Reliability Outlook

An adequacy assessment of Ontario's electricity system

October 2021 to March 2023

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Executive Summary

Despite the ongoing pandemic, demand for electricity in Ontario has been robust throughout 2021. Marking a significant shift for the province, demand is now expected to increase 1.1% in 2021, and another 1.4% in 2022, after years of declining annual consumption.

Like other jurisdictions, Ontario experienced a significant drop in electricity demand when the first lockdown began in spring 2020. Since that time, industrial load has returned to pre-pandemic levels. In some sectors, supply chain disruptions have caused production slowdowns and delays, resulting in weaker demand for electricity. The ongoing microchip shortage, for example, continues to impact the automotive sector and its suppliers.

While a fourth wave of COVID-19 is likely to affect day-to-day life in Ontario this fall and winter, these impacts have been integrated into IESO modelling. As with previous waves, the most significant impacts will be felt by the less electrically-intensive service sector. Overall, electricity demand will remain firm but a delay in the full re-opening of Ontario's economy could mean that these increases are pushed later into 2022.

Pent-up demand for goods and services is likely to nudge demand for electricity a little higher in 2022. When Ontario exits Stage 3 and a more normal life resumes, demand will increase as residents and businesses that have deferred large-scale spending move forward with major purchases.

Looking ahead, large parts of the workforce will continue to work from home in the months to come, resulting in residential loads that are higher than before the pandemic. Unlike commercial, industrial and institutional electricity consumption, which tend to have a flatter profile, residential load is highly weather-sensitive. This weather sensitivity has the greatest impact on the power system during the summer cooling season, when air conditioners are running across the province. This structural change to the work environment is likely to persist, with remote work and hybrid models becoming the norm. From the IESO's perspective, that translates into greater variability that needs to be managed.

The IESO is forging ahead with solutions to manage the forecasted demand growth identified in this Outlook. The resumption of the Industrial Conservation Initiative (ICI) helped reduce peak demands this past summer after being suspended last summer. The December 2020 Capacity Auction cleared almost 1,000 megawatts (MW) from 75 different resources. In addition to demand response, newly-eligible resource types - generation, storage and system-backed imports - cleared the auction. And as announced in the IESO's Annual Acquisition Report, the target capacities for the December 2021 Capacity Auction will be 1,000 MW for the summer 2022 obligation period, and 500 MW for the winter 2022/2023 obligation period.

On the supply side, approximately 160 MW of new generation capacity are expected to connect to Ontario's grid over this Outlook period, while 2,392 MW of generation capacity contracts will expire. Although negotiations with some asset owners are underway, for planning purposes these resources will not be considered available to meet demand for electricity until new contracts are in place. These contracts cover a pair of strategically-located generators and are an important step to ensure we have sufficient capacity in the years to come.

As noted in previous Outlooks, significant growth in the greenhouse sector has led to a high number of customer connection requests in the Windsor-Essex region. A new switching station at the Leamington Junction is scheduled to be in service by Q2 2022, which will alleviate some of these concerns. However, it may become difficult to accommodate outages in the area as new load connections are made and the necessary transmission reinforcements are being implemented.

In the north, the East-West Tie Expansion project, which consists of a new 230 kV transmission line roughly paralleling the existing East-West Tie Line between Wawa and Thunder Bay, is on track to be in service by Q1 2022. In addition, a one-month outage of a key circuit starting October 4, 2021 will reduce the transfer capability of the North-South Tie. And a one-month outage to a key circuit affecting Kapuskasing, Pinard and the surrounding area is being planned for early 2022, requiring close coordination.

Despite the many changes underway that affect demand, supply and transmission, the IESO is confident in our ability to manage changing grid conditions to ensure reliability for the period covered by this Outlook.

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1. Introduction

This Outlook covers the 18 months from October 2021 to March 2023, and supersedes the Outlook released on June 22, 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 July 2021, and has been updated to reflect the most recent economic projections. Actual weather and demand data for August 2021 are included in the tables.

2.2 Updates to Resources

This *Reliability Outlook* considers planned generator outages over the 18-month period, submitted by market participants to the IESO's outage management system as of September 3, 2021. 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.

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 July 27, 2021.

2.4 Updates to the Operability Outlook

The outlook for surplus baseload generation (SBG) conditions over the next 18 months is based on generator outage plans submitted by market participants to the IESO's outage management system as of September 3, 2021.

3. Demand Forecast

Electricity demand has been 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 for the pandemic remains uncertain.

The IESO is responsible for forecasting electricity demand on the IESO-controlled grid. This demand forecast covers the period from October 2021 to March 2023 and supersedes the previous forecast released in June 2021. Tables of supporting information are contained in the 2021 Q3 Outlook Tables.

Overall, the demand forecast is very similar to what was included in the previous Reliability Outlook as the key drivers remain basically unchanged. From a timing perspective, however, some aspects of the province's recovery have been delayed with the recent arrival of a fourth wave of COVID-19, which is expected to run its course this fall and winter. Like the second and third waves, the impact of the fourth wave will be focused on the service sector, which is less electricity-intensive than many other sectors of the economy. Overall, electricity demand will remain firm but the economic surge and parallel increase in electricity demand that will accompany a full reopening of the economy will be pushed later into 2022. Demand is expected to increase by 1.1% in 2021 (133.3 terawatt-hours, TWh) followed by another 1.4% increase in 2022 (135.2 TWh).

In light of ongoing public health restrictions, a large part of the workforce continues to work from home. This increases residential loads, which are more weather-sensitive and, consequently, have a greater influence on the power system. This will persist through the upcoming winter and will raise the peaks slightly. With the eventual end of the pandemic, there will be a structural change to the work environment. Work from home, remote work and hybrid models will remain in place for a segment of the workforce. Having more people at home impacts the weather sensitivity of the system, particularly in the summer when air conditioning load drives peak demand. The resumption of the Industrial Conservation Initiative (ICI) helped reduce peak demands this past summer after being suspended in 2020. Going forward, the seasonal peaks will be slightly higher, with residential loads the main cause.

