Annual Planning Outlook

Supply, Adequacy and Energy Outlook Module

December 2021

ieso
Connecting Today.
Powering Tomorrow.

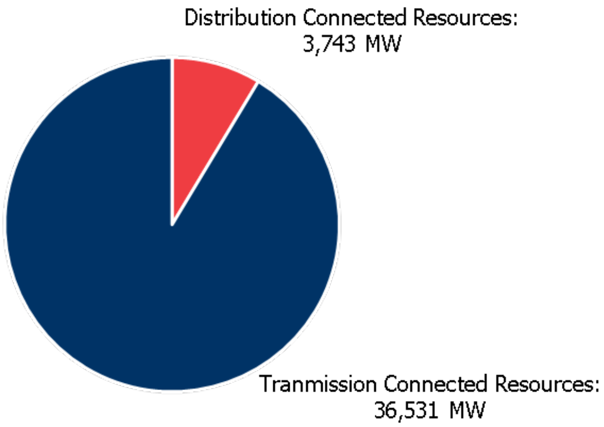
Table of Contents

1. Supply Outlook

1.1 2022 Transmission and Distribution Connected Installed Capacity

Of the approximately 40,275 MW of installed capacity that exists in the system today, about 91% is connected to the transmission system whereas the remaining 9% are connected to the distribution system. The transmission connected resources are generally connected to the IESO controlled grid and are mostly market participants. However, the distribution connected resources tend to be embedded resources consisting of either contracted or rate-regulated resources, and are mostly non-market participants. The distribution connected resources excludes behind the meter resources that do not have a contract with the IESO as the IESO has limited visibility of these resources. In 2022, there is 36,531 MW installed capacity of transmission connected resources and 3,743 MW installed capacity of distribution connected resources.

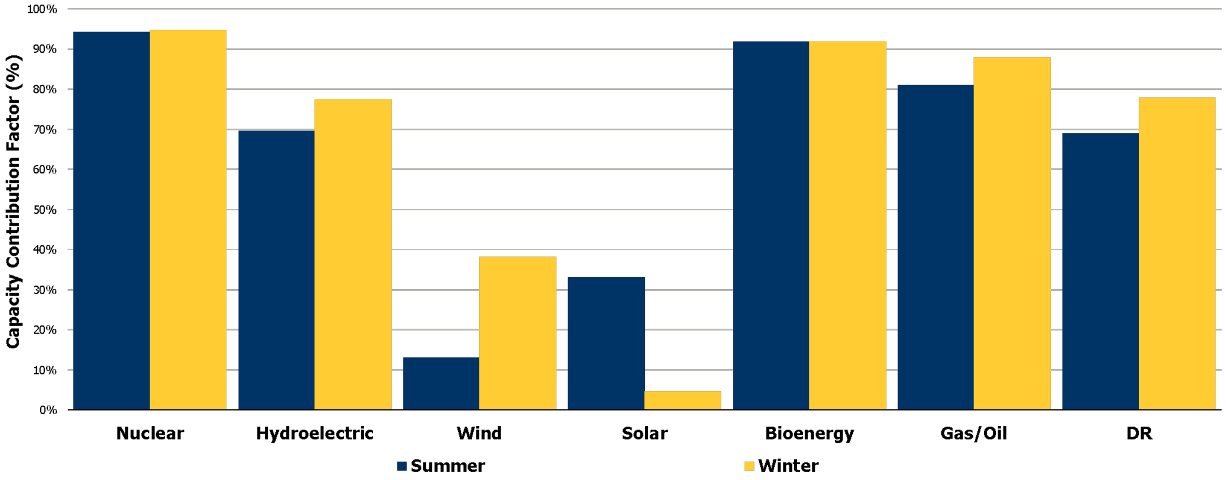
Figure 1 | 2022 Installed Capacity



1.2 Summer and Winter Capacity Contribution

Figure 2 represents the summer and winter capacity contribution by fuel type. As shown below, these values are higher in the winter than summer except for solar.

