Reliability Outlook

An adequacy assessment of Ontario's electricity system

July 2023 to December 2024

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Executive Summary

Ontario's electricity system is prepared for summer, with adequate supply expected to be available to meet electricity demand and maintain operating reserves. The IESO is prepared for tighter grid conditions that could develop if the province experiences extreme heatwaves – this is similar to last year and is the new norm for many jurisdictions around North America.

Demand for electricity in Ontario is at its highest during the summer months due to air conditioning load. This summer Ontario's electricity system will have multiple nuclear units undergoing refurbishment concurrently, which the IESO has been anticipating and planning for.

Ontario has a diverse supply mix and a variety of tools available to maintain the reliability of the grid. This includes deferring planned generator and transmission maintenance, imports from our neighbours, and consumer demand response.

The IESO's resource adequacy forecasts are intended to provide transparency around current maintenance outage requests and do not reflect final outcomes. Under the current extreme weather forecast, supply is lower than what is required to meet demand and maintain required reserves for 10 weeks this coming summer, reflecting current requests from generators to take maintenance outages. Reserve refers to the amount of supply, plus backup supply, needed to meet North American reliability standards.

If available supply is below requirement, the IESO imports power and/or defers generator maintenance outages to meet the requirement. In addition, the IESO also maintains backup supply to maintain reliability if challenging circumstances arise. Ontario's backup supply is typically equal to the largest generator plus half of the second largest.

The IESO will reject or defer non-essential generator maintenance as system conditions dictate. New requests by market participants for maintenance outages that impact grid reliability will not be approved to proceed during this time if they can be rescheduled.

There is ongoing coordination with nearby jurisdictions as imports will contribute to reliability this summer. Ontario consumers also play an important role in maintaining grid reliability each year. Large consumers participating in the Industrial Conservation Initiative are expected to reduce provincial demand by roughly six per cent. In addition, over 900 MW of consumer demand response secured in the most recent capacity auction can also contribute.

Electricity demand is expected to decline slightly to 136.1 TWh in 2023, a projected reduction of 0.4% from 2022. The impacts of interest rate hikes over the past year are expected to continue over the remainder of the year.

Economic growth is expected to increase electricity demand next year and over the long-term. For 2024, demand is expected to increase to 138.8 TWh, a projected increase of 1.9%. Over

the longer term, strong demand growth is expected as a result of electrification and activity in the mining, agricultural and industrial sectors.

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1. Introduction

This Outlook covers the 18 months from July 2023 to December 2024, and supersedes the Outlook released on March 23, 2023.

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 March 2023, and has been updated to reflect the most recent economic projections. Actual weather and demand data for April and May 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 June 13, 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, 2023.

2.3 Updates to the Transmission Outlook

This Outlook also considers transmission outage plans that were submitted to the IESO's outage management system by May 3, 2023.

3. Demand Forecast

Electricity demand is expected to decline slightly to 136.1 TWh, a projected reduction of 0.4% for 2023. This follows higher growth in each of the previous two years: 1.4% in 2021 (133.7 TWh) and a 2.2% increase in 2022 (136.7 TWh). For 2024, demand is expected to increase to 138.8 TWh (1.9%). 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 July 2023 to December 2024 and supersedes the previous forecast released in March 2023. Tables of supporting information are contained in the 2023 Q2 Outlook Tables.

Electricity demand is very closely tied to economic activity. For 2023, the impacts of interest rate hikes over the past year will continue to work their way through the economy, which may slow growth over the remainder of the year. Slowing growth may help ease inflationary pressures later in 2023 and into 2024. Lower rates combined with pent-up demand have the potential to result in strengthening economic and electricity demand next year.

Peak demands are expected to be effectively unchanged from the previous forecast as they are much more weather-driven and less impacted by economic activity. Additionally, 2023 energy demand is projected to decline by 0.4% 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. Electricity demand is forecast to increase by 1.9% with the economic expansion as inflation wanes and interest rates fall in 2024.

