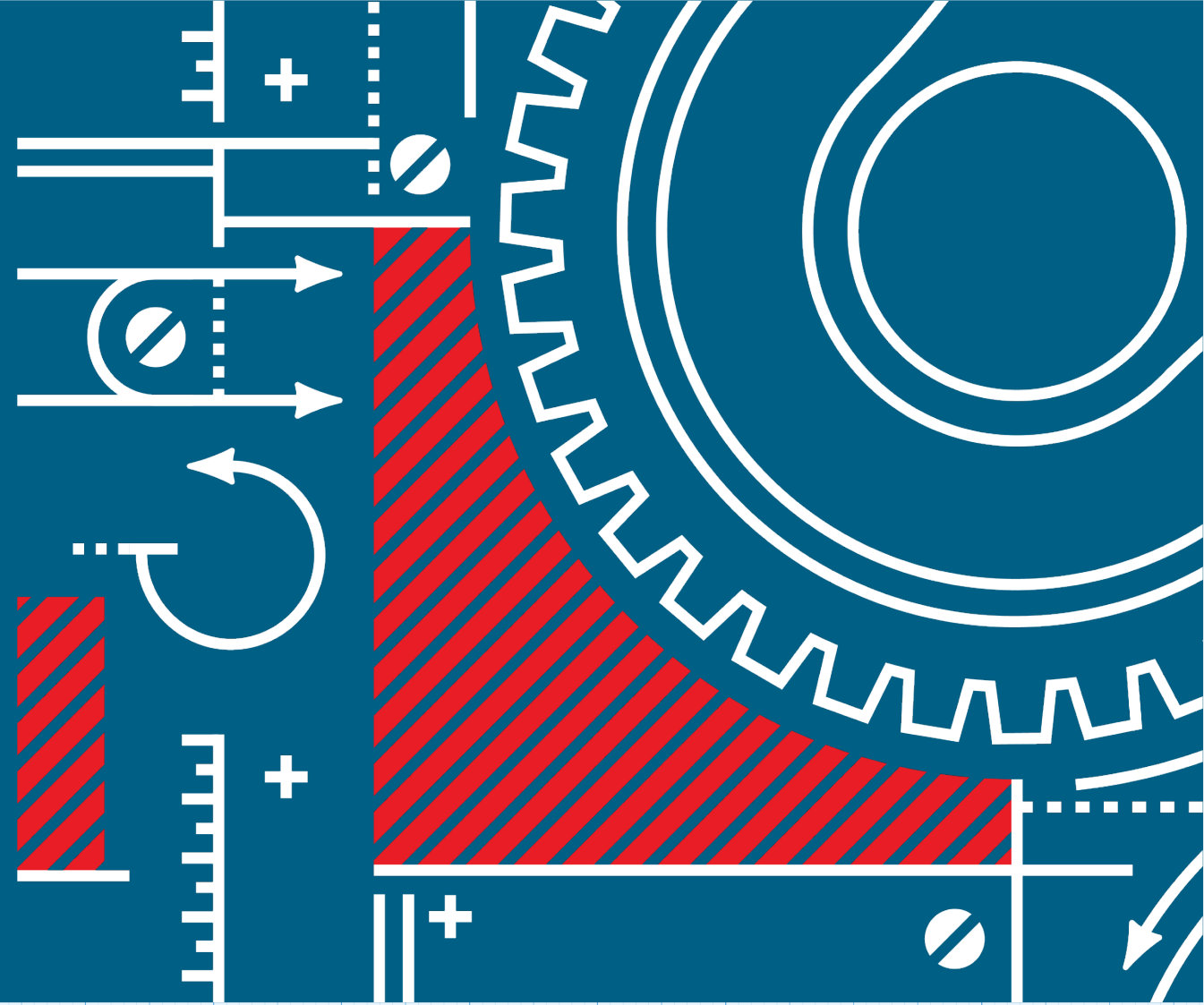


ENGtalks: Ontario's Electricity Dilemma & Ontario's Electricity Rates

Paul Acchione, P.Eng.



