MITIGATING ONTARIO'S ELECTRICITY SYSTEM RELIABILITY RISKS REQUIRES A NEW PLANNING APPROACH

Power Workers' Union, May 2024

This is the second in a series of four papers by the PWU that is intended to prompt discussion about better ways for Ontario to meet its growing electricity demand at a lower cost, with lower carbon emissions and in a more reliable, affordable and timely manner.

POWER WORKERS' UNION

The People Who Help Keep The Lights ON.

INTRODUCTION

The PWU's first paper described how Ontario's current planning approach for its electricity system is a major barrier to reliably and affordably electrifying the province's economy. Additionally, a better planning approach is a critical prerequisite for achieving net zero (NZ). This paper focuses on the inherent reliability risks associated with Ontario's current planning approach including: the underpinning conservative demand forecasts; inadequate consideration of the true needs of the province's electricity system; and, the challenges associated with ensuring the timely development of the needed supply directed by the Ministry of Energy. Mitigating these risks requires a radical rethink of Ontario's current electricity system planning approach.

Ontario's Electricity Policy Guidance Provides Clear Direction

The province's "*Powering Ontario's Growth (POG) Report*" laid out a pathway for securing the energy needed to power economic growth and electrification over the next three decades while maintaining its clean electricity advantage. The Minister of Energy continues to emphasise the need to double Ontario's electricity supply by 2050 while ensuring that the system will "*meet demand at any time*".

The recent "*Electrification and Energy Transition Panel (EETP) Report*" states that: *"Ontario's energy governance entities must show thought leadership and embrace the challenges and opportunities of electrification and the energy transition"* … with … *"reasonable risk-taking"* … to … *"enable private actors to make innovative investments that are aligned with the clean energy economy objective, while protecting consumers, maintaining affordability and bolstering reliability."*

The POG Report also states the need for the government to make better evidence-based and informed decisions. However, this requires transparent and full guidance to developers on the electricity demand to be met. While IESO staff verbally acknowledge the need to address electrification and the 2050 NZ objective [1], the IESO's primary planning guidance material, the *2024 Annual Planning Outlook (APO)*, fails to do so.

There are material consequences associated with underestimating demand growth from Ontario's energy transition. A lack of adequate power resources in other jurisdictions is deterring economic investments.[2] Ontario's supply risks are as real and severe. This paper highlights the failure of Ontario's current planning process to realistically convey an accurate forecast of the province's electricity needs to decision makers.

[1] IESO remarks at Toronto Regional Plan webinar, Apr 16, 2024.

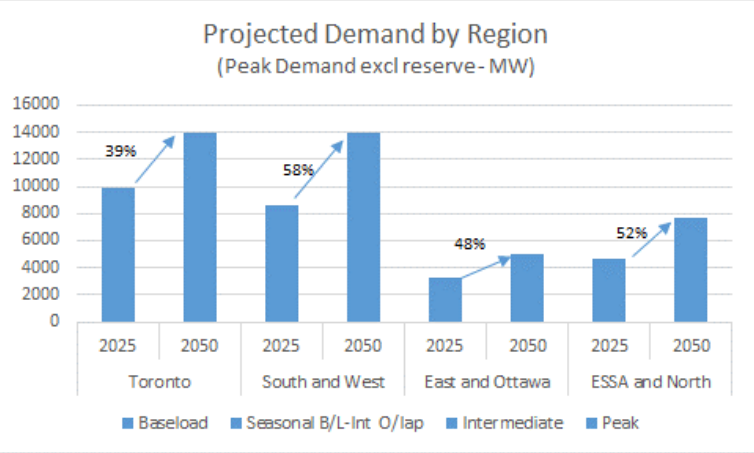
[2] British Columba and Quebec have been declining data centre and other connection requests due to anticipated supply shortage risks. https://www.nationalobserver.com/2024/02/06/news/bc-hydro-power-crypto-mining-company, https://news.gov.bc.ca/releases/2024EMLI0018-000470. Quebec is prioritizing connection opportunities that are the most economically beneficial. Quebec authorizes nearly 1,000 megawatts of electricity for 11 industrial projects, November 11, 2023 - CTV News.

