Reliability Outlook

An adequacy assessment of Ontario's electricity system

October 2022 to March 2024

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Executive Summary

Ontario's power system continues to be well positioned for reliability, with sufficient electricity expected to be available to meet the needs of residents, businesses and communities for the next 18 months. However, tight electricity supply conditions are emerging and will require active outage management and increased import volumes at specific times.

Ontario has entered a period during which generation and transmission outages will be increasingly difficult to accommodate. The IESO expects these conditions to persist for the foreseeable future. As a result, market participants are strongly encouraged to plan ahead and coordinate with us to ensure planned outages can be appropriately scheduled.

Overall, the province should have sufficient reserves for the winters of 2022/23 and 2023/24. Significant reserve shortages have the potential to materialize in summer 2023, primarily as a result of coincident generator outages. The IESO is working with the affected asset owners to reschedule outages to avoid any potential impacts on reliability. Ontario will likely rely on supply from other jurisdictions under extreme weather conditions, and may have to rely on limited imports to meet demand under normal weather conditions.

Electricity demand growth in the province is expected to slow to 0.3% in 2023 after strong growth in each of the previous two years (1.4% in 2021 and 2.1% in 2022 to date). As is the case in other parts of the world, Ontario's economic activity has declined in response to a number of external forces, including the pandemic, geopolitical tensions, supply chain disruptions, rising inflation, and other factors.

Slower economic growth is expected to impact demand for electricity in Ontario but consumption by the industrial and natural resources sectors is expected to remain strong. With a portion of the workforce likely to continue working from home, electricity demand from the residential sector is also expected to remain strong. Although economic growth is slowing in the near-term due to a variety of external forces, Ontario's long-term demand forecast shows strong growth due to electrification and new development in the mining, agricultural, and industrial sectors.

Ontario's transmission system is expected to reliably supply province-wide demand for the next 18 months. That said, there are a significant number of major generation and transmission projects currently underway or starting soon. As the timing of several projects overlap with each other and may require multiple equipment outages, reliability assessments will require close coordination. Transmitters and generators are strongly encouraged to plan ahead, submit outage requests early, and coordinate regularly with the IESO and with each other.

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1. Introduction

This Outlook covers the 18 months from October 2022 to March 2024, and supersedes the Outlook released on June 23, 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 June 2022, and has been updated to reflect the most recent economic projections. Actual weather and demand data for July and August 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 September 6, 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.

The following resource has completed the IESO's market registration process since the previous outlook:

- Nation Rise Wind Farm (100 MW)

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 August 4, 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 is expected to increase to 136.9 TWh, a projected growth rate of 0.3% in 2023. This follows higher growth in each of the previous two years - 1.4% in 2021 (133.7 TWh) and a projected 2.1% in 2022 (136.5 TWh). 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 October 2022 to March 2024 and supersedes the previous forecast released in June 2022. Tables of supporting information are contained in the 2022 Q3 Outlook Tables.

Electricity demand growth is expected to slow to 0.3% in 2023 after strong growth in each of the previous two years (1.4% in 2021 and 2.1% expected in 2022). Slower economic growth is expected over the outlook period, which will impact electricity demand. Energy demand from the industrial and resources sectors, however, is expected to remain strong. There isn't surplus capacity or production in these sectors, as they have been limited by supply chains and shortages of key components such as semi-conductors. As such, industrial output - and electricity demand from this sector - is expected to increase as supply constraints are eliminated.

With a portion of the workforce continuing to work from home going forward, electricity demand from the residential sector is also expected to remain strong. Weaker economic growth will be felt in the commercial sector. Households will cut discretionary spending and there will be less demand for entertainment, dining out and non-durable goods. The same segments that were hit hardest by the public health measures of the pandemic may also be the segments impacted by a slowing economy.

Summer and winter peak demands will continue to be buoyed by weather-sensitive loads of the residential sector. With a portion of the work force continuing to work remotely post-pandemic, the residential sector is not expected to see consumption drop back to pre-pandemic levels. Commercial loads may decline, however their peak demands are generally weather-sensitive and should not experience large decreases.

The industrial sector will continue to experience lower peak demands as the potential for cost savings through the Industrial Conservation Initiative (ICI) makes reductions enticing. With battery storage falling in cost, more Class A customers may be looking to install behind-the-meter storage. These downward pressures should offset much of the elevated weather sensitive load from the residential sector.

