Reliability Outlook

An adequacy assessment of Ontario's electricity system

April 2021 to September 2022

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Executive Summary

More than 12 months have now elapsed since the COVID-19 pandemic was declared, and Ontario's economy has started to rebound, which has increased demand for electricity. By the end of 2020, energy consumption in most sectors – including manufacturing – had returned to pre-COVID levels. However, this recovery has not been universal, and the economic disruption in some sectors will continue a little longer.

Electricity demand will increase over the forecast horizon, but the rate of recovery remains hard to predict. Demand in 2021 is expected to reach 133.5 terawatt-hours (TWh), representing a 1.0% increase over 2020 but still less than the total for 2019 (134.2 TWh). Increasing vaccination levels are expected to prompt many companies to call for a return to office, but a significant portion of Ontario's workforce is likely to continue working from home for the remainder of 2021. The outcome of these higher residential loads is a power system that is more weather sensitive than it was before COVID.

Under normal weather conditions, Ontario will have sufficient capacity throughout the entire Outlook period, including the summer of 2021, when 992.1 megawatts (MW) of capacity that was acquired in the December 2020 capacity auction is available.

Supply will also be adequate to meet needs in winter 2021/2022. Under extreme weather conditions, however, reserves may fall short for 10 weeks in the summer of 2022. This potential shortfall is partially attributed to planned generator outages scheduled during those weeks, and generators are advised not to schedule routine outages during this period. Any remaining shortfalls in reserves will be addressed by acquiring resources in the December 2021 Capacity Auction. 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. Looking ahead, the IESO will continue to use capacity auctions as the primary tool to meet capacity needs arising in Ontario in the short term.

The province's transmission system also plays a critical role in ensuring reliability. For the next 18 months, Ontario's transmission system is expected to continue operating reliably despite occasional, normal contingencies. That said, some combinations of transmission and/or generation outages may pose operating challenges. A number of high-priority transmission projects are underway in different regions with a view to enhancing existing service or accommodating growth.

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1. Introduction

This Outlook covers the 18 months from April 2021 to September 2022, and supersedes the Outlook released on December 16, 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 January 2021, and has been updated to reflect the most recent economic projections. Actual weather and demand data for February 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 March 8, 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, 2020.

The following resources completed market registration since the last Outlook:

- Henvey Inlet Wind Energy Centre – 300 MW
- Capacity Auction (various resources; summer 2021 commitment period) – 992.1 MW[1]

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 February 3, 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 March 8, 2021.

[1] More information about the Capacity Auction can be found on the IESO's website, including details on resources that cleared the auction, in the post-auction report

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 April 2021 to September 2022 and supersedes the previous forecast released in December 2020. Tables of supporting information are contained in the 2021 Q1 Outlook Tables

The outlook for the remainder of 2021 is very similar to what was included in the previous Outlook and the IESO expects to see increased electricity demand over the forecast horizon. There remains significant uncertainty in the forecast due to the fluid nature of the on-going COVID-19 pandemic, and questions remain remain regarding its long-term impacts on Ontario's economy and, thus, electricity consumption. Energy demand finished 2020 on an upswing with most sectors returning to pre-COVID levels. The manufacturing sector has continued to strengthen since the spring 2020 lockdown was lifted and has returned to pre-COVID levels. As the brunt of the economic disruption has been concentrated in sectors that are not particularly electrically intensive, there remains a divergence between economic conditions and electricity demand.

Demand in 2021 is expected to top 133.5 terawatt-hours (TWh), representing a 1.0% increase over 2020 but still below the value for 2019 (134.2 TWh). In spite of accelerating access to COVID vaccines, a significant portion of Ontario's workforce is likely to continue working from home over the remainder of 2021. The power system will continue to be more weather sensitive than it was before COVID due to higher residential loads. The summer 2021 peaks are expected to be slightly lower than those experienced in 2020 due to the resumption of the Industrial Conservation Initiative (ICI) program.

With the start of the school year in September, many elementary and high school students will be returning to in class learning. At the same time, more workers are expected to be returning to their offices. Although there will likely be some structural shifts in work arrangements due to the pandemic, the majority of those currently working from home are expected to transition back to the office in the later part of the outlook period. This will increase the commercial sector's loads while residential loads decline. Given how quickly the COVID situation is changing, there remains a significant amount of uncertainty regarding the demand forecast. The outlook for electricity demand is still fairly dependent on the pace and extent of Ontario's economic recovery. Our modelling reflects some generic stimulus as indicated by the federal government but we will integrate more details into future outlooks as they are announced. Finally, the Ontario economy is closely integrated with that of the United States; a strong U.S. recovery would be expected to help boost Ontario's economy.

