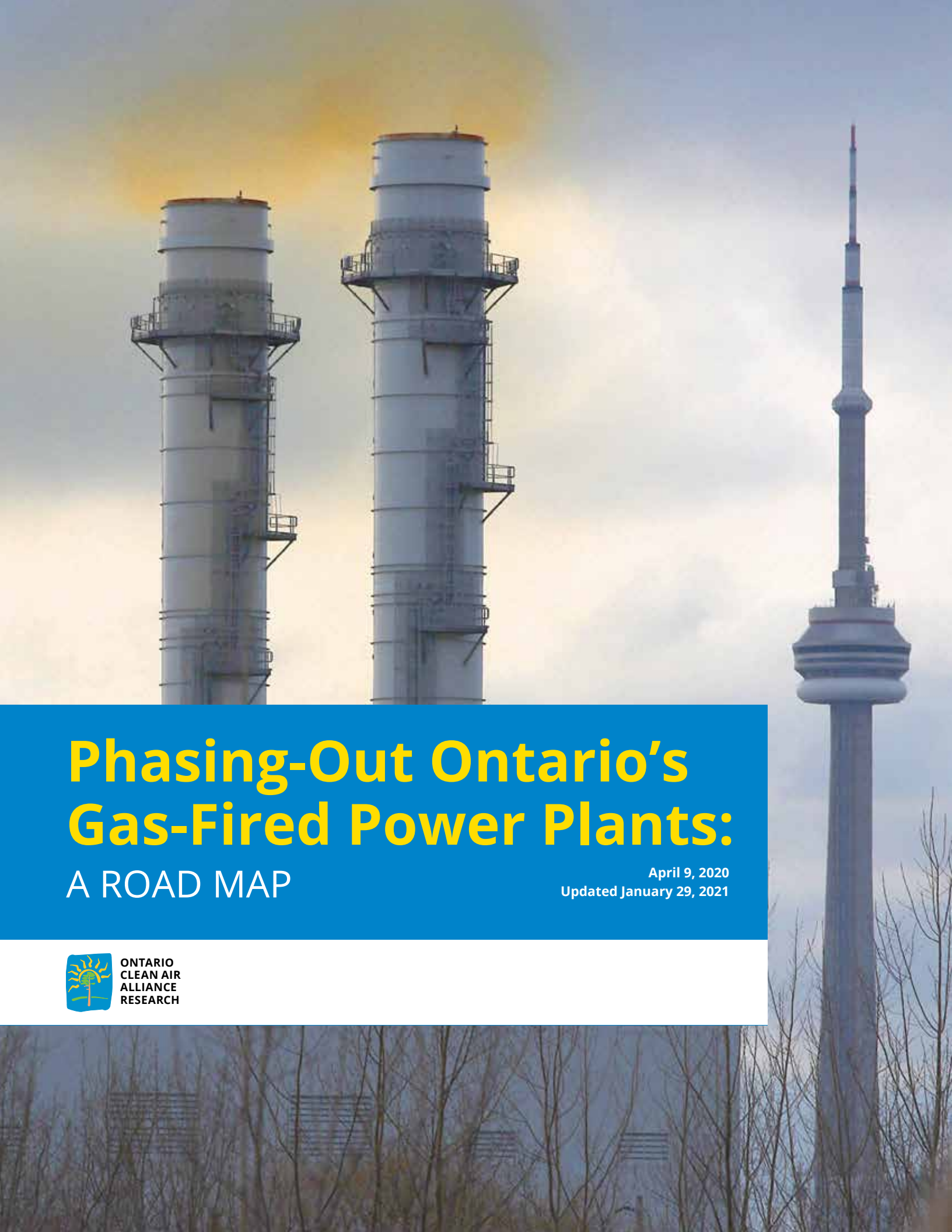

Phasing-Out Ontario's Gas-Fired Power Plants:

A ROAD MAP

April 9, 2020
Updated January 29, 2021

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Introduction

According to Ontario's Independent Electricity System Operator (IESO), **the greenhouse gas (GHG) pollution from Ontario's gas-fired power plants will increase by more than 300% by 2030 and by 500% or more by 2040** as the province uses gas to replace aging nuclear plants and to meet growing demand for electricity from population growth and increased electrification. If this occurs, Ontario will lose approximately 40% of the pollution reduction benefits it achieved by phasing-out its dirty coal plants.

This report provides an alternative road map for how Ontario can phase-out its gas plants by importing Quebec waterpower and by investing in energy efficiency and cost-effective Made-in-Ontario renewable energy while meeting future electricity demand. This report will show that if we ramp up our expenditures on energy efficiency and renewable energy and ramp down our expenditures on much higher cost nuclear re-build projects, we will be able to simultaneously phase-out the gas plants, achieve Ontario's 2030 climate target, move our province towards a 100% renewable electricity grid and lower our electricity bills.

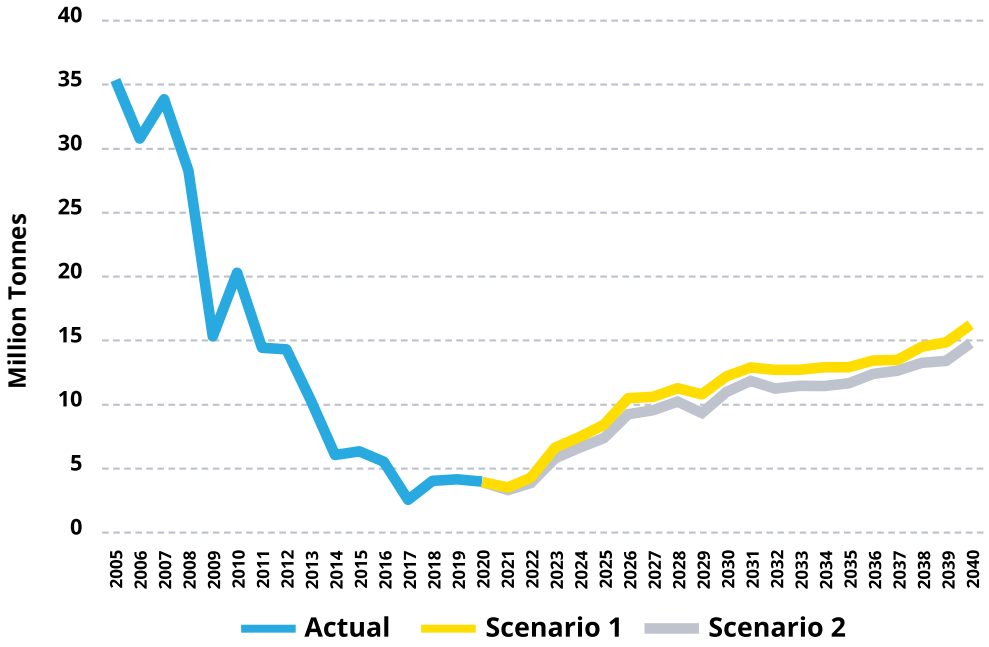
Thanks to the Echo Foundation, the M.H. Brigham Foundation, the Green Sanderson Family Foundation and the Taylor Irwin Family Fund at the Toronto Foundation for their generous support.

