Reliability Outlook

An adequacy assessment of Ontario's electricity system

July 2022 to December 2023

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Executive Summary

Ontario is expected to have an adequate supply of electricity to meet the needs of residents, businesses and communities for the next 18 months. However, the province has entered a period of increasingly tight electricity supply conditions that will require active outage management and increased import volumes during certain periods. The IESO expects these conditions to persist for the foreseeable future.

Reserve margins are decreasing as a result of several factors. The economic recovery from the pandemic continues to gain momentum and demand for electricity is expected to increase at a slow and steady rate. Total consumption is expected to rise to 136.0 terawatt-hours (TWh) for the year, an increase of 1.7% over 2021. By way of comparison, total demand in 2019 (pre-pandemic) was 134.1 TWh. Demand patterns are still evolving, and in general Ontario's electricity system is more sensitive to weather as a result of many employees still working from home.

Forecasting demand for electricity requires close consideration of a broad range of inputs. At this time, there are a number of factors contributing to some degree of uncertainty. These include supply chain issues, interest rate hikes, decarbonization efforts, and various geopolitical situations – such as the invasion of Ukraine – that may have long-term impacts on the global economy. The IESO is monitoring the situation and will update its forecasts as required.

On the supply side, concurrent nuclear outages coupled with regional transmission constraints have reduced the amount of supply available to meet the province's energy needs. Discussions with nuclear generators are ongoing, and the refurbishment schedule for 2023 is expected to change, resulting in a better adequacy outlook. Additional information will be provided in future Outlooks.

As a result of the tight conditions Ontario is already experiencing, outages have become increasingly difficult to accommodate – a situation that will be exacerbated in the summer of 2023. Generators and transmitters are strongly encouraged to plan ahead and coordinate with IESO staff to ensure planned outages can be appropriately scheduled.

The addition of new supply as well as resources acquired through the IESO's annual capacity auction will help meet Ontario demand. Although they have not yet completed the commissioning process, two new wind farms are already producing energy. Also undergoing rigorous testing are two new units at the Beck complex, which will replace two outdated units that were decommissioned in 2009. When fully integrated in the system, these wind farms and hydroelectric units will add approximately 280 megawatts of supply.

In general, Ontario's transmission system is expected to continue to reliably supply province-wide demand for the next 18 months. However, some combinations of transmission and/or generation outages could create operating challenges. For this reason, the IESO may reject market participants' requests if they pose reliability risks.

Reinforcements on the Hawthorne-Merivale transmission path will help meet local and regional needs while also boosting the import capability from Quebec. The project will get underway later this year, with an expected in-service date of Q4 2023.

Stakeholders who are interested in learning more about preparations for this summer are encouraged to attend the IESO's Operations Awareness Session on June 27 at 10 am.

Table of Contents

List of Figures

List of Tables

1. Introduction

This Outlook covers the 18 months from July 2022 to December 2023, and supersedes the Outlook released on March 24, 2022.

The purpose of the 18-month horizon in the *Reliability Outlook* is to:

- Advise market participants of the resource and transmission reliability of the Ontario electricity system
- Assess potentially adverse conditions that might be avoided by adjusting or coordinating maintenance plans for generation and transmission equipment
- Report on initiatives being implemented to improve reliability within this time frame

This Outlook assesses resource and transmission adequacy based on the stated assumptions, following the Methodology to Perform the Reliability Outlook. Due to uncertainties associated with various assumptions, readers are encouraged to use their judgment in considering possible future scenarios.

Additional supporting documents are located on the IESO website.

Security and adequacy assessments are published on the IESO website on a daily basis and progressively supersede information presented in this report.

For questions or comments on this Outlook, please contact us at 905-403-6900 (toll-free 1-888-448-7777) or customer.relations@ieso.ca.

2. Updates to this Outlook

2.1 Updates to the Demand Forecast

The demand forecast used in this Outlook is informed by actual demand, weather and economic data through to the end of April 2022, and has been updated to reflect the most recent economic projections. Actual weather and demand data for May 2022 are included in the tables.

2.2 Updates to Resources

This *Reliability Outlook* considers planned generator outages over the 18-month period, submitted by market participants to the IESO's outage management system as of June 1, 2022. Market participants are required annually to submit information to enable the IESO to conduct reliability assessments. This information, provided to the IESO through Form 1230, was submitted by April 1, 2022.

No new resources have completed the market registration process since the previous outlook.

2.3 Updates to the Transmission Outlook

This Outlook also considers transmission outage plans that were submitted to the IESO's outage management system by May 9, 2022.

2.4 Updates to the Operability Outlook

Surplus baseload generation (SBG) is not expected to be a significant issue in Ontario for the foreseeable future. As of Q1 2022, forecasts for SBG are no longer being produced or included in the *Reliability Outlook*. Looking ahead, we will continue to update our analysis of outage management concerns. In the meantime, however, no new operability issues have emerged since the last Outlook.

3. Demand Forecast

Electricity demand was fairly robust through 2021 despite the ongoing pandemic, and has been strong through the first half of 2022. Steady growth in both peak and energy demand is expected over the next 18 months. The IESO is closely monitoring major global macroeconomic and geopolitical factors that are likely to impact electricity demand over the 18-month horizon and will revise these forecasts accordingly.

The IESO is responsible for forecasting electricity demand on the IESO-controlled grid. This demand forecast covers the period from July 2022 to December 2023 and supersedes the previous forecast released in March 2022. Tables of supporting information are contained in the 2022 Q2 Outlook Tables.

As the pandemic impacts wane in Ontario, the pent-up demand for goods and services accrued over the past two years is impacting economic activity. Electricity demand has been strong to start 2022 and overall demand is expected to rise to 135.9 TWh for the year, an increase of 1.6% over 2021. This will push demand above the 2019 pre-pandemic level of 134.1 TWh.

The combination of global supply disruptions and pent-up demand has pushed inflation to the highest level in 25 years. The release of the March 2022 *Reliability Outlook* coincided with a 0.25 increase in interest rates from the Bank of Canada and this Outlook coincides with a 0.50 increase in rates, with further increases expected throughout 2022. Higher rates will moderate some of the underlying growth in 2022 and 2023, but it bears mentioning that the current increase sets rates back to their pre-pandemic levels.

Throughout the pandemic the service sector was disproportionately impacted due to public health measures. Outside of the spring of 2020, manufacturing and the service sectors have operated at or above a pre-pandemic level since that time. Conversely, the impacts felt by restaurants and travel have been negative and sustained. Subsequently, the "bounce back" of increased demand for services will have less of a direct impact on electricity demand than the demand for goods, which are more energy-intensive than the service sector. Demand is expected to rise to 136.8 TWh in 2023, an increase of 0.6% over 2022.

Employees are moving back to the office, though work from home will remain for a large number of workers either on a permanent, part-time or occasional basis. The pandemic increased daytime residential occupancy, which resulted in higher system peak demand as cooling and heating systems operated at a higher level in the province. Although with return to office, the impact will largely be reduced, it still means that the system is more weather sensitive than prior to the pandemic. The projected peak demands for the upcoming summer and winter seasons are not materially different from previous Outlooks as the underlying assumptions remain unchanged. Over the forecast horizon, peaks are expected to increase slightly due to overall system growth.

