

# 2022

## Ontario Power Generation Green bond impact report



June 2023

**ONTARIO**  
**POWER**  
GENERATION

## Overview

Ontario Power Generation (OPG) recognizes that operating in a safe, sustainable and inclusive manner is directly connected to business success and is expected by the company's customers, stakeholders, and Shareholder. As Ontario's largest clean energy provider, OPG strives to be a leader in sustainability and climate change action. This is accomplished through the implementation of operational and growth strategies that minimize OPG's environmental footprint, support reductions in greenhouse gas emissions, and increase resilience to climate change impacts, while taking into account impacts on customers.

Proceeds from green bond offerings provide an opportunity to finance and refinance projects that offer tangible environmental benefits. OPG updated its Green Bond Framework under which it issues green bonds and can use the proceeds for eligible projects in the following areas:

- Renewable Energy Generation
- Nuclear
- Energy Efficiency and Management
- Climate Adaptation and Resilience

***“Carbon-free nuclear energy has long been key to Ontario’s clean electricity grid, and the release of this updated green bond framework recognizes its crucial role in achieving our net-zero future.”***

*- Aida Cipolla, Chief Financial Officer, Ontario Power Generation*

Environmental benefits from these types of projects include avoided greenhouse gas emissions, improved air quality, resilience to the impacts of climate change, and increased energy efficiency.

This report presents information about the environmental benefits of eligible projects under OPG's Green Bond Framework as of December 31, 2022. This is OPG's fifth annual Green Bond Impact Report.

In conjunction with this report, OPG provides information about its environmental programs and performance, bond issuances, and the status of major projects in its annual ESG report, annual information form, management's discussion and analysis reports, and consolidated financial statements, all of which are available on [www.opg.com](http://www.opg.com).

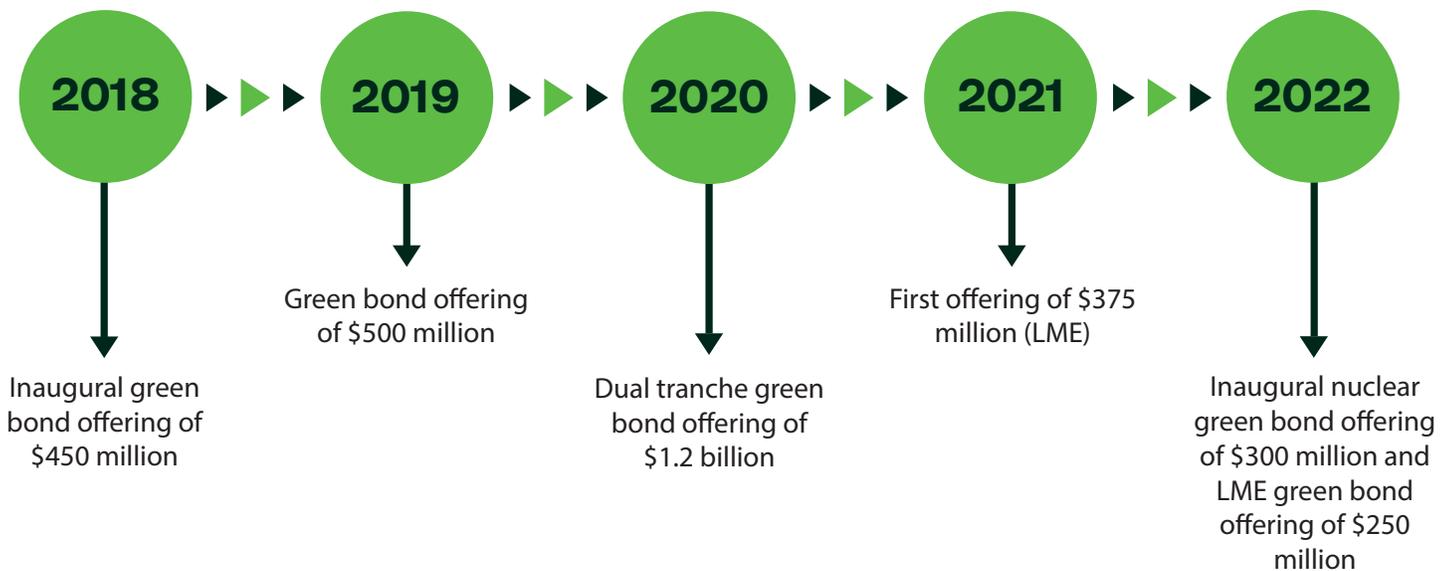


## Green bond offerings

In July 2022, OPG released an update to its Green Bond Framework and issued a first-of-its-kind nuclear green bond offering for \$300 million. The net proceeds from the issuance have been allocated to the Darlington Refurbishment project. Additionally, Lower Mattagami Energy Limited Partnership (LME), an entity wholly owned by OPG, completed the private placement offering with the

issuance of \$250 million of green bonds in October 2022. The net proceeds from the issuance have been allocated to the Little Long Dam Safety project. OPG was Canada's largest corporate issuer of green bonds as of the end of 2022 with total green bond issuances of \$3.08 billion (including \$625 million issuance by LME).

