



Financial
Accountability
Office of Ontario

ELECTRICITY TRADE AGREEMENT

An Assessment of the Ontario-Quebec Electricity
Trade Agreement

Spring 2018

About this Document

Established by the *Financial Accountability Officer Act, 2013*, the Financial Accountability Office (FAO) provides independent analysis on the state of the Province's finances, trends in the provincial economy and related matters important to the Legislative Assembly of Ontario.

The FAO produces independent analysis on the initiative of the Financial Accountability Officer. Upon request from a member or committee of the Assembly, the Officer may also direct the FAO to undertake research to estimate the financial costs or financial benefits to the Province of any bill or proposal under the jurisdiction of the legislature.

This report was prepared at the direction of the Officer in response to a request from a member of the Assembly. In keeping with the FAO's mandate to provide the Legislative Assembly of Ontario with independent economic and financial analysis, this report makes no policy recommendations.

This analysis was prepared by Matt Gurnham under the direction of Jeffrey Novak. External reviewers were provided with earlier drafts of this report for their comments. However, the input of external reviewers implies no responsibility for this final report, which rests solely with the FAO.



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Table of Abbreviations

Abbreviation	Long Form
EIA	Energy Information Administration
ETA	Electricity Trade Agreement
GHG	Greenhouse gas
HOEP	Hourly Ontario Energy Price
HQ	Hydro-Quebec
IESO	Independent Electricity System Operator
MMBtu	One million British Thermal Units
Mt	Megatonne
MW	Megawatt
MWh	Megawatt Hour
OEB	Ontario Energy Board
TWh	Terawatt Hour

1 | Essential Points

In 2016, Ontario and Quebec executed a series of agreements (collectively, the Electricity Trade Agreement or ETA) to facilitate electricity trade between the two provinces. The Government of Ontario's (the Province's) rationale for entering into the ETA is to promote imports from Quebec to displace domestic natural gas generation, reduce greenhouse gas (GHG) emissions and provide savings to Ontario ratepayers.

This report provides a financial assessment of the effect of the ETA on Ontario ratepayers and reviews the impact of the ETA on Ontario-based natural gas generation and electricity sector GHG emissions.

Impact of the ETA on Ontario Ratepayers

- The FAO estimates that the ETA will lower the cost of electricity paid by Ontario ratepayers by a net total of \$38 million from 2017 to 2023.

Breakdown of the ETA's total financial impact on Ontario ratepayers

ETA Component	Value to Ratepayers
Electricity Purchases	Cost of \$187 million
Electricity Cycling	Savings of \$99 million
Capacity Sales	Savings of \$126 million
Total	Savings of \$38 million

Note: the FAO estimates the net present value (NPV) in 2017 dollars of the total savings to be \$32 million.
Source: FAO.

The Electricity Trade Agreement consists of the following three components:

Electricity Purchases

- The electricity purchases component of the ETA provides Ontario with a firm arrangement to purchase 2 TWh of electricity annually from Quebec from 2017 to 2023 (14 TWh total) at a set contract price.

- The FAO estimates that Ontario ratepayers will pay \$187 million more to import the electricity from Quebec under the ETA compared to either generating the electricity domestically or importing the electricity absent the ETA.

Electricity Cycling

- The electricity cycling component of the ETA allows Ontario to export electricity to Quebec when demand and prices in Ontario are low and to import, or "recall," electricity when demand and prices in Ontario are high. There is no monetary exchange for the cycling of electricity.
- The FAO estimates that electricity cycling will secure a total of 2.1 TWh of imports from Quebec from 2017 to 2023 and will save ratepayers \$99 million.

Capacity Sales

- Under the capacity sales component of the ETA, Ontario will provide 500 MW of excess winter generating capacity to Quebec each year from 2016-17 to 2022-23. Quebec will make monthly payments to Ontario for the capacity, which the FAO estimates will result in incremental savings to ratepayers of \$126 million.

Overall Value to Ratepayers

- Overall, the FAO estimates that the three components of the ETA will provide Ontario ratepayers with a net total of \$38 million in savings from 2017 to 2023. The Independent Electricity System Operator (IESO) has indicated to the FAO that the ETA was negotiated as a bundled agreement and the individual components of the ETA could not have been executed independently. Given this assumption, the above-market cost of the electricity purchases component of the ETA appears to be reasonable because it is more than off-set by savings from the electricity cycling and capacity sales components of the ETA.

