular Reactors (SMRs)



At A Glance

Small Modular Reactors (SMRs) hold great potential as an emerging clean energy technology that is safe, stable and can provide baseload capacity in Canada. To create energy, SMRs use nuclear fission. However, in comparison to traditional nuclear power plants, SMRs are:

» Smaller in size and power output;
» Built faster, with shorter construction timelines;
» Designed to be deployed more efficiently;
» More affordable, with lower capitol cost (levelized cost of electricity is often 40% less);
» Operated with a higher degree of safety.[91]

As their name suggests, SMRs are built in a factory (as opposed to onsite) which makes them portable and scalable.[92] Their smaller size and modularity means they can be manufactured and then transported to remote, harder-to-access communities.

[88] Clean Energy Ideas, 19 September 2018. Wind Turbines At Sea. https://www.clean-energy-ideas.com/wind/wind-turbines/wind-turbines-at-sea/.
[89] International Energy Agency, November 2019. Offshore Wind Outlook 2019. iea.org/reports/offshore-wind-outlook-2019.
[90] Norton Rose Fulbright, March 2024. Global offshore wind: Canada. nortonrosefulbright.com/en/knowledge/publications/d77f6a16/global-offshore-wind-canada.
[91] NRCan, November 2018. A Call to Action: A Canadian Roadmap for Small Modular Reactors. https://smrroadmap.ca/wp-content/uploads/2018/11/SMRroadmap_EN_nov6_Web-1.pdf.
[92] Exner-Pirot, H., and McCormick, J. November 2023. Primer on Nuclear Energy, SMRs and First Nations. https://fnmpc.ca/wp-content/uploads/FNMPC_SMR_PRIMER_for_email.pdf.

CURRENT STATUS

The world's first active SMR began operation in 2020—a floating nuclear power plant in Russia. This reactor may be the first in its field, but there are dozens (+80) of other designs being developed around the world.[93] In Canada, SMRs have received significant funding and policy support from governments. To outline the long-term strategy for SMR deployment, Natural Resources Canada has created an SMR roadmap.[94]

Some examples of SMR progress in Canada include:

Ontario Power Generation (OPG)

OPG is working to deploy an SMR at its Darlington site by the late 2020s. OPG has selected GE Hitachi Nuclear Energy's BWRX-300 as the technology for this project.[95]

SaskPower

SaskPower is exploring the potential of SMRs to replace coal-fired plants and meet future energy demands in Saskatchewan.[96]

Canadian Nuclear Laboratories (CNL)

CNL is hosting an SMR demonstration project at its Chalk River site and collaborating with various technology developers.[97]

New Brunswick Power (NB Power)

NB Power is involved in the development of advanced SMR technology, with a focus on Moltex Energy's stable salt reactor and ARC Nuclear's ARC-100 reactor.[98]

North Shore Mi'kmaq Tribal Council SMR Investment

All 15 First Nations in New Brunswick have entered into MOU agreements with two leading SMR developers: Moltex and ARC Clean Energy. As well, seven First Nations who are part of the North Shore Mi'kmaq Tribal Council are making financial investments in both companies.[99]

There is great potential for SMRs to become an important clean energy source in Canada over the next few decades. However, continued funding and public support is necessary to make this happen. According to the Canadian Small Modular Reactor Roadmap, "conservative estimates place the potential value for SMRs in Canada at $5.3B between 2025 and 2040."[100] Some First Nations could be well positioned to leverage this economic opportunity.

---

93 International Atomic Energy Agency, 13 September 2023. What are Small Modular Reactors (SMRs)? https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs#:~:text=Russia's%20Akademik%20Lomonosov%2C%20the%20world's,the%20United%20States%20of%20America.

94 NRCan, November 2018. A Call to Action: A Canadian Roadmap for Small Modular Reactors. https://smrroadmap.ca/wp-content/uploads/2018/11/SMRroadmap_EN_nov6_Web-1.pdf.

95 Ontario Power Generation, 2024. Darlington nuclear station. https://www.opg.com/power-generation/our-power/nuclear/darlington-nuclear/.

96 SaskPower, 2024. Nuclear Power from Small Modular Reactors. https://www.saskpower.com/our-power-future/our-electricity/electrical-system/balancing-supply-options/nuclear-power-from-small-modular-reactors.

97 Canadian Nuclear Laboratories, 2024. Siting Canada's First SMR. https://www.cnl.ca/clean-energy/small-modular-reactors/siting-canadas-first-smr/.

98 NB Power, 2024. Advanced Small Nuclear Reactors. https://www.nbpower.com/en/about-us/projects/advanced-small-modular-reactors/.

99 FNMPC and Mokwateh, 2024. National Indigenous Electrification Strategy. April 2024. fnmpc.ca/wp-content/uploads/FNMPC_National_Electrification_digital_final_04222024.pdf.

100 NRCan, November 2018. A Call to Action: A Canadian Roadmap for Small Modular Reactors. https://smrroadmap.ca/wp-content/uploads/2018/11/SMRroadmap_EN_nov6_Web-1.pdf.