As in previous Outlooks, there are significant uncertainties surrounding the electricity demand forecast. The pandemic has caused significant disruption to the movement of people and goods, and has led to disruptions in the supply chains of the highly interconnected global economy. Although Ontario may have moved beyond some of the worst of the pandemic, the interconnected nature of the global economy means that Ontario is not immune to related disruptions from abroad. Global conflict has impacted oil prices and food prices and a further escalation could have uncertain economic repercussions. In addition, climate change may have wide and unpredictable impacts, which could impact both the Ontario economy and the electricity grid.

Table 3-1 | Forecast Energy Demand Summary

Year	Normal Weather Energy (TWh)	% Growth in Energy
2022	136.5	2.09%
2023	136.9	0.26%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Winter 2022-23	21,255	22,596
Summer 2023	22,599	24,580
Winter 2023-24	21,302	22,632

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)
02-Oct-22	17,936	19,340	420	2,397
09-Oct-22	17,051	18,410	554	2,385
16-Oct-22	17,160	17,787	786	2,354
23-Oct-22	17,392	18,832	507	2,429
30-Oct-22	17,559	19,076	392	2,458

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
06-Nov-22	17,737	19,276	318	2,484
13-Nov-22	18,874	19,172	416	2,538
20-Nov-22	19,183	19,807	601	2,619
27-Nov-22	19,522	20,440	342	2,668
04-Dec-22	19,812	20,930	607	2,721
11-Dec-22	20,241	21,528	409	2,759
18-Dec-22	20,234	21,627	555	2,797
25-Dec-22	20,025	21,708	690	2,812
01-Jan-23	19,918	21,153	362	2,676
08-Jan-23	20,391	21,476	528	2,781
15-Jan-23	20,847	22,059	570	2,888
22-Jan-23	21,012	22,179	547	2,912
29-Jan-23	21,255	22,596	483	2,931
05-Feb-23	20,984	22,014	404	2,901
12-Feb-23	20,845	21,825	734	2,873
19-Feb-23	20,437	21,671	635	2,865
26-Feb-23	20,233	21,811	581	2,819
05-Mar-23	19,818	21,401	501	2,791
12-Mar-23	19,663	21,076	531	2,738
19-Mar-23	18,961	20,353	649	2,691
26-Mar-23	18,528	19,969	611	2,624
02-Apr-23	18,178	19,238	569	2,559
09-Apr-23	17,937	18,722	567	2,476

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
16-Apr-23	17,777	18,271	471	2,476
23-Apr-23	17,300	18,269	496	2,449
30-Apr-23	16,953	17,771	531	2,392
07-May-23	17,087	18,895	721	2,377
14-May-23	17,110	19,552	849	2,360
21-May-23	17,269	21,014	845	2,382
28-May-23	17,464	20,782	1,175	2,312
04-Jun-23	18,997	21,277	1,330	2,402
11-Jun-23	19,396	21,849	1,292	2,432
18-Jun-23	20,948	22,256	1,055	2,497
25-Jun-23	21,654	23,018	835	2,542
02-Jul-23	22,038	23,744	754	2,573
09-Jul-23	22,340	24,202	1,016	2,662
16-Jul-23	22,416	24,294	814	2,690
23-Jul-23	22,580	24,580	838	2,739
30-Jul-23	22,599	24,477	1,035	2,775
06-Aug-23	22,353	24,463	841	2,799
13-Aug-23	22,313	24,299	958	2,740
20-Aug-23	22,254	24,564	985	2,764
27-Aug-23	22,488	24,301	1,362	2,724
03-Sep-23	22,215	24,255	1,413	2,703
10-Sep-23	21,622	23,540	1,370	2,575
17-Sep-23	21,494	22,748	680	2,555