Figure 2 | Summer and Winter Capacity Contribution



Capacity contribution factors reflect forced outages as well as reductions due to ambient conditions. The reasons for the differences in contribution by season are as follows:

- Nuclear units do not exhibit much variation between summer and winter capacity contributions though they can exhibit lower availability at times due to environmental constraints in summer.
- Hydroelectric capacity contribution factors are higher in the winter due to increased water availability.
- Wind capacity contribution factors varies throughout the year as a result of seasonal wind patterns. Wind speeds are typically higher in winter causing increased average production compare to summer resulting in higher contribution factors in winter.
- Solar contribution factors vary throughout the day, with the highest from noon to mid-afternoon. Since demand peaks are later in the evening in the winter, solar factors are lower in the winter and higher in the summer.
- Bioenergy resources are generally not sensitive to ambient temperatures and therefore are largely the same throughout the year.
- Gas/Oil units are sensitive to ambient temperatures, therefore have lower capacity contribution in the summer as units operate less efficiently under higher ambient temperatures.
- Demand Response (DR) capacity contribution factors are based on the DR historical performance from past DR activations and DR test results. Based on historical performance, higher contribution was recorded in winter compared to summer.

1.3 Energy Storage Resources

The procurement of energy storage resources at the IESO began in 2012 with the Alternative Technologies for Regulation (ATR) procurement. In 2014, the IESO initiated a competitive energy storage procurement framework that included two consecutive phases. The two-phase pilot procurement supported the province's efforts to better understand the integration of energy storage into Ontario's electricity system and market.

Under ATR and Energy Storage Phase 1, a total of 12 MW is under contract with IESO. Another 9.75 MW are contracted through Phase 2. However, these facilities have limited contribution to meeting reliability needs as they are all pilot projects for testing purposes only.[1] One 7 MW storage project cleared the December 2020 auction with a summer effective capacity of 1.7 MW.

Ontario currently has a 175-megawatt pumped hydro storage facility as part of the Sir Adam Beck complex. This facility is reflected in the adequacy and energy assessments under the hydroelectric resource category.

---

[1] More information on this pilot can be found on IESO's Energy Procurement Programs and Contracts website.

2. Capacity Adequacy Outlook

2.1 Nuclear Refurbishment Reserve

Resource adequacy assessments reflect additional planning reserve to manage the risk of nuclear refurbishment project delays. The planning reserve for nuclear refurbishment has been updated to reflect updates to the nuclear refurbishment schedule for Darlington NGS and Bruce NGS. The contribution of this additional planning reserve on summer and winter adequacy needs is shown in Figure 3 and Figure 4, respectively.

