Electricity storage

for a reliable and resilient New Brunswick

CONSERVATION COUNCIL OF NEW BRUNSWICK

Electricity is essential to our quality of life, health, and safety. It powers our homes and hospitals, lights up our roadways and classrooms, circulates clean air to breathe, and connects us to one another.

Electricity can be generated from different sources, including fossil fuels such as natural gas, oil, and coal. When burned, fossil fuels release harmful air pollutants and greenhouse gasses, fueling climate change.

In 2018, the Intergovernmental Panel on Climate Change (IPCC) released distressing news. Their historic report on the impacts of climate change found that even a 1.5°C increase in the global average temperature would have destructive effects on the world. This includes ongoing climate-fuelled forest fires, extreme weather events such as flooding and drought, and will result in 20-30% of the world's species becoming at risk of extinction.

The IPCC's 2023 report shows we are not moving fast enough to meet our emission reduction targets.

Canada has experienced an increase of 1.7°C since 1948, double the global rate.

An unprecedented energy transition is desperately needed for New Brunswick to mitigate the effects of a changing climate while keeping our communities safe, healthy, and financially protected.

New Brunswick needs to replace its fossil fuel-based grids with renewable energy-based grids. Clean energy is the new—and necessary—normal. **So how do we get there?**

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Electricity storage explained

Electricity storage is the process of capturing and storing electrical energy for later use, and is critical to the transition to a clean, reliable, and resilient energy system. As renewable energy sources continue to become more cost-competitive and widely adopted, electricity storage will play an important role in their integration and maximizing their benefits.

Electricity storage in New Brunswick is important for four reasons:

1. Integrating renewable energy: Electricity storage integrates renewable energy sources, such as wind and solar power, into New Brunswick's electrical grid by storing excess energy when it is generated and releasing it when it is needed. Storage reduces the need for fossil-fueled backup power.

2. Grid stability: Electricity storage provides fast-response power to address fluctuations in supply and demand, preventing power outages and reducing the need for expensive grid upgrades.

3. Peak shaving: Electricity storage reduces peak demand on the grid by storing excess energy during off-peak periods and releasing it during peak periods. This reduces the need for peaker plants, which are often fossil-fueled and expensive to operate. This strategy can help save consumers and businesses money by using stored electricity during expensive peak hours, and refilling their batteries during cheaper hours when there is less load on the grid, such as evenings or weekends.

4. Energy resilience: Electricity storage increases energy resilience by providing backup power in the event of a grid outage or other emergency. This can be particularly important in areas prone to extreme weather events or other natural disasters, which communities across New Brunswick are experiencing more frequently.

What types of electricity storage exist?

The most widely used types of electricity storage are thermal storage, pumped storage hydropower (PSH), and battery storage.

Thermal storage examples

Thermal storage stores excess thermal energy generated during periods of low electricity demand or high energy production and releases it when there is a higher demand for electricity. Sensible heat, latent heat, and thermochemical storage are all examples of thermal storage.

Sensible heat storage

Stores heat energy by raising the temperature of a solid or liquid, such as rocks, molten salt, or water. The stored heat can be released by transferring it back to a working fluid, such as steam, to drive a turbine and generate electricity.

Latent heat storage

Uses the heat absorbed or released during a phase change, such as the melting or solidification of a material. Phase change materials (PCMs) like paraffin wax or salt hydrates can store and release large amounts of energy during these transitions.

Thermochemical storage

Stores and releases heat through chemical reactions. Certain materials can undergo reversible chemical reactions that absorb and release heat energy, allowing for efficient storage and retrieval.

Although thermal storage can back up any electricity source, it's most beneficial when coupled with thermal energy sources such as concentrated solar power (CSP) plants or geothermal power plants as heat from thermal generation sources can be used directly in the complementary storage technology. Plus, thermal storage does not suffer from any geographical limitation—it can be built almost anywhere.

Pumped storage hydropower

Pumped storage hydropower (PSH) is a type of hydroelectric energy storage.

It consists of two reservoirs of water at different elevations that can generate power as water moves down from one to the other, passing through a turbine. The system also requires power as it pumps water back into the upper reservoir.

PSH acts similarly to a giant battery because it can store power and then release it when needed.