1 – *Emerging risks are concealed in the IESO's 2024 APO conservatively, low demand forecast*

The IESO's "*Annual Planning Outlook (APO)*" is the guiding planning document for its bulk system development and procurement activities. The PWU's first paper contrasted the substantially lower 2024 APO demand forecast to consensus opinion of other widely supported forecasts for achieving a NZ Ontario economy. Specifically, the APO's projected 60% energy growth and 40% capacity growth is less than half the respective growth identified by other stakeholder developed Net Zero forecasts for the province. This stems from the IESO basing its 2024 APO demand development on "*all firm/known policies, industrial projects, the Industrial Conservation Initiative and federal EV targets for 2035 at the time of development*".[3] Additional electrification trends were not included in developing the forecast. A notable example is the demand from data centres, which is based on year-old March 2023 information.[4] Since the 2024 APO reflects much higher demand than was considered for the near term in the Pathways to Decarbonization Study (P2D) and approximately the same demand as the P2D summer forecast may suggest to readers that the APO has considered fuller electrification of the economy. However, this could be misleading to decision makers. While the 2024 APO has adequately modelled the electrification implications from light duty transportation vehicles,[5] it has omitted several significant factors. For example, the 2024 APO considers only about 22% of the electrification of Ontario's heavy-duty transportation fleet, ignores most of the electrification of heating, and excludes all but token amounts of electrolytic hydrogen production – all critical elements of achieving a NZ economy.

Finally, the comparative results to the P2D are almost exclusively due to approximately 3 GW of industrial demand growth in the Southwest and Northern regions of Ontario. This industrial growth would need to be added to the P2D forecast to allow a fair comparison. Figure 1 shows how growth in peak demand (e.g. capacity needs) in the West and North regions exceeds 50%, where industrial growth is predicted, and is less than 40% in Toronto where industrial growth is absent.

FIGURE 1 – REGIONAL DEMAND GROWTH HIGHLIGHTS ABSENCE OF APO ELECTRIFICATION ASSUMPTIONS



[3] IESO 2024 APO Webinar, April 2024.
[4] Stated during the IESO April 23, 2024, APO webinar.
[5] The 2024 APO demand projections for transportation align closely with the Green Ribbon Panel 2021 report assumptions for light duty vehicles and 20% of heavy-duty vehicles.

By comparison, the IESO has adopted a demand forecast by the City of Toronto in the IESO's regional plan, that projects almost 60% summer capacity growth and over 65% winter capacity growth. It is laudable that these demand forecasts by the City of Toronto have taken a risk-informed approach. This provides a base case that reflects a probabilistic estimate of demand scenarios and also a further high case demand scenario for additional guidance. The IESO openly acknowledged that it anticipates its demand forecast will rise over the next year as they "*gain learnings*".[6] This reinforces the likely continuation of the trend of increasing capacity shortfalls in the IESO's annual planning efforts that the PWU introduced in the first paper of this series. To mitigate this trend, a risk-informed approach to resource adequacy has been previously recommended.[7]

The PWU has consistently advised the IESO to align its demand assumptions for regional planning with its APO.[8] Over the last few years, there has been a notable lag between the regional planning assumptions and the increasing demand forecast of each APO release. This increases the risks that regional plans may be significantly underestimating the infrastructure requirements of Ontario's bulk electricity system. The assumptions in the City of Toronto's regional plan are now out of sync with the APO by reflecting the more appropriate higher implications of electrification on the demand forecast, underscoring the risks that the APO represents to the bulk system transmission planning efforts that the Ministry has directed the IESO to undertake. **The PWU recommends that the IESO better align its assumptions for its internal planning activities and more fully consider the implications of electrifying Ontario's economy in its plans underway in 2024**.

2 - *The risks in Ontario's near-term resource acquisition approach are amplified by the conservative APO demand forecast.*

The reliability of Ontario's electricity system is also dependent upon the province's approach for securing the necessary supply. The IESO has a four-pronged resource adequacy framework (RAF): three mechanisms managed by the IESO; and, a government-directed bilateral negotiated contracts mechanism.[9] The IESO's three mechanisms include: Capacity Auctions that offer 1 year supply commitments; Medium Term (MT) procurements consisting of a Request for Proposal (RFP) process for re-securing existing resources with 5 year operating commitments; and Long-Term (LT) procurements addressing needs 5 years out with 20+ year commitments. It is notable that most of Ontario's supply has been secured under government directed bilateral contracts and this will continue given the POG-based nuclear and hydro directives. The IESO has currently completed its procurement mechanisms for the periods up to 2029, although the results of its LT1 RFP process have not yet been made public.