Compact Nuclear Fusion

At A Glance

Most nuclear reactors today use nuclear *fission* technology. In contrast, nuclear *fusion* does not split the atom: it joins two smaller atoms to make one larger one. This process is a scaled-down version of how stars—including the sun—combine hydrogen atoms to power themselves. However, unlike stars, power from nuclear fusion can be more easily deployed by isolating the process in a magnetic chamber—called magnetic confinement.[101]

As its name suggests, compact nuclear fusion is simply a nuclear fusion process that uses smaller, more compact fusion engines and reactors. Rather than needing a reactor that would fit in a large building, a compact fusion reactor could potentially fit in the back of a truck, with enough energy to power a small city.[102]

Compared to nuclear fission, nuclear fusion is:

- **Less reliable.** To date, it hasn't been able to sustain reactions for long enough to make it efficient.
- **More powerful.** It creates 3 to 4 times more energy than nuclear fission;
- **Safer.** It doesn't produce radioactive waste.[103]

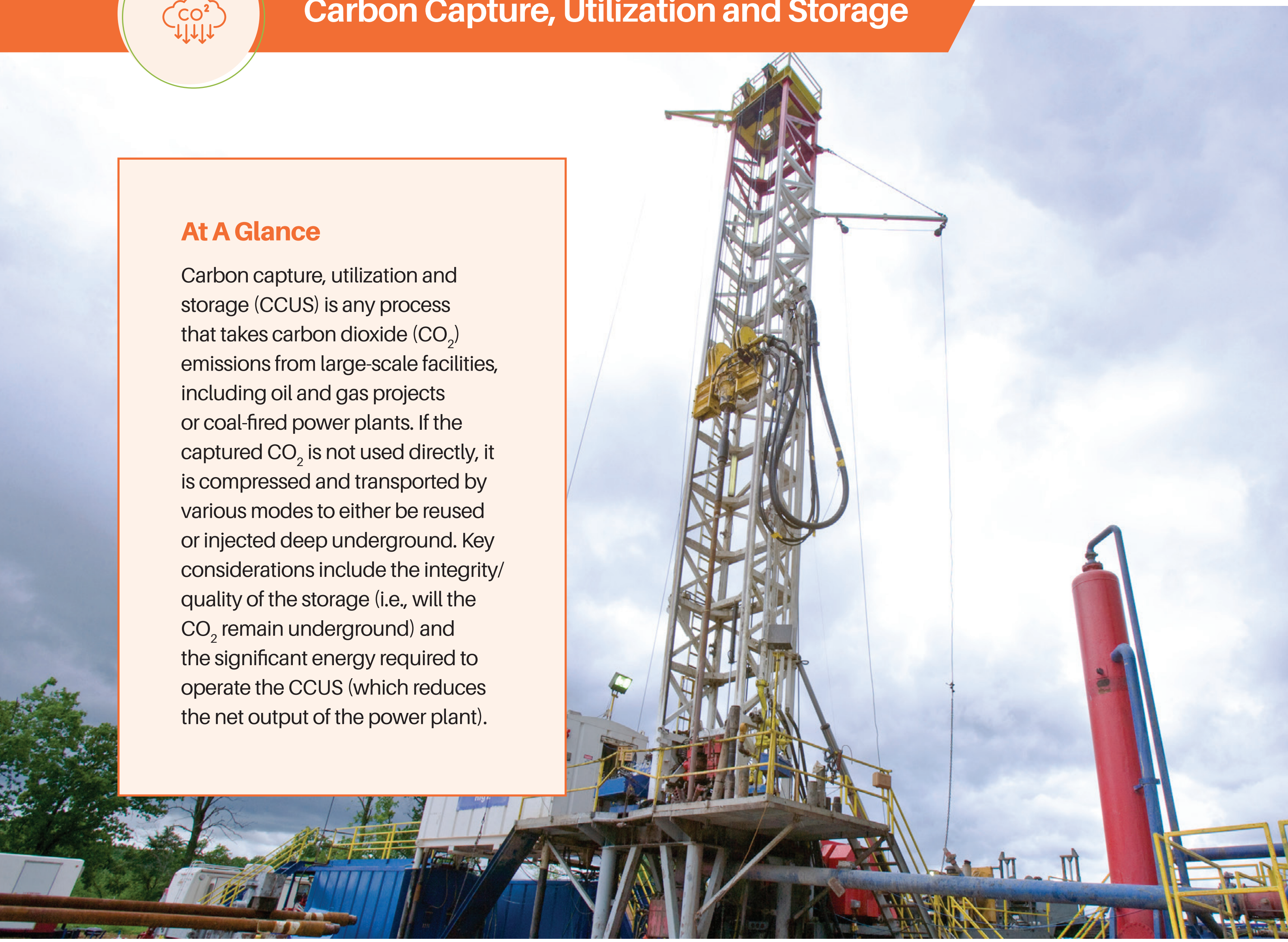
[101] Aerospace, 23 June 2021. Sizing Up Compact Fusion's Potential. https://aerospace.org/article/sizing-compact-fusions-potential.
[102] Lockhead Martin, 2024. Compact Fusion. lockheedmartin.com/en-us/products/compact-fusion.html.
[103] Clean Energy Ideas, 17 May 2020. What Is Nuclear Energy?

CURRENT STATUS

Nuclear fusion is still in a highly experimental phase, the technology is still being developed—there are now nearly 100 operating fusion experiments and demonstration facilities globally, 13 under construction, and another 33 planned.[104] A few projects of note include Lockheed Martin's Skunkworks,[105] MIT's SPARC[106] and NT-Tao's Modular Fusion Reactor.[107]

Compact nuclear fusion is also still under development. Although Canada has a leading fusion reactor organization (General Fusion), as of September 2024 there are currently no equivalent compact fusion projects.