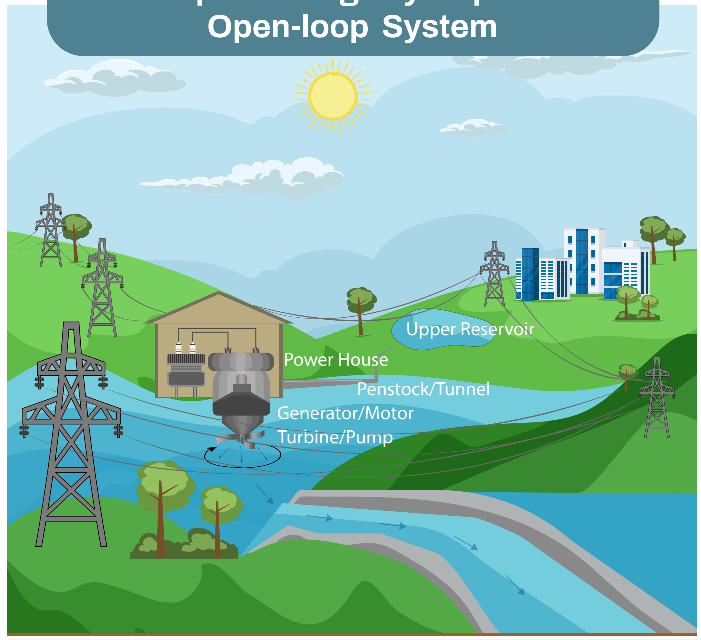
PSH is the most widely deployed grid-scale storage technology with 8,500 GWh of global capability in 2020, accounting for over 90% of total global electricity storage.

Unlike thermal storage, PSH cannot be used anywhere. It must be built in locations with elevation changes. However, PSH is more environmentally friendly than thermal storage as it does not require the use of chemicals or extreme heat.

Even if natural geographic locations are unavailable, abandoned mines can be used for PSH. These man-made elevation changes can give us the opportunity to repurpose old mines. This type of project is currently being proposed by Marmora, Ontario, an existing iron ore mine abandoned in 1978. New Brunswick could repurpose its old mines for a similar refurbishment to take advantage of the elevation change.

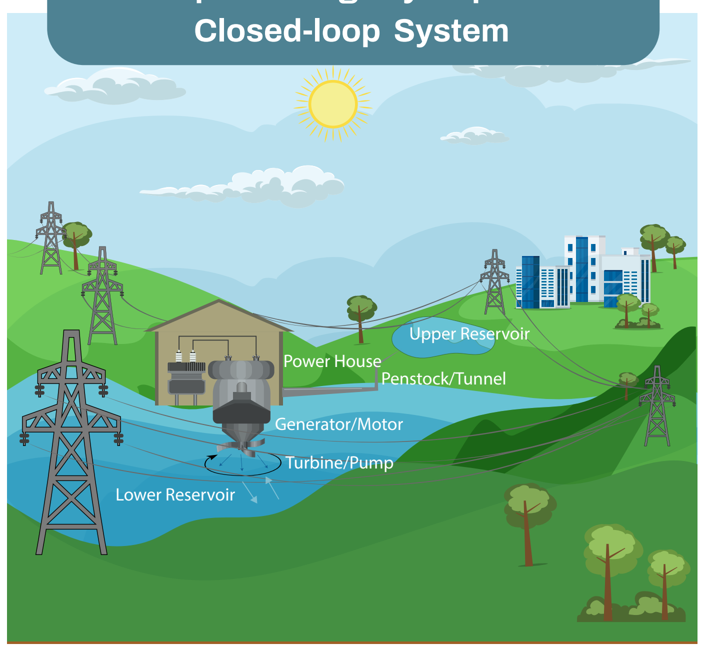
There are two types of storage hydropower:

Pumped storage hydropower: Open-loop System



One of the water reservoirs is connected to a natural flowing body of water like a lake.

Pumped storage hydropower: Closed-loop System



None of the reservoirs are connected to naturally flowing water.

Battery storage

Batteries store chemical energy and convert it into electrical energy. We use them to power our watches, cell phones, cars, homes, and more.

Battery storage is using rechargeable batteries to store electrical energy. This stored energy can be used later when needed, such as during peak demand periods or when there is a power outage. Battery storage systems typically consist of a bank of batteries, a battery management system, and a power inverter that converts the stored DC power into AC power for use in homes, buildings, or the grid.