There are significant uncertainties surrounding the demand forecast. The pandemic has caused significant disruption to the movement of people and goods as each wave of the pandemic has led to variability in the supply chains of the highly interconnected global economy. Although Ontario has one of the highest vaccination rates and the actions taken have mitigated some of the worst of the pandemic, the interconnected nature of the global economy means that Ontario is not immune from pandemic-related and other disruptions from abroad. For example, the Russian invasion of Ukraine has impacted global oil prices and food prices and a further escalation could have uncertain repercussions for the global economy.

Table 3-1 | Forecast Energy Demand Summary

Year	Normal Weather Energy (TWh)	% Growth in Energy
2022	135.9	1.6%
2023	136.8	0.6%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Summer 2022	22,542	24,675
Winter 2022-23	21,280	22,464
Summer 2023	22,601	24,694

Table 3-3 | Weekly Energy and Peak Demand Forecast

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
03-Jul-22	21,866	23,705	754	2,586
10-Jul-22	22,343	24,260	1,016	2,681
17-Jul-22	22,542	24,592	814	2,730
24-Jul-22	22,520	24,675	838	2,748
31-Jul-22	22,539	24,652	1,035	2,764
07-Aug-22	22,168	24,516	841	2,701

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
14-Aug-22	22,131	24,568	958	2,728
21-Aug-22	22,430	24,657	985	2,704
28-Aug-22	21,996	23,536	1,362	2,680
04-Sep-22	21,516	23,323	1,413	2,617
11-Sep-22	21,489	22,482	1,370	2,498
18-Sep-22	20,146	21,324	680	2,455
25-Sep-22	19,218	20,458	781	2,419
02-Oct-22	17,912	19,150	420	2,392
09-Oct-22	17,038	18,197	554	2,381
16-Oct-22	17,152	17,590	786	2,350
23-Oct-22	17,374	18,662	507	2,424
30-Oct-22	17,550	18,906	392	2,454
06-Nov-22	17,708	19,149	318	2,480
13-Nov-22	18,853	19,028	416	2,534
20-Nov-22	19,164	19,667	601	2,615
27-Nov-22	19,506	20,283	342	2,664
04-Dec-22	19,791	20,761	607	2,717
11-Dec-22	20,225	21,360	409	2,755
18-Dec-22	20,218	21,497	555	2,794
25-Dec-22	19,998	21,594	690	2,808
01-Jan-23	19,905	21,136	362	2,673
08-Jan-23	20,414	21,330	528	2,783
15-Jan-23	20,871	21,937	570	2,891
22-Jan-23	21,033	22,048	547	2,915

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
29-Jan-23	21,280	22,464	483	2,934
05-Feb-23	21,010	21,972	404	2,904
12-Feb-23	20,878	21,768	734	2,876
19-Feb-23	20,475	21,606	635	2,868
26-Feb-23	20,269	21,696	581	2,822
05-Mar-23	19,850	21,302	501	2,795
12-Mar-23	19,696	20,952	531	2,742
19-Mar-23	18,994	20,269	649	2,695
26-Mar-23	18,564	19,911	611	2,628
02-Apr-23	18,216	19,184	569	2,563
09-Apr-23	17,987	18,681	567	2,479
16-Apr-23	17,828	18,246	471	2,482
23-Apr-23	17,357	18,284	496	2,457
30-Apr-23	17,016	17,778	531	2,400
07-May-23	17,114	18,900	721	2,382
14-May-23	17,170	19,563	849	2,365
21-May-23	17,307	21,022	845	2,388
28-May-23	17,504	20,801	1,175	2,318
04-Jun-23	19,008	21,294	1,330	2,408
11-Jun-23	19,423	21,847	1,292	2,438
18-Jun-23	20,964	22,350	1,055	2,502
25-Jun-23	21,623	22,985	835	2,543
02-Jul-23	22,015	23,575	754	2,574
09-Jul-23	22,328	24,213	1,016	2,665

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
16-Jul-23	22,423	24,208	814	2,694
23-Jul-23	22,582	24,694	838	2,742
30-Jul-23	22,601	24,520	1,035	2,779
06-Aug-23	22,386	24,595	841	2,803
13-Aug-23	22,345	24,687	958	2,744
20-Aug-23	22,266	24,685	985	2,768
27-Aug-23	22,523	24,525	1,362	2,727
03-Sep-23	22,246	24,177	1,413	2,706
10-Sep-23	21,627	23,382	1,370	2,579
17-Sep-23	21,520	22,604	680	2,559
24-Sep-23	20,419	21,893	781	2,488
01-Oct-23	18,744	20,956	420	2,440
08-Oct-23	17,836	19,400	554	2,415
15-Oct-23	17,576	18,513	786	2,364
22-Oct-23	17,511	17,891	507	2,418
29-Oct-23	17,784	18,949	392	2,451
05-Nov-23	17,993	19,410	318	2,476
12-Nov-23	18,545	19,775	416	2,514
19-Nov-23	19,066	19,485	601	2,580
26-Nov-23	19,716	20,072	342	2,647
03-Dec-23	19,916	20,611	607	2,700
10-Dec-23	20,376	21,176	409	2,751
17-Dec-23	20,507	21,605	555	2,778
24-Dec-23	20,352	21,517	690	2,798

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
31-Dec-23	19,576	20,718	362	2,654

4. Resource Adequacy

Ontario is entering a period during which outages will be increasingly difficult to accommodate. The IESO expects these conditions to persist for the foreseeable future. Market participants are strongly encouraged to plan ahead and coordinate with the IESO to ensure planned outages can be appropriately scheduled.

The IESO expects to have sufficient reserves for the summer of 2022. Significant reserve shortages have the potential to appear in summer 2023, primarily as a result of coincident generator outages; the IESO is working closely with generators to ensure adequate reserves remain available. The IESO expects to have sufficient reserves for winter 2022/2023.

This section assesses the adequacy of resources to meet the forecast demand. Resource adequacy is one of the reliability considerations used for approving generation and transmission outages. When reserves are below required levels, with potentially adverse effects on the reliability of the grid, the IESO will reject outage requests based on their order of precedence. Conversely, when reserves are above required levels, additional outages can be contemplated, provided other factors – such as local considerations, operability or transmission security – do not pose a reliability concern. In those cases, the IESO may place an outage at risk, signaling to the facility owner to consider rescheduling the outage.

Ontario's existing installed generation capacity is summarized in Table 4-1. The forecast capability at the Outlook peak is based on the firm resource scenario, which includes resources currently in commercial operation, and takes into account deratings, planned outages and an allowance for capability levels below rated installed capacity.

Table 4-1 | Existing Grid-Connected Resource Capacity

Fuel Type	Total Installed Capacity (MW)	Forecast Capability at 2022 Summer Peak Normal Weather (MW)	Forecast Capability at 2022 Summer Peak Extreme Weather (MW)	Number of Stations	Change in Number of Stations	Change in Installed Capacity[1]
Nuclear	13,089	10,361	10,361	5	0	0
Hydroelectric	8,868	5,328	4,672	76	0	-49
Gas/Oil	10,482	9,448	9,033	33	0	-34
Wind	4,783	746	746	40	0	0
Biofuel	296	286	286	7	0	1
Solar	478	126	126	10	0	0
Demand Measures	-	662	662	-	-	-
Firm Imports (+) / Exports (-) (MW)	-	150	0	-	-	-
Total	**37,997**	**27,106**	**25,886**	**171**	**0**	**-82**

4.1 Assessment Assumptions

4.1.1 Generation Resources

All generation resources scheduled to come into service, be upgraded or be shut down within the Outlook period are summarized in Table 4-2. This includes generation projects in the IESO's connection assessment and approval (CAA) process, those under construction, and contracted resources. Details regarding the IESO's CAA process and the status of these projects can be found on the Application Status section of the IESO website.