Ontario Power Generation's Lennox Gas-Fired Power Plant, near Napanee.

Historic and Forecast GHG Pollution from Ontario's Electric Power Plants

As Figure 1 shows the **GHG pollution from our electricity system fell by 93% between 2005 and 2017** due to the phase-out of Ontario's coal plants. Specifically, it fell from 35.4 million tonnes in 2005 to 2.5 million tonnes in 2017.

Figure 1: Ontario's Historic and Forecast GHG Pollution from its Electric Power Plants[1]



Unfortunately, as Figure 1 reveals, in 2018 the GHG pollution from Ontario's power plants started to rise again – a rise that the IESO is forecasting will continue for the next 20 years. Specifically, the IESO is forecasting that the GHG pollution from Ontario's gas-fired power plants will rise by more than 300% by 2030 and by 500% or more by 2040, relative to the 2017 baseline.

The IESO's forecast is based on the following three assumptions.

1. **Ontario's demand for electricity will rise by approximately 1% per year.[2]**
2. **The Pickering Nuclear Station will close in 2025.[3]**
3. **Virtually all of our need for new electricity resources due to rising demand and the closure of the Pickering Nuclear Station will be met by ramping up the output of the province's gas-fired power plants.[4]**

The IESO's forecast is a reasonable assessment of the implications of the Ford Government's electricity plan, which is described on page 4.

The Ford Government's Electricity Plan

The Ford Government is planning to meet Ontario's electricity needs between 2020 and 2040 by:

1. **Ramping up the output of the province's existing gas-fired power plants;**[5]
2. **Re-building 10 of Ontario's aging nuclear reactors at a forecast cost of $25.8 billion;**[6]
3. **Working with New Brunswick and Saskatchewan to develop and deploy small modular nuclear reactors;**[7] **and**
4. **Upgrading Hydro One's transmission system to enable it to import up to 1,650 megawatts (MW) of firm power from Quebec by December 2023.**[8]
5. **Capping the IESO's energy efficiency programs budget at $173 million per year.**[9]

The Ford Government's plan does **not** include:

1. **Any new electricity supply agreements with Hydro Quebec; or**
2. **Any new investments in Made-in-Ontario renewable electricity projects.**

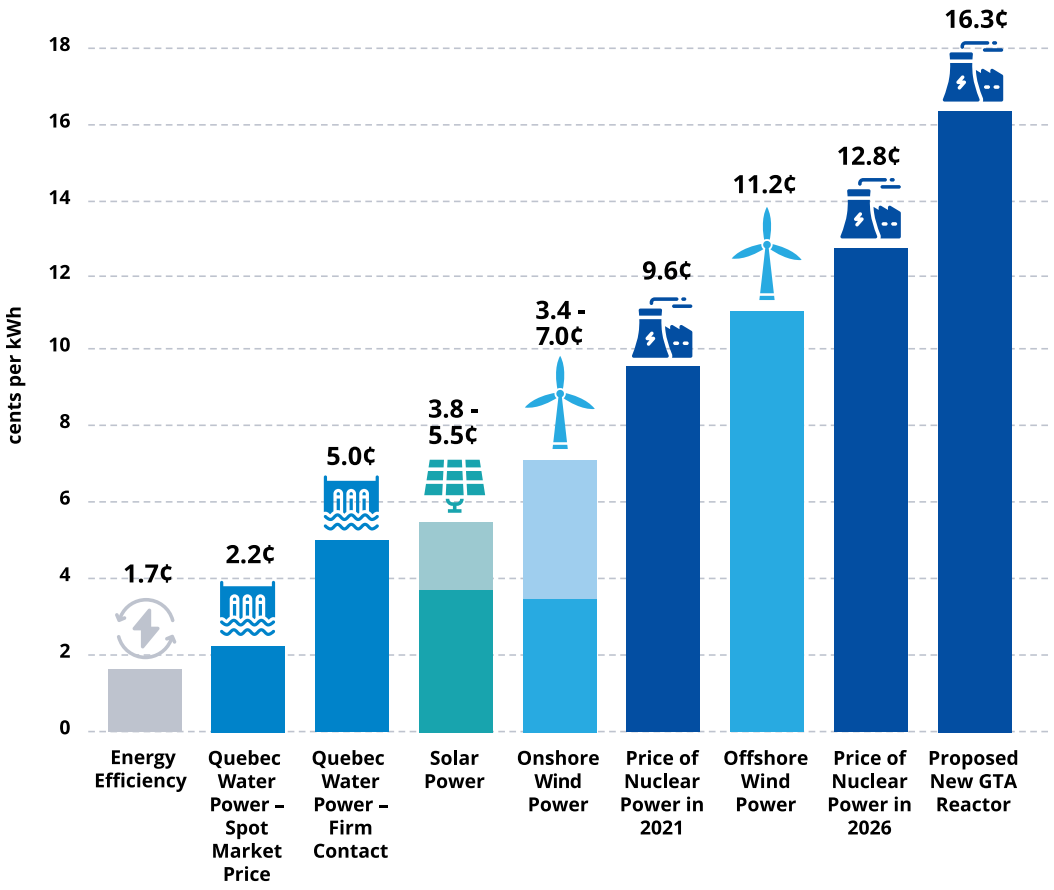
Since new small modular nuclear reactors and re-building the Darlington and Bruce Nuclear Stations are the highest cost options to keep our lights on, the Ford Government's plan will lead to **rising electricity rates** as well as **rising GHG pollution.**

How Ontario can phase-out its gas plants and lower our electricity bills

Figure 2 compares the costs of various options to keep our lights on. Specifically, it shows that the Ford Government's preferred nuclear options are significantly more costly than energy efficiency, Quebec power and Made-in-Ontario renewable electricity.