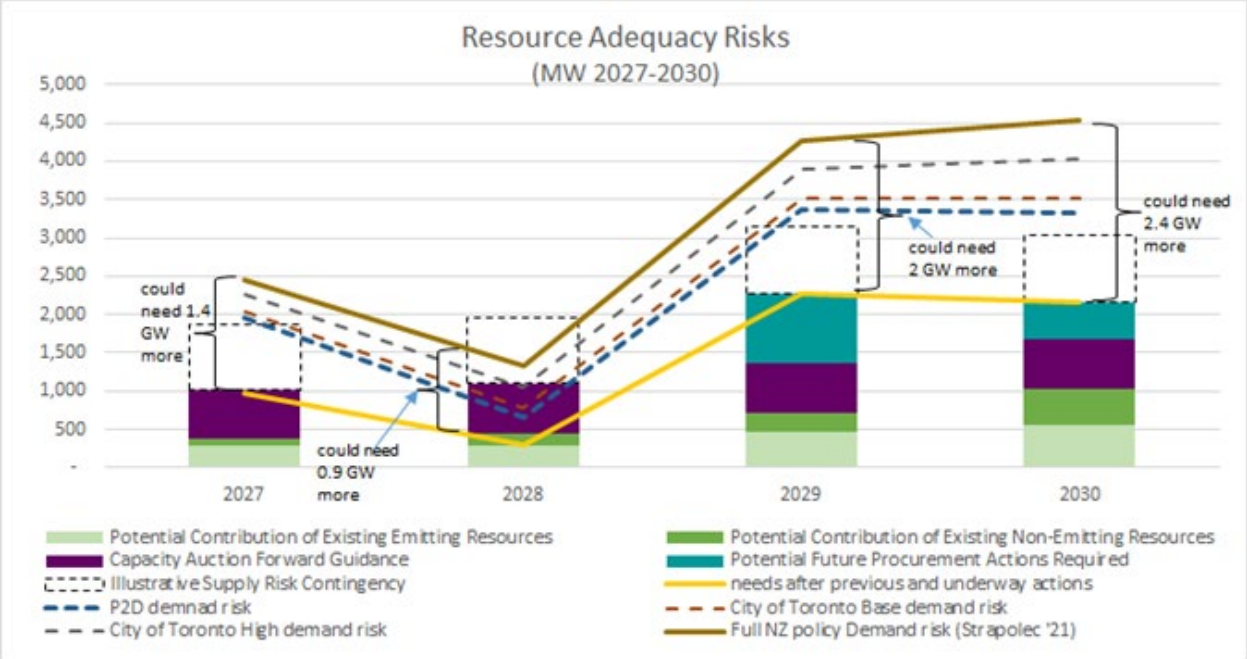
In comparison to its overall conservative demand forecasting approach, the IESO's APO reflects some aggressive assumptions on resource availability. The APO assumes continued participation growth in the Industrial Conservation Initiative (ICI) and the Capacity Auction. The ICI is more likely to see declines as the projected Hourly Ontario Electricity Price (HOEP) will devalue the benefit to ICI participants. While recent Capacity Auctions have achieved the projected outcomes, they rely on gas-fired generation and imports from the U.S. and Quebec.

[6] IESO remarks during the 2024 APO Webinar held Apr 23, 2024.
[7] PWU submissions to the IESO's Resource Adequacy consultations, 2019-2021; GRP, 2021; Strapolec, 2021.
[8] PWU submissions to the IESO regional and bulk system planning efforts from 2021 to 2023.
[9] IESO RAF is summarized in IESO Update to Government, Dec, 2023, "Evaluating Procurement Options for Supply Adequacy." RAF also includes programs not explicitly addressed by this paper.

These resources may not be available in the future as the IESO converts resources to longer term frameworks and demand in neighboring jurisdictions grows, limiting their export capability.

The combined consequences of the near-term demand and supply risks are illustrated in Figure 2 showing that Ontario could face a near-term reliability risk of a 3 GW resource shortfall by 2030.[10] If this shortfall occurs, Ontario could face brownouts in the late 2020s. In its 2024 APO the IESO indicated that extending the operation of the aging, 2 GW Lennox facility could provide a possible future risk mitigation. This would still leave a 1 GW shortfall that can be exacerbated by new demand, e.g., a new Honda battery plant in Alliston.[11] The IESO has likely run out of time to begin procuring to mitigate the risks of this shortage.

FIGURE 2 – POTENTIAL RISK CONSEQUENCES OF THE APO'S DEMAND/SUPPLY ASSUMPTIONS



Recommendation 23 in the EETP's Report stated that: … "*the ministry should: Reflect in planning, policy-making and direction to the IESO and the OEB that in the rapid shift to electrification and the transformation toward a clean energy economy the risk-return balance between proactive build-out of energy infrastructure and reactive planning has shifted.*" **The PWU recommends that the IESO conduct a risk-informed demand and supply forecast and that the OEB's new planning oversight role recommended by the EETP include an assessment of the appropriateness of any chosen risk-informed approach.**

3 - *The current long-term procurement focuses on energy supply post 2030; however, its misaligned performance criteria will not mitigate Ontario's risk of an energy shortfall.*

[10] Solid bars from 2024 APO, lines and notes reflect Strapolec analysis. The 3 GW includes the shown 2.4 addition and the 600 MW of Potential Future Procurement Actions identified in the 2024 APO.
[11] https://news.ontario.ca/en/release/1004485/honda-to-build-canadas-first-comprehensive-electric-vehicle-supply-chain-creating-thousands-of-new-jobs-in-ontario.