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. 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	136.1	-0.37%
2024	138.8	1.94%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Summer 2023	22,446	24,446
Winter 2023-24	21,361	22,592
Summer 2024	22,538	24,489

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-Jul-23	21,824	23,575	754	2,553
09-Jul-23	22,194	24,108	1,016	2,650
16-Jul-23	22,270	24,201	814	2,680
23-Jul-23	22,446	24,446	838	2,729
30-Jul-23	22,446	24,420	1,035	2,766
06-Aug-23	22,311	24,435	841	2,790
13-Aug-23	22,292	24,281	958	2,729
20-Aug-23	22,175	24,427	985	2,750
27-Aug-23	22,397	24,272	1,362	2,712
03-Sep-23	22,200	24,132	1,413	2,691

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
10-Sep-23	21,480	23,441	1,370	2,565
17-Sep-23	21,380	22,652	680	2,543
24-Sep-23	20,278	21,914	781	2,471
01-Oct-23	18,597	20,976	420	2,423
08-Oct-23	17,669	19,420	554	2,398
15-Oct-23	17,408	18,554	786	2,345
22-Oct-23	17,319	17,929	507	2,398
29-Oct-23	17,587	18,966	392	2,431
05-Nov-23	17,779	19,356	318	2,457
12-Nov-23	18,353	19,734	416	2,495
19-Nov-23	18,887	19,462	601	2,562
26-Nov-23	19,559	20,054	342	2,632
03-Dec-23	19,755	20,632	607	2,685
10-Dec-23	20,226	21,180	409	2,737
17-Dec-23	20,355	21,635	555	2,765
24-Dec-23	20,248	21,610	690	2,788
31-Dec-23	19,414	20,748	362	2,642
07-Jan-24	20,529	21,537	528	2,803
14-Jan-24	21,000	22,079	570	2,903
21-Jan-24	21,107	22,168	547	2,927
28-Jan-24	21,361	22,592	483	2,945
04-Feb-24	21,270	22,377	404	2,922
11-Feb-24	20,933	21,789	734	2,884

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
18-Feb-24	20,506	21,607	635	2,883
25-Feb-24	20,301	21,745	581	2,835
03-Mar-24	20,218	21,691	501	2,824
10-Mar-24	19,577	21,078	531	2,758
17-Mar-24	19,090	20,568	649	2,714
24-Mar-24	18,534	19,964	611	2,646
31-Mar-24	18,071	19,214	569	2,548
07-Apr-24	17,830	18,677	567	2,524
14-Apr-24	17,696	18,231	471	2,508
21-Apr-24	17,609	18,216	496	2,475
28-Apr-24	17,396	17,701	531	2,415
05-May-24	17,324	18,880	721	2,405
12-May-24	17,272	19,480	849	2,384
19-May-24	17,463	20,918	845	2,407
26-May-24	17,505	20,884	1,175	2,350
02-Jun-24	19,084	21,234	1,330	2,430
09-Jun-24	19,401	21,718	1,292	2,458
16-Jun-24	20,980	22,154	1,055	2,528
23-Jun-24	21,717	22,954	835	2,588
30-Jun-24	22,302	23,876	754	2,651
07-Jul-24	22,307	24,025	1,016	2,649
14-Jul-24	22,483	24,232	814	2,731
21-Jul-24	22,538	24,401	838	2,786

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
28-Jul-24	22,497	24,489	1,035	2,806
04-Aug-24	22,370	24,411	841	2,827
11-Aug-24	22,310	24,317	958	2,768
18-Aug-24	22,335	24,455	985	2,795
25-Aug-24	22,320	24,362	1,362	2,767
01-Sep-24	22,214	24,112	1,413	2,742
08-Sep-24	21,690	23,469	1,370	2,623
15-Sep-24	21,688	22,777	680	2,601
22-Sep-24	20,211	21,714	781	2,516
29-Sep-24	18,724	21,022	420	2,486
06-Oct-24	17,771	19,433	554	2,458
13-Oct-24	17,505	18,566	786	2,451
20-Oct-24	17,418	17,944	507	2,421
27-Oct-24	17,697	18,988	392	2,497
03-Nov-24	17,829	19,296	318	2,525
10-Nov-24	18,411	19,709	416	2,560
17-Nov-24	18,968	19,460	601	2,622
24-Nov-24	19,655	20,066	342	2,702
01-Dec-24	19,875	20,669	607	2,753
08-Dec-24	20,342	21,213	409	2,809
15-Dec-24	20,477	21,674	555	2,836
22-Dec-24	20,594	21,720	690	2,872
29-Dec-24	18,470	20,046	362	2,681

4. Resource Adequacy

Ontario's power system continues to operate in 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 prepare the system and ensure planned outages can be appropriately scheduled.

