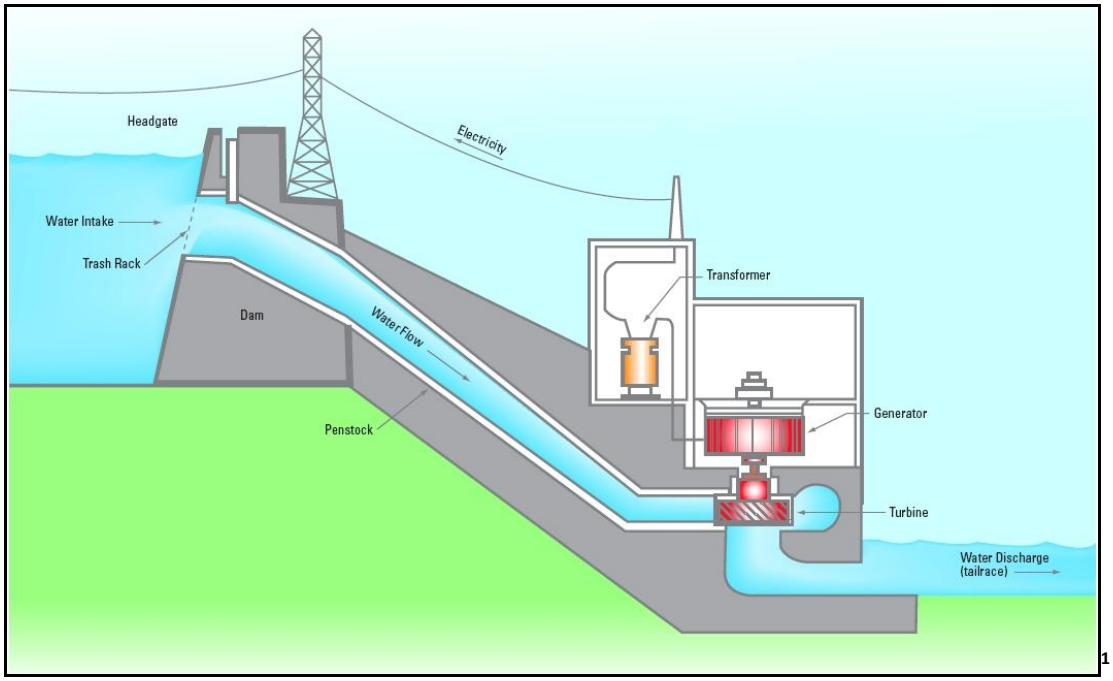
Micro Hydro Electric Power

Ontario's Waterpower Resources: Past and Present

The first hydroelectric generator in Canada was installed near Ottawa, which was the first city in North America to sign a contract to light its streets with electric power, in 1882. Waterpower provided all of Ontario's electricity until just over 50 years ago. Today, approximately 26% of Ontario's energy is produced by falling water, an amount that is roughly equivalent to that generated by fossil fuels. With approximately 200 waterpower facilities representing a total of 8,150 MW of installed capacity, waterpower represents a major component of the Ontario's energy mix with 60% of the facility locations in Southern Ontario. 35% of all facilities have capacity between 1 to 10MW. In northern Ontario, waterpower still accounts for 85% of the regional energy supply, while nuclear power accounts for 41%, fossil fuels (coal, gas, oil) 32%, and other renewables (wind, solar etc.) 1%.

Early installations were small in scale and it wasn't until after World War II that advances in technology allowed larger installations, which began to leave these smaller installations behind. Many sites were decommissioned because small-scale units and their potential sites became progressively less economical to maintain and operate by public utilities. As the environmental effects of large-scale hydro dams becomes more understood, and as the number of suitable large-scale sites are exhausted, there has been renewed interest in small-scale hydro.



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[1] Simple diagram of a hydroelectric generating station (www.opg.com/power/hydro/howitworks.asp)

A small-scale hydroelectric facility often uses existing structures or geological formations and requires only minor engineering works. This reduces both the cost of development and the installation's environmental impact. Small installations still require a good flow and adequate head of water (the height of the drop of water). Small hydroelectric plants can be developed at existing dams and have been constructed in connection with water level control of rivers, lakes, and irrigation schemes.