Carbon Capture, Utilization and Storage



At A Glance

Carbon capture, utilization and storage (CCUS) is any process that takes carbon dioxide (CO_2) emissions from large-scale facilities, including oil and gas projects or coal-fired power plants. If the captured CO_2 is not used directly, it is compressed and transported by various modes to either be reused or injected deep underground. Key considerations include the integrity/quality of the storage (i.e., will the CO_2 remain underground) and the significant energy required to operate the CCUS (which reduces the net output of the power plant).

[104] Canadian Nuclear Laboratories, 14 June 2024. CNL announces new programs to position Canada to seize opportunities in fusion energy. www.cnl.ca/cnl-announces-new-programs-to-position-canada-to-seize-opportunities-in-fusion-energy/.
[105] Lockhead Martin, 2024. Compact Fusion. lockheedmartin.com/en-us/products/compact-fusion.html.
[106] MIT Plasma Science & Fusion Center, 2024. SPARC. https://www.psfc.mit.edu/sparc.
[107] Lisbona, N., 27 April 2023. The Israeli plan to fit a fusion reactor into a container, BBC News. https://www.bbc.com/news/business-65123116.

CCUS uses the following processes:

Capture. First, carbon dioxide that would otherwise enter the atmosphere is rerouted from the facility site using a range of technologies. These include pre- or post-combustion capture, direct air capture, or oxy-fuel combustion, all of which have different applications and maturity stages of each technology.

Utilization. This process does not always occur. When it does, utilization refers to reusing the captured carbon for things like enhanced oil recovery, chemicals production, and raw material for concrete or plastics production.

Storage. Carbon storage–which may or may not accompany utilization—involves injecting the captured carbon underground, into depleted oil and gas fields, or saline aquifers.[108]

CURRENT STATUS

Global momentum for CCUS has recently grown: there are currently +500 CCUS-linked projects around the world, all at various development stages. However, according to the International Energy Association, "even at such level, CCUS deployment would remain well below what is required in the Net Zero Scenario."[109] Canada's CCUS landscape mirrors this, with the country's capture capacity projected to grow from 4.4Mt of CO_2 to 16.3 Mt by 2030—despite this growth, to meet net zero by 2050, a continued scaling-up is required.[110]

The following two major carbon capture projects are currently underway in Canada:

SaskPower's Boundary Dam [111]

This is a coal-fired power plant retrofit that is currently captured 1Mtpa of CO2. The captured carbon is sold to Cenovus for use in enhanced oil recovery (EOR). This project began capturing carbon in 2014. It is the first and only large-scale power plant CCS project in the world, and the first commercial application of post-combustion carbon capture.

Shell's Quest project[112]

Quest captures 1.2 Mtpa of CO2 from oil sands upgrading processes, which is then stored in a deep saline aquifer.