The IESO expects to have sufficient reserves for the winters of 2023/24 and 2024/25. However, 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.

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	13,144	8,560	8,560	5	0	55
Hydroelectric	8,922	5,055	4,434	76	0	-64
Gas/Oil	10,470	9,453	9,041	33	0	-12
Wind	4,883	720	720	41	0	0
Biofuel	296	286	286	7	0	0
Solar	478	66	66	10	0	0
Demand Measures	-	740	740	-	-	-
Firm Imports (+) / Exports (-) (MW)	-	223	0	-	-	-
Total	**38,193**	**25,103**	**23,847**	**172**	**0**	**-20**

4.1 Assessment Assumptions

4.1.1 Generation Resources

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

The estimated effective date column in Table 4-2 indicates when the market registration process is expected to be complete for each generation resource, based on information available to the IESO as of June 2, 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 Center	West	Wind	2023-Q3	Commercial Operation		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.

[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.

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 2023, 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)	6,167	6,090	5,910	5,927	5,958	5,769	5,604	5,306	5,087	5,453	5,708	6,162
Historical Hydroelectric Median Contribution without Outages (MW)	6,670	6,673	6,434	6,444	6,404	6,274	6,142	5,894	5,945	6,266	6,488	6,679

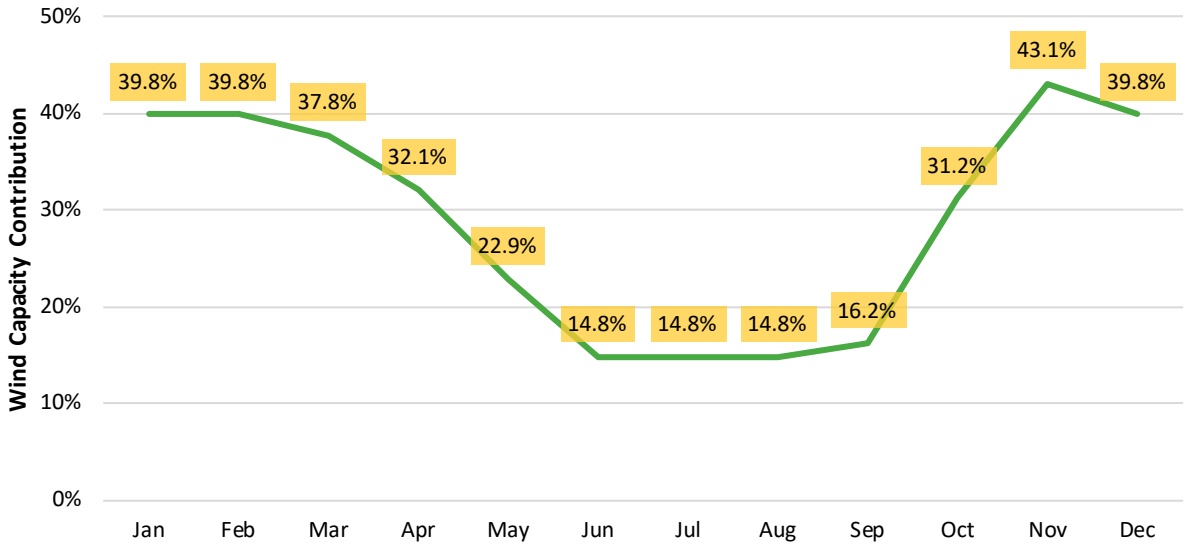
Thermal Generators

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.

