CAN ONTARIO MEET ITS BASELOAD POWER NEEDS WITH QUEBEC IMPORTS?

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INTRODUCTION

With the decommissioning of the Pickering Nuclear Generating Station (PNGS) 3,000 MW of baseload power will be removed from Ontario's electricity grid by the middle of this decade. When combined with the expected increase in electricity demand as the province moves toward further electrification, Ontario will soon be faced with making a choice: Either install new low-GHG emitting baseload power, or increase its reliance on CO_2-emitting natural gas to meet its power needs.

Some advocates argue that Ontario can meet its future baseload power needs by expanding the electricity interties with Quebec and entering into a long-term agreement to import firm baseload hydroelectric power from Hydro Quebec. Ontario currently has import capacity on seven intertie lines with Quebec. The primary tielines are the 1,250 MW Outaouais HVDC tieline, and the 800 MW Beauharnois line. The current intertie system plays a critical role in displacing carbon emitting natural gas with clean hydroelectric power during periods of peak demand in Ontario, and is designed to take advantage of Ontario and Quebec's complementary electricity needs. Ontario generally experiences peak electricity demand during the summer while Quebec's demand is generally greatest in winter. Ontario is a net importer of electricity from Quebec during the summer months, and a net exporter to Quebec during the winter.

Baseload Power: *The minimum amount of electricity needed to be supplied to the electrical grid over a given period, at a constant rate. Baseload power must be supplied by constant and reliable sources of electricity.*

Peaking Power: *Electricity required by the grid when demand exceeds the baseload supply. Common peaking periods might include hot summerw days when air conditioners are used. Peaking power supply is dispatchable, meaning they can be turned on or off and their output can be changed relatively quickly.*

Source: energyeducation.ca

As electricity imports from Quebec do provide an important source of carbon-free electricity during Ontario's peak periods, there may be value in expanding interties to provide additional import capacity to displace gas generation. However, for the reasons outlined below, even with expanded interties, relying on Quebec electricity imports is not a feasible option to meet Ontario's baseload power needs.

IT'S NOT THAT SIMPLE

Unfortunately, importing firm baseload power from Quebec is not as simple as signing a contract and flipping a switch. As a result of bottlenecks in Ontario's transmission system, pressures on Quebec's power supply and Ontario's ongoing reliance on Quebec for summer peak power, there are multiple reasons that imports are not the simple solution they may seem.

Transmission Congestion

Replacing the 3,000 MW of baseload power that Ontario's electricity grid will lose with the decommissioning of PNGS is more complicated than simply finding an additional 3,000 MW of new generation. Ontario must also consider how the province's electricity transmission system is designed. PNGS provides the Greater Toronto Area with approximately 25% of its peak electricity demand[1], and the transmission system infrastructure is designed to bring power from Pickering to distributors in the Greater Toronto Area.

Generation: *The conversion of an energy source into an electrical current to be transmitted through the electrical grid. Ontario Power Generation operates the majority of generating stations that produce electricity to be transmitted to distributors.*

Transmission: *The process of delivering generated electricity from generating stations to distributors. Hydro One operates most of the transmission lines that deliver electricity from generators to distributors.*

Distribution: *The final stage of the electricity grid which delivers electricity to residential, commercial, and industrial users. Local distribution companies like Toronto Hydro deliver electricity to our homes.*

[1] https://www.hydroone.com/abouthydroone/CorporateInformation/majorprojects/claringtonts/Documents/Clarington%20TS%20Panels.pdf

Increasing power imports from Quebec requires more than simply expanding the interties. In addition to the interties, Ontario's electricity transmission system would require significant upgrades to its physical infrastructure. The Independent Electricity System Operator (IESO) estimates that some of these projects would require lead times of up to 10 years[2].