Impact of the ETA on Natural Gas Generation and Electricity Sector Emissions

- The ETA will result in Quebec imports continuing to displace 2.3 TWh each year of natural gas generation and reducing GHG emissions by 0.92 Mt of carbon dioxide equivalent annually. However, based on the FAO's review, the imports secured by the ETA will not be incremental to what Ontario was already purchasing from Quebec in the open market.
- Although the ETA will not increase the amount of imports from Quebec above current levels, the ETA may reduce the risk that imports from Quebec will decline in the future. Quebec is projecting surpluses of electricity throughout the term of the ETA but Quebec is also pursuing large bi-lateral electricity trading agreements which could reduce that surplus. However, the Province's implementation of carbon pricing via the cap and trade program may also address the risk that imports from Quebec could decline in the future. Carbon pricing will increase the cost of natural gas generation in Ontario and will provide an added incentive for imports from Quebec to displace natural gas by offering Quebec higher prices in the future for its exports.

2 | Background

The Ontario and Quebec electricity transmission grids are connected at six interties¹ which allow for the exchange of electricity between the two provinces. In 2017, Ontario imported 4.2 TWh of electricity from Quebec, enough to supply approximately 460,000 households.²

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.

On November 25, 2016, the province of Ontario, represented by the Independent Electricity System Operator (IESO) and the province of Quebec, represented by Hydro-Quebec (HQ), executed a series of agreements (collectively, the Electricity Trade Agreement or ETA) to facilitate electricity trade between the two provinces. There are three key components to the Electricity Trade Agreement.

Electricity Purchases

- For each year, beginning January 1, 2017 and ending December 31, 2023, IESO is entitled to purchase 2,000,000 MWh (2 TWh) of electricity from Quebec. IESO will pay a set contract price for the electricity.³

Electricity Cycling

- For each year, beginning January 1, 2017 and ending December 31, 2023, IESO will export, or "cycle," up to a contracted amount of electricity to Hydro-Quebec.⁴ In return, the FAO estimates that IESO will be able to import, or

¹ An interconnection permitting passage of current between two or more electric utility systems.

² Total imports were 5.8 TWh, of which only 4.2 TWh were used domestically.

³ The FAO cannot disclose the contract price due to disclosure restrictions under s. 13 of the *Financial Accountability Officer Act, 2013*.

⁴ The FAO cannot disclose the contracted cycling volume due to disclosure restrictions under s. 13 of the *Financial Accountability Officer Act, 2013*.

"recall," up to 0.3 TWh per year.⁵ There is no monetary exchange for the cycling of electricity.

Capacity Sales

- For each winter period from 2016-17 to 2022-23 (defined as December 1 to March 31), Ontario will provide Quebec with 500 MW of generating capacity. HQ will make monthly payments to IESO for the capacity.⁶

The Province's rationale for entering into the ETA is to promote imports from Quebec to displace domestic natural gas generation, reduce greenhouse gas (GHG) emissions and provide savings to Ontario ratepayers.⁷

The purpose of this report is to:

- outline and explain the elements of the Electricity Trade Agreement;
- analyze the financial impact of the ETA on Ontario ratepayers; and
- analyze the effect of the ETA on electricity generation in Ontario and the Province's electricity sector GHG emissions targets.

Appendix D provides more information on the development of this report.

⁵ IESO. "Ontario-Quebec Interconnection Capability: A Technical Review." May 2017. The 0.3 TWh of cycled electricity is calculated as the difference between the IESO's estimation of the total electricity secured by the ETA of 2.3 TWh less the 2 TWh of imports secured under the electricity purchases component of the ETA.

⁶ The FAO cannot disclose the value of the capacity payments due to disclosure restrictions under s. 13 of the *Financial Accountability Officer Act, 2013*.

⁷ Ontario Newsroom. "Sale and Trade of Electric Power: Quebec and Ontario Sign Historic Economic Partnership." 15 Dec. 2016.

3 | Analysis of the Electricity Trade Agreement

The FAO estimates that the ETA will lower the cost of electricity paid by Ontario ratepayers by a net total of \$38 million from 2017 to 2023, made up of the following components:

- Electricity purchases will result in Ontario ratepayers paying higher than market prices to import 14 TWh of electricity from Quebec, which will increase the cost of electricity by a total of \$187 million.
- Electricity cycling will off-set the cost of generating 2.1 TWh of electricity, which will save ratepayers \$99 million.
- Capacity sales will generate \$126 million of incremental savings for ratepayers.

Breakdown of the ETA's total financial impact on Ontario ratepayers

ETA Component	Value to Ratepayers
Electricity Purchases	Cost of \$187 million
Electricity Cycling	Savings of \$99 million
Capacity Sales	Savings of \$126 million
Total	Savings of \$38 million

Note: the FAO estimates the net present value (NPV) in 2017 dollars of the total savings to be \$32 million.
Source: FAO.

