

Current and planned hydro development in Canada

Canadian Hydropower Association

Canada has the highest amount of hydro generation in the world, and substantial potential still exists for development in many provinces. This article, based on information submitted for our World Atlas 2003, gives an overview of current and future developments.

The gross theoretical hydropower potential of Canada is 1332 TWh/year, of which the technically feasible potential is estimated to be 981 TWh/year. The economically feasible hydro potential is estimated to be 536 TWh/year. Undeveloped technically feasible potential is equivalent to 118 000 MW.

Canada has an installed hydro capacity of 67 121 MW. About 2400 MW of additional hydro capacity is under construction, including nearly 600 MW of refurbishment projects; and, more than 6200 MW is planned. There are 221 hydro plants larger than 10 MW in operation.

Every province in Canada, with the exception of Prince Edward Island, has some hydro capacity, the greatest amounts being in Québec, British Columbia, Newfoundland & Labrador, Manitoba and Ontario.

Canada has the highest hydropower generation in the world (around 330 TWh/year); this represents close to 60 per cent of the country's electricity.

The following sections describe hydro projects in Canada which were recently completed, are still under construction or will go ahead shortly:

Projects under way

British Columbia

Upgrading and life extension work is being conducted at the Brilliant dam and powerplant on the Kootenay river. The 43 m-high dam was built in the 1940s and the four-unit powerplant currently has an installed capacity of 120 MW. A programme to uprate the plant by 20 MW began in 2000, and upgrades on two units have been completed. Work on the remaining two machines is scheduled for this year.

The Brilliant Expansion project consists of a short water intake canal and a second 100 MW powerhouse at the Brilliant dam site. The project has received its Project Approval certificate from the BC Environ-

The 43 m-high Brilliant dam and powerplant on the Kootenay river, BC.



The 185 MW Arrow Lakes project, under construction on the Columbia river.

mental Assessment Office. Construction should begin this year, with commissioning in 2005.

A fourth generating unit is currently being installed at the Seven Mile generating station and this will be in service shortly. The unit will add 210 MW of capacity and produce an average of 302 GWh/year.

A two-unit 185 MW powerplant is currently under construction at the Arrow Lakes generation station, at BC Hydro's Hugh Keenleyside storage dam on the Columbia river.

The first turbine unit is now operational and is generating power commercially. Work to commission the second turbine is continuing, and this is scheduled to be operational shortly.

The 29.5 MW Miller Creek run-of-river hydro scheme is being developed on the Miller Creek, a tributary of the Lillooet river, about 4 km north of Pemberton and 140 km north of Vancouver, BC.

Québec

Construction of the Sainte-Marguerite 3 plant, with a 171-m rockfill dam and a reservoir capacity of 12.5×10^9 m³ is now completed. The facility will be commissioned this year and has an installed capacity of 882 MW.



The 171 m-high rockfill dam at the Ste-Marguerite 3 plant, recently completed in Québec.



Site of the 77 m-high Toulnostuc concrete-faced rockfill dam in Québec, which went ahead recently.

Construction has begun on the Toulnostuc hydropower project. It will consist of a 77-m high concrete faced rockfill dam with a reservoir capacity of $3.87 \times 10^9 \text{ m}^3$ and a 517 MW powerplant. It is scheduled for completion in 2005.

The Grand-Mère powerplant, built in 1915, is being refurbished, with the addition of 220 MW of capacity. Work is scheduled to be completed in 2005.

The Mercier project involves a 25 m-high gravity dam on the Gaineau river, with a reservoir capacity of $3049 \times 10^6 \text{ m}^3$. The construction of the new 50 MW powerplant located at the existing Mercier dam started in September 2002 and is expected to be completed in 2008.

Work on the Portneuf and Saults-aux-Cochons partial river diversions began in September 2002. This work includes the construction of a very small dam and a canal to divert the flows into the existing Bersimis hydroelectric plants. The diversions will lead to an additional generation of 0.46 TWh/year.

The refurbishment work at the Outardes-3 hydropower plant will add about 260 MW to the existing 756 MW capacity of the facility. Work should be completed in 2006.

As part of its capital programme for 2001, Hydro Québec anticipates the investment of a total of C\$ 2.4 billion (about US\$ 1.5 billion) in new and ongoing powerplant projects.