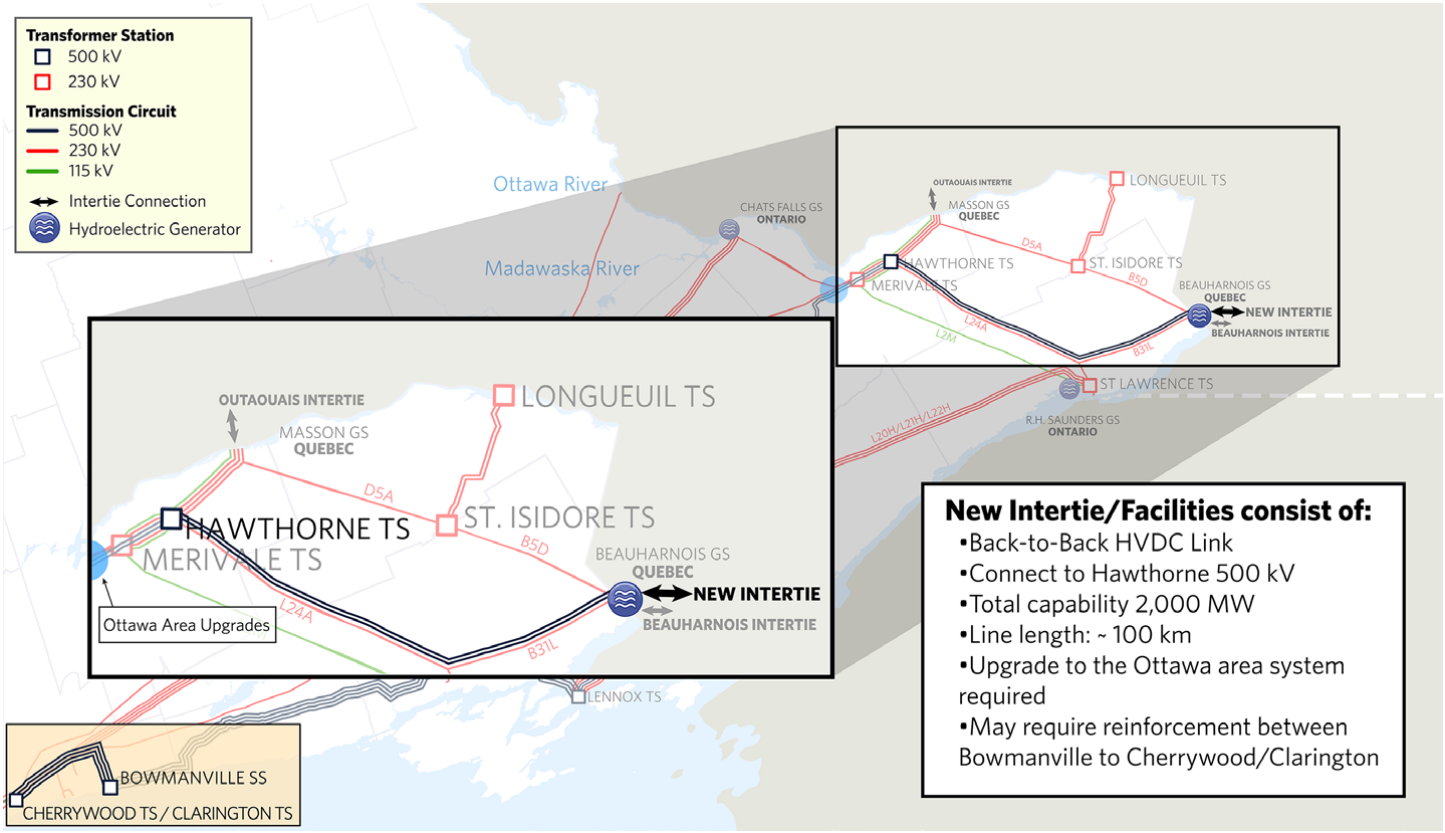
This is one of the issues raised by a recent technical review by the IESO, which looked at options for expanding the Ontario-Quebec electricity interties. The IESO identified scenarios where new 2,000 MW capacity interties could be built for firm imports at either Beauharnois or Outaouais. Both scenarios would require additional transmission capacity. The IESO also suggested that as the level of imports from Quebec increases, in conjunction with output from the Darlington generating station, supply to the GTA from the east, upgrades to the transmission capacity between Bowmanville and Clarington may also be required[3]. These upgrades are in addition to the transmission upgrades necessary in the Ottawa region, which would be necessary to build new interties at either Outaouais or Beauharnois.