Ontario ratepayers pay approximately \$20 billion annually for electricity,⁸ therefore, savings of \$38 million over seven years will have a very minor effect on electricity bills.

The Province had estimated that the ETA would provide Ontario ratepayers with \$70 million of savings from 2017 to 2023.⁹ The Province's estimate is not materially different from the FAO's estimate.

The following sections provide additional detail on each of the ETA's components.

⁸ IESO. "2016 Ontario Planning Outlook." Sept. 2016.

⁹ Ontario Newsroom. "Sale and Trade of Electric Power: Quebec and Ontario Sign Historic Economic Partnership." 15 Dec. 2016.

Electricity Purchases

The electricity purchases component of the ETA provides Ontario with a firm arrangement to purchase 2 TWh of electricity annually from Quebec from 2017 to 2023 (14 TWh total) at a set contract price.¹⁰ The imports into Ontario are targeted to occur when Ontario electricity demand is high in order to replace some of the generation from high GHG emitting Ontario-based natural gas plants.

The FAO estimates that from 2017 to 2023, Ontario ratepayers will pay \$187 million more to import the 14 TWh of electricity from Quebec under the ETA compared to either generating the electricity domestically or importing the electricity absent the ETA. Ontario ratepayers will pay more for electricity purchases under the ETA because the contract price that will be paid to Hydro-Quebec is forecast to be higher than the price of electricity in Ontario either through domestic generation or market imports.¹¹

Electricity Cycling

The electricity cycling component of the ETA allows IESO to deliver, or "cycle," up to a contracted amount of electricity to Quebec. In return, the FAO estimates that IESO will be able to import or "recall" up to 0.3 TWh in each year from 2017 to 2023 for a total of 2.1 TWh. This in effect allows Ontario to "store" electricity using Quebec's hydroelectric reservoirs.

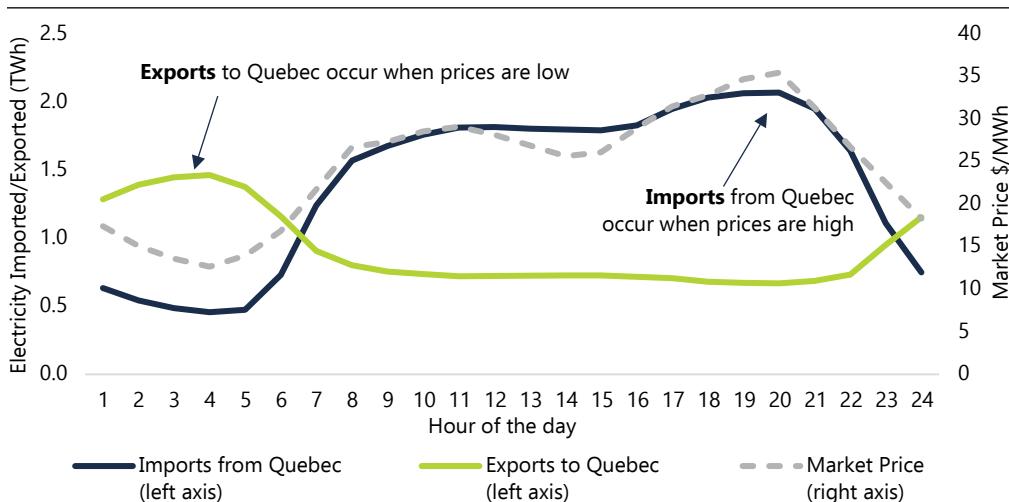
Currently, Quebec buys electricity from Ontario when demand and prices in Ontario are low and sells electricity back into the Ontario market when demand and prices are high. In 2017, Quebec purchased 2.0 TWh of electricity from Ontario at an average price of \$9.4/MWh and sold 5.8 TWh of electricity into the Ontario market at an average price of \$21.5/MWh.¹² The electricity cycling component allows IESO to cycle and recall a minor portion of the electricity currently being exchanged with Quebec at no cost. Without the ETA, Quebec would earn a profit on the same transactions.

¹⁰ The FAO cannot disclose the contract price under s. 13 of the *Financial Accountability Officer Act, 2013*.

¹¹ See appendices A and B for further analysis.

¹² Only 4.2 TWh of the electricity was used domestically.

Ontario-Quebec imports/exports vs. market price (hourly average from 2010 to 2017)



Source: FAO analysis of IESO data.