The pandemic has impacted Ontario's electricity demand and much of the supply chain. At the same time there has been an increase in electrification policy which will push demand forward. The relationship between the supply chain and electrification measures contributes to the uncertainties in electricity demand. These uncertainties are in some capacity tied to the evolution of the pandemic.

Table 3-1 | Forecast Energy Demand Summary

Year	Normal Weather Energy (TWh)	% Growth in Energy
2021	133.3	1.07%
2022	135.2	1.40%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Winter 2021-22	20,940	22,239
Summer 2022	22,555	24,782
Winter 2022-23	21,318	22,458

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-Oct-21	18,232	19,116	554	2,349
10-Oct-21	16,960	17,992	786	2,341
17-Oct-21	16,908	17,384	507	2,308
24-Oct-21	17,154	18,419	392	2,380
31-Oct-21	17,271	18,630	318	2,402
07-Nov-21	17,600	18,885	416	2,432
14-Nov-21	18,403	18,911	601	2,493
21-Nov-21	19,002	19,488	342	2,568
28-Nov-21	19,227	20,044	607	2,621
05-Dec-21	19,736	20,638	409	2,672
12-Dec-21	19,896	21,645	555	2,705
19-Dec-21	20,052	21,624	690	2,739

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
26-Dec-21	20,089	21,777	362	2,758
02-Jan-22	19,248	20,694	528	2,623
09-Jan-22	20,241	21,972	570	2,750
16-Jan-22	20,638	22,239	547	2,854
23-Jan-22	20,940	22,164	483	2,867
30-Jan-22	20,924	21,985	404	2,871
06-Feb-22	20,331	21,553	734	2,826
13-Feb-22	20,222	21,352	635	2,814
20-Feb-22	19,934	21,387	581	2,794
27-Feb-22	19,867	21,353	501	2,748
06-Mar-22	19,483	20,945	531	2,715
13-Mar-22	19,006	20,475	649	2,662
20-Mar-22	18,203	19,609	611	2,584
27-Mar-22	17,920	19,046	569	2,536
03-Apr-22	17,541	18,745	567	2,462
10-Apr-22	17,265	18,123	471	2,446
17-Apr-22	17,175	18,109	496	2,388
24-Apr-22	16,853	17,595	531	2,365
01-May-22	16,871	18,733	721	2,372
08-May-22	16,797	19,329	849	2,362
15-May-22	17,526	20,718	845	2,379
22-May-22	17,530	20,621	1,175	2,361
29-May-22	18,271	21,093	1,330	2,326
05-Jun-22	19,450	21,655	1,292	2,415

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
12-Jun-22	20,883	22,021	1,055	2,495
19-Jun-22	21,458	22,910	835	2,551
26-Jun-22	22,184	23,848	754	2,611
03-Jul-22	21,870	23,657	1,016	2,593
10-Jul-22	22,345	24,187	814	2,684
17-Jul-22	22,481	24,560	838	2,733
24-Jul-22	22,538	24,782	1,035	2,755
31-Jul-22	22,555	24,731	841	2,772
07-Aug-22	22,192	24,540	958	2,709
14-Aug-22	22,234	24,546	985	2,733
21-Aug-22	22,427	24,600	1,362	2,709
28-Aug-22	21,791	23,397	1,413	2,678
04-Sep-22	21,419	23,197	1,370	2,598
11-Sep-22	21,331	22,378	680	2,482
18-Sep-22	20,087	21,291	781	2,439
25-Sep-22	19,102	20,490	420	2,420
02-Oct-22	17,808	19,094	554	2,389
09-Oct-22	16,906	18,218	786	2,379
16-Oct-22	17,057	17,609	507	2,346
23-Oct-22	17,204	18,670	392	2,419
30-Oct-22	17,392	18,875	318	2,442
06-Nov-22	17,521	19,055	416	2,472
13-Nov-22	18,612	19,087	601	2,531
20-Nov-22	18,999	19,675	342	2,609

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
27-Nov-22	19,318	20,242	607	2,662
04-Dec-22	19,520	20,681	409	2,711
11-Dec-22	20,155	21,325	555	2,750
18-Dec-22	20,146	21,461	690	2,786
25-Dec-22	20,021	21,562	362	2,806
01-Jan-23	19,949	21,109	528	2,656
08-Jan-23	20,376	21,355	570	2,770
15-Jan-23	20,910	22,005	547	2,879
22-Jan-23	21,036	22,087	483	2,900
29-Jan-23	21,318	22,458	404	2,917
05-Feb-23	21,096	22,069	734	2,897
12-Feb-23	20,940	21,824	635	2,871
19-Feb-23	20,583	21,630	581	2,858
26-Feb-23	20,381	21,669	501	2,812
05-Mar-23	20,074	21,439	531	2,790
12-Mar-23	19,714	21,093	649	2,737
19-Mar-23	18,874	20,265	611	2,677
26-Mar-23	18,573	19,897	569	2,629
02-Apr-23	18,331	19,366	567	2,574

4. Resource Adequacy

The IESO expects to have sufficient generation supply for winters 2021/2022 and 2022/2023, accounting for zonal transmission constraints. Potential risks in spring and summer 2022 are expected to be mitigated through outage rescheduling and resources to be acquired in the 2021 Capacity Auction.