The estimated effective date column in Table 4-2 indicates when the market registration process is expected to be complete for each generation resource, based on information available to the IESO as of June 1, 2022. Two scenarios are used to describe project risks:

[1] Changes to installed capacity are the result of an annual process of updating our resource database based on the latest information from generators.

- The **planned scenario** assumes that all resources scheduled to come into service are available over the assessment period.
- The **firm scenario** assumes that only resources that have reached commercial operation status and completed commissioning at the time this assessment was completed are available.

Planned shutdowns or permanent [2]retirements of generators that have a high likelihood of occurring are considered for both scenarios.

Table 4-2 | Committed Generation Resources Status

Project Name	Zone	Fuel Type	Estimated Effective Date	Project Status	Firm (MW)	Planned (MW)
Romney	West	Wind	2022-Q2	Commissioning		60
Nation Rise	Ottawa	Wind	2022-Q2	Commissioning		100
Beck 1 New G1[3]	Niagara	Hydro	2022-Q2	Commissioning		59
Beck 1 New G2	Niagara	Hydro	2022-Q3	Commissioning		59
Total						**278**

Notes on Table 4-2:

The total may not add up due to rounding and does not include in-service facilities. Project status provides an indication of the project progress, using the following terminology:

- Under Development – projects in approvals and permitting stages (e.g., environmental assessment, municipal approvals, IESO connection assessment approvals) and projects under construction
- Commissioning – projects undergoing commissioning tests with the IESO
- Commercial Operation – projects that have achieved commercial operation status under the contract criteria, but have not met all of the IESO's market registration requirements

[2] Given the evolving nature of resource acquisitions and commitments in Ontario, Table 4-2 will be listing new resources as they commission and existing resources that are expected to permanently retire or mothball at the end of their current commitments.
[3] "New Beck" units are the previously removed and now replaced G1 and G2.

- Expiring Contract – contracts that will expire during the Outlook period are included in both scenarios only up to their contract expiry date. Generators (including non-utility generators) that continue to provide forecast output data are also included in the planned scenario for the rest of the 18-month period.

4.1.2 Generation Capability

Hydroelectric

A monthly forecast of hydroelectric generation output is calculated based on median historical values of hydroelectric production and contribution to operating reserve during weekday peak demand hours. Through this method, routine maintenance and actual forced outages of the generating units are implicitly accounted for in the historical data (see the first row in Table 4-3).

To reflect the impact of hydroelectric outages on the reserve above requirement (RAR) and allow the assessment of hydroelectric outages as per the outage approval criteria, the hydroelectric capability is also calculated, without accounting for historical outages (see the second row of Table 4-3). Table 4-3 uses data from May 2002 to March 2022, which are updated annually to coincide with the release of the Q2 Outlook.

Table 4-3 | Monthly Historical Hydroelectric Median Values for Normal Weather Conditions

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Historical Hydroelectric Median Contribution (MW)	6,130	6,054	5,874	5,891	5,922	5,735	5,570	5,274	5,056	5,420	5,674	6,126
Historical Hydroelectric Median Contribution without Outages (MW)	6,630	6,633	6,395	6,406	6,366	6,237	6,105	5,859	5,909	6,228	6,449	6,639

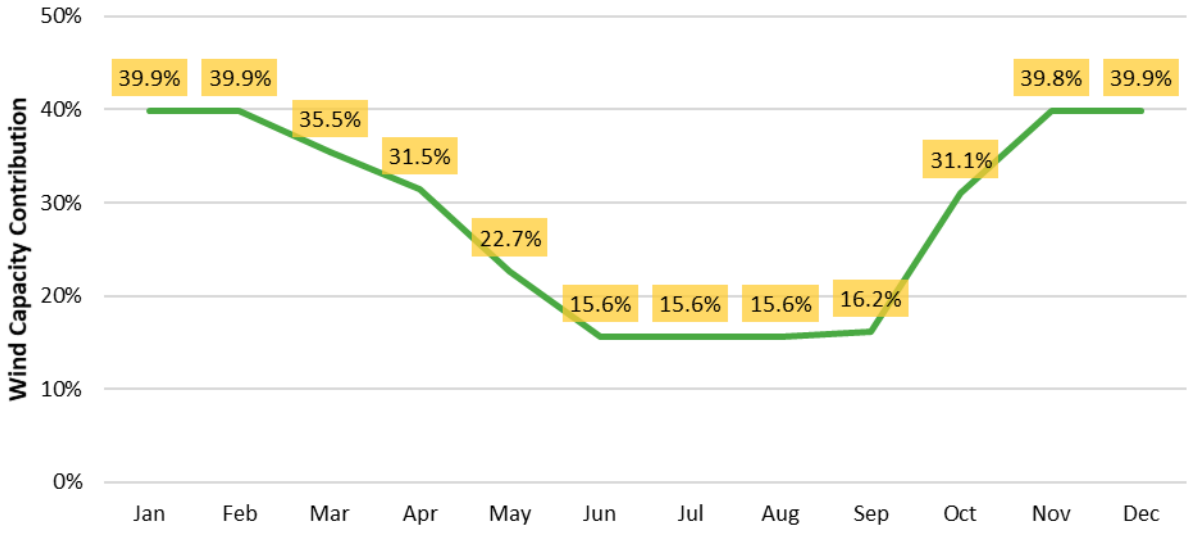
Thermal Generators

Thermal generators' capacity, planned outages and deratings are based on market participant submissions. Forced outage rates on demand are calculated by the IESO based on actual operational data. The IESO will continue to rely on market participant-submitted forced outage rates for comparison purposes.

Wind

For wind generation, monthly wind capacity contribution (WCC) values from the weekday peak hour are used. The process for determining wind contribution can be found in the Methodology to Perform the Reliability Outlook. Figure 4-1 shows the monthly WCC values, which are updated annually with the release of the Q2 Outlook.

Figure 4-1 | Monthly Wind Capacity Contribution Values

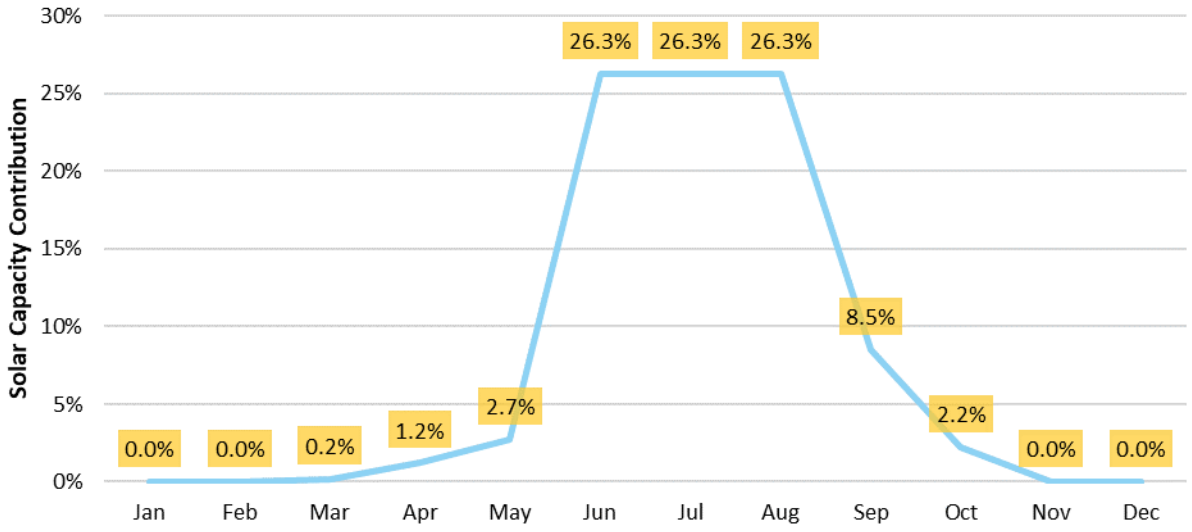


Solar

For solar generation, monthly solar capacity contribution (SCC) values from the weekday peak hour are used. Information on how the solar contribution is calculated can be found in the Methodology to Perform the Reliability Outlook. Figure 4-2 shows the monthly SCC values, which are updated annually for the release of the Q2 Outlook.