IESO will target the cycling of electricity to Quebec when there is surplus baseload generation in the Ontario market. Surplus baseload generation occurs when Ontario market demand is lower than the baseload electricity supply of Ontario's nuclear, hydroelectric and wind generation.¹³ At those times, the market price¹⁴ of electricity is at its lowest. For reference, in 2016 the market price of electricity in Ontario was at or below zero 23 per cent of the time and Ontario exported 0.62 TWh to Quebec during that time.¹⁵ This means that in 2016 Ontario ratepayers paid generators contracted prices for 0.62 TWh of electricity that was sold to Quebec for \$0 or less.¹⁶

IESO will target the electricity to be recalled from Quebec when demand and prices are highest to displace natural gas generation. In 2016, the most expensive 0.3 TWh of imports occurred when the market price was above \$41/MWh.

Overall, the cycling component of the ETA will provide savings to ratepayers equal to the difference between the market price of the cycled and recalled electricity. The FAO estimates that the average difference in the market price of the cycled and recalled electricity will be \$47/MWh over the life of the agreement, which will provide ratepayers with \$99 million of savings.¹⁷

¹³ Baseload generators are designed and priced to constantly generate electricity.

¹⁴ Market price refers to the Hourly Ontario Energy Price (HOEP).

¹⁵ Calculations only apply to the Outaouais HVDC Intertie.

¹⁶ Appendix A explains the market price of electricity in Ontario in more detail.

¹⁷ See appendices A and B for further analysis.

Capacity Sales

The capacity sales component of the ETA is an amended version of a seasonal capacity sharing agreement that was entered into on May 8, 2015. Under the seasonal capacity sharing agreement, Ontario was obligated to provide Quebec with 500 MW of generating capacity in the winter of 2015-16 and 2016-17.¹⁸ In return, Ontario was entitled to receive 500 MW of summer capacity in any two years up to 2025.¹⁹

The ETA amended the 2015 agreement to a one-way sale of capacity from Ontario to Quebec. For each winter period (defined as December 1 to March 31) from 2016-17 to 2022-23, IESO will provide HQ with 500 MW of electricity generating capacity.²⁰ In return, HQ will make monthly capacity payments to IESO.²¹

The FAO estimates that amending the 2015 capacity sharing agreement to capacity sales in the ETA will provide \$126 million of incremental value to ratepayers. The capacity sales revenue will be used to off-set electricity costs that would otherwise be paid by Ontario ratepayers.

Overall Value to Ratepayers

In summary, the electricity purchases component of the ETA secures a total of 14.0 TWh of imports from Quebec from 2017 to 2023. The FAO estimates that ratepayers will pay \$187 million more for imports from Quebec under the electricity purchases component of the ETA compared to the cost of domestic generation or imports absent the ETA.

The electricity cycling component of the ETA secures 2.1 TWh of Quebec imports to displace natural gas generation which the FAO estimates will save Ontario ratepayers \$99 million. Combined, the electricity purchases and cycling components of the ETA secure a total of 16.1 TWh of Quebec imports from 2017 to 2023 or 1.6 per cent of estimated Ontario demand at a combined net cost of \$88 million.

The \$88 million net cost of securing 16.1 TWh of Quebec imports through the electricity purchases and cycling components of the ETA is more than off-set by the \$126 million of incremental savings generated from the capacity sales component of the ETA. Electricity demand fluctuates both daily and seasonally and Ontario needs to have sufficient generating capacity to meet peak demand. Ontario currently has

¹⁸ Ontario also had the option to provide winter capacity (and receive summer capacity) for up to two additional years.

¹⁹ IESO. "Summary of Capacity Sharing Agreement between Ontario and Quebec." 12 Nov. 2015.

²⁰ Ontario is also entitled to receive the return of one period of summer capacity prior to 2030 in exchange for capacity that was provided to Quebec in the winter of 2015-16.

²¹ The FAO cannot disclose the amount of the capacity payments due to disclosure restrictions under s. 13 of the *Financial Accountability Officer Act, 2013*. However, the FAO benchmarked the capacity payment against capacity payments made to Ontario natural gas generators and concluded that the payments are sufficient to recover the cost of the 500 MW of capacity paid by Ontario ratepayers.

slightly higher peak electricity demand in the summer months compared to the winter months, so the winter capacity sales to Quebec will generate revenue from Ontario's excess capacity which will offset some of the payments made by ratepayers to domestic generators that are underutilized in the winter.

Overall, the FAO estimates that the three components of the ETA will provide Ontario ratepayers with a net total of \$38 million in savings from 2017 to 2023. IESO has indicated to the FAO that the ETA was negotiated as a bundled agreement and the individual components of the ETA could not have been executed independently. Given this assumption, the above-market cost of the electricity purchases component of the ETA appears to be reasonable because it is more than off-set by savings from the electricity cycling and capacity sales components of the ETA.