The APO identifies three LT procurements under development: LT2 for 2030 supply; LT3 for 2032 supply; and LT4 for 2034 supply. The IESO is currently developing the LT2 RFP with the stated objective of addressing a 5 TWh unserved energy need.

The approach to the LT2 RFP has several weaknesses that will inhibit the acquisition of the supply needed to address Ontario's energy shortfall:[12]

- While the stated purpose of the LT2 RFP is to address "unserved energy", no explicit definition of that term is provided in the LT2 RFP materials. As well, the conditions under which the energy is to be supplied by the generation being procured is not provided;
- The LT2 RFP is seeking to procure 2000 MW of installed capacity to provide the 5 TWh of energy required, with a strong bias to securing renewables. The subsequent LT3 and LT4 RFPs are currently defined to target an additional 1.5 GW each. Together, these measures will not meet the stated needs; and,
- The LT2 RFP's five-year development time and rated non-curtailed cost of energy criteria favours independent wind and solar solutions, which cannot meet the unserved energy requirement.

The energy shortfall is defined in the 2024 APO as shown in the extracted figures below. It is noteworthy that the energy shortfall is expected to be present only 45% of the time by 2035, even less frequently in 2030. The estimated unserved energy in 2030 by Time of Use (TOU) periods shows a significant energy shortfall in winter and for the On- and Mid-peak periods in summer. Solar cannot contribute to the winter shortfall, even though the LT2 RFP criteria heavily favours solar solutions. Wind cannot supply the on-peak energy in summer. Furthermore, the 2030 peak needs of 6771 MW are much higher than the 2000 MW being procured.

FIGURE 3 – APO EXHIBITS FOR UNSERVED ENERGY

Figure 20 | Unserved Energy Duration Curve (As Is Case)

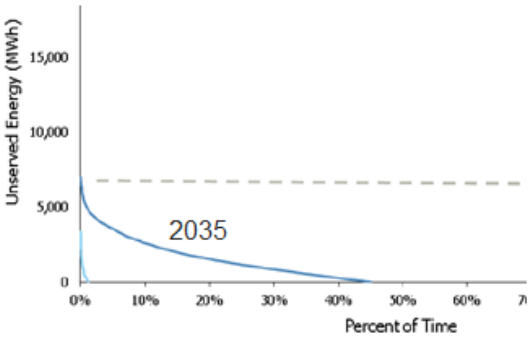


Figure 13| Total GWh Unserved Energy by TOU periods (High Nuclear Case)

	Winter			Summer			Shoulder		Annual
Year	On-Peak	Mid-Peak	Off-Peak	On-Peak	Mid-Peak	Off-Peak	Mid-Peak	Off-Peak	Total
2025	2	2	2	1	2	5	45	16	74
2030	1,016	1,025	987	856	1,106	289	585	118	5,981

Figure 17 | Max MWh Unserved Energy by TOU periods (High Nuclear Case)

	Winter			Summer			Shoulder		Annual
Year	On-Peak	Mid-Peak	Off-Peak	On-Peak	Mid-Peak	Off-Peak	Mid-Peak	Off-Peak	Max
2025	809	935	407	405	537	2,087	3,358	3,098	3,358
2030	5,348	5,587	5,359	6,771	6,684	3,751	4,535	3,747	6,771

Most importantly, analyses show that the wind resources required to supply the 5 TWh of unserved energy at the times of the energy shortfall would require closer to 10 GW of wind resources, plus additional solar resources for summer which would still be unable to address the peak needs. The APO acknowledges the risk of misalignment between renewables resources and the stated energy shortfall but offers no solutions other than an extension of the operating life of the Lennox facility and to revisit any shortfalls in future APOs [at the cost

[12] PWU submissions to the IESO on its LT2 RFP design, January and February, 2024.

of a one-year delay]. There is no alignment between stated objective for the RFP to address the unserved energy and the LT2 RFP approach for securing renewables solutions. The PWU believes that this misalignment results in decision-makers, investors and the public being mis-informed about the true procurement objectives.