In the Q2 2022 Outlook, the peak window has shifted to earlier in the day as compared to the previous outlook, perhaps as a result of indirect impacts of the COVID-19 pandemic on electricity consumption patterns. As a result, the contribution from grid-connected solar resources at the time of peak Ontario demand has increased significantly.

Figure 4-2 | Monthly Solar Capacity Contribution Values



4.1.3 Demand Measures

Both demand measures and load modifiers can impact demand, but differ in how they are treated within the Outlook. Demand measures, such as dispatchable loads and demand response procured through the IESO's capacity auction, are not incorporated into the demand forecast and are instead treated as resources. Load modifiers are incorporated into the demand forecast. The impacts of activated demand measures are added back into the demand history prior to forecasting demand for future periods.

4.1.4 Firm Transactions

Capacity-Backed Exports

The IESO allows Ontario resources to compete in the capacity auctions held by certain neighbouring jurisdictions, but only if Ontario has adequate supply. No capacity-backed exports have been approved for the period May to October 2022.

System-Backed Exports

As part of the electricity trade agreement between Ontario and Quebec, Ontario will supply 500 MW of capacity to Quebec for next winter from December 2022 to March 2023. In addition, Ontario will receive up to 2.3 TWh of clean energy annually, scheduled economically via Ontario's real-time markets. The economically imported energy will target peak hours to help reduce greenhouse gas emissions in Ontario. The agreement includes the opportunity to cycle energy.

As part of this capacity exchange agreement, Ontario can call on 500 MW of capacity during summer before September 2030, based on the province's needs. Ontario does not expect to call on this capacity during this 18-month period (as discussed in the 2022 Annual Acquisition Report, the IESO expects to exercise this option in the summer of 2026).

4.1.5 Summary of Scenario Assumptions

To assess future resource adequacy, the IESO must make assumptions about the amount of available resources. The Outlook considers two scenarios: a firm scenario and a planned scenario.

The starting point for both scenarios is the existing installed resources shown in Table 4-1. The planned scenario assumes that all resources scheduled to come into service are available over the assessment period. The firm scenario considers only those resources that have reached commercial operation status as of the time of this assessment. Generator-planned shutdowns or retirements that have a high likelihood of occurring are considered for both scenarios. They also both reflect planned outages submitted by generators. Table 4-4 shows the available resources that are forecast over the 18-month Outlook, under both scenarios in normal weather conditions, and at the time of the summer and winter peak demands during the Outlook.

Table 4-4 | Summary of Available Resources under Normal Weather

Notes	Description	Summer Peak 2022 Firm Scenario	Summer Peak 2022 Planned Scenario	Winter Peak 2022/2023 Firm Scenario	Winter Peak 2022/2023 Planned Scenario	Summer Peak 2023 Firm Scenario	Summer Peak 2023 Planned Scenario
1	Installed Resources (MW)	37,997	38,216	37,997	38,275	37,997	38,275
2	Total Reductions in Resources (MW)	11,703	11,857	11,724	11,962	13,248	13,420
3	Demand Measures (MW)	662	662	614	614	850	850
4	Firm Imports (+) / Exports (-) (MW)	150	150	-500	-500	0	0
5	Available Resources (MW)	27,106	27,171	26,387	26,427	25,599	25,705
6	Bottling (MW)	0	0	1,551	1,662	0	0
7	Available Resources without Bottling (MW)	27,106	27,171	27,938	28,089	25,599	25,705

Notes on Table 4-4:

1. Installed Resources: The total generation capacity assumed to be installed at the time of the summer and winter peaks.
2. Total Reductions in Resources: The sum of deratings, planned outages, limitations due to transmission constraints and allowances for capability levels below rated installed capacity.
3. Demand Measures: The amount of demand reduction expected to be available at the time of peak.
4. Firm Imports/Exports: The amount of expected firm imports and exports at the time of summer and winter peaks.
5. Available Resources: Installed Resources (line 1) minus Total Reductions in Resources (line 2) plus Demand Measures (line 3) and Firm Imports/Exports (line 4). This differs from the Forecast Capability at System Peak shown in Table 4-1 due to the impacts of generation bottling (transmission limitations).
6. Available Resources without Bottling: Available resources after they are reduced due to bottling.

4.2 Capacity Adequacy Assessment

The capacity adequacy assessment accounts for zonal transmission constraints resulting from planned transmission outages assessed as of January 27, 2022. The generation planned outages occurring during this Outlook period have been assessed as of June 1, 2022.

4.2.1 Firm Scenario with Normal and Extreme Weather

The firm scenario incorporates all capacity that had achieved commercial operation status as of June 1, 2022.

Figure 4-3 shows Reserve Above Requirement (RAR) levels, which represents the difference between available resources and required resources. The required resources equals demand plus the required reserve.

Capacity secured in the December 2021 Capacity Auction (CA) has been included in this assessment. The target capacity for the December 2022 Capacity Auction, as announced in the IESO's Annual Acquisition Report, has been included and modelled asdemand measures in the firm resource scenario for summer 2023.