## Green financing timeline

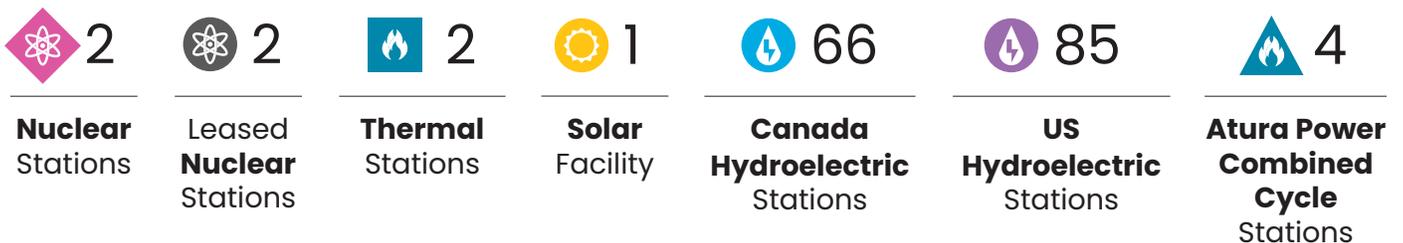


## About OPG

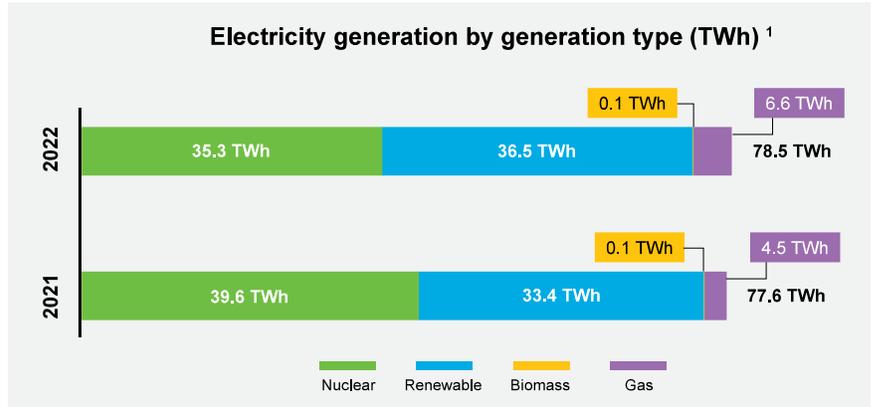
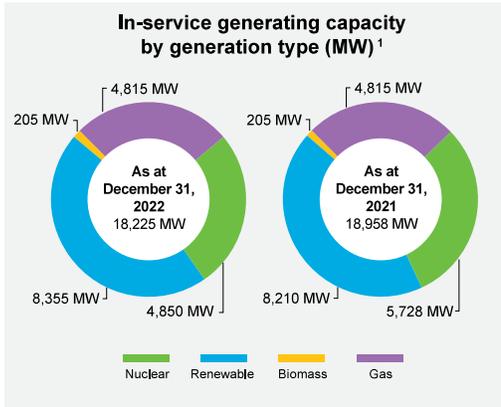
OPG is an Ontario-based electricity generation company whose principal business is the generation and sale of electricity. OPG was established under the Business Corporations Act (Ontario) and is wholly owned by the Province of Ontario. OPG's electricity generation portfolio had an in-service generating capacity of 18,225 megawatts (MW) as at December 31, 2022.

As at December 31, 2022, OPG owned and operated two nuclear generating stations, 66 hydroelectric generating stations, two thermal generating stations, one solar facility and four combined cycle gas turbine plants in

Ontario, Canada. The combined cycle plants are natural gas-fired facilities owned and operated through a wholly-owned subsidiary operating as Atura Power. Through its US-based wholly-owned subsidiary, OPG Eagle Creek Holdings LLC (Eagle Creek), OPG also wholly or jointly owned and operated 85 hydroelectric generating stations and held minority interests in 14 hydroelectric and two solar facilities in the US as at December 31, 2022. In addition, OPG owns two nuclear generating stations in Ontario, the Bruce A Generating Station (GS) and the Bruce B GS, which are leased on a long-term basis to, and operated by, Bruce Power L.P.