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
24-Sep-23	20,386	22,017	781	2,484
01-Oct-23	18,733	21,092	420	2,436
08-Oct-23	17,815	19,542	554	2,412
15-Oct-23	17,549	18,666	786	2,360
22-Oct-23	17,478	18,042	507	2,414
29-Oct-23	17,753	19,085	392	2,447
05-Nov-23	17,956	19,483	318	2,473
12-Nov-23	18,516	19,858	416	2,510
19-Nov-23	19,038	19,578	601	2,576
26-Nov-23	19,691	20,163	342	2,644
03-Dec-23	19,889	20,732	607	2,696
10-Dec-23	20,353	21,277	409	2,747
17-Dec-23	20,481	21,723	555	2,774
24-Dec-23	20,333	21,646	690	2,795
31-Dec-23	19,557	20,856	362	2,650
07-Jan-24	20,542	21,575	528	2,806
14-Jan-24	21,010	22,131	570	2,908
21-Jan-24	21,117	22,217	547	2,930
28-Jan-24	21,302	22,632	483	2,947
04-Feb-24	21,273	22,433	404	2,924
11-Feb-24	20,958	21,858	734	2,886
18-Feb-24	20,554	21,705	635	2,883
25-Feb-24	20,345	21,833	581	2,834

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
03-Mar-24	20,227	21,781	501	2,822
10-Mar-24	19,691	21,145	531	2,754
17-Mar-24	19,198	20,631	649	2,708
24-Mar-24	18,644	20,026	611	2,639
31-Mar-24	18,171	19,273	569	2,540

4. Resource Adequacy

Ontario has entered a period during which generation and transmission 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 winters of 2022/23 and 2023/24. Significant reserve shortages have the potential to appear in summer 2023, primarily as a result of coincident generator outages. The IESO expects to mitigate any risks by rejecting outage requests during these periods, and the IESO is working closely with generators to ensure adequate reserves remain available.

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 2023Summer Peak Normal Weather (MW)	Forecast Capability at 2023 Summer Peak Extreme Weather (MW)	Number of Stations	Change in Number of Stations	Change in Installed Capacity
Nuclear	13,089	8,759	8,759	5	0	0
Hydroelectric	8,868	5,417	4,766	76	0	0
Gas/Oil	10,482	9,221	8,820	33	0	0
Wind	4,883	761	761	41	1	100
Biofuel	296	286	286	7	0	0
Solar	478	126	126	10	0	0
Demand Measures	-	850	850	-	-	-
Firm Imports (+) / Exports (-) (MW)	-	0	0	-	-	-
Total	**38,096**	**25,420**	**24,369**	**172**	**1**	**100**

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 September 6, 2022. Two scenarios are used to describe project risks:

- 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[1] 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-Q4	Commissioning		60
Beck 1 New G1[2]	Niagara	Hydro	2023-Q1	Commissioning		59
Beck 1 New G2	Niagara	Hydro	2023-Q1	Commissioning		59
Total						**178**

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
- 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.

[1] 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.
[2] "New Beck" units are the previously removed and now replaced G1 and G2.

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

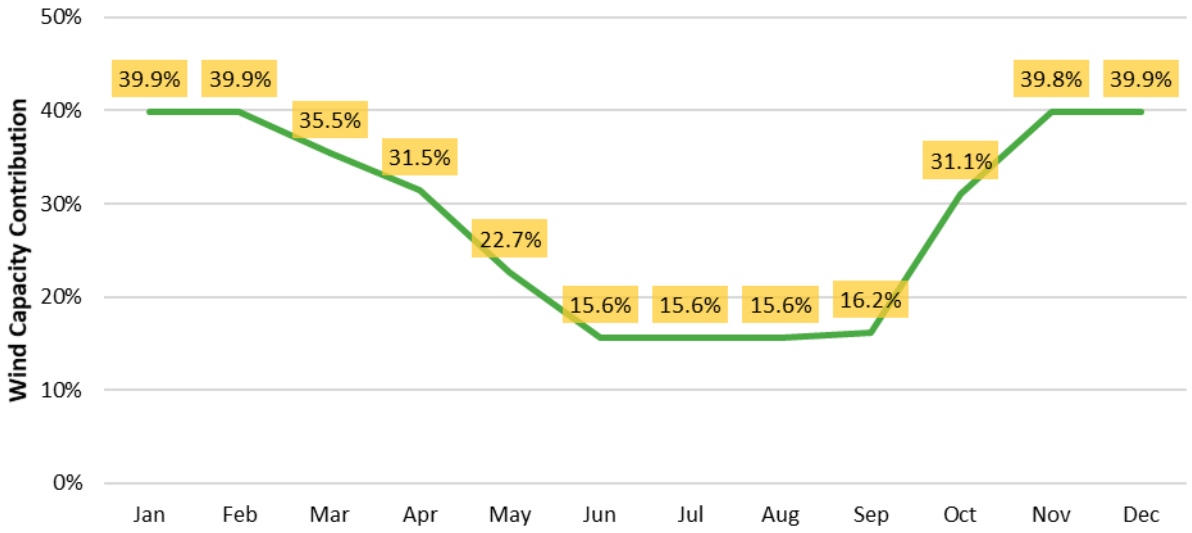
Thermal Generators

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.