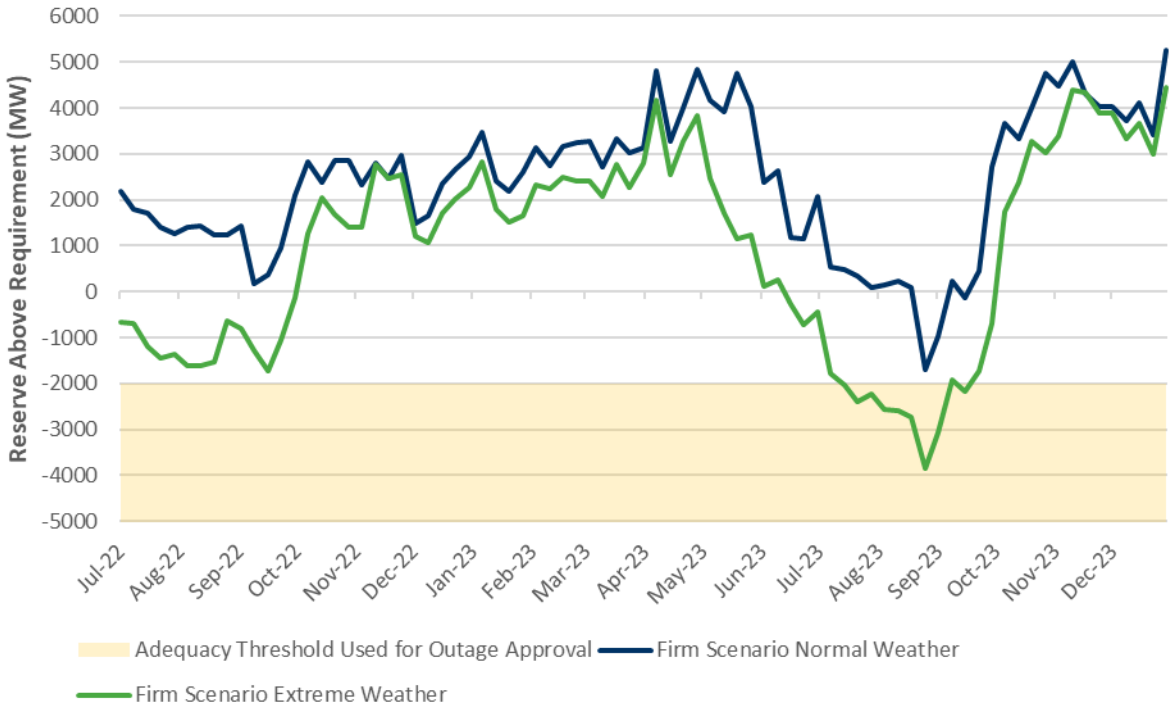
The IESO expects to have sufficient reserves for the summer of 2022 and the winter of 2022/23. In the firm scenario under normal weather conditions, available reserves fall below the requirement for three weeks in summer 2023. In the firm scenario under extreme weather conditions, the reserve is lower than the -2,000 MW adequacy threshold for nine weeks in summer 2023. Under the current outage schedule, the RAR is below the adequacy threshold for the eight-week period from July 10 to September 3, 2023 as well as the week ending September 17, 2023.

These potential shortfalls are primarily attributed to planned generator outages scheduled during those weeks. While the IESO expects to be able to mitigate any risks by rejecting outage requests during periods of low reserves, Ontario will likely rely on up to 2,000 MW of supply from other jurisdictions under extreme weather conditions, and may have to rely on some imports to meet demand under normal weather conditions.

Outage requests during periods where reserves fall below the adequacy threshold under extreme weather conditions will be put at risk and may be rejected should those conditions materialize. The IESO will continue to work with both generators and transmittors to ensure outages are appropriately scheduled.

As Ontario enters a period of tighter supply conditions, planned generator maintenance outages will become increasingly difficult to schedule. Generators are advised not to schedule outages during periods when reserves are forecast to be low, and are strongly encouraged to plan ahead and coordinate the timing of outages with IESO staff.

Figure 4-3 | Comparison of Normal and Extreme Weather: Firm Scenario Reserve Above Requirement

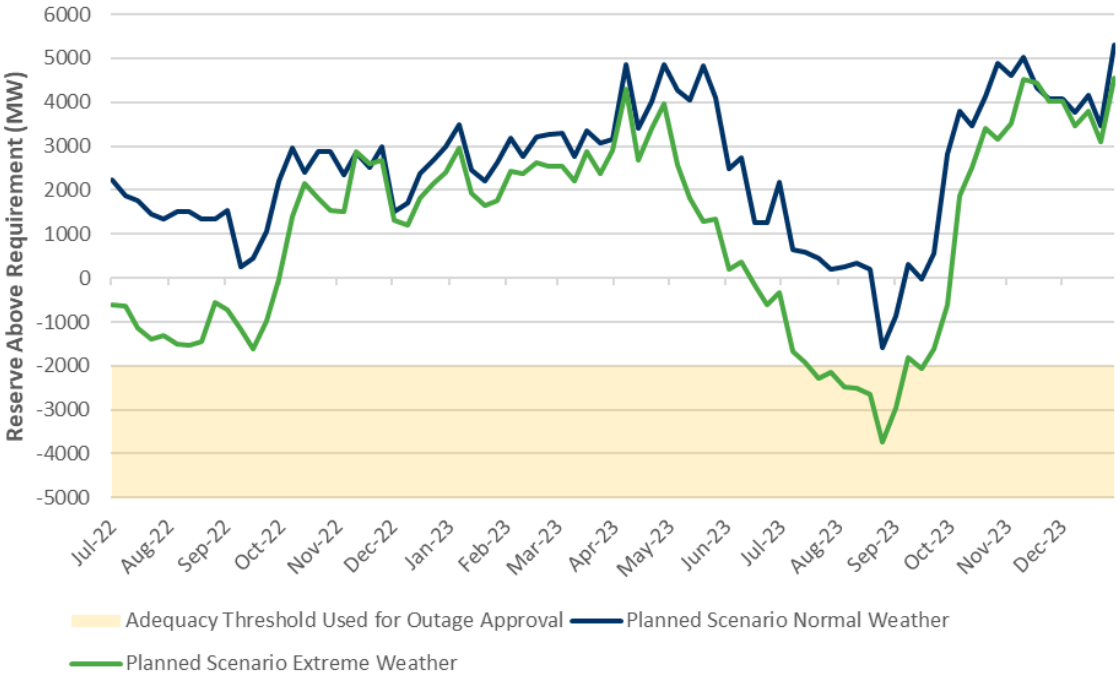


4.2.2 Planned Scenario with Normal and Extreme Weather

The Planned scenario incorporates all existing capacity, as well as all capacity expected to come into service. Approximately 278 MW of new generation capacity is expected to connect to Ontario's grid over this Outlook period.

Figure 4-4 shows RAR levels under the Planned scenario. As in the Firm scenario, reserves fall below requirements for three weeks in 2023 under normal weather conditions. Under the extreme weather scenario, reserves fall short during most of the summer of 2023. These shortfalls are expected to be resolved through outage rescheduling.

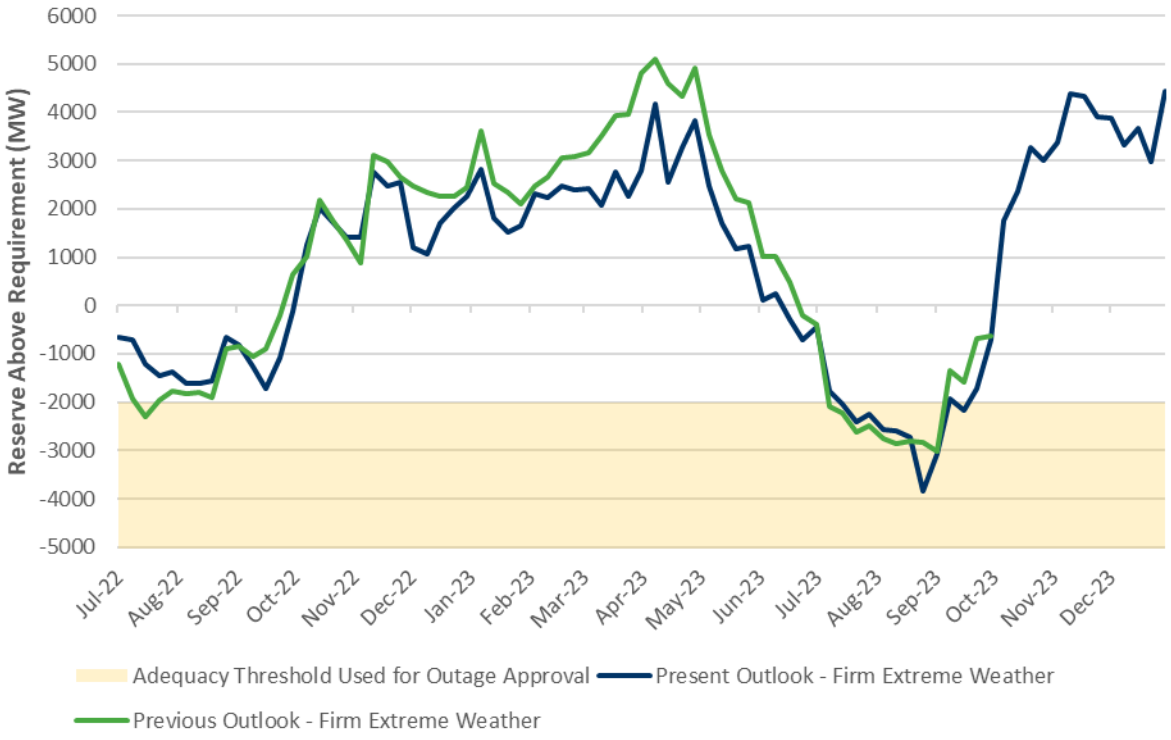
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



