Reliability Outlook

An adequacy assessment of Ontario's electricity system

January 2021 to June 2022

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Executive Summary

The COVID-19 pandemic continues to impact Ontario's economy as well as its energy usage and patterns, but with a vaccine on the horizon, prospects for a solid recovery look more promising than in the last Outlook. The pandemic has affected different industry sectors in different ways, but overall energy consumption has increased over the second half of 2020. However, with a significant portion of the workforce continuing to work from home, the system will remain more weather-sensitive than it was before COVID due to higher residential loads.

Although there are still some uncertainties with the forecast, the IESO expects demand in 2021 to increase over 2020 by 1.0%. Nevertheless, 2021 demand (133.3 TWh) will still be less than it was in 2019 (134.2 TWh).

The IESO expects to have sufficient generation supply for both winter 2020/2021 and winter 2021/2022, but there are periods in the summer of 2021 when reserve margins may fall short of requirements, resulting in deferred outages. However, this outlook does not include 992.1 megawatts of capacity that was acquired in the December capacity auction for a commitment period of May 1 to October 31, 2021.

In a milestone for Ontario's electricity system, the capacity auction included participation from a broad range of eligible resources. Resources that were successful in the auction include industrial and commercial consumers providing demand response, imports, generation and energy storage. Having a flexible and competitive mechanism that can respond to changing system needs delivers significant value to ratepayers and ensures cost-effective reliability while balancing consumer/supplier risks. The full auction results can be found on the IESO website but given time constraints, this new capacity has not been included in the modelling for this Outlook.

During the shoulder seasons, Ontario will continue to experience potential surplus baseload generation conditions, but they can be managed with existing market mechanisms such as exports and curtailment of variable generation.

And finally, 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.

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1. Introduction

This Outlook covers the 18 months from January 2021 to June 2022, and supersedes the Outlook released on September 22, 2020.

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 October 2020, and has been updated to reflect the most recent economic projections. Actual weather and demand data for November 2020 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 December 2, 2020. 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, 2020.

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 October 27, 2020.

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 December 2, 2020.

3. Demand Forecast

Electricity demand is expected to increase moderately over the forecast period, but remain below 2019 levels through 2021. Given the current state 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 January 2021 to June 2022 and supersedes the previous forecast released in September 2020. Tables of supporting information are contained in the 2020 Q4 Outlook Tables

The outlook for 2021 shows a small improvement when compared to 2020. However, the forecast remains uncertain given the continuing health crisis and the resulting economic impacts. Significant questions remain, especially with respect to the speed and scope of Ontario's economic recovery, which will affect electricity demand and consumption patterns. Energy demand has increased over the second half of 2020 but different parts of the economy are experiencing different recovery rates. For example, the pandemic has had a disproportionate impact on the service sector. The manufacturing sector, by contrast, has been generally robust since the lifting of the spring lockdown. The brunt of the economic disruption has been borne by the accommodation, hospitality and entertainment sectors which are not electrically intensive.

With the overall growth in demand and a vaccine on the horizon, which will drive a return to "normal" life, including energy usage, the IESO expects demand in 2021 to increase over 2020 by 1.0%. However, 2021 demand (133.3 TWh) will still be less than the value for 2019 (134.2 TWh).

With the onset of the second wave and a significant portion of the workforce continuing to work from home, the system will continue to be more weather-sensitive than pre-COVID due to higher residential loads. The 2020-21 winter peaks are expected to be slightly higher for the same reason.

With the anticipated deployment of a vaccine in the spring and summer of 2021, employees across many sectors of the economy will begin returning to the office. Fewer people working from home will reduce the weather sensitivity of the system as the year progresses. This, in conjunction with the resumption of the Industrial Conservation Initiative (ICI) will act to keep put downward pressure on summer peaks as compared to the peaks experienced in the summer of 2020, which was characterized by extended periods of hot weather.

There remains a significant amount of uncertainty regarding the demand forecast. As the vaccine is deployed and restrictions are lifted, it will become clear how much of the reduced employment and economic activity was temporary and how much has become permanent. Stimulus measures have been an important factor over the course of the pandemic. The post-pandemic recovery, including its trajectory, will also be shaped by government policies and actions. For the purposes of this Outlook, the IESO has assumed some generic stimulus funding as indicated by the federal government but will reflect details as they are announced.

Finally, the Ontario economy is closely integrated with that of the United States. The U.S. response to COVID and its post-pandemic recovery will have longer term impacts on Ontario that extend far beyond just the timing of the re-opening of the border. A strong U.S. recovery will help boost Ontario's economy. Conversely, should the U.S. economy struggle in 2021, that would act as a drag on Ontario's economy.

Table 3-1 | Forecast Energy Summary

Year	Normal Weather Energy (TWh)	% Growth in Energy
2020	132.0	-1.63%
2021	133.3	1.02%
2022	134.1	0.60%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Winter 2020-21	21,176	22,612
Summer 2021	22,592	24,438
Winter 2021-22	20,959	22,154

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-Jan-21	19,943	21,462	528	2,649
10-Jan-21	20,959	22,612	570	2,850
17-Jan-21	20,922	22,400	547	2,854
24-Jan-21	21,154	22,390	483	2,869
31-Jan-21	21,176	22,408	404	2,870
07-Feb-21	20,760	21,801	734	2,795
14-Feb-21	20,306	21,437	635	2,786

