Reliability Outlook

An adequacy assessment of Ontario's electricity system

April 2022 to September 2023

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Executive Summary

Ontario's electricity system is expected to remain reliable over the next 18 months after accounting for changes to generator outage schedules and imports.

Over the outlook period, multiple nuclear refurbishments will be taking place concurrently, and transmission upgrades and new infrastructure are needed across the province. This means that transmission and supply conditions will be tighter during the next two summers compared to recent years.

Generators should note that outages are becoming increasingly difficult to accommodate, and market participants are strongly encouraged to plan ahead and coordinate with IESO staff to ensure planned outages can be appropriately scheduled. Discussions are underway with nuclear generators to make changes to the refurbishment schedule for 2023, which will improve the adequacy outlook. These updates will be reflected in the next outlook.

The addition of 160 megawatts of wind generation over the outlook period, as well as resources acquired through the IESO's annual capacity auction, will help meet Ontario demand.

Despite multiple waves of COVID-19 and economic disruption to the economy, electricity demand in Ontario increased by 1.4% to 133.7 terawatt-hours (TWh) in 2021. This is still below the pre-COVID level of 134.7 TWh from 2019.

Economic activity is expected to pick up in 2022, with remaining public health restrictions expected to be lifted this spring, and pent-up demand for goods and services stimulating consumer spending. Electricity demand is forecast to reach 135.4 TWh in 2022, a 1.4% increase over 2021.

As noted in previous Reliability Outlooks, there is substantial uncertainty about the demand forecast going forward. For example, existing factors related to supply chain constraints, interest rate hikes and decarbonization efforts, and the crisis in Ukraine may have long-term impacts on the global economy.

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

For example, significant growth in the greenhouse sector has led to a number of customer connection requests in the Windsor-Essex region. A new switching station at the Leamington Junction is proceeding toward a Q2 2022 in-service date, which will increase capacity in the region. As a result, outages may be difficult to accommodate as new load connections are made and required transmission reinforcements are being implemented.

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1. Introduction

This Outlook covers the 18 months from April 2022 to September 2023, and supersedes the Outlook released on December 20, 2021.

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 January 2022, and has been updated to reflect the most recent economic projections. Actual weather and demand data for February 2022 are included in the tables.

2.2 Updates to Resources

This *Reliability Outlook* considers planned generator outages over the 18-month period, submitted by market participants to the IESO's outage management system as of March 1, 2022. Market participants are required annually to submit information to enable the IESO to conduct reliability assessments. This information, provided to the IESO through Form 1230, was submitted by April 1, 2021.

The following resources cleared the December, 2021 Capacity Auction and are included in this assessment:

- Capacity Auction (various resources)
    - Summer 2022 obligation period – 1,286.7 MW
    - Winter 2022/23 obligation period – 841.9 MW

2.3 Updates to the Transmission Outlook

This Outlook also considers transmission outage plans that were submitted to the IESO's outage management system by January 27, 2022.

2.4 Updates to the Operability Outlook

Surplus baseload generation (SBG) is not expected to be a significant issue in Ontario for the foreseeable future. Beginning in this Outlook, forecasts for SBG will no longer be produced. Other relevant studies related to operability will be highlighted in this section. There are no updates to the Operability Outlook since the last Outlook.

3. Demand Forecast

Electricity demand was fairly robust through 2021 despite the ongoing pandemic. As the province emerges from the public health crisis and the economy reopens, electricity consumption is expected to increase. Pent-up demand for goods and services will buoy the economy and push electricity demand above the level seen in 2019. However, there is significant risk to the accuracy of this demand forecast as the outlook and timing for the pandemic recovery remain uncertain. Significant broader macroeconomic and geopolitical factors are also likely to ultimately impact electricity demand over the 18-month horizon; the precise impact of these factors is not yet clear, and the IESO is monotoring these trends closely.

The IESO is responsible for forecasting electricity demand on the IESO-controlled grid. This demand forecast covers the period from April 2022 to September 2023 and supersedes the previous forecast released in December 2021. Tables of supporting information are contained in the 2022 Q1 Outlook Tables.

Despite multiple COVID waves and the disruption to the economy they entailed, electricity demand showed an increase of 1.4% to 133.7 TWh in 2021. However, this is still below the pre-COVID level of 134.7 TWh from 2019. Economic activity is expected to pick up in 2022. The expected removal of remaining public health restrictions this spring, coupled with pent-up demand for goods and services, will stimulate growth. This will translate into higher electricity demand of 135.4 TWh, a 1.4% increase over 2021 and return to the pre-COVID levels of electricity consumption.

Higher demand for goods and services, combined with supply chain issues have caused inflation to spike leading to the Bank of Canada raising rates by 25 basis points. Higher interest rates act as a drag on the economy, but this modest interest rate increase isn't expected to negatively impact growth at this time. Future action and statements from the Bank of Canada will be monitored and forecasts will be updated accordingly. Electricity demand is expected to increase over the remainder of the forecast period as longer term trends of structural change due to decarbonization and hardening supply chains impact many sectors.