Table 3-1 | Forecast Energy Demand Summary

Year	Normal Weather Energy (TWh)	% Growth in Energy
2021	133.5	1.23%
2022	135.1	1.13%

Table 3-2 | Forecast Seasonal Peaks

Season	Normal Weather Peak (MW)	Extreme Weather Peak (MW)
Summer 2021	22,500	24,518
Winter 2021-22	21,033	22,200
Summer 2022	22,580	24,762

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-Apr-21	17,449	18,652	567	2,437
11-Apr-21	17,070	17,844	471	2,420
18-Apr-21	17,057	17,892	496	2,404
25-Apr-21	16,771	17,392	531	2,357
02-May-21	16,750	18,769	721	2,348
09-May-21	16,635	19,138	849	2,308
16-May-21	17,243	20,615	845	2,317
23-May-21	16,992	20,544	1,175	2,301
30-May-21	18,055	21,032	1,330	2,281
06-Jun-21	19,504	22,137	1,292	2,377
13-Jun-21	20,823	23,259	1,055	2,447
20-Jun-21	21,297	23,785	835	2,498

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
27-Jun-21	22,162	23,786	754	2,573
04-Jul-21	21,691	23,443	1,016	2,541
11-Jul-21	22,373	24,417	814	2,648
18-Jul-21	22,410	24,421	838	2,690
25-Jul-21	22,483	24,217	1,035	2,717
01-Aug-21	22,500	24,228	841	2,721
08-Aug-21	21,978	24,361	958	2,662
15-Aug-21	22,141	24,329	985	2,687
22-Aug-21	22,332	24,518	1,362	2,669
29-Aug-21	21,783	23,270	1,413	2,617
05-Sep-21	21,096	23,268	1,370	2,560
12-Sep-21	21,307	23,395	680	2,462
19-Sep-21	20,052	22,886	781	2,420
26-Sep-21	18,944	21,277	420	2,382
03-Oct-21	18,176	19,152	554	2,359
10-Oct-21	16,793	18,165	786	2,350
17-Oct-21	16,939	17,545	507	2,321
24-Oct-21	17,139	18,625	392	2,396
31-Oct-21	17,200	18,811	318	2,418
07-Nov-21	17,594	18,836	416	2,431
14-Nov-21	18,490	18,962	601	2,498
21-Nov-21	19,105	19,544	342	2,569
28-Nov-21	19,368	20,201	607	2,632
05-Dec-21	19,756	20,732	409	2,670

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
12-Dec-21	19,918	21,631	555	2,701
19-Dec-21	20,064	21,589	690	2,732
26-Dec-21	20,179	21,778	362	2,739
02-Jan-22	19,415	20,858	528	2,625
09-Jan-22	20,314	21,992	570	2,770
16-Jan-22	20,713	22,200	547	2,874
23-Jan-22	21,029	22,117	483	2,888
30-Jan-22	21,033	21,942	404	2,890
06-Feb-22	20,371	21,468	734	2,845
13-Feb-22	20,284	21,342	635	2,831
20-Feb-22	19,909	21,398	581	2,820
27-Feb-22	19,903	21,376	501	2,763
06-Mar-22	19,487	20,941	531	2,732
13-Mar-22	18,996	20,492	649	2,676
20-Mar-22	18,220	19,638	611	2,599
27-Mar-22	17,988	19,073	569	2,553
03-Apr-22	17,637	18,738	567	2,471
10-Apr-22	17,204	17,896	471	2,443
17-Apr-22	17,193	17,943	496	2,388
24-Apr-22	16,909	17,431	531	2,370
01-May-22	16,887	18,809	721	2,375
08-May-22	16,817	19,233	849	2,338
15-May-22	17,430	20,699	845	2,354
22-May-22	17,453	20,638	1,175	2,331

Week Ending	Normal Peak (MW)	Extreme Peak (MW)	Load Forecast Uncertainty (MW)	Normal Energy Demand (GWh)
29-May-22	18,149	21,131	1,330	2,311
05-Jun-22	19,501	21,801	1,292	2,399
12-Jun-22	20,821	22,155	1,055	2,480
19-Jun-22	21,383	22,850	835	2,531
26-Jun-22	22,262	23,892	754	2,606
03-Jul-22	21,846	23,613	1,016	2,596
10-Jul-22	22,449	24,222	814	2,680
17-Jul-22	22,492	24,509	838	2,722
24-Jul-22	22,568	24,762	1,035	2,750
31-Jul-22	22,580	24,701	841	2,753
07-Aug-22	22,087	24,471	958	2,700
14-Aug-22	22,260	24,449	985	2,725
21-Aug-22	22,448	24,635	1,362	2,706
28-Aug-22	21,893	23,379	1,413	2,653
04-Sep-22	21,433	23,068	1,370	2,592
11-Sep-22	21,361	22,383	680	2,489
18-Sep-22	20,111	21,389	781	2,447
25-Sep-22	19,006	20,379	420	2,410
02-Oct-22	17,866	18,995	554	2,387

4. Resource Adequacy

The IESO expects to have sufficient generation supply for summer 2021 and winter 2021/2022, accounting for zonal transmission constraints. Capacity acquired in the IESO's December 2020 capacity auction has added 992.1 MW of firm capacity for the summer of 2021.

Potential risks in summer 2022 are expected to be mitigated through outage rescheduling and resources to be acquired in the 2021 Capacity Auction.