Battery storage is excellent for its greater flexibility in managing electricity supply and demand.

For example, renewable energy sources such as solar and wind power are intermittent. By using battery storage to store excess energy during periods of high production, that energy can be used later when production drops or demand increases, reducing the need for fossil fuel power plants.

Battery storage also provides a backup power source during power outages or emergencies, improving the reliability and resiliency of the electricity grid.

Plus, battery storage reduces peak demand charges for commercial and industrial customers, which can lead to significant cost savings. Battery storage is an important technology for enabling the integration of renewable energy sources into the electricity grid and improving the efficiency and reliability of the grid.

Five commonly used battery storage technologies

Lithium-ion batteries

These are the most widely used batteries in energy storage systems, thanks to their high energy density, long cycle life, and low maintenance requirements. They are commonly used in electric vehicles, consumer electronics, and stationary energy storage systems.

Lead-acid batteries

These have been used for many years and are known for their low cost and durability. They are commonly used in backup power applications and off-grid systems, but are less commonly used for large-scale energy storage due to their lower energy density and shorter cycle life.

Flow batteries

These batteries store energy in electrolyte solutions that are stored in separate tanks. They are designed for long-duration storage and can be used repeatedly without degrading the electrodes. However, they are more expensive and have lower energy density than some other battery technologies.

Sodium-ion batteries

These batteries store These batteries use sodium ions instead of lithium ions to store energy, making them a potential low-cost alternative to lithium-ion batteries. They are still in the early stages of development but show promise for large-scale energy storage applications.

Solid-state batteries

These batteries use a solid electrolyte instead of a liquid or gel electrolyte, which improves safety and potentially allows for higher energy density. However, they are still in the early stages of development and are not yet widely available.

Lithium-ion batteries are commonly used in electric vehicles

Cost savings of electricity storage for New Brunswick

Although an initial investment is needed, electricity storage can save a significant amount of money for ratepayers from peak shaving, preventing the need for expensive imported energy during storms, and allowing for the integration of more cheap renewable energy. Below, we show Lazard's 2023 unsubsidized Levelized Cost of Storage (LCOS) for storage.

Storage solutions become much cheaper when coupled with solar or wind energy at the grid and residential scale.

Additionally, battery storage costs have dropped steadily over the past decade, and are expected to drop by at least 28 per cent by 2030.

The unsubsidized Levelized Cost of Storage (LCOS) in ($CAD/MWh) from Lazard			
Storage	**Capacity (MW)**	**Duration (h)**	**Cost ($CAD)**
Utility-Scale Standalone	100	1	329-426
Utility-Scale Standalone	100	1	264-340
Utility-Scale PV (100 MW) + Storage	50	1	145-173
Utility-Scale Wind (100 MW) + Storage	50	1	91-104
Residential Standalone	0.006	1	1606-1782
Residential PV (0.01) + Storage	0.006	1	876-965

Mining's role in the clean electricity storage transition

New Brunswick generated 11,760 Gigawatt hours (GWh) of electricity in 2021, 34 per cent of which came from fossil fuels which released 3,390 kiloton of carbon dioxide equivalent. Switching to clean electricity storage and renewable energy will lower New Brunswick's greenhouse gas emissions and put us on a greener path.

Making this future a reality for decades to come will need a lot of batteries. These batteries not only power medical devices and keep the heat on throughout a cold winter's night, but they also store solar and wind power.

The most common battery used in electricity storage is lithium-ion, which is made up of lithium, but often also cobalt, manganese, and nickel. Wind turbines depend on rare earths for their magnet-based generators. Solar panels rely on gallium, indium, tellurium, and silver.

The most common elements needed for batteries	
Element	**Where it is used**
Lithium	Main component of lithium-ion batteries
Cobalt	Commonly used in lithium-ion batteries, particularly those used in portable electronics and electric vehicles
Nickel	Common in lithium-ion batteries and is often used in combination with other metals such as cobalt and manganese to improve battery performance
Manganese	Often used in lithium-ion batteries as a component of the cathode, which is the positive electrode of the battery
Graphite	Key component of the anode, which is the negative electrode of the battery, and is used in lithium-ion batteries due to its ability to store and release large amounts of energy.

