Reliability Outlook

An adequacy assessment of Ontario's electricity system

July 2021 to December 2022

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Executive Summary

Fifteen months after the COVID-19 pandemic was declared, case counts are falling, vaccination rates are accelerating, the economy is picking up steam, and Ontarians are emerging from an extended lockdown. Despite these changes to the overall landscape, demand for electricity is not expected to increase in a material way in the near term, having largely returned to normal after initial lockdowns last spring.

Ontario's economy is expected to gradually reopen over the course of the summer and fall, but most of the province's large industrial and resource-based loads are already operating at near pre-pandemic levels and have been for many months. By contrast, the economic impacts of the pandemic have been concentrated in the less energy-intensive service sectors, including hospitality, retail, tourism and personal care.

Despite the robust energy demand, summer peaks are likely to be lower than last year, mostly due to the resumption of the Industrial Conservation Initiative. This program has reduced peak demand by 1,550 megawatts (MW) in past years. Another factor that will influence demand for electricity this summer is the expected reopening of the Canada-US border. The resumption of trade in goods and services will further stimulate Ontario's economy.

Given the number of Ontario residents still working from home, the power system still has a high degree of weather sensitivity from home heating/cooling. The summer of 2020 was characterized by a number of prolonged heat waves. If extremely hot weather materializes again during the summer of 2021, residential loads may push summer peaks higher than what was experienced from 2015 to 2019. In any case, the 992.1 MW of firm capacity that was acquired during the 2020 capacity auction will help ensure reliability during the summer of 2021.

On the resource side, there is adequate supply expected this summer but reserves are forecast to be less than needed during the summer of 2022. This potential shortfall is expected to be mitigated by outage management and by the availability of a diverse set of resources acquired in the December 2021 capacity auction. The MW targets for the auction, which will procure capacity for the summer 2022 and winter 2022/2023 obligation periods, will be announced in the IESO's forthcoming Annual Acquisition Report, and have not been included in this forecast.

Another period of low reserves emerges in the fall of 2022 resulting from a number of coincident outages as well as the expiry of the Lennox GS contract. However, this is unlikely to pose any reliability issues. The IESO is actively engaged in bilateral negotiations to extend Lennox's contract, as a temporary measure until there is sufficient competition in the area, and will continue to work with generators to ensure outages are optimally scheduled to minimize any potential risks.

Transmission availability also plays a critical role in ensuring the reliability of Ontario's power system. The province's transmission system is expected to continue to reliably supply province-wide demand, while experiencing occasional, normal contingencies.

Of note, the East-West Tie Expansion is scheduled to come into service during the first quarter of 2022. This major project comprises 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. In addition, a new switching station in Leamington will come into service in Q2 2022, increasing the ability to meet demand in Windsor-Essex, where demand is growing fast due to expansion in the agriculture sector.

This Reliability Outlook, sets out potential reliability concerns as well as the steps being taken to address them, to ensure that the Ontario's electricity system is well-positioned to manage demand this summer and beyond. More information about the data used to support these assessments as well as the methodology used is available on the IESO website.

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1. Introduction

This Outlook covers the 18 months from July 2021 to December 2022, and supersedes the Outlook released on March 24, 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 April 2021, and has been updated to reflect the most recent economic projections. Actual weather and demand data for May 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 June 1, 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 April 28, 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 June 1, 2021.

3. Demand Forecast

Electricity demand is expected to increase over the forecast period, remaining below 2019 levels through 2021 before surpassing them in 2022. Given the changing nature of the COVID-19 pandemic, significant uncertainty remains in the forecast.

The IESO is responsible for forecasting electricity demand on the IESO-controlled grid. This demand forecast covers the period July 2021 to December 2022 and supersedes the previous forecast released in March 2021. Tables of supporting information are contained in the 2021 Q2 Outlook Tables

The outlook is very similar to what was included in the previous Outlook as the key elements remain unchanged. After the initial lockdown in the spring of 2020, large industrial and resource sectors have returned to pre-pandemic load levels. The brunt of the economic disruption has been concentrated in the service sectors that are not particularly electrically intensive, resulting in a divergence between economic conditions and electricity demand. This divergence will close over the Outlook timeframe as economic growth will exceed the growth in electricity demand when the depressed sectors rebound.

Demand is forecast to experience modest growth in 2021 and increase by 0.6% to 132.7 terawatt-hours (TWh) before rising to 135.2 TWh or 1.8% due to economic expansion. There will likely be structural shifts in Ontario's economy over the outlook period, with remote work being the most impactful electrically.

This summer, the system will be particularly weather sensitive as large numbers of people are expected to continue working from home, resulting in high residential loads. Offsetting some of the peak demands driven by increased air conditioning load will be reductions from large users that participate in the Industrial Conservation Initiative (ICI) which resumed in May 2021 after being suspended at the beginning of summer 2020.

As workers return to the office and students go back to school, this weather sensitivity should lessen. However, a segment of the workforce will likely continue to work remotely – either full or part time. The power system will continue to be more weather sensitive than it was before COVID for these reasons.

There remains a significant amount of uncertainty regarding the demand forecast due to COVID. Additionally, as governments release policy to encourage economic activity this could further impact the demand for electricity.