Coinciding with the removal of COVID restrictions across the province, many employees are moving back to the office. Although work from home will be the new normal for some, the vast majority will return to the workplace on a full-time or part-time basis. This will alleviate some of the increased weather sensitivity that the system experienced over the past two summers, but it will not represent a return to pre-COVID residential demand. Likewise, higher building occupancy and improved air handling systems will increase commercial demand as compared to the previous two summers. Combined, the impact will be to see small increases to summer peak demands. Conversely, winter peaks should moderate going forward as the past two winter peaks have been during lockdowns, with reduced office and school occupancy. The fall of 2022 should be representative of the new normal as schools are expected to be predominately in-person and work from home will be the exception and not the rule. As such, the 2022-23 winter peak is anticipated to be slightly lower than this past winter's.

As in previous Outlooks, there continues to be a significant amount of uncertainty regarding the demand forecast. The pandemic and the global disruption that it has caused has resulted in economic, political and social upheaval impacting the movement of goods and people. Each wave of the pandemic has led to major disruptions in the supply chains of the highly interconnected global economy. Although Ontario has one of the highest vaccination rates in the world and the actions taken by residents have mitigated some of the worst of the pandemic, the Ontario economy is also one of the most internationally interconnected in the global economy. That means Ontario is vulnerable to disruptions in other jurisdictions, whether due to semiconductor chip shortages or food shortages resulting from a lack of field workers. The chaos emanating from the invasion of Ukraine will have implications as well but at this point it is too early to tell how they may manifest themselves.

Table 3-1 | Forecast Energy Demand Summary

Year	Normal Weather Energy (TWh)	% Growth in Energy
2022	135.6	1.43%
2023	136.2	0.40%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Summer 2022	22,546	24,675
Winter 2022-23	21,287	22,464
Summer 2023	22,604	24,694

Table 3-3 | Weekly Energy and Peak Demand Forecast

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
03-Apr-22	17,475	18,653	569	2,457
10-Apr-22	17,264	18,184	567	2,451
17-Apr-22	17,213	18,135	471	2,395
24-Apr-22	16,878	17,605	496	2,365
01-May-22	16,942	18,768	531	2,362

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
08-May-22	16,763	19,331	721	2,341
15-May-22	17,530	20,697	849	2,362
22-May-22	17,581	20,651	845	2,351
29-May-22	18,274	21,179	1,175	2,322
05-Jun-22	19,387	21,679	1,330	2,407
12-Jun-22	20,831	22,058	1,292	2,485
19-Jun-22	21,510	22,938	1,055	2,541
26-Jun-22	22,173	23,918	835	2,606
03-Jul-22	21,819	23,705	754	2,589
10-Jul-22	22,396	24,260	1,016	2,686
17-Jul-22	22,474	24,592	814	2,729
24-Jul-22	22,555	24,675	838	2,746
31-Jul-22	22,524	24,652	1,035	2,756
07-Aug-22	22,161	24,516	841	2,696
14-Aug-22	22,173	24,568	958	2,724
21-Aug-22	22,399	24,657	985	2,705
28-Aug-22	21,849	23,536	1,362	2,682
04-Sep-22	21,446	23,323	1,413	2,606
11-Sep-22	21,341	22,482	1,370	2,484
18-Sep-22	20,035	21,324	680	2,435
25-Sep-22	19,086	20,458	781	2,407
02-Oct-22	17,755	19,150	420	2,379
09-Oct-22	16,906	18,197	554	2,368
16-Oct-22	17,045	17,590	786	2,335

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
23-Oct-22	17,231	18,662	507	2,409
30-Oct-22	17,430	18,906	392	2,435
06-Nov-22	17,595	19,149	318	2,465
13-Nov-22	18,694	19,028	416	2,520
20-Nov-22	19,014	19,667	601	2,600
27-Nov-22	19,368	20,283	342	2,656
04-Dec-22	19,610	20,761	607	2,704
11-Dec-22	20,083	21,360	409	2,743
18-Dec-22	20,087	21,497	555	2,780
25-Dec-22	19,972	21,594	690	2,798
01-Jan-23	19,873	21,136	362	2,653
08-Jan-23	20,306	21,330	528	2,759
15-Jan-23	20,796	21,937	570	2,867
22-Jan-23	20,959	22,048	547	2,891
29-Jan-23	21,283	22,464	483	2,911
05-Feb-23	21,015	21,972	404	2,886
12-Feb-23	20,891	21,768	734	2,859
19-Feb-23	20,553	21,606	635	2,850
26-Feb-23	20,375	21,696	581	2,805
05-Mar-23	19,969	21,302	501	2,778
12-Mar-23	19,596	20,952	531	2,727
19-Mar-23	18,900	20,269	649	2,681
26-Mar-23	18,511	19,911	611	2,617
02-Apr-23	18,179	19,184	569	2,552