OPG's total electricity production in 2022 was 78.5 terawatt hours (TWh). Low-carbon emitting sources account for the majority of OPG's in-service generating capacity and electricity generation.



<sup>1</sup> Includes OPG's proportionate share of in-service generating capacity and electricity generation from co-owned and minority-held facilities, as applicable. Gas category includes the dual-fueled Lennox GS and Atura Power's combined cycle plants.

## Green bond framework

Proceeds obtained from green bond issuance are used to finance or refinance eligible projects that offer tangible environmental benefits. OPG's Treasury group is responsible for the review and selection of green projects that will qualify as eligible projects. The Treasury group verifies the suitability and eligibility of such investments in collaboration with internal experts and stakeholders, including OPG's Operations and Environment groups. Projects are evaluated using financial and risk-based analyses as well as strategic considerations.

Under OPG's most recent Green Bond Framework released in July 2022, eligible projects are expanded to include eligible nuclear projects in recognition of the critical role the technology plays in fighting climate change and in achieving OPG's own ambitious climate change goals. Net proceeds from green bonds can be used to finance maintenance and/or refurbishment of existing nuclear facilities that produce low-cost power free of carbon emissions.

Without limitation, eligible projects generally fall into the categories specified in the following table.

	<b>Renewable energy generation</b>
Investments that help supply energy from renewable sources	<p><b>Solar energy</b></p> <ul style="list-style-type: none"><li>• Construction of new solar energy facilities</li><li>• Maintenance and/or refurbishment of existing solar energy facilities</li></ul> <p><b>Wind energy</b></p> <ul style="list-style-type: none"><li>• Construction of new wind energy facilities</li><li>• Maintenance and/or refurbishment of existing wind energy facilities</li></ul> <p><b>Hydroelectricity</b></p> <ul style="list-style-type: none"><li>• Construction of new run-of-river hydroelectricity projects</li><li>• Refurbishment, repowering, modernization, and/or maintenance of existing hydroelectricity facilities with the purpose of increasing generation efficiency, operational life span and/or renewable energy output while maintaining or improving the level of operational safety</li></ul>
	<b>Nuclear</b>
Investments that help supply energy from nuclear reactors	<p><b>Nuclear energy</b></p> <ul style="list-style-type: none"><li>• Maintenance and/or refurbishment of existing nuclear energy facilities</li></ul>
	<b>Energy efficiency and management</b>
Investments that help reduce energy consumption or help manage and store energy	<ul style="list-style-type: none"><li>• Transportation Electrification (e.g. development of electric vehicles related infrastructure)</li><li>• Industrial Efficiency</li><li>• Climate change and eco-efficient products, production technologies and process (e.g. energy storage or charging facilities)</li></ul>
	<b>Climate adaptation and resilience</b>
Investments that help reduce potential damages from extreme weather events	<ul style="list-style-type: none"><li>• Flood protection and stormwater management</li><li>• Extreme weather resistant infrastructure and other forms of flooding mitigation</li></ul>



The green bond proceeds can also be used to finance the acquisition, including minority equity participation, of eligible projects.

OPG commits to not knowingly using green bond proceeds for financing assets and/or projects that involve generation of electricity from fossil fuels as its primary source of fuel.

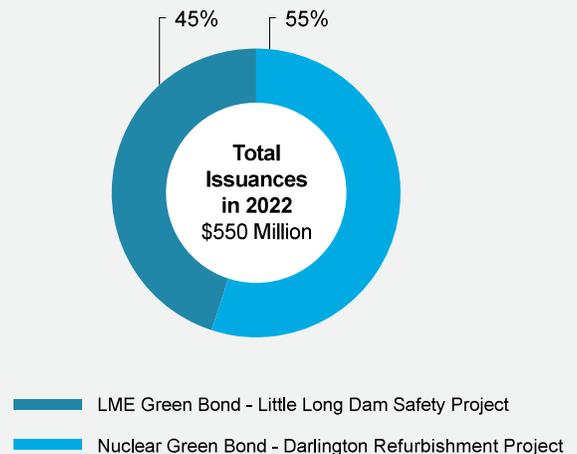
CICERO Shades of Green, a leading provider of independent, research-based evaluations of green bond and sustainability financing frameworks, completed a second-party opinion on OPG's green bond framework with a CICERO Medium Green shading and a governance score of Good.

## 2022 green bond offering

On July 14, 2022, OPG issued \$300 million of green bonds under its Medium Term Note Program. The issuance consisted of senior notes maturing in July 2032, with a coupon interest rate of 4.92 percent. The net proceeds from the issuance were used for funding the Darlington Refurbishment project.