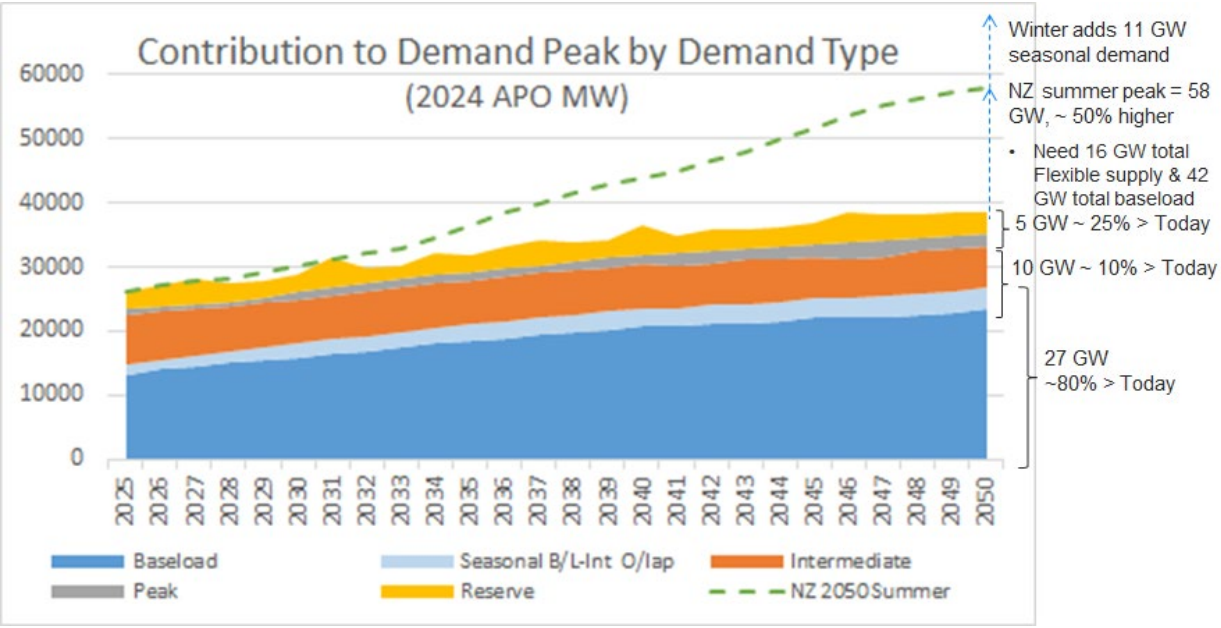
Proper specifications of the emerging system needs and the rating criteria for compliance is required in the IESO's procurement materials to ensure the reliability of the system.

Part of the IESO's challenge in developing these RFPs is due to its bias for using administered markets in procuring Ontario's needed energy resources. Numerous analyses show that electricity markets are ill-suited for procuring the non-emitting resources required to meet Ontario's supply mix requirements and that a different approach is warranted.[13] Ontario's resource adequacy needs would be better met by resource procurements that align with the province's growing baseload demand.

4 - *The resource adequacy framework for procuring resources does not align with the needs of Ontario's electricity system, notwithstanding the POG directives.*

Demand will be growing faster than the APO has planned and creating both supply gap risks and a "dirtier" electricity system. Ontario's electricity demand includes baseload, intermediate, and peak/reserve characteristics [See Appendix A for definitions]. Demand is best not viewed by capacity and energy terms. Based on a detailed hourly forecast by year from the 2024 APO, Figure 4 illustrates the evolving needs of Ontario's electricity system by the aforenoted types of demand.

FIGURE 4 – EVOLVING NATURE OF DEMAND REFLECTED IN THE 2024 APO



[13] Strategic Policy Economics, "Electricity Markets in Ontario", 2019.