Manitoba

At the Great Falls refurbishment project, 3.4 MW of additional capacity is under way and will be completed this year; a further 3.4 MW upgrade is planned for completion in 2004.

Meanwhile, the Pine Falls generating station refurbishment will provide an additional capacity of 5 MW by 2006.

Newfoundland & Labrador

The Granite Canal hydroelectric development project is under construction within the existing Bay d'Espoir scheme in southern Newfoundland (see p54). This 40 MW project will exploit the approximately 38 m of head available between the Granite lake and Meelpaeg reservoirs to produce an average of 220 GWh/year. Construction began in May 2000, and the plant should begin production later this year.

At the Grand Falls expansion, approximately 27 MW of additional capacity should be available this year, as well as an extra 5 MW at the Bishop Falls Upgrade.

Ontario

In Ontario, the generators and turbines at the Sir Adam Beck 2 generating station are being rehabilitated. The

total capacity will be increased by 208 MW to 1536 MW. The project began in 1996 and is scheduled for completion in 2004.

The generators and turbines are also being rehabilitated at the R.H. Saunders station, where the total capacity will be increased by 132 MW to 1024 MW. This programme began in 1989 and is scheduled for completion this year.

The US\$ 75 million High Falls redevelopment project near Wawa, about 230 km north of Sault Ste Marie, is under construction. It involves an 8 m-high earthfill dam with a reinforced concrete intake and spillway section, on the Michipicoten river. The original 26 MW plant was built in 1930 and upgraded in 1950. The redevelopment involves the construction of a new plant with an installed capacity of 45 MW. The planned completion date is December 2002 (see also *H&D Issue Three, 2001*).

Rehabilitation work on Phase 3 of the Chaudière No 4 generating station on the Ottawa river, in the centre of the City of Ottawa, was completed on schedule in October last year. The first and second phases of the rehabilitation work were completed in 1999 and 2000, respectively.

The Lac Seul generating station is a new 12 MW hydro plant which will be built near the existing 17 MW Ear Falls generating station, on the English river. Construction is scheduled to begin in middle of this year and the planned operation date is November 2003.

Future potential developments

The following sections briefly describe major hydro projects currently under study in Canada:

British Columbia

The Waneta Expansion project is at the pre-feasibility study or design stage. It consists of the construction of a second powerplant just below the Waneta dam site. The Waneta dam is near Trail, British Columbia, on the Pend d'Oreille river. The current plan proposes a 380 MW powerplant. Construction is planned to begin in 2005, with commissioning in 2008.

Québec

The following projects are at the feasibility study stage:

- the Eastmain-1A and the Rupert partial river diversion project (up to 770 MW, going ahead shortly);
- the Péribonka run-of-river project (400 MW);
- the La Romaine hydro project (200 MW); and,
- the Chute Allard (70 MW) and Rapides-des-Coeurs (80 MW) run-of-river projects in the Haut Saint-Maurice region.

Manitoba

At the Kelsey generating station refurbishment, an additional capacity of 3.4 MW is planned for implementation later this year. The existing dam is an 18.3 m-high earthfill structure. The current capacity is 224 MW. An assessment is expected shortly to determine the possibility of an additional refurbishment of up to 25 MW, but there are no firm plans for this.

The Winnipeg Hydro Pointe du Bois refurbishment project could provide an estimated 20 MW over 10 years, but there are no firm plans.

The Notigi generating station on the Rat river/Burntwood river (Notigi lake), with a capacity of 100 MW, is in the initial planning stage. The project

will include a 14 m-high earthfill dam with a storage capacity of 5×10^6 m³.

The Wuskwatim generating station on the Burntwood river (Wuskwatim lake), will include a 21.5 m-high earthfill dam with a storage capacity of 85 000 m³, and a powerplant with an installed capacity of 200 MW.

The Gull (Keeyask) generating station on the Nelson river (Gull Rapids), will include a 30.5 m-high earthfill dam and a powerplant with an installed capacity of 620 MW.

The Conawapa generating station will include a 32.2 m-high earthfill dam with a storage capacity of 31 000 m³ and a hydropower capacity of 1400 MW.

The last four projects are at the initial planning stages and no commitments to begin their construction have been made. The four projects are not expected to begin service for 10 years, at the earliest.