On October 31, 2022, OPG's wholly-owned subsidiary LME completed a private placement bond offering with the issuance of \$250 million of green bonds, maturing in October 2033 with a coupon interest rate of 4.85 percent. The net proceeds from the issuance were used for funding the Little Long Dam Safety project.

**Value and use of net proceeds from green bond offerings**



## Green bond project summary

OPG has used the majority of its green bond proceeds to fund projects that increase the company's renewable energy generation capacity. The following table summarizes the projects with green bond financing as of December 31, 2022.

Eligible project	Project Status	Allocated Proceeds (millions of dollars)	Approved Budget (millions of dollars)	Generation Capacity Added (MW)	2022 Electricity Production (Gigawatt hours (GWh))
<b>Nuclear</b>					
Refurbishment of all 4 units at Darlington Nuclear Station. The project is expected to be completed in 2026.	In progress	297.9	12,800	-	13,889
<b>Renewable generation - acquisitions</b>					
Acquisition of Eagle Creek Renewable Energy in 2018 and Cube Hydro Partners in 2019. Now operating as Eagle Creek.	In operation	1,612.5	-	691	2,195
<b>Renewable generation - new facilities</b>					
Peter Sutherland Senior hydroelectric GS. The station was in-service as of 2017.	In operation	29.7	300	28	110
Nanticoke Solar. The facility was in-service as of 2019.	In operation	76.6	107	44	79

## Renewable generation - existing facilities

Lower Mattagami River redevelopment. New hydroelectric units were added to the existing Little Long, Harmon and Kipling stations. The station at the Smoky Falls site was replaced with a new three-unit station. The six new units were placed in-service in 2014.	In operation	223.7	2,600	438	1,474
Sir Adam Beck Pump hydroelectric GS reservoir refurbishment. The project was completed in 2017.	In operation	27.1	58	-	-
Sir Adam Beck water conveyance system rehabilitation assessment. An extensive condition survey of the canal was completed in 2017-2018.	Assessment complete	5.5	12.4	-	-
Ranney Falls hydroelectric GS Unit 3 redevelopment. Completed in 2022.	In operation	60.2	77	10	61 (All units)
Sir Adam Beck 1 hydroelectric GS replacement of two decommissioned generating units. Completed in 2022.	In operation	2.6	128	115	1,937 (All units)
Sustaining capital. Various upgrades, replacements and other modifications at over 40 hydroelectric facilities.	In operation	322.1	-	-	-

## Climate adaptation and resilience

Little Long Dam safety improvements on the Mattagami River. The project is expected to be completed in 2023.	Under construction	397.4	700	-	-
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Status updates for OPG's eligible projects as at December 31, 2022 are as follows.

### **Sir Adam Beck I GS Units G1 and G2 replacement**

OPG executed a project to replace two older generating units at the ten-unit Sir Adam Beck I GS. The two units used outdated line frequency technology of 25 hertz prior to being decommissioned in 2009. OPG successfully completed the replacement of the G1 unit and the G2 unit at the Sir Adam

Beck I GS in October 2022 and May 2022 respectively. Successful completion of this work at G1 and G2 added approximately 115 MW of clean electricity at OPG's flagship hydroelectric station. The overall project was completed below its \$128 million budget.

### **Ranney Falls Hydroelectric GS**

In 2017, OPG began construction work on a 10 MW single-unit powerhouse on the Ranney Falls GS site to replace an existing unit that reached its end of life in 2014. In June 2022, OPG successfully completed the replacement of the G3 unit at the Ranney Falls GS site,

doubling the site's in-service generating capacity from 10 to 20 MW. The project also included a new powerhouse and spillway. The overall project was completed within its \$77 million budget.



*New generating unit and powerhouse at the Ranney Falls facility*

## Little Long Dam Safety project

In 2019, OPG initiated a project to improve dam safety along the Lower Mattagami River in northeastern Ontario. The Little Long Dam Safety project will increase the discharge capacity and make other improvements at the Little Long Main Dam, helping OPG to comply with updated dam safety requirements established by the Province of Ontario.

In 2022, OPG began commissioning the replaced Adam Creek gates and commenced the demolition of the east upstream dam

in front of the two new sluice gate bays. During the fourth quarter of 2022, the east cofferdam was fully removed as part of gate commissioning activities. The project is expected to be completed in 2023 and is tracking toward its revised budget of \$700 million. The revised budget is primarily a result of construction challenges, disruptions related to the COVID-19 pandemic, and additional costs incurred in 2022 to manage unusual fall freshet.