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

Ontario's existing installed generation capacity is summarized in Table 4-1. This includes capacity from new facilities that have completed the IESO's market registration process since the previous Outlook, 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
Nuclear	13,009	10,495	10,469	5	0	0
Hydroelectric	9,060	5,285	4,267	76	0	0
Gas/Oil	11,317	9,442	9,052	32	0	0
Wind	4,786	676	676	40	1	300
Biofuel	295	254	254	7	0	0
Solar	478	64	64	10	0	0
Demand Measures	-	621	621	-	-	-
Firm Imports (+) / Exports (-) (MW)[2]	-	80	0	-	-	-
Total	38,944	26,918	25,404	170	1	300

4.1 Assessment Assumptions

4.1.1 Generation Resources

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

The estimated effective date column in Table 4-2 indicates when the market registration process is expected to be complete for each generation resource, based on information available to the IESO as of March 8, 2021. Two scenarios are used to describe project risks:

[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 **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
Total					**-169**	**-9**

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

[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

- 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 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

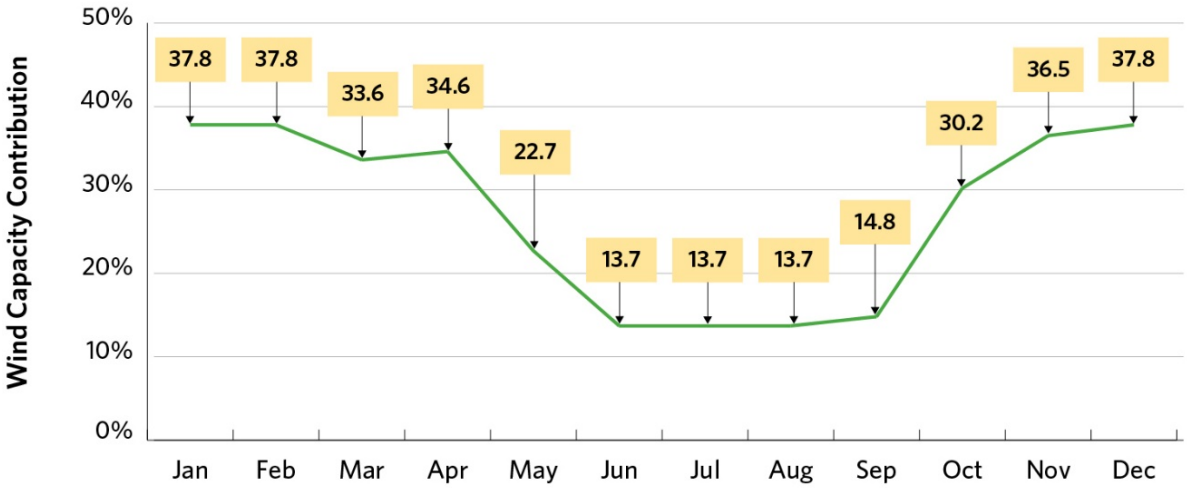
Thermal Generators

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

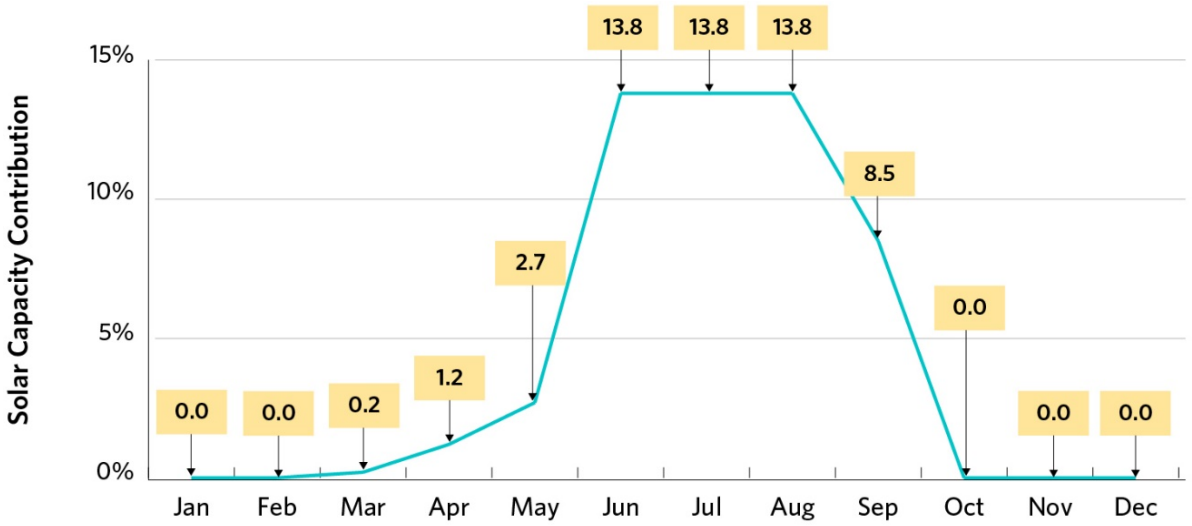


Solar

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[4], such as dispatchable loads and demand response procured through the IESO's capacity auction, are not incorporated into the demand forecast and are instead treated as resources. Load modifiers are incorporated into the demand forecast. The impacts of activated demand measures are added back into the demand history prior to forecasting demand for future periods.

4.1.4 Firm Transactions

Capacity-Backed Exports

The IESO allows Ontario resources to compete in the capacity auctions held by certain neighbouring jurisdictions, but only if Ontario has adequate supply. New York Independent System Operator (NYISO) auction results for capacity-backed exports for delivery between May andOctober 2021 will be known in 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.

