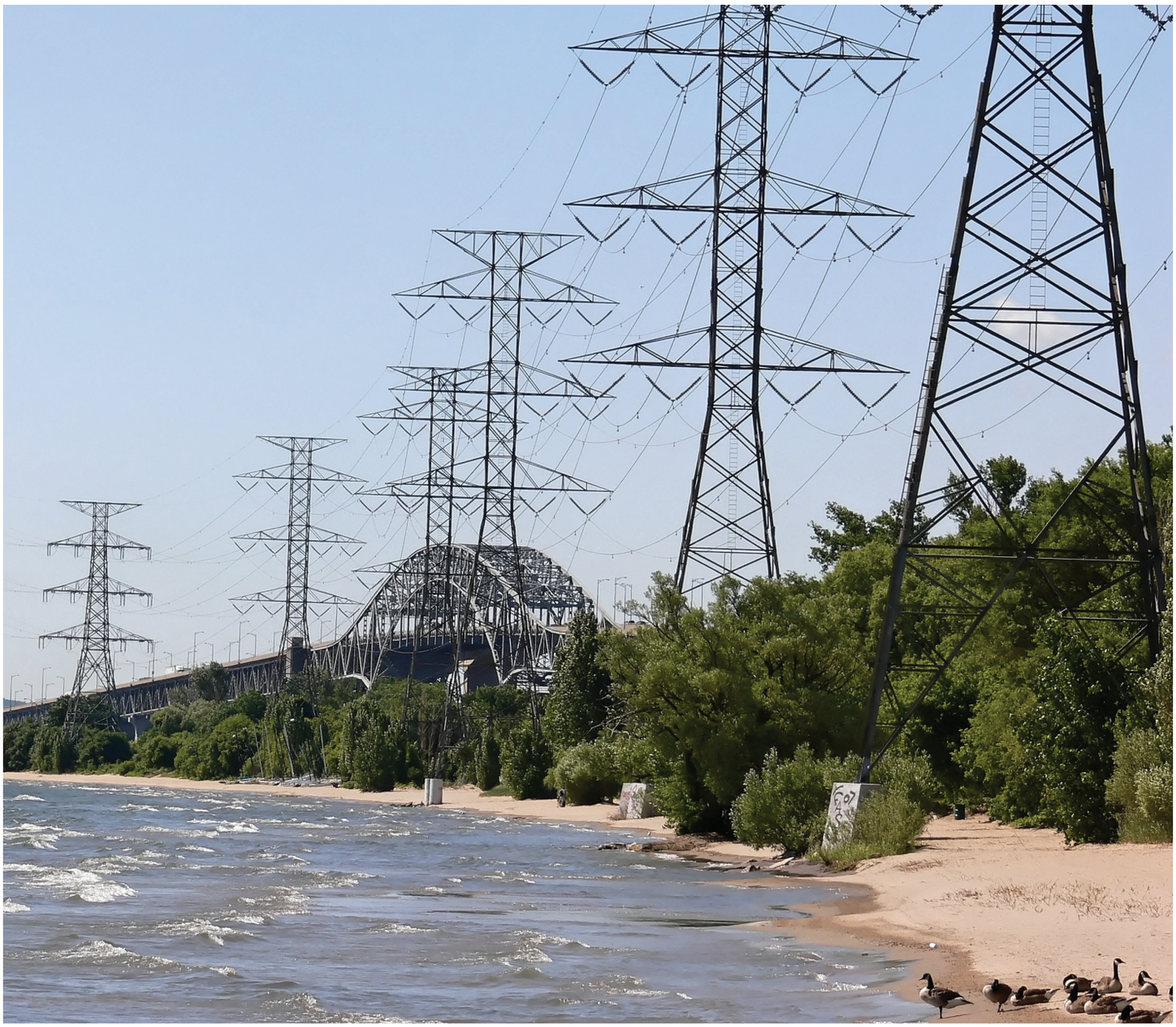


# ENERGY

## Wind, Water and Electricity Generation

*How do the Great Lakes act as a source of energy?*

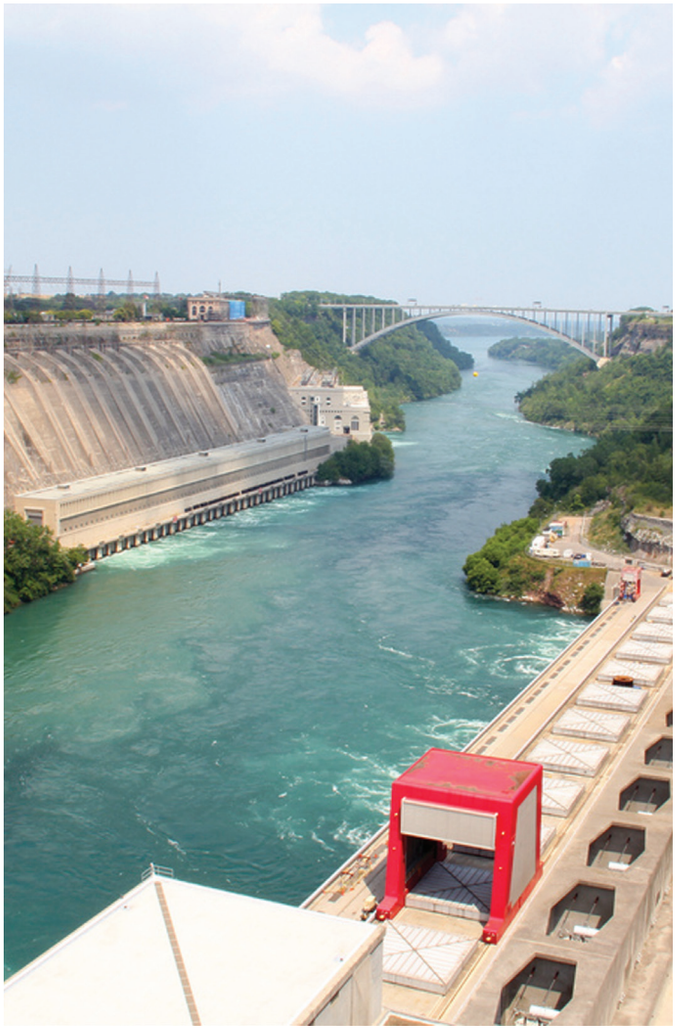
GREAT LAKES FACT SHEET

6

# Background

The Great Lakes support an immense and complex electricity generation infrastructure that powers economic and social development across the region. The lakes currently help to generate 80 per cent of Ontario's electricity. While the relationship between energy and water is not unique to the Great Lakes Basin, its vast supplies of fresh water make it particularly suitable for water-intensive energy production.

The best-known hydroelectric generation site in the Great Lakes region is Niagara Falls. This area is also an important tourist destination and centre of economic vitality and was identified early on as requiring regulation and protection. In 1950, the Niagara Treaty was enacted to regulate the amount of water that can be harnessed for power generation. The treaty sets guidelines for in-stream flow and takes into account monthly water levels and tourism. The Niagara Falls area exemplifies how economic, social and conservation needs can be balanced in order to benefit surrounding communities and protect the environment.



## WHAT TYPES OF ENERGY GENERATION ARE ASSOCIATED WITH THE GREAT LAKES?

In 2011, the Great Lakes Basin was home to more than 580 electricity generating facilities of various types – nuclear, thermoelectric, hydroelectric and wind.

Electricity generated at Ontario's three nuclear power facilities – Darlington and Pickering on Lake Ontario and Bruce on Lake Huron – accounts for more than half of the province's supply. Nuclear reactors generate heat through a process called fission, which involves the splitting of uranium atoms into smaller, less heavy elements. The tremendous amount of heat released by this process is used to boil