Figure 3 | Planning Reserve for Nuclear Refurbishment, Summer

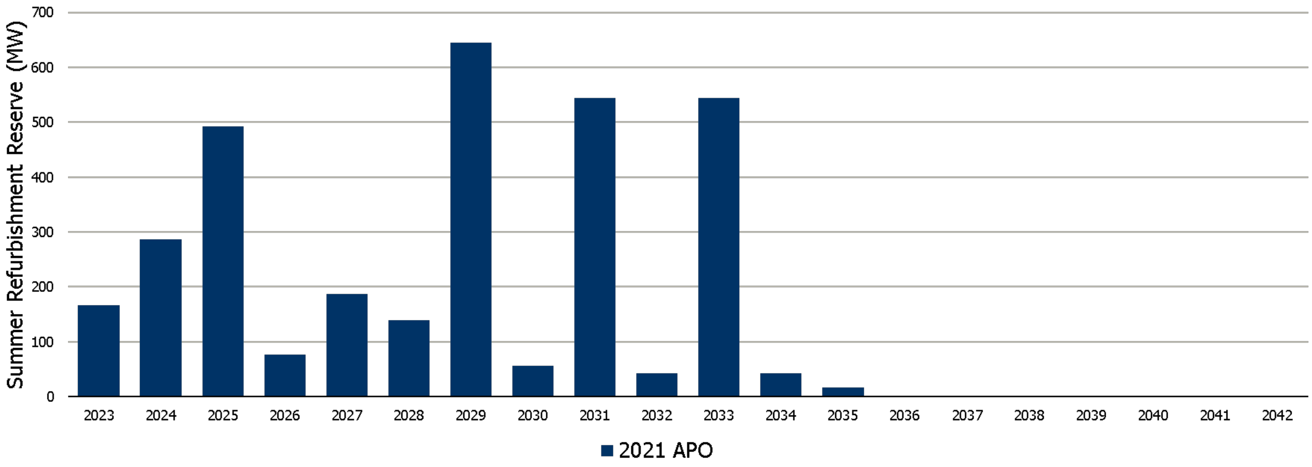
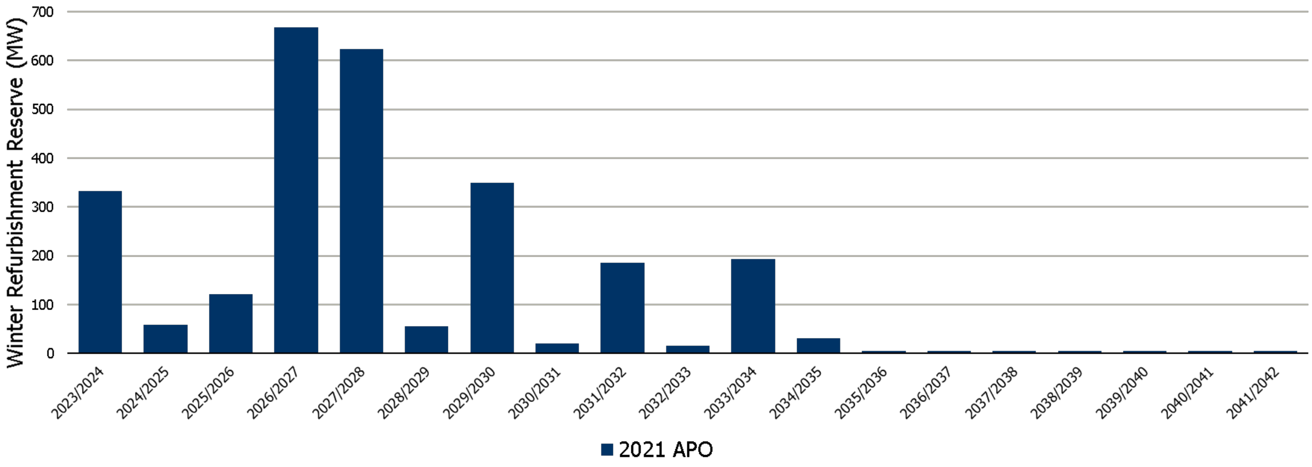


Figure 4 | Planning Reserve for Nuclear Refurbishment, Winter



2.2 Seasonal LOLE Allocation

The IESO's resource adequacy criteria require an annual loss-of-load expectation (LOLE) of 0.1 days/year. The criteria do not provide guidance on how the LOLE should be allocated across seasons. The IESO allocates LOLE across seasons to minimize capacity needs, based on the prevailing supply and demand conditions within a given year.

In the long-run, internal studies have shown that annual average resource requirements are minimized when the LOLE is split 0.06 days/year in summer and 0.04 days/year in winter. In the near-term, different allocations minimize the resource requirements. The 2021 APO LOLE allocation is shown in Table 1 and Table 2.

Table 1 | Summer LOLE Allocation

Season	2023	2024	2025	2026-2042
Target LOLE (days/year)	0.09	0.09	0.09	0.06

Table 2| Winter LOLE Allocation

Season	2023/24	2024/25	2025/26	2026/27-2042
Target LOLE (days/year)	0.01	0.01	0.01	0.04

The impact of the 2021 APO LOLE allocation, described in the previous paragraph, compared to the long-run 60/40 assumption is shown in Figure 5 and Figure 6 for summer and winter, respectively. The capacity surplus/deficit values are shown assuming the continued availability of existing resources. This LOLE allocation has the effect of reducing winter surpluses and lowering summer needs.