[4] 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.

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)	38,944	39,104	38,944	39,104	38,944	39,104
2	Total Reductions in Resources (MW)	12,727	12,865	13,026	13,146	12,854	12,991
3	Demand Measures (MW)	621	621	137	137	63	63
4	Firm Imports (+) / Exports (-) (MW)	80	80	-500	-500	0	0
5	Available Resources (MW)	26,918	26,940	25,555	25,595	26,153	26,176
6	Bottling	0	0	474	498	0	0
7	Available Resources without Bottling (MW)	26,918	26,940	26,028	26,092	26,153	26,176

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 February 3, 2021. The generation planned outages occurring during this Outlook period have been assessed as of March 8, 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

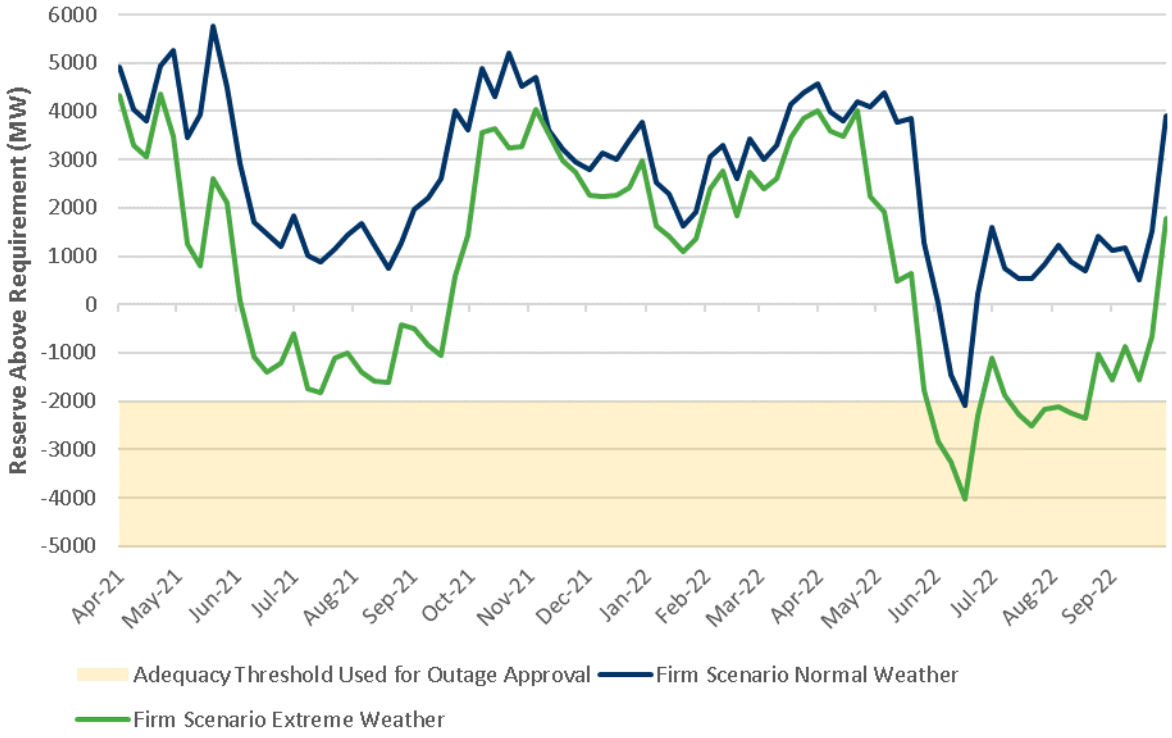
The firm scenario incorporates all capacity that had achieved commercial operation status as of March 8, 2021.

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.

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 10 weeks in the summer of 2022. Under the current outage schedule, the RAR is below the -2,000 MW threshold for four weeks in June, three weeks in July, and three weeks in August 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. 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 maintenance outage requests to ensure that Ontario demand is met during the summer peak periods. 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