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. This includes capacity from new facilities that have completed the IESO's market registration process since the previous Outlook. 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	10,447	10,447	5	0	0
Hydroelectric	8,918	5,072	4,358	76	0	0
Gas/Oil	10,515	9,211	8,800	33	0	0
Wind	4,783	727	727	40	0	0
Biofuel	296	254	254	7	0	0
Solar	478	66	66	10	0	0
Demand Measures	-	753	753	-	-	-
Firm Imports (+) / Exports (-) (MW)	-	0	0	-	-	-
Total	38,079	26,529	25,404	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 September 3, 2021. 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 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	2021-Q3	Commissioning		60
Nation Rise	Ottawa	Wind	2021-Q3	Commissioning		100
Calstock[1]	Northeast	Biofuel	2021-Q4	Expiring Contract	-38	-38
Iroquois Falls	Northeast	Gas	2021-Q4	Expiring Contract	-131	-131
Lennox GS[2]	East	Gas/Oil	2022-Q4	Expiring Contract	-2,200	-2,200
Nipigon GS	Northwest	Gas/Oil	2022-Q4	Expiring Contract	-23	-23
Total					**-2,392**	**-2,232**

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

[1] On January 15, 2021, the Ministry of Energy, Northern Development and Mines requested the IESO enter into preliminary discussions with Atlantic Power regarding a Power Purchase Agreement for Calstock. Further details

[2] Lennox GS is critical to reliability due to its location, size, and operating characteristics. As a transitional measure until there is greater competition in the area, the IESO and OPG are engaged in bilateral negotiations on a contract extension.

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

4.1.2 Generation Capability

Hydroelectric

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

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

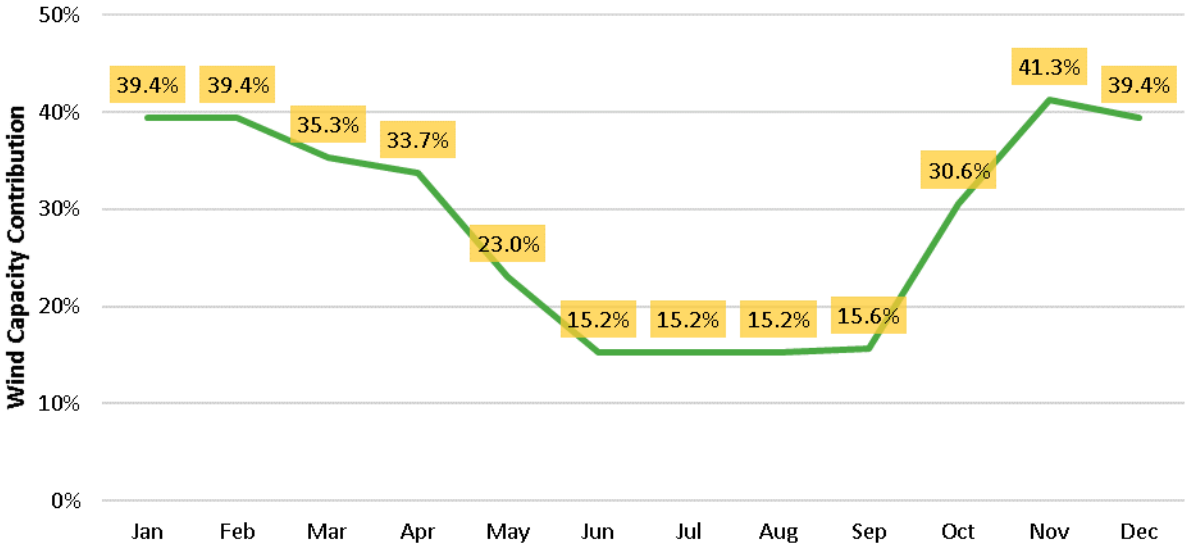
Thermal Generators

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

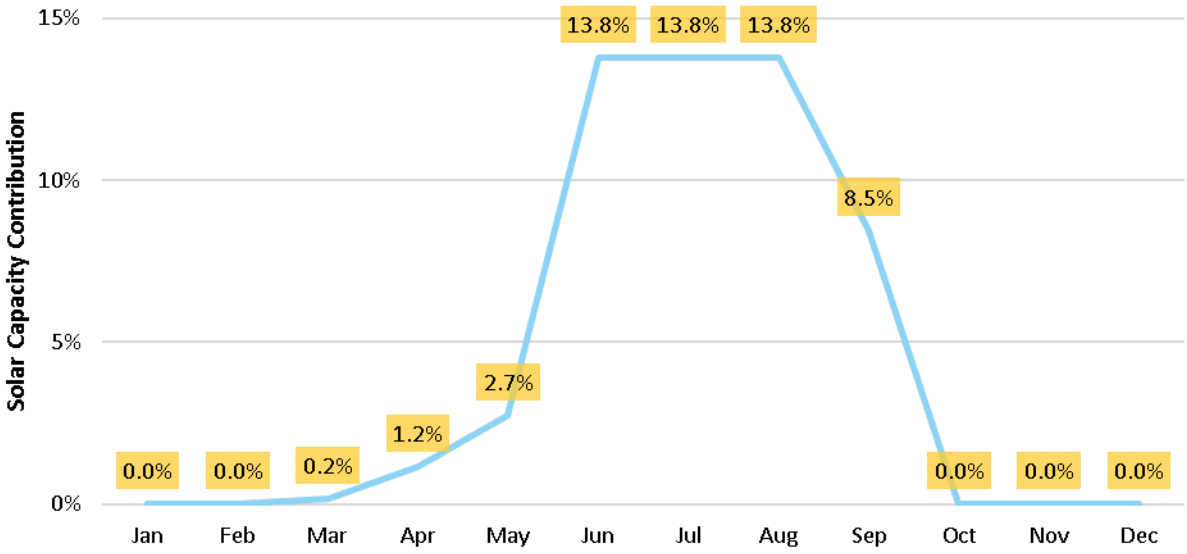


Solar

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[3], 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 42 MW of capacity-backed exports from Ontario for winter months, November 2021 to April 2022. The amounts of MW cleared in the NYISO capacity auctions will be included in the future Outlooks.

[3] Note that 1.7 MW of storage capacity that cleared the 2020 Capacity Auction are included in the "demand measures" totals throughout this report, as well as in the accompanying data tables, given that it is an embedded resource that is a market participant.