Figure 5| Impact of 2021 APO LOLE Allocation vs. Long-Run Assumption, Summer

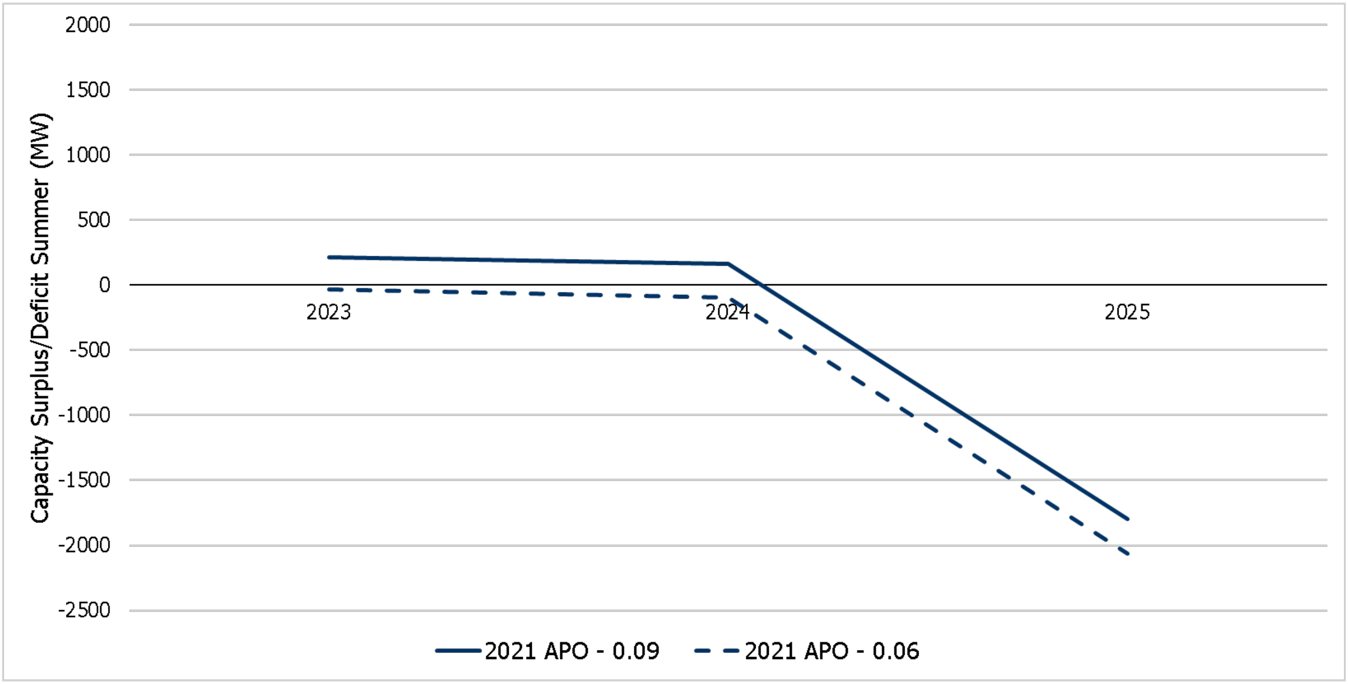
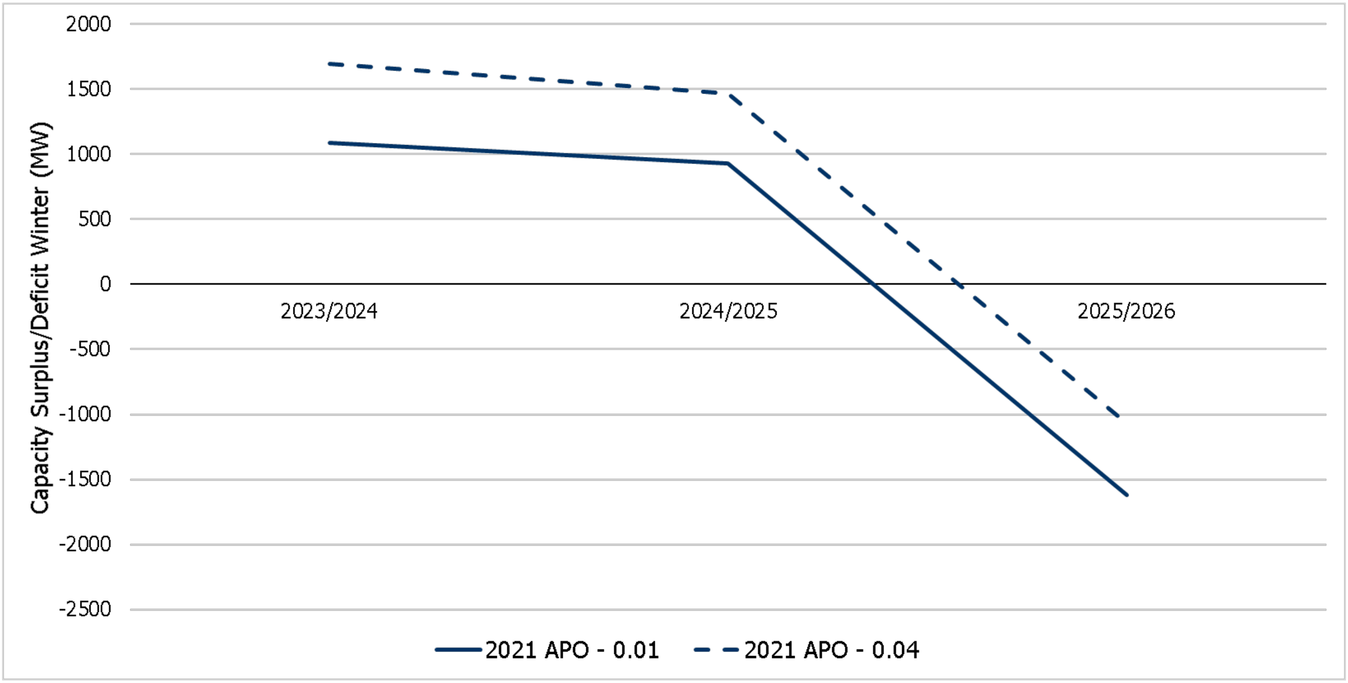


