ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

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An Analysis of Ontario's Clean Electricity Exports

Prepared by the Ontario Society of Professional Engineers (OSPE)

November, 2017

Executive Summary

The electrical power system is the largest, most complex engineered system under the direction of decision-makers at Queen's Park. Complex systems when properly designed have the ability to be optimized according to elements of risk and uncertainty such as safety, reliability, cost, and environmental impact. When complex system dynamics and inter-system interactions are not fully simulated, analyzed, and optimized by engineering experts, waste is produced in various forms including significant and unnecessary financial costs that are transferred to the ratepayer.

In 2016, Ontario imported 8.0 TWh and exported 21.9 TWh. This represents enough energy to power 2,200,000 homes for an entire year. That same year, OSPE estimates that Ontario exported 14.6 TWh of clean electricity. This clean exported electricity cost Ontario's power system $1.04 billion to produce. It was then sold to neighbouring jurisdictions earning between $364 and $656 million in export revenue, and ultimately resulted in a financial loss ranging from $384 to $675 million.

In 2017, from January 1 to September 30, Ontario imported 5.2 TWh and exported 14.3 TWh. During that period, OSPE estimates that Ontario exported 11.2 TWh of clean electricity. The clean exported electricity cost Ontario's power system $845 million to produce. It was then sold to neighbouring jurisdictions earning between $273 and $497 million in export revenue which ultimately resulted in a financial loss ranging from $348 to $572 million for the first three quarters of the year.[1,2]

Instead of exporting surplus clean electricity, our province has a tremendous opportunity to use this energy as an economic driver—stimulating all-new waves of made-in-Ontario innovation and growth. One clear option is to make surplus clean electricity available to Ontario businesses for less than 2 cents per kWh to displace fossil fuels used for thermal applications (like: hot water, space heating, and industrial steam), for charging electric vehicles, and for the cost-effective production of clean hydrogen through electrolysis. Each of these initiatives will stimulate Ontario's economy, drive innovation, and assist in achieving our ambitious emission reduction targets.

As the voice of engineers in Ontario, OSPE's primary goal is to promote the proliferation and retention of engineering positions. At a high-level, OSPE's concerns regarding Ontario's energy system are two-fold. First, we are concerned that there is a lack of engineering involvement and influence in Ontario's energy policy decisions. This lack of input negatively impacts the design of the province's most complex engineered system, which reduces its efficiency and increases costs to ratepayers. Second, sub-optimal energy policies reduce Ontario's economic competitiveness.

Ontario competes in what is an increasingly global, competitive world. We cannot afford to absorb substantial costs associated with the sub-optimal design of large systems that hamstring industry and negatively affect the ability of our businesses to compete. Failure to address these concerns encourages the migration of investment, industry and jobs to neighbouring jurisdictions—which includes the loss of significant engineering talent. Doubling the impact of capital and employer migration is the lost tax revenue that Ontario needs to deliver services like healthcare and education.

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[1] Based on Ontario Energy Board (OEB) published generation costs.

[2] Exact export revenue figures are not currently available from the Independent Electricity System Operator (IESO). Exports reduce the net cost of Ontario's generation surpluses and reduce emissions in adjoining jurisdictions but could be more productively used to stimulate economic growth and investment in Ontario.

Introduction

The Ontario Society of Professional Engineers (OSPE) is the voice of the engineering profession in Ontario. OSPE represents the entire engineering community, including professional engineers, engineering graduates and engineering students.

OSPE produced this report to help the Government of Ontario develop more cost effective energy policies to enhance our technically complex electrical power system. Cost effective clean electricity is a key resource for Ontario's transition into the next phase of emission reductions: transforming non-electrical energy systems to meet international greenhouse gas (GHG) emission reduction obligations.

The Ontario Society of Professional Engineers has used summary data from the Independent Electricity System Operator (IESO) [1] and Ontario Energy Board (OEB) [4] to prepare our analysis of Ontario's costs and revenues associated with the export of clean electricity.