Table 3-1 | Forecast Energy Demand Summary

Year	Normal Weather Energy (TWh)	% Growth in Energy
2021	132.7	0.61%
2022	135.2	1.83%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Summer 2021	22,413	24,416
Winter 2021-22	20,894	22,114
Summer 2022	22,505	24,669

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)
04-Jul-21	21,514	23,269	1,016	2,532
11-Jul-21	22,267	24,230	814	2,645
18-Jul-21	22,337	24,416	838	2,687
25-Jul-21	22,406	24,168	1,035	2,715
01-Aug-21	22,413	24,116	841	2,718
08-Aug-21	21,880	24,300	958	2,653
15-Aug-21	22,043	24,325	985	2,683
22-Aug-21	22,235	24,370	1,362	2,672
29-Aug-21	21,658	23,170	1,413	2,624
05-Sep-21	20,973	23,125	1,370	2,555
12-Sep-21	21,212	23,225	680	2,459
19-Sep-21	19,947	22,755	781	2,418

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
26-Sep-21	18,944	21,247	420	2,385
03-Oct-21	18,080	19,066	554	2,365
10-Oct-21	16,876	17,905	786	2,353
17-Oct-21	16,884	17,354	507	2,322
24-Oct-21	17,128	18,393	392	2,395
31-Oct-21	17,261	18,609	318	2,417
07-Nov-21	17,506	18,770	416	2,435
14-Nov-21	18,301	18,820	601	2,497
21-Nov-21	18,884	19,397	342	2,567
28-Nov-21	19,228	20,037	607	2,632
05-Dec-21	19,625	20,557	409	2,676
12-Dec-21	19,785	21,433	555	2,709
19-Dec-21	19,935	21,400	690	2,740
26-Dec-21	20,071	21,674	362	2,748
02-Jan-22	19,289	20,750	528	2,636
09-Jan-22	20,196	21,842	570	2,765
16-Jan-22	20,595	22,114	547	2,870
23-Jan-22	20,894	22,049	483	2,887
30-Jan-22	20,885	21,903	404	2,891
06-Feb-22	20,301	21,429	734	2,842
13-Feb-22	20,176	21,226	635	2,827
20-Feb-22	19,832	21,259	581	2,816
27-Feb-22	19,807	21,200	501	2,760
06-Mar-22	19,442	20,781	531	2,728

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
13-Mar-22	18,952	20,307	649	2,674
20-Mar-22	18,164	19,456	611	2,597
27-Mar-22	17,875	18,885	569	2,548
03-Apr-22	17,497	18,598	567	2,474
10-Apr-22	17,219	17,982	471	2,458
17-Apr-22	17,161	17,994	496	2,400
24-Apr-22	16,793	17,458	531	2,378
01-May-22	16,775	18,656	721	2,379
08-May-22	16,747	19,194	849	2,353
15-May-22	17,381	20,519	845	2,366
22-May-22	17,417	20,459	1,175	2,343
29-May-22	18,092	20,937	1,330	2,320
05-Jun-22	19,476	21,581	1,292	2,408
12-Jun-22	20,841	21,926	1,055	2,488
19-Jun-22	21,344	22,722	835	2,539
26-Jun-22	22,206	23,884	754	2,609
03-Jul-22	21,744	23,549	1,016	2,594
10-Jul-22	22,352	24,113	814	2,681
17-Jul-22	22,429	24,427	838	2,722
24-Jul-22	22,502	24,669	1,035	2,751
31-Jul-22	22,505	24,608	841	2,755
07-Aug-22	21,983	24,304	958	2,690
14-Aug-22	22,157	24,440	985	2,720
21-Aug-22	22,347	24,483	1,362	2,708

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
28-Aug-22	21,762	23,231	1,413	2,659
04-Sep-22	21,321	22,942	1,370	2,589
11-Sep-22	21,241	22,330	680	2,485
18-Sep-22	19,981	21,190	781	2,444
25-Sep-22	18,931	20,248	420	2,411
02-Oct-22	17,845	18,961	554	2,393
09-Oct-22	16,847	18,032	786	2,379
16-Oct-22	16,962	17,487	507	2,349
23-Oct-22	17,067	18,534	392	2,421
30-Oct-22	17,295	18,753	318	2,443
06-Nov-22	17,406	18,886	416	2,462
13-Nov-22	18,472	18,928	601	2,521
20-Nov-22	18,869	19,513	342	2,592
27-Nov-22	19,286	20,158	607	2,657
04-Dec-22	19,392	20,518	409	2,698
11-Dec-22	19,929	21,134	555	2,736
18-Dec-22	20,089	21,266	690	2,768
25-Dec-22	19,939	21,492	362	2,779
01-Jan-23	19,905	21,079	528	2,649

4. Resource Adequacy

The IESO expects to have sufficient generation supply for summer 2021 and winter 2021/2022, 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.

A number of coincident outages, as well as contract expiries, are creating a period of low reserves in the fall of 2022. The IESO does not expect this to present a reliability concern, and will continue to work with generators to ensure outages are optimally scheduled to minimize any risks to reliability.

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, which includes Henvey Inlet Wind Energy Centre. 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 2021 Summer Peak Normal Weather (MW)	Forecast Capability at 2021 Summer Peak Extreme Weather (MW)	Number of Stations	Change in Number of Stations	Change in Installed Capacity[1]
Nuclear	13,089	10,495	10,495	5	0	80
Hydroelectric	8,918	4,956	4,250	76	0	-142
Gas/Oil	10,515	9,443	9,013	33	1	-801
Wind	4,783	727	727	40	0	-3
Biofuel	296	254	254	7	0	1
Solar	478	66	66	10	0	0
Demand Measures	-	713	713	-	-	-
Firm Imports (+) / Exports (-) (MW)[2]	-	80	0	-	-	-
Total	**38,079**	**26,734**	**25,517**	**171**	**1**	**-865**

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.