Figure 6 | Impact of 2021 APO LOLE Allocation vs. Long-Run Assumption, Winter



2.3 Capacity from Hydro Quebec per Ontario-Hydro Quebec Trade Agreement

Ontario currently provides 500 MW of capacity to Hydro Quebec (HQ) during Quebec's winter peak periods. This agreement is in place until winter 2022/23. The winter capacity adequacy assessments shown in the APO reflect this amount of capacity being unavailable up until the end of the commitment period.

The IESO has the option to call on 500 MW of import capacity from HQ to contribute towards resource adequacy. This option is available in any summer prior to 2030. It would reduce the need to acquire capacity in the amount/year exercised. The summer capacity adequacy assessments shown in the APO are before the use of the 500 MW HQ import capacity. However, when the decision is made to commit this capacity, it will be reflected in summer resource adequacy assessments.

2.4 Zonal Constraints

Zonal adequacy constraints are available in the 2021 APO, Chapter 5 and for a detailed methodology refer to the 2021 APO Resource Adequacy and Energy Assessment Methodology document. This section provides details on these constraints.

Transmission interface transfer capabilities can have an impact on the extent to which a resource can contribute towards adequacy. The 0.1 days/year LOLE criteria is not set at a zonal level – it is an adequacy target for the province as a whole. The same LOLE can be achieved by placing resources in different locations. However, some locations may be better than others as a result of interface limits.

Zonal adequacy constraints help identify where adequacy needs exist across the system and where they can most effectively contribute towards meeting resource adequacy needs. The zonal constraint curves described below only reflect adequacy needs and not security needs. Security needs are considered as part of a transmission assessment and may lead to additional constraints on the amount of capacity acquired in a zone. The zonal constraints reported in the APO reflect resource adequacy and security constraints.