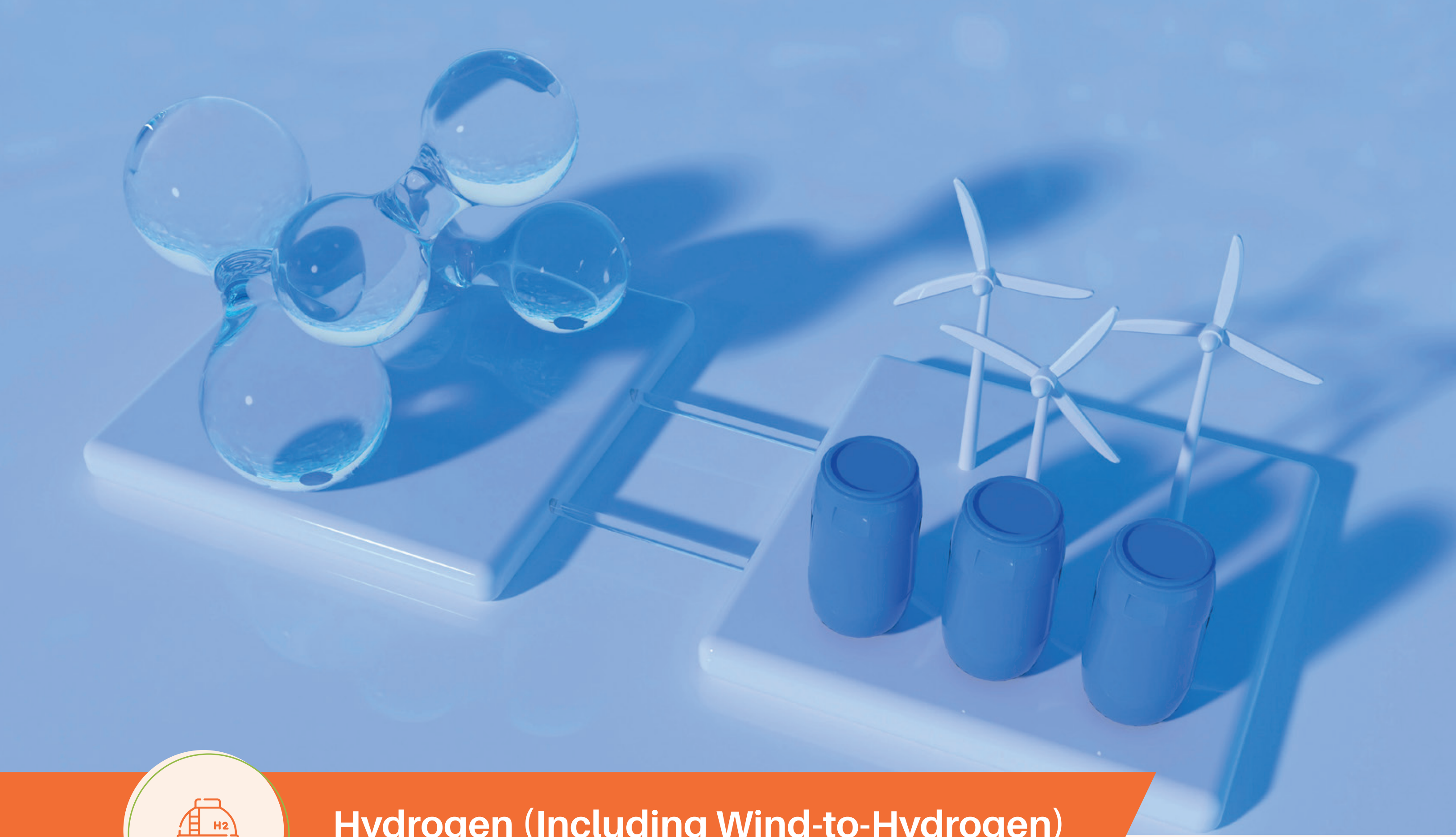
Other projects

Two other large Canadian projects are in the construction phase: Spectra's gas processing plant CCS retrofit, and Alberta Carbon Trunk Line—the world's largest CCS project.[113] In Northern Alberta, a major proposed project is the $16.5B CCS pipeline network that would transport captured carbon from over twenty oil sands facilities to an underground storage facility near Cold Lake.[114] As well, just east of Edmonton, the Frog Lake First Nation NET Power Station is a 51% Indigenous-owned project that will includes CCUS technology.

As the carbon capture sector continues to expand, there may opportunities for First Nations to partner on commercial and economic CCS-CCUS projects. However, ongoing environmental concerns connected to carbon storage need to be clarified, particularly to ensure First Nations' territorial integrity.

---

108 United States Department of Energy, 2024. Carbon Capture, Utilization & Storage. https://www.energy.gov/carbon-capture-utilization-storage.
109 International Energy Association, 2024. Carbon Capture, Utilisation and Storage. https://www.iea.org/energy-system/carbon-capture-utilisation-and-storage.
110 Government of Canada, 2024. Canada's Carbon Management Strategy. https://natural-resources.canada.ca/climate-change/canadas-green-future/capturing-the-opportunity-carbon-management-strategy-for-canada/canadas-carbon-management-strategy/25337.
111 SaskPower, 2024. Boundary Dam Carbon Capture Project. https://www.saskpower.com/our-power-future/infrastructure-projects/carbon-capture-and-storage/boundary-dam-carbon-capture-project.
112 Shell, 2024. Quest Carbon Capture and Storage. https://www.shell.ca/en_ca/about-us/projects-and-sites/quest-carbon-capture-and-storage-project.html.
113 Alberta Government, 2024. Alberta Carbon Trunk Line. https://majorprojects.alberta.ca/details/Alberta-Carbon-Trunk-Line/622.
114 Graney, E., 13 December 2022. Oil sands coalition to start exploratory drilling for carbon-capture project. Globe and Mail. https://www.theglobeandmail.com/business/article-pathways-alliance-carbon-capture-oil-sands/.



Hydrogen (Including Wind-to-Hydrogen)

At A Glance

Hydrogen is the most abundant element in the universe. Considering the fact that stars are made almost entirely hydrogen, its plentiful nature is not surprising. On Earth, hydrogen only occurs naturally with other elements, such as water. However, hydrogen can be separated from sources—such as water, fossil fuels, biomass. Once hydrogen is produced, among other zero-emissions uses, it can fuel vehicles, heat and power buildings, and store energy (via fuel cells).

The two most common ways to pull hydrogen from its source are called *steam reforming and electrolysis*.[115] Because hydrogen is make in different ways, it is given different color categories such as:

Grey hydrogen: made by a chemical reaction between steam and methane (the main element in natural gas).

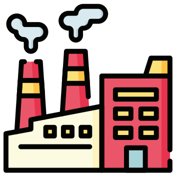
Blue hydrogen: made when carbon capture and storage is used to remove carbon dioxide emissions from the steam reforming process.

Green hydrogen: made through renewable energy sources using electrolysis, by running an electric current through water to split oxygen and hydrogen atoms.[116] Hydrogen made in this way can be stored and used in fuel cells, creating power when the renewable resource (such as wind) is low.

[115] US Energy Information Administration, 2024. Hydrogen. https://www.eia.gov/kids/energy-sources/hydrogen/.
[116] Government of Canada, 2024. The Hydrogen Strategy. https://natural-resources.canada.ca/climate-change/canadas-green-future/the-hydrogen-strategy/23080.

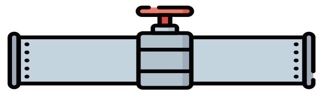
Participation in hydrogen production is often in one of three areas: **production**, **distribution**, and/or **zero-emission end uses** (Figure 5).