[1] The IESO has made changes to better align the its Reliability Outlook methodology with the Annual Planning Outlook, and to more accurately account for the current installed capacity of resources across Ontario. This includes aligning installed capacity figures with the latest available information, factoring in ongoing changes at individual resource facilities. This change in accounting does not impact the amount of supply available for resource adequacy purposes.

[2] 80 MW of firm imports shown here in the normal weather scenario were acquired in the 2020 Capacity Auction. The IESO's outage management process using the extreme weather scenario, as outlined in the *Reliability Outlook* methodology, assumes the availability of 2,000 MW of import capacity. This is assumed to inclusive of firm import capacity acquired through the Capacity Auction.

The estimated effective date column in Table 4-2 indicates when the market registration process is expected to be complete for each generation resource, based on information available to the IESO as of June 1, 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 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-Q1	Commissioning	0	60
Nation Rise	Ottawa	Wind	2021-Q2	Commissioning	0	100
Calstock[3]	Northeast	Biofuel	2021-Q4	Expiring Contract	-38	-38
Iroquois Falls	Northeast	Gas	2021-Q4	Expiring Contract	-131	-131
Lennox GS[4]	East	Gas/Oil	2022-Q4	Expiring Contract	-2,200	-2,200
Total					**-2,369**	**-2,209**

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

[3] 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

[4] 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.

- 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

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

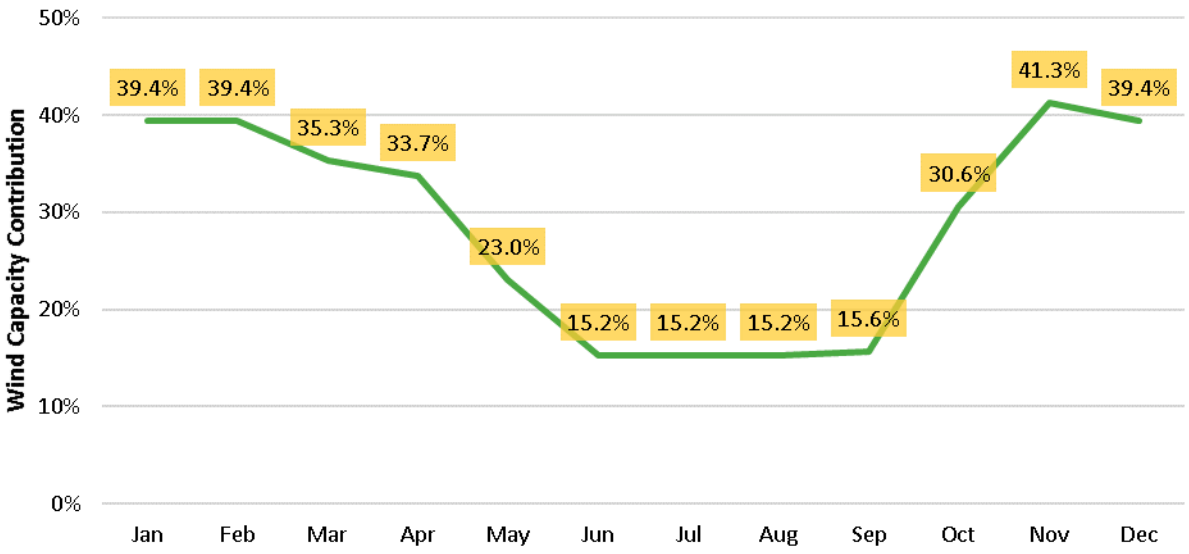
Thermal Generators

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

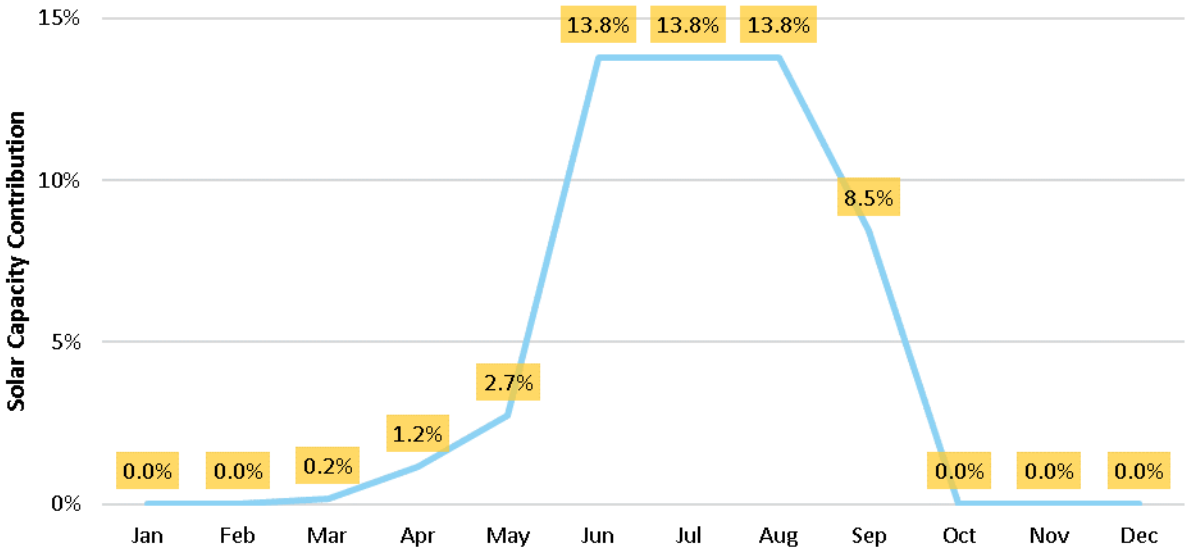


Solar

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[5], 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. Approximately 41 MW of capacity-backed exports were successful in the New York Independent System Operator (NYISO) auctions for delivery in both May and October 2021.