This analysis contains answers to four important questions:[3]

1. How much electricity does Ontario import and export?
2. When does Ontario import and export electricity?
3. What is the cost of the electricity Ontario exports?
4. Does Ontario make a profit or suffer a loss when it exports electricity?

To enhance clarity, electrical units are communicated in two convenient formats:

Units of POWER (capacity utilization):

- Kilowatt (kW) = 1000 watts (W) = 1.34 horsepower
- Megawatt (MW) = 1000 kilowatts
- Gigawatt (GW) = 1000 megawatts or 1,000,000 kW

Units of ENERGY (energy consumption):

- Kilowatthour (kWh) = 1000 watthours (Wh) = 1.34 horsepower for a full hour
- Megawatthour (MWh) = 1000 kWh
- Gigawatthour (GWh) = 1000 MWh or 1,000,000 kWh
- Terawatthour (TWh) = 1000 GWh or 1,000,000 MWh or 1,000,000,000 kWh

Ontario's Power System:

The electrical power system is the largest, most complex engineered system overseen by provincial decision-makers. Complex systems when properly designed have the ability to be optimized according to elements of risk and uncertainty such as safety, reliability, cost, and environmental impact. When complex system dynamics and inter-system interactions are not fully simulated, analyzed, and optimized by engineering experts we get waste in various forms including poor technical performance.

In this context, waste includes the costs of overproduction: the need for additional storage, the export of clean surplus electricity at a financial loss, and the curtailment (dumping) of surplus clean electricity, as OSPE reported in June 2017. Waste also includes the capital cost and

[3] Note: the range (min/max) of revenues communicated in this analysis reflects assumptions that were necessary to use the publicly available summary data for the cost analysis. For an exact determination of revenues, the IESO needs to make historical revenue data available to the public.

operating labour expenses for overbuilt clean generation capacity. Unless they are written off or deferred, the structure of Ontario's system transfers these costs to the ratepayer.

Ontario's unprecedented achievement, the reduction of GHG emissions in its electrical sector by 80% in only 12 years [6], has resulted in a power system that is indeed clean but is not yet currently optimized. The resulting cost for the inefficiencies (waste) is shouldered by industry and consumers, undermining Ontario's competitiveness. These inefficiencies must be reduced for Ontario to remain competitive in the NAFTA, CETA, and TPP trade zones that Canada has joined or intends to join.

OSPE is concerned about the reduced industry competitiveness resulting from the inefficiencies that are currently being borne by industry. Industry is a large employer of both engineers and the public at large. Ontario's employers compete in what is an increasingly global, competitive world. Ontario cannot afford to imbed substantial costs associated with the sub-optimal design of large systems that hamstring industry and make our businesses less able to compete. Failure to address these competitiveness concerns results in a migration of investment, industry, and jobs to neighbouring jurisdictions—including significant engineering positions and talent. The doubling impact of lost competitiveness is that capital and employer migration takes with it the tax revenue we depend on for the delivery of health care, education, and social services for Ontario residents.

This report analyzes the cost of production and the revenue from exports of surplus low GHG emitting electricity. OSPE has done this analysis to persuade the government and the public that there are better ways to use our surplus clean electricity. OSPE has suggested that Ontario use its surplus clean electricity to displace GHG emissions in other sectors to help achieve our environmental commitments at an affordable cost.

Surplus clean electricity is sold on the Ontario wholesale market for less than the retail price of natural gas to residential and small commercial consumers. When we export clean electricity at these low prices Ontario consumers and businesses are effectively paying for electrical capacity that contributes to the clean-up of other jurisdictions' energy systems.

If Ontario develops a new retail market for interruptible electricity it can be used to displace fossil fuels in non-electrical sectors, such as transportation. Due to our international agreements that electricity needs to be provided to Ontario retail consumers with the same terms and conditions as the exported electricity we sell in the wholesale electricity market. The required internet based controllers, fuel switching equipment, and Local Distribution Company (LDC) enhanced billing systems can be developed domestically, stimulating and supporting made-in-Ontario innovations. We can also export that technology and create well paying, full-time jobs in Ontario.