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
09-Apr-23	17,909	18,681	567	2,469
16-Apr-23	17,706	18,246	471	2,472
23-Apr-23	17,247	18,284	496	2,449
30-Apr-23	16,944	17,778	531	2,393
07-May-23	17,154	18,900	721	2,383
14-May-23	17,165	19,563	849	2,364
21-May-23	17,320	21,022	845	2,390
28-May-23	17,505	20,801	1,175	2,317
04-Jun-23	19,092	21,294	1,330	2,415
11-Jun-23	19,487	21,847	1,292	2,440
18-Jun-23	21,047	22,350	1,055	2,512
25-Jun-23	21,576	22,985	835	2,547
02-Jul-23	21,950	23,575	754	2,572
09-Jul-23	22,453	24,213	1,016	2,665
16-Jul-23	22,337	24,208	814	2,692
23-Jul-23	22,610	24,694	838	2,740
30-Jul-23	22,576	24,520	1,035	2,771
06-Aug-23	22,422	24,595	841	2,798
13-Aug-23	22,288	24,687	958	2,733
20-Aug-23	22,213	24,685	985	2,765
27-Aug-23	22,392	24,525	1,362	2,728
03-Sep-23	22,150	24,177	1,413	2,694
10-Sep-23	21,455	23,382	1,370	2,562
17-Sep-23	21,390	22,604	680	2,534

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
24-Sep-23	20,274	21,893	781	2,472
01-Oct-23	18,585	20,956	420	2,423

4. Resource Adequacy

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

In particular, risks identified in spring and summer 2022 are expected to be mitigated by rescheduling outages. More prolonged reserve shortages appear in summer 2023, primarily as a result of coincident generator outages; the IESO is working closely with generators to ensure adequate reserves remain available. The IESO expects to have sufficient generation supply for winter 2022/2023, accounting for zonal transmission constraints.

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

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

Table 4-1 | Existing Grid-Connected Resource Capacity

Fuel Type	Total Installed Capacity (MW)	Forecast Capability at 2022 Summer Peak Normal Weather (MW)	Forecast Capability at 2022 Summer Peak Extreme Weather (MW)	Number of Stations	Change in Number of Stations	Change in Installed Capacity
Nuclear	13,089	10,432	10,432	5	0	0
Hydroelectric	8,918	4,715	4,137	76	0	0
Gas/Oil	10,515	9,422	8,998	33	0	0
Wind	4,783	727	727	40	0	0
Biofuel	296	286	286	7	0	0
Solar	478	66	66	10	0	0
Demand Measures	-	666	666	-	-	-
Firm Imports (+) / Exports (-) (MW)	-	150	0	-	-	-
Total	**38,079**	**26,464**	**25,310**	**171**	**0**	**0**

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 1, 2022. Two scenarios are used to describe project risks:

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

Planned shutdowns or 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	2022-Q2	Commissioning		60
Nation Rise	Ottawa	Wind	2022-Q1	Commissioning		100
Iroquois Falls[1]	Northeast	Gas	2023-Q2	Expiring Contract	-131	-131
Nipigon GS	Northwest	Gas/Oil	2022-Q4	Expiring Contract	-23	-23
Total					-154	6

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] Iroquois Falls was recently successful in the IESO's December 2021 Capacity Auction and is modelled in both the firm and planned scenario for the both the summer (May to October, 2022) and winter (November 2022 to April 2023) obligation periods. For more information about capacity secured in the auction, please see sections 2.2, 4.2.1, and the IESO's website.

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 2021, 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)	6,207	6,128	5,948	5,898	5,981	5,798	5,667	5,326	5,103	5,478	5,733	6,200
Historical Hydroelectric Median Contribution without Outages (MW)	6,692	6,717	6,451	6,397	6,419	6,300	6,143	5,882	5,952	6,304	6,486	6,700