4.2.3 Comparison of the Current and Previous Weekly Adequacy Assessments for the Firm Extreme Weather Scenario

Figure 4-5 compares forecast RAR values in the current Outlook with those in the previous Outlook, which was published on March 24, 2022. The difference is primarily the result of changes in planned outages.

Figure 4-5 | Comparison of Current and Previous Outlook: Firm Scenario Extreme Weather Reserve Above Requirement



Resource adequacy assumptions and risks are discussed in detail in the Methodology to Perform the Reliability Outlook.

4.3 Energy Adequacy Assessment

This section assesses energy adequacy to determine whether Ontario has sufficient supply to meet its forecast energy demands, while highlighting potential adequacy concerns during the Outlook time frame. At the same time, the assessment estimates the aggregate production by resource category to meet the projected demand based on assumed resource availability.

4.3.1 Summary of Energy Adequacy Assumptions

The energy adequacy assessment (EAA) uses the same set of assumptions as the capacity assessment, as outlined in Table 4-1 and Table 4-2, which indicate the total capacity of committed resources and when they are expected to be available over the next 18 months. The monthly forecast of energy production capability, based on energy modelling results, is included in the 2022 Q2 Outlook Tables.

For the EAA, only the firm scenario in Table 4-5 with normal weather demand is assessed. The key assumptions specific to this assessment are described in the Methodology to Perform the Reliability Outlook.

4.3.2 Results – Firm Scenario with Normal Weather

Table 4-5 summarizes the energy simulation results over the next 18 months for the Firm scenario with normal weather demand both for Ontario and for each transmission zone.

Table 4-5 | Summary of Zonal Energy for Firm Scenario Normal Weather

Zone	18-Month Energy Demand TWh	18-Month Energy Demand Average MW	18-Month Energy Production TWh	18-Month Energy Production Average MW	Net Inter-Zonal Energy Transfer TWh	Zonal Energy Demand on Peak Day of 18-Month Period GWh	Available Energy on Peak Day of 18-Month Period GWh
Bruce	1.1	87.0	59.9	4,546.0	58.8	1.8	112.4
East	11.9	905.0	19.0	1,444.0	7.1	25.3	95.9
Essa	13.1	996.0	4.1	309.0	-9.0	28.7	15.6
Niagara	6.3	479.0	21.2	1,609.0	14.9	15.0	52.6
Northeast	15.1	1,143.0	14.8	1,124.0	-0.3	25.4	32.7
Northwest	6.8	517.0	6.7	510.0	-0.1	11.9	20.9
Ottawa	13.1	995.0	0.3	21.0	-12.8	30.2	1.0
Southwest	41.2	3,126.0	8.5	644.0	-32.7	94.0	23.4
Toronto	74.4	5,647.0	54.3	4,120.0	-20.1	174.1	125.2
West	22.0	1,673.0	16.1	1,220.0	-5.9	52.7	76.3
Ontario	**205.1**	**15,568.0**	**204.8**	**15,547.0**	**-0.3**	**459.1**	**556.0**

4.3.3 Findings and Conclusions

The EAA indicates that Ontario is expected to have sufficient supply to meet its forecast energy needs throughout the outlook period for the Firm scenario with normal weather demand, without having to rely on support from external jurisdictions, with the exception of the summer months in 2023. During this period, a large number of coincident generation outages are leading to a possibility of unserved energy under normal weather conditions, and without support from external jurisdictions. The IESO expects that this risk will be mitigated once certain outages have been rescheduled.

The figures and tables in this section are based on a simulation of the province's power system, using the assumptions presented within the Outlook to assess whether Ontario will be energy adequate.

Figure 4-6 breaks down projected production by fuel type to meet Ontario's energy demand for the next 18 months, while Figure 4-7 shows the expected production by fuel type for each month. The province's energy exports and imports are not considered in this assessment. Table 4-6 summarizes these simulated production results by fuel type, for each year.