According to the IESO, "the estimated cost for these system expansion options is as high as $1.4 billion, including the cost of the new tieline, as well as required upgrades to the eastern Ontario transmission system"[4].

In one scenario presented by the IESO, in order to accommodate a 2,000 MW intertie for firm power imports at Beauharnois, 100 km of 500 kV transmission would be required to connect to the Hawthorne Transmission Station.

This scenario would require upgrades to the Ottawa-area transmission system, and may require reinforcement between Bowmanville and Clarington.

These upgrades do not include the additional requirements in Quebec.



Source: IESO

[2] IESO, Ontario-Quebec Interconnection Capability: A Technical Review, May 2017
[3] Ibid
[4] Ibid

Quebec May Not Have the Power

Generation capacity at Hydro Quebec may also be an issue that would limit the feasibility of importing firm baseload power from Quebec. The IESO review references a Hydro Quebec report which notes that the Quebec utility has identified a need for up to 1,500 additional MW of winter peaking electricity by 2023, concluding that "to be able to supply Ontario with firm *year-round capacity*, it is expected that [Hydro Quebec] would need to build resources above what they have for internal capacity needs[5]" [emphasis added]. In short, Hydro Quebec likely does not have the surplus power necessary to provide Ontario with year-round baseload imports.

These concerns predate Quebec's ambitious, recently announced, 2030 Plan for a Green Economy. The plan calls for significant investments in electrification of the province's transportation sector, setting targets of 1.5 million battery electric vehicles by 2030, banning the sale of internal combustion vehicles by 2035, electrifying urban public transit and school buses and installing 7,000 new EV charging stations, among other initiatives. Increased internal demand for electricity within Quebec will further reduce available export capacity over the next decade.

Robbing Peter to Pay Paul (or Robbing Peak to Pay Baseload)

Finally, any shift towards firm baseload imports from Quebec would have to be in addition to the 2.3 TWh currently imported as flexible energy imports through the existing tielines. As mentioned, the current import agreement with Quebec is an important component of Ontario's electricity grid If the power generation and transmission interties currently used for peak offset are used instead for firm baseload import, Ontario would need to find a replacement for the lost peaking power, which means burning more natural gas for peak generation.

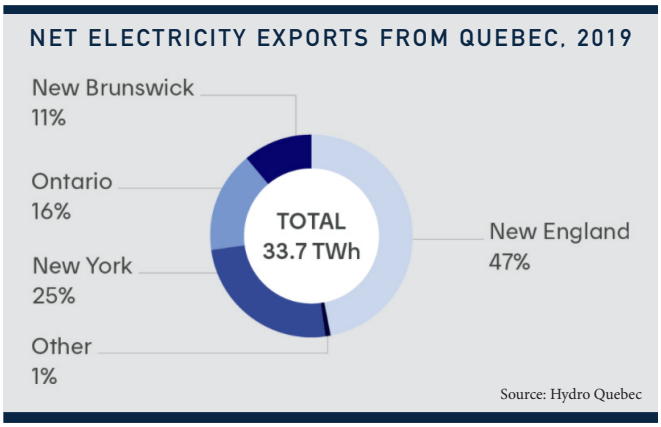
IT'S POOR CLIMATE POLICY

Ontarians have made great progress in the last two decades removing carbon emissions from the province's electricity grid. The transition away from coal generation was an expensive one, but it was an important step towards reducing Ontario's carbon emissions. Ontario now generates 94% of its electricity from GHG emission-free sources, with only 6% of electricity generated by natural gas.

However, the decommissioning of the Pickering Nuclear Generating Station, combined with projected increases in electricity demand, has led the IESO to project that natural gas generation, and GHG emissions from the electricity grid, will more than double in the next twenty years.

Ontario needs to replace the emissions-free power generation it is losing when PNGS shuts down, and it cannot rely on natural gas if it is to avoid undoing the progress made to decarbonize the grid since the decommissioning of coal power. However, if the goal is to combat climate change, relying on baseload imports from Quebec is not a reasonable option. As mentioned earlier, even if it were feasible to expand the transmission system to accommodate new baseload imports, the province would no longer be able to rely on imports to offset natural gas generation during peak periods. The net result remains the same: an increased reliance on natural gas.

