# Peterborough to Kingston Integrated Regional Resource Plan

November 4, 2021

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## List of Abbreviations

| | |
|---|---|
| CDM | Conservation Demand Management |
| DER | Distributed Energy Resources |
| DESN | Dual Element Spot Network |
| DG | Distributed Generation |
| | |
| Hydro One | Hydro One Networks Inc. |
| IESO | Independent Electricity System Operator |
| IRRP | Integrated Regional Resource Plan |
| kV | Kilovolt |
| LDC | Local Distribution Company |
| LMC | Load Meeting Capability |
| LTR | Limited Time Rating |
| | |
| MW | Megawatt |
| NERC | North American Electric Reliability Corporation |
| OEB | Ontario Energy Board |
| ORTAC | Ontario Resource and Transmission Assessment Criteria |
| PPWG | Planning Process Working Group |
| RIP | Regional Infrastructure Plan |
| TS | Transformer Station |
| TSC | Transmission System Code |
| Working Group | Technical Working Group of the Peterborough to Kingston Region |

This Integrated Regional Resource Plan (IRRP) was prepared by the Independent Electricity System Operator pursuant to the terms of its Ontario Energy Board licence, EI-2013-0066.

This IRRP was prepared on behalf of the Technical Working Group (Working Group) of the Peterborough to Kingston region, which is composed of the following licensed transmitters and licensed distributors:

- Elexicon Energy Inc. (Elexicon)
- Hydro One Networks Inc. (Distribution) (Hydro One (Distribution))
- Hydro One Networks Inc. (Transmission) (Hydro One (Transmission))
- Independent Electricity System Operator (IESO)
- Lakefront Utilities Inc. (Lakefront Utilities)
- Utilities Kingston
- Eastern Ontario Power

The Working Group assessed the adequacy of electricity supply to customers in the Peterborough to Kingston region over a 20-year period beginning in 2019; developed a plan that considers opportunities for coordination in anticipation of potential demand growth and varying supply conditions in the region; and developed an implementation plan for the recommended options, while maintaining flexibility in order to accommodate changes in key conditions over time.

The Working Group developed a plan that considers the potential for long-term electricity demand growth in the region and maintains the flexibility to accommodate changes to key conditions over time.

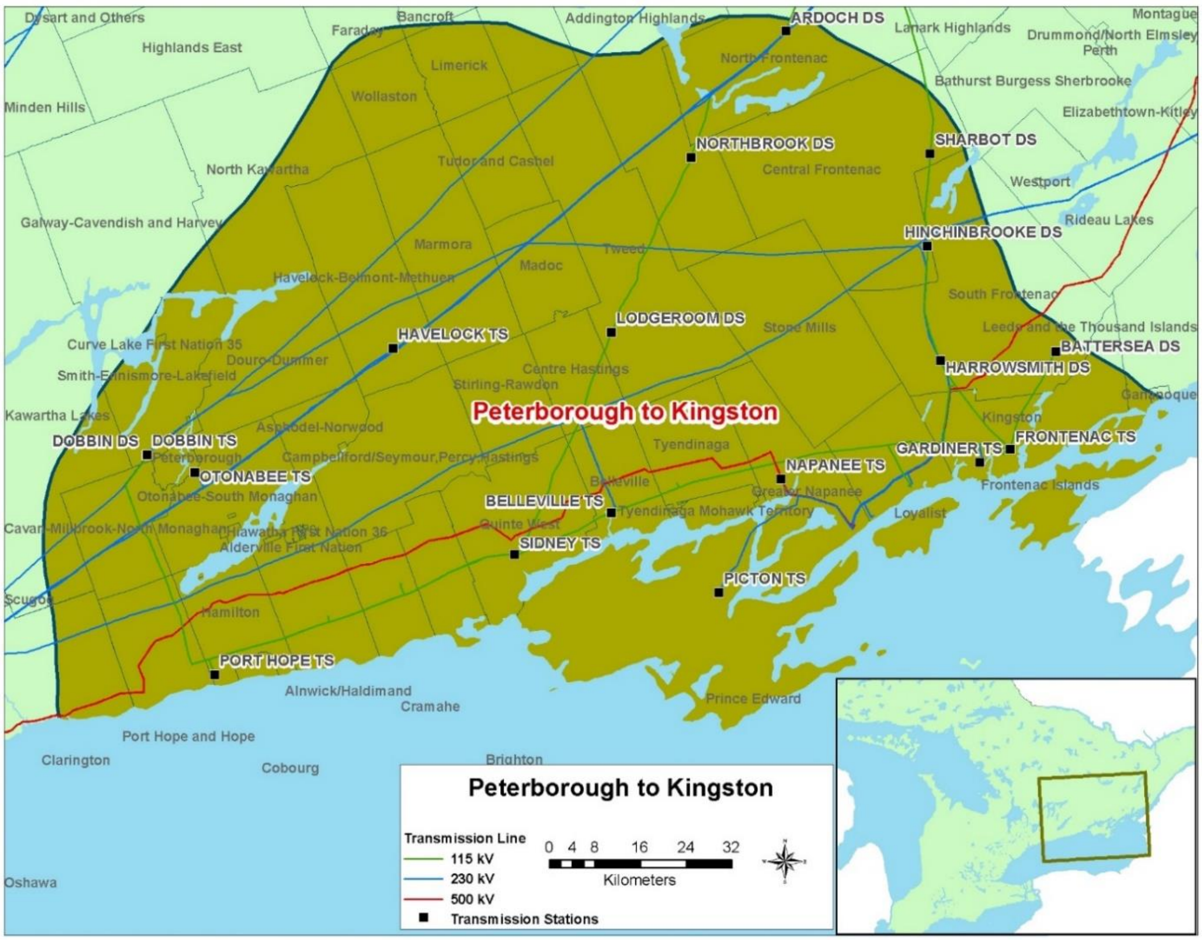
The Working Group members agree with the IRRP's recommendations and support implementation of the plan, subject to obtaining necessary regulatory approvals and appropriate community engagement and consultations.