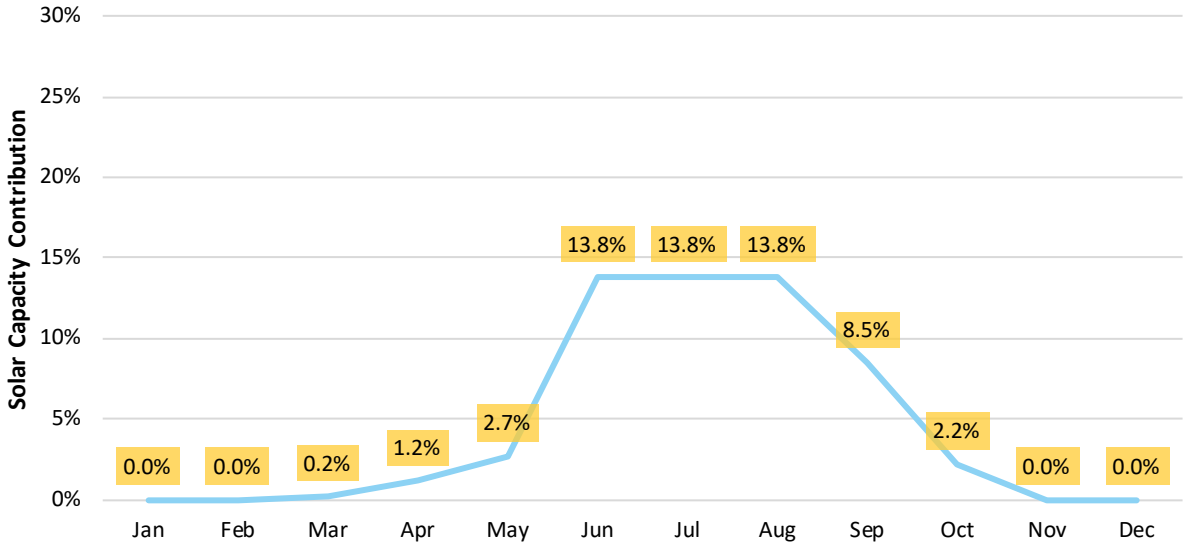
Figure 4-1 | Monthly Wind Capacity Contribution Values



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. The solar capacity contribution dropped to pre-pandemic levels as the peak window reverted as well. We will continue to monitor the demand peaks every quarter and adjust accordingly. In addition, there has been no change to the existing methodology.

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) will allow up to 80 MW of capacity-backed exports from Ontario in summer 2023.

System-Backed Exports

The electricity trade agreement between Ontario and Quebec has expired as of March 2023, ending the supply of 500 MW of capacity to Quebec for winter months. However, Ontario will continue to receive up to 2.3 TWh of clean energy annually until December 31 2023, 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 anticipates exercising this option in the summer of 2026). Ontario and Quebec will continue with economic imports and exports outside of this agreement.

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)	38,193	38,193	38,193	38,253	38,193	38,253
2	Total Reductions in Resources (MW)	14,053	14,053	11,609	11,629	11,981	11,992
3	Demand Measures (MW)	740	740	777	777	1,022	1,022
4	Firm Imports (+) / Exports (-) (MW)	223	223	17	17	0	0
5	Available Resources (MW)	25,103	25,103	27,378	27,418	27,234	27,283
6	Bottling (MW)	0	0	659	683	0	0
7	Available Resources without Bottling (MW)	25,103	25,103	28,036	28,100	27,234	27,283

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 May 3, 2023. The generation planned outages occurring during this Outlook period have been assessed as of June 13, 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 June 13, 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.

Capacity secured in the December 2022 Capacity Auction (CA) has been included in this assessment. Firm guidance targets for capacity in the December 2023 Capacity Auction, as announced in the IESO's 2022 Annual Acquisition Report, have been included and modelled as demand measures in the firm resource scenario for summer 2024 and winter 2024/25[2].

The IESO expects to have sufficient reserves for the winters of 2023/24 and 2024/25. In the firm scenario under normal weather conditions, available reserves fall below the requirement for six 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 in the weeks spanning July 9 to September 24, 2023, with the exception of the weeks of September 3 and 17, where it is marginally above the threshold.