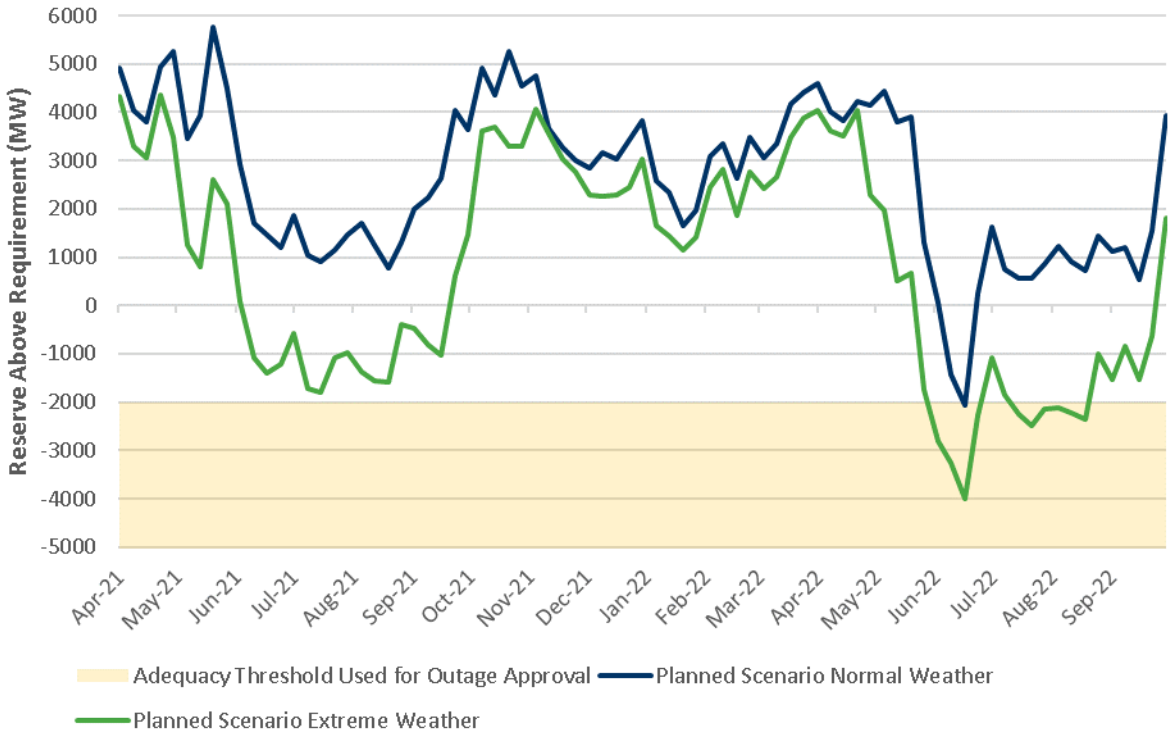


4.2.2 Planned Scenario with Normal and Extreme Weather

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 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. Under the extreme weather scenario, sufficient reserves exist throughout 2021. However, reserves fall short during the summer of 2022 under the extreme scenario.

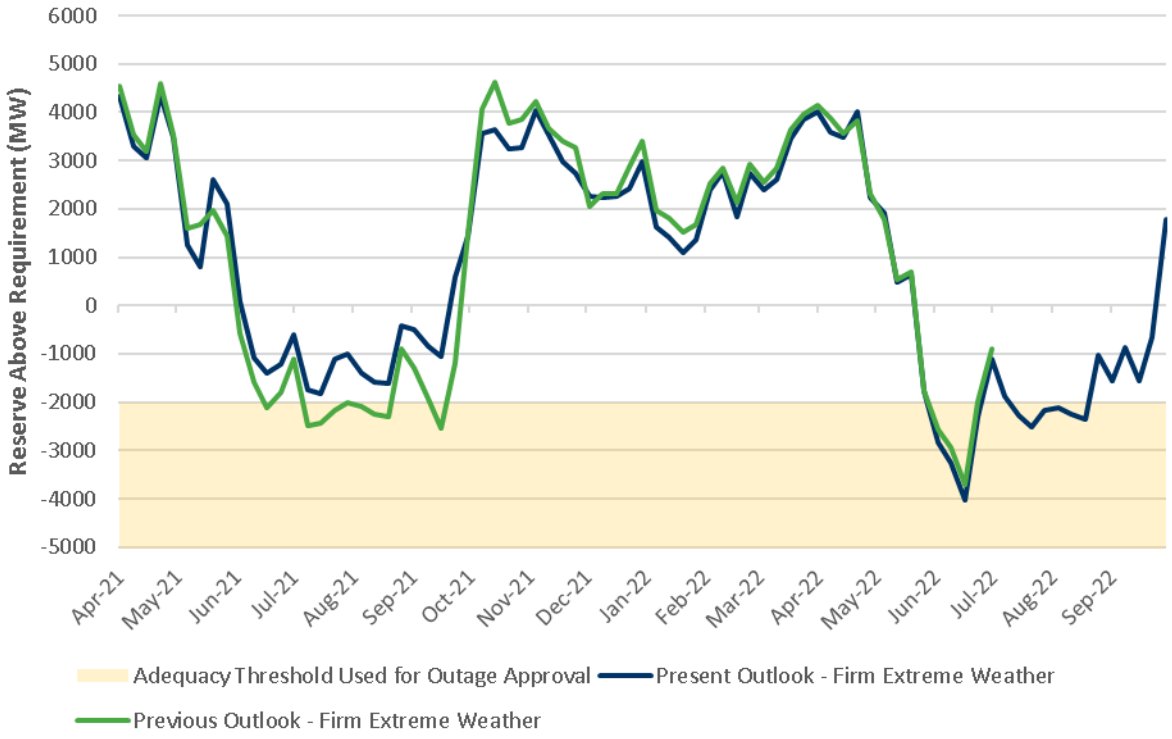
Figure 4-4 | Comparison of Normal and Extreme Weather: Planned Scenario Reserve Above Requirement



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 Q1 Outlook Tables.