# 1 Introduction

The Peterborough to Kingston region is located in eastern Ontario as shown in

Figure 1-1. It includes Frontenac County, Hastings County, Northumberland County, Peterborough County, Prince Edward County, parts of Lennox and Addington County, and related municipalities. Peterborough, Belleville and Kingston are the three largest population centres in the region. The region also comprises several Indigenous communities including Alderville First Nation, Hiawatha First Nation, Curve Lake First Nation, Mohawks of the Bay of Quinte, Tyendinaga Mohawk, Kawartha Nishnawbe and the traditional territory of the Huron Wendat.

**Figure 1-1 | Overview of the Peterborough to Kingston Region and Transmission System**




The region is supplied by the following local distribution companies:

- Elexicon which serves Port Hope and Belleville;
- Eastern Ontario Power, which is embedded to Hydro One Distribution, serves over 3,500 distribution customers in Gananoque, Ontario;
- Lakefront Utilities, embedded to Hydro One Distribution, serves 10,000 distribution customers across the Town of Cobourg and the Village of Colborne;

- Kingston Utilities serves 28,000 distribution customers in Central Kingston; and
- Hydro One Distribution[1], which supplies distribution customers in the surrounding areas of the region.

These LDCs receive power at the step-down transformer stations and distribute it to end users, i.e., industrial, commercial and residential customers.

In Ontario, planning to meet the electrical supply and reliability needs of a large area or region is conducted through regional electricity planning, a process that was formalized by the Ontario Energy Board (OEB) in 2013. In accordance with this process, transmitters, distributors and the IESO are required to carry out regional planning activities for each of the province's 21 electricity planning regions, including the Peterborough to Kingston region, at least once every five years.

This IRRP identifies needs pertaining to power system capacity, reliability requirements, and end-of-life asset replacement and coordinates options to meet customer needs in the area over a 20-year period. Given forecast uncertainty, the longer development lead time and the potential for technological change, the plan does not recommend specific investments or projects to meet mid- and long-term needs, but maintains the flexibility to evolve in step with emerging developments. Instead, this IRRP focuses both on recommendations to meet near-term needs, and on the near-term actions required to lay the groundwork for determining options to meet mid- and long-term needs.

The focus of this IRRP is providing an adequate reliable supply to support community growth. A key consideration in this analysis is whether near-term actions maintain, or act as a barrier to, long-term options. The recommended near-term actions are intended to be completed before the next IRRP cycle, scheduled for 2025, or sooner, depending on demand growth or other factors. In some cases, the scope of near-term actions includes the continuation of defined planning activities coordinated among key stakeholders to develop and complete recommendations within a specific time period. The completion of these actions will inform decisions for the next scheduled planning cycle, or sooner, particularly around integrated solutions that address multiple needs, as well as demand-side options and capabilities for which sufficient information is not currently available.

This report is organized as follows:

- A summary of the recommended plan for the Peterborough to Kingston region is provided in Section 2;
- The process and methodology used to develop the plan are discussed in Section 3;
- The context for electricity planning in the Peterborough to Kingston region and the study scope are discussed in Section 4;
- The demand outlook scenarios, and energy efficiency and distributed energy resource (DER) assumptions, are described in Section 5;
- Electricity needs in the Peterborough to Kingston region are presented in Section 6;
- Alternatives and recommendations for addressing the needs are described in Section 7;
- A summary of engagement activities to date and moving forward, is provided in Section 8; and
- A conclusion is provided in Section 9.

[1] Includes former Peterborough Distribution which was sold to Hydro One Distribution serves distribution customers in Peterborough, Lakefield, and Norwood.

# 2 The Integrated Regional Resource Plan

This Integrated Regional Resource Plan (IRRP) provides recommendations to address the electricity needs of the Peterborough to Kingston region over the next 20 years. The needs identified are based on the demand growth anticipated in the region and the capability of the existing transmission system as evaluated through application of the IESO's Ontario Resource and Transmission Assessment Criteria (ORTAC)[2] and reliability standards governed by the North American Electric Reliability Corporation (NERC).

This IRRP identifies three planning horizons: from the base-year (2019)[3] through the near term (up to 2024), medium term (year 6 to 10, through to 2029), and longer term (year 11 to 20, or through to 2038). These planning horizons reflect the inverse relationship between the length of time and demand certainty (in that the longer the outlook, the less certain it is), lead time for electricity resource development, and planning commitment required.

This IRRP identifies and recommends specific projects for implementation in the near term. This is necessary to ensure that they are in-service in time to address the area's more urgent needs, respecting the lead-time for development of the recommended projects or actions. This IRRP also identifies possible long-term electricity needs, some of which may advance to the near or medium term for a high growth scenario. However, as these needs are forecast to arise in the future, it is not necessary, nor would it be prudent given forecast uncertainty and the potential for technological change, to commit specific projects at this time. Instead, near-term actions are identified to gather information and lay the groundwork for future options. These actions are intended to be completed before the next IRRP cycle so that their results can inform further discussion at that time or so the Working Group can respond in a timely manner, if a high growth scenario were to materialize.

## 2.1 Near- to Medium-Term Plan

The plan to meet the near-and medium-term needs of electricity customers in the Peterborough to Kingston region was developed to maximize the use of the existing electricity system in consideration of planning criteria such as reliability, cost, and feasibility. The near-term plan was also developed to be consistent with the long-term development of the region's electricity system.

The Working Group's recommendations for the near- and medium-term plan focus on addressing both station capacity needs in Belleville and Kingston and supply capacity needs on pockets of the 115 kV system. The area's near-term supply capacity needs in the Peterborough and Quinte West area are impacted by ongoing bulk system planning activities in the area. Further planning studies to assess bulk system impacts are also identified. The recommendations are summarized below.