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
21-Feb-21	19,674	21,605	581	2,741
28-Feb-21	19,659	21,295	501	2,751
07-Mar-21	19,384	20,671	531	2,683
14-Mar-21	18,621	20,227	649	2,634
21-Mar-21	18,090	19,406	611	2,560
28-Mar-21	18,046	18,895	569	2,515
04-Apr-21	17,468	18,545	567	2,418
11-Apr-21	16,953	17,642	471	2,393
18-Apr-21	16,886	17,633	496	2,377
25-Apr-21	16,845	17,139	531	2,330
02-May-21	16,823	18,603	721	2,328
09-May-21	16,656	19,264	849	2,308
16-May-21	17,266	20,534	845	2,319
23-May-21	17,286	20,474	1,175	2,301
30-May-21	17,941	20,989	1,330	2,281
06-Jun-21	19,440	22,076	1,292	2,379
13-Jun-21	20,765	23,199	1,055	2,451
20-Jun-21	21,342	23,724	835	2,502
27-Jun-21	22,213	23,767	754	2,577
04-Jul-21	21,738	23,296	1,016	2,558
11-Jul-21	22,463	24,438	814	2,677
18-Jul-21	22,501	24,237	838	2,718
25-Jul-21	22,574	24,361	1,035	2,746
01-Aug-21	22,592	24,372	841	2,746
08-Aug-21	21,954	24,217	958	2,659

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
15-Aug-21	22,117	24,186	985	2,684
22-Aug-21	22,308	24,374	1,362	2,666
29-Aug-21	21,758	23,131	1,413	2,614
05-Sep-21	21,038	23,095	1,370	2,553
12-Sep-21	21,248	23,222	680	2,460
19-Sep-21	19,992	22,715	781	2,411
26-Sep-21	18,884	21,113	420	2,373
03-Oct-21	18,116	19,060	554	2,344
10-Oct-21	16,845	17,911	786	2,326
17-Oct-21	16,840	17,296	507	2,298
24-Oct-21	17,007	18,398	392	2,372
31-Oct-21	17,081	18,618	318	2,394
07-Nov-21	17,326	18,728	416	2,412
14-Nov-21	18,515	18,768	601	2,479
21-Nov-21	18,846	19,342	342	2,551
28-Nov-21	19,236	20,012	607	2,614
05-Dec-21	19,599	21,011	409	2,662
12-Dec-21	20,006	21,513	555	2,696
19-Dec-21	19,966	21,471	690	2,727
26-Dec-21	19,937	21,661	362	2,735
02-Jan-22	19,503	20,740	528	2,623
09-Jan-22	20,263	21,939	570	2,766
16-Jan-22	20,794	22,147	547	2,871
23-Jan-22	20,948	22,134	483	2,885
30-Jan-22	20,959	22,154	404	2,887

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
06-Feb-22	20,335	21,544	734	2,819
13-Feb-22	20,143	21,165	635	2,801
20-Feb-22	19,718	21,192	581	2,791
27-Feb-22	19,699	21,133	501	2,734
06-Mar-22	19,486	20,771	531	2,711
13-Mar-22	18,699	20,324	649	2,657
20-Mar-22	18,157	19,474	611	2,580
27-Mar-22	18,100	18,956	569	2,535
03-Apr-22	17,553	18,621	567	2,449
10-Apr-22	17,043	17,734	471	2,416
17-Apr-22	16,985	17,730	496	2,361
24-Apr-22	16,935	17,225	531	2,343
01-May-22	16,913	18,690	721	2,351
08-May-22	16,751	19,354	849	2,332
15-May-22	17,364	20,631	845	2,348
22-May-22	17,386	20,574	1,175	2,325
29-May-22	18,038	21,085	1,330	2,305
05-Jun-22	19,447	21,580	1,292	2,395
12-Jun-22	20,767	21,902	1,055	2,475
19-Jun-22	21,330	22,625	835	2,527
26-Jun-22	22,208	23,661	754	2,602
03-Jul-22	21,793	23,400	1,016	2,604

4. Resource Adequacy

The IESO expects to have sufficient generation supply for both winter 2020/2021 and winter 2021/2022, accounting for zonal transmission constraints. Potential risks in summer 2021 and early summer 2022 are expected to be mitigated by outage rescheduling.

This section assesses the adequacy of resources to meet the forecast demand. Resource adequacy is one of the reliability considerations used for approving 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.

The 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 Outlook Peak Normal Weather (MW)	Forecast Capability at Outlook Peak [Extreme] (MW)	Number of Stations	Change in Number of Stations	Change in Installed Capacity
Nuclear	13,009	10,504	9,988	5	0	0
Hydroelectric	9,060	5,133	4,509	76	0	0
Gas/Oil	11,317	9,339	8,914	32	0	0
Wind	4,486	634	634	39	0	0
Biofuel	295	254	254	7	0	0
Solar	478	64	64	10	0	0
Demand Measures	-	28	28	-	-	-
Firm Imports (+) / Exports (-) (MW)	-	0	0	-	-	-
Total	**38,644**	**25,956**	**24,391**	**169**	**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 December 2, 2020. 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)
Henvey Inlet Wind Farm	Essa	Wind	2020-Q4	Commissioning		300
Romney Wind Energy Centre	West	Wind	2021-Q1	Commissioning		60
Nation Rise	Ottawa	Wind	2021-Q2	Commissioning		100
Calstock[1]	Northeast	Biofuel	2021-Q4	Expiring Contract	-38	-38
Iroquois Falls	Northeast	Gas	2021-Q4	Expiring Contract	-131	-131
Total					**-169**	**291**

Notes on Table 4-2:

The total may not add up due to rounding and does not include in-service facilities. Project status provides an indication of the project progress, using the following terminology:

- Under Development – projects in approvals and permitting stages (e.g., environmental assessment, municipal approvals, IESO connection assessment approvals) and projects under construction
- Commissioning – projects undergoing commissioning tests with the IESO
- Commercial Operation – projects that have achieved commercial operation status under the contract criteria, but have not met all of the IESO's market registration requirements
- Expiring Contract – contracts that will expire during the Outlook period are included in both scenarios only up to their contract expiry date. Generators (including non-utility generators) that continue to provide forecast output data are also included in the planned scenario for the rest of the 18-month period.