Achieving these goals will require an improved dialogue between government and Ontario's engineering experts. Engineering experts need to be consulted at the beginning of the policy development process in complex areas like energy and climate change.

How Much Electricity Does Ontario Import and Export?

Quick Facts:

- In 2016, Ontario **imported 8.0 TWh** of electricity, enough energy for approximately **800,000 homes** for one year. Most imports were from Quebec.

- In 2016, Ontario **exported 21.9 TWh** of electricity, enough energy for approximately **2,200,000 homes** for one year. Most exports are to Michigan and New York.

- From January 1 to September 30, 2017, Ontario **imported 5.2 TWh** of electricity

- From January 1 to September 30, 2017, Ontario **exported 14.3 TWh** of electricity.

Focusing on Clean Electricity Exports:

It is useful to differentiate between total electricity exports and clean electricity exports.

Clean exports are from clean generation. In this analysis clean generation is defined as a facility that has near zero GHG operating emissions. Hydroelectric, wind, solar, nuclear, and sustainable bio-energy generating facilities constitute clean generation by that definition.[4]

Clean generation dependable capacity is more expensive relative to the market price for natural gas dependable capacity in North America. Consequently, it is not economic to build clean generation in Ontario to supply American markets. This is because both electrical energy and capacity prices in these jurisdictions are low due to significant amounts of electricity production via natural gas-fired generation. Ontario must maintain natural gas-fired capacity for flexibility and backup, especially for wind and solar generation because they are variable sources. When the gas-fired reserve is not being used, it is reasonable to export gas-fired electricity to assist neighbouring jurisdictions.

However, when clean electricity is surplus to Ontario's electricity needs, rather than exporting it at a low price, Ontario can use that clean electricity to displace fossil fuels that are used to supply thermal energy for hot water, space heating and industrial steam, charging electric vehicles, and the production of clean hydrogen through electrolysis. All of these initiatives would help Ontario achieve its future emission reduction targets. As neighbouring jurisdictions reduce their power system emissions they too will eventually have surplus clean electricity at the same time Ontario does. It would benefit the province to have other domestic options (other than curtailment) for this clean electricity. Ontario could also then benefit from low cost clean imports from adjoining jurisdictions.

It is well known that Ontario has more clean generation than it needs. This is the result of a number of factors. The major causes have been slower than expected economic growth following the Financial Crisis of 2008, a successful conservation program, and failure to scale back generation acquisition when electricity demand stopped rising several years ago.

To estimate the amount of clean electricity exports, OSPE had to account for the energy production to meet Ontario's load demand for every hour of the 21-month period described in the Tables below. Ontario typically keeps some natural gas plants running because of their flexibility to accommodate errors in forecasting. OSPE's analysis assumes that the first 900 MW of natural gas production can be considered necessary for flexibility and the analysis assigns that capacity to meet Ontario's load demand. Imports are typically clean from Quebec and Manitoba and these are combined with Ontario's clean generation resources to meet the Ontario load. OSPE's analysis ignores "wheeling" transactions where two adjoining jurisdictions

[4] Natural gas generating facilities are not clean generation because they emit approximately 400 grams carbon dioxide per kWh of production. Ontario's power system has an overall emission profile of about 40 grams carbon dioxide per kWh of production because natural gas generation is used to provide the backup for all clean generation types.

use Ontario only as a transmission link. After all the Ontario load demand is met any surplus clean generation production was assumed to be clean exported electricity. Finally, the remaining gas-fired generation production that was not needed to meet Ontario's load demand was considered part of the total exports and were therefore not included in clean exports.

Figure 1 below shows that Ontario exports a considerable amount of clean electricity to neighbouring jurisdictions at low prices. This is due to poor market conditions in those markets and Ontario's significant surplus situation with respect to clean generation. The reduced revenue from these low export prices results in Ontario consumers paying for more of the fixed costs of the installed capacity.