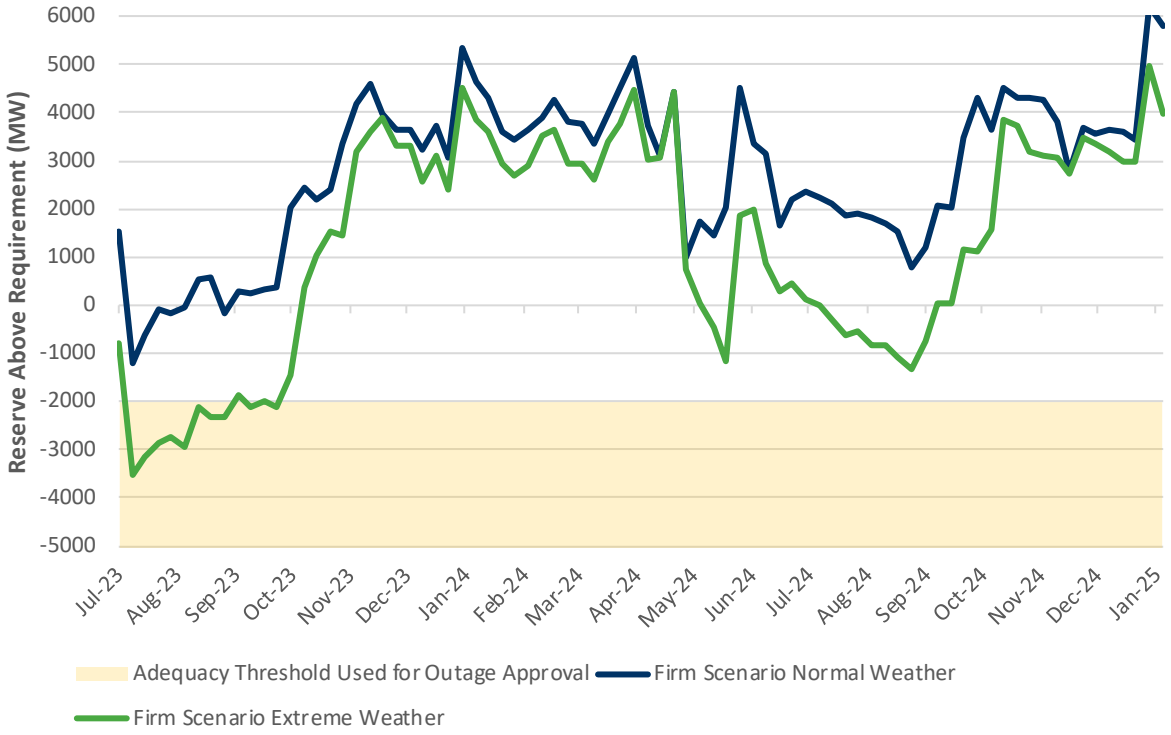
These potential shortfalls are primarily attributed to planned generator outages scheduled during those weeks, including a number of coincident nuclear and gas outages. The IESO is in direct communications with market participants that have planned outages during this period to ensure Ontario maintains 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 is in ongoing discussion with generators whose scheduled outages impact the RAR. We will continue to work closely with both these generators and transmitters to ensure outages are appropriately scheduled.

[2] Results of the December 2023 Capacity Auction were not available at the time this assessment was completed. 2022 Capacity Auction results can be found in the post-auction report on the IESO's webpage, and will be included in the firm scenario in future outlooks.

As Ontario continues to experience a period of tight supply conditions, planned generator maintenance outages will become increasingly difficult to schedule during summer. The IESO is prepared to work with Market Participants to reschedule outages to ensure the reliability of the system. 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