### Recommended Actions

1. **Build a new 230 kV Dual Element Spot Network (DESN) transformer station at Belleville TS**

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[2] Refer to ORTAC for details: http://www.ieso.ca/-/media/files/ieso/Document%20Library/Market-Rules-and-Manuals-Library/market-manuals/market-administration/IMO-REQ-0041-TransmissionAssessmentCriteria.pdf

[3] To be consistent with Regional Plan's Needs Assessment, the 2019 was used as a base year

To address today's station capacity need at Belleville TS, as well as to serve the growing electricity demand in the region, Elexicon will work with Hydro One (Transmission) to initiate the development of a new Dual Element Spot Network (DESN) transformer station at Belleville, with an expected in-service date of 2025. This will increase the supply capacity to the region and will resolve the capacity need at Belleville TS until the end of the planning horizon.

### 2. Hydro One Distribution load transfer – Gardiner TS DESN #1 to Gardiner TS DESN #2

There is an immediate need for new capacity at Gardiner TS DESN #1. As a first step, performing a load transfer of 11 MW between Gardiner TS DESN #1 and Gardiner TS DESN #2 by 2022 is the cost-effective way to reduce load at Gardiner TS DESN #1. Although, a second load transfer of 11 MW can be performed, it comes with a high cost. Therefore, instead of performing a second load transfer, the next part of the solution is recommended action #3 - to advance end-of-life replacement of transformers at Gardiner TS DESN #1. After implementing first load transfer and recommended action #3, the Working Group will continue to monitor load at Gardiner TS DESN #1 and, evaluate if a second 11 MW load transfer is needed.

### 3. Hydro One Transmission to advance end-of-life replacement of transformers at Gardiner TS DESN #1

The station transformers at Gardiner TS DESN #1 are reaching end-of-life in the mid-2020s. Replacement of these transformers with units of a higher limited time emergency rating (LTR) is recommended as soon as possible (2024-2025), as the need is imminent. Advancing the replacement date, combined with the load transfer in recommended action #2, will address the Gardiner TS DESN #1 capacity need for the duration of the planning horizon for the reference load forecast and for the mid-term horizon for the high growth load forecast

### 4. Monitor load growth and initiate development and siting work to build a new 230 kV DESN transformer station in Kingston when needed

Building a new 230 kV station in Kingston will address the local need for station capacity at both Frontenac TS and Gardiner TS over the long term and for multiple growth scenarios. Due to the uncertainty in the forecast, the timing of the need for the new station could be in the near- to medium term or as late as 2029. Hence, Hydro One Distribution and Utilities Kingston will work together to monitor the load growth in their service areas, and work with Hydro One Transmission to commence the development work and subsequent construction of a new 230 kV station and required line connection, either transmitter or distributor owned, when it is deemed to be appropriate.

### 5. Address implementation and cost allocation barriers to cost-effectively deploying non-wires alternatives to defer needs

The development of a non-wire alternative, specifically additional energy efficiency or a local storage solution, could defer the new station ultimately required to accommodate load growth in the City of Kingston. This is cost-effective, under the reference load growth scenario, if cost-allocation can reflect the system benefits the non-wires alternative would provide. Additional barriers to implementation also exist around who would implement the solution and how they would seek cost-recovery, particularly if the transmitter or both benefiting LDCs were to implement a part of the solution. The IESO will work with the impacted transmitter and LDCs between regional planning cycles to address these barriers to implementation and cost allocation for a non-wires alternative, in tandem with developing plans for a new transformer station.

### 6. Complete the ongoing Gatineau Corridor End-of-Life Study and implement recommendations

The outcomes of the Gatineau Corridor End-of-Life Study will improve the supply capability in the Peterborough to Kingston region. Namely, addressing the identified supply capacity need to the Peterborough and Quinte West area. By implementing the recommendations of the Gatineau Corridor End-of-Life study this need should be addressed.

**7. Upgrade Cataraqui autotransformers' secondary conductors and reassess as part of the Lennox to St. Lawrence bulk system study**

Upgrading the autotransformers' secondary conductors will increase the thermal capacity of these autotransformers from 250 MW to 285 MW and will resolve the thermal violation after losing one of the autotransformers. A future Lennox to St. Lawrence bulk system study will reassess the need with this solution in place and study if additional capacity is required.

**8. Replace Port Hope TS T3/T4 with the closest available standard size transformers**

Port Hope TS T3/T4 are reaching end-of-life and there are no opportunities for end-of-life optimization at this time. This IRRP recommends like-for-like replacements with the closest available standard size transformers of equal or greater capacity.

## 2.2 Long-Term Plan

A number of alternatives are possible to meet the region's long-term needs. While specific solutions do not need to be committed today, it is appropriate to begin work now to gather information, monitor developments, engage the community, and develop alternatives to support decision making in the next iteration of the IRRP. This IRRP sets out near-term actions required to ensure that options remain available to address future needs, if and when they arise.

### Recommended Actions

**1. Implement Conservation**

The implementation of provincial conservation targets is a key near-term action of the Peterborough to Kingston region's long-term plan. In developing the demand forecast, peak demand impacts associated with meeting provincial targets were assumed before identifying the residual needs.

Meeting provincial conservation targets amounts to approximately 73 MW, or 5% of the total forecast demand growth, by the end of the study period.

To ensure these savings materialize, it is recommended that conservation efforts be focused as much as possible on measures that will contribute to meeting program energy targets while also maximizing peak demand reductions. The monitoring of conservation success will lay the foundation for the long-term plan by evaluating the performance of specific conservation measures in the sub-region and assessing potential for additional conservation.

**2. Study the potential bulk system impact of future supply reinforcement to Belleville TS**

After building a new 230 kV station at Belleville, the transmission system supply into Belleville is expected to meet the load growth over the 20-year planning horizon. However, beyond this time horizon, the system supply capability will be limited due to excessive voltage change violations during contingency conditions. To solve this issue, transmission reinforcement to Belleville might be necessary. Before the next planning cycle, the bulk system impact of transmission reinforcement to Belleville TS should be included in the scope of a relevant individual bulk planning study for the area.