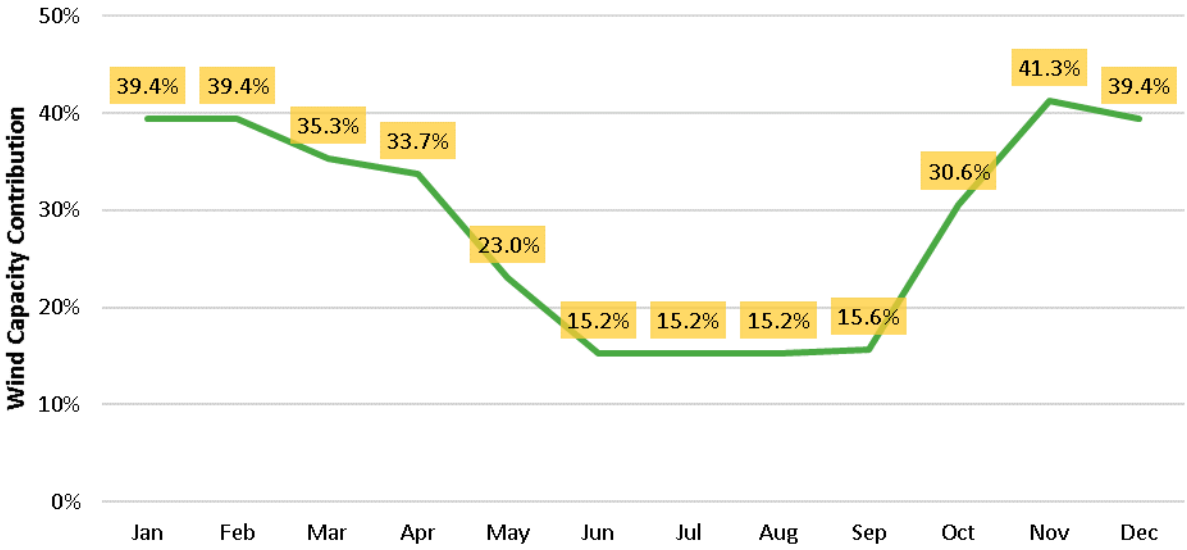
Thermal Generators

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

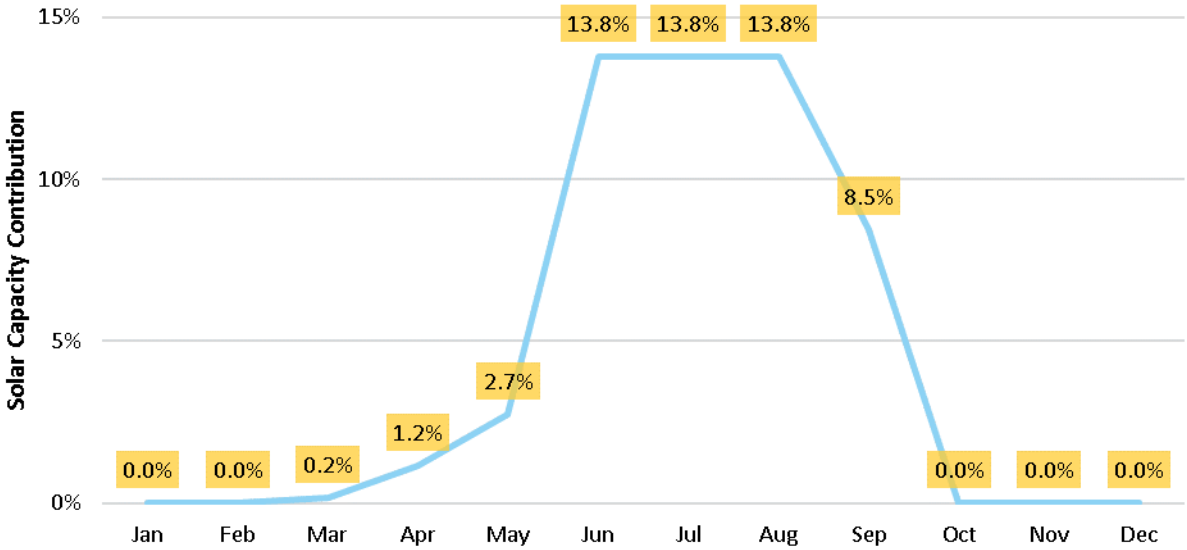


Solar

For solar generation, monthly solar capacity contribution (SCC) values are used from the weekday peak hour. 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 grid demand profile has been changing, due in part to the penetration of embedded solar generation, which is pushing summer peaks to later in the day. As a result, the contribution from grid-connected solar resources has declined at the time of peak Ontario demand.

Figure 4-2 | Monthly Solar Capacity Contribution Values



4.1.3 Demand Measures

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

4.1.4 Firm Transactions

Capacity-Backed Exports

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

System-Backed Exports

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

As part of this capacity exchange agreement, Ontario can call on 500 MW of capacity during summer before September 2030, based on the province's needs. Ontario does not expect to call on this capacity during this 18-month period.

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 for the 18 months, under the two scenarios in normal weather conditions, at the time of the summer and winter peak demands during the Outlook.

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

Notes	Description	Summer Peak 2022 Firm Scenario	Summer Peak 2022 Planned Scenario	Winter Peak 2022/2023 Firm Scenario	Winter Peak 2022/2023 Planned Scenario	Summer Peak 2023 Firm Scenario	Summer Peak 2023 Planned Scenario
1	Installed Resources (MW)	38,079	38,239	38,079	38,239	38,079	38,239
2	Total Reductions in Resources (MW)	12,431	12,567	11,191	11,312	13,419	13,555
3	Demand Measures (MW)	666	666	614	614	850	850
4	Firm Imports (+) / Exports (-) (MW)	150	150	-500	-500	0	0
5	Available Resources (MW)	26,464	26,488	27,002	27,041	25,510	25,534
6	Bottling (MW)	0	0	1,524	1,547	0	0
7	Available Resources without Bottling (MW)	26,464	26,488	28,526	28,588	25,510	25,534

Notes on Table 4-4:

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

4.2 Capacity Adequacy Assessment

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

4.2.1 Firm Scenario with Normal and Extreme Weather

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

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

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

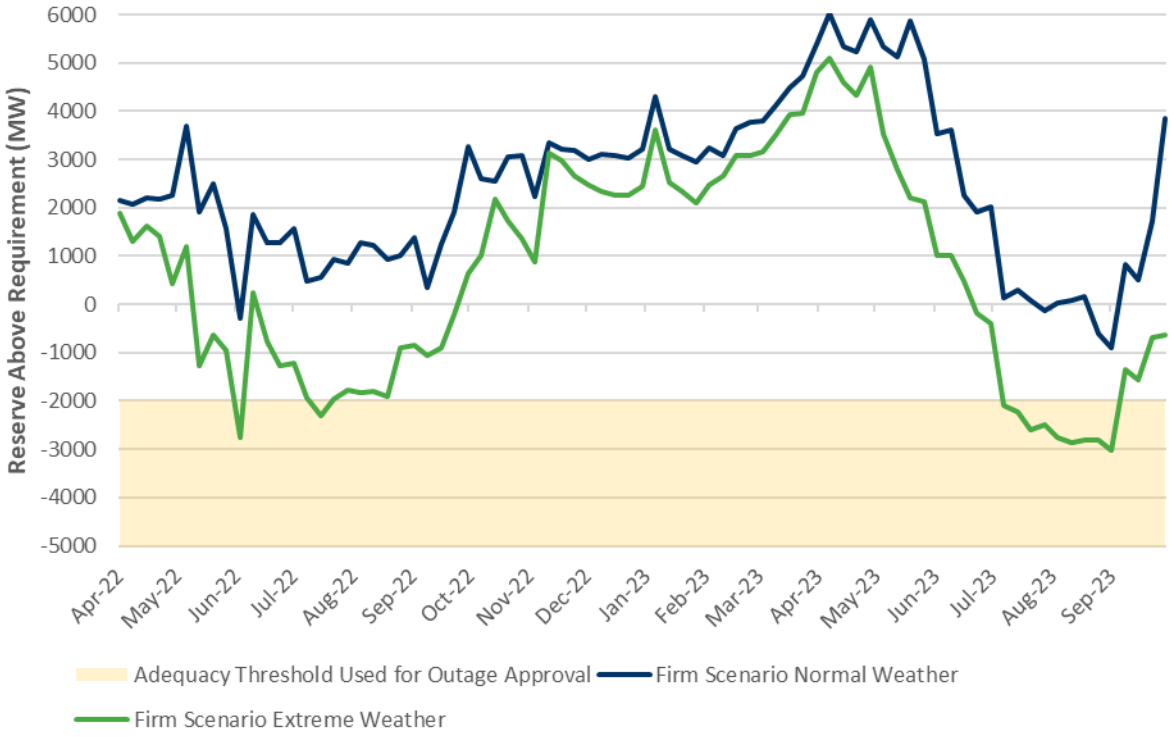
In the firm scenario under normal weather conditions, available reserves fall below the requirement for one week in spring 2022, and three weeks in summer 2023. In the firm scenario under extreme weather conditions, the reserve is lower than the -2,000 MW adequacy threshold for two weeks in the spring and summer of 2022, as well as nine weeks in summer 2023. Under the current outage schedule, the RAR is below the adequacy threshold for one week in June, and one week in July of 2022, as well the nine week period from July 3 to September 3, 2023.

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

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

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

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

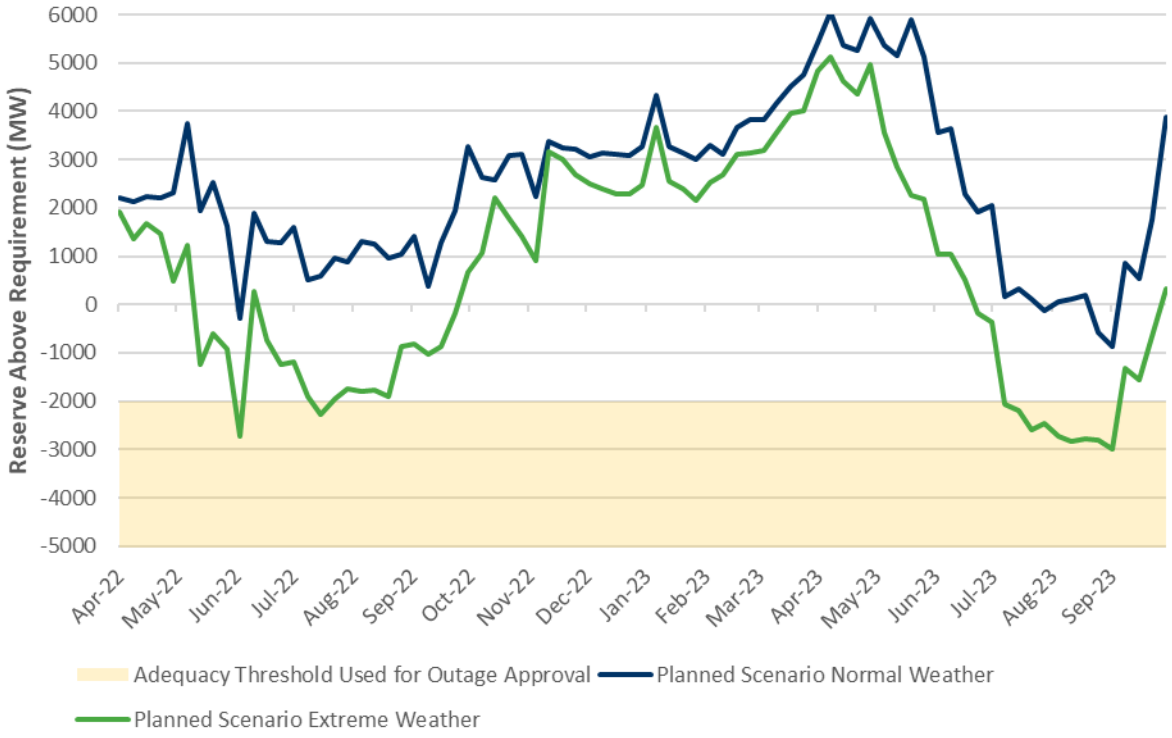


4.2.2 Planned Scenario with Normal and Extreme Weather

The planned scenario incorporates all existing capacity, as well as all capacity expected to come into service. Approximately 160 MW of new generation capacity is expected to connect to Ontario's grid over this Outlook period, while 154 MW of generation capacity contracts will expire and, for planning purposes, will not be considered to be available to meet demand for electricity.