In 2016, OSPE estimates that Ontario exported 14.6 TWh of clean electricity.

From January 1 to September 30, 2017, OSPE estimates that Ontario exported 11.2 TWh of clean electricity.

When Does Ontario Import or Export?

Over the course of a year, Ontario exports far more electricity than it imports.

Import Characteristics:

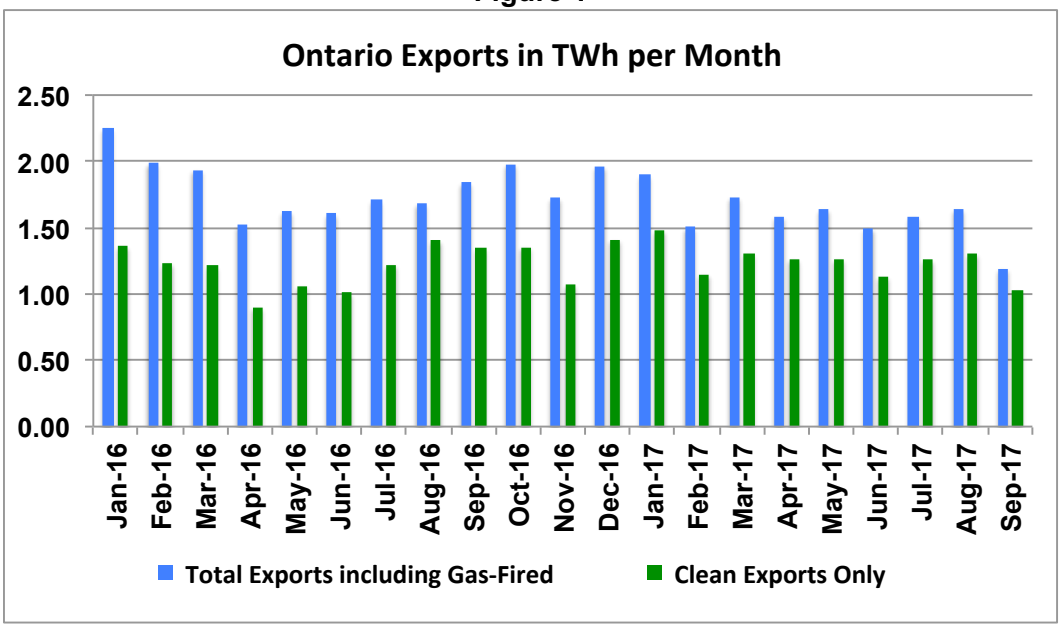
Imports from Quebec and Manitoba increase when Ontario's demand is high and Ontario's gas-fired generation is operating. Hydroelectric imports from Quebec and Manitoba have a low marginal cost of production and can even displace Ontario's higher marginal cost hydroelectric plants when overall demand in Ontario is low.

Export Characteristics:

Ontario's monthly exports are shown in Figure 1.

Exports tend to increase when Ontario has surplus low marginal cost clean electricity and when adjoining systems in Michigan and New York are producing power using higher marginal cost natural gas. However, Ontario also exports natural gas generated electricity when demand is high especially during peak hours of the day.