4 | Impact of the ETA on Natural Gas Generation and GHG Emissions

One of the primary rationales for the ETA is to secure a firm contractual arrangement that ensures electricity imports from Quebec will displace a portion of Ontario-based natural gas generation and the associated GHG emissions. The FAO estimates that the ETA will result in Quebec imports continuing to displace 2.3 TWh each year of natural gas generation and reducing 0.92 Mt of GHG emissions annually.²² However, based on the FAO's review, the imports secured by the ETA will not be incremental to what Ontario was already purchasing from Quebec in the open market.

According to IESO, the 2.3 TWh of annual imports secured by the ETA will occur during "on peak" Ontario demand.²³ It is important to note that 2.3 TWh is the maximum amount of natural gas generation that can be displaced with imports from Quebec during "on peak" demand with Ontario's current transmission infrastructure.²⁴ In 2016, the year prior to entering into the ETA, the FAO estimates that Ontario already imported 2.2 TWh from Quebec during on peak demand. Therefore, the FAO estimates that the electricity purchases component of the ETA secures, at a higher price, a firm contract for electricity that Ontario was already importing from Quebec.

Since 2013 Ontario has already been importing most of the electricity secured by the ETA

Year	On Peak Imports (TWh)	Per cent of 2.3 TWh	Average Price (\$/MWh)
2013	1.4	62%	31
2014	1.5	67%	45
2015	1.7	76%	34
2016	2.2	96%	25

Note: "on peak" is defined as the 16 peak weekday hours in the winter and summer months and the five peak weekday hours in the spring and fall months. For a review of total annual imports from Quebec, see appendix C.

Source: FAO analysis of IESO Power Data.

²² Mt refers to megatonnes of carbon dioxide equivalent. The FAO estimates that Ontario natural gas plants have a 0.43 Mt/TWh emissions rate.

²³ The FAO defines "on peak" demand as the 16 peak weekday hours in the winter and summer months and the five peak weekday hours in the spring and fall months.

²⁴ IESO. "Ontario-Quebec Interconnection Capability: A Technical Review." May 2017. All imports will be transmitted across the Outaouais HVDC Intertie which has a capacity of 1,250 MW.

Although the ETA will not increase the amount of imports from Quebec above current levels, it may reduce the risk that Ontario is not able to economically displace the current amount of natural gas generation and GHG emissions with Quebec imports in the future. Looking ahead, Quebec is projecting continuing surpluses of electricity throughout the term of the agreement, but Quebec is also pursuing additional large bi-lateral electricity trading agreements which could reduce that surplus.²⁵ For example, Quebec was negotiating an agreement to supply Massachusetts with 9.45 TWh of electricity beginning in 2020.²⁶

However, the Province's implementation of carbon pricing via the cap and trade program also addresses this risk. Carbon pricing will increase the cost of natural gas generation which will subsequently increase the market price of electricity in Ontario during peak demand.²⁷ This will serve to increase the attractiveness of the Ontario market for Quebec to sell its surplus electricity by offering Quebec higher prices in the future for its low emissions exports.

In summary, the FAO concludes that the ETA will not have a significant effect on natural gas generation in Ontario or GHG emissions. The Province is already displacing close to the maximum amount of natural gas generation possible during on peak demand with the current transmission infrastructure. To the extent that Ontario needed to address the risk that imports from Quebec would decline in the future, carbon pricing via the cap and trade program will provide an incentive for imports from Quebec to displace natural gas by offering Quebec higher market prices for its exports to Ontario.

²⁵ Hydro-Québec. "Plan d'approvisionnement 2017-2026." Oct 2016.

²⁶ The northern pass project that was initially selected by Massachusetts did not receive regulatory approval. Hydro-Québec is now negotiating an alternative agreement which is proposed to begin in 2022. CBC News. "Hydro-Québec welcomes new plan to supply power to US after Northern Pass rejected." 28 Mar. 2018.

²⁷ See appendix B for more analysis.

5 | Appendices

Appendix A: Electricity Pricing in Ontario

This appendix provides additional detail on electricity pricing in Ontario. There are two main components to the price of electricity paid by Ontario ratepayers, the market price and the Global Adjustment.