Figure 2: Ontario's Electricity Options: A Cost Comparison

[References for Figure 2 are provided at the end of this report.]



As Figure 2 shows, Ontario Power Generation's (OPG) price for nuclear power in 2021 is 9.6 cents per kilowatt-hour (kWh). **According to OPG, its price of nuclear electricity must rise to 12.8 cents per kWh by 2026 to pay for the re-building of the Darlington Nuclear Station.**

Small modular nuclear reactors are also a very high-cost option. The Canadian nuclear industry is forecasting that their cost will be **16.3 cents per kWh.** However, they note that if there is a 3% capital cost overrun, the cost will rise to 21.5 cents per kWh. They are hoping that the first commercial small nuclear reactor will be in-service by 2030, but currently no commercial designs have been approved in Canada and proponents have not explained what will be done with radioactive waste from these new reactors. (After 50 years of commercial operation of nuclear reactors, Canada still has no long-term storage site available).

In contrast, in 2017, the IESO purchased electricity savings from residential, commercial and industrial consumers at an average cost of only **1.7 cents per kWh**, which is less than one-seventh OPG's forecast price of nuclear power in 2026.

Our lowest-cost source of renewable electricity is spot market purchases of Quebec water power, which had an average cost of **2.2 cents per kWh** in 2017.

Hydro Quebec is offering to sell us a firm supply of **waterpower at a price of only 5 cents per kWh** under a long-term contract. Hydro Quebec's proposed price for a 20-year firm supply is less than one-half of OPG's forecast price of nuclear electricity in 2026.

In the past, wind and solar were very high-cost sources of electricity supply, but in recent years their costs have fallen dramatically due to technological improvements and economies of scale. According to the International Energy Agency, onshore wind and solar are now the lowest cost sources of new electricity supply in most countries.[10] Bloomberg New Energy Finance is forecasting that the cost of wind and solar power will fall by an additional 48% and 63% respectively by 2050.[11]

As a consequence, if Ontario ramps down its planned expenditures on high-cost nuclear reactor re-builds while it increases its imports of Quebec water power and invests in energy efficiency and Made-in-Ontario renewable electricity, it will be able to simultaneously phase-out its gas plants and lower our electricity bills.

Our Energy Efficiency Potential

In 2018 Ontario's Independent Electricity System Operator and the Ontario Energy Board retained Navigant Consulting to estimate the potential for energy efficiency investments to reduce the demand for electricity at an average cost of 3.9 cents per kWh or less. Table 1 below summarizes their findings.

Table 1: Ontario's Achievable Energy Savings for 3.9 cents per kWh or less[12]

Year	Energy Savings	Average Cost per kWh Saved
2023	6.9 billion kWh	2.7 cents per kWh
2030	17.1 billion kWh	3.3 cents per kWh
2038	23.8 billion kWh	3.9 cents per kWh

As Table 1 shows energy-efficiency investments could reduce Ontario's electricity demand by 17.1 billion kWh per year by 2030 at an average cost of 3.3 cents per kWh. This is equivalent to approximately 55 to 60% of the forecast output of Ontario's gas plants in 2030. [See Table 3 below]

By 2038, energy efficiency investments could lower our electricity demand by 23.8 billion kWh. This is equivalent to up to 67% of the forecast output of Ontario's gas plants in 2038.

But there is no reason why our energy efficiency investments should be capped at an average cost of 3.3-3.9 cents per kWh. **To minimize our electricity costs the Government of Ontario should pursue all energy efficiency investments that can keep our lights on at a lower cost than nuclear power.** As we have noted above, in 2021 OPG's price of nuclear power is 9.6 cents per kWh and OPG says it will need to raise its price of nuclear electricity to 12.8 cents per kWh by 2026 to pay for the re-building of its aging Darlington nuclear reactors. If the Government of Ontario were to pay up to just 9.6 cents per kWh for electricity savings, it is reasonable to assume that the resulting reduction in our electricity demand would save more energy than Ontario's gas plants are forecast to produce in 2030.

Quebec Water and Wind Power

> “Quebec generates a large surplus of electricity, primarily from emissions free hydroelectric generating stations, and electricity prices in Quebec are the lowest in Canada. The proximity of Quebec to Ontario’s major cities presents an attractive opportunity for Ontario to meet its electricity needs with imports from Quebec.”[13]
>
> -Financial Accountability Office of Ontario

Existing interconnections

As Figure 3 shows, there are seven interconnections between the Ontario and Quebec electricity transmission systems. Using these existing interties, Ontario can import 16.5 to 18.5 billion kWh per year from Quebec.[14]

In 2020, Ontario’ net electricity imports from Quebec were only 4.1 billion kWh.[15] As a result, Ontario could increase its electricity imports from Quebec by up to 14.4 billion kWh per year using existing transmission lines. This is equivalent to approximately 50% of Ontario’s forecast gas-fired electricity generation in 2030. [See Table 3 below]

Furthermore, by expanding its transmission links with Quebec, Ontario could import even more low cost, clean and safe renewable electricity.

Potential new interties

In 2017 the IESO issued a report that described three options to increase our ability to import power from Quebec. The report’s key findings are summarized in Table 2.