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

4.3.2 Results – Firm Scenario with Normal Weather

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

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

Zone	18-Month Energy Demand TWh	18-Month Energy Demand Average MW	18-Month Energy Production TWh	18-Month Energy Production Average MW	Net Inter-Zonal Energy Transfer TWh	Zonal Energy Demand on Peak Day of 18-Month Period GWh	Available Energy on Peak Day of 18-Month Period GWh
Bruce	1.0	73	55.7	4,231	54.7	1.5	131.4
East	12.0	915	18.1	1,374	6.1	25.4	98.1
Essa	12.7	968	3.7	281	-9.0	27.9	15.0
Niagara	5.8	441	20.5	1,561	14.7	14.1	54.1
Northeast	15.3	1,164	14.5	1,104	-0.8	26.3	30.6
Northwest	5.3	403	6.8	519	1.5	9.0	21.1
Ottawa	12.8	970	0.2	15	-12.6	29.3	1.2
Southwest	40.8	3,100	6.5	492	-34.3	92.8	21.3
Toronto	73.5	5,585	60.0	4,562	-13.5	173.4	141.8
West	20.8	1,578	13.4	1,017	-7.4	49.7	75.8
Ontario	**199.9**	**15,196**	**199.3**	**15,156**	**-0.5**	**449.4**	**590.4**

4.3.3 Findings and Conclusions

As noted in section 4.2.1, Ontario is expected to have adequate reserves for the duration of the outlook in the firm resource, normal weather scenario. The EAA indicates that Ontario is also expected to have sufficient supply to meet its forecast energy needs throughout the outlook period for the firm scenario with normal weather demand, without having to rely on support from external jurisdictions.