Market Price and Global Adjustment

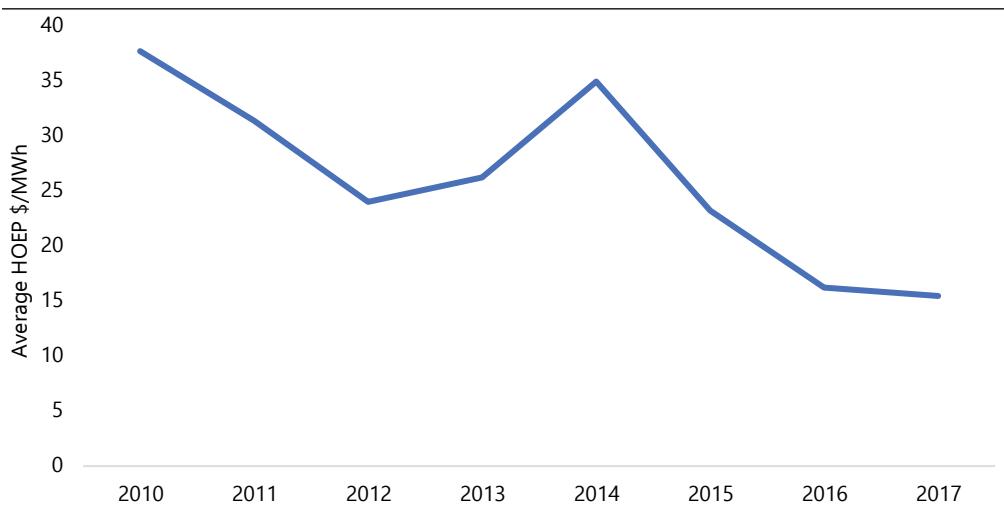
Ontario currently operates on a real-time electricity market. The market price of electricity in Ontario is called the Hourly Ontario Energy Price (HOEP). The HOEP is a market clearing price that changes in response to the supply and demand for electricity in Ontario.²⁸ Electricity generators and adjoining jurisdictions make offers into the Ontario market outlining the amount of electricity they are willing to sell and at what price. IESO then accepts the offers of enough generators/imports to supply Ontario electricity demand and the market clearing price is set based on the highest cost generator that is needed to satisfy market demand.²⁹ The market clearing price represents the cost to generate the next megawatt hour of electricity, or the marginal cost of generation.

The average HOEP has decreased from \$38/MWh to \$15/MWh from 2010 to 2017. The primary reasons for the decrease in the HOEP are lower Ontario electricity demand and the replacement of fossil fuel generation with nuclear and renewable generation, which have a much lower marginal cost of generation. As well, lower natural gas prices have contributed by reducing the price of electricity at peak demand.

²⁸ The HOEP is the average of the previous twelve 5-minute market clearing prices.

²⁹ All generators receive the same market price for electricity.

HOEP declined from 2010 to 2017



Source: FAO analysis of IESO data.

The market price of electricity, however, is not the price ratepayers pay. The HOEP pricing mechanism is in place to create a market whereby the IESO can dispatch the lowest cost generation resources that are available.

Most electricity generators in Ontario receive a fixed price for their generation that is either set by the Ontario Energy Board (OEB) or is based on a contract with IESO. These generators still sell electricity into the market at the HOEP but the transactions are settled outside the market at the fixed contract/regulated prices which are much higher than the average market price. The difference between the market and contracted prices charged to ratepayers is called the Global Adjustment. The average price of each type of generation paid by ratepayers is outlined in Table 5-1.

Table 5-1: Unit cost of generation sources in Ontario

Generation Source	Percent of Total Supply	Unit Cost (\$/MWh)
Nuclear	60%	69
Hydro	24%	58
Wind	8%	173
Natural Gas	6%	205
Solar	2%	480
Bio Energy	0%	131
Average Cost		92

Source: OEB Regulated Price Plan Price Report.

The reason that the average HOEP is so much lower than the cost of generation is that the HOEP only reflects the marginal cost of generation. In 2016, over 90 per cent of electricity in Ontario was generated by nuclear, wind and hydroelectric generators that are paid contracted prices and have very low marginal costs of generation. Therefore, they are required to offer into the market at very low prices. The difference between the amount generators offer into the market and the contract prices paid to generators is recovered through the Global Adjustment.

The average market price (the HOEP) of electricity in 2017 was \$15/MWh and the FAO estimates that the average generating cost of electricity was \$92/MWh. Therefore, 84 per cent or \$77/MWh of the cost of generation was recovered through the Global Adjustment in 2017.

Appendix B: Pricing of Natural Gas and Imports

The FAO estimates that the electricity purchases component of the ETA will cost ratepayers \$187 million and the electricity cycling component will save ratepayers \$99 million. These estimates are based on the assumption that the imports secured by the ETA will displace natural gas generation.