*Downstream overview of Adam Creek Sluice Gates*

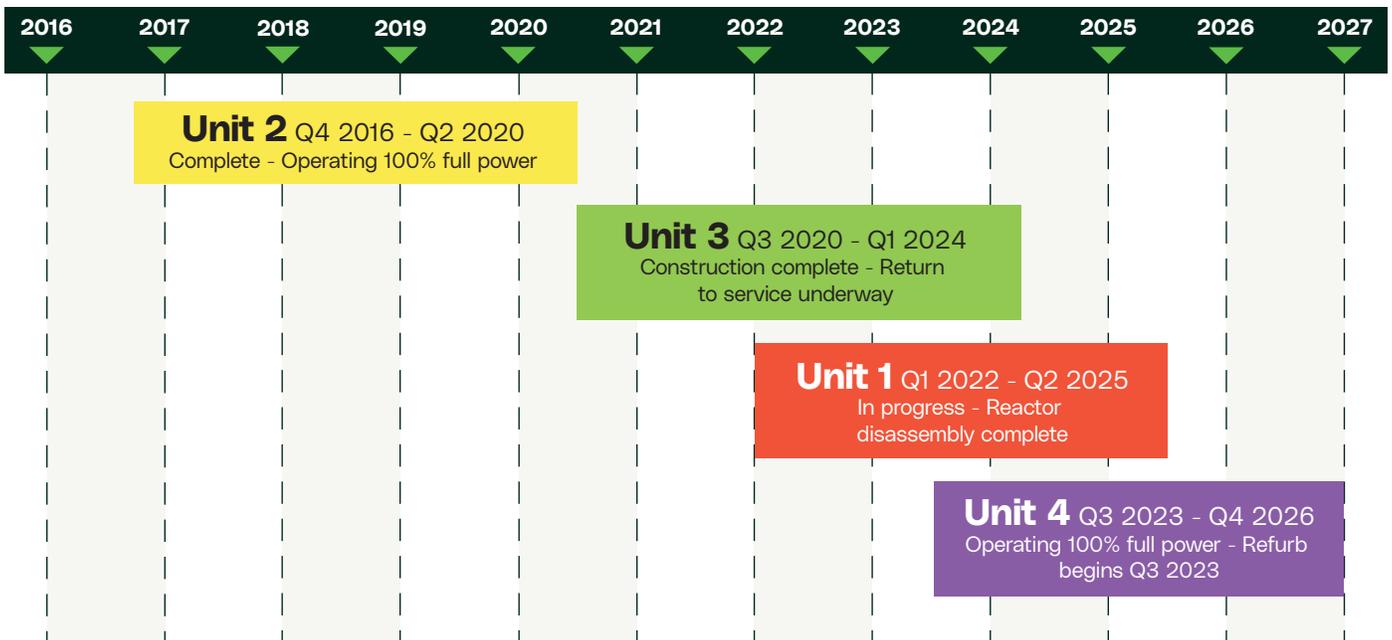
## Darlington Refurbishment project

The Darlington Refurbishment project commenced in 2016 as the four Darlington GS units were approaching their originally designed end-of-life. Refurbishment of the four generating units is expected to extend the operating life of the station by at least 30 years. The second unit, Unit 3, commenced refurbishment in September 2020 and is expected to be returned to service in the second half of 2023, ahead of the originally planned date in the first quarter of 2024. The third unit, Unit 1, commenced refurbishment

in February 2022 and is scheduled to be returned to service in the second quarter of 2025. Planning and pre-requisite activities for the refurbishment of the fourth unit, Unit 4, are progressing as planned. The planning, pre-requisite and execution work for the Unit 4 refurbishment has and will incorporate the benefits of experience with the first three units and additional strategic improvements. The refurbishment of Unit 4 is expected to commence in 2023 and is scheduled to be completed by the end of 2026.



### Refurbishment outage schedule



\*Total duration 120 months

The Darlington Refurbishment project is a multi-phase program comprising the following five major sub-projects:

- Defueling and Fuel Handling, which involves the defueling of the reactors and the refurbishment of the fuel handling equipment;
- Re-tube and Feeder Replacement (RFR), which includes the removal and replacement of feeder tubes and fuel channel assemblies in each reactor;
- Turbines and Generators, which consists of inspections and repairs of turbine generator sets and the replacement of analog control systems with digital control systems for Units 3, 4, and 1;
- Steam Generators, which includes mechanical cleaning, water lancing and inspection and maintenance work on the generators; and

- Balance of Plant, which consists of work on a number of projects to replace or repair certain other station components.