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.

[5] 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.

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.

System-Backed Imports

The IESO's December, 2020 Capacity Auction cleared 80 MW of system-backed imports from Hydro Quebec for the summer, 2021 obligation 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 2021 Firm Scenario	Summer Peak 2021 Planned Scenario	Winter Peak 2021/2022 Firm Scenario	Winter Peak 2021/2022 Planned Scenario	Summer Peak 2022 Firm Scenario	Summer Peak 2022 Planned Scenario
1	Installed Resources (MW)	38,079	38,239	38,079	38,239	38,079	38,239
2	Total Reductions in Resources (MW)	12,150	12,286	12,531	12,651	12,053	12,189
3	Demand Measures (MW)	713	713	137	137	63	63
4	Firm Imports (+) / Exports (-) (MW)	80	80	-500	-500	0	0
5	Available Resources (MW)	26,722	26,746	25,185	25,225	26,089	26,113
6	Bottling	12	12	889	913	64	64
7	Available Resources without Bottling (MW)	26,734	26,758	26,074	26,137	26,153	26,177

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 April 28, 2021. The generation planned outages occurring during this Outlook period have been assessed as of June 1, 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 June 1, 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.

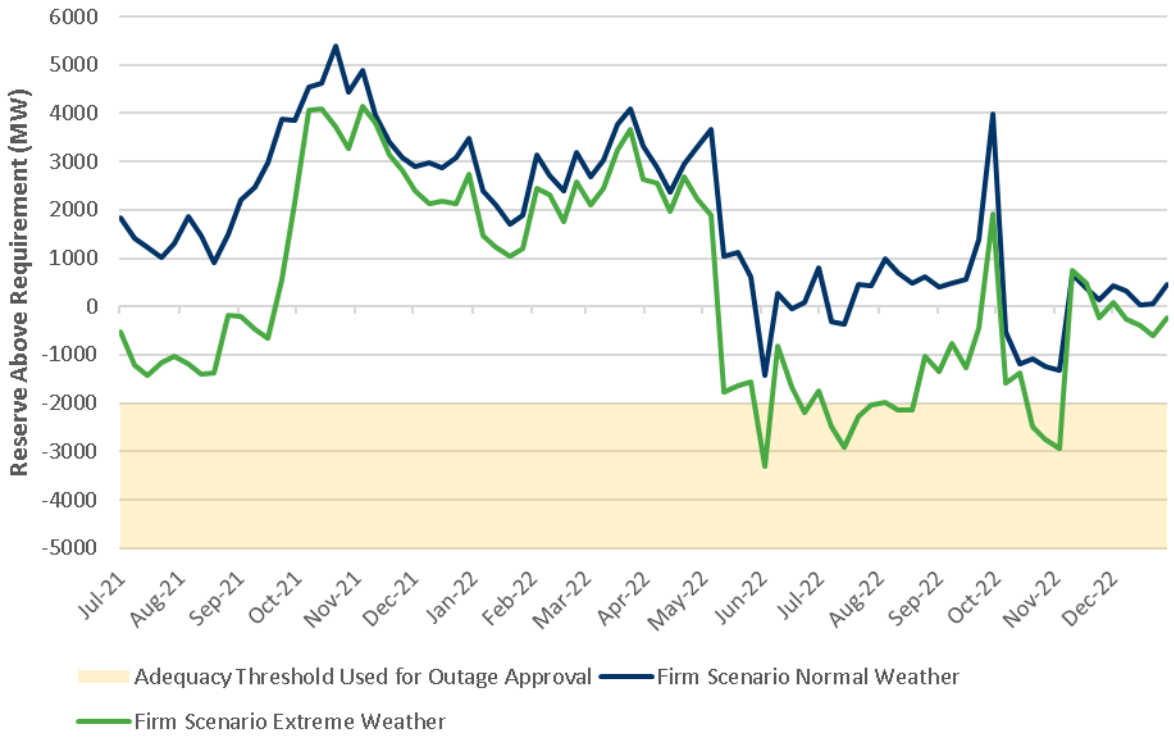
The IESO successfully ran its December 2020 Capacity Auction between December 2 - 3, 2020, clearing 992.1 MW for the summer 2021 obligation period. The target capacity for the December 2021 Capacity Auction, which will procure capacity for the summer 2022 and winter 2022/2023 obligation periods, will be announced in the IESO's forthcoming Annual Acquisition Report, and has not been included in 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 eight weeks in the spring and summer of 2022, as well as three weeks in the fall of 2022. Under the current outage schedule, the RAR is below the -2,000 MW threshold for one week in June, five weeks in July, two weeks in August, two weeks in October, and one week of November 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. At this time, the brief period of low reserves in October and November, 2022 is forecast to be challenging, and generators should consider moving outages planned for this period. These challenges will be mitigated by the recontracting of Lennox GS, and 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



