Reliability Outlook

An adequacy assessment of Ontario's electricity system

April 2023 to September 2024

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Executive Summary

The IESO is preparing for another summer of tight grid conditions and will continue to work with market participants to maintain grid reliability.

As has been documented in previous Outlooks, generation and transmission outages will continue to require close coordination with the IESO. The peak period for nuclear refurbishments and retirements has begun, removing several units from service at the same time. These conditions are likely to persist for the foreseeable future, requiring active planning and careful outage management.

After two years of very modest growth, demand for electricity is expected to decline by 0.5 per cent to 136 terawatt-hours (TWh) in 2023. This decrease is mostly as a result of economic factors such as high inflation and geopolitical events that contribute to uncertainty and instability. Demand for electricity is expected to increase in 2024 as economic conditions improve. The long-term demand forecast shows strong growth due to electrification and activity in the mining, agricultural and industrial sectors.

Reserve shortages have the potential to appear in summer 2023, primarily as a result of coincident generator outages. The IESO is working with participants to reschedule outages and maintain system reliability through this period. If outages cannot be moved, Ontario may have to rely on more supply from other jurisdictions and/or additional operating procedures in order to ensure reliability, especially under extreme weather conditions. Sufficient reserves should be available for the winter of 2023/24.

The IESO's December 2022 capacity auction secured over 1,400 MW of supply for the summer, and these resources – including Ontario consumers providing demand response, imports, generation and energy storage – will contribute to grid reliability this summer.

Large consumers participating in the Industrial Conservation Initiative helped reduce summer peaks by six per cent in 2022, and they are expected to make a similar contribution this summer. In addition, a new residential demand response program is expected to launch this spring that will allow households with smart thermostats to further reduce summer peaks.

Ontario's transmission system is expected to reliably meet province-wide demand for the next 18 months. However, some combinations of transmission and/or generation outages could create operating challenges and may need to be rescheduled. The sheer volume of outage requests and the limited time periods available to complete the work will require close and active management of outage scheduling for the foreseeable future.

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1. Introduction

This Outlook covers the 18 months from April 2023 to September 2024, and supersedes the Outlook released on December 21, 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 December 2022, and has been updated to reflect the most recent economic projections. Actual weather and demand data for January and February 2023 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 March 3, 2023. 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:

- Two Beck1 E_BUS unit upgrades

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 February 14, 2023.

2.4 Updates to the Operability Outlook

Results of an updated Regulation Service needs assessment, conducted in 2022, are discussed in the Operability Outlook.

3. Demand Forecast

Electricity demand is expected to fall to 136.0 TWh, a projected reduction of 0.5% for 2023. This follows higher growth in each of the previous two years: 1.4% in 2021 (133.7 TWh) and a projected 2.2% increase in 2022 (136.7 TWh). The IESO continues to monitor the evolving economic situation to assess the likely impacts to electricity demand over the 18-month horizon.

The IESO is responsible for forecasting electricity demand on the IESO-controlled grid. This demand forecast covers the period from April 2023 to September 2024 and supersedes the previous forecast released in September 2022. Tables of supporting information are contained in the 2023 Q1 Outlook Tables.

Electricity demand is very closely tied to economic activity, and there are a number of important factors influencing Ontario's economic outlook over the next 18 months, including supply chain disruptions, inflation and interest rates. Economic output may weaken in 2023 before rebounding in 2024 as economic demand strengthens, supply chains normalize, and inventories build back up. Peak demands are expected to be slightly lower in 2023 than previously forecast due to lower levels of economic activity underpinning those peaks. Additionally, 2023 energy demand is projected to decline by 0.5% compared to 2022 due to the economic outlook. Toward the end of the forecast period, overall electricity demand – both peaks and energy – is expected to trend upward. Expectations are for electricity demand to increase 1.5% with the economic expansion in 2024 as longer term. Additionally, other factors are affecting the demand for electricity. The post-pandemic effect of work from home and remote working still make the grid more sensitive to temperature. Conversely, the Industrial Conservation Initiative (ICI) acts to reduce peak demands from the commercial and industrial sectors. Storage options, self-generation and other technological advancements are enabling participants to more effectively avoid peak system demands and increase their ICI savings.

The demand forecast faces significant uncertainties. Interest rate impacts can lag significantly and achieving a "soft landing" carries a risk of further interest rate hikes or a longer, deeper period of reduced economic growth. Geopolitical events contribute to uncertainty and instability should they spread to other countries.