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

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

Figure 4-6 | Forecast Energy Production by Fuel Type

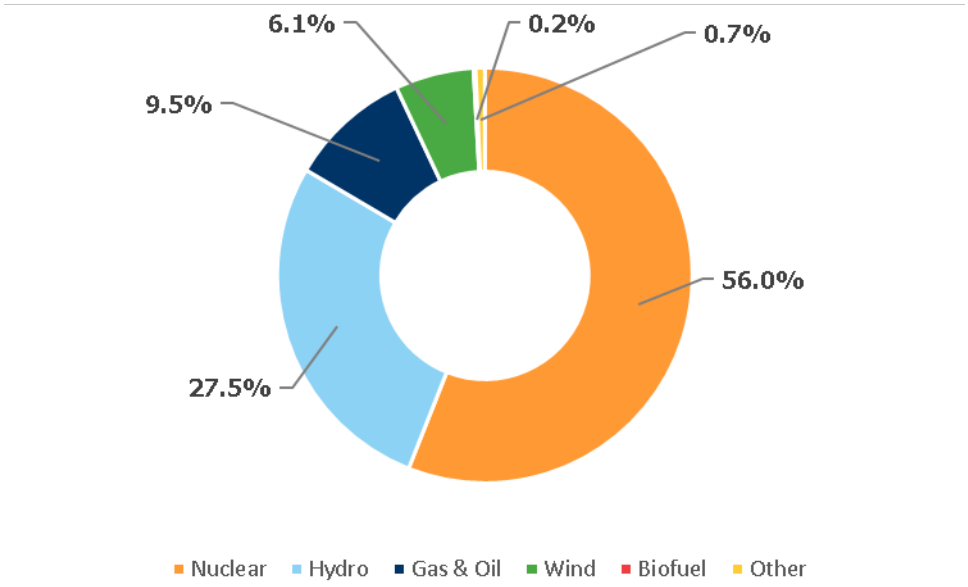


Figure 4-7 | Forecast Monthly Energy Production by Fuel Type

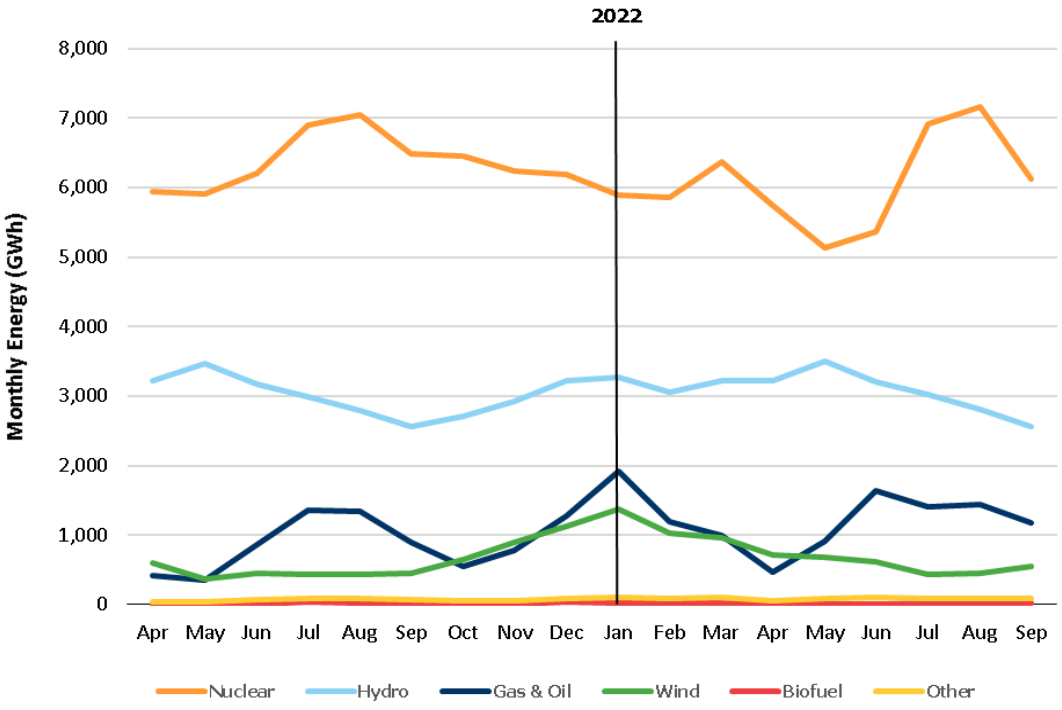


Table 4-6 | Energy Production by Fuel Type for the Firm Scenario Normal Weather

Fuel Type (Grid-Connected)	2021 (Apr 1 – Dec 31) (GWh)	2022 (Jan 1 – Sep 30) (GWh)	Total (GWh)
Nuclear	57,357	54,558	111,914
Hydro	27,059	27,853	54,912
Gas & Oil	7,858	11,165	19,023
Wind	5,423	6,832	12,256
Biofuel	159	164	322
Other (Solar & DR)	605	829	1,434
Total	**98,460**	**101,401**	**199,861**

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 December 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 February 3, 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 230 kV switchyard, which requires careful coordination of transmission and generation outages. This project is scheduled to be completed by Q4 2021. There is a one-week outage of circuit B502M starting October 18, 2021 that will impact the transfer capability out of Bruce zone. There is a one-week outage of circuits B569B, M585M, and N581M starting April 17, 2021 that will impact the transfer capability into the West zone and out of Bruce zone. 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 were 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 Q4 2021 for the second reactor.

Aging circuit breakers in the Richview 230 kV switchyard are scheduled to be replaced by Q2 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 August 16, 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 and an one-month outage of circuit X504E starting October 4, 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 one-and-a-half-month outage of circuit J5D starting April 9, 2021 will reduce import and export transfer capability between Ontario and Michigan.

A planned six-month outage of circuit BP76 starting July 15, 2021 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.

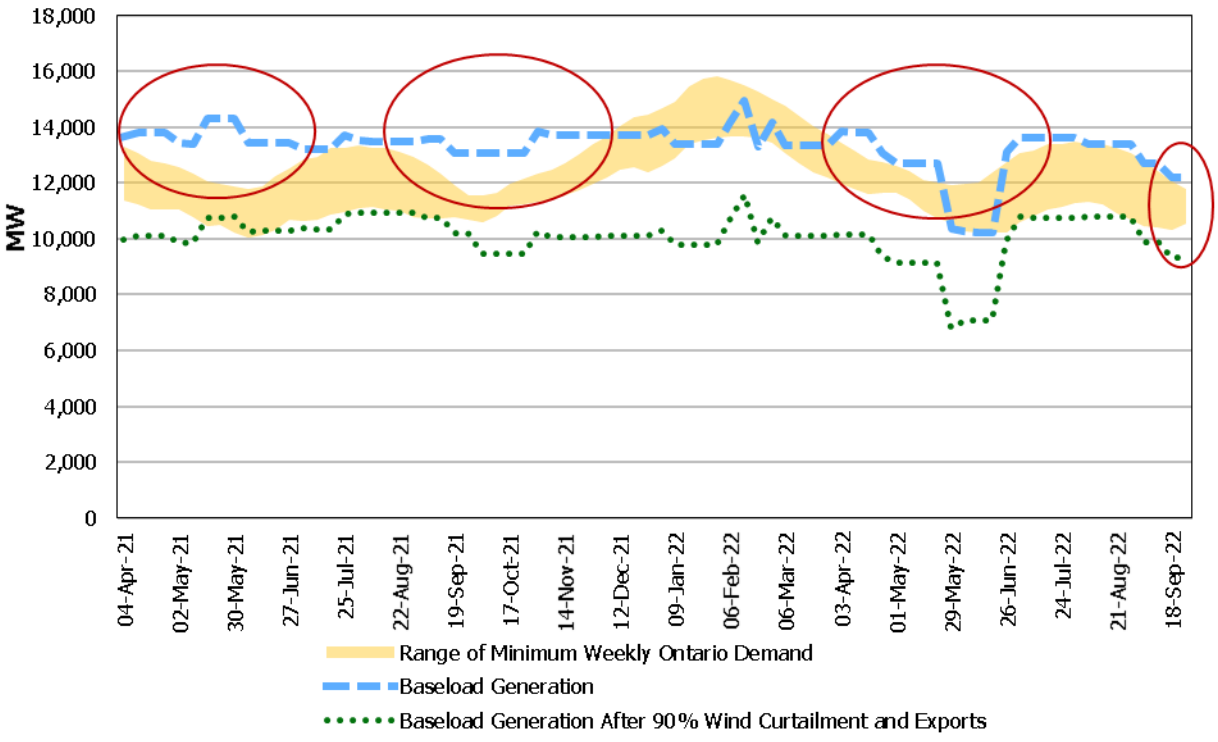
This section highlights existing or emerging operability issues that could impact the reliability of Ontario's power system.

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.