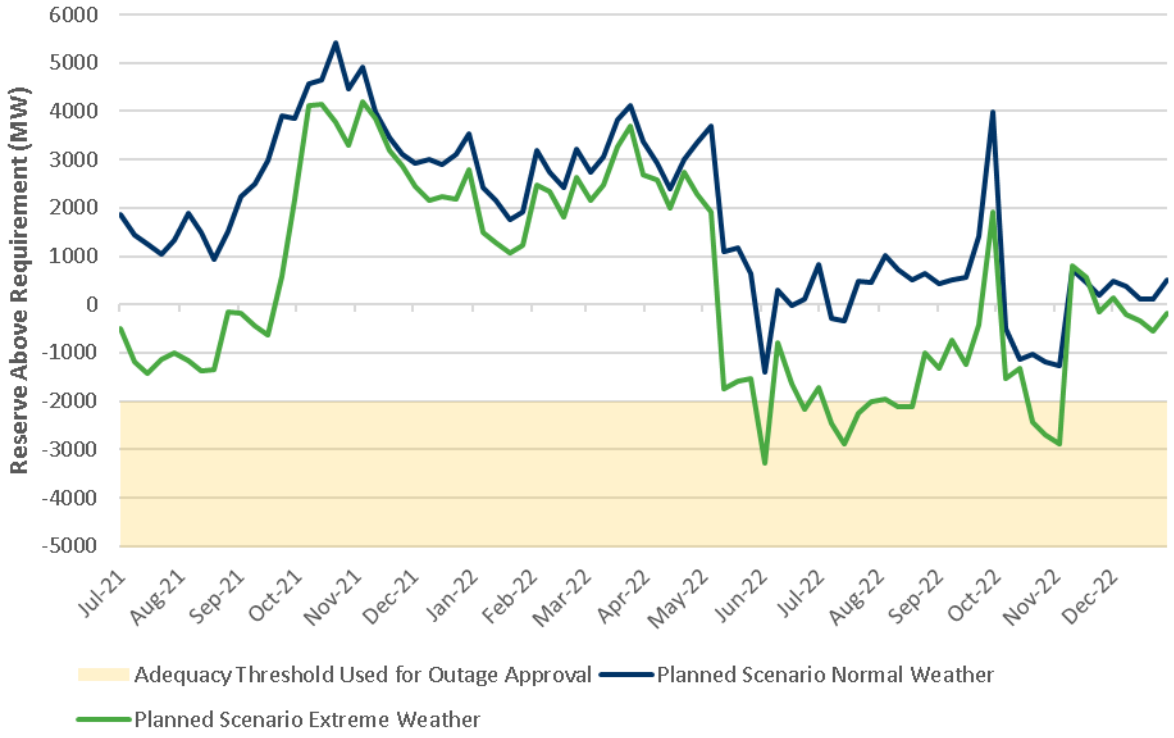
4.2.2 Planned Scenario with Normal and Extreme Weather

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 2,369[6] 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 summer and fall of 2022 under the extreme scenario.

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

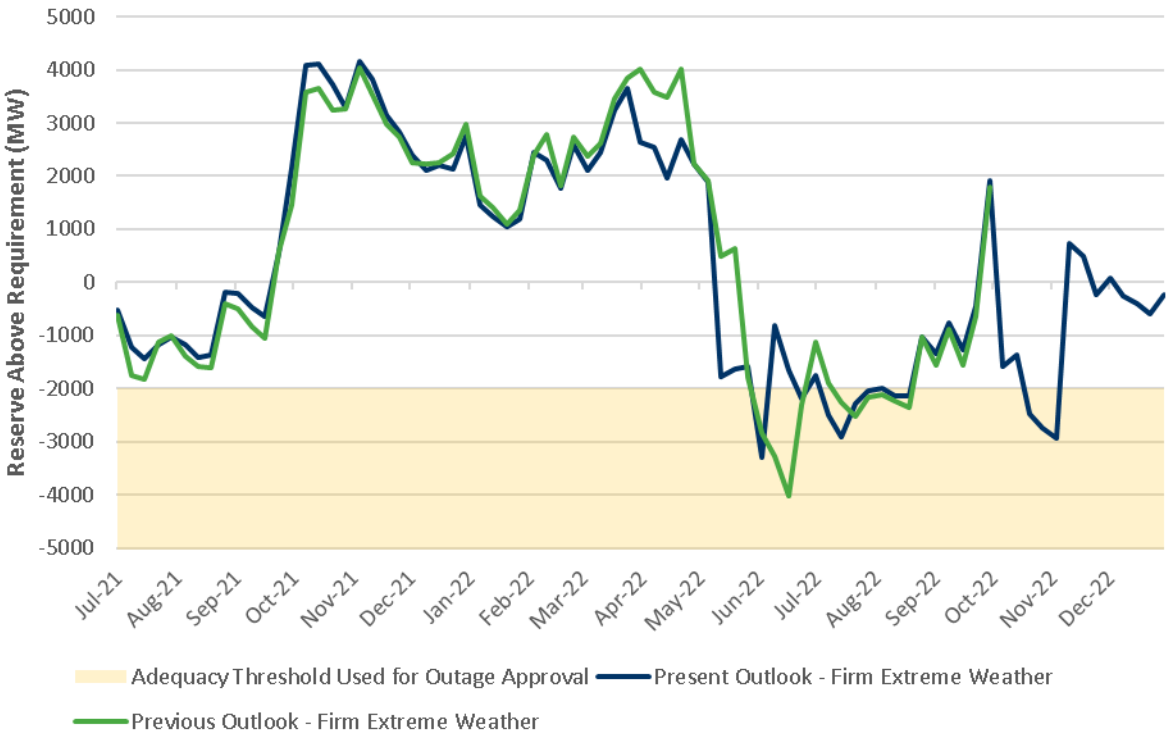
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



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 December 16, 2020. The difference is primarily the result of changes in planned outages and, for summer 2021, capacity that cleared the December 2020 capacity auction.