OSPE Energy Task Force

Current Initiatives Aimed at Rapid Decarbonization

- OSPE supports decarbonization, but...
- OSPE also wants to ensure people have access to reliable, affordable and abundant energy - essential for public support of any decarbonization policy
- Ontario has already decarbonized its electricity grid at a retail price equal to the average price of electricity in North America:
 - 60% dependable nuclear
 - 25% dependable hydroelectric
 - 10% intermittent renewables (wind and solar)
 - 5% natural gas for renewable backup and reserves

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- Electrification of personal-use vehicles is now practical
- Energy efficiency and conservation is practical
- Heavy duty and off-road vehicles need a different solution (hydrogen, ammonia or synthetic liquid fuels)
- Heating also requires different solutions based on location (various options available)
- Energy policy needs to recognize local circumstances and their energy needs in order to decarbonize energy use affordably
- Engineering expertise is key to good energy policy!

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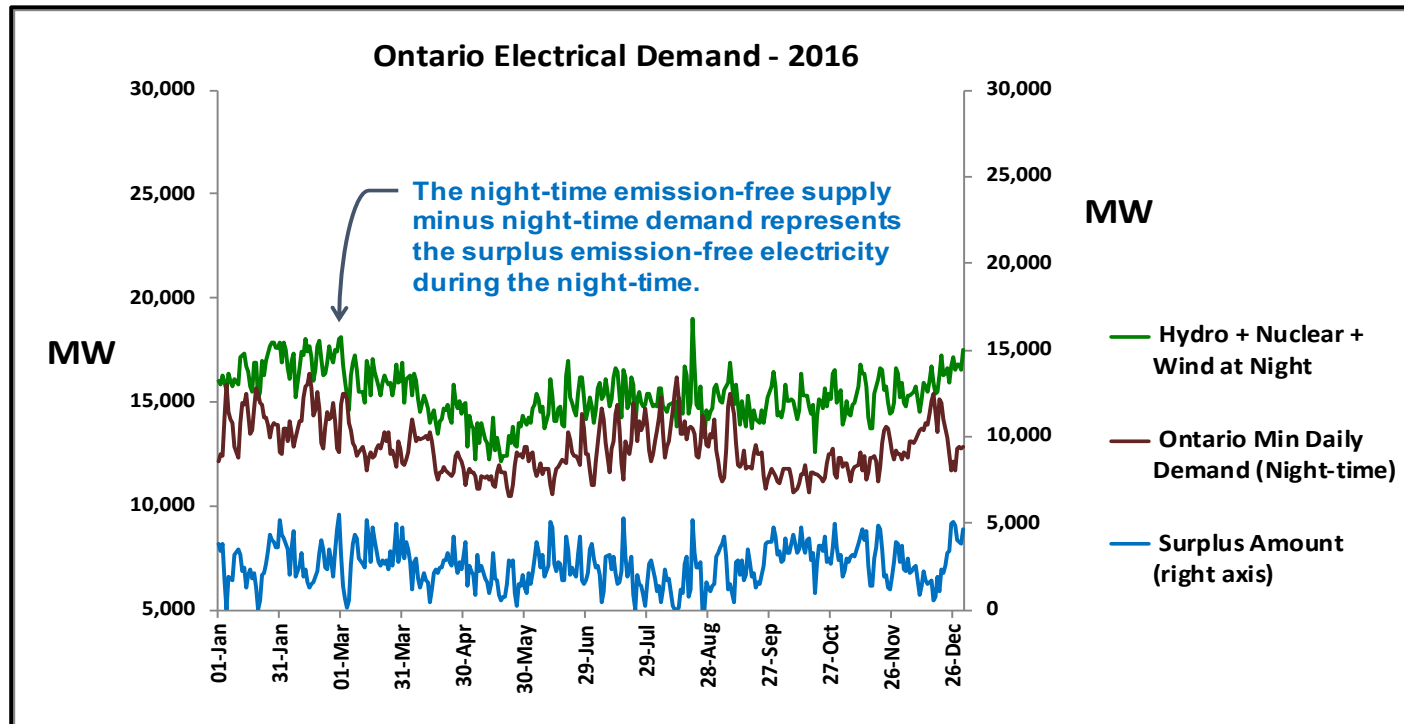
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Why Do We Have Surplus Emission-Free Electricity?