Figure 4-6 | Forecast Energy Production by Fuel Type

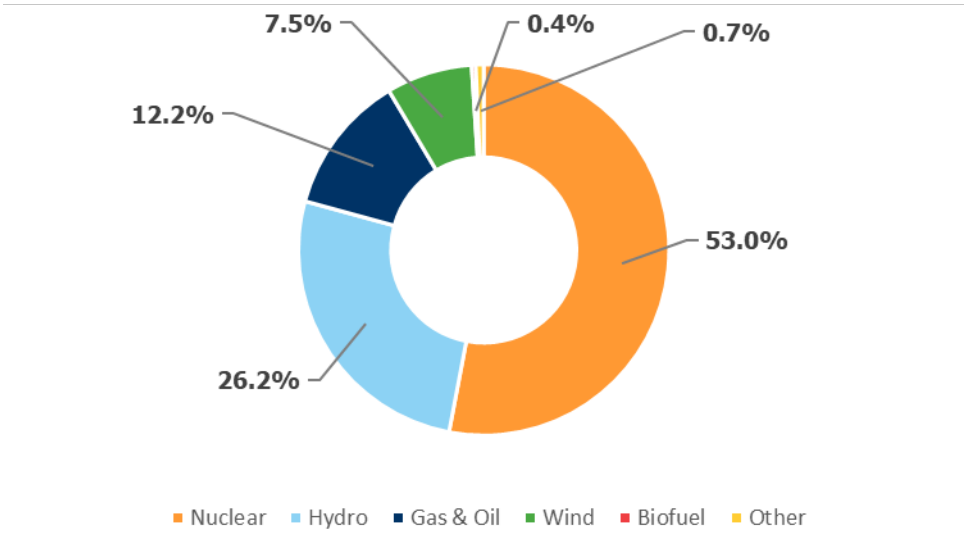


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

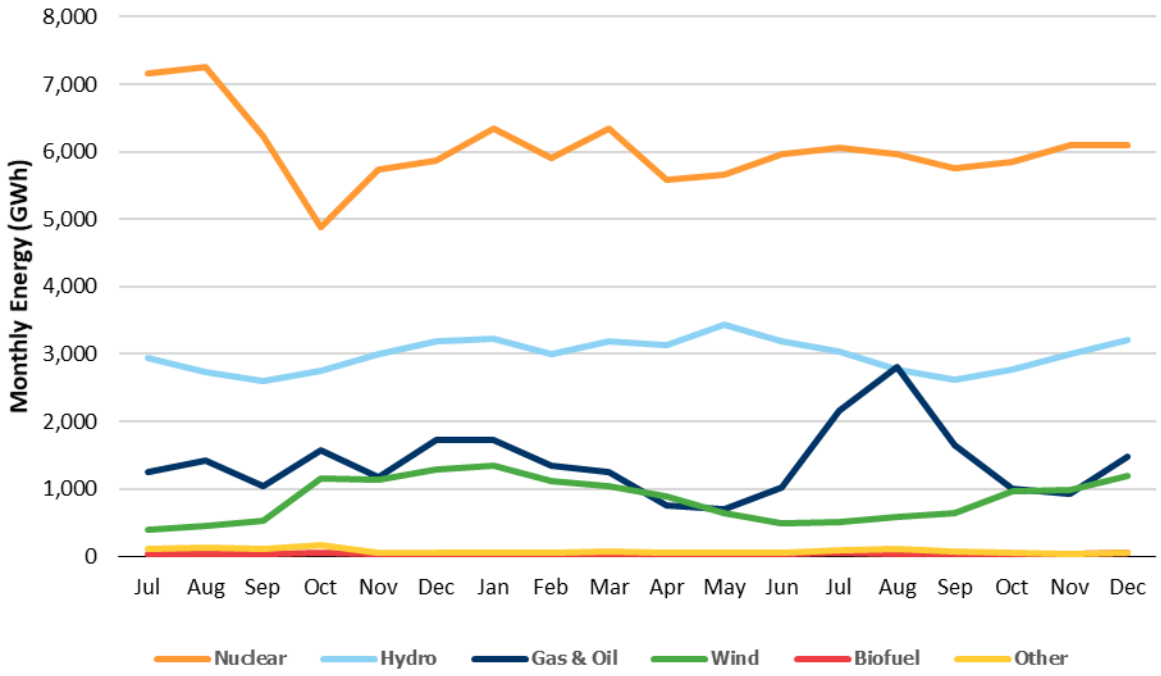


Table 4-6 | Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2022 (July 1 – Dec 31) (GWh)	2023 (Jan 1 – Dec 31) (GWh)	Total (GWh)
Nuclear	37,117	71,613	108,730
Hydro	17,214	36,589	53,803
Gas & Oil	8,200	16,841	25,041
Wind	4,967	10,421	15,388
Biofuel	251	494	744
Other (Solar & DR)	622	793	1,414
Total	**68,370**	**136,750**	**205,121**

5. Transmission Reliability Assessment

Ontario's transmission system is expected to continue to reliably supply province-wide demand for the next 18 months, even while experiencing normal contingencies defined by planning criteria. However, some combinations of transmission and/or generation outages could create operating challenges. For this reason, it is – and will continue to be – increasingly difficult to schedule certain outages to avoid reliability concerns. The sheer volume of outage requests and the limited time periods available to complete the work will make scheduling a challenge for the foreseeable future.

The IESO assesses transmission adequacy using a methodology based on conformance to established criteria, including the Ontario Resource and Transmission Assessment Criteria (ORTAC), NERC transmission planning standard TPL 001-4 and NPCC Directory #1 as applicable. Planned system enhancements and projects, and known transmission outages are also considered in the studies.

Ontario's transmission system is expected to continue to reliably supply province-wide demand for the next 18 months, even while experiencing normal contingencies defined by planning criteria.

5.1 Transmission Projects

This section considers the information transmitters have provided with respect to transmission projects that are planned for completion within the next 18 months. The list of transmission projects can be found in Appendix B1. Note that the planned in-service dates in this table and throughout this document are as of April 2022. These dates are subject to change as the COVID-19 pandemic may impact project logistics. Any changes will be communicated through subsequent Reliability Outlooks.

5.2 Transmission Outages

The IESO's assessment of transmission outage plans is shown in Appendix C, Tables C1 to C11. The methodology used to assess the transmission outage plans is described in the Methodology to Perform the Reliability Outlook. This Outlook reflects transmission outage plans submitted to the IESO as of May 9, 2022.

5.3 Transmission Considerations

The purpose of this section of the report is to highlight projects and outages that may affect reliability and/or the scheduling of other outages, and to consolidate these considerations by zone. For more information about the IESO's transmission zones and interfaces, please see the Transfer Capability Assessment Methodology.

Bruce, Southwest, and West Zones

https://www.ieso.ca/-/media/Files/IESO/Document-Library/exemptions/ex_1359_rec.ashxSignificant growth in the greenhouse sector has led to a number of customer connection requests in the Windsor-Essex region that are expected to exceed the capacity of the existing transmission system in the area. The new switching station ("Lakeshore TS") at the Leamington Junction has been installed and two of the existing circuits have been cut over. The remaining circuits will be cut over throughout Q3 and the new Lakeshore RAS will be installed. Operational measures available will be restrictive over the course of this period. During this time, system resiliency will be reduced, and per market rule exemption 1359, certain customers in the area may experience a lower level of reliability.

A planned one-month outage starting January 23, 2023, on circuit B550V will impact the flow out of the Bruce zone.

Toronto, East, and Ottawa Zones

Operational challenges due to high voltages in eastern Ontario and the Greater Toronto Area continue to occur during low-demand periods. High voltages are the result of lower minimum demand for electricity. The IESO and Hydro One have been managing this situation by removing from service certain 500 kV circuits, mainly in eastern Ontario and occasionally in the Bruce area during those periods. To address this issue on a longer-term basis, two 500 kV line-connected shunt reactors are being installed at Lennox TS. The first reactor has been installed and is in-service. The second reactor is expected to go into service in Q2 2023.

There are upcoming nuclear refurbishments of multiple units at Darlington with overlapping timelines. As a result, it will be increasingly challenging for market participants to take outages impacting the Flow East Towards Toronto (FETT) interface. Future planned outages will necessitate enhanced coordination between transmitters and generators. Planned outages for certain windows may need to be rescheduled or rejected to ensure reliability.

Of particular note, the FETT Capacity Upgrade (i.e., Richview-Trafalgar Reinforcement) project to address future needs is underway; the project is expected to be in-service date of Q1 2026.

The Hawthorne-Merivale transmission path supplies load in western Ottawa and delivers eastern Ontario resources, and imports from Quebec, to southern Ontario load centres. The reinforcement consists of upgrading the two 230 kV circuits between Merivale TS and Hawthorne TS, a length of 12 km. Hydro One will begin the project this year, with an expected in-service date of Q4 2023.

A planned one-month outage starting June 14, 2022, on circuit C3S will impact the flow into Ottawa. A planned two-month outage starting September 12, 2022, on circuit X522A will impact the flow into Ottawa.

Northwest, Northeast, and Essa Zones

A one-month outage on circuit X504E starting October 3, 2022, will reduce the transfer capability of the North-South Tie.

A series of planned outages on circuit W21M from September 2022 to April 2024 will also reduce the transfer capability of the East-West Tie.

The East-West Tie Expansion project consists of a new 230 kV transmission line roughly paralleling the existing East-West Tie Line between Wawa and Thunder Bay. The new line will increase the electricity transfer capability into Northwest Ontario and will improve the flexibility and efficiency of the Northwest electricity system. As part of this project, upgrades were planned for the Lakehead, Marathon and Wawa transformer stations to accommodate the new line. The project was placed in-service at the end of Q1 2022. However, the full benefit of the project will not be realized right away due to ongoing and upcoming outages as a result of work in the Northwest.