[1] Atlantic Power recently announced a 1-year extension to its Calstock Power Purchase Agreement, to December 2021; Table 4-2 reflects this change. However, the analysis in this report assumes the prior expiry date of December 2020. This will be updated in the Q1 2021 Outlook.

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 2020, 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)	6,327	6,266	6,068	6,021	6,116	5,940	5,790	5,431	5,227	5,600	5,851	6,312
Historical Hydroelectric Median Contribution without Outages (MW)	6,835	6,854	6,593	6,542	6,561	6,427	6,238	5,998	6,068	6,430	6,601	6,815

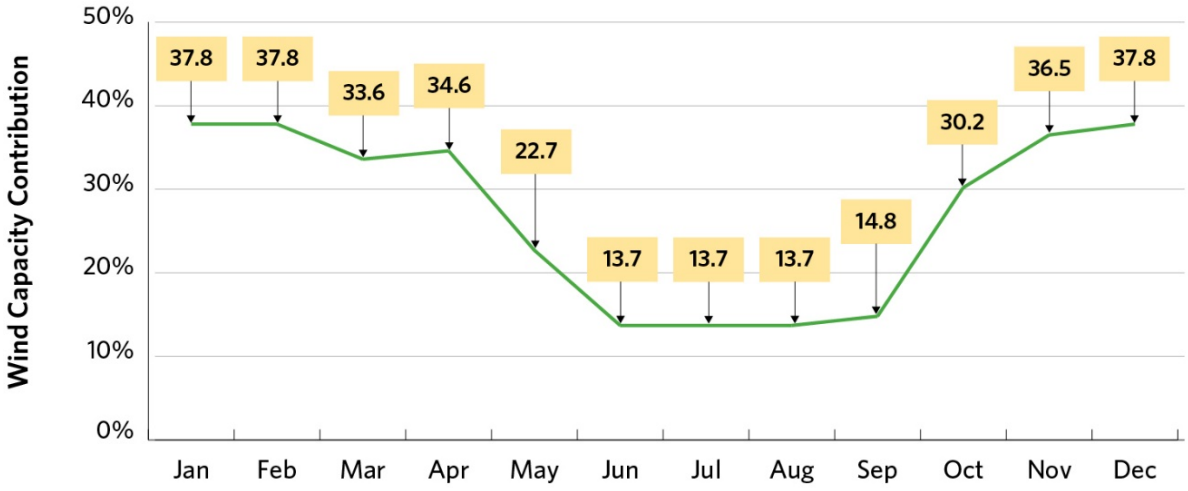
Thermal Generators

Thermal generators' capacity, planned outages and deratings are based on market participant submissions. Forced outage rates on demand are calculated by the IESO based on actual operational data. The IESO will continue to rely on market participant-submitted forced outage rates for comparison purposes.

Wind

For wind generation, monthly wind capacity contribution (WCC) values from the weekday peak hour are used. The process for determining wind contribution can be found in the Methodology to Perform the Reliability Outlook. Figure 4-1 shows the monthly WCC values, which are updated annually with the release of the Q2 Outlook.

Figure 4-1 | Monthly Wind Capacity Contribution Values

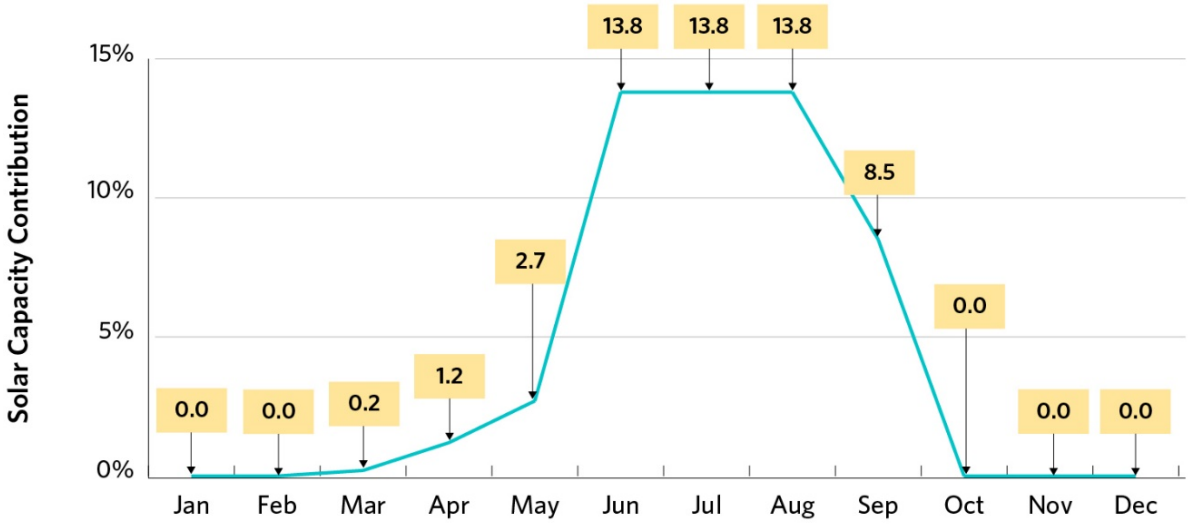


Solar

For solar generation, monthly solar capacity contribution (SCC) values are used from the weekday peak hour. Information on how the solar contribution is calculated can be found in the Methodology to Perform the Reliability Outlook. Figure 4-2 shows the monthly SCC values, which are updated annually for the release of the Q2 Outlook.