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	Winter Peak 2021/2022 Firm Scenario	Winter Peak 2021/2022 Planned Scenario	Summer Peak 2022 Firm Scenario	Summer Peak 2022 Planned Scenario	Winter Peak 2022/2023 Firm Scenario	Winter Peak 2022/2023 Planned Scenario
1	Installed Resources (MW)	38,079	38,239	38,079	38,239	38,079	38,239
2	Total Reductions in Resources (MW)	12,583	12,704	12,302	12,438	15,499	15,620
3	Demand Measures (MW)	132	132	753	753	522	522
4	Firm Imports (+) / Exports (-) (MW)	-500	-500	0	0	-500	-500
5	Available Resources (MW)	25,128	25,167	26,530	26,554	22,602	22,641
6	Bottling (MW)	905	928	0	0	803	803
7	Available Resources without Bottling (MW)	26,033	26,096	26,530	26,554	23,406	23,445

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 expected to be available for reduction 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 July 27, 2021. The generation planned outages occurring during this Outlook period have been assessed as of September 3, 2021.

As already noted, the outbreak of COVID-19 has added some uncertainty to our forecasts. The IESO will continue to provide timely updates to these assessments as information becomes available.

4.2.1 Firm Scenario with Normal and Extreme Weather

The firm scenario incorporates all capacity that had achieved commercial operation status as of September 3, 2021.

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.

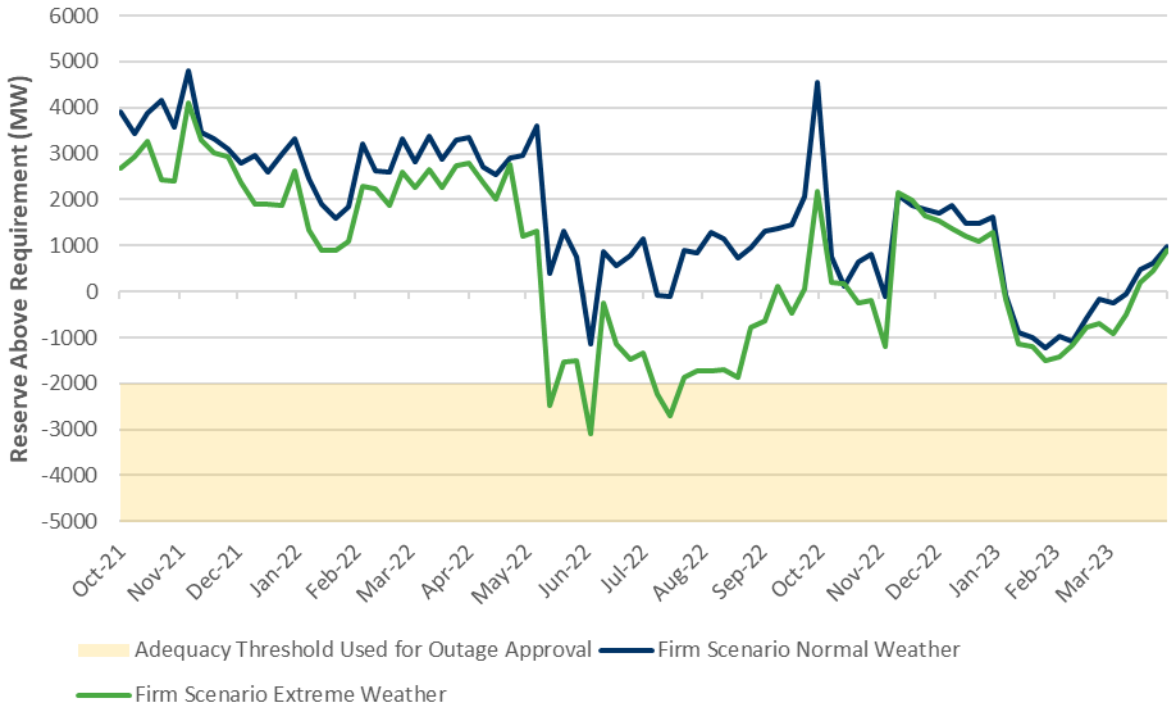
The target capacities for the December 2021 Capacity Auction, as announced in the IESO's Annual Acquisition Report, have been included in the firm resource scenario for this forecast.

The reserve requirement in the firm scenario under normal weather conditions is met throughout the entire Outlook period. In the firm scenario under extreme weather conditions, the reserve is lower than the requirement for four weeks in the spring and summer of 2022. Under the current outage schedule, the RAR is below the -2,000 MW threshold for one week in May, one week in June, and two weeks in July of 2022.

This potential shortfall is partially attributed to planned generator outages scheduled during those weeks, and generators are advised not to schedule outages during this period, or any other period when reserves are forecast to be low. Any remaining shortfalls in reserves will be addressed by acquiring additional resources in the December 2021 Capacity Auction.

If extreme weather conditions materialize, the IESO may reject some generator outage requests to ensure that Ontario demand is met. The IESO will continue to work with generators to ensure outages are optimally scheduled.