**3. Monitor the Peterborough to Quinte West 115 kV system voltage performance following the recommendations of the Gatineau corridor end-of-life study**

Low voltage violations are observed during contingency conditions in the long-term planning horizon on the 115 kV system in the Peterborough to Quinte West area. These violations may naturally be resolved by the outcome of recommendations in the forthcoming Gatineau corridor end-of-life study; therefore, this need will be monitored and re-assessed during the next planning cycle.

### 4. Monitor demand growth, conservation achievement and distributed generation uptake

On an annual basis, the IESO, with the Working Group, will review CDM achievement, the uptake of provincial DG projects, and actual demand growth in the Peterborough to Kingston Region. This information will be used to determine when decisions on the long-term plan are required, and to inform the next cycle of regional planning for the area. Information on CDM and DG is also a useful input into the ongoing development of non-wires alternatives as potential long-term solutions.

### 5. Initiate the next regional planning cycle early, if needed

Along with the indices outlined above, the Working Group will monitor changes in growth targets, progress in electrification in the region, and any significant changes in forecast growth. If monitoring activities determine that the region’s growth is exceeding the load forecast (the high demand forecast in Belleville and Kingston, or the reference demand forecast in the remainder of the region), it may be necessary to initiate the next iteration of the regional planning process earlier than 2025 given the lead time for the long-term supply options.

# 3 Development of the Plan

## 3.1 The Regional Planning Process

In Ontario, planning to meet an area's electricity needs at a regional level is completed through the regional planning process, which assesses regional needs over the near, medium, and long term, and develops a plan to ensure cost-effective, reliable electricity supply. A regional plan considers the existing transmission electricity infrastructure, local supply resources, forecast growth and area reliability; evaluates options for addressing needs; and recommends actions to be undertaken.

The current regional planning process was formalized by the OEB in 2013, and is conducted for each of the province's 21 electricity planning regions by the IESO, transmitters and local distribution companies (LDCs) on a five-year cycle.

The process consists of four main components:

1) A Needs Assessment, led by the transmitter, which completes an initial screening of a region's electricity needs;
2) A Scoping Assessment, led by the IESO, which identifies the appropriate planning approach for the identified needs and the scope of any recommended planning activities;
3) An IRRP, led by the IESO, which identifies recommendations to meet needs requiring coordinated planning; and
4) A Regional Infrastructure Plan (RIP) led by the transmitter, which provides further details on recommended wires solutions.

More information on the regional planning process and the IESO's approach to regional planning can be found in Appendix B - Development of the Plan.

In addition to regional planning process, there are bulk planning and distribution planning processes. Distribution system planning is for system at 44 kV and lower, while bulk and regional planning are for higher voltages. Furthermore, regional planning focuses more on a particular, local part of the grid, while bulk planning reviews electricity transfers across the province. There are inherent overlaps in all three levels of electricity infrastructure planning.

The IESO has recently completed a review of the regional planning process following the completion of the first cycle of regional planning for all 21 regions. Additional information on the Regional Planning Process Review along with the final report is posted on the IESO's website.

## 3.2 Peterborough to Kingston IRRP Development

Development of the Peterborough to Kingston IRRP was initiated in 2020 with the release of the Needs Assessment report. This product was prepared by Hydro One (Transmission) with participation from the IESO, Elexicon Energy, Hydro One (Distribution), Lakefront Utilities, Eastern Ontario Power, and Utilities Kingston. Screening for needs was carried out to identify needs that may require coordinated regional planning. The subsequent Scoping Assessment Outcome Report, which was prepared by the IESO, recommended that an IRRP should be developed to address previously identified and new needs in this region due to the potential for coordinated solutions.

In 2020, the Working Group was formed to develop finalize Terms of Reference for this IRRP, gather data, identify near- to long-term needs in the region, and recommend actions to address them.

# 4 Background and Study Scope

This is the second cycle of regional planning for the Peterborough to Kingston region. During the first cycle of regional planning, a Needs Assessment[4] was conducted for the Peterborough to Kingston region in February 2015 that was led by Hydro One Networks Inc. Transmission, and included representatives from the IESO, the former Veridian Connections Inc., Kingston Hydro, and the former Peterborough Distribution Inc. and Hydro One Networks Inc. Distribution. After reviewing the needs identified in the report, the participants recommended that further regional coordination was not required, and instead the needs would be addressed through a local study.

This cycle of regional planning identified a number of needs requiring further regional coordination and recommended an IRRP be initiated. This report presents an integrated regional electricity plan for the next 20-year period starting from 2019[5].

## 4.1 Study Scope

This IRRP, prepared by the IESO on behalf of the Working Group, recommends options to meet the electricity needs of Peterborough to Kingston region over near- to medium-term timeframe and sets out near-term actions required to ensure that options remain available to address long-term needs. Guided by the principle of maintaining an adequate level of reliability performance as per the Ontario Resource and Transmission Assessment Criteria (ORTAC)[6], this IRRP reviews needs identified and discussed as part of the Scoping Assessment, with the focus on:

- Providing an adequate, reliable supply to support community growth;
- Minimizing the impact of supply interruptions; and
- Coordinating and aligning end-of-life asset replacements with evolving needs.

Given that parts of the Peterborough to Kingston region's 230 kV and 115 kV transmission networks also serve as major pathways for the flow of power to and from adjacent regions (Greater Toronto Area and Ottawa) and the connection of large generation facilities, the IRRP assesses the Peterborough to Kingston region 230 kV and 115 kV networks under certain system conditions. A detailed assessment of the bulk electricity system examining various bulk system conditions is typically undertaken through a separate planning process, as described in section 4.2, and is beyond the scope of this IRRP.