The grid demand profile has been changing, due in part to the penetration of embedded solar generation, which is pushing summer peaks to later in the day. As a result, the contribution from grid-connected solar resources has declined at the time of peak Ontario demand.

Figure 4-2 | Monthly Solar Capacity Contribution Values



4.1.3 Demand Measures

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

4.1.4 Firm Transactions

Capacity-Backed Exports

The IESO allows Ontario resources to compete in the capacity auctions held by certain neighbouring jurisdictions, but only if Ontario has adequate supply. No capacity-backed exports were successful in the New York Independent System Operator (NYISO) auctions for delivery between November 2020 to April 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 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 2020/2021 Firm Scenario	Winter Peak 2020/2021 Planned Scenario	Summer Peak 2021 Firm Scenario	Summer Peak 2021 Planned Scenario	Winter Peak 2021/2022 Firm Scenario	Winter Peak 2021/2022 Planned Scenario
1	Installed Resources (MW)	38,644	38,944	38,644	39,104	38,644	38,944
2	Total Reductions in Resources (MW)	11,529	11,708	12,744	13,139	12,326	12,505
3	Demand Measures (MW)	702	702	28	28	702	702
4	Firm Imports (+) / Exports (-) (MW)	-500	-500	0	0	-500	-500
5	Available Resources (MW)	27,317	27,438	25,928	25,993	26,520	26,641
6	Bottling	479	479	29	29	597	597
7	Available Resources without Bottling (MW)	27,795	27,916	25,957	26,022	27,117	27,238

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 October 27, 2020. The generation planned outages occurring during this Outlook period have been assessed as of December 2, 2020.

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

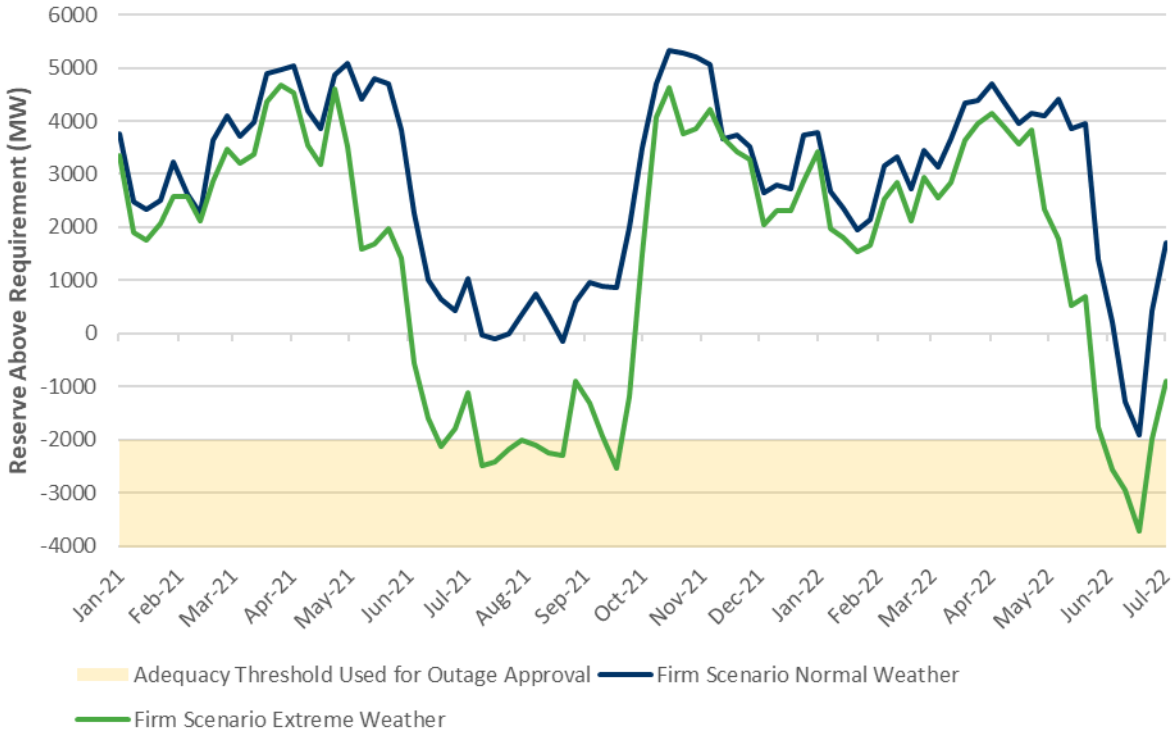
The firm scenario incorporates all capacity that had achieved commercial operation status as of December 2, 2020.

Figure 4-3 shows Reserve Above Requirement (RAR) levels, which represent 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 and December 3, 2020, clearing 992.1 MW for the summer 2021 obligation period. Given the timing of the auction, this capacity has not been accounted for in this Outlook; it will be included in the resource adequacy assessment in the Q1 2021 *Reliabilty Outlook*.

