



Ontario Power Generation: Management and Maintenance of Hydroelectric Generating Stations

2022 Value-for-Money Audit

Why we did this audit

- Hydroelectric power is an important electricity source, accounting for approximately 23% to 25% of Ontario's electricity supply since 2007. It is renewable energy that can help Ontario reduce its reliance on fossil fuels, and reduce carbon emissions.
- Ontario Power Generation (OPG) owns and operates 66 hydroelectric generating stations; 86% have been operating for over 50 years, and the oldest have been operating for over 100 years.
- As of March 31, 2022, hydroelectric generation represents 7,500 MW (or 51%) of the total installed generating capacity of OPG.

Why it matters

- Over the five years from 2017–2021, while revenue from OPG's hydroelectric generation has remained relatively stable in the \$1.8 to \$1.9 billion range, costs for capital projects to replace aging equipment increased by 215%, from \$208 million in 2017 to \$656 million in 2021.
- Given the forecasted increase in electricity demand and predicted future shortfall due to the expected closure of Pickering Nuclear Generating Station in 2024/25, as well as the challenges of building new hydroelectric generating stations, it is important that OPG continue to maintain and manage its existing stations to allow for cost-effective and efficient electricity production.

What we found

OPG's Hydroelectric Generating Capacity Underutilized

- OPG has been a reliable provider of hydroelectric power to the province. There is opportunity to improve the utilization of the existing hydroelectric generating capacity.
- OPG has not been able to fully utilize its hydroelectric generating capacity over seven years from 2015 to 2021. Over this period, OPG was only using between 48% and 50% of the stations' total installed capacity. OPG could have generated approximately 269 million megawatt hours (MWh) of electricity but only generated 226 million MWh, meaning about 43 million MWh of generating capacity went unused.
 - In 2021 alone, OPG could have generated an additional 4.6 million MWh of electricity, or enough to power over 540,000 Ontario households for a year.
- There is a significant difference between installed capacity and actual generation. OPG informed us that this is due to multiple reasons, which include insufficient water availability, spilling of water in response to surplus power conditions and other system constraints, and outages.

RECOMMENDATION 1

Significant Lead Time Needed for the Building of New Hydroelectric Generating Stations

- In January 2022, the government asked OPG to examine opportunities for new hydroelectric development in Northern Ontario, and asked the Independent Electricity System Operator (IESO) to identify related transmission infrastructure and costs.
- While potential unbuilt capacity (about 3,000–4,000 MW) in Northern Ontario and up to an additional 1,000 MW in southern Ontario could provide opportunities for new stations, there are many challenges and uncertainties in terms of timing and costs. For example:

- It could take over 10 years (including assessments, construction and installation of transmission lines) with significant cost (ranging from \$5 million to \$22 million per MW of power capacity), depending on location and site conditions. It could cost even more after considering additional transmission-related costs.

RECOMMENDATION 2

OPG Recorded about \$730 Million in Revenue Since 2015 for Spilling Water on Request from IESO without Generating Any Electricity Due to Excess Power Supply in Ontario

- When electricity supply exceeds demand in Ontario, OPG may be directed by the IESO to reduce generation by spilling (or releasing) water, because there are no practical options to store hydroelectric energy for future use. For 54 of 66 hydroelectric stations, OPG is compensated at a fixed rate (\$43.88 per MWh) for spilling water.
- In 2021, the amount of electricity lost as a result of spilling was 1.9 million MWh, enough to power about 220,000 households for a year.
- Since 2015, OPG has spilled water that could have generated 25 million MWh of electricity. It recorded approximately \$730 million in revenue without generating any power.
- The current compensation method (which takes both OPG's fixed costs and variable costs of operating stations into account) does not appear to be achieving value-for-money for ratepayers.
- When spilling water without generating any power, OPG incurs limited variable costs for operating the stations. Therefore, the compensation method should consider fixed costs while variable costs should be limited.

RECOMMENDATION 3

Increase in Maintenance Work Orders and a Continuous Backlog of Work Orders Due to Aging Hydroelectric Stations

- Between 2015 and 2021, the number of maintenance work orders for OPG's hydroelectric stations increased by 83% (from 18,400 to 33,800). Most work orders were for preventative maintenance to avoid equipment failures that can lead to unplanned outages.
- More than 90% of work orders in each of the last five years (ranging from 13,000 in 2017 to 28,000 in 2021) were not completed by the due dates. These delays contributed to a continuous backlog of about 9,500 work orders at the end of 2021.