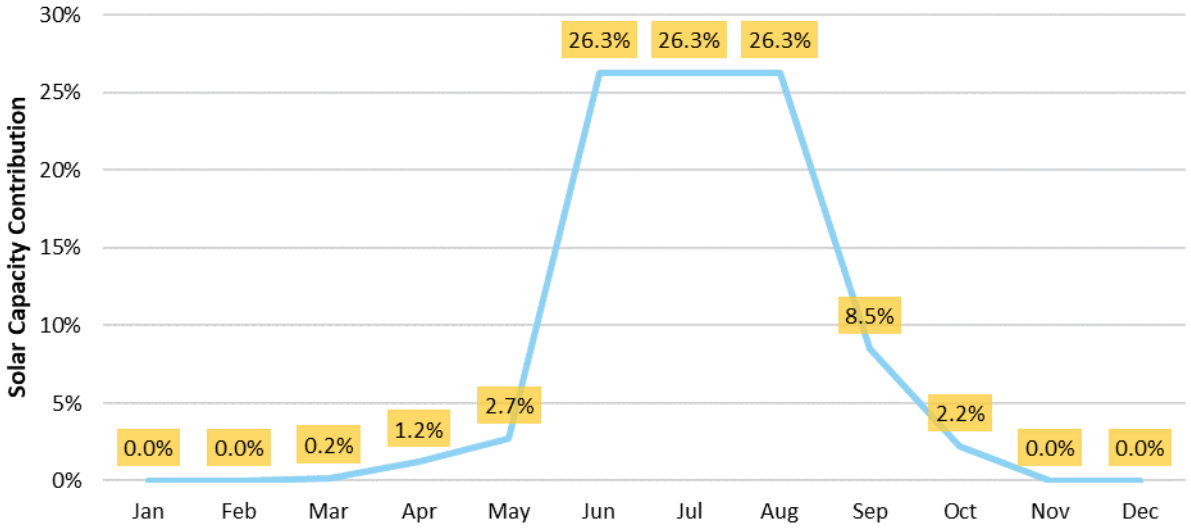
Figure 4-1 | Monthly Wind Capacity Contribution Values



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.

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 winter months 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	Winter Peak 2022/2023 Firm Scenario	Winter Peak 2022/2023 Planned Scenario	Summer Peak 2023 Firm Scenario	Summer Peak 2023 Planned Scenario	Winter Peak 2023/2024 Firm Scenario	Winter Peak 2023/2024 Planned Scenario
1	Installed Resources (MW)	38,096	38,273	38,096	38,273	38,096	38,273
2	Total Reductions in Resources (MW)	11,934	12,111	13,526	13,613	12,111	12,288
3	Demand Measures (MW)	614	614	850	850	798	798
4	Firm Imports (+) / Exports (-) (MW)	-500	-500	0	0	0	0
5	Available Resources (MW)	26,276	26,276	25,420	25,510	26,783	26,783
6	Bottling (MW)	1,557	1,580	0	0	835	835
7	Available Resources without Bottling (MW)	27,832	27,856	25,420	25,510	27,618	27,618

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 August 4, 2022. The generation planned outages occurring during this Outlook period have been assessed as of September 6, 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 September 6, 2022.

Figure 4-3 shows Reserve Above Requirement (RAR) levels, which represents the difference between available resources and required resources. The required resources equals forecast 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 as demand measures in the firm resource scenario for summer 2023.