The following transmission facilities were included in the scope of this study:

**230 kV connected stations:** Belleville TS, Dobbin TS, Gardiner TS, Havelock TS, Napanee TS, Otonabee TS, Picton TS and a customer owned station.

**115 kV connected stations:** Ardoch DS, Battersea DS, Dobbin DS, Frontenac TS, Harrowsmith DS, Hinchinbrooke DS, Lodgeroom DS, Northbrook DS, Port Hope TS, Sharbot DS, Sidney TS, and four customer owned stations.

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[4] The 2015 Needs Assessment Report for the Peterborough to Kingston Region is available on the Hydro One website (link)

[5] To be consistent with Regional Plan's Needs Assessment, the 2019 was used as a base year

[6] The Ontario Resource and Transmission Assessment Criteria is available on the IESO website (link)

**230 kV transmission lines:** C27P, H23B, H27H, P15C, T22C, T25B, T31H, T32H, X1H, X1P, X21, X22, X2H, X3H and X4H.

**115 kV transmission lines**: B1S, B5QK, P3S, P4S, Q3K, Q3M6, Q6S and S1K.

**230/115 kV autotransformers:** Dobbin T1, T2[7], T5 and Cataraqui T1 & T2.

Electricity to the Peterborough to Kingston region is supplied primarily through the 500 kV station Lennox TS, located in Lennox and Addington County, in conjunction with a number of 230 kV transmission lines from Clarington TS and Cherrywood TS, both located in the GTA East area. A large portion of the load in the Peterborough to Kingston region is connected to a regional 115 kV system, supplied by the 230 kV transmission system through five (5)[7] 230-115 kV autotransformers located at Dobbin TS and Cataraqui TS.

The Peterborough to Kingston region can be broken out into a number of sub-systems or areas with common supply points/limitations, which includes Peterborough, Port Hope to Quinte West, Belleville, and Kingston.

- The Peterborough area is supplied by two step-down transformer stations, Dobbin TS and Otonabee TS. Power is delivered into this area through the 230 kV transmission circuits P15C, C27P, T22C and T31H running between GTA East and the Ottawa area.
- The Port Hope to Quinte West area is supplied by two step-down transformer stations, Port Hope TS and Sidney TS which are both served by the regional 115 kV system.
- The Belleville area is supplied by one step-down transformer station, Belleville TS which is supplied via the 230 kV transmission circuits T25B and H23B.
- Lastly, the Kingston area is supplied by three step down transformer stations, Frontenac TS, Gardiner TS #1 and Gardiner TS #2. Frontenac TS is supplied by the regional 115 kV system, whereas Gardiner TS (#1 & #2) are supplied by the 230 kV transmission circuits X2H and X4H.
- Together, the Peterborough area and the Port Hope to Quinte West area, form part of a larger electrical sub-system within the Peterborough to Kingston region, referred to as the Peterborough to Quinte West sub-system or area.

The Peterborough to Kingston IRRP was developed by completing the following steps:

- Preparing a 20-year electricity demand forecast and establishing needs over this timeframe;
- Examining the load meeting capability (LMC) and reliability of the existing transmission system, taking into account facility ratings and performance of transmission elements, transformers, local generation, and other facilities such as reactive power devices. Needs were established by applying ORTAC and NERC planning criteria;
- Assessing system needs by applying a contingency-based assessment and reliability performance standards for transmission supply in the IESO-controlled grid as described in Section 7 of ORTAC;
- Confirming identified end-of-life asset replacement needs and timing with LDCs;
- Establishing alternatives to address system needs, including, where feasible and applicable, possible energy efficiency, generation, transmission and/or distribution, and other approaches such as non-wires alternatives;

[7] Normally, Dobbin T2 is operated out of service

- Engaging with the community on needs, findings, and possible alternatives;
- Evaluating alternatives to address near- and long-term needs; and
- Communicating findings, conclusions, and recommendations within a detailed plan.

## 4.2 Related Bulk System Planning Studies

**Gatineau Corridor End-of-Life Study**

As shown in Figure 4-1, the Gatineau corridor consists of five (5) 230 kV transmission circuits stretching between GTA East and Ottawa area. As shown, these circuits form a major pathway on the bulk transmission system and provide or support supply to Ottawa and Peterborough, connection of Chats Falls area generation and imports from Quebec. The study assesses transmission equipment end-of-life needs forecast to arise over the next five to ten years, in addition to forecast reliability needs in the areas of Ottawa and Peterborough to Quinte West.

**Figure 4-1 | Gatineau Corridor**


The Gatineau corridor circuits are critical in supporting the regional 115 kV supply system, and in some cases directly supply step-down transformer stations (Dobbin TS and Otonabee TS). The options being assessed as part of the study have a direct impact on the supply to the Peterborough to Kingston region. Forecast needs between the Gatineau Corridor End-of-Life study and the Peterborough to Kingston regional planning studies have been coordinated, seeking opportunities for integrated solutions addressing both bulk and regional needs. The IESO's participation on the Working Group in the next stage of regional planning, the RIP, will help ensure recommendations are aligned with the latest bulk system information.

# 5 Electricity Demand Forecast

Regional planning in Ontario is driven by the need to meet peak electricity demand requirements in the region. In order for the Working Group to plan for the future electricity needs of the region, a 20-year planning demand forecast was developed. This section outlines the demand forecast methodology, discusses historical electricity demand trends, development of the planning demand forecasts (both coincident and non-coincident) as well as the expected contributions of CDM and DG towards reducing the peak demand in the region. By taking all of these factors into consideration the planning demand forecast is developed and it is used to plan the transmission grid such that the grid can operate reliably and economically in the long term.

Furthermore, high growth forecast scenarios were developed to provide insight into the system's capability when faced with higher load than projected by the reference planning demand forecast. Two demand forecast sensitivity scenarios have been established and outlined in sections 5.9 and 5.10: a scenario where DG resources were expected to be out of service following their contract expiration, and a scenario to account for increased load growth, particularly in Kingston and Belleville, due to electrification.