Studies in the Kirkland Lake area have indicated the need for transmission reinforcements due to potential load growth and limited transfer capabilities, as well as load security violations under planning scenarios. Until these reinforcements are finalized and put in service, the addition of new loads may be difficult and subject to requirements such as pre-contingency load curtailment and post-contingency load rejection.

Interconnections

The failure of the Phase Angle Regulator (PAR) connected to the Ontario-New York 230 kV circuit L33P in early 2018 continues to hinder the province's ability to import electricity from New York, through the New York-St. Lawrence interconnection, and from Quebec through the Beauharnois interconnection. This has required enhanced coordination with affected parties and more focused management of St. Lawrence-area resources in real-time. Careful coordination of transmission and generation outages will continue to be required in the area.

PARs are unique pieces of equipment and replacements are not readily available. Replacement options were investigated by the IESO, in conjunction with Hydro One, the NYISO and the New York Power Authority. The proposed replacement will provide greater flexibility to control both current and future intertie flows with New York. The PAR on L34P will be upgraded to match L33P. The expected in-service date is Q3 2022 for the PAR on L33P and Q3 2023 for the PAR on L34P.

The recent failure of the PAR connected to the Ontario-Michigan 230kV circuit J5D will hinder the province's ability to import elecitricity from Michgan.Several planned outages involving circuits BP76 from June to December 2022 will also reduce the import and export transfer capability between Ontario and New York.

6. Operability

Ontario is entering a period of tighter supply conditions; surplus baseload generation is not expected to be a significant issue for the foreseeable future. The IESO will continue to assess other aspects of operability and report on them in future Outlooks where appropriate.

This section highlights existing or emerging operability issues that could impact the reliability of Ontario's power system.

Operability refers to the IESO's ability to manage a variety of conditions on the power system as they occur in real-time. The IESO works to ensure that the power system is reliable under changing system conditions, variability of supply and fluctuations in load, while respecting thermal, voltage and transient stability limits on the system. Operability is assessed in advance to ensure that the power system is adequately prepared for expected real-time conditions, while also having the ability to absorb and adapt to unexpected changes.

6.1 Outage Management Considerations

Ontario is entering a period during which outages will be increasingly difficult to accommodate. In addition to meeting global Ontario adequacy needs, transmission adequacy and security must be safeguarded.

There are a significant number of major generation and transmission projects either currently underway or expected to begin in the near future. As the timing of many of these projects overlap with each other and can require multiple equipment outages, reliability assessments are increasingly complex. An example mentioned earlier is the completing of major projects that are related to the Flow East Towards Toronto (FETT) interface.

With consideration of equipment failure, tighter supply conditions and other factors such as supply chain delays, outages may need to be rejected and rescheduled. Transmitters and generators are strongly encouraged to plan ahead, coordinate with one another, submit outage requests early, and coordinate with the IESO; scheduling outages at desired times may still be difficult due to the significant number of major projects. Furthermore, outages are not guaranteed as unanticipated equipment failures may change reliability assessments.

One important aspect of grid equipment outages is recall time. Recall times indicate how long it takes for equipment on outage to return to service. Minimizing recall times increases the likelihood of outages being approved. If many outages are non-recallable, it can be difficult to accomodate additional outages as there needs to be a reliable plan to reposture the system after an equipment failure occurs on the grid. If multiple equipment failures occur, there may be instances where outage management alone will not address the concern. Under such circumstances the IESO may need to rely on additional non-firm imports or emergency operating procedures in order to ensure reliability.

6.2 Surplus Baseload Generation

Ontario is entering a period of tighter supply conditions. Surplus baseload generation is not expected to be a significant issue for the foreseeable future and for this reason, forecasts for SBG are no longer being produced.

6.3 Ancillary Services

Ancillary Services are services that help ensure the reliable operation of the power system. The IESO contracts for four ancillary services: certified black start facilities, regulation service, reactive support and voltage control service, and reliability must-run. The IESO regularly studies the needs for these services. Salient details of recent studies are presented below.

6.3.1 Regulation Service

The IESO conducted a regulation service needs assessment in 2021 to determine if an incremental regulation need exists beyond today's minimum +/-100 MW requirement, for a period up to 2026. The assessment found that there is no incremental need for more than +/-100 MW of regulation to be scheduled in Ontario over the outlook period.

7. Resources Referenced in This Report

The table below lists additional resources in the order they appear in the report.

Table 7-1 | Additional Resources

Resource	URL	Location in This Report
Reliability Outlook Webpage	http://www.ieso.ca/en/Sector-Participants/Planning-and-Forecasting/Reliability-Outlook	Introduction
Security and Adequacy Assessments	http://www.ieso.ca/power-data/data-directory	Introduction
2022 Q2 Outlook Tables	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookTables_2022Jun.xls	Throughout
Connection Assessments and Approval Process	http://www.ieso.ca/en/sector-participants/connection-assessments/application-status	Assessment Assumptions
Methodology to Perform the Reliability Outlook	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookMethodology.pdf	Throughout
Capacity Auction	http://www.ieso.ca/en/Sector-Participants/Market-Operations/Markets-and-Related-Programs/Capacity-Auction	Demand Measures
Enabling Capacity Exports	http://www.ieso.ca/en/Sector-Participants/Market-Renewal/Capacity-Exports	Firm Transactions
Ontario Resource and Transmission Assessment Criteria	https://www.ieso.ca/-/media/Files/IESO/Document-Library/Market-Rules-and-Manuals-Library/market-manuals/connecting/IMO-REQ-0041-TransmissionAssessmentCriteria.ashx	Transmission Considerations
NERC Transmission Planning Standard TPL-001-4	http://www.nerc.com/pa/Stand/Reliability%20Standards/TPL-001-4.pdf	Transmission Considerations
NPCC Directory #1	https://www.npcc.org/Standards/Directories/Directory_1_TFCP_rev_20151001_GJD.pdf https://www.npcc.org/content/docs/public/program-areas/standards-and-criteria/regional-criteria/directories/directory-01-design-and-operation-of-the-bulk-power-system.pdf	Transmission Considerations
Market Manual 4 Part 4.2	http://www.ieso.ca/-/media/Files/IESO/Document-Library/Market-Rules-and-Manuals-Library/market-manuals/market-operations/mo-dispatchdatartm.pdf?la=en	Surplus Baseload Generation

8. List of Acronyms

Acronym	Definition
CAA	Connection Assessment and Approval
DR	Demand Response
EAA	Energy Adequacy Assessment
FETT	Flow East Toward Toronto
GS	Generating Station
GTA	Greater Toronto Area
ICI	Industrial Conservation Initiative
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Plan
kV	Kilovolt
LDC	Local Distribution Company
MW	Megawatt(s)
NERC	North American Electric Reliability Corporation
NPCC	Northeast Power Coordinating Council
NYISO	New York Independent System Operator
ORTAC	Ontario Resource and Transmission Criteria
PAR	Phase Angle Regulator
RAR	Reserve Above Requirement
RAS	Remedial Action Scheme
SBG	Surplus Baseload Generation
SCC	Solar Capacity Contribution
TS	Transmission/Transformer Station
TWh	Terawatt-hour(s)
WCC	Wind Capacity Contribution

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