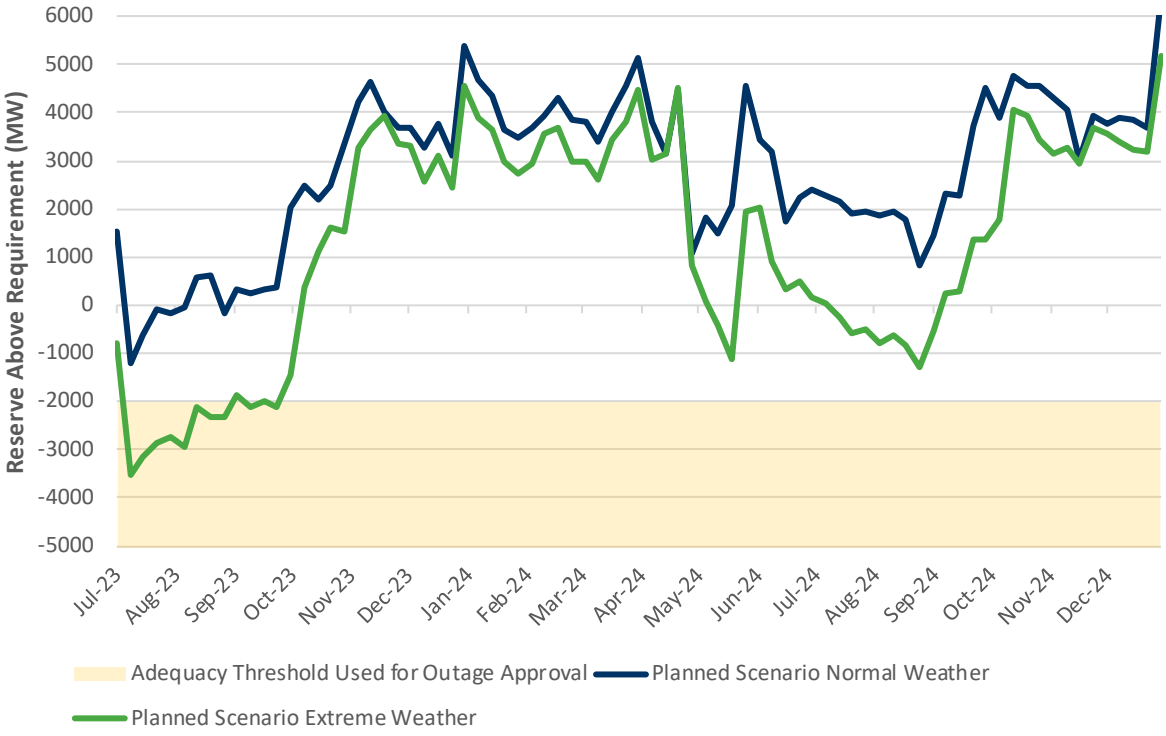


4.2.2 Planned Scenario with Normal and Extreme Weather

The Planned scenario incorporates all existing capacity, as well as all capacity expected to come into service. Approximately 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 six weeks in 2023 under normal weather conditions. Under the extreme weather scenario, reserves fall short for 10 weeks in the summer of 2023.

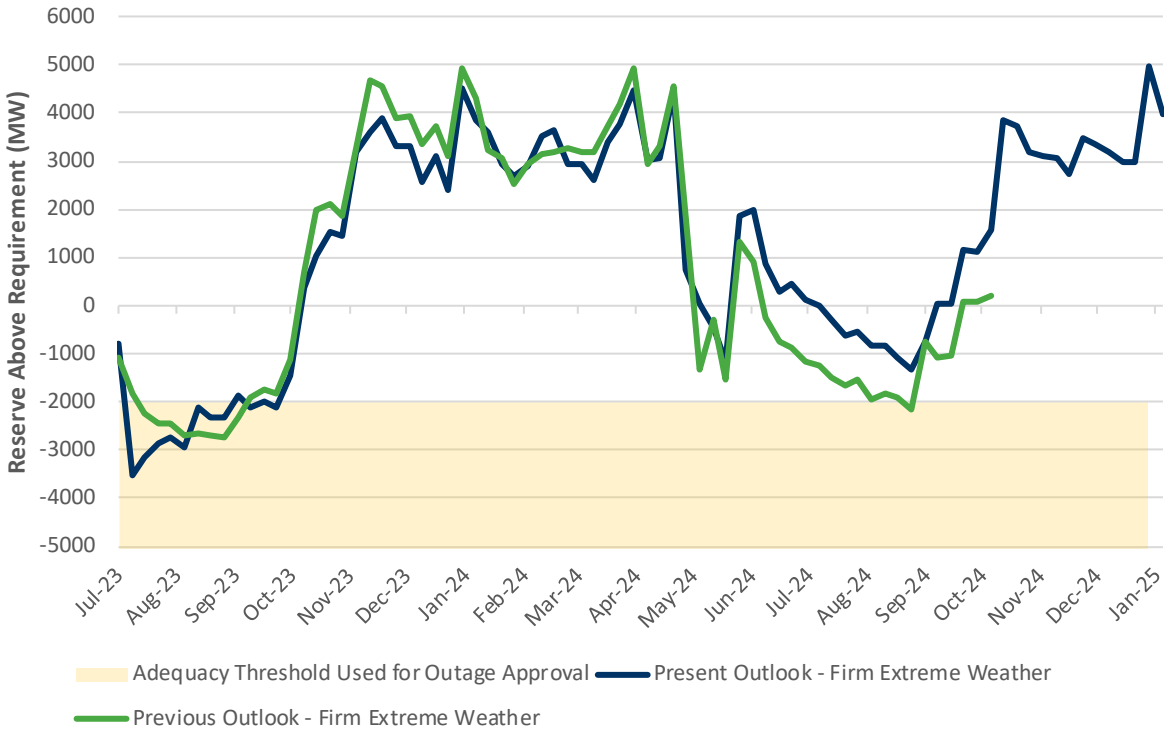
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



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 March 23, 2023. 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 Q2 Outlook Tables.