Ontario

The Ontario Government Action Plan, announced in November 2002 includes the following:

- The Beck Tunnel Project will proceed at Niagara Falls, as an expansion of the Sir Adam Beck generating station. Tax reductions are proposed to help support this project.
- The Ministry of Energy will proceed with an independent study on the feasibility of moving forward with the Beck 3 generating project at Niagara Falls.

Newfoundland & Labrador

The proposed Gull Island (Lower Churchill) hydroelectric development could be built on the Churchill river in Labrador, 225 km downstream of the existing Churchill Fall generating station.

The earthfill dam would be 99 m high, with a crest length of 1315 m and a volume of 12.9×10^6 m³. The reservoir will have a live storage of approximately 600×10^6 m³.

The plans for the Gull Island site are currently based on an installed capacity of 2000 MW, with a proposed commissioning date of 2010.

Small hydro

There are 224 small, mini or micro hydro plants in operation in Canada (≤ 10 MW), with a total capacity of 996 MW.

The Misema Power Partnership (MPP) is now developing a 3 MW run-of-river station on the Misema river at Eighty Foot Falls, just north of Englehart, in Ontario.

Construction began in November last year and the generating station is scheduled to be operational by November this year. The project will produce enough electricity to serve a community of approximately 400 homes.

In Québec, two small hydro projects proposals were accepted at the end of 2002: the Magpie project on Québec's North shore (38 MW) and the Matawin project (12 MW). Both will be developed by private companies.

BC Hydro has identified more than 600 potential micro hydropower sites across the province of British Columbia and has published a handbook to assist independent power producers in developing this resource and selling power to the utility.

A number of companies interested in developing micro hydropower have already approached the utility.

Environment and public awareness

The Canadian Environmental Assessment Act (CEAA), passed into law in 1995, ensures that all development projects that require a federal decision receive careful review. Environmental assessment (EA) is a comprehensive and systematic process designed to identify, analyse and evaluate the environmental effects of proposed projects. EA involves the public in an open and participatory manner and allows for the effective integration of environmental considerations and public concerns into decision-making. All energy projects are covered by the legislation.

When a new or refurbishment scheme is planned, various methods are used to communicate with local people, depending on the scope and context of the project. These include public hearings, round table discussions, formal and informal meetings, information sessions and the creation of committees.

In Canada, all hydropower projects are subject to a comprehensive environmental assessment which covers planning, construction and operation. Legislation also requires the participation of all parties involved, including the local population. Local communities are invited to collaborate in identifying ways to alleviate some of the negative impacts of a project, for example, by reforestation, wetland establishment and fish reclamation; and to ensure that they benefit from the project through improved quality of life, employment and business opportunities, and long-term revenues. In Canada today, a project can only be developed when it is deemed to be socially and environmentally acceptable.

Overview of Canadian hydro potential by region*

- Canada is the world's largest producer of hydropower, generating 353 TWh/year.
- The installed capacity of all hydropower plants in Canada is 67 121 MW.
- Canada still holds significant hydropower potential that can be developed with respect for the environment and in collaboration with local communities.
- The gross remaining hydropower potential in Canada is 183 622 MW.
- The technically feasible hydropower potential is 117 978 MW.
- Every province, except Prince Edward Island, has some hydropower capacity, as well as remaining potential for future hydropower project development.
- The province of Québec has the largest hydropower capacity (33 016 MW in 2000) and the most remaining potential (66 286 MW gross; 34 844 MW technically feasible).
- British Columbia's hydropower capacity (11 624 MW) and potential is second largest (33 137 MW gross; 18 168 MW technically feasible).
- The Yukon, Northwest Territories, Alberta, and Nova Scotia all have significant technically feasible hydropower potential (more than 8000 MW each).
- Manitoba and Ontario each have more than 5000 MW of technically feasible potential.
- Newfoundland & Labrador has more than 1500 MW of technically feasible potential on the Island and over 4300 MW in Labrador. ◇

* Data source for overview of potential: Canadian electrical utilities and Natural Resources Canada. Statistics for Québec are from *L'énergie au Québec* - Édition 2001. Gross potential is the total resource that could be developed if there were no technical, economic or environmental constraints (excludes sites already developed or under construction).