- Ontario has a very low emission electrical system (~20 g CO₂ /kWh)
- All very low emission electrical systems produce surpluses
- Clean surpluses in Ontario's grid are about 15% of total production
- Ontario does not have sufficient grid storage to utilize the surpluses
- Currently, grid scale electrical storage is too expensive to deploy
- Retail electricity price plans make surplus electricity too expensive to buy
- Surplus clean electricity is sold at a deep discount to adjoining power systems or is curtailed (discarded / wasted)

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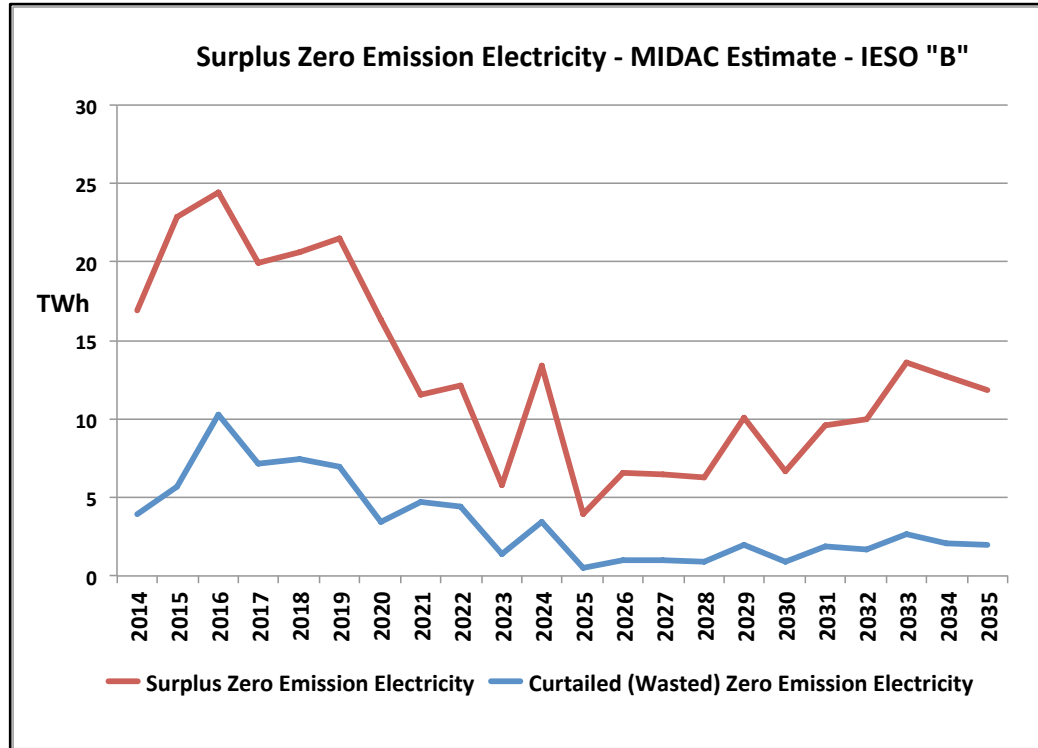
At night Ontario has more zero emission electricity than demand.

The excess is currently exported at low prices or curtailed (wasted).

We could use that surplus to displace fossil fuels in other sectors if the price was right !

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All low emission electrical systems create surplus zero emission electricity.