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



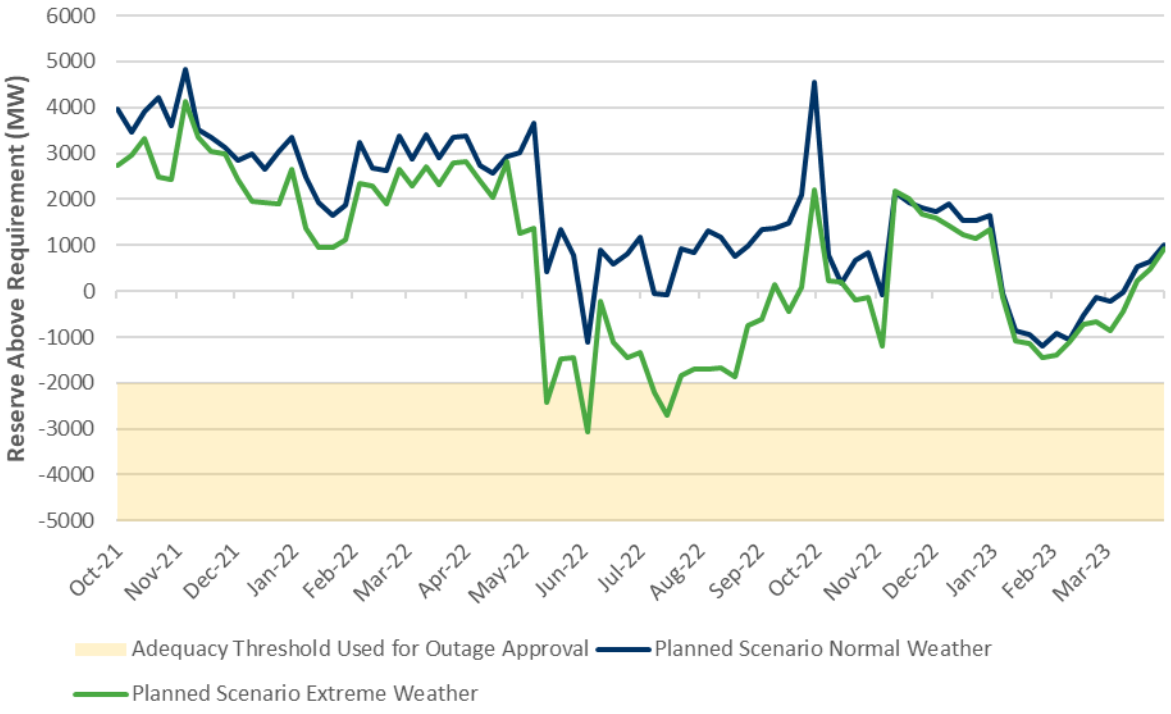
4.2.2 Planned Scenario with Normal and Extreme Weather

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 2,392[4] MW of generation capacity contracts will expire and, for planning purposes, until these resources are recontracted, they will not be considered to be available to meet demand for electricity.

Figure 4-4 shows RAR levels under the planned scenario. As observed, the reserve requirement will be met throughout the Outlook period under normal weather conditions. Under the extreme weather scenario, sufficient reserves exist throughout 2021. However, reserves fall short during the spring and summer of 2022 under the extreme weather scenario.

[4] This figure includes the expiry of contracts at Calstock and Lennox GS. See notes to Table 4-2 for further details.

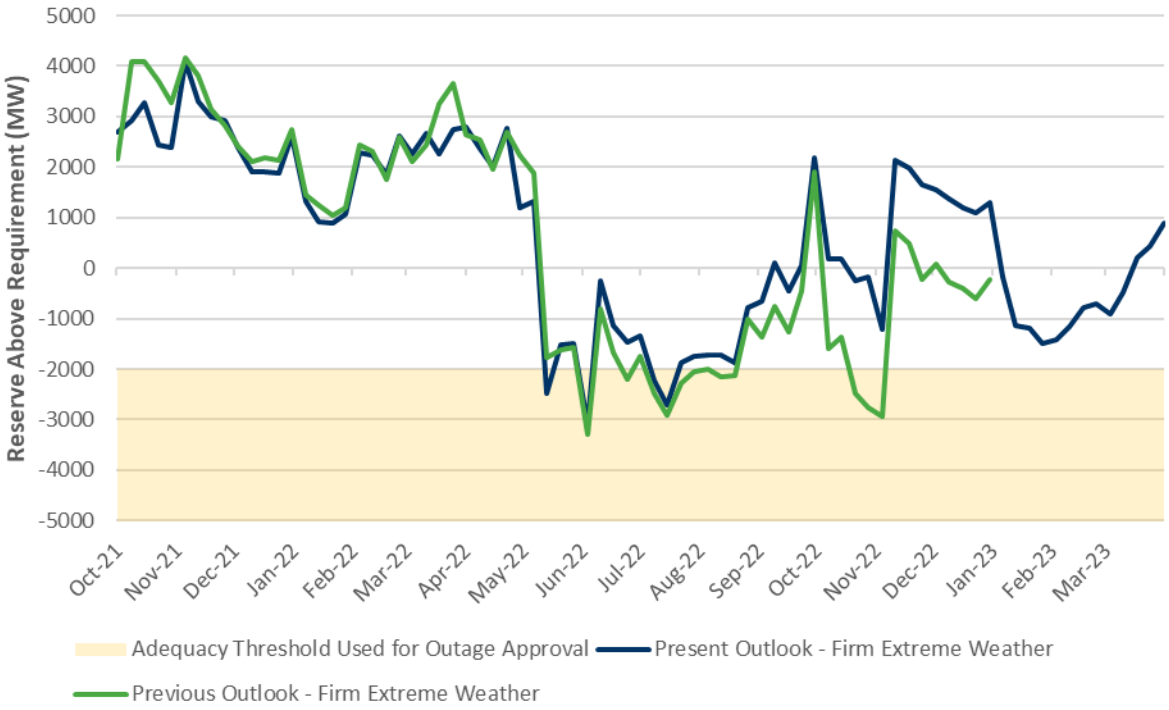
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



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

Figure 4-5 compares forecast RAR values in the current Outlook with those in the previous Outlook, which was published on June 22, 2021. The difference is primarily the result of changes in planned outages.