For the zones without minimums, the assumption is the zone's adequacy needs would be satisfied by acquiring the system's capacity need while not violating the zonal maximums. For zones without maximums, it implies that the true maximum is outside the scope/upper bound of the model and any capacity acquired would be capped at the provincial capacity need. Although zonal maximums limit the amount of capacity that can be added to a zone, the total amount of capacity added to all zones is limited by the global resource adequacy (capacity) need.

As noted in the 2021 APO Resource Adequacy and Energy Assessment Methodology, for each zone (or group of zones) that has a limited transfer capability in or out (of the study zone), a zonal constraint curve is developed that represents the system LOLE as a function of study zone incremental capacity MWs, while the total amount of incremental capacity is held constant.

Where the curve slopes upwards, MWs in the study zone become less effective than MWs in the rest of the system for satisfying resource adequacy, and a zonal constraint can be established at or near where the curve diverges from, or crosses, the flat section of the curve as seen in Figure 7.

Figure 7 | General Shape of Zonal Constraint Curve

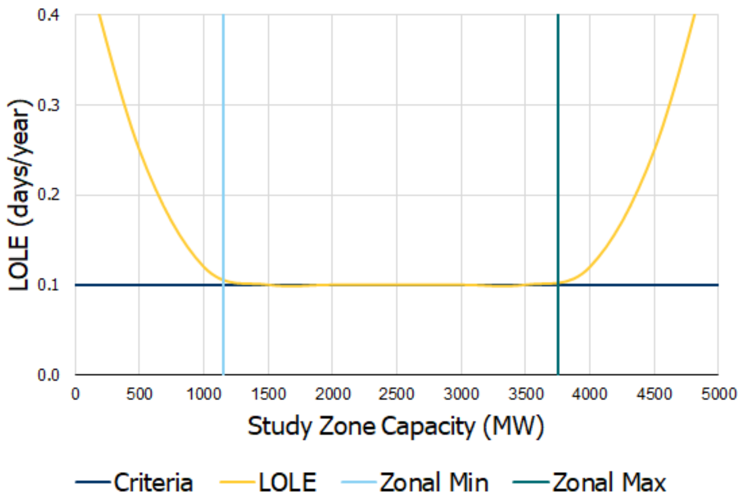


Table 3 and Table 4 provide a summary of the zones and their defining interfaces considered in the zonal adequacy assessment along with the assumed transmission transfer capability across each interface.

Table 3 | Zones and Defining Interfaces

Area	**Interface**
Bruce	FABC
Niagara	QFW
Northwest	E-W
West	BLIP
Toronto+Essa+East+Ottawa	FETT, FN/FS
Northeast+Northwest	E-W, FN/FS
Bruce+West+Niagara+Southwest	FABC, BLIP, FETT, QFW

Table 4| Transmission Transfer Capabilities (2023-2042)

Interface	Positive Direction Interface Transfer Capability (MW)	Negative Direction Interface Transfer Capability (MW)
E-W	500	350
FABC	9,999	9,999
BLIP	Ranges from 2,020 to 3,700	Ranges from 570 to 1,550
QFW	2,400	9,999
FETT	Ranges from 4,700 to 7,350	9,999
TEC	9,999	9,999
FIO	2,950	9,999
FN/FS	1,850	1,750
CLAN	9,999	9,999

2.5 Hourly Probability of Loss of Load

Given the hourly load forecast and the available resources at each hour, the probability of loss of load is different for every hour. If the system's reserve margin falls below zero in a particular hour, then loss of load is certain. In a probabilistic assessment, IESO has analyzed hundreds of simulations at different load levels, to determine a metric to best represent the probability of loss of load at every hour of the year. Figure 8 and Figure 9 showcase the described metric at every hour of the day for each month in 2026, against the reference demand forecast and a supply outlook assuming existing resources are available post contract expiry. Summer months such as July and August, exhibit a higher probability of need during the hours 16-22. While in winter, there is a small spike around 9-10 and then a larger need during the hours 17-23. In Ontario, summer months constitute most of the hourly needs given that the system is summer peaking, however the shape of the hourly profiles change from year to year and are impacted by factors such as the demand forecast, load forecast uncertainty, supply forecast, outages, and transmission constraints.