While waterpower is a proven technology, it continues to evolve and improve. Improvements to turbine technology have increased efficiencies and new technology has been developed to take advantage of low head applications at a cost which makes smaller water power installations financially feasible. Sustainable waterpower development added 150 MW to Ontario's waterpower portfolio in the last ten years alone, largely in response to the demand for renewable energy sources. There are approximately 200 waterpower facilities currently operating in the province, ranging in capacity from less than 1 MW to Niagara Falls, which generates close to 2,000 MW.

Other Facts and Figures:

An Energy-Efficient Source of Electricity:

- The average facility converts kinetic energy to electric energy at a rate of between 75% and 95%
- A typical waterpower generating facility has a long life cycle of between 75 and 100 years
- The average energy payback ratio (energy required vs. energy produced) is by far the highest among all sources at 32:1
- Relative to other sources, the production of waterpower could be considered a form of energy conservation

A Province Rich in Water Resources:

- Ontario has more than 250,000 lakes and tens of thousands of kilometres of rivers and streams
- About 50 systems support all of Ontario's waterpower production and fewer than a dozen account for more than eighty percent of power produced
- Niagara Falls comprises almost a quarter of the installed capacity
- Waterpower facilities are located within 10 km of every major town and all cities in north-western Ontario

Realizing the Potential for Clean, Renewable Waterpower:

- An inventory of waterpower potential in Ontario identified 2,000 sites with basic hydraulic conditions (regularly flowing water and change in elevation) to produce waterpower energy
- Just 200 sites have been developed in the last century
- Distance to the transmission grid, other natural resource values, and the demand for renewable energy are important factors in realizing waterpower potential

Sustainable Energy – An Asset for the Future:

- Like other natural resources, Ontario's waterpower resources must be managed and developed to meet present needs and anticipate the requirements of future generations
- The waterpower potential that remains in Ontario should be treated as an asset that can continue to contribute energy, now and in the future
- Acknowledging and protecting this potential will increase our energy options for the future

The Market

In Ontario, the Green Energy and Green Economy Act offers a Feed-In Tariff (FIT) incentive designed to help drive investment in small hydro projects. Although the industry classifies microhydro installations as having less than 30MW generating capacity, the Feed-In-Tariff (FIT) program divides its two waterpower size categories at 10MW.

FIT Waterpower Projects	≤ 10 MW	> 10 MW ≤ 50MW
Contract price paid per kWh	13.1 ¢/kWh	12.2 ¢/kWh

The length of the contracts are 40 years with an escalation percentage tied to the Ontario Consumer Price Index (CPI) starting on the contract's commercial operation date. A peak performance factor is applied to the contract price at the rate of 1.35 for all peak hours and 0.90 for all off-peak hours. The average lead time for small hydro projects is 4 to 5 years.

Small hydro operators may wish to establish corporations which would require inputs from the Canada Revenue Agency and the Ontario Ministry of Finance. Other inputs may include insurance, legal advice and accounting services.

Government Programs

To encourage local ownership of renewable energy projects under the FIT program, the Ontario Power Authority (OPA) and the Government of Ontario initiated the **Community Energy Partnerships Program (CEPP)**. The grant program assists community power projects with funding support of up to $200,000. This funding opportunity helps cover the early stage soft costs of renewable energy projects. The program is divided into two grants. The first applies to project design and development activities, such as site planning, environmental and regulatory analysis, and business plan development. The second part of the program applies to regulatory approvals, such as renewable energy approval, ESA approval, and project management. The maximum CEPP grant for waterpower between 10.1 kW and 10,000 kW is $200,000.

Also administered by the OPA are the **Aboriginal Renewable Energy Fund (AREF)** and the **Municipal Renewable Energy Program (MREP)**. The AREF and MREP will assist Aboriginal communities and municipalities, respectively, in covering a portion of project costs associated with developing a renewable energy project.

The Federal Government provides for a 50% **Capital Cost Allowance (CCA) for Renewable Energy** projects. Corporations can write off the capital cost of a microhydro system against other revenue resulting in attractive tax consequences. Individuals and businesses can only claim CCA up to the amount of income generated from the wind turbine system. Once the CCA is used, they will have to pay tax on income generated from the system.

Participants

Microhydro electric operations can be owned/developed/installed by an individual, groups of individuals, energy cooperatives, corporations, municipalities, or utilities. Power generated from microhydro facilities can be used for personal or local consumption or fed into the grid.