water to make steam. The steam drives turbines to generate electricity. There are also a number of thermoelectric plants in the Great Lakes region that burn fossil fuels, such as coal and natural gas, to produce high-pressure steam or exhaust gases to drive electricity generating turbines.

Hydropower stations use the energy of falling water to drive turbines to generate electricity, while wind turbines harness the power of the wind. The rivers flowing into and linking the Great Lakes provide abundant potential for hydroelectric development, and wind speeds tend to be stronger over large, open bodies of water like the lakes.

Electricity is the primary form of energy generation associated with the Great Lakes. However, there is increasing interest in developing oil and gas reserves beneath the lakes and in the basin. The water resources of the Great Lakes are also in demand for the development of alternatives to fossil fuels, such as ethanol and biodiesel processed from biomass sources, including tree residues, agricultural crops and organic wastes.

## HOW DOES ELECTRICITY GENERATION AFFECT THE GREAT LAKES?

### Electricity generation ...

- **draws water from the lakes:** Power plants require large amounts of water for their operation – power generation uses more water from the lakes than any other economic sector. Nuclear power plants are generally built adjacent to a water source because they require a constant inflow of cooling water to absorb waste heat and to cool equipment used in generating electricity. Like nuclear plants, thermoelectric stations also require access to large quantities of water to cool equipment and condense steam back into water after it has been used to drive turbines. Because storage reservoirs provide large surface areas where the evaporation of water can occur, water is also lost at hydropower projects, although the total effect is difficult to estimate.