Overview: Hydrogen



Production

- Split water with electricity
- Upgrade natural gas (with CSS)



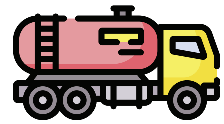
Distribution

Carrier Type

- Gaseous hydrogen
- Liquid hydrogen
- Ammonia (NH_3)

Infrastructure

- Trailers
- Pipelines
- Tankers
- Trains



Zero-Emission End Uses

Via fuel cells to:

- Move heavy vehicles
- Make power

Via combustion to:

- Move heavy vehicles
- Heat buildings (regionally)
- Make high-temp heat for industry
- Make power

Storage

Figure 5. Hydrogen production, distribution, and end uses. Source: Transition Accelerator.

CURRENT STATUS

The use of hydrogen as a clean energy solution has received both commercial and political attention, mostly for its potential as a large-scale, affordable and stable energy source. As well, its future as an export product is currently being explored, particularly by coastal regions.

However, costs associated with building hydrogen infrastructure—and subsequent start-up—remain a barrier to scaling-up hydrogen production. Given that hydrogen is effectively an energy storage mechanism, to deploy hydrogen at scale would take a complete retooling of energy systems that have been geared towards carbon and electricity for centuries.

That said, many hydrogen projects are underway in Canada. These include: Air Products Hydrogen Plant, a large-scale blue hydrogen plant in Edmonton; ATCOR and Suncor's partnership to produce more than 300,000 tonnes of hydrogen in Alberta; Atlantic Canada's Project Nujio'qonik will build a green hydrogen and ammonia plant; and, EverWind Fuel's Point Tupper and Burin Peninsula projects.[117,118]

First Nations' partnerships on hydrogen projects are being actively explored. For example, EverWind is partnering with Membertou Nation on its Phase 1 Power Generation project, and with Potlotek Nation on its Point Tupper Project.[119]

[117] Air Products, 23 April 2024. World-Leading Hydrogen Supplier's Latest Commitment Further Supports Canada's Climate and Energy Goals and 5,000 Hydrogen Vehicle Challenge. https://www.airproducts.com/company/news-center/2024/04/0423-air-products-to-build-commercial-scale-multi-modal-hydrogen-refueling-station-net-work-in-canada#:~:text=Air%20Products%20is%20building%20a,for%20permanent%20sequestration%20safely%20underground.

[118] ATCO, 2024. ATCO Hydrogen Projects. atco.com/en-au/for-business/hydrogen/ATCOs-Hydrogen-Projects.html.

[119] EverWind, 2024. Our project at Point Tupper. https://everwindfuels.com/projects/point_tupper.

Ocean Energy: Tidal & Wave


Tidal Energy

Wave Energy

At A Glance

Tidal and wave energy harness the power of the ocean's movement to generate electricity. These movements include a natural rise-fall (waves) and push-pull (tide). Although both energy sources are powered by the ocean, the way they work differs.

Tidal energy captures potential energy created by differences in high and low tide. One way to do this is with tidal barrages. With this approach, dams are built across the entrance of a tidal basin, trapping high water. As it returns to the ocean, the flow is redirected through electricity-generating turbines. Another approach for tidal energy, is to use stream generators—underwater turbines that function similarly to wind turbines.[120]

Wave energy can be captured either onshore or out in the open ocean. This technology uses point absorbers—floating structures that move with the waves and convert kinetic energy into electricity—or, water columns. Water columns use the rise-fall of water within a column to drive air through a turbine.[121]

[120] National Geographic, 2024. Tidal Energy. https://education.nationalgeographic.org/resource/tidal-energy/.

[121] Cuadra, L., et. al., May 2016. Computational intelligence in wave energy: Comprehensive review and case study, Renewable and Sustainable Energy Reviews, 58. sciencedirect.com/topics/engineering/oscillating-water-column.

CURRENT STATUS

Given Canada's long coastline, it's no surprise that tidal and wave energy are seen as emerging solutions to help Canada transition to a clean energy future. On the east coast, the Fundy Ocean Research Centre for Energy (FORCE) is driving research and development for scalable tidal stream energy in Nova Scotia's Bay of Fundy. On the west coast, Mowachat/Muchalaht First Nation are working with CalWave on a wave energy project in Yuquot, British Columbia. Although still in the developmental phase, this project offers an example of Indigenous participation from the outset.[122]

[122] CalWave, 2024. Offshore energy. https://www.offshore-energy.biz.