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 a total of eight weeks in 2021 and three weeks in the first half of 2022. Under the current outage schedule, the RAR is below the -2,000 MW threshold for one week in June, three weeks in July, three weeks in August and one week in September of 2021, as well as three weeks in June of 2022. This potential shortfall is largely attributed to planned generator outages scheduled during those weeks. If extreme weather conditions materialize, the IESO may reject some generator maintenance outage requests to ensure that Ontario demand is met during the summer peak periods. At this time, the brief period of low reserves in June, 2022 is forecast to be particularly difficult, and generators are advised to consider moving outages planned for this period. 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

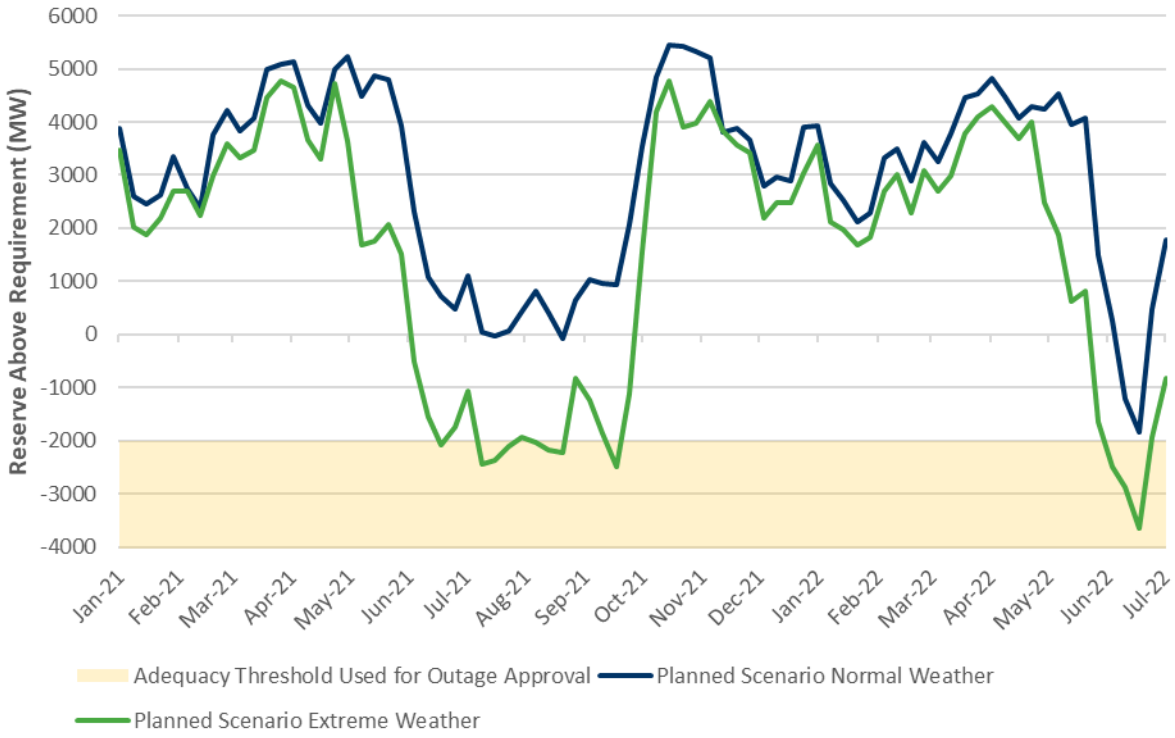


4.2.2 Planned Scenario with Normal and Extreme Weather

The planned scenario incorporates all existing capacity, as well as all capacity expected to come into service. Approximately 460 MW of new generation capacity is expected to connect to Ontario's grid over this Outlook period, while 169 MW of generation capacity contracts will expire, and these resources will no longer 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.

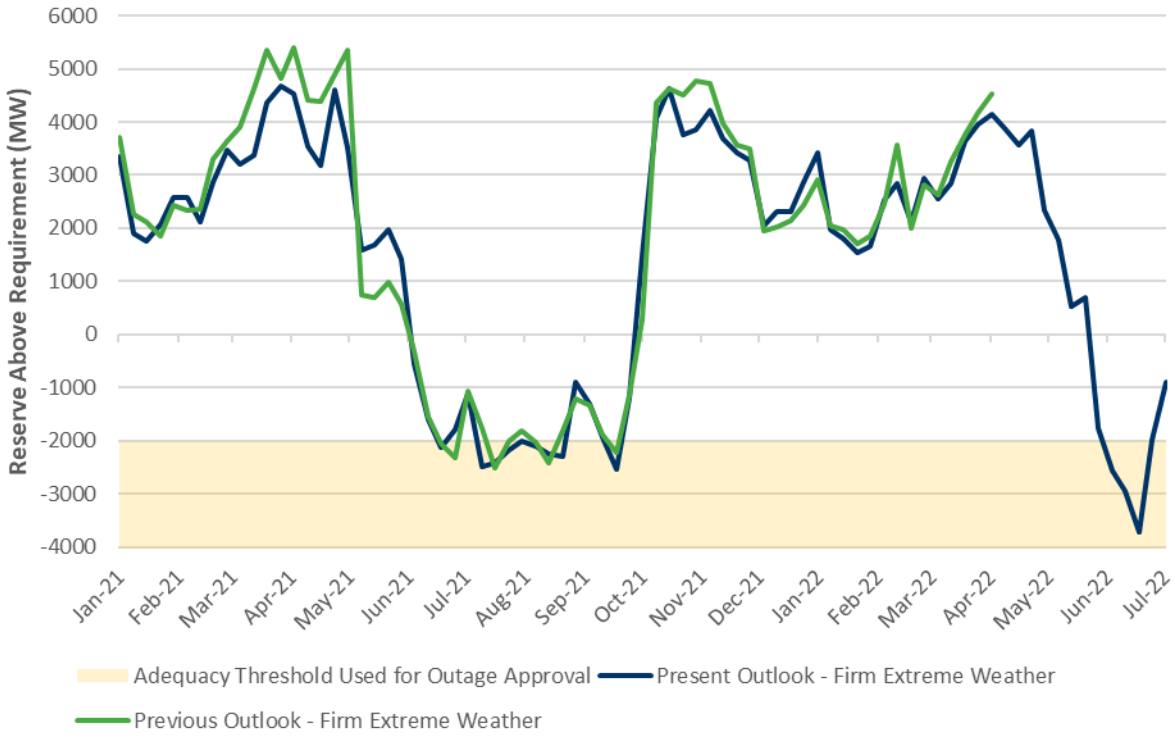
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