Table 3-1 | Forecast Energy Demand Summary

Year	Normal Weather Energy (TWh)	% Growth in Energy
2023	136.0	-0.5%

Year	Normal Weather Energy (TWh)	% Growth in Energy
2024	138.0	1.5%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Summer 2023	22,439	24,420
Winter 2023-24	21,297	22,579
Summer 2024	22,516	24,449

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-Apr-23	18,029	19,146	569	2,537
09-Apr-23	17,786	18,610	567	2,455
16-Apr-23	17,638	18,154	471	2,455
23-Apr-23	17,169	18,159	496	2,429
30-Apr-23	16,824	17,655	531	2,370
07-May-23	16,967	18,800	721	2,356
14-May-23	16,976	19,432	849	2,339
21-May-23	17,112	20,910	845	2,362
28-May-23	17,307	20,689	1,175	2,293
04-Jun-23	18,870	21,175	1,330	2,384
11-Jun-23	19,274	21,744	1,292	2,413
18-Jun-23	20,794	22,151	1,055	2,479

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
25-Jun-23	21,495	22,915	835	2,522
02-Jul-23	21,885	23,626	754	2,553
09-Jul-23	22,250	24,149	1,016	2,648
16-Jul-23	22,212	24,242	814	2,677
23-Jul-23	22,370	24,420	838	2,726
30-Jul-23	22,439	24,418	1,035	2,763
06-Aug-23	22,247	24,377	841	2,785
13-Aug-23	22,216	24,220	958	2,725
20-Aug-23	22,122	24,376	985	2,749
27-Aug-23	22,394	24,220	1,362	2,710
03-Sep-23	22,142	24,174	1,413	2,689
10-Sep-23	21,518	23,480	1,370	2,562
17-Sep-23	21,405	22,675	680	2,540
24-Sep-23	20,283	21,919	781	2,466
01-Oct-23	18,607	20,981	420	2,417
08-Oct-23	17,673	19,430	554	2,391
15-Oct-23	17,411	18,552	786	2,339
22-Oct-23	17,325	17,930	507	2,392
29-Oct-23	17,596	18,964	392	2,425
05-Nov-23	17,777	19,353	318	2,450
12-Nov-23	18,353	19,734	416	2,489
19-Nov-23	18,888	19,464	601	2,555
26-Nov-23	19,559	20,057	342	2,624

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
03-Dec-23	19,759	20,638	607	2,678
10-Dec-23	20,226	21,183	409	2,730
17-Dec-23	20,354	21,635	555	2,758
24-Dec-23	20,212	21,574	690	2,780
31-Dec-23	19,386	20,712	362	2,633
07-Jan-24	20,458	21,520	528	2,796
14-Jan-24	20,926	22,069	570	2,898
21-Jan-24	21,043	22,152	547	2,921
28-Jan-24	21,297	22,579	483	2,939
04-Feb-24	21,209	22,370	404	2,916
11-Feb-24	20,879	21,785	734	2,879
18-Feb-24	20,463	21,633	635	2,877
25-Feb-24	20,260	21,793	581	2,829
03-Mar-24	20,171	21,740	501	2,817
10-Mar-24	19,608	21,105	531	2,749
17-Mar-24	19,114	20,594	649	2,704
24-Mar-24	18,561	19,988	611	2,636
31-Mar-24	18,096	19,233	569	2,538
07-Apr-24	17,857	18,701	567	2,514
14-Apr-24	17,718	18,254	471	2,498
21-Apr-24	17,636	18,247	496	2,465
28-Apr-24	17,428	17,731	531	2,404
05-May-24	17,658	18,910	721	2,393

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
12-May-24	17,322	19,513	849	2,373
19-May-24	17,700	20,955	845	2,394
26-May-24	17,528	20,909	1,175	2,336
02-Jun-24	19,058	21,295	1,330	2,416
09-Jun-24	19,388	21,790	1,292	2,446
16-Jun-24	20,959	22,233	1,055	2,517
23-Jun-24	21,685	23,025	835	2,574
30-Jun-24	22,284	23,948	754	2,640
07-Jul-24	22,311	24,125	1,016	2,639
14-Jul-24	22,465	24,314	814	2,719
21-Jul-24	22,516	24,383	838	2,772
28-Jul-24	22,453	24,449	1,035	2,792
04-Aug-24	22,353	24,400	841	2,811
11-Aug-24	22,274	24,297	958	2,750
18-Aug-24	22,307	24,279	985	2,778
25-Aug-24	22,302	24,346	1,362	2,753
01-Sep-24	22,196	24,143	1,413	2,725
08-Sep-24	21,667	23,547	1,370	2,606
15-Sep-24	21,660	22,847	680	2,582
22-Sep-24	20,216	21,769	781	2,496
29-Sep-24	18,738	21,048	420	2,463
06-Oct-24	17,796	19,465	554	2,434

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.