The RFR sub-project is the largest sub-project and represents a majority of the critical path schedule. The major sub-projects are executed over four major segments for each unit:

- Shut Down, which involves removing fuel from the reactor and islanding the unit;
- Disassembly, which involves removing the required reactor components including feeder tubes, fuel channels and calandria tubes;
- Reassembly, which involves procuring, installing and inspecting new reactor components; and
- Power Up, which involves loading new fuel into the reactor, restoring the reactor vault, reconnecting the unit to the rest of the station, and returning the unit to service.

# Darlington Nuclear Refurbishment project

## 30 more years of clean electricity

Nuclear energy plays a fundamental role in Ontario's clean-energy equation

The refurbished Darlington Station will reduce greenhouse gas emissions by an estimated

**297**  
million tonnes

That's the equivalent of removing

**2** million cars per year

from Ontario's roads

**1 in 5** homes and businesses are powered by Darlington with virtually no greenhouse gases



**~20%** of Ontario's power is supplied by Darlington - enough to serve a city of 2 million people



**60%** of Ontario's daily electricity needs are supplied by this province's nuclear fleet



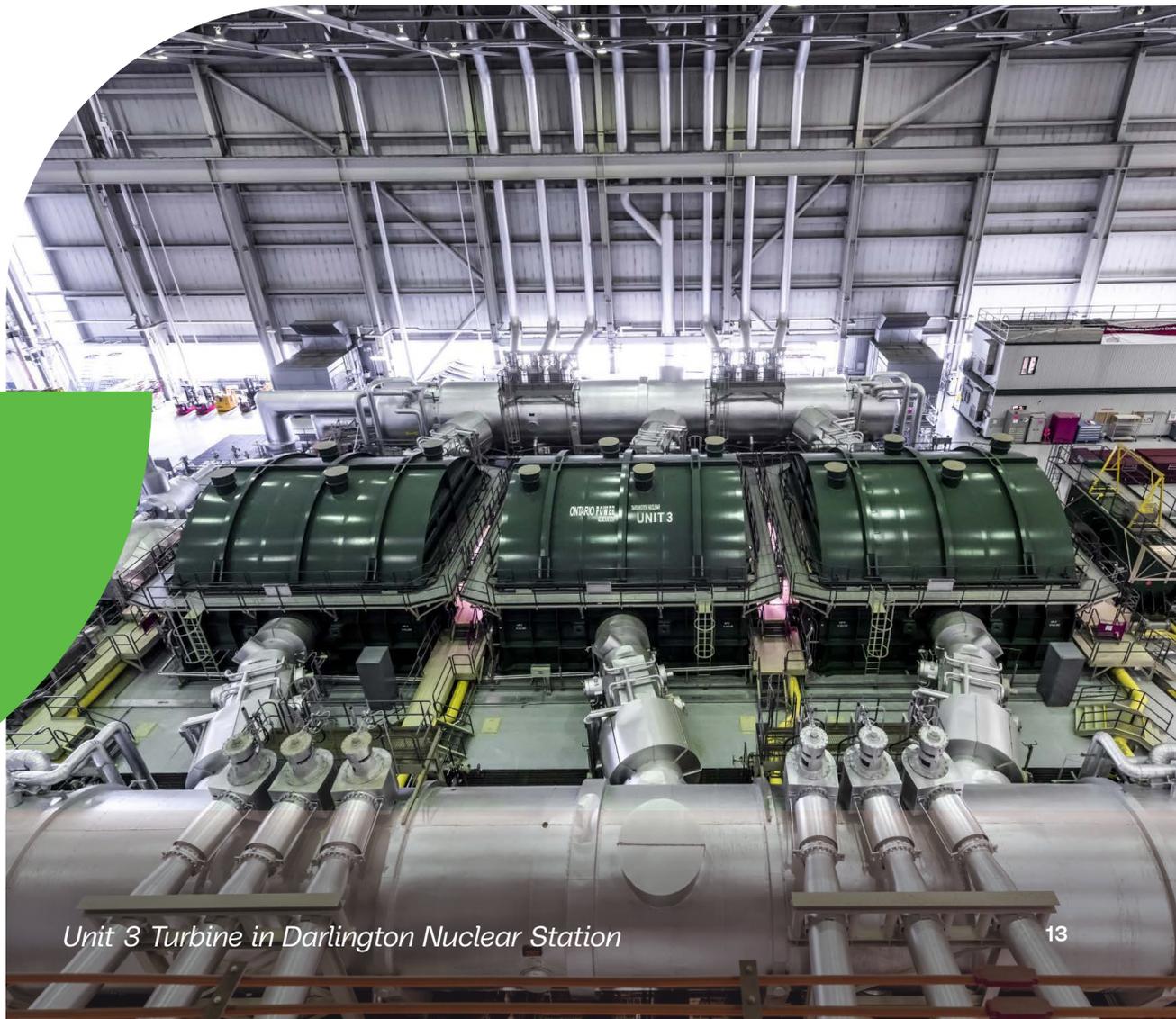
**8¢ kWh** 30 years of power below average costs