All of these potential new transmission lines would be built in existing Hydro One transmission corridors.[17]

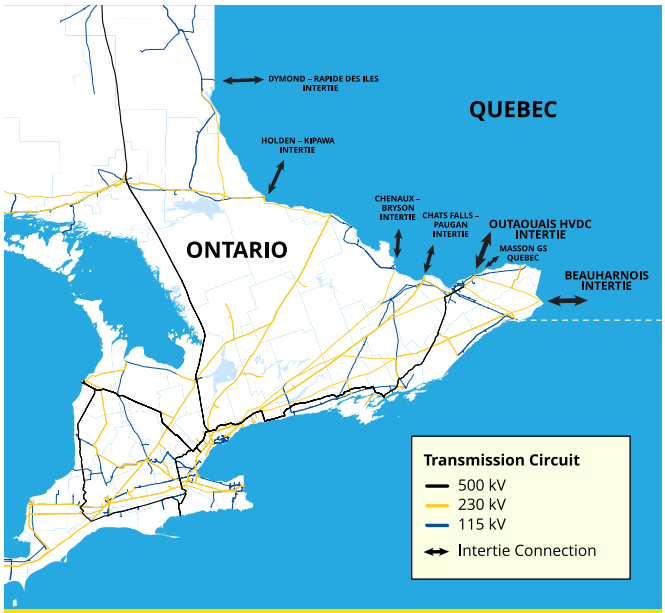


Figure 3: Existing Ontario-Quebec Interconnections[18]

If just one of these interties was built, our total import capability would rise to approximately 35 billion kWh per year, which would be equivalent to approximately 120% of Ontario’s forecast gas-fired generation in 2030.

Table 2: Potential new interties to allow Ontario to import more power from Quebec[16]

Option	Length	Peak Capacity	Maximum Annual Electricity Imports	Cost
New Intertie in Ottawa	20 km	2,000 megawatts (MW)	17.52 billion kWh	Approximately $80 million
New Intertie near Beauharnois	100 km	2,000 MW	17.52 billion kWh	Approximately $400 million
New Intertie at Chats Falls	350 km	2,000 MW	17.52 billion kWh	Up to $1.4 billion

Quebec's existing exports

In 2019, Hydro Quebec exported 35 billion kWh of electricity at an average price of 4.3 cents per kWh.[19] Most of Quebec's exports are spot market sales to the U.S., which could be easily diverted to Ontario.

Quebec energy efficiency investments can increase export potential

Quebec's electricity consumption per person is the highest in the world.[20] As a consequence, Quebec could export even more waterpower by investing in low-cost energy efficiency measures, which would reduce the electricity bills of its domestic customers and free up even more of its existing heritage water power capacity for export.

According to Professor Pierre-Olivier Pineau of the University of Montreal, cost-effective energy efficiency investments could increase Quebec's export potential by approximately 30 billion kWh per year.[21]

New wind power projects can increase export potential

Hydro Quebec prices are low thanks to its heritage waterpower facilities. But developing new hydro dams would be expensive and environmentally damaging.

Fortunately, Quebec's lowest cost source of new electricity is now wind power.[22] Quebec has enormous wind power potential and could produce approximately 300 billion kWh of wind power per year at a cost of approximately 6 cents per kWh.[23] That is, Quebec's wind power potential is more than double Ontario's total annual electricity consumption.

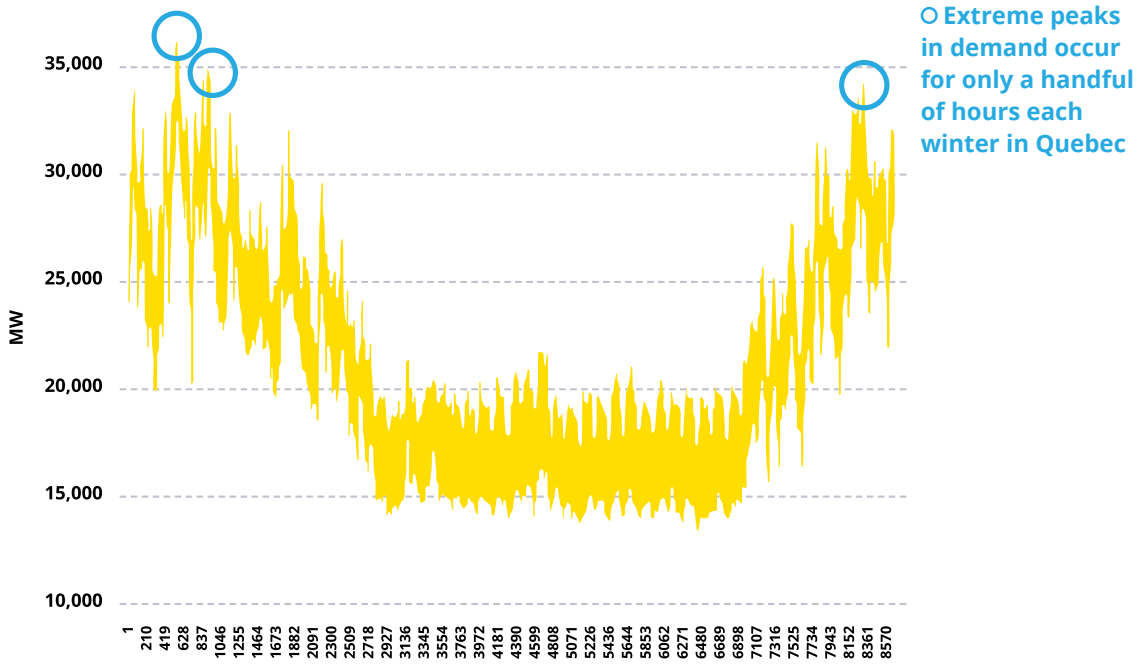
Because of its large system of waterpower reservoirs that can be operated like giant batteries (water stored when wind is blowing, released to generate power when it is not), Quebec can turn intermittent wind power into firm exportable power, available 24/7.