Significant reserve shortages have the potential to appear in summer 2023, primarily as a result of coincident generator outages. Should market participants be unable to reschedule certain outages during this period, Ontario may have to rely on more than 2,000 MW of supply from other jurisdictions and/or additional operating actions in order to ensure reliability under extreme weather conditions. The IESO expects to have sufficient reserves for the winter of 2023/24.

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 2023 Summer 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	8,753	8,753	5	0	0
Hydroelectric	8,985	5,185	4,572	76	0	117
Gas/Oil	10,482	9,464	9,063	33	0	0
Wind	4,883	761	761	41	0	0
Biofuel	296	286	286	7	0	0
Solar	478	126	126	10	0	0
Demand Measures	-	687	687	-	-	-
Firm Imports (+) / Exports (-) (MW)	-	223	0	-	-	-
Total	38,214	25,484	24,248	172	0	117

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 March 3, 2023. 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 Wind Energy Centre	West	Wind	2023-Q2	Commercial Operation	0	60
Total						**60**

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.

4.1.2 Generation Capability

Hydroelectric

[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.

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)	6,211	6,134	5,952	5,969	6,001	5,811	5,644	5,344	5,123	5,492	5,749	6,207
Historical Hydroelectric Median Contribution without Outages (MW)	6,718	6,720	6,480	6,490	6,450	6,319	6,186	5,936	5,988	6,311	6,534	6,727

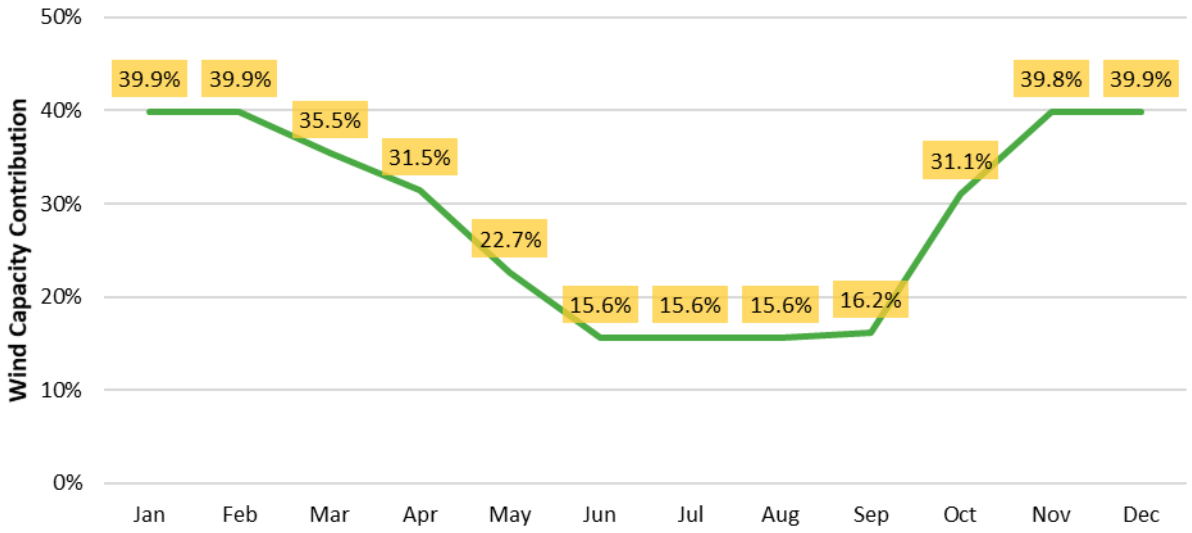
Thermal Generators

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.