During the fourth quarter of 2022, the project completed the lower feeder installation series and the lower body supports installation series of the Unit 3 refurbishment, signifying the end of the Reassembly segment. The Power Up segment commenced following the completion of the Reassembly segment with the loading of new fuel into the reactor, which was completed in January 2023. The project is currently working to restore the reactor vault, which includes removing the bulkheads to reconnect Unit 3 back to the operating units. Vault restoration is on track for completion in the first half of 2023. Achievement of this milestone will represent the completion of construction work, full reconnection of Unit 3 to the station, and transition of the unit to start-up activities.

Unit 1 refurbishment is currently in the Disassembly segment, with activities progressing on schedule. During the fourth quarter of 2022, the project completed the removal of 960 feeder tubes from the reactor and preparatory work to support the removal of 480 fuel channel assemblies. The removal of fuel channel assemblies is in progress, with the removal of end fittings completed in January 2023 and the removal of pressure tubes and calandria tubes expected to be completed in the first half of 2023, which will mark the end of the Disassembly segment.

OPG continues to assess and seek ways to manage the impact of the COVID-19 pandemic on the project's total cost, which is otherwise continuing to track to the \$12.8 billion budget.



*Unit 3 Turbine in Darlington Nuclear Station*

## Green bond impacts

### Renewable energy generation

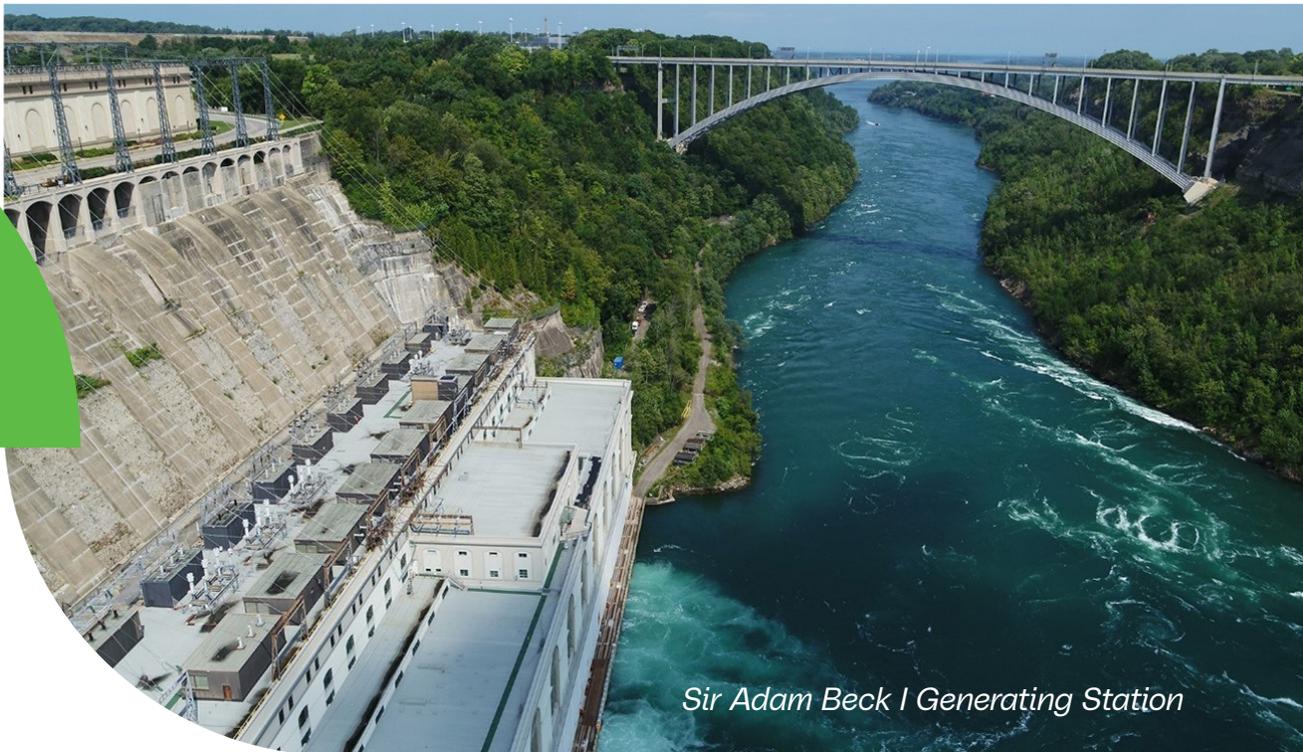
At OPG, hydroelectricity is by far the most significant form of renewable energy produced by the company, providing baseload, intermediate and peaking generation depending on physical characteristics and hydrological conditions. OPG maintains a rigorous maintenance and asset management program to ensure continuing reliable and efficient operations of these long-lasting assets. OPG continues to explore opportunities for solar development opportunities beyond its initial project at Nanticoke.