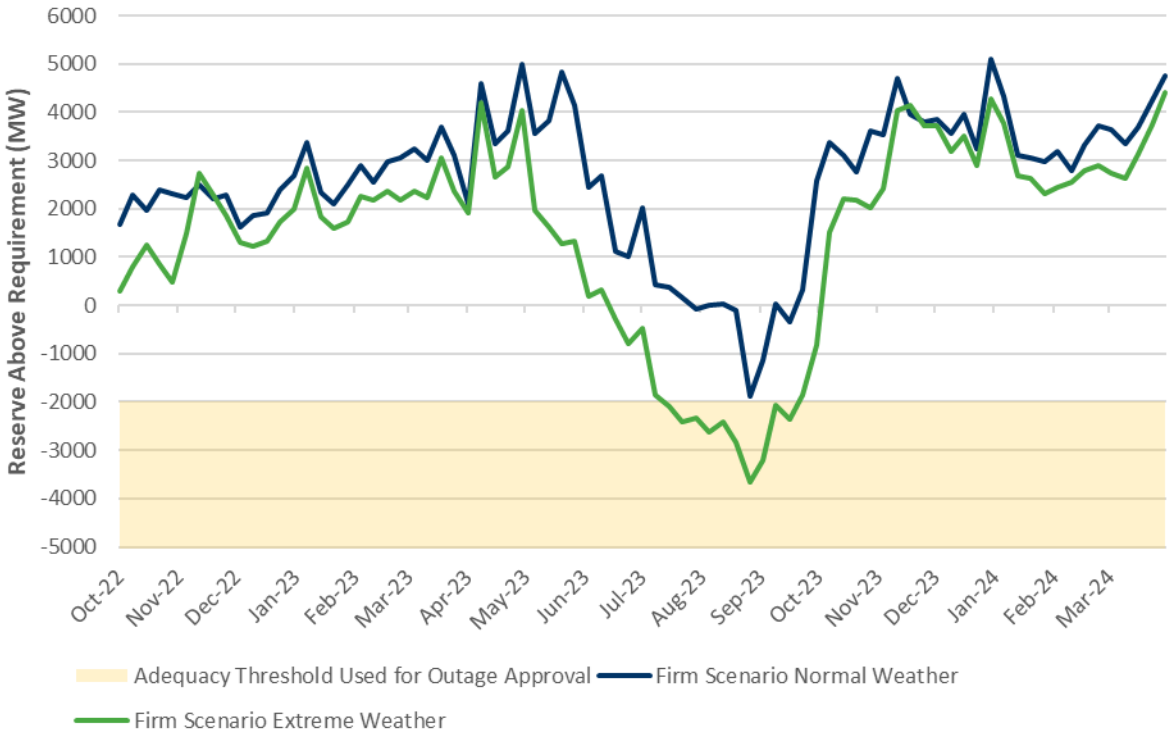
The IESO expects to have sufficient reserves for the winters of 2022/23 and 2023/24. In the firm scenario under normal weather conditions, available reserves fall below the requirement for five weeks in summer 2023. In the firm scenario under extreme weather conditions, the reserve is lower than the -2,000 MW adequacy threshold for 10 weeks in summer 2023. Under the current outage schedule, the RAR is below the adequacy threshold for the 10-week period from July 10 to 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 when 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 transmitters 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