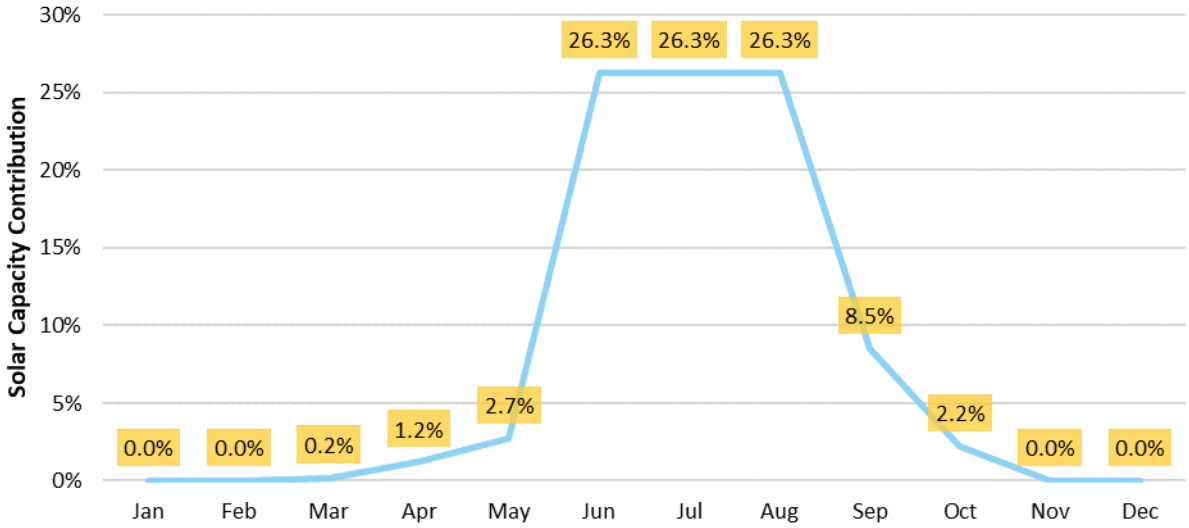
Figure 4-1 | Monthly Wind Capacity Contribution Values



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. New York Independent System Operator (NYISO) auction results for capacity-backed exports for delivery between May to October 2023 will be known in April 2023.

System-Backed Exports

The electricity trade agreement between Ontario and Quebec has expired and is no longer part of our resource adequacy assessment, which had Ontario supply 500 MW of capacity to Quebec for winter months of December to March. However, 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.

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

Notes	Description	Summer Peak 2023 Firm Scenario	Summer Peak 2023 Planned Scenario	Winter Peak 2023/2024 Firm Scenario	Winter Peak 2023/2024 Planned Scenario	Summer Peak 2024 Firm Scenario	Summer Peak 2024 Planned Scenario
1	Installed Resources (MW)	38,214	38,274	38,214	38,274	38,214	38,274
2	Total Reductions in Resources (MW)	13,640	13,690	12,197	12,217	12,918	12,929
3	Demand Measures (MW)	687	687	1,040	1,040	712	712
4	Firm Imports (+) / Exports (-) (MW)	223	223	17	17	0	0
5	Available Resources (MW)	25,483	25,493	27,074	27,114	26,008	26,057
6	Bottling (MW)	0	0	695	719	0	0
7	Available Resources without Bottling (MW)	25,483	25,493	27,769	27,833	26,008	26,057

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 February 14, 2023. The generation planned outages occurring during this Outlook period have been assessed as of March 3, 2023.

4.2.1 Firm Scenario with Normal and Extreme Weather

The firm scenario incorporates all capacity that had achieved commercial operation status as of March 3, 2023.

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.

The results from the December 2022 capacity auction have been modelled in the resource adequacy analysis for the periods of Summer 2023 and Winter 2023/24. For the period beyond Winter 2023/24 that makes up the 18-month period, IESO's Annual Acquisition Report has been used to derive the procurement's target capacity, which is also included in the resource adequacy assessment.

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 eight weeks in summer 2023. Under the current outage schedule, the RAR is below the adequacy threshold for the eight-week period from July 16 to September 3, 2023.