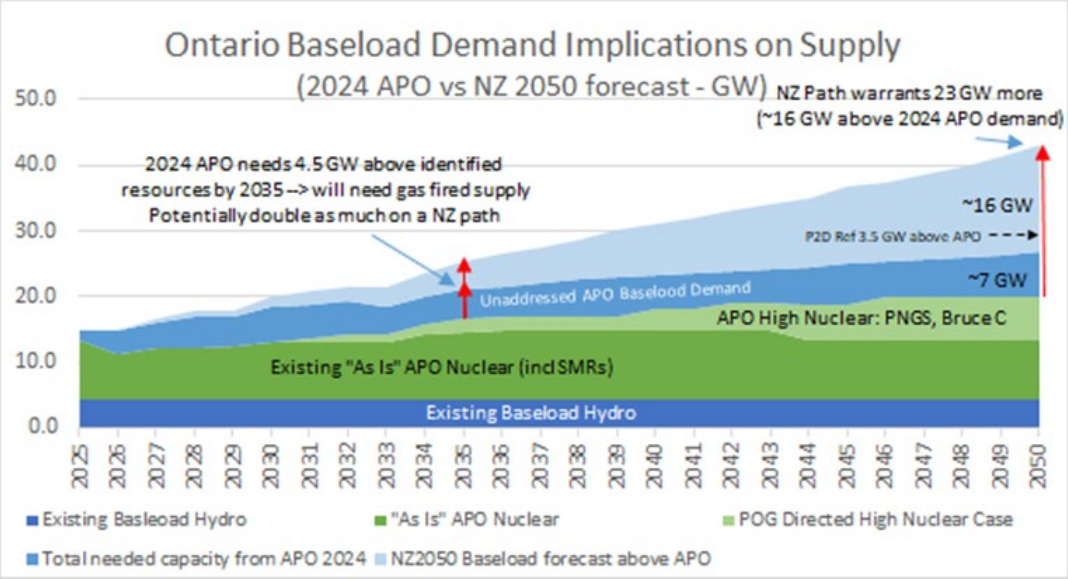
Most of the growth is for new baseload demand with only modest growth for intermediate and peaking/reserve supplies. The APO assumption of substantial demand side management (DSM), such as managed EV charging profiles that move demand from peak hours into off-peak hours, provides one reason for this growth in demand for baseload supplies. It is worth noting that Ontario already has ~ 13.5 GW of flexible supply. Renewing the existing natural gas, bioenergy, hydropower and battery resources would almost be sufficient to meet the intermediate, peak and reserve capacity needs in 2050, according to the 2024 APO. Furthermore, the LT1 RFP objectives to secure 2500 MW of new capacity may close any remaining gap, even for the NZ 2050 forecast.

As a result, Ontario's most urgent need is to secure baseload resources as Ontario's existing gas-fired fleet is best suited to meet on-going system intermediate and peak/reserve needs. The IESO's current approach to procure capacity and unserved energy on the margin relies upon the existing fossil fleet to provide the required baseload energy – this increases emissions from Ontario's electricity sector. **The IESO should be procuring for baseload supply not additional flexible resources, beginning now with the LT2 RFP.**

The P2D report recognized the importance of new baseload supplies and identified a need for over 18 GW of new baseload supply by 2050[14] and a "no-regrets" recommendation that hydroelectric and nuclear options be evaluated. As a result, the POG has directed procuring additional SMRs, the refurbishment of Pickering and an assessment of the need for additional units at Bruce Nuclear Complex — all of which are now reflected in the 2024 APO high nuclear scenario.

Figure 5 illustrates the outcome of these directives in the context of the baseload demand defined by the APO, a Net Zero scenario and the P2D identified potential for new nuclear and hydropower.

FIGURE 5 – ONTARIO'S GROWING NEED FOR NEW BASELOAD SUPPLY



[14] Including both new nuclear and new hydro.

According to the APO forecast, by 2035 Ontario needs 4.5 GW additional baseload over the APO's high nuclear supply case and 7 GW by 2050. Given the lengthy nuclear and hydroelectric baseload resource development timelines, the near-term emergence of a sustained 4.5 GW of new baseload demand can only be supplied with gas-fired facilities - a challenge given recent public objections. This is more challenging for the NZ forecast as there may be insufficient time to develop even gas-fired generation. Additionally, relying on baseload natural gas generation to support Ontario's new storage fleet will increase both emissions and cost. **Ontario requires a transparent transition strategy for non-emitting baseload resources required to displace the use of gas-fired generation, while mitigating the risks of stranding assets acquired to address near term risks.**

While renewables solutions to the baseload challenge could reduce the emissions from a full natural gas-fired option, analyses show it would require, for example, an integrated solution of 12 GW of wind, 3 GW of natural gas-fired generation and 3 GW of 24 hour storage – four times as much new capacity to be sited and an additional incremental amount of transmission.[15] Even then, 30% of the emissions would still remain.

Given the forecast baseload needs associated with a NZ scenario, the viability of developing 23 GW of new hydro and nuclear facilities by 2050 will be challenging to say the least. It is clearly evident that Ontario will need to continue operating a significant natural gas-fired fleet at high operating factors well past 2050. This problem will persist as the IESO has not reframed its procurement approach and / or demand forecasting methodologies despite the substantial advice it has received beginning in 2019.[16] **Ontario is best served by accelerating the procurement of non-emitting, long-economic life resources, e.g. nuclear, for reliable and affordable baseload.**

As well, the IESO's response to the Environment and Climate Change Canada (ECCC) draft Clean Electricity Regulation (CER) understates Ontario's continued reliance on natural gas-fired generation.[17] The IESO's recommended 30-year end of life provision will see most gas facilities retired by 2045, 10 years later than the ECCC's preference, but potentially 10 years sooner than Ontario will need. The IESO's conservative demand forecasting approach effectively misinforms policy makers on the urgency needed to address Ontario's NZ electrification challenge.