Figure 4-4 shows RAR levels under the planned scenario. As in the Firm scenario, reserves fall below requirements for one week in 2022 and 3 weeks in 2023 under normal weather conditions. Under the extreme weather scenario, reserves fall short during the spring and summer of 2022, as well as most of the summer of 2023. These shortfalls are expected to be resolved through outage rescheduling.

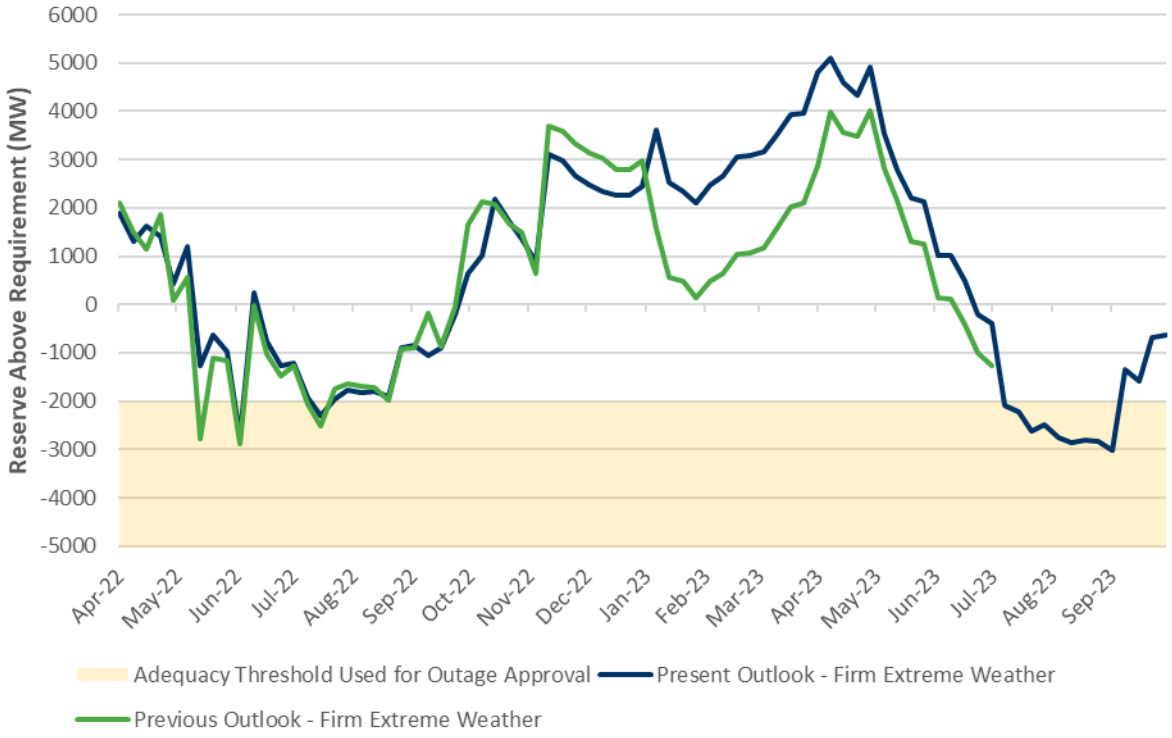
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



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

Figure 4-5 compares forecast RAR values in the current Outlook with those in the previous Outlook, which was published on December 20, 2021. The difference is primarily the result of changes in planned outages, as well as correction of a modelling error which affected forecast reserves from January to June, 2023. The impact of this correction was to increase forecast reserves during this period.

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



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

4.3 Energy Adequacy Assessment

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

4.3.1 Summary of Energy Adequacy Assumptions

The energy adequacy assessment (EAA) uses the same set of assumptions as the capacity assessment, as outlined in Table 4-1 and Table 4-2, which indicate the total capacity of committed resources and when they are expected to be available over the next 18 months. The monthly forecast of energy production capability, based on energy modelling results, is included in the 2022 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
Bruce	1.1	82	57.7	4,387	56.6	1.6	115.1
East	11.6	879	19.3	1,464	7.7	24.9	98.4
Essa	12.6	962	4.1	314	-8.5	28.3	15.6
Niagara	6.2	471	21.0	1,596	14.8	14.9	52.4
Northeast	14.9	1,130	15.2	1,154	0.3	26.1	32.7
Northwest	6.7	506	6.7	506	0.0	12.0	20.7
Ottawa	13.0	987	0.3	20	-12.7	30.5	1.2
Southwest	40.9	3,107	7.7	587	-33.2	93.1	24.5
Toronto	73.8	5,615	54.9	4,172	-18.9	172.5	123.7
West	21.5	1,638	15.1	1,145	-6.4	51.4	77.2
Ontario	**202.2**	**15,376**	**201.8**	**15,346**	**-0.4**	**455.3**	**561.5**