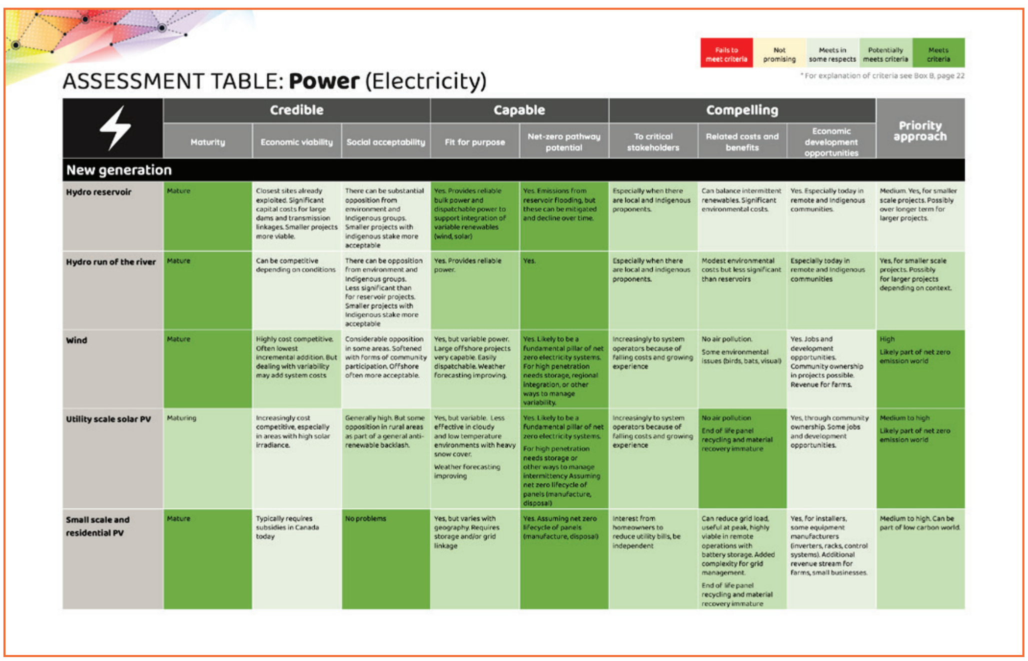
Considerations for First Nations in Clean Energy Projects

What Makes a Clean Energy Project a Good Fit for a First Nation?

Only a First Nation and its membership can decide whether to participate or partner on a clean energy project, and if so, which one best suits the values, geography, priorities, capacity, grid reliability, and circumstances of the Nation. The Transition Accelerator's Assessment Table for Power (Electricity) is a helpful starting place for considerations of the technologies themselves. The assessment table analyzes many of the technologies in this primer including consideration of:[123]

- Maturity
- Economic viability
- Social acceptability
- Fitness for purpose
- Net zero pathway potential
- Critical stakeholders
- Costs and benefits
- Economic development opportunities

Visit the Transition Accelerators Assessment Table to help with decision making:
https://transitionaccelerator.ca/wp-content/uploads/2023/05/TA_Pathways-to-Net-Zero_Power-Electricity-Table.pdf



Fails to meet criteria | Not promising | Meets in some respects | Potentially meets criteria | Meets criteria

ASSESSMENT TABLE: **Power** (Electricity)

* For explanation of criteria see Box B, page 22

	Credible			Capable		Compelling			Priority approach
	Maturity	Economic viability	Social acceptability	Fit for purpose	Net-zero pathway potential	To critical stakeholders	Related costs and benefits	Economic development opportunities	
New generation									
Hydro reservoir	Mature	Closest sites already exploited. Significant capital costs for large dams and transmission linkages. Smaller projects more viable.	There can be substantial opposition from environment and Indigenous groups. Smaller projects with indigenous stake more acceptable	Yes. Provides reliable bulk power and dispatchable power to support integration of variable renewables (wind, solar)	Yes. Emissions from reservoir flooding, but these can be mitigated and decline over time.	Especially when there are local and Indigenous proponents.	Can balance intermittent renewables. Significant environmental costs.	Yes. Especially today in remote and Indigenous communities.	Medium. Yes, for smaller scale projects. Possibly over longer term for larger projects.
Hydro run of the river	Mature	Can be competitive depending on conditions	There can be opposition from environment and Indigenous groups. Less significant than for reservoir projects. Smaller projects with Indigenous stake more acceptable	Yes. Provides reliable power.	Yes.	Especially when there are local and indigenous proponents.	Modest environmental costs but less significant than reservoirs	Especially today in remote and Indigenous communities	Yes, for smaller scale projects. Possibly for larger projects depending on context.
Wind	Mature	Highly cost competitive. Often lowest incremental addition. But dealing with variability may add system costs	Considerable opposition in some areas. Softened with forms of community participation. Offshore often more acceptable.	Yes, but variable power. Large offshore projects very capable. Easily dispatchable. Weather forecasting improving.	Yes. Likely to be a fundamental pillar of net zero electricity systems. For high penetration needs storage, regional integration, or other ways to manage variability.	Increasingly to system operators because of falling costs and growing experience	No air pollution. Some environmental issues (birds, bats, visual)	Yes. Jobs and development opportunities. Community ownership in projects possible. Revenue for farms.	High Likely part of net zero emission world
Utility scale solar PV	Maturing	Increasingly cost competitive, especially in areas with high solar irradiance.	Generally high. But some opposition in rural areas as part of a general anti-renewable backlash.	Yes, but variable. Less effective in cloudy and low temperature environments with heavy snow cover. Weather forecasting improving	Yes. Likely to be a fundamental pillar of net zero electricity systems. For high penetration needs storage or other ways to manage intermittency Assuming net zero lifecycle of panels (manufacture, disposal)	Increasingly to system operators because of falling costs and growing experience	No air pollution End of life panel recycling and material recovery immature	Yes, through community ownership. Some jobs and development opportunities.	Medium to high Likely part of net zero emission world
Small scale and residential PV	Mature	Typically requires subsidies in Canada today	No problems	Yes, but varies with geography. Requires storage and/or grid linkage	Yes. Assuming net zero lifecycle of panels (manufacture, disposal)	Interest from homeowners to reduce utility bills, be independent	Can reduce grid load, useful at peak, highly viable in remote operations with battery storage. Added complexity for grid management. End of life panel recycling and material recovery immature	Yes, for installers, some equipment manufacturers (inverters, racks, control systems). Additional revenue stream for farms, small businesses.	Medium to high. Can be part of low carbon world.