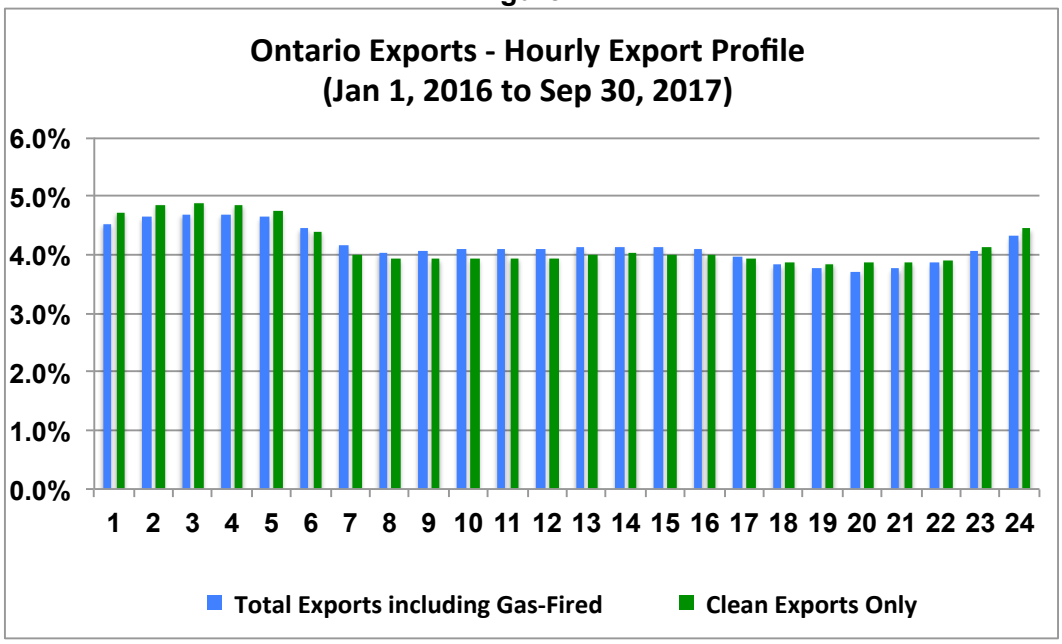
Figure 1



Hourly Export Profile Characteristics:

The hourly profile of Ontario's exports is shown in Figure 2 below. Exports tend to increase in the late evening during Ontario's lower demand hours and fall in the daytime during Ontario's higher demand hours. However, a review of individual days shows that exports can also increase when Ontario experiences a windy and/or sunny afternoon and renewables are producing more output than Ontario can use.[5]

Figure 2



[5] Figure 2 is plotted on the basis of the percentage of each of the 24 hours' production over the entire 21-month period. Both total and clean exports for the 24-hours add up to 100% so they cannot be compared with each other using Figure 2.

What is the Cost of Electricity When Ontario Exports?

Quick Facts:

- The simple average wholesale electricity price in 2016 was $14.9/MWh or 1.49 cents/kWh. The weighted average price based on production volumes was $16.6/MWh or 1.66 cents/kWh. That is about ½ the retail price of natural gas for residential consumers on an equivalent energy content basis [7].

- The overall average retail price for residential consumers in 2016 was 17 to 27 cents/kWh [8] depending on location.

- The difference between the wholesale market price and the retail price is used to pay for and maintain the installed capacity of generation, transmission, and distribution equipment.

In Ontario, New York, and Michigan, electricity is sold on the wholesale market at its marginal cost of production for the next MW added to the supply-demand balance point. That price is the market clearing price. Generators with lower marginal costs receive the clearing price so they get some of their capacity costs covered from the energy market. Higher cost generators do not get capacity costs covered in the market. Any deficiencies between market revenues and contract guaranteed prices are paid from Ontario's global adjustment account.

For these jurisdictions the marginal cost of production for each generation technology is effectively their fuel cost. Since zero-emission clean generation has very low or zero fuel costs, Ontario's energy price in the wholesale market is usually very low unless natural gas generation is required to meet load demands.

A clean power system typically has more than 90% of its costs associated with installed capacity and less than 10% associated with energy production. Installed capacity costs including plant labour are fixed. This means that using less energy does not reduce total power system costs materially. Conservation works at the individual consumer level to lower the consumer's bill, but at the power system level the reduced consumption actually causes rates to rise in order to pay for the same fixed costs until the surplus capacity reaches the end of its contract and is retired.