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 September 22, 2020. 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 2020 Q4 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	0.9	65	55.4	4,227	54.5	1.4	110.9
East	12.5	952	18.0	1,373	5.5	26.0	104.2
Essa	12.6	963	3.9	300	-8.7	27.0	15.7
Niagara	5.7	436	20.6	1,575	14.9	14.1	52.9
Northeast	15.3	1,171	15.1	1,155	-0.2	27.1	34.0
Northwest	5.8	439	7.0	532	1.2	9.3	21.8
Ottawa	13.6	1,041	0.2	16	-13.4	30.8	1.2
Southwest	40.6	3,099	7.0	537	-33.6	92.6	25.5
Toronto	72.6	5,539	58.8	4,490	-13.8	172.9	159.4
West	20.3	1,553	13.8	1,053	-6.5	49.3	75.5
Ontario	**199.9**	**15,257**	**199.9**	**15,257**	**0.0**	**450.5**	**601.0**

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

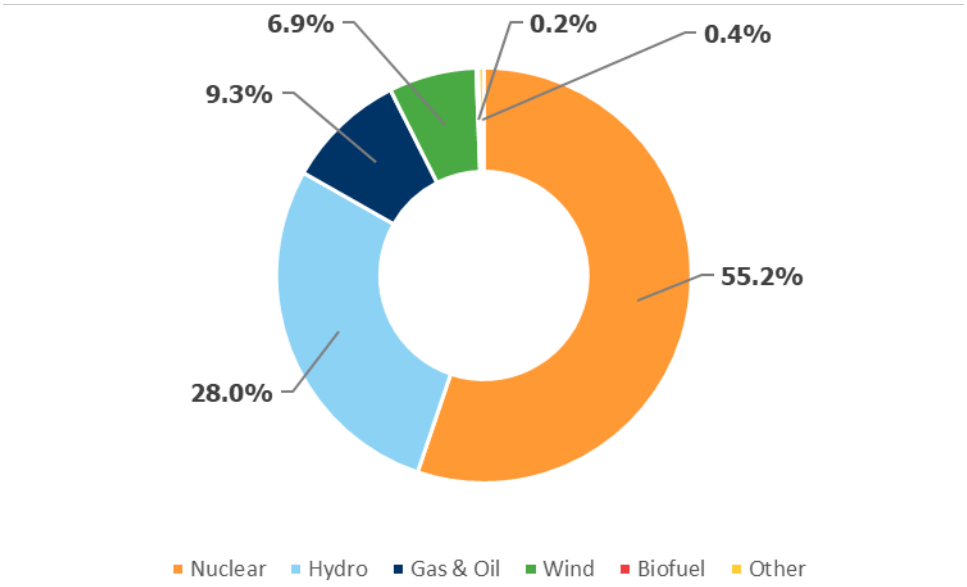


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

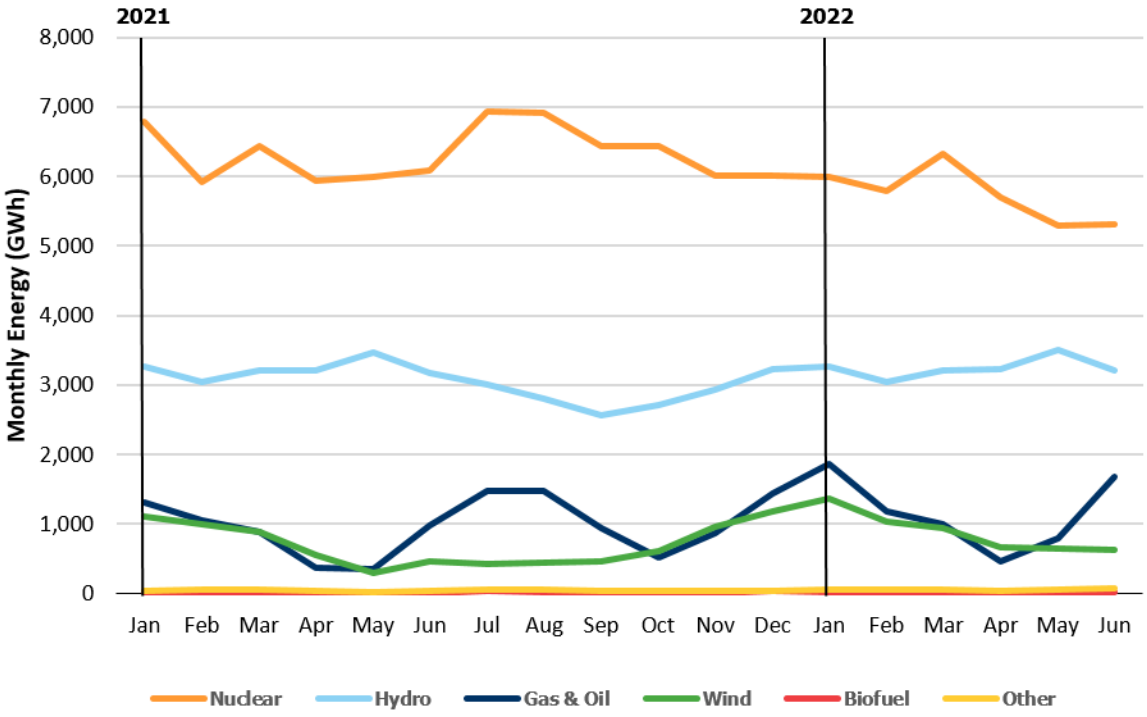


Table 4-6 | Ontario Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2021 (Jan 1 – Dec 31) (GWh)	2022 (Jan 1 – Jun 30) (GWh)	Total (GWh)
Nuclear	75,919	34,398	110,318
Hydro	36,605	19,469	56,074
Gas & Oil	11,667	7,007	18,674
Wind	8,390	5,306	13,696
Biofuel	211	99	310
Other (Solar & DR)	522	334	856
Total	**133,315**	**66,612**	**199,927**