RECOMMENDATION 4

Assessment of Hydroelectric Station Conditions and Implementation of Engineering Recommendations Lacked Timeliness

- Conditions of hydroelectric stations were not always assessed at regular intervals. OPG did not complete assessments for approximately 20% (or 13) of its 66 stations within the last 10 years.
- The timing between assessments was inconsistent. For example:
 - For Sir Adam Beck I and II Stations (two of OPG's largest stations), 18 years passed between their most recent assessment and the previous one, but for Cameron Falls Station, the gap was 10 years.
- OPG did not always address engineering recommendations of what work is required to maintain its generating stations and address any issues found in a timely way. For example:
 - For Abitibi Canyon Station, of 37 major recommendations made in 2016, only three were fully addressed, another three were in the process of being addressed, and 31 had either been scheduled only or not yet addressed in the 2021 assessment.

RECOMMENDATION 5, 6

Frequency of Forced Outages Improving

- Our review of the amount of electricity production loss due to both planned and forced outages found that losses generally increased up to 2019, then decreased in 2020 and 2021.
 - The loss in 2021 due to outages amounted to 623,000 MWh, more than three times higher than the loss in 2012 (198,000 MWh). This lost electricity would have been enough to power approximately 73,000 homes for a year in Ontario.

RECOMMENDATION 7

Capital Projects and Assessments Were Not Always Completed in a Cost-Effective and Timely Manner

- Our review of large hydroelectric capital projects completed over the last 15 years found that OPG experienced delays of some projects and cost overrun of one project as a result of insufficient planning. For example:
 - For the Niagara Tunnel Project, sub-surface geotechnical investigations carried out before the project started did not adequately note the rock conditions and work required. This resulted in a 62% increase in project cost (from \$985 million to \$1.6 billion) and a three-year delay in project completion (from 2010 to 2013).
- OPG did not always complete post-project reviews in a timely way. For example:
 - For the Lower Mattagami River Redevelopment Project completed in 2014, OPG did not complete the post-project review until 2020, six years later.

RECOMMENDATION 8, 9

Rate-Setting Process Not Regulated for All OPG's Hydroelectric Stations

- Of OPG's 66 hydroelectric stations, 12 stations are not subject to the OEB's rate regulation because they contract directly with the IESO. Their rates are significantly higher than those for rate-regulated stations.
 - The rates for non-rate-regulated stations vary (from \$65 to \$250 per MWh), meaning that they are at least 1.5 to almost six times higher than the rate for rate-regulated stations (\$43.88 per MWh).

RECOMMENDATION 10

Public Safety Incidents Remain High While Dam Safety Events Have Gone Down

- Over the last seven years, while dam safety (involving the dam structure or station itself) incidents decreased (from 41 events in 2015 to 19 events in 2021), events related to public safety increased and remained high in recent years (145 events in 2021).
 - Most of these public safety issues arose because the public either ignored or did not notice warning signs.

RECOMMENDATION 11

Monitoring and Reporting Needed on OPG's Foreign Acquisitions and Investments

- In addition to owning generating stations in Ontario, OPG has invested in generation assets in the US through a series of subsidiaries operating as Eagle Creek. OPG's rate of return on investment from its US-based hydroelectric generation assets is about 1.2% lower than expected at the time of acquisition in 2019.

RECOMMENDATION 12

Conclusions

- OPG has been a reliable provider of hydroelectric power to the province. Forced outages have declined and it is addressing its work order backlog. There is opportunity to improve its incapability factor, which measures the percentage of time a generating unit is unavailable over a specific time frame for outages within OPG's control,
- Opportunities for developing future supply of hydroelectric power that could address the forecasted increase in electricity demand and predicted future supply shortfall have not been fully explored.
 - OPG has not been able to fully utilize its hydroelectric generating capacity over seven years from 2015 to 2021 due to multiple reasons, which include insufficient water availability, spilling of water in response to surplus power conditions or other system constraints, and outages..
 - As the province's largest energy producer, OPG plays a critical role in exploring opportunities for expanding its hydroelectric operations in Ontario.
- OPG needs to manage its future hydroelectric stations and capital projects cost-effectively and efficiently to fulfil its mandate to provide low-cost power in a reliable and sustainable manner.
 - OPG needs to follow and address engineering assessments, recommendations and any lessons learned on a more timely basis to avoid future risks and increased costs.