Each 1 TWh is enough power for >100,000 homes for 1 year.

Surplus electricity quantities will drop during the nuclear refurbishment program but will rise again when the reactors come back into service.

The difference between the 2 lines is exported surplus zero emission electricity and is sold at low very prices.

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Deficiencies of Current Retail Electricity Price Plans

- They overcharge for surplus electrical energy (kWh)
- They don't allow Ontario consumers to purchase surplus emission-free electricity at its marginal cost of production (0.62 ¢/kWh in 2018, 0.49 ¢/kWh in 2019).
- They cause too much curtailment (waste) of emission-free electricity.
- This can be corrected by a policy change in how surplus clean electricity is priced in Ontario.
- One option is to offer a very low price overnight (midnight to 6 am) when there is lots of surplus electricity available.

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Retail price reform will make decarbonization of heating economic and won't cost the electricity system any money!

**Fossil Fuel Marginal
Prices for 1 kWh of heat**

Fuel Type	Billing Units	Residential	Commercial	Industrial
Fuel Oil	¢/kWh	13.9	12.3	8.0
Propane	¢/kWh	7.9	5.7	7.8
Natural Gas	¢/kWh	1.8	1.8	1.7

**Surplus Emission-Free
Electricity Marginal
Prices for 1 kWh of heat**

Description	Billing Units	Residential	< 50 kW	< 1,000 kW	< 5,000 kW	>= 5,000 kW
Present Retail Price Plans (min)	¢/kWh	8.71	9.99	7.05	7.05	7.05
Present Retail Price Plans (max)	¢/kWh	15.41	16.69	11.94	11.94	7.05
Wholesale Market Price – 2018	¢/kWh	0.62	0.62	0.62	0.62	0.62

Note 1: Fossil fuel prices are from the Ontario Fuel Technical Report except residential natural gas was Union Gas price in Milton, Ont. Price increased to reflect 85% combustion efficiency.

Note 2: Marginal costs represent the next kWh of energy. Excludes fixed monthly costs.

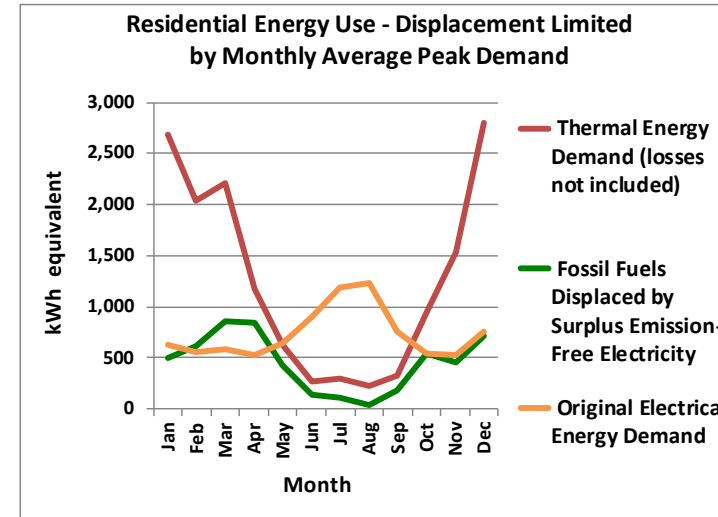
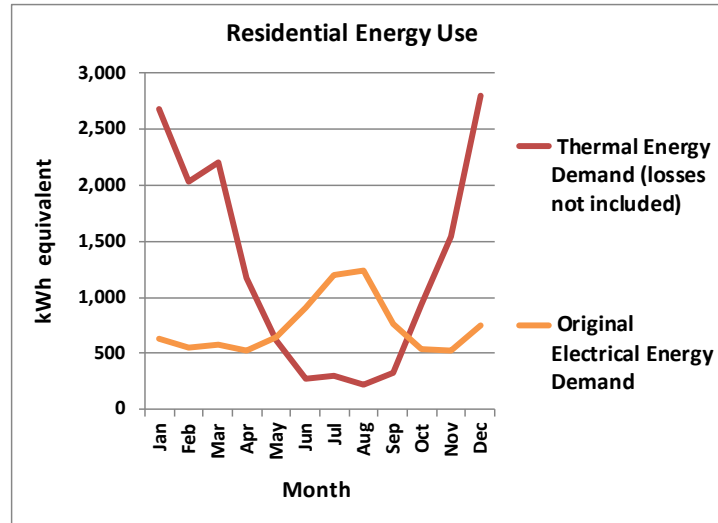
Note 3: Surplus emission-free electricity marginal costs are calculated from the weighted average wholesale market prices when surplus electricity was available.