4.3.3 Findings and Conclusions

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

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

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

Figure 4-6 | Forecast Energy Production by Fuel Type

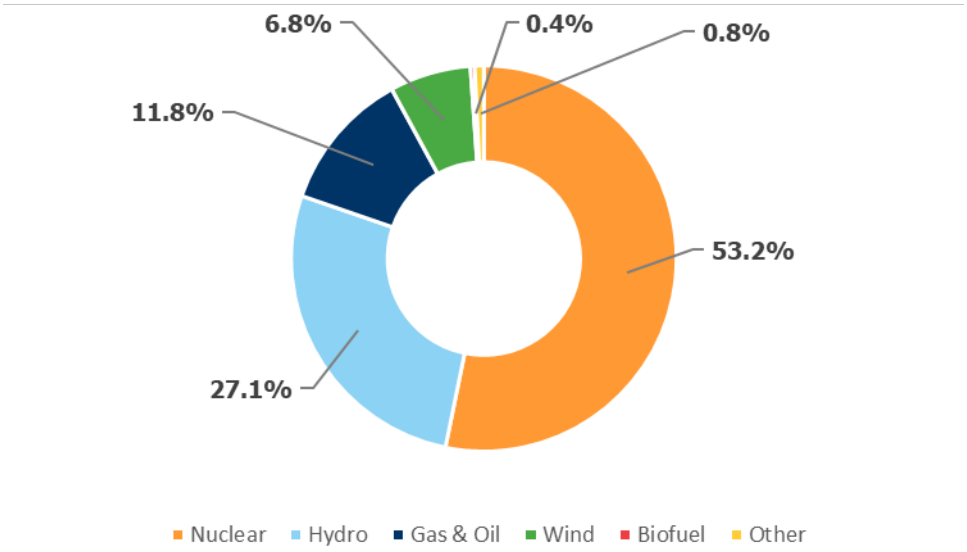


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

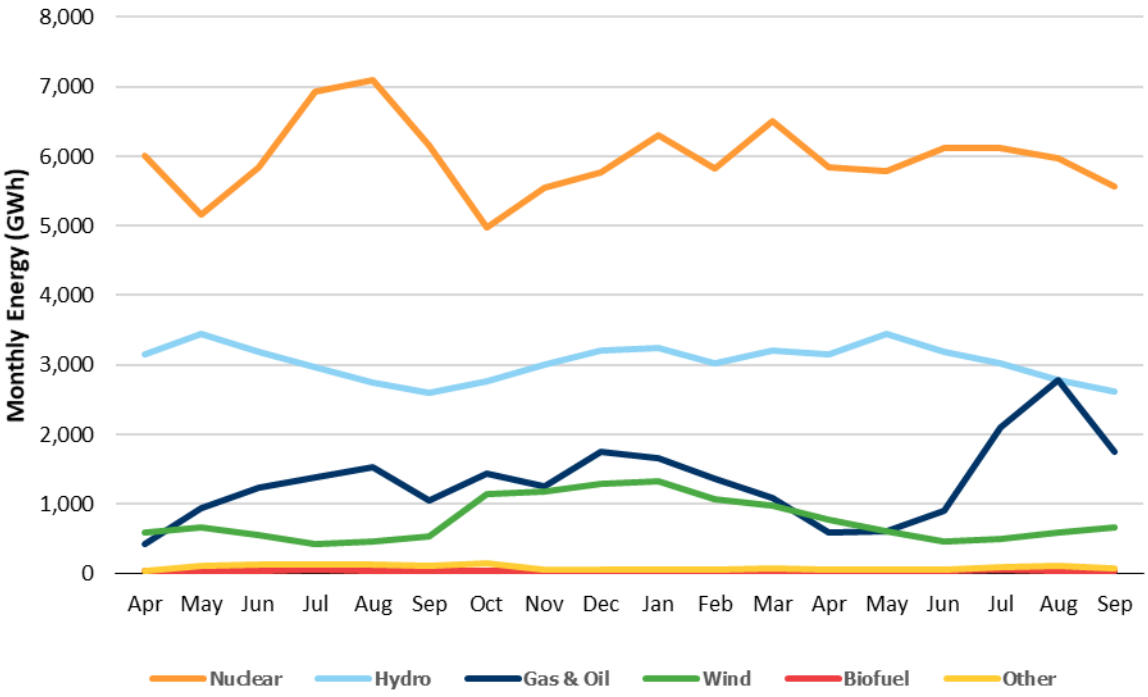


Table 4-6 | Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2022 (Apr 1 – Dec 31) (GWh)	2023 (Jan 1 – Sep 30) (GWh)	Total (GWh)
Nuclear	53,517	54,085	107,602
Hydro	27,056	27,670	54,725
Gas & Oil	10,999	12,850	23,849
Wind	6,826	6,954	13,780
Biofuel	370	367	737
Other (Solar & DR)	915	614	1,529
Total	99,684	102,538	202,222

5. Transmission Reliability Assessment

Ontario's transmission system is expected to continue to reliably supply province-wide demand, while experiencing normal contingencies defined by planning criteria for the next 18 months. 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 due to sheer volume and limited periods to avoid undesirable combinations.

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

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

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 2022. These dates are subject to change as the COVID-19 pandemic may impact project logistics. Any changes will be communicated through subsequent Reliability Outlooks.