Renewable technologies and clean electricity storage depend on metals and minerals spanning the entire periodic table. However, more batteries require more mining for the metals and minerals used to build them.

The 2022 Report of the Auditor General of New Brunswick on Contaminated Sites showed the province recorded a liability of $50.8 million in 2021-2022 for contaminated sites with a backlog of over 1,000 contaminated site files spanning over 35 years. The Conservation Council of New Brunswick recognizes the pressing need for newly-mined minerals and metals, but recognizes it must be done in a socially- and environmentally-sustainable way that does not add to the list of contaminated sites.

There are seven producing mineral and metal mines in New Brunswick. While these resources are critical to the products and technologies of a modern society and the shift to green electricity, the mining industry must strive to extract these finite resources in ways that support our communities, economies, and the environment.

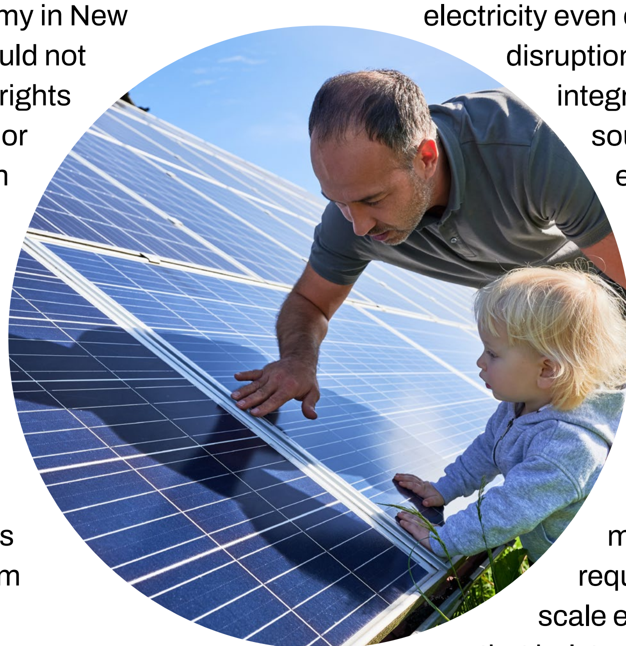
For example, ensuring a well planned and executed mine closure and post-mining transition to rehabilitate and convert the mine site for other uses—such as renewable energy—will be crucial to meeting the global shortages of metals and minerals. A groundbreaking Canadian example is SunMine: the conversion of the world's largest lead-zinc mine in British Columbia into a 105 MW solar photovoltaic plant, powering over 275 homes while contributing to the community's economy.

Global supplies of cobalt and lithium are not projected to meet the growing demand. Mineral and metal recycling—the act of extracting these finite resources from old products or infrastructure—will also be crucial to mitigating the predicted shortfall and empowering the clean energy transition.

Another approach to meet the growing demand is to utilize extraction technologies that can access the brine under abandoned oil wells. This method presents a more sustainable and less harmful approach to traditional mining.

Recommendation

The transition to a sustainable economy must be fair for workers and Indigenous communities, here and abroad. A green economy in New Brunswick and Canada should not come at the expense of the rights of Indigenous communities or their land. The Conservation Council of New Brunswick recommends that Canada work toward a circular economy and develop policies that reduce demand for new metals and minerals to limit the harm done to the environment and Indigenous and settler communities from resource extraction.



Investing in grid-scale energy storage is crucial for New Brunswick for several reasons. **First**, it enhances the reliability and stability of the electrical grid, ensuring a consistent supply of electricity even during peak demand or unforeseen disruptions. **Second**, it facilitates the integration of renewable energy sources like wind and solar by storing excess energy during times of low demand and releasing it during high demand periods. This reduces reliance on fossil fuels and promotes a cleaner, more sustainable energy mix. **Third**, it provides an opportunity for economic growth and job creation, as the development and maintenance of storage facilities require skilled labor. Overall, grid-scale energy storage is a wise investment that bolsters energy security, environmental sustainability, and economic prosperity in New Brunswick.

Established in 1969, the Conservation Council of New Brunswick is the province's leading public advocate for environmental protection. A member of the United Nations' Global 500 Roll of Honour, we work to find practical solutions to help families and citizens, educators, governments and businesses protect the air we breathe, the water we drink, the precious marine ecosystem and the land, including the forests, that support us.

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