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



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

4.3 Energy Adequacy Assessment

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

4.3.1 Summary of Energy Adequacy Assumptions

The energy adequacy assessment (EAA) uses the same set of assumptions as the capacity assessment, as outlined in Table 4-1 and Table 4-2, which indicate the total capacity of committed resources and when they are expected to be available over the next 18 months. The monthly forecast of energy production capability, based on energy modelling results, is included in the 2021 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	1.0	77.0	58.5	4,453.0	57.5	0.0	1.5
East	13.3	1,010.0	19.6	1,490.0	6.3	0.2	26.8
Essa	13.9	1,058.0	4.6	347.0	-9.3	0.0	28.6
Niagara	5.8	441.0	21.3	1,621.0	15.5	0.0	14.3
Northeast	15.8	1,203.0	15.0	1,139.0	-0.8	0.2	24.2
Northwest	6.4	489.0	6.8	521.0	0.4	0.1	10.2
Ottawa	13.1	997.0	0.3	22.0	-12.8	0.1	28.5
Southwest	40.9	3,114.0	9.1	697.0	-31.8	0.3	92.4
Toronto	73.2	5,576.0	51.9	3,953.0	-21.3	0.1	174.8
West	21.1	1,609.0	16.8	1,280.0	-4.3	0.5	51.1
Ontario	**204.5**	**15,574.0**	**203.8**	**15,523.0**	**-0.7**	**1.6**	**452.4**

4.3.3 Findings and Conclusions

As noted in section 4.2.1, Ontario is expected to have adequate reserves for the duration of the outlook in the firm resource, normal weather scenario. The EAA indicates that Ontario is also 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.

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 confirm that 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 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

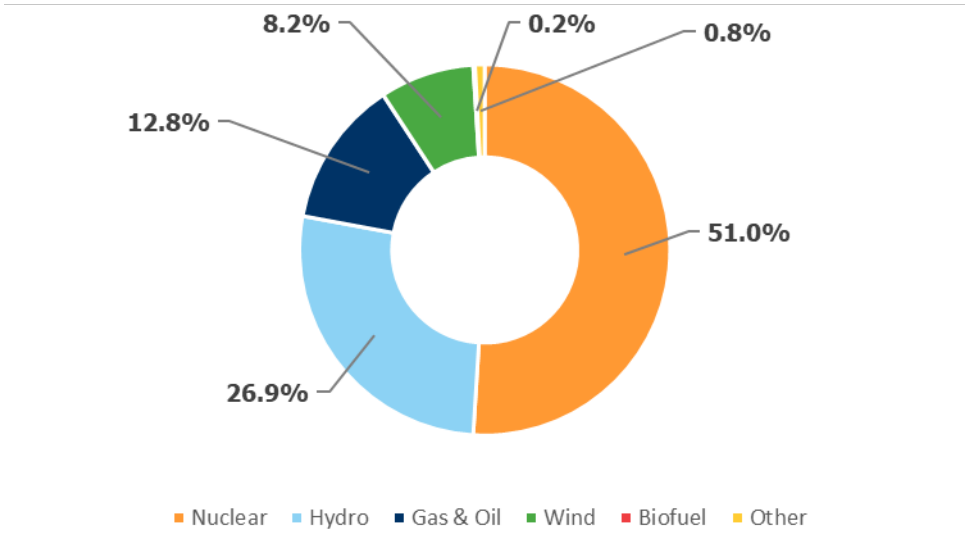


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

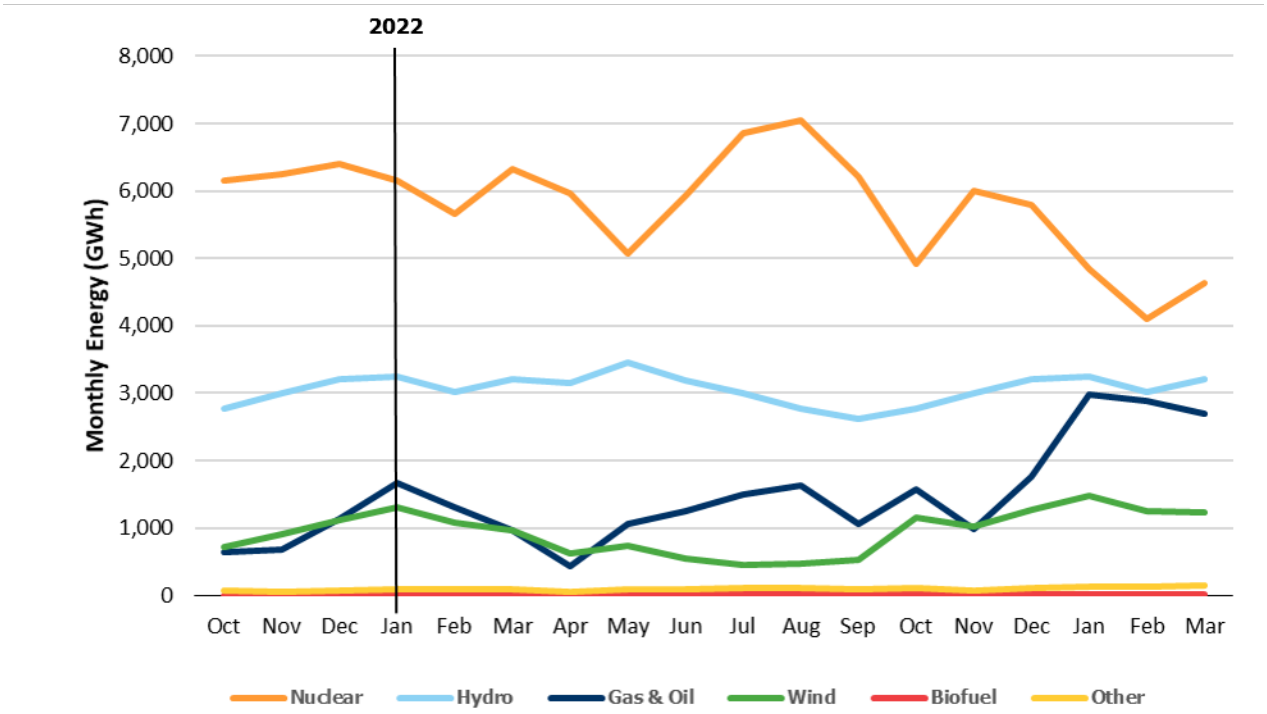


Table 4-6 | Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2021 (Oct 1 – Dec 31) (GWh)	2022 (Jan 1 – Dec 31) (GWh)	2023 (Jan 1 – Mar 31) (GWh)	Total (GWh)
Nuclear	18,794	71,898	13,579	104,271
Hydro	8,972	36,640	9,481	55,093
Gas & Oil	2,463	15,199	8,552	26,214
Wind	2,750	10,124	3,957	16,831
Biofuel	55	221	58	334
Other (Solar & DR)	203	1,112	402	1,717
Total	**33,236**	**135,194**	**36,028**	**204,459**

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.