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

4.3.2 Results – Firm Scenario with Normal Weather

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

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

Zone	18-Month Energy Demand TWh	18-Month Energy Demand Average MW	18-Month Energy Production TWh	18-Month Energy Production Average MW	Net Inter-Zonal Energy Transfer TWh	Zonal Energy Demand on Peak Day of 18-Month Period GWh	Available Energy on Peak Day of 18-Month Period GWh
Bruce	1.2	90	64.9	4,919	63.7	1.7	137.6
East	11.7	886	17.5	1,323	5.8	23.9	104.1
Essa	13.3	1,006	3.4	255	-9.9	28.4	16.4
Niagara	6.7	507	20.7	1,566	14.0	15.2	48.7
Northeast	15.6	1,180	15.0	1,134	-0.6	27.4	39.1
Northwest	6.8	517	6.6	503	-0.2	12.1	18.9
Ottawa	13.1	995	0.6	45	-12.5	30.0	1.8
Southwest	41.6	3,153	7.5	568	-34.1	92.8	23.6
Toronto	75.1	5,688	55.7	4,218	-19.4	173.4	149.6
West	22.2	1,683	15.0	1,133	-7.2	51.2	80.9
Ontario	**207.3**	**15,705**	**206.8**	**15,666**	**-0.5**	**456.1**	**620.8**

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 six weeks in the summer of 2023 occuring primarily in July and two weeks in August. During this period, a 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