The IESO should develop a reliability-risk-informed, long-term demand forecast with horizons that encompass anticipated development timelines for the large-scale bulk system resources e.g., nuclear. Two key criteria would include: IESO compliance with the North American Electricity Reliability Corporation's (NERC) Loss of Load Expectation (LOLE) requirement of no more than 0.1 days per year; and, full and appropriate consideration of the future demand risks associated with electrification as identified by the consensus opinions of aforenoted reports. The recent Cost-Effective Energy Pathways Study received by the Ministry of Energy in December 2023, but not yet publicly disclosed, may be a valuable reference.

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[15] High fidelity system models are required to analyse these implications as described in the PWU's November 2023 submission to the ECCC on the CER.

[16] PWU submissions to the IESO's Resource Adequacy consultations, 2019-2021; PWU submission to the MENDM, May 2021; GRP, 2021; Strategic Policy Economics: "Electrification Pathways for Ontario", 2021 and "Electricity Markets in Ontario", 2019.

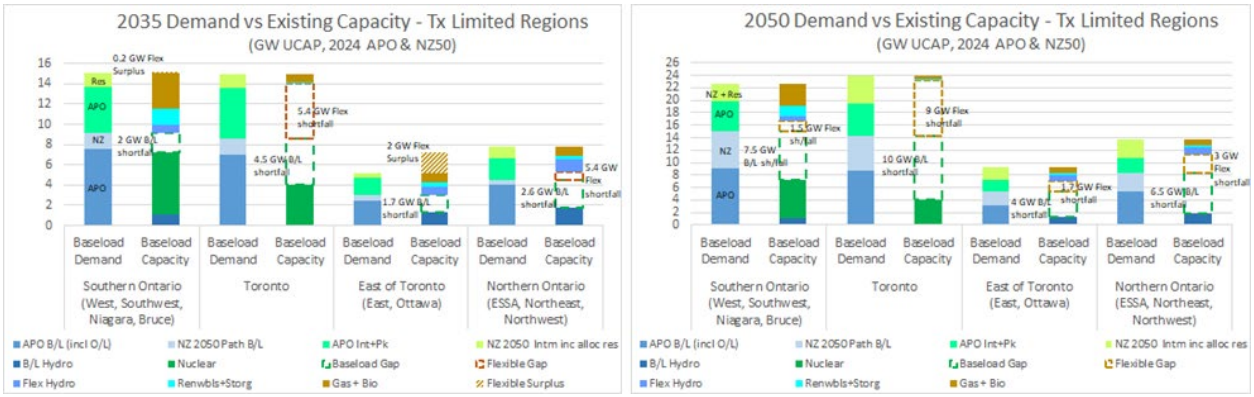
[17] P2D Report, 2022, Section Gas Moratorium, IESO submission to the ECCC on the CER, Nov 2023; IESO submission to the ECCC, March 2024.

5 - *Zonal transmission interconnection constraints warrant consideration of regional reliability needs.*

Ontario has been segmented into zones based on constraints in the transmission system that have evolved over time. The zonal demand implications for 2035 and 2050 are illustrated in Figure 6 in contrast to existing supply capacities.[18] This figure highlights the emerging regional needs for both flexible and baseload supply. A lack of flexible supply options is apparent, particularly for Toronto, in both the 2035 and 2050 forecasts, with flexible supply shortfalls identified in all zones by 2050.[19]

The apparent gaps in anticipated baseload supply across all zones in both 2035 and 2050 underscore the need for an Ontario baseload procurement strategy. There are no known options for supplying the regional baseload gaps in 2035. Even after including the 2 GW of refurbished Pickering nuclear reflected in the APO's high nuclear case, Toronto could face a baseload supply shortfall of 2.5 GW in 2035. With all zones forecast to have shortfalls and considering transmission system uncertainty, planning, development and timeline implications, new generation resources may best be prioritized for local supply within each region. Meeting Toronto's need requires the development of new generation resources, either within Toronto or in neighbouring zones that will already be baseload-supply-challenged. Transmission capacity around Toronto could be as high as 12 GW suggesting that there may be no limitation to supply options by 2035,[20] however there may be material restrictions by 2050 that could impact bulk system generation choices.