Due to disclosure restrictions under the *Financial Accountability Officer Act, 2013*, the FAO cannot disclose non-public details of the ETA such as the electricity purchase contract price or the method by which Quebec will offer the imports into the Ontario market. Therefore, the FAO cannot disclose its calculations. However, this appendix provides additional detail regarding the pricing of natural gas generation and imports from Quebec to support the conclusions of the report.

Natural Gas Pricing

As outlined in appendix A, the average cost of natural gas in 2017 was \$205/MWh, more than double the average generation cost in Ontario. However, that price includes the capacity payment or “net revenue requirement” paid to natural gas generators which is settled outside the market and is recovered from ratepayers through the Global Adjustment.³⁰ The net revenue requirement covers fixed costs to ensure that natural gas generation is available when there is sufficient demand. The reason the price of natural gas generation in Ontario is relatively high is due to the low utilization of Ontario’s natural gas plants. In 2017, Ontario’s natural gas

³⁰ The capacity payment is based on the amount of generating capacity they are contracted to provide to the market.

generators only generated 5.9 TWh, or 7 per cent of their generating potential, therefore, the capacity payments were spread over a very small amount of generation leading to a high unit cost.

The FAO estimates that the natural gas generation displaced by imports due to the ETA will not reduce the capacity payments made to natural gas generators. The imports from Quebec will, however, displace the marginal cost of natural gas generation which consists mostly of the cost of fuel and carbon emissions.³¹ Those costs are recovered primarily from selling electricity at the HOEP and are the key drivers of the HOEP when natural gas is on the margin.

In 2016, the FAO estimates that the cost of natural gas generation that the ETA is targeting to displace was \$25-\$30/MWh. Over the term of the ETA, the FAO projects that increases in carbon pricing under Ontario's cap and trade program as well as increases in the spot price of natural gas will place upward pressure on the cost of natural gas generation. The cap and trade program began in 2017 and priced carbon at approximately \$18/tonne. By 2023, the price of carbon is projected to rise to \$24/tonne.³² The FAO estimates that \$18/tonne carbon will add about \$7.7/MWh to the cost of natural gas and \$24/tonne would add about \$10.2/MWh to the cost. As well, the Energy Information Administration (EIA) is projecting the price of natural gas to increase from 2016 to 2023, which the FAO estimates will increase the cost of natural gas generation by about \$17/MWh. Due to a combination of increasing gas and carbon prices, the FAO estimates that the cost of natural gas generation which the imports from Quebec under the ETA are targeted to displace will increase to \$53-\$57/MWh by 2023. Therefore, the price of electricity in Ontario at peak demand when natural gas generation is setting the HOEP will increase.

The sum of the difference between the cost of importing 2.0 TWh of electricity each year at the ETA contract price versus paying the FAO's forecast for the cost of natural gas generation through 2023 equals the \$187 million cost to ratepayers of electricity purchases under the ETA. The electricity cycling component of the ETA will provide savings to ratepayers equal to the difference between the market price of the cycled electricity and the cost of the 0.3 TWh of natural gas generation displaced annually. The FAO estimates that the average difference in the price of the cycled and recalled electricity will be \$47/MWh over the life of the ETA, which will provide ratepayers with \$99 million of savings.

³¹ There are also variable operating costs.

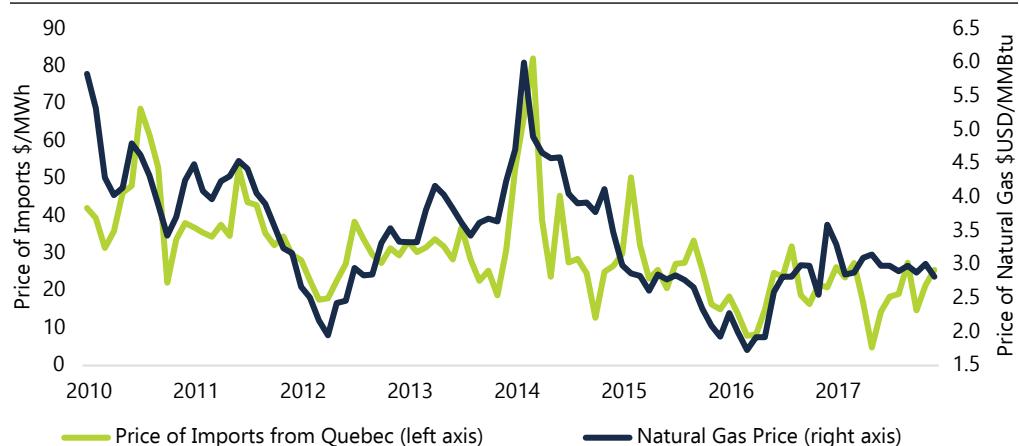
³² Ontario Energy Board. "Long-term Carbon Price Forecast." 19 Jul. 2017.