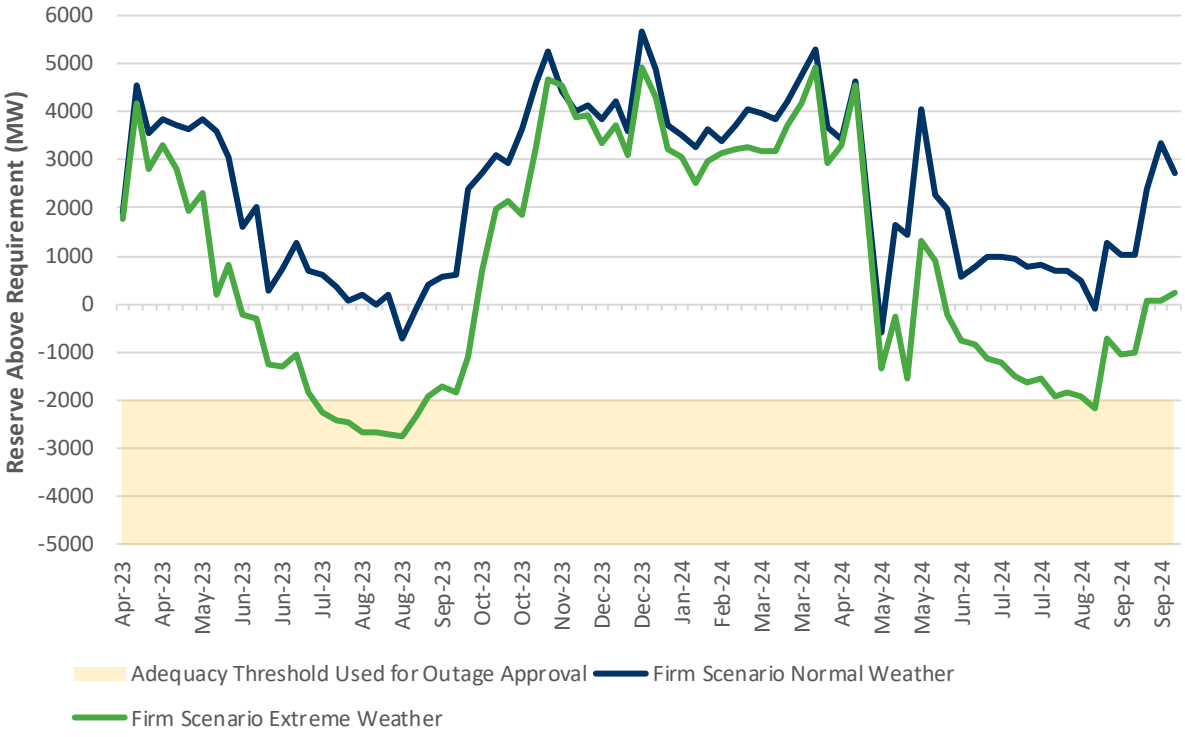
These potential shortfalls are primarily attributed to planned generator outages scheduled during those weeks, including a large number of coincident nuclear outages. The IESO is working closely with participants that have planned outages during this period to ensure Ontario maintains adequate reserves. However, should those participants be unable to reschedule certain outages during periods of low reserves, Ontario may have to rely on more than 2,000 MW of supply from other jurisdictions and/or additional operating actions in order to ensure reliability under extreme weather conditions. Likewise, Ontario 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.

The IESO expects to have sufficient reserves for the winter of 2023/24.