Availability of Quebec power

According to a spokesperson for Canada's nuclear industry, Quebec power is not a viable option for Ontario since it is not available in the winter.[24] Fortunately, this claim has no basis in fact.

Figure 4 shows Quebec's demand for electricity for electricity during every hour of the year from January to December in 2013.

Figure 4: Hydro Quebec's 2013 Hourly Demand for Electricity[25]



As Figure 4 shows Quebec's demand for electricity spikes sharply upwards on a few very cold winter days. When these needle peaks occur Quebec may not have power available for export. But these needle peaks last for less than 1% of the hours of the year. As a result, **during at least 99% of the hours of the year Quebec has surplus power available for export.**

In 2019 Hydro Quebec introduced time-of-use pricing for its residential and business customers to provide them with a financial incentive to reduce their electricity demands on very cold winter days.[26] By ramping up its energy conservation and efficiency programs and by providing its customers with financial incentives to reduce their electricity demands during very cold winter hours, Hydro Quebec can ensure that it will be able to export power to Ontario and the U.S. during 100% of the hours of the year.

In this context, it is important to remember that nuclear generating stations are not available for 100% of the hours of the year either. In fact, **the Darlington Nuclear Station's average annual capacity factor is only 83%.[27]**

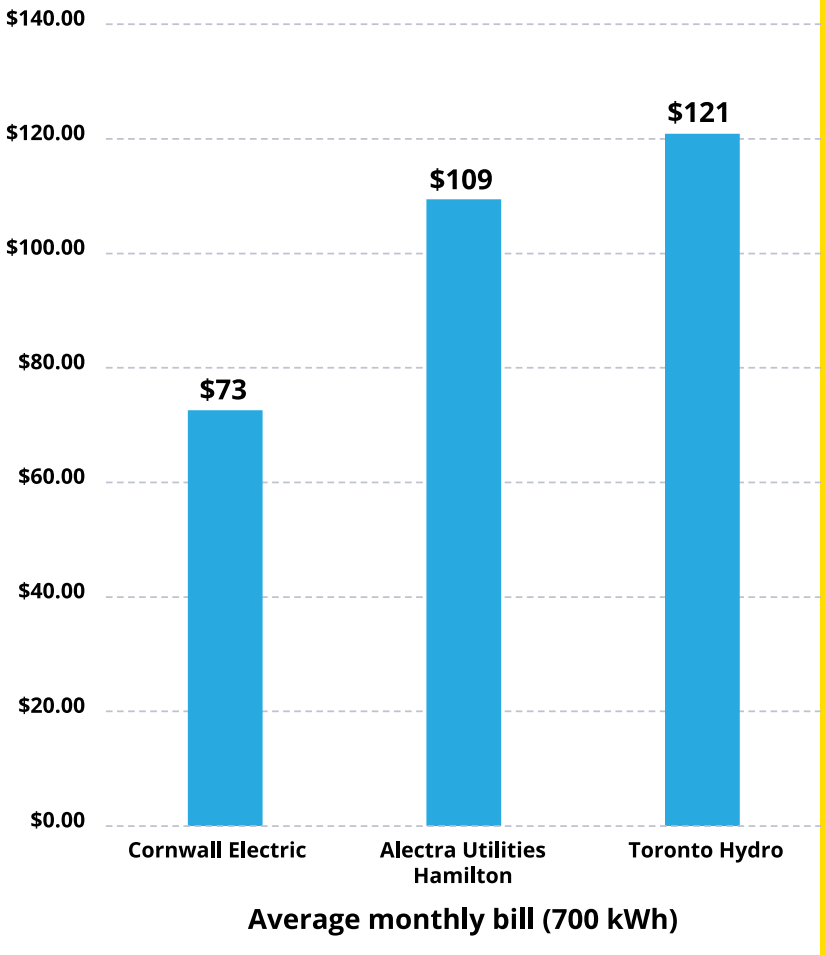
City of Cornwall

The City of Cornwall's electricity rates demonstrate the economic benefits of Quebec waterpower. **Cornwall has obtained 100% of its electricity from Hydro Quebec for 50 years and it has the lowest electricity rates in Ontario.**

As Figure 5 shows the average residential electricity bills in Hamilton (Alectra Utilities) and Toronto are 50% and 66% higher respectively than Cornwall's.

In addition, during the 2003 blackout the lights did not go out in Cornwall, whereas in the rest of Ontario it took more than eight days to return our electricity system to full power due to our dependency on nuclear power.[29]

Figure 5: Average Monthly Residential Electricity Bills[28]



Ontario Wind and Solar Power

Ontario also has a large potential supply of wind and solar energy that could be developed to help phase-out Ontario's gas-fired power plants. For example, a report prepared for the Ontario Power Authority identified 64 potential off-shore wind power sites in the Great Lakes that could produce 111.5 billion kWh of electricity per year.[30] This is equivalent to 82% of Ontario's total electricity consumption in 2019.[31]

However, since the wind doesn't always blow and the sun doesn't always shine, these intermittent renewable energy resources must be combined with storage systems if they are to displace gas-fired generation during every hour of the year.

According to a recent Massachusetts Institute of Technology (MIT) report, Hydro Quebec's existing hydro-electric reservoirs are the best storage (load balancing) option for wind and solar power in New England and New York State. For example, when wind power production is above average in the U.S northeast, the surplus wind energy could be exported to Quebec to keep the lights on in Montreal, and as a consequence Hydro Quebec could store more water it its reservoirs. Conversely when U.S. wind power generation is below average, Hydro Quebec could use the extra water in its reservoirs to produce hydro-electricity for export to the U.S.

"Two-way trading of electricity with Quebec helps Northeastern states balance renewable intermittency at multiple time scales, mitigating the daily mismatch between solar and evening peak demand, the synoptic (multi-daily) mismatch between demand and wind output, and the seasonal mismatch between high summer demand and low summer wind output." [32]

According to the MIT report, an extra 4,000 megawatts of electricity transmission capacity needs to be built between Quebec and New England to enable New England to take full advantage of Quebec's hydro-electric reservoirs to balance its intermittent wind and solar generation.