- **affects water quality:** Harmful pollutants, such as mercury, sulphur dioxide and nitrogen oxides, can be released into the air during the combustion of coal and can redeposit on the surface of the lakes. These harmful pollutants can contaminate water and have negative effects on human health and the environment. In addition, organic material may build up behind hydropower dams where it decomposes, consuming oxygen in the water. This can cause the lowest levels of some reservoirs to become "dead zones," lacking enough oxygen to support aquatic life.

- **impacts fish and wildlife:** Water used to cool power-producing equipment in nuclear and thermoelectric plants may be discharged back into the lakes at a much higher temperature than when it was withdrawn. This can affect fish populations and other aquatic organisms, disrupting growth rates as well as feeding patterns and other routine behaviours. Warmer water can also decrease oxygen levels in the water, making it difficult for species to survive. The construction of dams and reservoirs can radically alter the landscape, eliminating important habitat both on land and in the river below. Once in place, hydropower dams break a river in two, splitting populations of fish and other

organisms into upstream and downstream subgroups. This can reduce genetic diversity and lead to population reductions, while depleted water levels downstream can have devastating impacts on fish spawning grounds. Aquatic populations are also significantly reduced when fish and other organisms are drawn into the intake filters that are used to remove debris from water entering power plant cooling systems.

## CHALLENGES AHEAD

As energy demands increase with population growth, the Great Lakes region faces significant challenges in achieving more integrated and sustainable energy systems.

**Aging infrastructure:** Investment in energy infrastructure and new generating capacity in Ontario between 1995 and 2003 was historically low, leaving the province with an aging supply network. Experts estimate that as much as 80 per cent of the province's existing power facilities will need to be refurbished or replaced over the next 20 years. In addition, as a key element in its plan to reduce greenhouse gas (GHG) emissions by 2050, Ontario has committed to ending the use of coal by the year 2014, which will require new strategies to maintain a robust supply of energy services.

**Developing clean or renewable energy sources:** New energy sources considered "clean" may require substantial resources from the Great Lakes environment in a variety of ways. For example, large amounts of land and water are required for crops used to produce ethanol and biodiesel, two forms of energy promoted as fossil fuel replacements. Wind turbines sited in or near the lakes can disturb lake beds and shorelines, and contaminants can be released from lake sediments when electric cables running from the turbines are buried beneath the lake bed. In 2011, the Government of Ontario suspended development of offshore wind projects to allow for further scientific research into the potential effects on human health, fish habitat, bird and bat communities, and navigation.

**Nuclear waste:** The possibility of shipping radioactive waste materials through the Great Lakes has caused concern among residents of the region. Proposals to bury nuclear waste in underground repositories in the basin have also raised concerns. Given the significant position nuclear power generation occupies in Ontario's energy mix, the safe transport and disposal of nuclear wastes are becoming increasingly pressing issues in the basin.

**Drilling for oil and gas:** In 2005, the U.S. Congress banned offshore drilling for oil and gas from the deposits lying beneath the Great Lakes. There has also been intense debate on both sides of the border about the development of shale gas reserves located in the Great Lakes Basin. Hydraulic fracturing, or "fracking," is a drilling process used to extract natural gas from shale. Sand, water and chemicals are pumped into shale formations at high pressure, fracturing the rock and releasing natural gas. This process requires large amounts of water from the lakes. Concerns have been raised about the potential of both drilling and fracking to release harmful pollutants and naturally occurring radioactive materials as well as to contaminate drinking water with methane.

**Climate change:** Climate change is expected to reduce water levels in the Great Lakes, which may compromise the operation of hydropower facilities. It is also predicted that air and water temperatures in the region will become warmer. Thermoelectric power generation becomes less efficient as temperatures rise. In addition, the decreases in wind speeds that are predicted for some parts of the Great Lakes may limit the potential for wind power generation. At the same time as energy systems face these challenges, rising temperatures are likely to accelerate demands for electricity to provide air conditioning and refrigeration.

## WHAT IS BEING DONE?

The following are some examples of initiatives and strategies that are currently in place to address the energy challenges facing the Great Lakes region:

### International Collaboration

» **Great Lakes Water Quality Agreement (GLWQA):** In 1972, Canada and the United States signed the GLWQA in order to "restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes." Most recently amended in 2012, the agreement requires power generating facilities to manage releases of persistent toxic substances as well as thermal and radioactive releases that may adversely impact the water quality of the lakes.