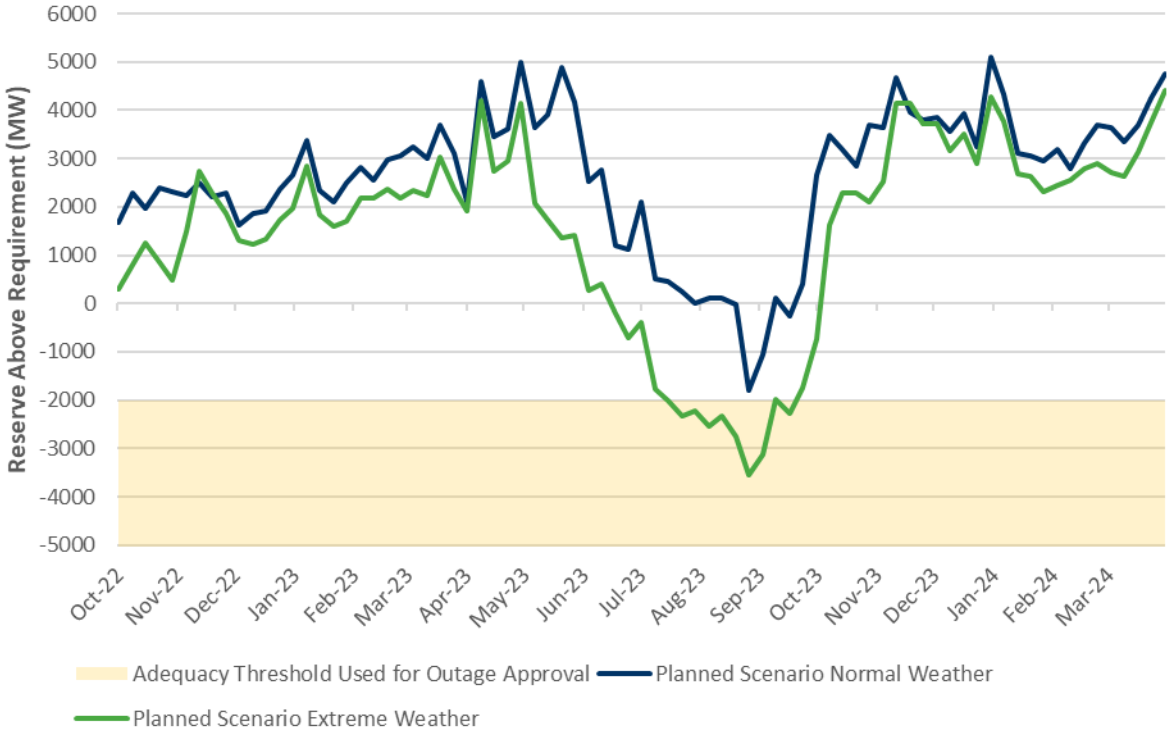


4.2.2 Planned Scenario with Normal and Extreme Weather

The Planned scenario incorporates all existing capacity, as well as all capacity expected to come into service. Approximately 178 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 four weeks in 2023 under normal weather conditions. Under the extreme weather scenario, reserves fall short for nine weeks in the summer of 2023. These shortfalls are expected to be resolved through outage rescheduling.

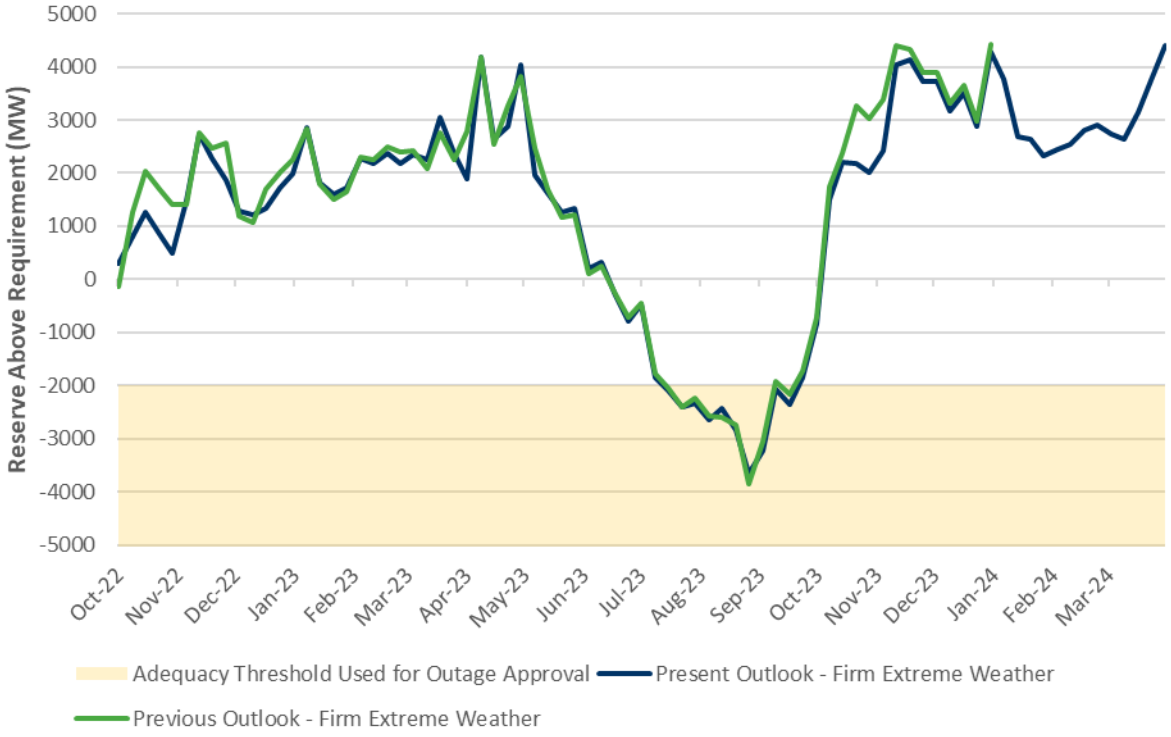
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