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	74	58.0	4,399	57.0	1.5	118.1
East	12.6	953	17.7	1,342	5.1	25.4	95.8
Essa	13.4	1,014	3.9	293	-9.5	28.0	15.4
Niagara	5.9	445	20.9	1,586	15.0	14.1	54.1
Northeast	15.4	1,169	14.4	1,094	-1.0	25.5	33.9
Northwest	5.8	439	6.7	507	0.9	10.5	21.0
Ottawa	12.8	975	0.2	17	-12.6	28.8	1.2
Southwest	40.9	3,100	7.3	553	-33.6	90.1	26.7
Toronto	73.6	5,589	58.1	4,408	-15.5	171.1	162.4
West	21.2	1,606	14.8	1,122	-6.4	49.9	78.8
Ontario	**202.5**	**15,366**	**201.9**	**15,321**	**-0.6**	**444.9**	**607.5**

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

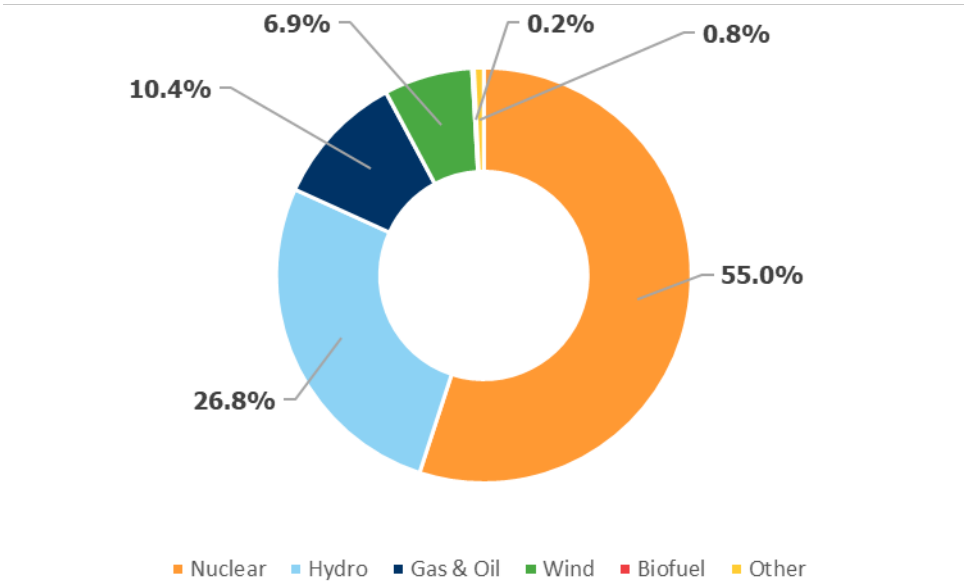


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

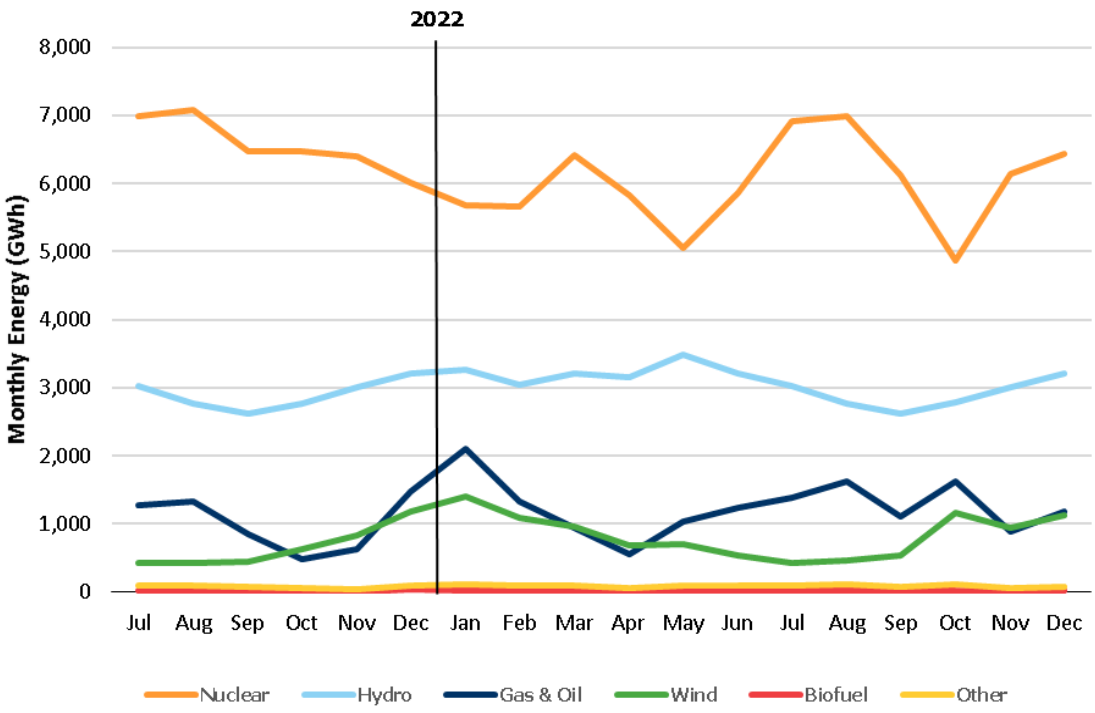


Table 4-6 | Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2021 (July 1 – Dec 31) (GWh)	2022 (Jan 1 – Dec 31) (GWh)	Total (GWh)
Nuclear	39,410	71,990	111,400
Hydro	17,393	36,806	54,198
Gas & Oil	6,023	15,004	21,027
Wind	3,940	10,036	13,975
Biofuel	105	219	324
Other (Solar & DR)	440	1,097	1,537
Total	**67,309**	**135,152**	**202,461**

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 March 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 April 28 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

Hydro One has begun replacing some of the aging infrastructure at the Bruce A 230 kV switchyard, which requires careful coordination of transmission and generation outages. This project is scheduled to be completed by Q2 2021.