FIGURE 6 – ONTARIO MAJOR ZONAL DEMAND AND SUPPLY BALANCE FORECAST



By 2050, even including the high nuclear case [not shown], Southern Ontario is forecast to be 3 GW short of baseload supply, Toronto 8 GW short and the expected 10.5 GW in the East and

[18] Based on APO zonal demand data and generating resource database. The generation resource database has been corrected for missing hydro data including Mattagami, some small hydro and an overall 5% gap scaled across all regions. The 2035 illustrated surplus east of Toronto is almost entirely due to the Lennox GS which is unlikely to be operating by 2035, given its age. For existing nuclear, Pickering excluded, SMRs included per IESO As Is case. High nuclear case not shown. Supply options do not reflect the unannounced outcomes of the LT1 RFP.

[19] Note that most flexible supplies will have come off contract by 2035 and so the illustrated flexible supply shortfalls underrepresent the procurement needs.

[20] IESO, Transmission System energy flow charts, 2018, which the IESO is no longer publishing; APO 2024: Ontario's Transmission Interfaces and Interties.

North are not addressed. These supply shortages present significant implications for the planning of the future bulk system. Given the transmission bottleneck in and around Toronto, the needs of the North could be best addressed by resources located in the North. Toronto's needs and those in the East may best be addressed by new baseload resources sited in the East. And finally, the needs of Southwest Ontario could require much more than the POG-identified Bruce C additions. Despite how location of new supply options will impact the long-term development of the bulk transmission system, the APO defers discussion on these matters.

Ontario needs a long-term baseload supply strategy in order to characterize the timing and resource location options and to better identify and inform the provincial bulk transmission system requirements definition.

Ontario's electricity system and its reliability are interconnected with neighbouring jurisdictions. Historically, Ontario has imported from Quebec in the summer and exported to Quebec in the winter. Recently, on average Ontario has exported electricity to the U.S. from the Southwest. However, forecasts indicate that all neighboring jurisdictions are experiencing their own supply challenges. Ontario should not be assuming electricity imports will be available to meet the province's needs before and beyond 2035. Alternatively, these shortfalls in neighboring jurisdictions could represent an economic opportunity for Ontario generators. **A more prudent electricity plan would address the downside risks and upside opportunities including how the emerging need in the U.S. may provide a risk mitigation against unintended generation surpluses in Ontario.**

CLOSING – *Ontario should identify and procure reasonably available, low carbon, cost-effective supply options by region*

This paper described the urgent need for Ontario to revise its electricity planning approach that better considers: the emerging demand from electrification; the associated risks of supply shortfalls; the significant growth in baseload demand; and, the integration of regional baseload needs into a provincial baseload resource plan. **There is minimal risk for Ontario to aggressively build out non-emitting baseload supply which may instead enable upside opportunities.**

The next discussion paper will explore the affordability risks presented by this new demand given Ontario's current procurement approach, including: gaps in accountability; the efficacy of Ontario's IESO administered electricity markets; the IESO's timeline for procuring medium and long-term low-carbon resources; and, the effectiveness of regional planning.

For over seventy years, the men and women of the PWU have played a critical role helping to keep the province's lights on. The PWU remains a strong supporter and advocate for the prudent and rational reform of Ontario's electricity sector and recognizes the importance of planning for low-cost, low-carbon energy solutions to enhance the competitiveness of Ontario's economy. The PWU has a successful track record working with other energy stakeholders to strengthen and modernize Ontario's electricity system. The PWU is committed to the following principles: Create opportunities for sustainable, high-pay, high-skill jobs; ensure reliable, affordable, environmentally responsible electricity; build economic growth for Ontario's communities; and, promote intelligent reform of Ontario's energy policy.

APPENDIX A – DEFINITION OF DEMAND TYPES

Demand consists of three types:

- Baseload demand is present 24x7, 365 days per year and in Ontario have been typically supplied by nuclear and hydro.
- Peak/Reserve demand arises rarely, substantially less than 5% of the time and is best served by classic peaking supplies e.g., natural gas, but now evolving to use more storage.
- Intermediate demand is the demand that varies on a daily, weekly and seasonal basis and has typically been served by flexible supplies such as hydro, storage and gas-fired generation. Demand Side Management (DSM) resources, such as bidirectional EV charging and building energy management systems help moderate the volatility associated with intermediate demand. The use of renewables requires integrated solutions that include all of the above resources to provide backup and help optimize output.

As part of the APO background materials, the IESO has provided the hourly demand forecast for every year up to 2050 and also by region.

The figure below illustrates the above definitions using the APO provided data for its 2025 forecast. **The PWU recommends that the IESO's procurement approach be based on detailed specifications and characteristics for procuring each demand type instead of using the abstract concepts of capacity and energy**.