## 5.1 Demand Forecast Methodology

For the purpose of the IRRP, a 20-year planning forecast was developed to assess electricity supply and reliability needs. Transmission infrastructure supplying an area is sized to meet peak-demand requirements (rather than energy demand requirements). Peak demand requirements are first determined at the station or DESN[8] level, allowing capability in pockets where there is load growth, or where existing equipment has been historically close to its load supply capability, to be more accurately assessed. These forecasts are then aggregated to understand the limits of the transmission system and identify overall regional electricity needs during regional coincident peak times.

The planning forecast is divided notionally into four time horizons: present day, near, medium, and long term. The near term (one to five years) has the highest degree of certainty; any near-term needs are typically met using regional transmission or distribution solutions. Other methods (i.e., conservation and demand management (CDM) or DG) are considered in the near- to mid-term (six to 10 years), since lead times to develop and incorporate these options depend on the size of the need.

The long-term forecast covers the 10- to 20-year period and has the lowest degree of certainty. It is used to identify potential longer-term needs, and for the consideration and development of integrated solutions, including CDM, DG, and major transmission upgrades. Early identification of potential needs and possible solutions enables engagement with the local community and all levels of government long before the need is triggered, maximizes opportunities for input to inform decision-making, and helps ensure local planning can account for new infrastructure.

[8] A dual-element spot network, or DESN, refers to a standard station layout used throughout the province, where two supply transformers are configured in parallel to supply one or two low-voltage switchgear which the distributor uses to supply load customers. This paralleled dual supply ensures a standard level of reliability where one supply transformer can be lost due to an outage or planned maintenance but supply to the customer can be maintained. A single local transformer station can have one, two, or more individual DESNs.

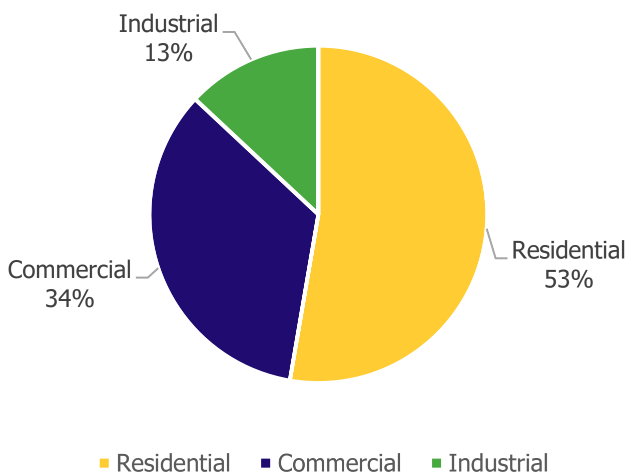
To address the long-term uncertainty in the electricity demand outlook, the robustness of the existing system was assessed to determine the capability of the existing system and its ability to supply customers, given possible outages and system states (e.g., contingencies).

Additional details on the demand outlook assumptions can be found in Appendix A - Methodology and Assumptions for Demand Forecast. The demand outlook was used to assess any growth-related electricity needs in the region.

## 5.2 Historical Electricity Demand

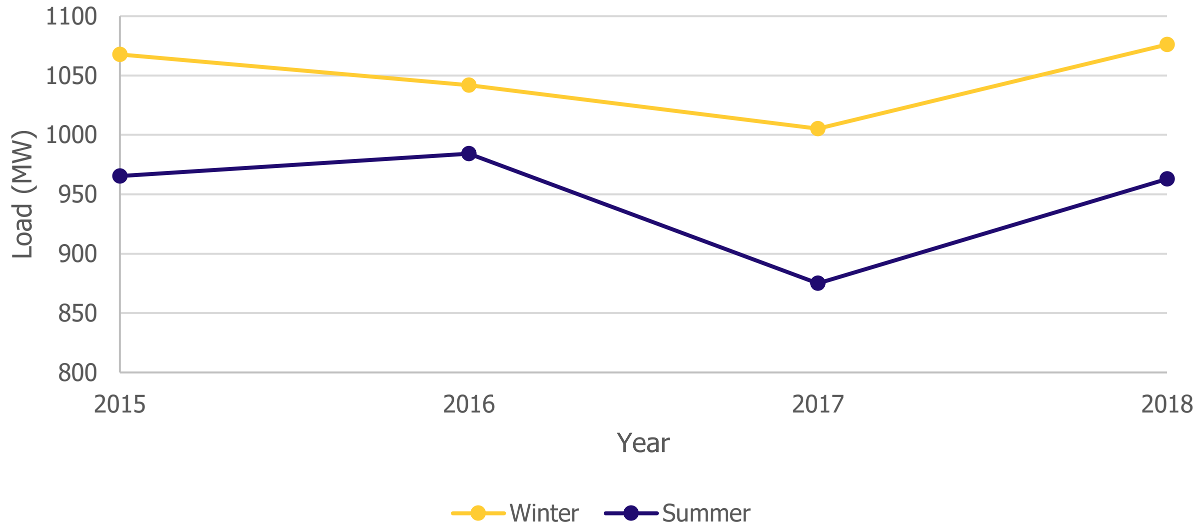
The Peterborough to Kingston region electricity demand is a mix of residential, commercial and industrial loads, encompassing diverse economic activities ranging from educational institutions to large business parks. As seen in Figure 5-1, the region's residential sector is the largest consumer of electricity accounting for approximately 50% of the peak load. The commercial and industrial sectors also have impactful contributions to the region's peak load, accounting for approximately 35% and 15% respectively. Peak demand can also be influenced by extreme weather conditions, with peaks in demand typically occurring after several days of extreme temperatures. In addition to weather, factors affecting commercial and industrial energy demand, such as increased economic activity, improvements in energy efficiency, and on-site generation development have impacts on the regional peak.