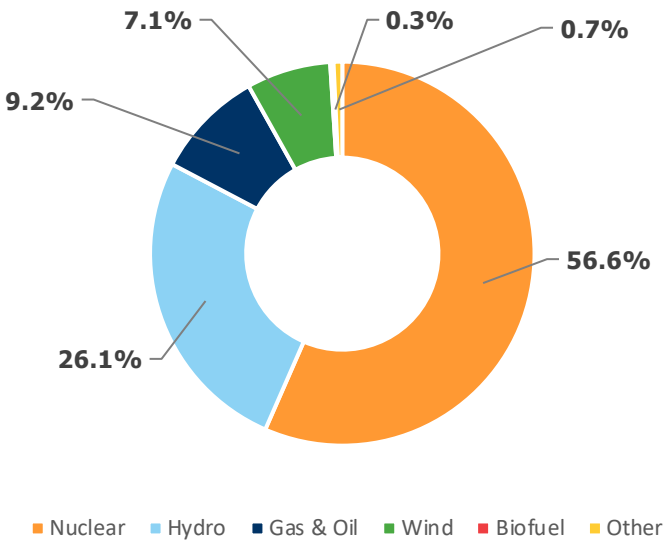


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

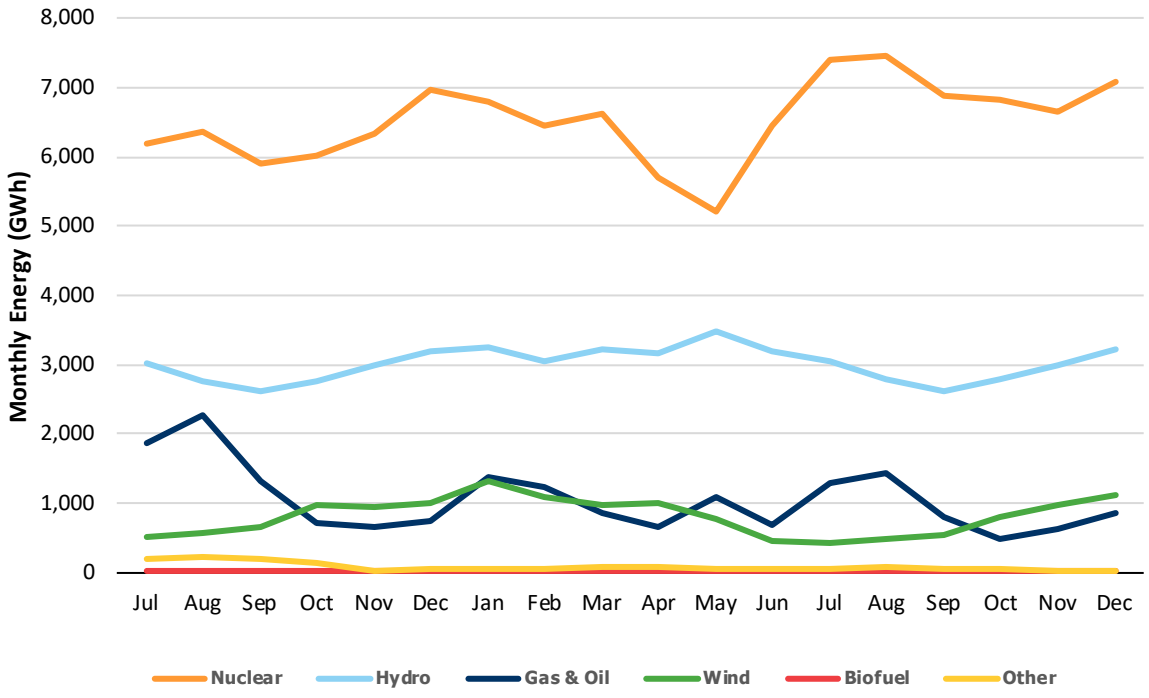


Table 4-6 | Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2023 (July 1 – Dec 31) (GWh)	2024 (Jan 1 – Dec 31) (GWh)	Total (GWh)
Nuclear	37,775	79,497	117,271
Hydro	17,392	36,801	54,192
Gas & Oil	7,594	11,455	19,050
Wind	4,691	10,007	14,698
Biofuel	226	360	586
Other (Solar & DR)	843	673	1,516
Total	**68,521**	**138,792**	**207,313**

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 outage 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 other 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 April 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 May 3, 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 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 circuits have been cut over. As well, the new Lakeshore RAS has been installed. New loads are starting to connect to the first South Middle Rd. load station connected by radial circuits from Lakeshore TS, and work is on-going for additional load stations in the area. During this time, system resiliency will be reduced, and per market rule exceptions in the area, certain customers in the area may experience a lower level of reliability.

Multiple new transmission lines are under development in the region that will increase available supply starting mid-decade. In June 2023, construction began on two new 230-kV circuits from Chatham SS to Lakeshore SS to support continued load growth. This line is expected to be in service in 2025.

The Bruce B 500 kV switchyard is being rebuilt and all improvements are expected to be in be in-service by 2024 Q4. The existing, integrated circuits are being cut-over to the new switchyard, among other outages that are required. The following outages will impact the flow out of the Bruce zone:

- A planned two-week outage starting June 19, 2023, on circuit B561M
- A planned seven-week outage starting August 1, 2023, on circuit B502M, and another planned four-week outage starting October 21, 2023
- A planned five-week outage starting September 18, 2023, on circuit B560V, and another planned six-week outage starting August 26, 2024

Toronto, East, and Ottawa Zones

To address high voltages in eastern Ontario and the Greater Toronto Area, two 500 kV line-connected shunt reactors have now been installed and are in-service at Lennox TS. There may continue to be a need to remove from service certain 500 kV circuits for voltage control during specific prevailing conditions.

There are upcoming nuclear refurbishments of multiple units at Darlington with overlapping timelines. As a result, it will be increasingly challenging for market participants to take outages impacting the Flow East Towards Toronto (FETT) interface. Future planned outages will necessitate enhanced coordination between transmitters and generators. Planned outages for certain windows may need to be rescheduled or rejected to ensure reliability. Of particular note, the FETT Capacity Upgrade (i.e., Richview-Trafalgar Reinforcement) project to address future needs is underway; the project is expected to be in-service by Q1 2026.

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

The following outages will impact the flow into Ottawa:

- A planned one-month outage started May 28, 2023, on circuit X523A, and will be followed by another planned four-week outage starting October 16, 2023

Northwest, Northeast, and Essa Zones

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

- A one-week outage on circuit X504E starting June 24, 2023
- A four-week outage on circuit X503E starting October 2, 2023

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

In the Kirkland Lake area, a new RAS is planned to be in service in December 2023, eliminating 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.

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.

Interconnections

The Phase Angle Regulators (PARs) between Ontario and New York are being replaced in order to provide greater flexibility to control intertie flows between Ontario and New York. The new PAR on L33P was put into service 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

Ontario's power system is operating within a period of tighter supply conditions requiring careful consideration of outage management. 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 continues to experience a period during which generation and transmission outages will be increasingly difficult to accommodate, and the IESO is working with market participants to manage this. 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 have become 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, 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: IESOControlled Grid Operating Procedures.

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 Q2 Outlook Tables	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookTables_2023Jun.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

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