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

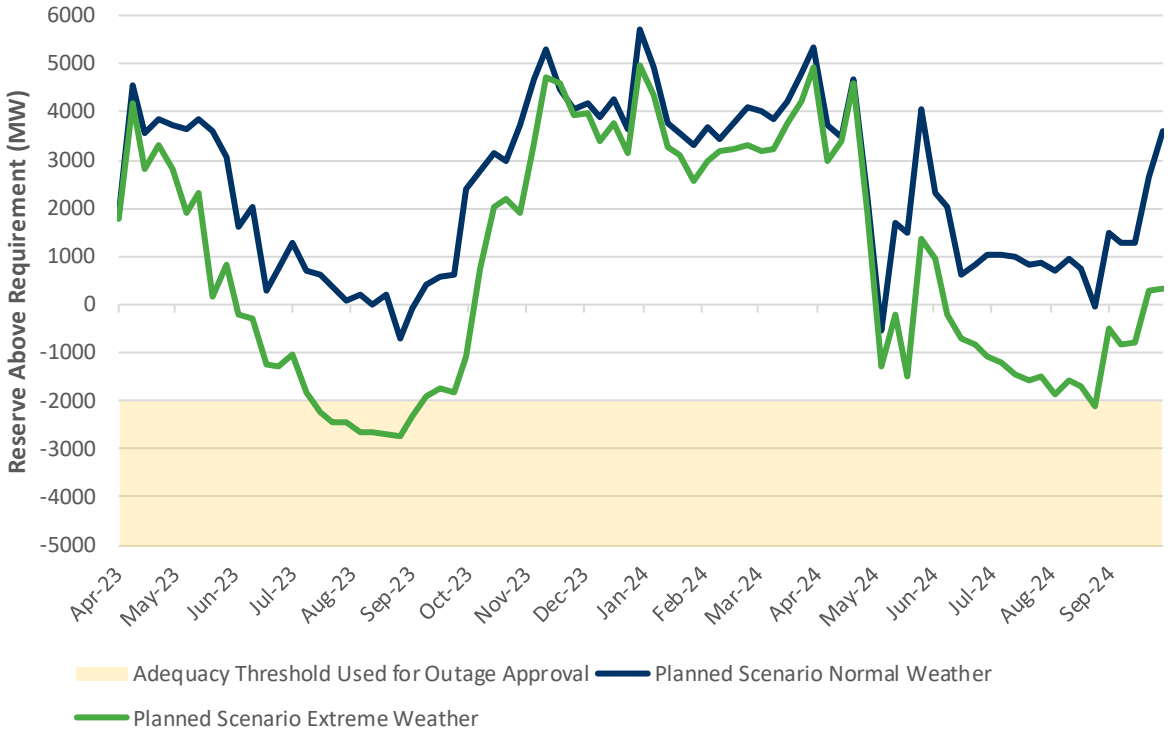


4.2.2 Planned Scenario with Normal and Extreme Weather

The Planned scenario incorporates all existing capacity, as well as all capacity expected to come into service. Approximately 60 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. Reserves fall below requirements for three weeks in 2023 under normal weather conditions. Under the extreme weather scenario, reserves fall short for eight weeks in the summer of 2023.

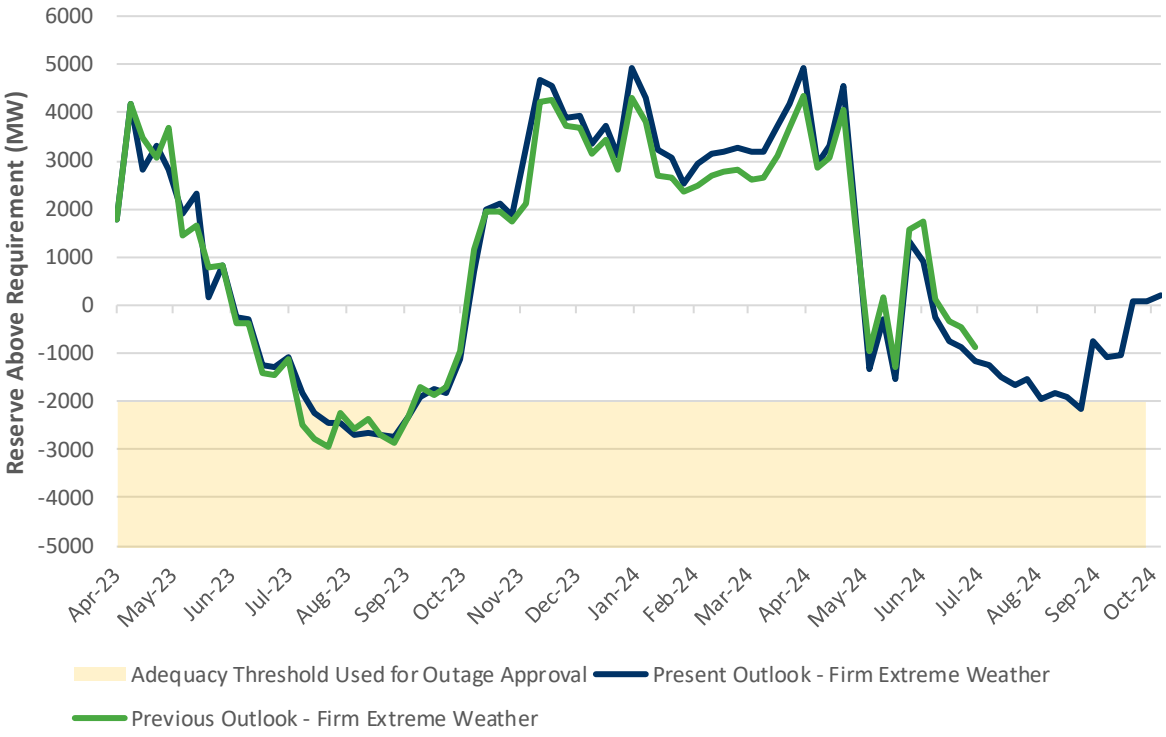
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



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 December 21, 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 2023 Q1 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
Ontario	**203.5**	**15,444**	**203.1**	**15,417**	**0.4**	**454.9**	**576.0**
Bruce	1.1	86	120.2	9,119	119.1	1.7	135.1
East	11.1	842	26.6	2,019	15.5	23.6	95.1
Essa	12.9	976	-5.7	-433	-18.6	28.5	16.6
Niagara	6.5	493	35.4	2,686	28.9	15.1	48.9
Northeast	15.2	1,153	15.2	1,152	0.0	26.9	36.2
Northwest	6.7	506	6.8	519	0.1	12.0	20.2
Ottawa	12.9	976	-11.5	-872	-24.4	29.8	1.9
Southwest	41.1	3,119	-24.5	-1,860	-65.6	92.8	22.1
Toronto	74.2	5,633	30.3	2,300	-43.9	173.0	122.0
West	21.9	1,659	10.4	787	-11.5	51.5	78.0

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 and 2024. During this period, a large number of coincident generation outages suggest a possibility of unserved energy under normal weather conditions, and Ontario may require support from external jurisdictions in order to meet energy demand.