Please visit Transition Accelerator to see a readable, interactive version of this Assessment Table:
https://transitionaccelerator.ca/wp-content/uploads/2023/05/TA_Pathways-to-Net-Zero_Power-Electricity-Table.pdf.

[123] Transition Accelerator, 2-24. Assessment Table. https://transitionaccelerator.ca/wp-content/uploads/2023/05/TA_Pathways-to-Net-Zero_Power-Electricity-Table.pdf.

Questions that First Nations may wish to Consider for Participation in Clean Energy Projects:

Initial Project Exploration

QUESTION	WHY IT'S IMPORTANT TO ASK THIS QUESTION
What type of clean energy project is being proposed?	Different project types carry different benefits, risks, and potential revenues.
Does the project align with First Nation priorities and values?	Projects have different impacts, risks, revenues, scales, and timelines which can only be weighed by the potential host First Nation.
What are the UNDRIP and economic reconciliation implications?	First Nations may want to consider how the potential project does or does not contribute to self-determination, furthering the principles of UNDRIP and reconciliation.
How will First Nations consent, and Indigenous partnership, be included in the project?	First Nations may want to consider how the potential project does or does not contribute to self-determination, furthering the principles of UNDRIP and reconciliation.

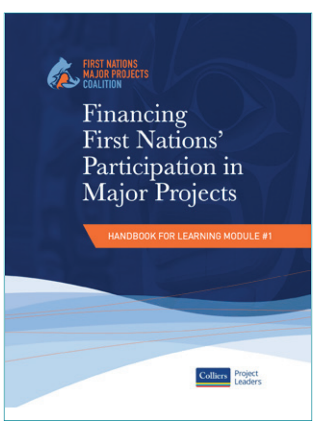
To find out more about the barriers, challenges and recommendations around Indigenous participation and ownership in electrification, please visit FNMPC's National Indigenous Electrification Strategy.

https://fnmpc.ca/wp-content/uploads/FNMPC_National_Electrification_digital_final_04222024.pdf

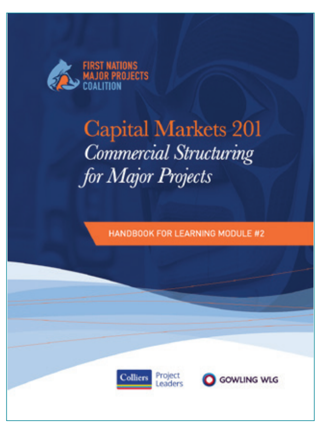
Financing and Types of Economic Participation in Clean Energy Projects

QUESTION	WHY IT'S IMPORTANT TO ASK THIS QUESTION
What are the economic participation possibilities for First Nations?	Various participation models – equity ownership, impact benefit agreements – have different implications on governance, financing, risks, revenues, etc.
How will First Nations finance the project?	To own/participate in parts, or all, of an energy project, First Nations may need to consider financing alternatives such as own source revenues, bank/ industry loans, loan guarantees, and forms of government support.[124]
What are the employment and procurement possibilities for the proposed project?	In addition to other forms of participation such as ownership, First Nations businesses have the potential to benefit from well-negotiated procurement contracts, employment, and skills training embedded in the project.
What will the rates of return to the First Nation?	First Nations may want to weigh participation in a project against other investments or projects.

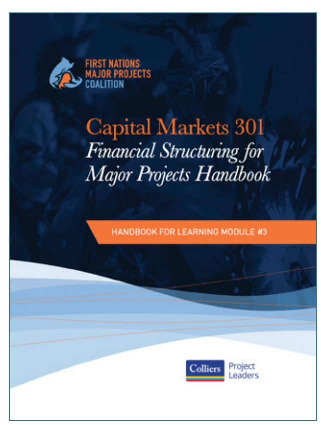
Find out more about financing Indigenous participation in major projects and capital markets.



Capital Markets 101:
Financing First Nations' Participation in Major Projects



Capital Markets 201:
Commercial Structuring for Major Projects

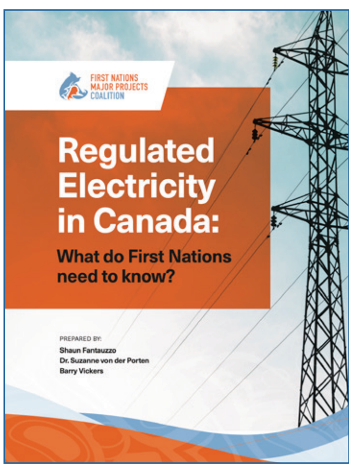


Capital Markets 301:
Financial Structuring for Major Projects Handbook

[124] For example, to support First Nations bidding on BC's current Call for Power, the Canada Infrastructure Bank by making a loan package available to winning bidders.

Market and Regulatory Setting

QUESTION	WHY IT'S IMPORTANT TO ASK THIS QUESTION
What is the regulatory setting of the proposed clean energy project?	Depending in which province/territory the project is located, how the project is regulated varies, impacting its profitability and ownership structure.
What are the current best practices for FirstNation-owned clean energy projects?	Indigenous ownership of electrification projects in several provinces and territories in Canada and around the world has been well-established. The highest standards and best examples should be explored.
What are the risks of the project?	Each type clean energy project carries its own risk which is influenced by factors such as markets, regulations, commodity prices, construction risks, projected vs. actual demand, environmental impacts, etc.

