March 16, 2022

Via Email: [redacted]

Mr. Chuck Farmer Vice President, Planning, Conservation and Resource Adequacy Independent Electricity System Operator Toronto, Ontario

Re : Pathways to Decarbonization Study

Dear Mr. Farmer and IESO Modelling team:

It is encouraging that the IESO is modelling a low carbon future for the Ontario electricity system, and I look forward to the results from the current Pathways to Decarbonization" modelling work.

You modeling team held a good engagement session February 24, and I have reviewed the "assumptions for Feedback" document in detail.

My own background is 20 years as a professional engineer performing energy systems design and lead project engineer functions, as well as 15 years creating and teaching energy systems design and energy efficiency in the first such program in Canada at St. Lawrence College in Kingston. I work as an independent consultant, but this letter is submitted only in my own interest to support Ontario developing a low to zero carbon economy.

I understand that the IESO responds to the mandates provided by our provincial government, but I also feel that given the urgency of addressing Greenhouse Gas emissions, the IESO has the depth of knowledge to be a leader in proposing solutions that the government itself may not have taken the lead on. You will see that some of my feedback relates to areas where a modeling scenario is one that is effectively also suggesting or requiring policy change. I believe there are specific scenarios that will likely enable lower electricity costs while also reducing Greenhouse Gas emissions and that the government must be made aware of these opportunities and only the IESO has the modelling capacity and authority to lead on these solutions.

Feedback on the March 2, 2022, " Assumptions for Feedback":

1/ Electric Vehicles and Grid Opportunity:

About 400,000 cars, light duty trucks and SUVs are sold each year in Ontario. I recognize the IESO is modelling demand created by the electrification of 50% of the fleet sales by 2030 and 100% by 2035, as per federal mandates. However, a huge and important opportunity is not being modelled, and that is the bidirectional charging and supply potential of a large electric vehicle fleet. When I asked during the public engagement about this potential, the reason given for not assessing it was that it is a "speculative" possibility. This is where the IESEO can encourage the government to turn this possibility from speculation to policy, programs and possibly incentives.

Let me illustrate with a simple projection of the MW capacity and storage possibilities as EV vehicle sales increase to 2035. Note that I have reduced the market penetration projections by 20% to be conservative and also have not accounted for increased sales due to population growth.

From a system CAPEX perspective, I think it is critical to recognize that the storage capacity of the EV batteries is being financed by the vehicle purchasers, the IESO does not bear that expense, but would of course have expenses related to tapping into this resource. These expenses would relate to the development of the "Smart" network and no doubt some hardware revisions in the grid to access this stored EV energy. Now is the time to start working with automobile and charger manufacturers as well as the government to develop the necessary policy mechanisms to develop this resource.

Below is a very basic model that identifies the massive EV kWh and MW potential. Note that by 2035 the capacity of storage in EV batteries is the in the range of 64,000 MWh and the demand or supply potential is in the range of 18,000 MW. It would be a huge mistake to not determine now whether some or all of this capacity would allow a more cost-effective grid development. The storage capacity is especially relevant to addressing the intermittent nature of wind and solar deployment and the commensurate need for storage. Note that I have assumed conservative, sales, battery access and efficiency numbers.

Potential Grid Storage, Demand and Supply Opportuntiy of EVs

Input EV Data

2	% 2022 Ontario EV sales
50	% 2030 Ontario EV sales
100	% 2035 Ontario EV sales
80	Conservative % EV sales target reached

Year of sales	Total Ontario Vehicle Sales	Federal mandate % EV sales	Actual EV sales (80% of Target)
2022	400000	2	6400
2023	400000	8	25600
2024	400000	14	44800
2025	400000	20	64000
2026	400000	26	83200
2027	400000	32	102400
2028	400000	38	121600
2029	400000	44	140800
2030	400000	50	160000
2031	400000	60	192000
2032	400000	70	224000
2033	400000	80	256000
2034	400000	90	288000
2035	400000	100	320000
Total vehicles on the road by 2035 (assuming 13 year life)			2028800

Capacity and Demand or Supply power per EV

70	kWh Average EV battery capacity per vehicle
35	kWh Capacity per vehicle available to grid operators
10	kW power charging or discharging per vehicle

Results

Bi-directional collective impact of total numbr of EVs by 2035 on the Ontario Grid

10	% charge and discharge losses
2028800	Number of vehicle batteries
63907	MWh of capacity storage supply to the gric
18259	MW total EV supply or demand

2/ Elimination of Electric Resistance Space Heating

All electric resistance space heating in residential, commercial and institutional sites must be identified through auditing and the potential to shift those loads to central and mini split air source heat pumps be assessed. My experience performing building energy audits identified over and over again, various electric resistance heating installations where owners were not aware of current lower cost options. An incentive program for switching to air source heat pumps through incentivized energy auditing is critical to this conversion. Energy technology systems graduates from various Ontario colleges are ideal people to perform this auditing work.

3/ Air Source Heat Pump Water heating

All electric resistance water heating in residential, commercial and institutional sites must be identified. The application of air source water heaters and potentially photovoltaic electric water heater pre-heat must also be assessed for overall electricity system cost effectiveness. Almost all current air source heat pump water heaters have time of use demand controls and the system cost effectiveness of their potential demand management should be assessed in the current modeling exercises. These systems will reduce summer air conditioner loads (and that should be modelled) compared to all other domestic water heating methods, while also adding some winter heating loads. With our summer peaking grid, air source water heaters should therefore have system wide demand cost savings impacts.

4/ Air Source Heat Pump Clothes Dryers

The current modeling assumptions only address resistance electric clothes dryers. There are also heat pump clothes dryers and with their widespread adoption there will be system demand cost savings that should be assessed to see what level of subsidy could support increased penetration of heat pump clothes dryers. One of the big advantage of these systems is that their waste heat stays in the building, which is an assist to air source water heaters and building space heating. The overall electricity system level impacts on heating, air conditioning and demand costs of heat pump dryers needs to be assessed.

5/ Modelling System LCOE Optimization

Does the present IESO model allow solar and wind systems to be built out to levels where they might be significantly curtailed due to excess solar or wind generation, but still remain the lowest cost options? In my experience of hour by hour modelling off-grid solar/battery systems, it was often most cost effective to provide a level of photovoltaics power such that for much of the year it would in effect be curtailed due to the batteries being fully charged, but this extra solar avoided the addition of more storage and allowed reduced generator run time. Taken to the extreme, if photovoltaics are very, very low cost and batteries are extremely high cost, the system design shifts more and more to have "overclocked" the photovoltaic power.

a/ Will the IESO look at "overclocking" solar and wind supply and whether that in effect can produce a lower LCOE.

b/ Can the IESO model use a Newton Raphson or other technique to create an optimized LCOE based ona wide variety of input data?

Thank you for your attention. The electrification of Ontario is an exciting opportunity for the province to be a leader in global efforts to reduce greenhouse gases and the IESO has a critical role to play in creating the vision and practical plan for how our grid helps us achieve a near zero carbon society.

Please keep me informed on the modeling results.

Sincerely

Steve Lapp P.Eng. M.Sc.

[redacted]

[redacted]

cc: IESO modelling team through web based feedback