Imports Pricing

With the exception of firm contractual arrangements such as the ETA, Ontario trades electricity with other jurisdictions on a marginal cost basis. Quebec, like any generator or adjoining jurisdiction can offer electricity into the Ontario market and the imports will be accepted when economical. The transactions between Ontario and Quebec are settled at the market clearing price (i.e. there is no Global Adjustment for market imports) plus adjustments for intertie congestion. However, imports cannot set the HOEP, therefore, the market price at which imports are settled is based on the domestic resource that is on the margin at the time the imports occur.³³ During on peak demand when the ETA imports are being targeted, natural gas is most often on the margin, therefore, the marginal cost of natural gas is indicative of what Quebec would be paid if the transactions were settled in the market (rather than the contract price in the ETA).

How much electricity Quebec is willing to export to Ontario is affected by how much surplus electricity Quebec has and the prices Quebec's other export partners are willing to pay. Most of Quebec's surplus electricity is sold to New England and New York where electricity prices are higher than in Ontario. Those jurisdictions generate electricity primarily by natural gas and Quebec's export prices are closely tied to natural gas prices. As a result, the price Quebec receives for its exports is expected to increase in line with the projected increase in natural gas prices. Therefore, the price of market imports absent the ETA should increase in line with the cost of natural gas.

Price of imports from Quebec into Ontario is closely related to natural gas prices



Source: FAO analysis of EIA and IESO data.

³³ Imports are scheduled one hour ahead and are treated as non-dispatchable load. Although imports will influence what resource is on the margin, imports cannot set the margin.

Appendix C: Quebec Import/Export Trends

Ontario's electricity transmission network is connected to the networks of Quebec, Manitoba, Michigan, New York and Minnesota. Overall, Ontario is a net exporter of electricity, meaning that it exports more electricity than it imports. However, Ontario is a net importer from Quebec and Manitoba and the vast majority of imports into Ontario come from Quebec. In 2017, Ontario imported 6.6 TWh of electricity, 5.8 TWh of which came from Quebec, and exported 19.1 TWh, 16.6 TWh of which went to the U.S. markets of Michigan, New York and Minnesota.

Quebec Import/Export History

Imports from Quebec to Ontario have increased significantly since 2010.³⁴ In 2016, the average market price in Ontario when imports occurred was \$19.7/MWh.

Table 5-2: Volume and price of Quebec imports and exports since 2010

Year	Total Imports (TWh)	Average Ontario Market Price When Imports Occur (\$/MWh)	Total Exports (TWh)	Average Ontario Market Price When Exports Occur (\$/MWh)
2010	2.4	42.9	4.8	32.9
2011	2.5	38.9	3.4	26.3
2012	3.9	28.2	1.4	21.9
2013	4.2	28.8	2.2	25.1
2014	3.6	41.7	3.5	34.3
2015	4.8	28.7	2.9	23.8
2016	6.8	19.7	1.8	12.0
2017	5.8	21.5	2.0	9.4

Source: FAO analysis of IESO data.

Appendix D: Development of this Report

Authority

The Financial Accountability Officer accepted a request from a member of the Legislative Assembly to undertake the analysis presented in this report under paragraph 10(1)(b) of the *Financial Accountability Officer Act, 2013*.

³⁴ The decrease in 2017 is due to a reduction in "wheel-through" transactions. Imports for domestic use increased from 2016 to 2017.

Key Questions

The following key questions were used as a guide while undertaking research for this report:

- How will the agreement impact Ontario ratepayers?
 - What is the projected cost of the electricity that will be imported from Quebec (including any required transmission investment)?
 - What is Quebec paying for the 500 MW of winter capacity Ontario is providing?
 - What is Ontario paying for the ability to cycle energy through Quebec?
- How will the agreement affect electricity generators in Ontario?
 - What is the projected cost of electricity generation being displaced by electricity imports and energy cycling?
 - How will replacing domestic electricity generation with imported electricity impact electricity generation employment in Ontario?
- How does the agreement support the Province's electricity market initiatives?
 - How does the agreement support the Province's climate change initiatives?
 - How does the agreement support the Province's demand management initiatives?

Methodology

This report has been prepared with the benefit of information provided by, and meetings with staff from, the Ministry of Energy and the Independent Electricity System Operator, and a review of relevant literature and other publicly available information. Specific sources are referenced throughout.

All dollar amounts are in Canadian, current dollars (i.e. not adjusted for inflation) unless otherwise noted.

All average prices are weighted.