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 June 23, 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 outlined in Tables 4-1 and 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 Q3 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	1.2	91.0	60.7	4,612.0	59.5	1.8	113.8
East	12.5	951.0	19.4	1,475.0	6.9	24.8	93.1
Essa	13.7	1,042.0	4.5	341.0	-9.2	28.6	15.3
Niagara	6.3	477.0	21.5	1,638.0	15.2	15.0	53.8
Northeast	16.0	1,213.0	15.3	1,165.0	-0.7	26.2	32.3
Northwest	7.0	530.0	6.9	522.0	-0.1	12.2	20.1
Ottawa	13.2	1,006.0	0.7	56.0	-12.5	29.8	1.9
Southwest	41.1	3,127.0	9.5	721.0	-31.6	93.4	22.9
Toronto	74.3	5,646.0	51.3	3,898.0	-23.0	173.5	127.1
West	21.9	1,662.0	17.2	1,309.0	-4.7	52.6	77.5
Ontario	**207.1**	**15,745.0**	**207.0**	**15,737.0**	**-0.1**	**457.9**	**557.9**

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 suggest a possibility of unserved energy under normal weather conditions, and without support from external jurisdictions. However, 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

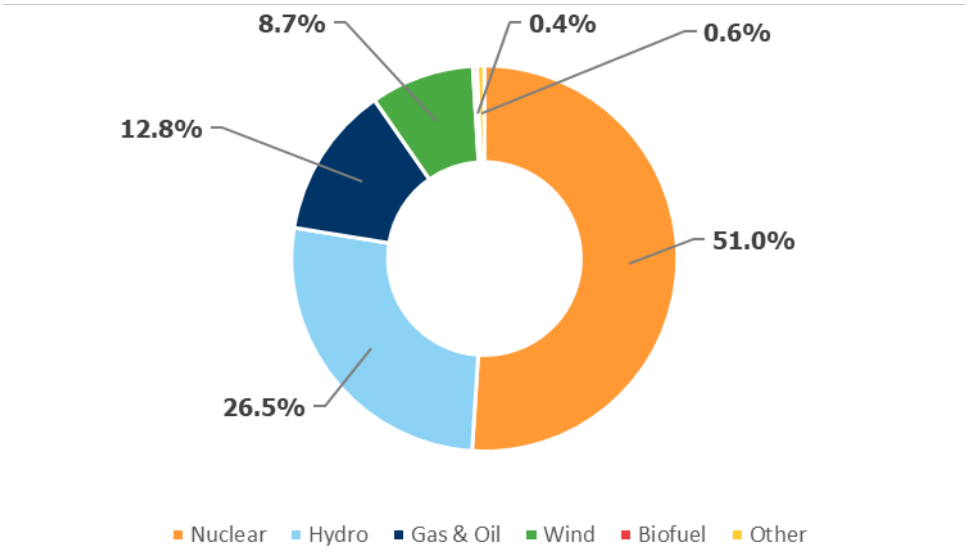


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

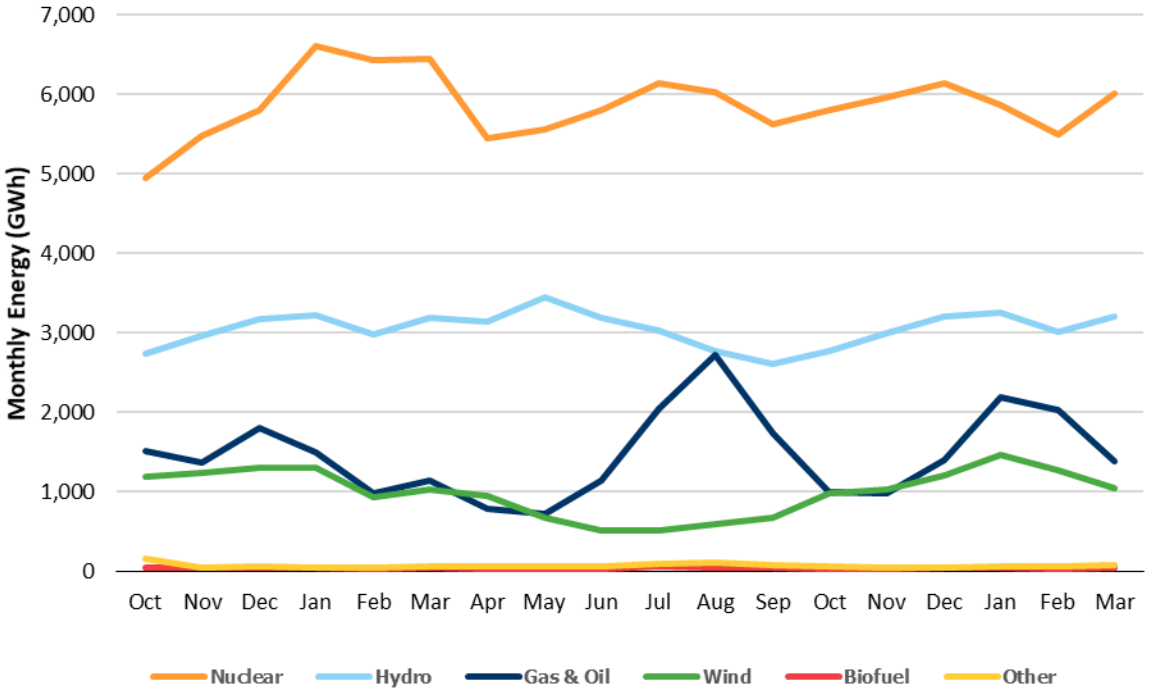


Table 4-6 | Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2022 (Oct 1 – Dec 31) (GWh)	2023 (Jan 1 – Dec 31) (GWh)	2024 (Jan 1 – Mar 31) (GWh)	Total (GWh)
Nuclear	16,237	72,025	17,391	105,653
Hydro	8,873	36,609	9,467	54,948
Gas & Oil	4,688	16,183	5,601	26,472
Wind	3,752	10,446	3,794	17,991
Biofuel	127	493	123	744
Other (Solar & DR)	270	782	204	1,256
Total	**33,946**	**136,538**	**36,580**	**207,064**

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.

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 July 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 August 4, 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

Significant 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 all four of the existing circuits have been cut over. There is on-going work for loads to be connected by radial circuits from Lakeshore TS and to install the new Lakeshore RAS. 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.

The following outages will impact the flow out of the Bruce zone:

- A planned one-month outage that began September 8, 2022, on circuit B561M
- A planned three-week outage starting November 14, 2022, and another planned three-week outage starting April 16, 2023, on circuit B501M
- A planned three-week outage starting January 23, 2023, on circuit B560V

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 ongoing 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, with an expected 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 began the project this year, with an expected in-service date of Q4 2023.

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

Northwest, Northeast, and Essa Zones

The following planned outages will reduce the transfer capability of the North-South tie:

- A one-month outage on circuit D5H starting September 6, 2022
- A one-month outage on circuit X504E starting October 3, 2022
- A series of planned outages on circuit W21M from September 2022 to April 2024

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 increases the electricity transfer capability into Northwest Ontario and improves 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. Reinforcements such as the Kirkland Lake Remedial Action Scheme and the Ansonville to Kirkland Lake A8K/A9K transmission circuit refurbishment, are planned to be in-service by Q4 2022 and Q2 2023, respectively.

Interconnections

Following the recent failure, and then replacement, of the Phase Angle Regulator (PAR) connected to the Ontario-New York 230 kV circuit L33P, the PAR connected to L34P will also be replaced. 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.

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 generation and transmission 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 describes 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. More information on actions the IESO can take to ensure reliability can be found in Market Manual 7.1: IESOControlled Grid Operating Procedures.

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 Q3 Outlook Tables	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookTables_2022Sep.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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