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 July 2021. 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 July 27 2021.

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.

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. A new switching station at the Leamington Junction is proceeding toward a Q2 2022 in-service date. Outages may be more challenging to accommodate as new load connections are made and required transmission reinforcements are being implemented.

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, which has been exacerbated by the impacts of COVID-19.

The IESO and Hydro One are currently managing this situation by removing from service certain 500 kV circuits mainly in eastern Ontario and occasionally in the Bruce area during those periods. Up to three 500 kV circuits have been removed from service during the lowest demand periods in Ontario. To address this issue on a longer-term basis, two 500 kV line-connected shunt reactors will be installed at Lennox TS with a target in-service date of Q3 2021 for the first reactor and Q1 2022 for the second reactor.

Northwest, Northeast, and Essa Zones

An one-month outage of circuit X504E starting October 4, 2021 will reduce the transfer capability of the North-South Tie.

A one-month D501P outage is being planned for early 2022, and will result in operational challenges in managing local supply and demand balancing. Close coordination with various loads and generators in Kapuskasing, Pinard, and the surrounding area, will be required over this period.

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 Q1 2022.

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.

Due to multiple equipment failures in the Northeast, there have been high-voltage operational concerns. This has resulted in challenges in accommodating outages that exacerbate high-voltage concerns.

There have been several forest fires in the Northwest that prompted market participants to delay outages. The impacts of forest fire will continue to be monitored.

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 IESO is currently finalizing the SIA for these replacements. The expected in-service date is Q2 2022 for the PAR on L33P and Q2 2023 for the PAR on L34P.

A planned five-month outage of circuit PA301 starting January 18, 2022 and another planned five-month outage of circuit BP76 starting July 15, 2022 will reduce import and export transfer capability between Ontario and New York.

6. Operability

During the Outlook period, Ontario will continue to experience potential surplus baseload generation conditions, much of which can be managed with existing market mechanisms, such as exports and curtailment of variable generation.

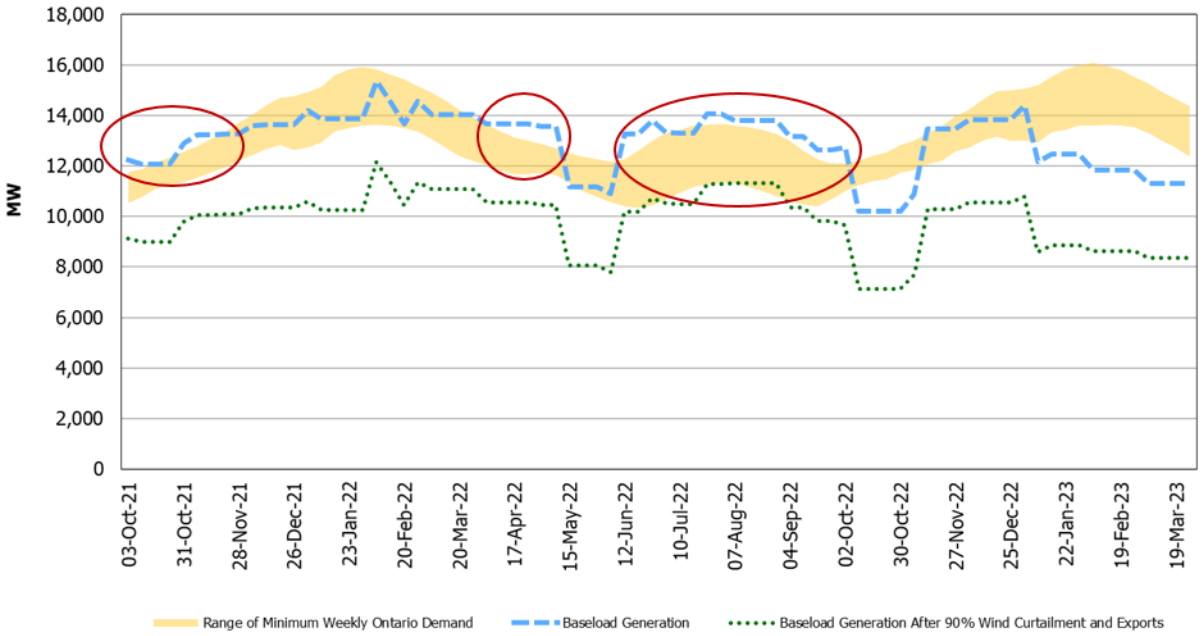
This section highlights existing or emerging operability issues that could impact the reliability of Ontario's power system.

6.1 Surplus Baseload Generation

Baseload generation comprises nuclear, run-of-the-river hydroelectric and variable generation, such as wind and solar. When baseload supply is expected to exceed Ontario demand, market signals reflect such conditions through lower prices, and resources in Ontario and at the interties respond accordingly. The resulting market outcomes may include higher export volumes, dispatching down of hydroelectric generation and grid-connected renewable resources, and nuclear manoeuvring or shutdowns. For severe surplus conditions that could affect the reliability of the system, the IESO may take out-of-market actions, such as manually curtailing resources and/or imports.