Figure 8 | Hourly Probability of Loss of Load, Summer of 2026

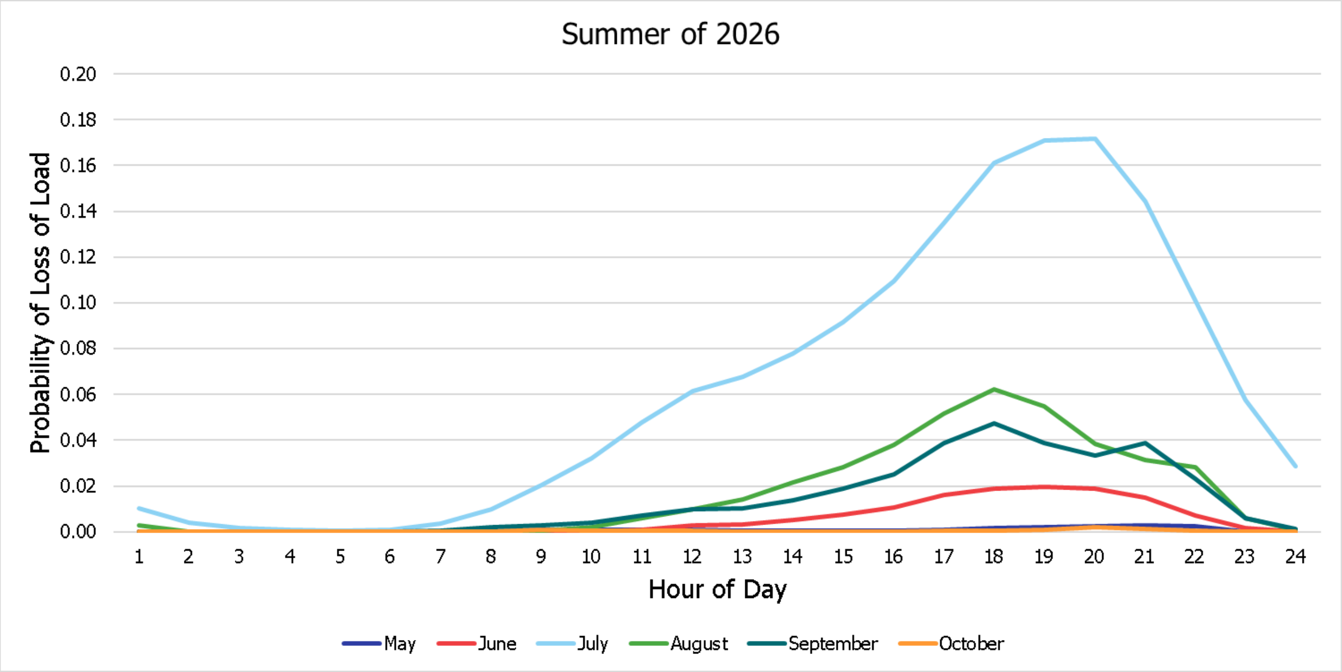
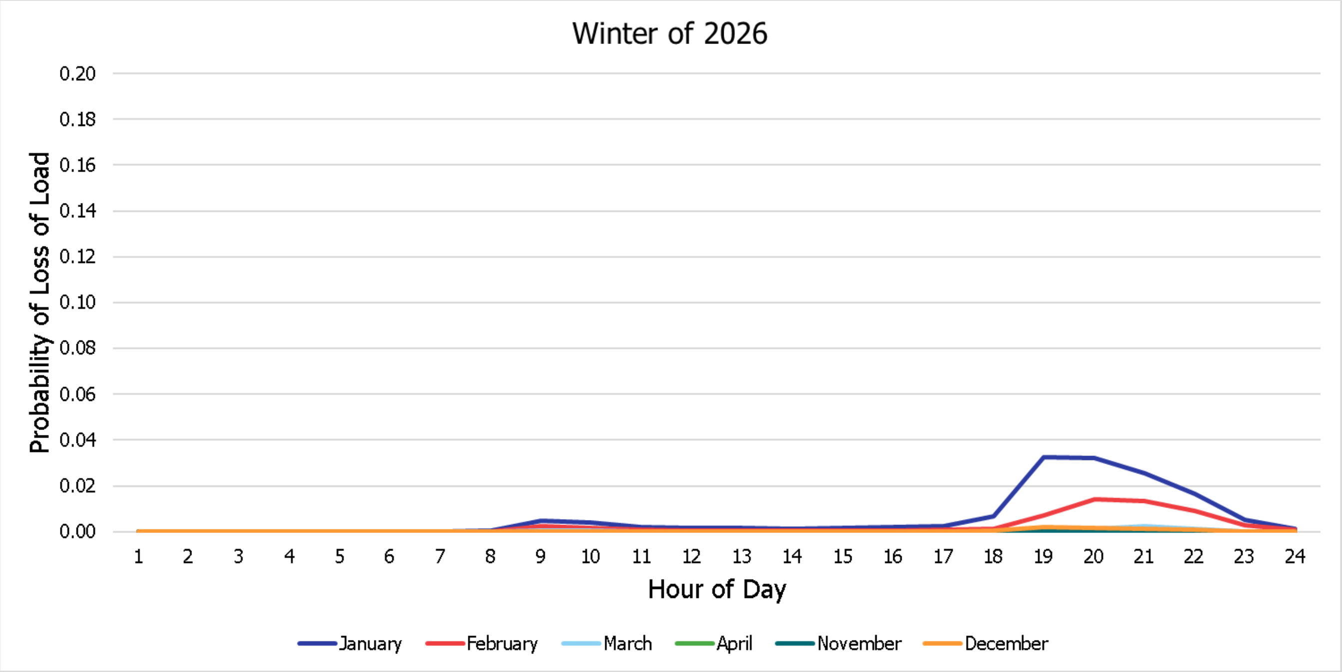