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

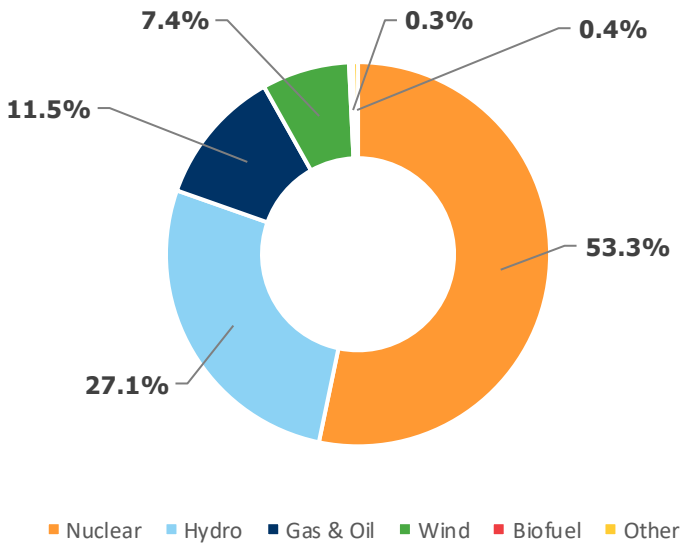


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

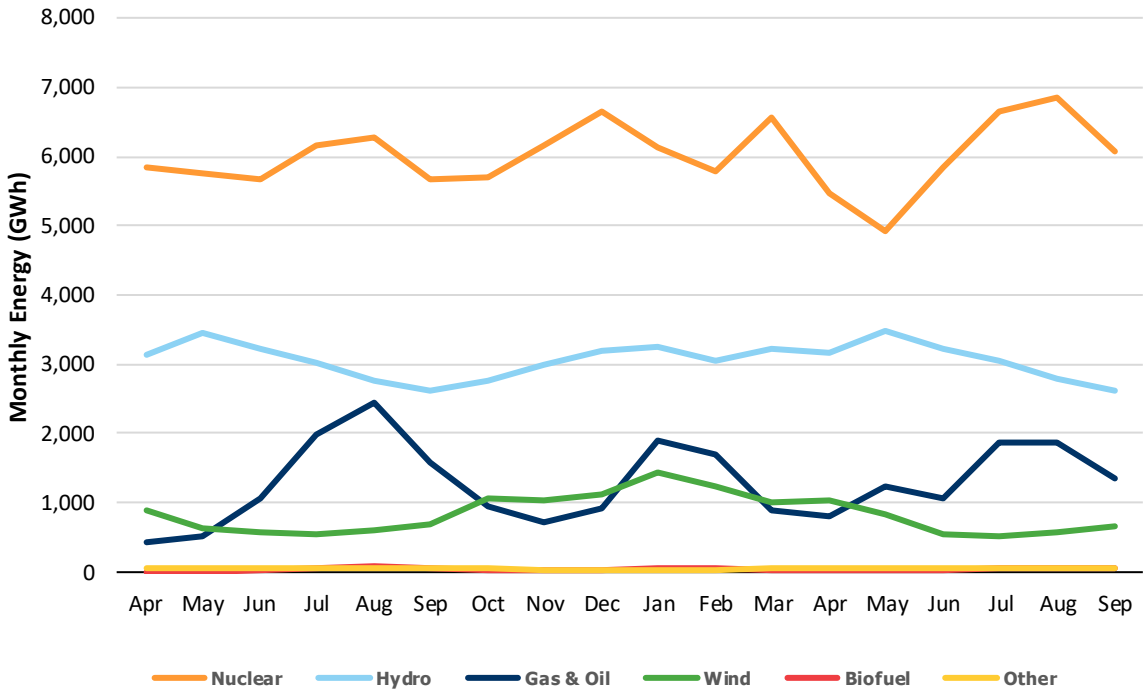


Table 4-6 | Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2023 (Apr 1 – Dec 31) (GWh)	2024 (Jan 1 – Sep 30) (GWh)	Total (GWh)
Nuclear	53,878	54,330	108,208
Hydro	27,232	27,851	55,083
Gas & Oil	10,631	12,680	23,311
Wind	7,141	7,850	14,991
Bio Fuel	327	372	699
Other (Solar & DR)	414	424	839
Total	**99,623**	**103,508**	**203,131**

5. Transmission Reliability Assessment

Ontario's transmission system is expected to continue to reliably supply province-wide demand for the next 18 months. However, electricity demand is growing significantly in certain parts of the province and, as such, a large number of outages will be needed to implement the bulk transmission system reinforcements and build the load stations needed to supply this increase in demand. Until this work is completed, managing the outages in these parts of the province will be challenging.