Imports and exports on the wholesale market are transacted at the energy price and are not subject to a capacity charge like the global adjustment paid by domestic consumers. This is because imports and exports are not capacity backed. Wholesale electricity can be interrupted if the province has a shortage as long as doing so does not cause a reliability problem on the interconnected grid. This means that adjoining power systems can buy lower reliability interruptible electricity in the Ontario market at the wholesale market price.

Smaller industrial, commercial and residential loads (Class B loads) in Ontario are non-dispatchable. They cannot be shut-down by system operators under normal conditions. Larger industrial loads can participate in the wholesale market and become dispatchable loads if they qualify and must reduce load when the market price is above their bid price. These large dispatchable loads have access to energy at the wholesale market price.

In 2016, electricity was available in the wholesale market in Ontario at a volume-weighted price of 1.66 cents/kWh. Surplus clean electricity was available at an average price of about 1 cent/kWh but smaller Class B industrial, commercial, and residential consumers could not

access it at this price due to kWh energy charges imposed by the OEB regulated retail price plans. Many of those OEB approved charges are capacity (kW) based costs but have traditionally been applied as an energy (kWh) charge. These charges are reasonable in fossil fueled power systems where fuel costs represent a significant percentage of the total costs. However, Ontario's power system now operates with less than 10% fuel costs, meaning that kWh charges are unnecessarily preventing consumers from accessing low cost surplus clean electricity to displace their fossil fuel use.

Costs by Technology Type:

The cost of producing electricity varies depending on the source. The cost of production of each technology on an aggregated basis is published by the OEB twice a year, typically in April and October in their Regulated Price Plan Reports [4].

Table 1 and 2 below show the cost of production effective May 1 of each year. The blended cost for clean electricity in the tables was used to conduct the analysis for the whole year:

Table 1 – 2016 Commodity Cost Data

	OEB 2016 Costs	IESO
	Cents/kWh	% of Total
Nuclear	6.8	61.0%
Hydro	5.7	23.7%
Nat Gas	14.0	8.4%
Wind	13.3	6.2%
Solar	48.1	0.3%
Bio-Fuel	13.0	0.3%
Clean Blend	**7.12**	**91.6%**

The blended cost of clean electricity on the IESO high voltage grid in 2016 was 7.12 cents/kWh or $71.2/MWh. The low voltage distribution system produces about 4% of the total energy. More than half of it is solar. The low voltage distribution system data is not included in Table 1 or 2.

Table 2 – Jan to Sep 2017 Commodity Cost Data

	OEB 2017 Costs	IESO Q1/Q2
	Cents/kWh	% of Total
Nuclear	6.9	62.0%
Hydro	5.8	27.5%
Nat Gas	20.5	2.6%
Wind	17.3	7.3%
Solar	48.0	0.4%
Bio-Fuel	13.1	0.3%
Clean Blend	**7.55**	**97.4%**

The blended cost of clean electricity in 2017 is 7.55 cents/kWh or $75.5/MWh. Prices for wind and natural gas energy increased substantially due to the greater curtailment of these two sources expected in 2017. Curtailed amounts do not appear in IESO's plant production data.

OSPE published the 2016 curtailment amount (7.6 TWh) in the summer of 2017 [5]. The total curtailment amount for 2017 has not yet been prepared by OSPE.

Does Ontario Make a Profit on Exports?

The IESO receives *revenue* from export sales and uses it to pay producers. When there is no congestion on the transmission system and the inter-ties used for importing or exporting, the electricity is bought and sold at the wholesale market clearing price plus a modest uplift and IESO administration charges.

When there is congestion on the power system, exporters are also required to pay a higher price at that inter-tie node to access the capacity they need. That additional charge is called an inter-tie congestion price. The inter-tie congestion price is used to pay generators for their production which then reduces the generators payments from the global adjustment account to cover any market shortfalls compared to their contractual price. The reduction of the global adjustment payments to the generators also lowers the global adjustment charge that the consumer pays.