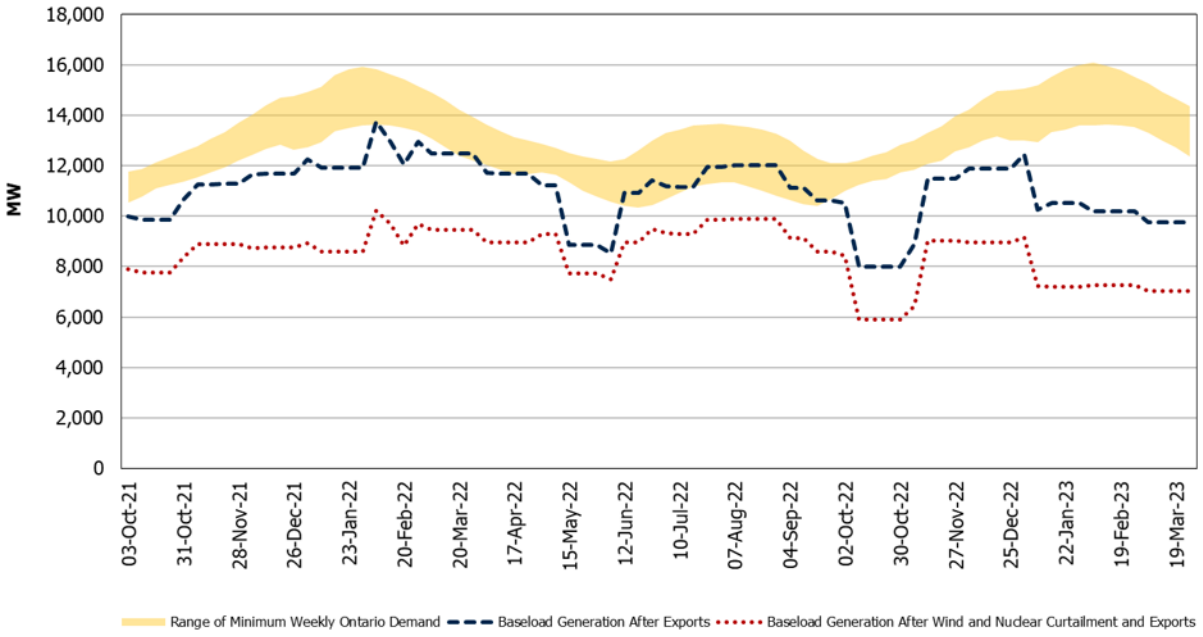
Ontario is expected to experience potential surplus baseload conditions during the shoulder periods throughout the Outlook. Figure 6-1 highlights the periods during which expected baseload generation may exceed forecast demand.

Figure 6-1 | Minimum Ontario Demand and Baseload Generation



Surplus baseload conditions can be managed with existing market mechanisms signaling for exports, and by curtailing variable and nuclear generation. Going forward, as shown in Figure 6-2, existing mechanisms will be sufficient for managing SBG.

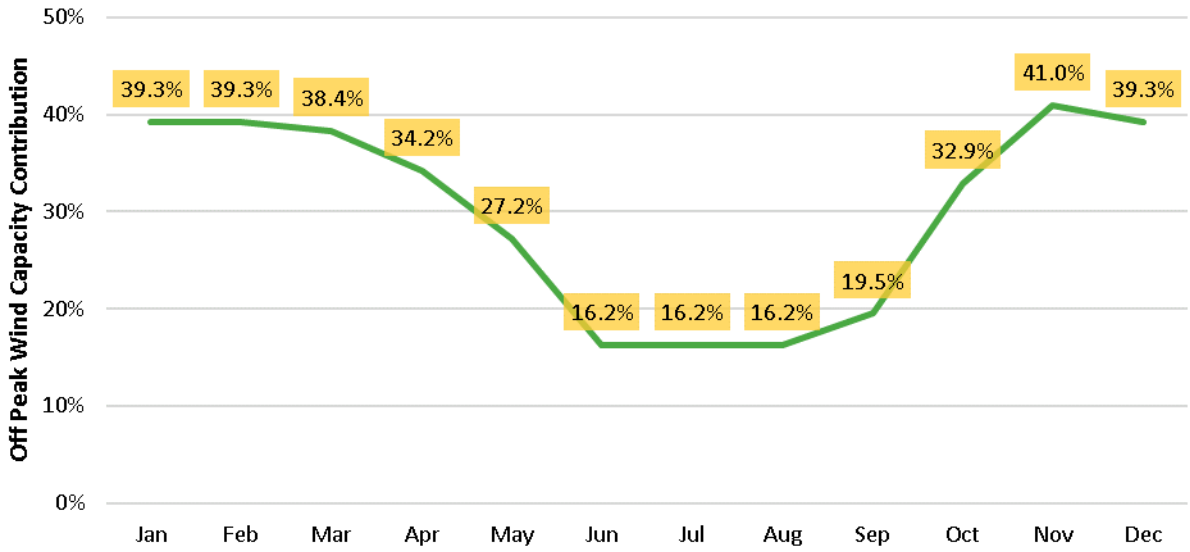
Figure 6-2 | Minimum Ontario Demand and Baseload Generation



The baseload generation assumptions include expected exports and run-of-the-river hydroelectric production, the latest planned outage information and in-service dates for new or refurbished generation. The expected contribution from self-scheduling and intermittent generation has been updated to reflect the latest data. Information on the dispatch order of wind, solar and flexible nuclear resources can be found in Market Manual 4 Part 4.2.

Output from commissioning units is explicitly excluded from this analysis due to uncertainty and the highly variable nature of commissioning schedules. Figure 6-3 shows the monthly off-peak wind capacity contribution values calculated from actual wind output up to March 31, 2021. These values are updated annually to coincide with the release of the Q2 Outlook.

Figure 6-3 | Monthly Off-Peak Wind Capacity Contribution Values



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
2021 Q3 Outlook Tables	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookTables_2021Jun.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
Grid-LDC Interoperability Standing Committee	http://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Standing-Committees/Grid-LDC-Interoperability-Standing-Committee	Distributed Energy Resources

8. List of Acronyms

Acronym	Definition
CAA	Connection Assessment and Approval
CROW	Control Room Operations Window
DER	Distributed Energy Resource
DR	Demand Response
EAA	Energy Adequacy Assessment
ESAG	Energy Storage Advisory Group
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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