This extra transmission capacity would permit New England to fully decarbonize its electricity grid and it would lower New England's and Quebec's costs of achieving a zero-emissions power system by 17 to 28%.[33]

It is reasonable to assume that Hydro Quebec's reservoirs are also the lowest-cost storage option for Ontario's wind and solar generation.[34]

The good news is that Hydro Quebec wants to expand its transmission links with Ontario and the U.S. northeast so that its hydro-electric reservoirs can provide load balancing for wind and solar power in Ontario, New York and New England.

> "To step up our exports and help decarbonize northeastern North America, we need to build new transmission infrastructure and promote the load balancing capability of our hydroelectric generating fleet as a means of supporting the growth of intermittent renewables such as wind and solar power." [35]
>
> - Hydro Quebec

Stopping Gas-Fired Electricity Exports

In 2019 Ontario exported approximately 3.4 billion kWh of gas-fired electricity.[36] This represents 35% of the total output of Ontario's gas plants in 2019. Ontario can reduce its greenhouse gas pollution by curtailing its exports of gas-fired electricity.

Ontario's 2030 Climate Target

The Government of Ontario has promised to reduce Ontario's greenhouse gas pollution by 30% by 2030 relative to the 2005 level. But according to the Ontario's Auditor General, the province does not have a plan that will achieve even this modest goal. Specifically, according to the Auditor General, Ontario needs to implement measures that will reduce Ontario's GHG pollution by an additional 7.3 to 14 million tonnes per year to meet its 2030 climate target.[37]

As Table 3 shows the forecast GHG pollution from Ontario's gas-fired power plants in 2030 is 10.9 to 12.2 million tonnes. Therefore, **a phase-out of Ontario's gas plants would provide our province with all or virtually all of the incremental GHG pollution reductions that it needs to achieve its 2030 climate target.**

Table 3: Historic and Forecast GHG Pollution and Electricity Generation from Ontario's Gas-Fired Power Plants[38]

Year	2017	2018	2019	2020	2025	2030	2040
GHG Pollution (Million Tonnes)	2.5	4.0	4.1	4.2	7.3 - 8.0	10.9 - 12.2	15.0 - 16.3
Electricity Generation (Billion kWh)	5.9	9.6	9.5	9.7	18.5 - 20.6	27.9 - 31.3	39.0 - 42.3

Phasing-Out Ontario's Gas-Fired Power Plants

Ontario can phase-out its gas plants and lower its electricity costs by aggressively pursuing all of our energy efficiency and renewable energy options that can keep our lights on at a lower cost than continuing to operate the Pickering Nuclear Station and re-building 10 of the Darlington and Bruce Nuclear Stations' aging reactors.

Therefore, we recommend that the Government of Ontario take the following actions to achieve: i) a complete gas plant phase-out by 2030; and ii) an interim 2.5 million tonne per year cap on the gas plants' GHG pollution as soon as possible.

1. **Direct the IESO to maximize its spot market purchases of Quebec water power before it dispatches gas-fired generation.**
2. **Direct the IESO to stop its spot market gas-fired electricity exports (except for emergency exports).**
3. **Direct the IESO to pay residential, commercial, institutional and industrial consumers up to the price of nuclear electricity (e.g., 9.6 cents per kWh in 2021) for each kWh they save by investing in energy efficiency.**
4. **Direct Hydro One to build a new 20 km transmission line in Ottawa, to increase our ability to import Quebec power by 17.5 billion kWh per year, at a cost of approximately $80 million.**
5. **Direct the IESO to seek to negotiate long-term electricity supply and storage (load balancing) contracts with Hydro Quebec to help phase-out our gas plants and to meet our electricity needs at a lower cost than re-building up to 10 nuclear reactors.**
6. **Put a moratorium on the re-building of our aging nuclear reactors while the IESO seeks to negotiate long-term electricity supply and storage contracts with Hydro Quebec.**
7. **Direct the IESO to purchase Made-in-Ontario wind and solar power that can keep our lights on at a cost that is less than the price of nuclear electricity (e.g., 9.6 cents per kWh in 2021).**