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 January 2023. 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 February 14, 2023.

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 Windsor-Essex region has led to the capacity of the existing transmission system in the area being exceeded. Market rule exemptions are in place, acknowledging this exceedance. Until system reinforcements are completed, operating the area requires exceptional operational plans and control actions, which can include customer load shedding in certain situations.

The new switching station Lakeshore TS at the Leamington Junction has been installed and all four of the existing circuits have been cut over. All new loads connected to the first South Middle Rd. load station by radial circuits from Lakeshore TS, are now being supplied. The Lakeshore Remedial Action Scheme (RAS), one of the largest in the province, is also in-service. Work is on-going for for the connection of Mastron II CTS, expected to be in-service by Q3 2023, at which point the area will be required to operate to more stringent contingencies to meet NPCC security requirements.

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

- A planned five-week outage starting April 27, 2023, on circuit B501M
- A planned one-week outage starting June 23, 2023, on circuit B561M
- A planned three-week outage starting August 1, 2023, on circuit B502M, followed by another planned four-week outage starting August 21, 2023
- A planned five-week outage starting August 18, 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 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, specifically those associated with the FETT upgrade project and the Bruce B station re-build, 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 by 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 in 2022, with an expected in-service date of Q4 2023.

The following outages will impact the flow into Ottawa:

- A planned three-week outage starting June 10, 2023, on circuit X523A, and another planned six-week outage starting September 25, 2023

Northwest, Northeast, and Essa Zones

The East-West Tie Expansion project consists of two new 230 kV transmission lines 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 lines. 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.

In the Kirkland Lake area, a new RAS is planned to be in service in December 2023, which will enable load rejection, reducing the need for pre-contingency load curtailment. The Ansonville to Kirkland Lake A8K/A9K transmission circuit refurbishment is planned to be in-service by Q2 2023, improving transmission system capacity in the area.

In the Sault Ste. Marie area, there will be an increase in load as a result of Algoma Steel converting their coke-fired furnaces to electric-arc furnaces over the next couple of years. . The fluctuating nature of electric-arc furnace operation in an electrical area with limited transmission will require special attention to manage voltage and power fluctuations prior to the system reinforcements recommended in the Northeast Bulk System plan being completed.

The "Barrie Area Transmission Upgrade" project is expected to come into service in Q4 2023. This project will convert the existing Barrie TS and its supply lines from Essa TS (circuits E3B and E4B) from 115 kV to 230 kV, enabling additional load to be supplied from Barrie TS. The existing 230/115 kV auto-transformers at Essa TS will no longer be needed after this conversion and will be retired.

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

- A one-month outage on circuit X504E starting June 1, 2023
- A three-week outage on circuit D5H starting May 11, 2023

Interconnections

Phase Angle Regulators (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 L33P is now in-service, as of Q3 2022. The PAR on L34P is being replaced to match L33P; it is currently out of service for replacement work, and has an expected in-service date of Q4 2023.

6. Operability

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 the risk of equipment failure, tighter supply conditions and other factors such as supply chain delays, some 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 that are planned for the same time. 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 accommodate 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: IESO Controlled Grid Operating Procedures.

6.2 Ancillary Services

Ancillary services 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.

6.2.1 Regulation Service

The 2022 regulation needs assessment updates the assessment identified in the previous *Reliability Outlook*, based on incremental improvements. The assessment found that there may be an increased need for regulation service in the upcoming years. The IESO is currently considering options to address the potential need for more regulation.

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
2023 Q1 Outlook Tables	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookTables_2023Mar.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
Market Manual 7.1	https://www.ieso.ca/en/sector-participants/market-operations/-/media/ccdae55168cc4ae8a4b73894ba305ebe.ashx	Operability
Annual Acquisition Report	https://www.ieso.ca/en/Sector-Participants/Planning-and-Forecasting/Annual-Acquisition-Report	Resource Adequacy

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

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

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

ieso.ca

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