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 provide with respect to transmission projects that are planned for completion within the next 18 months. The list of transmission projects is provided in Appendix B1. Note that the planned in-service dates in this table and throughout this document are as of October 2020. 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 October 27, 2020.

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 230 kV switchyard, which requires careful coordination of transmission and generation outages. This project is scheduled to be completed by Q2 2021. A series of non-contiguous planned outages on 500 kV circuits in southern Ontario will impact the flow out of Bruce and the transfer capability from and to the West zone from January to June 2021.

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 Q4 2022 in-service date. Outages may be more challenging to facilitate 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 were removed from service during instances of 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 Q1 2021 for the first reactor and Q4 2021 for the second reactor.

Aging circuit breakers in the Richview 230 kV switchyard are to be replaced by Q1 2021. Hydro One and the IESO will coordinate the outages required to reduce the impact on the Flow East Toward Toronto transfer capabilities.

There is a one-and-a-half-week outage of circuit B5D starting January 18, 2021 that will impact the transfer capability into the Ottawa zone.

Northwest, Northeast, and Essa Zones

A three-and-a-half-week outage of circuit X503E starting May 31, 2021 will reduce transfer capability of the North-South Tie.

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 for the unit are being investigated by the IESO, in conjunction with Hydro One, the NYISO and the New York Power Authority. The replacement will provide greater flexibility to control both current and future intertie flows with New York. The return-to-service date is expected to be between March 2022 and March 2023.

A planned two-month outage of circuit J5D starting March 29, 2021 will reduce import and export transfer capability between Ontario and Michigan.

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 Seasonal Readiness

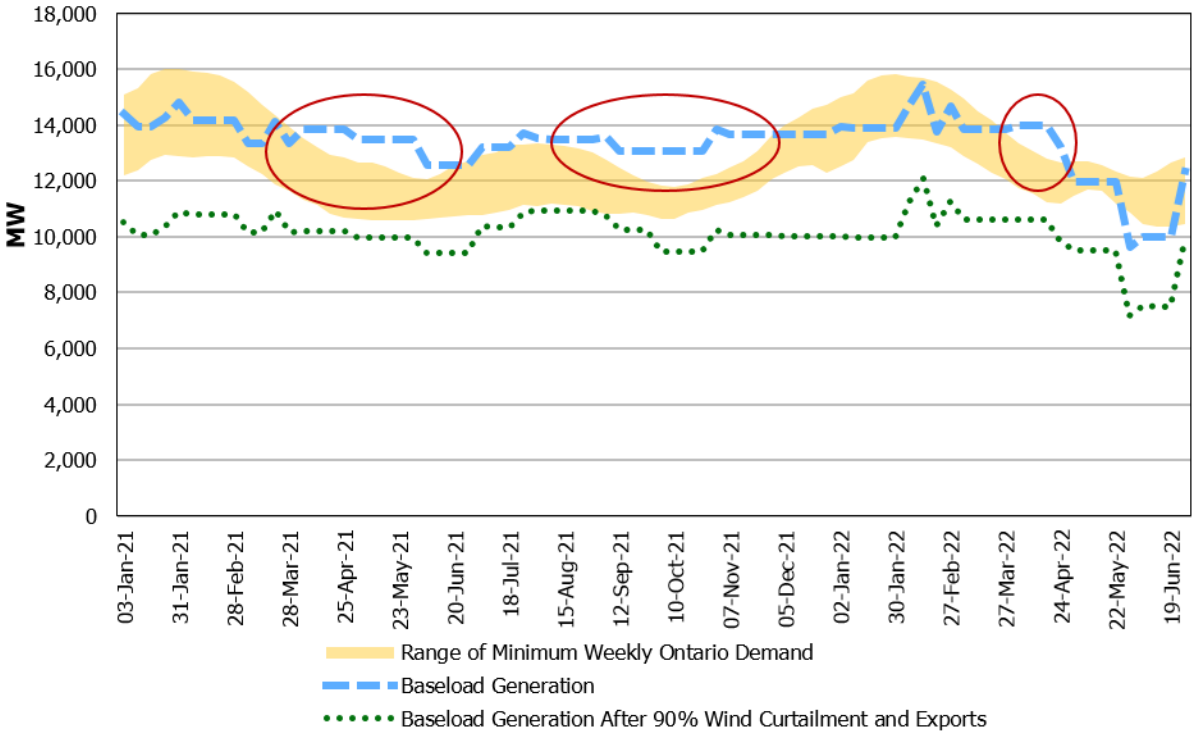
The IESO continues to use its existing programs to test the readiness of the generation fleet for the upcoming winter season. The IESO also continues to track industry developments, utility best practices and programs implemented by other jurisdictions for winter readiness and, where appropriate, will share the relevant information with market participants to facilitate the development and enhancement of their winter readiness programs. More information and guidance on cold weather preparedness can be found in the IESO's winterization guideline.