Endnotes

1 IESO, *Annual Planning Outlook*, (January 2020), page 32 and *Annual Planning Outlook: Ontario's electricity system needs: 2022-2040*, (December 2020), page 68.
2 *Annual Planning Outlook,* (December 2020), pages 14 and 16.
3 *Annual Planning Outlook,* (December 2020), page 29.
4 *Annual Planning Outlook*, (January 2020), page 21.
5 *Annual Planning Outlook*, (January 2020), page 21.
6 *Annual Planning Outlook*, (January 2020), page 11; and *Ontario's Long-Term Energy Plan 2017*, pages 45 & 46.
7 Government of Ontario, Newsroom, "Premier Ford, Premier Higgs and Premier Moe Sign Agreement on the Development of Small Modular Reactors", (December 1, 2019).
8 Hydro One's forecast cost of this upgrade is $21.3 million. Email to Jack Gibbons from Leonard Kula, Chief Operating Officer, IESO, (February 14, 2019); and Ontario Energy Board Docket No. EB-2020-0265, Exhibit B, Tab 1, Schedule 1, pages 3 and 4.
9 https://www.ieso.ca/en/Corporate-IESO/Ministerial-Directives/2021-2024-Conservation-and-Demand-Management-Framework
10 International Energy Agency, *Renewables 2020: Analysis and forecast to 2025,* page 12.
11 Bloomberg New Energy Finance, *New Energy Outlook 2019: Executive Summary*.
12 Navigant Consulting Ltd., *2019 Integrated Ontario Electricity and Natural Gas Achievable Potential Study*, (September 13, 2019), page v.
13 Financial Accountability Office of Ontario, *Electricity Trade Agreement: An Assessment of the Ontario-Quebec Electricity Trade Agreement*, (Spring 2018), page 4.
14 IESO, *IESO Response to Questions from the Ontario Clean Air Alliance*, (November 2014).
15 Email to Jack Gibbons from David Barrett, Supervisor, Customer Relations, Independent Electricity System Operator, (January 22, 2021).
16 According to the IESO report, the 350 km transmission line option could cost up to $1.4 billion, we have estimated the cost of the other two transmission options by assuming that their costs per km would be the same as the 350 km option. IESO, *Ontario-Quebec Interconnection Capability: A Technical Review*, (May 2017), pages 24 to 27.
17 IESO, *Ontario-Quebec Interconnection Capability: A Technical Review*, (May 2017), pages 25 to 27.
18 IESO, *Ontario-Quebec Interconnection Capability: A Technical Review*, (May 2017), page 10.
19 Hydro Quebec, *Annual Report 2019*, page 97.
20 Jean-Thomas Bernard & Jean-Yves Duclos, *Quebec's Green Future: The Lowest-Cost Route to Greenhouse Gas Reductions*, C.D. Howe Institute Backgrounder No. 118, (October 2009), page 2.
21 Chaire de gestion du secteur de l'energie, HEC Montreal, *2016 Etat De L'Energie Au Quebec*, page 28.
22 Equiterre and Ontario Clean Air Alliance Research, *Higher Profits and Lower Bills: A New Electricity Strategy for Hydro Quebec*, (July 14, 2010), pages 2 and 3; and Hydro Quebec, *Press Release,* "Calls for tenders for the purchase of 450 MW of wind power: Hydro-Quebec Distribution accepts 3 bids totaling 446.4 MW", (December 16, 2014).
23 Quebec has the potential to produce 299 billion kWh of wind energy per year from sites that are within 25 km of Hydro Quebec's existing transmission lines. In 2014 Hydro Quebec contracted for wind energy at an average cost of 6.3 cents per kWh. Since 2014, due to technological improvements, the cost of wind energy has fallen significantly and in 2019 Bloomberg New Energy Finance forecast that the cost of wind power will fall by an additional 48% by 2050. See: Helimax Energie Inc., *Etude Sur L'Evaluation Du Potential Eolien, De Son Prix De Revient Et Des Retombees Economiques Pouvant En Decouler Au Quebec*, (2004), page vi; Hydro Quebec, *Press Release*, "Calls for tenders for the purchase of 450 MW of wind power: Hydro Quebec Distribution accepts 3 bids totalling 446.4 MW", (December 16, 2014); and Bloomberg New Energy Finance, *New Energy Outlook 2019: Executive Summary*.
24 Taylor McKenna, "Don't overlook Ontario's nuclear advantage", *Hamilton Spectator*, (February 6, 2020).
25 Pierre-Olivier Pineau, Professor, HEC Montreal, "Can Ontario and Quebec benefit from more electricity market integration? A long-term perspective", Power Point Presentation for York University Conference, January 9, 2015.
26 Hydro Quebec, *Annual Report 2019*, page 11.
27 Ontario Energy Board Docket No. EB-2013-0321, Undertaking J14.3.
28 Cornwall Electric's residential rate schedule is posted on the CornwallElectric.com web site. We used the OEB.ca bill calculator to calculate the typical residential bills in Hamilton and Toronto.

29 The August 2003 blackout began on August 14th at 4:11 p.m. Ontario's power emergency did not end until 8 p.m. on August 22nd. Independent Electricity Market Operator, *Participant News*, "IMO Says Ontario Residents Deserve Special Thanks", (August 22, 2003); and Ontario Ministry of Energy, *August 14, 2003 Outage Report*.

30 Helimax Energy Inc., *Analysis of Future Offshore Wind Farm Development in Ontario*, (April 2008), pages iii, 18 & 19.

31 In 2019 Ontario consumed 135.1 billion kWh. See IESO, *News Release*, "2019 Year in Review", (January 30, 2020).

32 Emil Dimanchev, Joshua Hodge and John Parsons, *Two-Way Trade in Green Electrons: Deep Decarbonization of the Northeastern U.S. and the Role of Canadian Hydropower*, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research, (February 2020), page 53.

33 *Two-Way Trade in Green Electrons: Deep Decarbonization of the Northeastern U.S. and the Role of Canadian Hydropower*, page 1.

34 Paul Burke, *Post-Pickering Technical Discussion Paper,* Pollution Probe, (January 2020), pages 17 and 18.

35 Hydro Quebec, *Annual Report 2019*, page 31.

36 https://www.cleanairalliance.org/wp-content/uploads/2020/04/OCAA-2019-GFG-Export-Est-Apr-2020-v4.pdf

37 Auditor General of Ontario, *Climate Change: Ontario's Plan to Reduce Greenhouse Gas Emissions*, (2019), page 123.

38 Email to Jack Gibbons from David Barrett, Supervisor, Customer Relations, IESO, (February 6, 2020); https://www.ieso.ca/en/corporate-ieso/media/year-end-data; and https://www.ieso.ca/en/Sector-Participants/Planning-and-Forecasting/Annual-Planning-Outlook.

Figure 2 notes

Energy efficiency: In 2017 the Independent Electricity System Operator's (IESO) average levelized unit energy cost (LUEC) of procuring a kWh of electricity savings was 1.69 cents. Independent Electricity System Operator, 2017, *Report on Energy-Efficiency Activities,* page 8.

Quebec water power – spot market price: In 2017 the average price of Ontario's spot market electricity purchases from Quebec was 2.2 cents per kWh. Financial Accountability Office of Ontario, *Electricity Trade Agreement: An Assessment of the Ontario-Quebec Electricity Trade Agreement*, (Spring 2018), page 7.

Quebec water power – firm contract: On June 22, 2017 Hydro Quebec offered to sell Ontario 8 billion kWh per year, for 20 years, at a price of 6.12 cents per kWh. In August 2017 Hydro Quebec lowered its proposed price to 5 cents per kWh, but the Government of Ontario still refused to accept the offer. Letter from Steve Demers, Vice President, Hydro Quebec to Peter Gregg, CEO, Independent Electricity System Operator, (June 22, 2017); and Pierre Couture, "Hydro Quebec l'Ontario en ligne de mire", *Journal de Montreal,* (August 16, 2017).