Figure 9 | Hourly Probability of Loss of Load, Winter of 2026



3. Energy Adequacy Outlook

3.1 Exchange Rate and Ontario Natural Gas Price Forecast

The annual exchange rate and natural gas fuel forecast assumption is from the Sproule Price Outlook released June 30, 2021.[2] Table 5 provides a summary of the forecast exchange rate and natural gas prices.

Table 5 | Henry Hub, Dawn Natural Gas Prices and Exchange Rate

Year	Henry Hub ($USD/MMBtu)	USD/CAD Exchange Rate	Dawn ($CAD/MMbtu)
2023 and onward	2.83	0.80	3.38

3.2 Discussion

Overall, the trends in the energy outlook in the 2021 APO is consistent with previous outlooks. While Pickering retirement drives year over year trends of declining surplus baseload generation (SBG), growth in demand in the longer term increases capacity and energy requirements. Nuclear generation continue to be a major source of generation in Ontario. Energy from non-hydroelectric renewables has not changed materially while hydroelectric production is expected to be lower due to SBG. The extent to which existing resources remain in the market will dictate whether the need for future supply is primarily capacity or energy driven.

Fuel forecast changes are seen to have an impact on import and export flows. In addition to demand and supply drivers, fuel/carbon price differentials add uncertainties to the amount and direction of electricity trade and the extent to which Ontario's gas fleet is dispatched to meet Ontario's demand versus export demand.

Energy results are shown for normal or median conditions. Weather conditions can have a substantial effect on energy demand and production from wind, hydroelectric, and solar resources. When interpreting energy outlooks, focus should be on trends, order of magnitude, and relative direction.

---

[2] More information on this report can be found on Sproule's website.

Independent Electricity System Operator
1600-120 Adelaide Street West
Toronto, Ontario M5H 1T1

Phone: 905.403.6900
Toll-free: 1.888.448.7777
E-mail: customer.relations@ieso.ca

ieso.ca

@IESO_Tweets
facebook.com/OntarioIESO
linkedin.com/company/IESO

ieso
Connecting Today.
Powering Tomorrow.