When congestion occurs, an exporter would generally not bid more than the price of electricity in the receiving jurisdiction. In practical terms the average export price typically falls between the Ontario market price and the price in the adjoining jurisdictions. The price in adjoining American jurisdictions is typically the natural gas marginal cost of production. That means Ontario does not recover the full fixed cost of the capacity used to export our electricity.

Therefore, from an economic perspective, export sales reduce the net loss from idle capacity, but exports do not produce a profit.

However, it is important to note that if the export sale had not taken place, the economic loss would have been larger. This is because the fixed costs of the unused capacity would still be incurred by the power system, whether it was sold or not. If there is no productive use for that electricity in Ontario, it is advantageous to export the surplus clean electricity rather than curtailing (dumping) it—assuming the financial reward is greater than zero. Also, it should be noted that clean electricity exports can help adjoining jurisdictions to reduce their emissions which in turn benefits our province because prevailing winds often move airborne emissions from the United States into Ontario.

The congestion price can vary significantly between inter-ties and during different hours, especially if there is an unexpected supply deficiency and higher cost resources must be started up for a short period. For example, on October 20, 2017, the inter-tie congestion charge was zero for most hours on most of the inter-ties except for Michigan, Minnesota, and New York. The highest congestion price occurred on the Michigan inter-tie at 3:00 PM for 1 hour when it reached $80.75/MWh. At the same hour the congestion charge for all the other inter-ties except Minnesota was zero. The Minnesota congestion charge was $23.90/MWh for that hour.

For cost analysis purposes OSPE was not able to obtain the inter-tie congestion charges for each inter-tie, for all of the hours during the 21-month period. The IESO does however maintain that data online for the previous 30 days. OSPE sampled 3 days within the 30-day period from mid-October to mid-November 2017 and selected an average congestion charge which ranged from $10 to $30/MWh inclusive of any modest uplift and IESO administration charges to perform our cost analysis.

Applying a range from $10 to $30/MWh to the data results in the costs, revenue, and losses shown in Table 3 and Table 4 below. The Hourly Ontario Energy Price (HOEP) is the hourly average of the twelve 5-minute wholesale market clearing prices. HOEP was used as a proxy for all the Ontario nodal inter-tie prices.

Table 3 – 2016 Cost Analysis

Clean Energy Exported	14.60	TWh
2016 Simple Average Hourly Ontario Energy Price (HOEP)	14.90	$/MWh
Min. Average Intertie Congestion Price	10.00	$/MWh
Max. Average Intertie Congestion Price	30.00	$/MWh
Minimum Revenue for Clean Exports	363.5	Million $
Maximum Revenue for Clean Exports	655.5	Million $
Cost of Clean Energy	7.12	cents/kWh
Cost of Clean Energy Exports	1,039.2	Million $
Min. Loss on Clean Exports	383.7	Million $
Max. Loss on Clean Exports	675.7	Million $

Table 4 – January – September 2017 Cost Analysis

Clean Energy Exported	11.19	TWh
2017 Simple Average Hourly Ontario Energy Price (HOEP)	14.38	$/MWh
Min. Average Intertie Congestion Price	10.00	$/MWh
Max. Average Intertie Congestion Price	30.00	$/MWh
Minimum Revenue for Clean Exports	272.9	Million $
Maximum Revenue for Clean Exports	496.8	Million $
Cost of Clean Energy	7.55	cents/kWh
Cost of Clean Energy Exports	845.3	Million $
Min. Loss on Clean Exports	348.6	Million $
Max. Loss on Clean Exports	572.4	Million $

Conclusions

When we export clean electricity at low prices Ontario consumers and businesses effectively pay for electrical capacity that contributes to neighbouring energy systems.

When clean electricity is surplus to Ontario's electrical demand, it is better for us to use that clean electricity within Ontario to displace fossil fuels in other sectors. That clean electricity can be used whenever it is available by using fuel switching technologies to supply thermal energy for hot water, space heating, and industrial steam, for charging electric vehicles, and the production of clean hydrogen through electrolysis. Each of these initiatives would help Ontario achieve its future emission reduction targets.