5.2 Transmission Outages

The IESO's assessment of transmission outage plans is shown in Appendix C, Tables C1 to C11. The methodology used to assess the transmission outage plans is described in the Methodology to Perform the Reliability Outlook. This Outlook reflects transmission outage plans submitted to the IESO as of January 27, 2022.

5.3 Transmission Considerations

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

Bruce, Southwest, and West Zones

Significant growth in the greenhouse sector has led to a number of customer connection requests in the Windsor-Essex region that are expected to exceed the capacity of the existing transmission system in the area. Beginning in Q2 and over the course of approximately five months, a new switching station ("Lakeshore TS") at the Leamington Junction being installed. Over the course of those approximately five months, existings circuits will successively be placed on outage and cut-over to the new Lakeshore station, and operational measures available will be restrictive. System resiliency will be reduced during this time, and per market rule exemption 1359, certain customers in the area will experience a particularly lower lever of reliability during this time.

A series of planned outages spanning a month starting May 9, 2022 on circuit B502M will impact the flow out of Bruce zone.

Toronto, East, and Ottawa Zones

Operational challenges due to high voltages in eastern Ontario and the Greater Toronto Area continue to occur during low-demand periods. High voltages are the result of lower minimum demand for electricity.The IESO and Hydro One have been managing this situation by removing from service certain 500 kV circuits mainly in eastern Ontario and occasionally in the Bruce area during those periods. To address this issue on a longer-term basis, two 500 kV line-connected shunt reactors are being installed at Lennox TS. The first reactor has been installed and 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 related to 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 needs in 2026 is expected to begin this year, with an expected in-service date of Q1 2026.

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

The South Nepean transmission reinforcement is being installed beginning this month; of particular note, Cambrian MTS will be connected to E34M and the Cambrian Remedial Action Scheme (RAS). The Cambrian RAS, when armed, will effectively transfer Cambrian MTS from the 230 kV system on E34M to the 115 kV system on S7M to provide improved load security to local customers. The IESO will direct the arming of the scheme when system conditions permit the load transfer.

A series of planned outages on circuits X522A and/or M32S for the months April to June and September to October will impact the flow into Ottawa.

Northwest, Northeast, and Essa Zones

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

A one-and-a-half-month outage on circuit M24L starting April 4, 2022 will reduce the transfer capability of the East-West Tie. A series of planned outages on circuit W21M from September 2022 to April 2024 will also reduce the transfer capability of the East-West Tie.

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

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

Interconnections

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

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

Several planned outages involving circuits PA301 and BP76 from March to December 2022 will reduce the import and export transfer capability between Ontario and New York.

6. Operability

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

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

Operability refers to the IESO's ability to manage a variety of conditions on the power system as they occur in real-time. The IESO works to ensure that the power system is reliable under changing system conditions, variability of supply and fluctuation 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 Surplus Baseload Generation

Ontario is entering a period of tighter supply conditions; surplus baseload generation is not expected to be a significant issue for the foreseeable future. Beginning in this Outlook, forecasts for SBG will no longer be produced.

6.2 Ancillary Services

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

6.2.1 Regulation Service

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

7. Resources Referenced in This Report

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

Table 7-1 | Additional Resources

Resource	URL	Location in this report
Reliability Outlook Webpage	http://www.ieso.ca/en/Sector-Participants/Planning-and-Forecasting/Reliability-Outlook	Introduction
Security and Adequacy Assessments	http://www.ieso.ca/power-data/data-directory	Introduction
2022 Q1 Outlook Tables	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookTables_2022Mar.xls	Throughout
Connection Assessments and Approval Process	http://www.ieso.ca/en/sector-participants/connection-assessments/application-status	Assessment Assumptions
Methodology to Perform the Reliability Outlook	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookMethodology.pdf	Throughout
Capacity Auction	http://www.ieso.ca/en/Sector-Participants/Market-Operations/Markets-and-Related-Programs/Capacity-Auction	Demand Measures
Enabling Capacity Exports	http://www.ieso.ca/en/Sector-Participants/Market-Renewal/Capacity-Exports	Firm Transactions
Ontario Resource and Transmission Assessment Criteria	https://www.ieso.ca/-/media/Files/IESO/Document-Library/Market-Rules-and-Manuals-Library/market-manuals/connecting/IMO-REQ-0041-TransmissionAssessmentCriteria.ashx	Transmission Considerations
NERC Transmission Planning Standard TPL-001-4	http://www.nerc.com/pa/Stand/Reliability%20Standards/TPL-001-4.pdf	Transmission Considerations
NPCC Directory #1	https://www.npcc.org/Standards/Directories/Directory_1_TFCP_rev_20151001_GJD.pdf https://www.npcc.org/content/docs/public/program-areas/standards-and-criteria/regional-criteria/directories/directory-01-design-and-operation-of-the-bulk-power-system.pdf	Transmission Considerations
Market Manual 4 Part 4.2	http://www.ieso.ca/-/media/Files/IESO/Document-Library/Market-Rules-and-Manuals-Library/market-manuals/market-operations/mo-dispatchdatartm.pdf?la=en	Surplus Baseload Generation

8. List of Acronyms

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

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