**Figure 5-1 | Regional Sector Segmentation Data (Winter)**




The regional historical loading data from 2015 to 2018 shows that the electricity system in the region has typically been winter-peaking. As shown in Figure 5-2, the coincident net peak demand in the region has been around 950 MW and 1050 MW in the summer and winter respectively. Upon review of the data, the Working Group determined that 2018 loading data would prove to be the most effective base year to use for the purposes of developing the planning load forecast. The regional peak in 2018 was approximately 1080 MW in the winter and 960 MW in the summer.

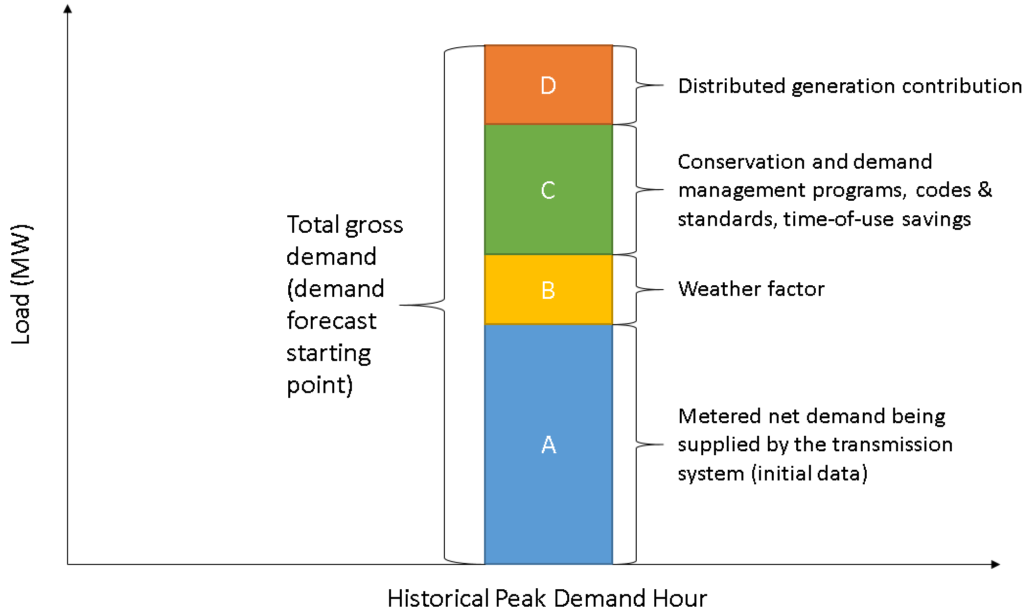
**Figure 5-2 | Historical Net Peak Demand in the Peterborough to Kingston Region**




## 5.3 Gross Demand Forecast Starting Point

To develop a forecast starting point, a net metered load data was obtained for all LDCs at each station within the region for both the summer and winter peak hours of 2018. The historical metered data is not a satisfactory representation of the true demand in the region as it does not account for the impacts of DG, CDM, and the effects of weather during a particular year. In order to account for the aforementioned factors, through a procedure known as the "unbundling" process, the Working Group established a new starting point to reflect the actual gross demand under median weather conditions. Having a gross demand starting point allows the LDCs to forecast growth from a starting point which represents the actual demand in the region, as opposed to simultaneously forecasting net load growth, DG, and CDM savings. This approach is summarized in Figure 5-3. Note that for the Peterborough to Kingston region, unbundling gross load was achieved to the extent for which the necessary data was available. For a more detailed look at the weather correction methodology see Appendix A.1 - Method for Accounting for Weather Impact on Demand.

**Figure 5-3 | Normal/Extreme Weather Corrected Coincident Net and Gross Peak Demand in the Peterborough to Kingston Region**



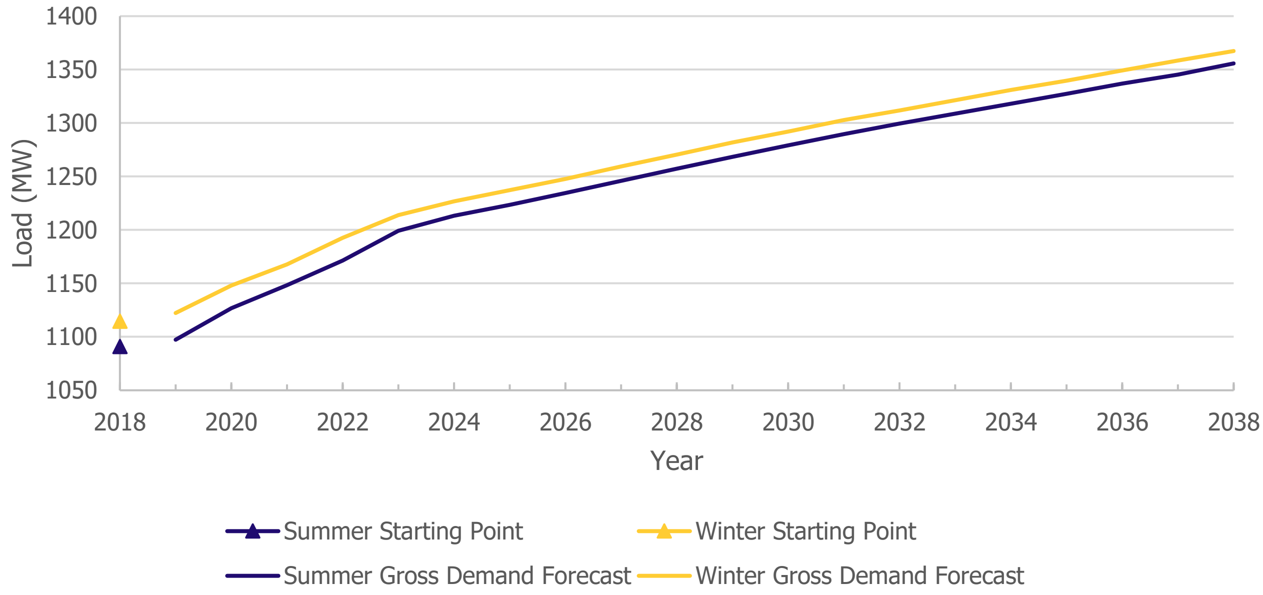

## 5.4 Gross Demand Forecast

Utilizing the established gross demand, median weather starting points, the LDCs provided 20-year forecasts at a station level. LDCs are tasked with the development of their own gross load forecasts at each station. This is due to the fact that LDCs have strong insights into customer and regional growth expectations over the planning horizon due to their direct relationship with customers. This insight includes known connection applications and knowledge regarding typical electrical demand for various types of customer groups.