Currently there appears to be only one company located in Ontario engaged in the design and development of small turbines for hydroelectric generation up to 600 KW for low head plants. They also provide assembly assistance and turnkey services. The system is easy to install and ready to go requiring very little infrastructure work.

There are two companies that manufacture turbines for large power plants.

There are myriad regulatory organizations from which approvals are required (refer to list on pg. 5).

Investment competition for hydro projects comes from other sources of green energy. Current participants are in the process of assessing project viability based on the difficulty to overcome barriers, cost of the system, and FIT rate income.

Key Success Factors

One of the most important success factors is that hydro power has been in existence in Canada since 1882 and enjoys a solid reputation. It is a readily accepted technology that does not need to earn a track record.

Unlike some renewable energy sources, water flow is relatively predictable and therefore, financial returns are also relatively predicable. Microhydro can generate one of the highest returns on energy invested compared to all other energy sources and it has an extremely high energy conversion rate. As well, waterpower has one of the lowest carbon and environmental footprints of any energy generation technology.

The complexity of facility requirements depends on the size of the power plant and whether there is existing infrastructure. For example, a 300 KW system located at an existing dam requires very little in infrastructure upgrades. However, a 10 MW system, where no suitable infrastructure exists, would require extensive construction work.

Labour Market

Since waterpower facilities have been in existence for a long time the required skills sets are available. Most microhydro facilities require only periodic operational attention – mainly to clear debris from intake openings. Installation employment opportunities will exist for civil construction work and electricians familiar with installing control systems and connecting loads. There will also be some jobs in turbine and controls manufacturing.

Regulatory Considerations

There are many regulations and approvals required for small hydro projects including:

- Ministry of Environment
- Ministry of Natural Resources (Lakes and Rivers Improvement Act)
- Canadian Coast Guard
- Local Conservation Authorities
- Hydro One or local power authority
- Electrical Safety Authority
- Ontario Power Authority (FIT)
- Ministry of Fisheries and Oceans
- Permits and approvals may be required from other regulators such as the Municipal Building Department and Fire Department.

Social and Environmental Considerations

Unlike some green energy sources, small hydro projects are relatively unobtrusive. There are no known ill effects to humans. In some cases there can be disruption of fish migration and some sedimentation at the water intake, and system layout conditions may cause reduced flow in waterways.

In a case study of an Ontario microhydro development project, a number of community concerns were identified. Public safety around the dam site was a major concern amongst the community, but overall, the community had an interest in the project on a much broader scale than the development company originally expected. Some of the other concerns included ensuring municipal ownership of the site, managing water levels, and local job creation.

To address these concerns, the project developer's hired a local community liaison to improve communication with the community throughout the project's development. Community communication and consultation was a major factor in this project's success. Another recommendation from the developers was the need to be open and transparent about the development process from the very beginning.

Industry Outlook

With more than 2,000 identified locations across the province with the raw hydraulic potential to produce energy, waterpower will continue to contribute to local, regional, and provincial requirements in a manner that balances social, environmental, and economic objectives. It is estimated that there is the potential for another 1,350 MW of generating capacity available from the redevelopment of some existing facilities and another 250 MW of new development potential on sites that have been previously assessed.

In addition to producing energy, many waterpower facilities are managed to provide a number of important ancillary benefits, including flood mitigation, water level stability for recreation, flow maintenance for dilution or habitat protection, and erosion control.

Small hydro installations are divided into three categories based on size. All can feed electricity onto the grid and provide base load stability. Micro installations produce less than 100 kW of electricity, or only enough to power a couple of homes. Mini installations produce between 100 and 1000 kW (1 MW) of electricity, which is about enough to power a small factory or community. Small installations range between 1 MW and 30 MW of capacity and most often supply power to the electricity grid.

> *In an environment of consumer choice, it is clear that renewable energy will continue to be valued, and that waterpower, which comprises over 95% of Ontario's renewable power assets, will build on its long history of contributing to the continued prosperity of the province.*

Ian Baines, chair of the OWA Board of Directors, indicates "it is clear that the province will depend more and more on existing and new waterpower production. Ontario has enormous untapped potential that could be realized, but we also have one of the most complex regulatory regimes. We need the value of waterpower acknowledged and reflected across government policies and programs".[2]

[2] Note: Major sources for this sector overview came from the Ontario Waterpower Association and the Ontario Power Authority.