It is also worth noting that Quebec's power supply and export capacity is finite. In 2019, Quebec was a net-exporter of 33.7 TWh of power, with almost half of the exported power going to New England (a regional operator comprised of several states in the north eastern United States) and the rest being exported to neighbouring jurisdictions in New Brunswick, Ontario and New York.

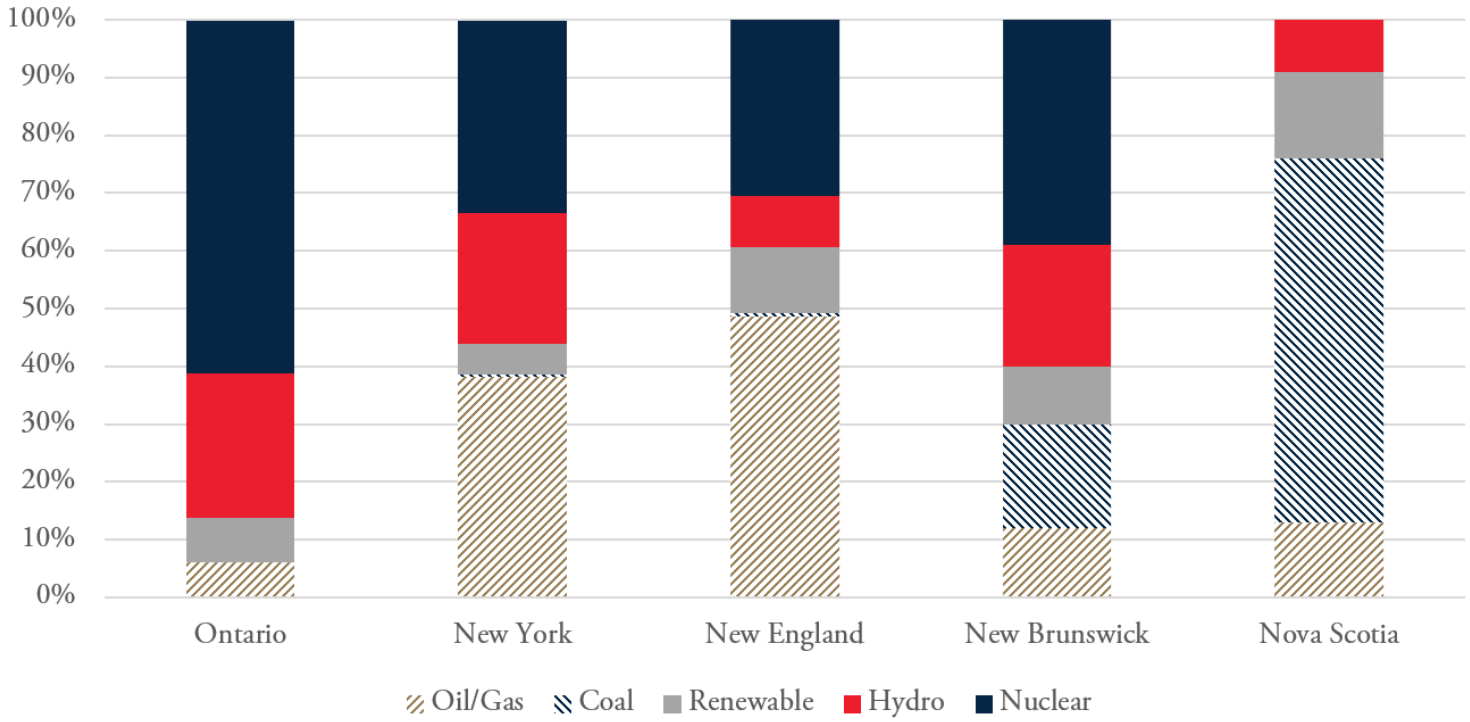


[5] Ibid

Increasing exports to Ontario means less electricity that can be exported to other jurisdictions. From a global climate perspective, that means less emission-free hydroelectricity that can be used to displace GHG emitting generation in far more carbon-intensive electricity grids, such as those in the United States.

If the goal is to reduce carbon emissions, it is far better to export Quebec's surplus electricity to neighbouring jurisdictions that are still more reliant on GHG emitting fuel sources, such as those using coal to power their grid.