In 2017 the average price of Hydro Quebec's short and long-term electricity exports was 4.7 cents per kWh. Hydro Quebec, *Annual Report* 2017, page 76.

Utility Scale Solar: According to Lazard, the cost of utility scale solar PV is 2.9 to 4.2 cents per kWh (US $). We have converted these costs to Canadian dollars by multiplying them by 1.3. Lazard, *Lazard's Levelized Cost of Energy Analysis – Version 14.0* (October 2020) page 2.

Onshore Wind: According to Lazard, the cost of onshore wind is 2.6 to 5.4 cents per kWh (US $). We have converted these costs to Canadian dollars by multiplying them by 1.3. Lazard, *Lazard's Levelized Cost of Energy Analysis – Version 14.0* (October 2020) page 2.

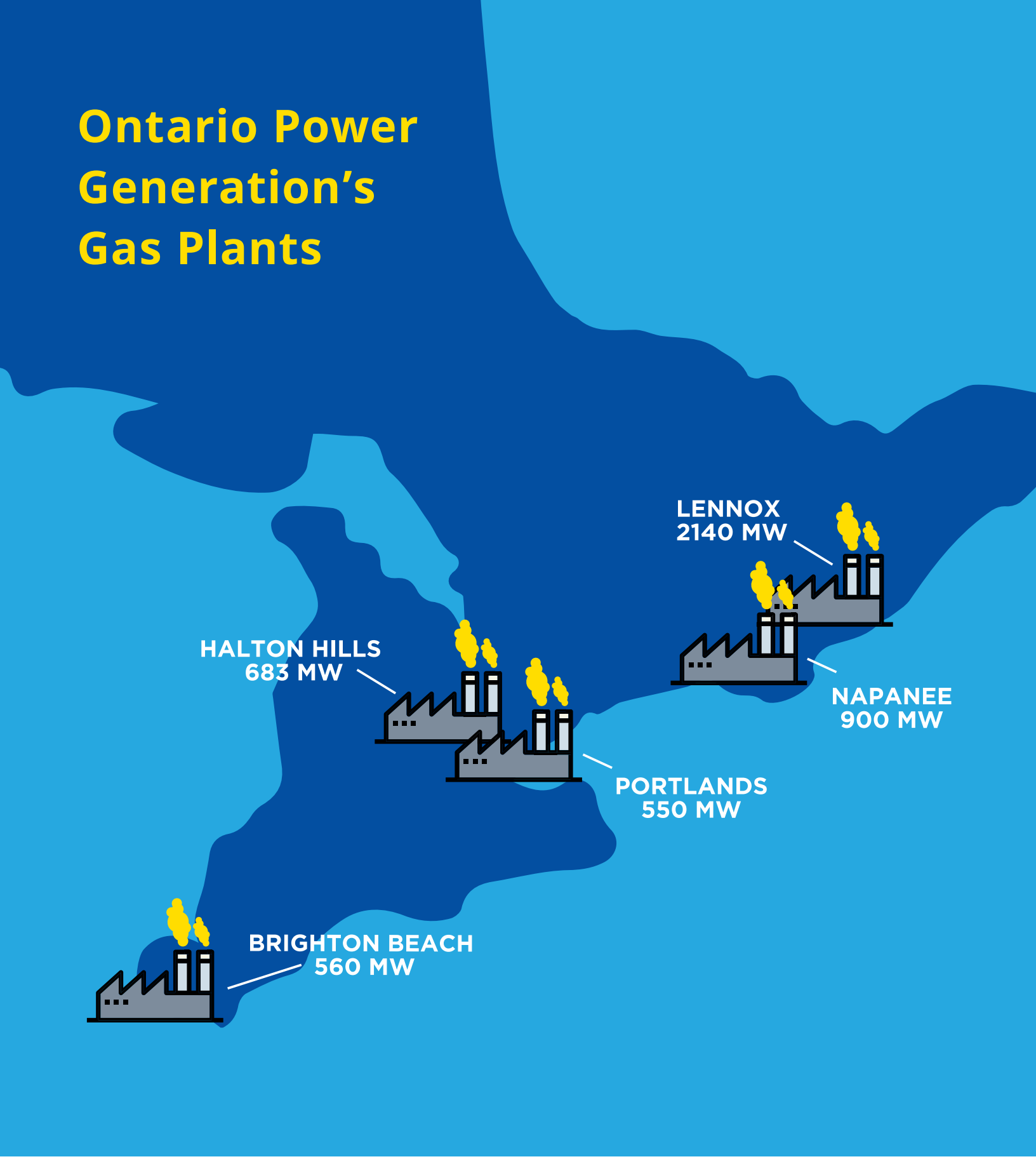
OPG's Price of Nuclear Power in 2021: Ontario Energy Board Docket No. EB-2020-0290, Exhibit I1, Tab 1, Schedule 2, Table 2.

Offshore Wind: According to Lazard, the cost of offshore wind is 8.6 cents per kWh (US $). We have converted this cost to Canadian dollars by multiplying it by 1.3. Lazard, *Lazard's Levelized Cost of Energy Analysis – Version 14.0* (October 2020) page 2.

OPG's Price of Nuclear Power in 2026: Ontario Energy Board Docket No. EB-2020-0290, Exhibit I1, Tab 1, Schedule 2, Table 2.

Proposed New GTA Nuclear Reactor: Ontario Power Generation (OPG) is proposing to build a small modular reactor (SMR) near Oshawa. The Canadian nuclear industry is forecasting that the cost of electricity from a SMR will be 16.3 cents per kWh; however they note that if there is a 3% capital cost overrun the cost will rise to 21.5 cents per kWh. They are hoping that the first commercial SMR will be in-service by 2030. Canadian Small Modular Reactor Roadmap Steering Committee (2018), *A Call to Action: A Canadian Roadmap for Small Modular Reactors,* pages 35 and 54.

Ontario Power Generation's Gas Plants



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