The following planned outages in 2021 will impact the flow out of Bruce zone: three-week duration on B501M from July 30; six days on B560V starting September 7; three-week duration on B502M starting on November 22.

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.

There is a six-day outage of circuit M23S starting April 6, 2022 and seven-day outage of circuit B5D starting August 16, 2021 that will impact the transfer capability into Ottawa zone.

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 series of planned outages on circuits W21M and W22M starting on June 28, 2021 into July will reduce the transfer capability of the East-West Tie. A 40-day outage of circuit M23L starting November 1, 2021 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 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.

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 BP76 starting July 15, 2022 will reduce import and export transfer capability between Ontario and New York.

A planned five-month outage of circuit PA301 starting January 18, 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.

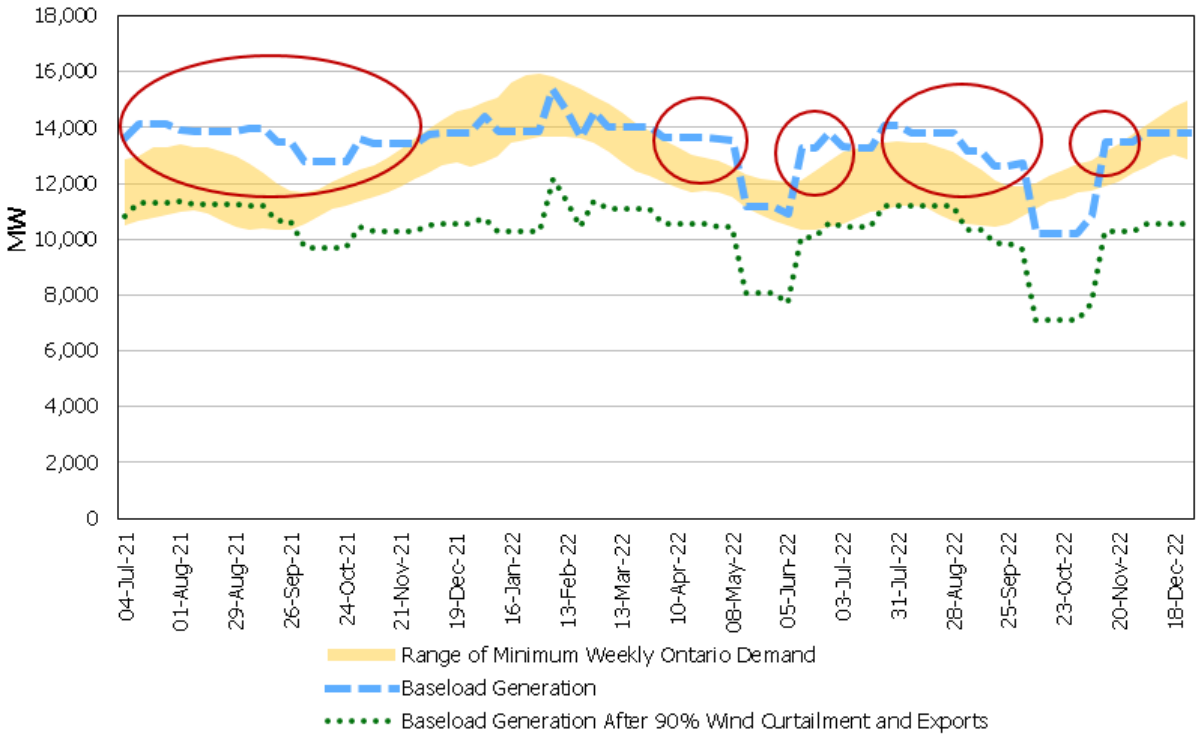
This section highlights existing or emerging operability issues that could impact the reliability of Ontario's power system.

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.