6.2 Surplus Baseload Generation

Baseload generation is made up of 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.

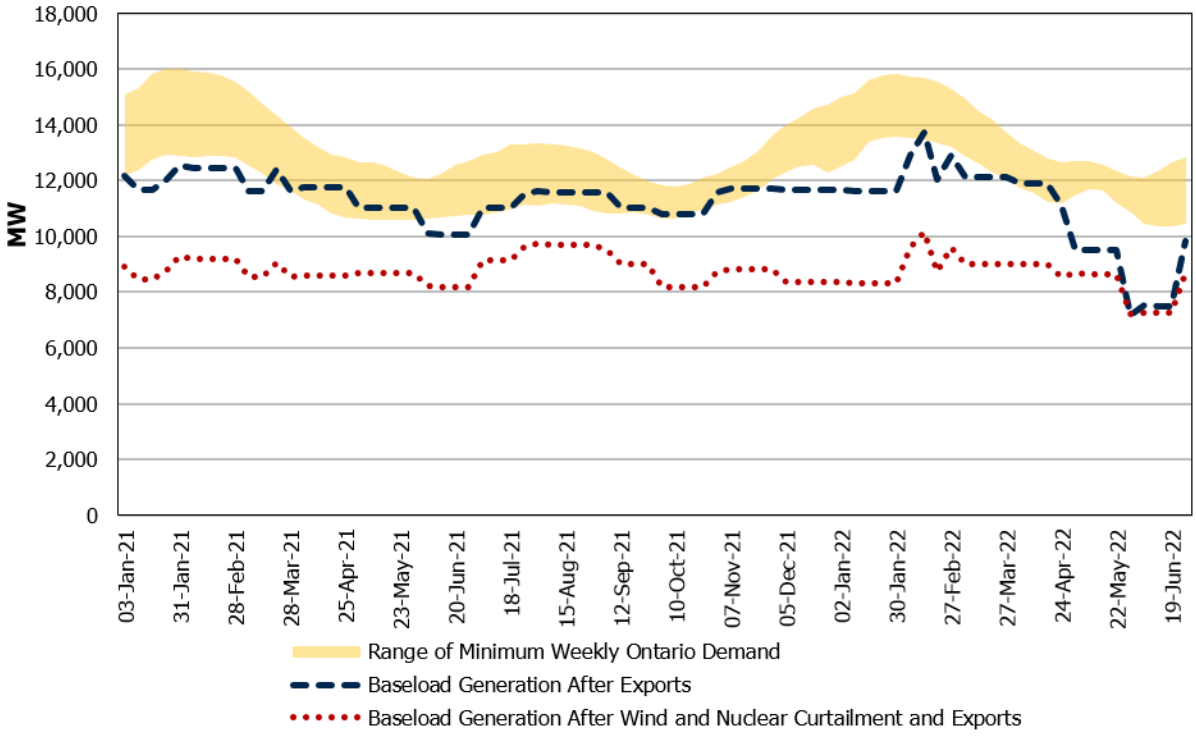
Ontario is expected to experience potential surplus baseload conditions during the shoulder periods throughout the Outlook. Figure 6-1 highlights the periods during which expected baseload generation may exceed forecast demand.

Figure 6-1 | Minimum Ontario Demand and Baseload Generation



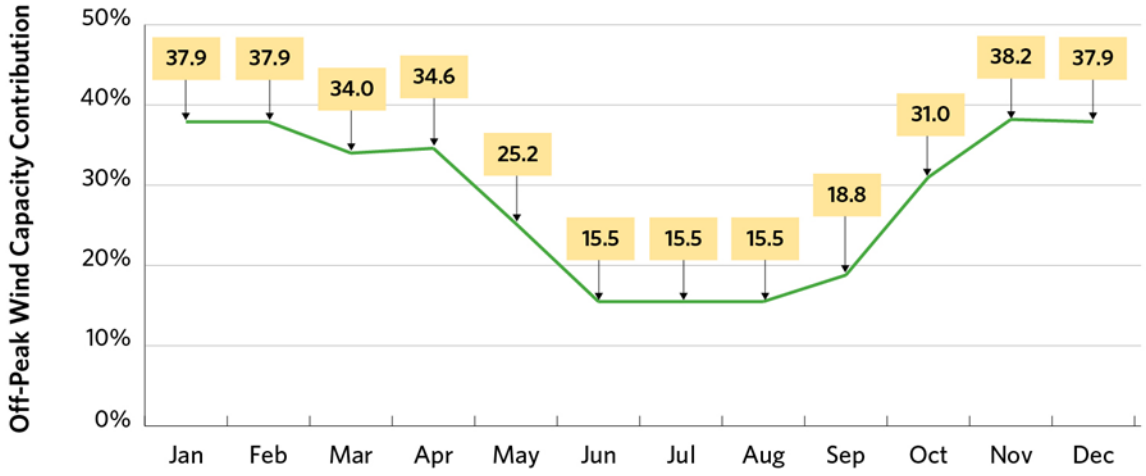
Surplus baseload conditions can be managed with existing market mechanisms signaling for exports, and by curtailing variable and nuclear generation. Going forward, as shown in Figure 6-2, existing mechanisms will be sufficient for managing SBG.

Figure 6-2 | Minimum Ontario Demand and Baseload Generation



The baseload generation assumptions include expected exports and run-of-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, 2020. 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
2020 Q4 Outlook Tables	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookTables_2020Dec.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/ReliabilityOutlookMethodology2020Dec.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
Winterization Guidelines	https://www.ieso.ca/-/media/Files/IESO/Document-Library/training/IESO-Winterization-Guidelines.ashx	Seasonal Readiness
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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