Surplus clean electricity is sold on the wholesale market for less than the retail price of natural gas to residential and small commercial consumers. Displacing fossil fuels using surplus clean electricity can be made economical if Ontario's retail electricity market and electricity price plans are more appropriately aligned with our clean electrical power system.

When surplus clean electricity is available the preferred order of energy use should be:

1. Make surplus clean electricity available to Ontario ratepayers for displacing fossil fuels in other sectors.

2. Export the balance of the clean surplus electricity that cannot be used in Ontario.

3. Curtail any residual amounts that cannot be used either for fossil fuel displacement within Ontario or exported.

The Ministry of Energy should engage in consultations with appropriate engineering experts on how best to introduce an interruptible retail electricity market so the benefits of Ontario's substantial investments in clean generation technologies can be utilized within the province to achieve our future emission reduction goals.

If the Ontario government engaged in consultations with appropriate engineering experts before finalizing public policies, Ontario could have more cost effective policies related to energy, climate change, and other technically complex strategies.

As neighbouring jurisdictions reduce their power system emissions they too will eventually have surplus clean electricity. It would benefit Ontario to have other domestic options for this clean electricity so it does not have to be curtailed (wasted). Ontario could then benefit from low cost clean imports from adjoining jurisdictions.

What is made abundantly clear throughout this analysis is that building capacity that is exclusively for the export market is not a profitable business practice for Ontario.

Questions & Comments:

For questions and/or comments regarding this document, please contact Patrick Sackville, Lead, Policy and Government Relations at (416) 223-9961 ext. 225 or patrick@ospe.on.ca.

References

The data for this report was obtained from publicly available sources at the IESO and OEB websites. Below is a list of references used to prepare this report:

1. IESO generation production and market price data can be found at its website under the heading Power Data at: http://www.ieso.ca/en/power-data/data-directory

2. IESO data on embedded generation in the distribution system can be found in the IESO Ontario Planning Outlook, September 2016, at: http://www.ieso.ca/sector-participants/planning-and-forecasting/ontario-planning-outlook

3. IESO training materials on the electricity market can be found at: http://www.ieso.ca/sector-participants/market-operations/marketplace-training/training-materials

4. OEB reports on the cost of generation can be found in its Regulated Price Plan reports at: https://www.oeb.ca/industry/policy-initiatives-and-consultations/regulated-price-plan-rpp

5. OSPE press release on curtailed generation in 2016 can be found at: https://blog.ospe.on.ca/featured/ontario-wasted-more-than-1-billion-worth-of-clean-energy-in-2016-enough-to-power-760000-homes/

6. Ministry of Energy 2017 Long Term Energy Plan identifies the GHG emission profile of Ontario's electrical system on page 108 and 109 at: https://www.ontario.ca/page/ontarios-long-term-energy-plan

7. Consumers Gas residential gas rates can be found at: https://www.enbridgegas.com/homes/accounts-billing/residential-gas-rates/purchasing-gas-from-enbridge.aspx

8. OEB Bill Calculator can be used to calculate the cost of your electricity anywhere in Ontario at: https://www.oeb.ca/consumer-protection/energy-contracts/bill-calculator

About the Ontario Society of Professional Engineers (OSPE):

The Ontario Society of Professional Engineers (OSPE) is the voice of the engineering community in Ontario. We represent 80,000 professional engineers and over 250,000 engineering graduates who contribute to the most strategic sectors of Ontario's economy.

OSPE elevates the profile of engineers by advocating with governments, offering career building services, and providing opportunities for ongoing learning, networking, and community building.

Engineers are trained, innovative problem solvers who develop solutions by considering costs and benefits, sustainability, public safety, and the complete lifecycle and integration of projects. Engineers are also on the frontlines of developing, safeguarding, and maximizing Ontario's investments.

OSPE was formed in 2000 after members of Professional Engineers Ontario (PEO) voted to separate regulatory and advocacy functions into two distinct organizations.

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