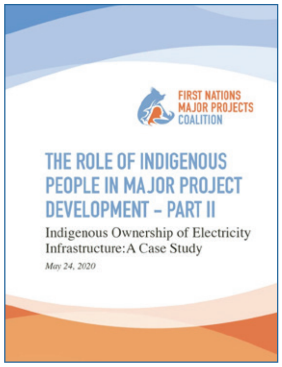


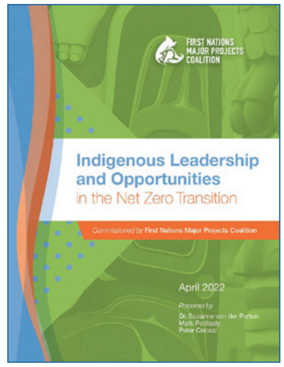
To find out more about electricity markets and rate-regulation, please see FNMPC's report on Regulated Electricity in Canada.

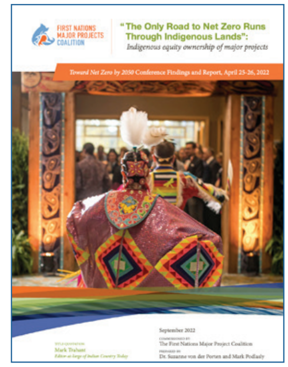
https://fnmpc.ca/wp-content/uploads/FNMPC_Elect_Primer_FINAL-Feb-1-2024.pdf

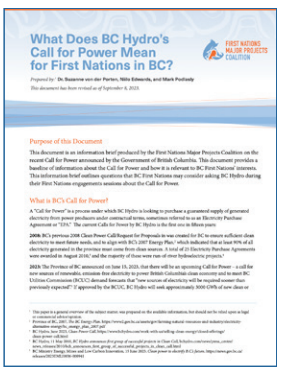
FNMPC Readings on First Nation Participation in the Electricity Sector

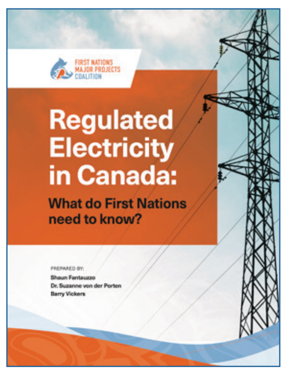
FNMPC has produced several research papers highlighting Indigenous leadership in the clean energy sector. These papers are accessible online for reference through the following links:











1. Paths for Indigenous Participation in Electricity Infrastructure, July 2019
2. Indigenous Ownership of Electricity Infrastructure: A Case Study, May 2020
3. Indigenous Leadership and Opportunities in the Net Zero Transition, April 2022
4. The Only Road to Net Zero Runs Through Indigenous Lands, September 2022
5. What Does BC Hydro's Call for Power Mean for First Nations in BC?, September 2023
6. Regulated Electricity in Canada, February 2024
7. National Indigenous Electrification Strategy, April 2024

Photo Credits

Cover: Nazarin Babashova (Unsplash)
Page 4: Matthew Henry (Unsplash), Robert Gramner (Unsplash)
Page 6: Chris Leboutillier (Unsplash)
Page 10: Sander Weeteling (Unsplash), American Public Power Association (Unsplash), Hannah Wright (Unsplash), Matthew Smith (Unsplash)
Page 13: Karen Davey (Unsplash)
Page 15: American Public Power Association (Unsplash)
Page 16: Awasis Solar, Chalice Lake
Page 17: Manny Becerra (Unsplash), Karsten Wurth (Unsplash)
Page 19: Uashat Mak Mani-utenam Wind Farm, Henvey Inlet First Nation on Wikimedia
Page 20: Casey Horner on Unsplash+
Page 21: Hupacasath First Nation Run-of-river on Flickr, Taku River Tlingit First Nation, SKQ Dam - Energy Keepers Inc.
Page 22: Biomass Power Plant on Wikimedia
Page 24: Menominee Biomass Ribbon Cutting on Wikimedia, Biomass Pellets on Wikimedia
Page 25: Nicolas Hippert (Unsplash)
Page 27: NuScale Carbon Free Power Project on Wikimedia
Page 28: Nesjavellir Power Plant on Wikimedia
Page 29: Mark Kuiper (Unsplash)
Page 30: Matthew Minnick, RESPEC, Ounalashka Corporation, Nesjavellir Power Plant on Wikimedia
Page 31: Padraig O'Flannery (Unsplash)
Page 34: Tesvolt Energy Battery Storage System on Wikimedia
Page 36: Tesvolt Energy Battery Storage System on Wikimedia, Racoon Mountain Pump on Wikimedia
Page 37: Gemasolar on Wikimedia
Page 38: Alexander Mils on Unsplash+
Page 39: Diagram on NuScale Reactor on Wikimedia
Page 41: SPARC of Fusion Energy on Wikimedia
Page 42: Coal Carbon Capture Technology on Wikimedia
Page 44: Allison Saeng on Unsplash+
Page 46: Rance Tidal Power on Wikimedia, Wave Claper on Wikimedia
Page 47: Jeremy Bishop (Unsplash)