Investing in renewable energy generation provides environmental and health benefits. Renewable energy sources reduce the need for electricity generated from fossil fuels (i.e. coal, diesel, oil, natural gas) that produce air pollution – pollutants such as sulphur oxides, nitrogen oxides, particulate matter and mercury that contribute to the formation of smog and acid rain. Renewable energy sources also have a lower carbon intensity than fossil fuel generation, which reduces greenhouse gas emissions that contribute to climate change.

### Nuclear energy generation

Nuclear generation harnesses the energy released during controlled nuclear fission reactions to produce steam that is used to drive turbines to generate electricity. Nuclear generation produces virtually no greenhouse gas, sulphur dioxide, nitrogen

oxide or mercury emissions. Nuclear power remains one of the most effective tools in the fight against climate change because of its ability to produce clean, low-cost, carbon-free baseload power 24/7, 365 days a year.



*Sir Adam Beck I Generating Station*

## 2022 carbon dioxide emissions avoided

A commonly used metric to quantify the positive impact of clean energy is carbon dioxide (CO<sub>2</sub>) emissions avoided. For the purposes of this report, OPG will consider the amount of electricity produced from its eligible projects that have added renewable generation capacity and use regional CO<sub>2</sub> grid emission factors to provide an estimate of CO<sub>2</sub> emissions potentially avoided.

The calculation of Eagle Creek's CO<sub>2</sub> emissions avoided are based on the United States Environmental Protection Agency Avoided Emissions and Generation Tool (AVERT) regional emissions factors. For 2022, AVERT has reorganized its regional calculations and now splits the contiguous

48 states into 14 regions. The calculation of CO<sub>2</sub> emissions avoided in Ontario is based on computer-based modelling that determines how much the electricity production from eligible projects will displace generation from combined cycle gas turbine plants.

Note: The actual amount of carbon emissions avoided by renewable electricity displacing electricity from fossil fuels depends on where and when electricity is produced. Regions that already have clean electricity systems have lower potential to avoid emissions, and the mix of generation sources serving an electrical grid system at particular time can impact which sources are displaced.



Eligible Project	Region	2022 Electricity Production (GWh)	Grid Emission Factor (tonnes CO <sub>2</sub> /GWh)	2022 Estimated Emissions Avoided (tonnes CO <sub>2</sub> )
Eagle Creek (excludes generation from minority owned facilities)	New England region	386	540	208,361
	New York region	241	540	130,187
	Mid-Atlantic region	571	800	456,585
	Midwest region	194	910	176,957
	Carolinas region	761	780	593,390
	California region	11	540	5,766
	Northwest region	32	790	25,446
Peter Sutherland Senior GS	Ontario	110	400	44,068
Nanticoke Solar	Ontario	79	400	31,553
Lower Mattagami River stations (new units)	Ontario	1,474	400	589,553
Sir Adam Beck 1 GS	Ontario	1,937	400	774,800
Ranney Falls GS	Ontario	61	400	24,400
Darlington Nuclear Station (Unit 2)	Ontario	5,954	400	2,381,600

Total = 5,442,666

## OPG's climate change goals

OPG commits to being a North American clean energy leader and a driver of efficient, economy-wide decarbonization. The Climate Change Plan outlines OPG's goals and a range of solutions to help achieve decarbonization while balancing economic and environmental benefits and electricity system needs.

OPG has set the following goals as part of the Climate Change Plan:

- OPG will continue to be a climate leader by investing in and implementing carbon reductions and offsets to achieve net-zero carbon emissions by 2040.

- OPG will be a leading energy innovation company, advancing clean technologies and solutions to help the markets where it operates achieve net-zero carbon economies by 2050.

To help achieve these goals, OPG has developed an action plan in the areas of carbon emissions reductions, climate change adaptation, energy sector innovation and climate change leadership.

OPG's Climate Change Plan can be found on the Company's website at [www.opg.com](http://www.opg.com).

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