Note 4: data for resistance heating is shown but ground source heat pumps are 4x more effective.

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OSPE's Proposed Retail Price Reform Fossil Fuel Reduction Potential for Building Heating



Note: Chart to the right shows the amount of fossil fuel displacement if the maximum power demand in any hour is limited to the consumer's monthly average peak power demand. This limitation prevents the electricity system peak from becoming higher at night.

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OSPE's Proposed Retail Price Reform Annual Total Energy Cost Reduction Potential

Carbon Price \$ / tonne CO ₂	Power Limit kW	Fossil Fuel Displaced	Nat Gas Savings /yr	Propane Savings /yr	Fuel Oil Savings /yr
\$ 0	2.53	36 %	\$ 64	\$ 395	\$ 721
\$ 20	2.53	36 %	\$ 86	\$ 423	\$ 754
\$ 50	2.53	36 %	\$ 118	\$ 461	\$ 803
\$ 0	Unlimited	67 %	\$ 120	\$ 741	\$ 1,351
\$ 20	Unlimited	67 %	\$ 161	\$ 792	\$ 1,412
\$ 50	Unlimited	67 %	\$ 223	\$ 863	\$ 1,504

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OSPE's Proposed Retail Price Reform Carbon Dioxide Emissions Reduction Potential

Year	Surplus Emission-Free Electricity in TWh/yr	Max Emission Reduction Nat Gas in Mt CO ₂ /yr	Max Emission Reduction Propane in Mt CO ₂ /yr	Max Emission Reduction Heating Oil in Mt CO ₂ /yr
2020	16.3	3.5	4.1	4.8
2021	11.5	2.5	2.9	3.4
2022	12.1	2.6	3.1	3.6
2023	5.8	1.2	1.5	1.7
2024	13.4	2.9	3.4	3.9
2025	3.9	0.8	1.0	1.2
2026	6.6	1.4	1.7	1.9
2027	6.5	1.4	1.6	1.9
2028	6.3	1.3	1.6	1.9
2029	10.1	2.2	2.6	3.0
2030	6.7	1.4	1.7	2.0
2031	9.6	2.0	2.4	2.8
2032	9.9	2.1	2.5	2.9
2033	13.6	2.9	3.4	4.0
2034	12.7	2.7	3.2	3.7
2035	11.8	2.5	3.0	3.5
16-yr Annual Average	9.8	2.1	2.5	2.9
16-yr Total	157.0	33.4	39.7	46.1

Emission reductions in the table assume all surplus emission-free electricity quantities are used for fossil fuel displacement. In practice likely about 70% of the values shown will be achieved after the retail price reform is fully deployed.

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Implications for Energy Policy

- Ontario's retail electricity prices should be reformed to:
 - Reduce the curtailment (waste) of emission-free electricity.
 - Economically enable the use of surplus emission-free electricity to:
 - Charge EV's overnight (modified TOU rate plan)
 - Displace fossil fuels overnight (modified TOU rate plan)
 - Produce green electrolytic hydrogen (anytime using smart grid)
 - Deploy the new price plans on a voluntary basis.
- Don't wait until cheaper renewables and storage or small modular reactors become available, lots of options to reduce emissions now at little or no cost!