### Federal Initiatives

» **Fisheries Act (1985):** This act makes provision for the protection of Canadian fisheries waters and fish habitat and includes specific regulations for water intakes and discharges applicable to energy producers.

### Federal-Provincial Collaboration

» **Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA):** This agreement, ratified in 1971 and currently being updated to reflect recent amendments to the GLWQA, makes provision for the federal and provincial governments to work together on issues related to the Great Lakes. One of the guiding principles of the COA is the "conservation of energy, water and other resources to sustain the physical, chemical and biological integrity of the Basin Ecosystem."

### Provincial Initiatives

» **Ontario Water Resources Act (1990):** This act is designed to conserve, protect and manage Ontario's water resources for sustainable use. The act was introduced in part to protect the province's water resources from industrial and commercial users, including power plants, that may draw out more water than the lakes can sustain.

» **Green Energy and Green Economy Act (2009):** This act promotes energy efficiency and the integration of wind, solar, hydro and bioenergy into the Ontario energy supply mix. Key elements of the legislation and related policies include streamlined approvals for renewable energy projects and opportunities for municipalities and Aboriginal groups to build, own and operate their own renewable energy projects.

» **Lakes and Rivers Improvement Act (2010):** This act promotes the protection and preservation of Ontario's lakes and rivers; the preservation of fish and wildlife; and the protection of shorelines, banks and natural amenities. One of the key purposes of the act is to ensure that hydropower dams are suitably located and constructed and that they are operated in a safe and appropriate manner.

## WHAT CAN YOU DO?

- **Conserve water:** The treatment and circulation of clean municipal water is an energy-intensive undertaking. By using less water, you can help to conserve the water supply and reduce your demands on the energy system. Switching to a low-flow showerhead or toilet, replacing old dishwashers and washing machines with new, more efficient ones, and using rainwater instead of municipal water to water the garden all contribute to conserving water and energy.

- **Conserve energy:** In addition to conserving water, you can reduce your energy use in a whole range of other ways. Turning off electronic equipment such as computers, monitors and printers at the end of the day helps to reduce unnecessary energy use. Turn off the lights when you leave a room, unplug your cell phone charger after use, and wash your clothes with cold water and hang them to dry. Switch to compact fluorescent lamps (CFLs) and buy ENERGY STAR® appliances. Running major appliances such as dishwashers and washing machines during off-peak hours lets you take advantage of lower rates based on time of use and helps to reduce the demand for energy during peak hours. Many electronic devices, such as TVs, DVD players and cable boxes, draw power even when they are turned off. Each of those devices on its own may use a small amount of electricity, but taken together, they can use twice as much energy as a fridge over a year. You can reduce your use of standby power by plugging electronic equipment into a power bar that can be turned off or shuts off automatically.

- **Get involved:** Look for opportunities to get involved in public consultations on important issues such as energy and on agreements and legislation related to the Great Lakes. Urge government, businesses and other organizations to take action on Great Lakes issues.


## SELECTED RESOURCES

For more information on energy and the Great Lakes, consult the following resources:

Environment Canada. Wise Water Use. **http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=F25C70EC-1**

International Joint Commission. Great Lakes Water Quality Agreement. **http://www.ijc.org/rel/agree/quality.html**

National Energy Board. Who we are & our governance. **http://www.neb-one.gc.ca/clf-nsi/rthnb/whwrndrgvrnnc/whwrndrgvrnnc-eng.html**

Natural Resources Canada. Key Energy Legislation. **http://www.nrcan.gc.ca/energy/policy/1620**

Natural Resources Canada. Overview of Canada's Energy Policy. **http://www.nrcan.gc.ca/energy/policy/1352**

Ontario Ministry of Energy. **http://www.energy.gov.on.ca/en/**

Pollution Probe. Primer on Energy Systems in Canada. **http://www.pollutionprobe.org/energy/energyliteracy/energy_primer.asp**

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PHOTOS

**Cover:** Burlington Bay James N. Allan Skyway, Ontario

**Background:** Robert Moses Niagara Hydroelectric Power Station, New York

**Aging infrastructure:** Aging power plant. © Rainee Lipski

**Nuclear waste:** Enrico Fermi Nuclear Generating Station, Lake Erie, Frenchtown Charter Township, Michigan

**Drilling for oil and gas:** Oil well on Lake Erie. © R. Potter