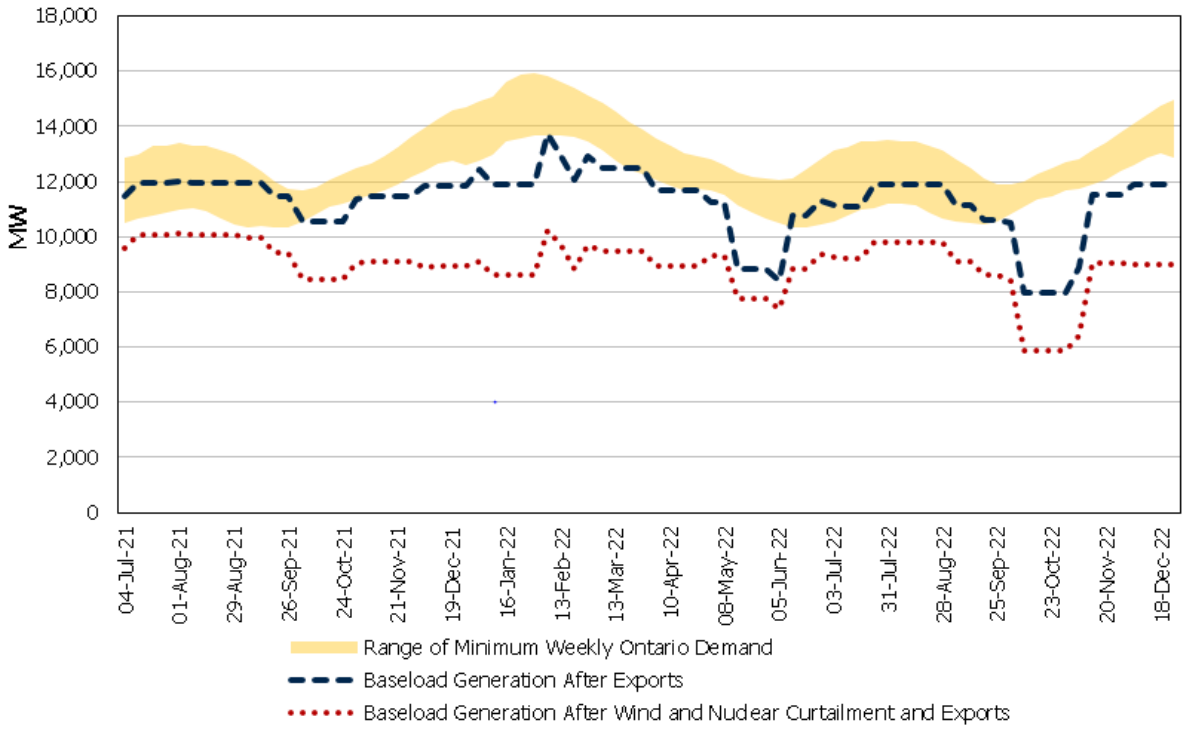
Ontario is expected to experience potential surplus baseload conditions during the shoulder periods throughout the Outlook. Figure 6-1 highlights the periods during which expected baseload generation may exceed forecast demand.

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.

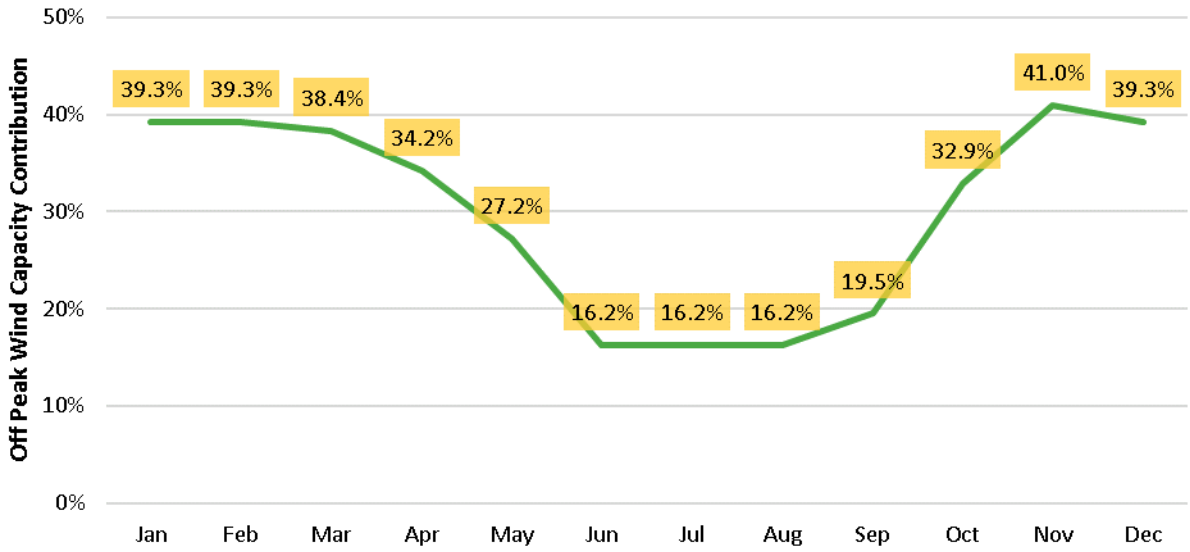
Figure 6-2 | Minimum Ontario Demand and Baseload Generation



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 Q2 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/ReliabilityOutlookMethodology2021Jun.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	http://www.ieso.ca/-/media/files/ieso/Document%20Library/Market-Rules-and-Manuals-Library/market-manuals/market-administration/IMO-REQ-0041-TransmissionAssessmentCriteria.pdf	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	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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