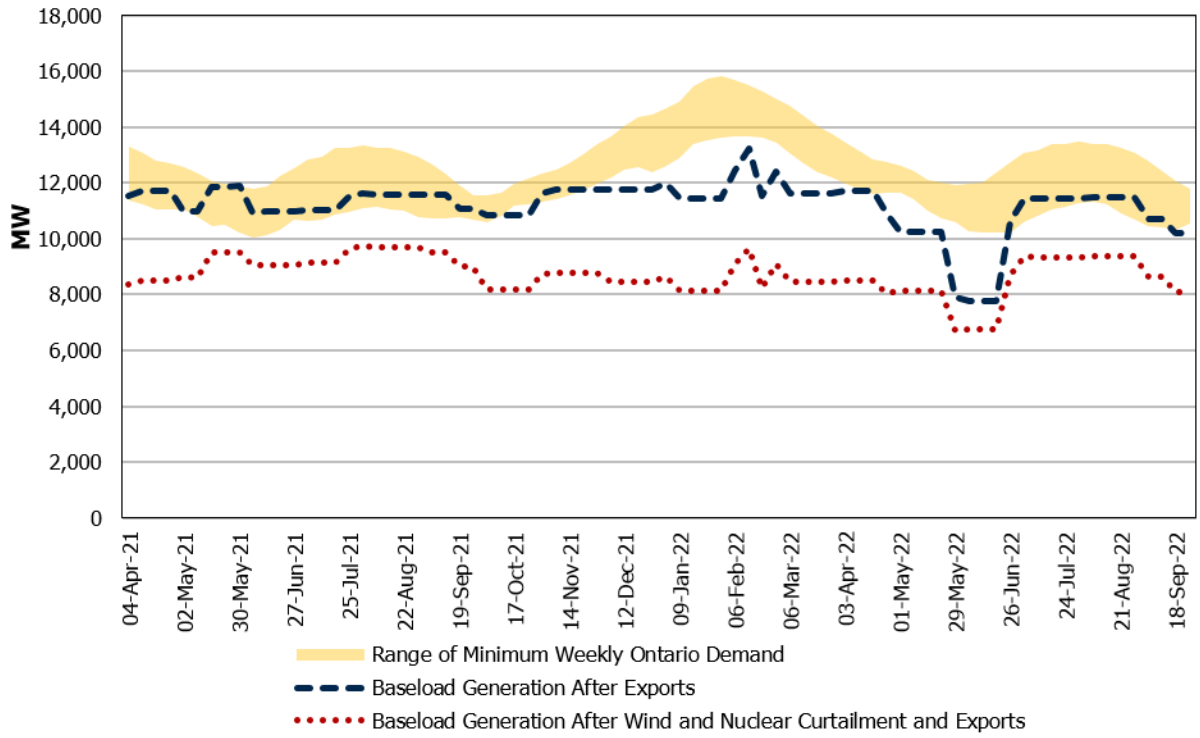
Ontario is expected to experience potential surplus baseload conditions during the shoulder periods throughout the Outlook. Figure 6-1 highlights the periods during which expected baseload generation may exceed forecast demand.

Figure 6-1 | Minimum Ontario Demand and Baseload Generation



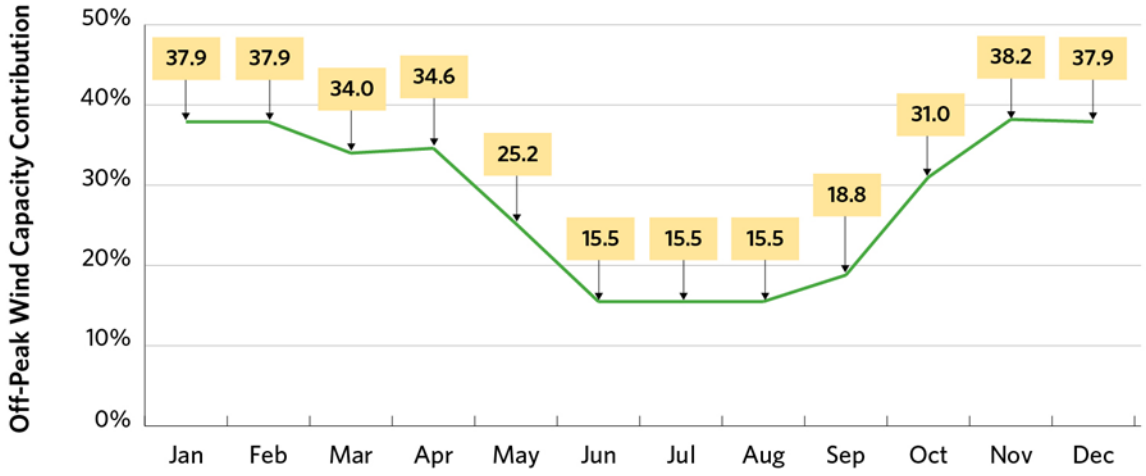
Surplus baseload conditions can be managed with existing market mechanisms signaling for exports, and by curtailing variable and nuclear generation. Going forward, as shown in Figure 6-2, existing mechanisms will be sufficient for managing SBG.

Figure 6-2 | Minimum Ontario Demand and Baseload Generation



The baseload generation assumptions include expected exports and run-of-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
2021 Q1 Outlook Tables	http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/reliability-outlook/ReliabilityOutlookTables_2021Mar.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/ReliabilityOutlookMethodology2021Mar.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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