ELECTRICITY GENERATION BY FUEL SOURCE IN QUEBEC'S NEIGHBOURING JURISDICTIONS



From a pan-Canadian perspective, investing in intertie capacity from Quebec to New Brunswick to help displace coal generation from the New Brunswick power grid, or investing in the even more ambitious Atlantic Loop project to connect Nova Scotia, which still relies on coal for 63% of its electricity generation, would be a more worthwhile step in helping Canada meet its national climate targets.

As an example, New Brunswick's electricity grid emits approximately 300 tonnes of CO_2e for every GWh of electricity generated. Nova Scotia, which relies primarily on coal generation, emits approximately 677 tonnes of CO_2e per GWh generated. By comparison, Ontario's grid emits only 13 tonnes of CO_2e for every GWh of electricity generated[6].

IT COSTS MORE

Finally, the cost of electricity continues to be a major concern for Ontarians. Far from being a way to reduce energy costs, importing Quebec hydro is one of the most expensive options for increasing Ontario's electricity supply.

A report by the Financial Accountability Office of Ontario compared the Levelized Unit Electricity Cost (LUEC) of different options to build new electricity

Levelized Unit Electricity Cost: *Measures the lifetime cost of energy production by calculating the present value of the total cost of building and operating a power plant over an assumed lifetime. The LUEC allows for the comparison of different technologies of unequal life spans, project size, capital cost, risk, return, and capacities.*

Source: U.S. Department of Energy

[6] https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/index.html

generation capacity in Ontario. In comparing the options for new capacity, the FAO showed that the LUEC of firm imports from Quebec was among the most expensive options for new capacity, at a cost of $160/MWh for large scale (up to 3,300 MW) firm imports[7]. The FAO report states that the "high cost of imports stems mainly from three factors: competition from US markets, lack of transmission capacity, and a projected reduction of surplus electricity in Quebec in the future.[8]"

While the lowest cost option for new capacity is natural gas, the FAO points out that the price can rise significantly in the future depending on future decisions regarding carbon pricing.

Of the non-GHG emission sources of new electricity capacity, the most cost-effective options are the planned refurbishments of Darlington and Bruce nuclear generating stations.

According to the FAO estimates, the lowest priced option to generate new baseload capacity is a large new nuclear generating station, which is 25% less expensive than large scale firm imports from Quebec.

It should be noted that the FAO report does not consider the LUEC of new Small Modular Reactor (SMR) nuclear generation. SMRs are much smaller than traditional CANDU reactors. SMRs are manufactured in a plant and then assembled on site, lowering the cost of constructing a new generating station. While the technology is still being developed, there is reason to be optimistic that SMRs will also be a viable and affordable option for new capacity.

RESOURCE	LUEC (2016 $/MWh)
NUCLEAR GENERATION	
Large new nuclear	$120
Refurbished nuclear: Darlington	$82
Refurbished nuclear: average Bruce Contract Price	$78
NATURAL GAS GENERATION	
Baseload Natural Gas (CCGT)	$60-110
RENEWABLE GENERATION	
Hydro	$140
Wind	$86
Solar (photovoltaic)	$140-290
Bioenergy	$164
IMPORTS	
Firm imports (<1,250 MW)	$120
Firm imports (up to 3,300 MW)	$160

Source: Financial Accountability Office of Ontario

CONCLUSION

Ontario will lose 3,000 MW of baseload power when PNGS is decommissioned. Unfortunately, talk of replacing that power with new Quebec imports is little more than wishful thinking. In reality, even if Quebec were to have year-round surplus energy to sell, it would be far more costly to import additional power from Quebec than other carbon-free options because it would necessitate significant upgrades to Ontario's transmission system that could take a decade to build. Additionally, it would divert clean power away from other jurisdictions that have a greater need to displace their carbon-emitting fuel sources than Ontario. It is not good energy policy or economic policy for Ontario, and is not the optimal climate policy if the goal is to reduce broader greenhouse gas emissions beyond Ontario's provincial borders.

[7] https://www.fao-on.org/en/Blog/Publications/FAO-NR-Report-Nov-2017
[8] Ibid



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