The LDC forecasts account for increases in demand due to various factors such as new or intensified development, economic growth, population growth, changes in consumer behaviour, etc. It is noted that the gross demand forecast that was developed did not account for future DG or new conservation measures, such as codes and standards and demand response programs. These components were accounted for in later portions of the demand forecasting process as described in section 5.1. Most LDCs cited alignment with municipal and regional official plans as a primary source for input data. Other common considerations included known connection applications and typical electrical demand for similar customer types. For a more detailed look into each LDCs forecast methodology see Appendix A - Methodology and Assumptions for Demand Forecast.

Both the summer and winter median weather, gross demand forecasts are depicted in Figure 5-4.

**Figure 5-4 | Coincident, Median Weather, Gross Demand Forecasts**



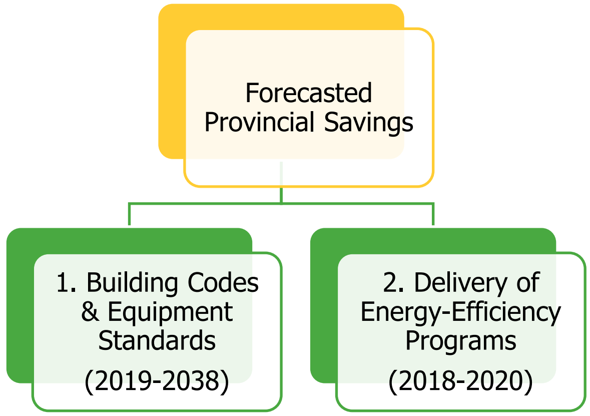

## 5.5 Contribution of Conservation to the Forecast

Conservation and Demand Management (CDM) is a clean and cost effective resource for helping to meet Ontario's electricity needs and has played an integral part in ensuring the development of a reliable and sustainable electricity system through provincial and regional planning. CDM is achieved through a mix of program-related activities, and mandated efficiencies from building codes and equipment standards. It plays a key role in maximizing the use of existing assets and maintaining reliable supply by offsetting a portion of a region's demand growth, and helping to ensure it does not exceed equipment capability.

Future CDM savings for the Peterborough to Kingston region have been projected out over the course of the 20-year planning horizon to take into account both policy-driven conservation through the provincial CDM Framework, as well as expected peak demand impacts due to building codes and equipment standards for the duration of the forecast.

To estimate the peak-demand impact of existing and committed CDM savings in the region, the forecast for provincial savings were divided into two main categories, as shown in Figure 5-5.

**Figure 5-5 | Categories of Conservation & Demand Management Savings**




For the Peterborough to Kingston region, the IESO worked with the LDCs to identify the breakdown of load per customer sector on a station level. The breakdown of load was divided into three categories: residential, commercial and industrial. This provided higher resolution when forecasting energy efficiency, as energy efficiency potential estimates vary by sector due to differing energy consumption characteristics and applicable measures.

The estimated impact of existing or committed CDM programs and codes and standards for the Peterborough to Kingston region have been applied to the gross demand extreme weather forecast, along with DG (as described in Section 5.7), to determine the net peak demand for the region. Additional details are provided in Appendix A - Methodology and Assumptions for Demand Forecast.

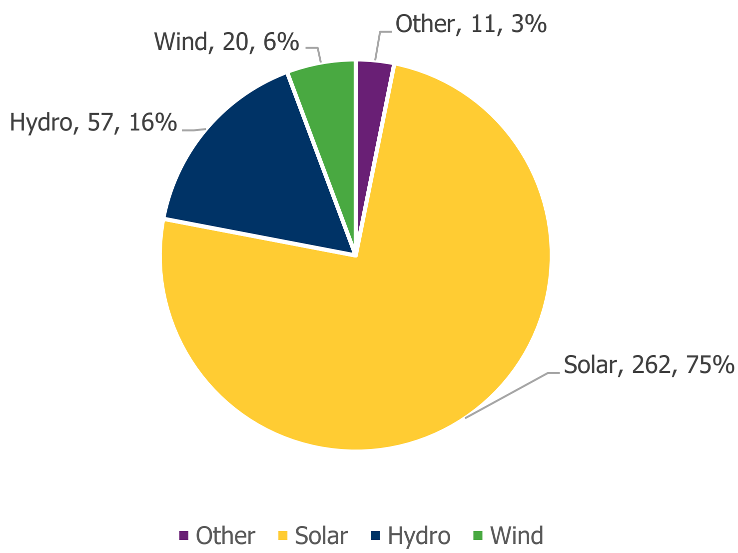
**Table 5-1 | Reduction to Summer Demand Forecast due to Conservation**

| Year | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 | 2032 | 2034 | 2036 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|
| Savings (MW) | 15 | 35 | 61 | 74 | 80 | 82 | 80 | 75 | 72 | 72 |

## 5.6 Contribution of Distributed Generation to the Forecast

The IESO has contracts with several distributed generators in the Peterborough to Kingston region. For the purposes of the planning demand forecast only IESO contracted DG and significant behind the meter resources noted by the LDCs have been included when accounting for the DG resources in the region. A breakdown by fuel type of distributed generation resources in the region for the year 2019 is shown in Figure 5-6.

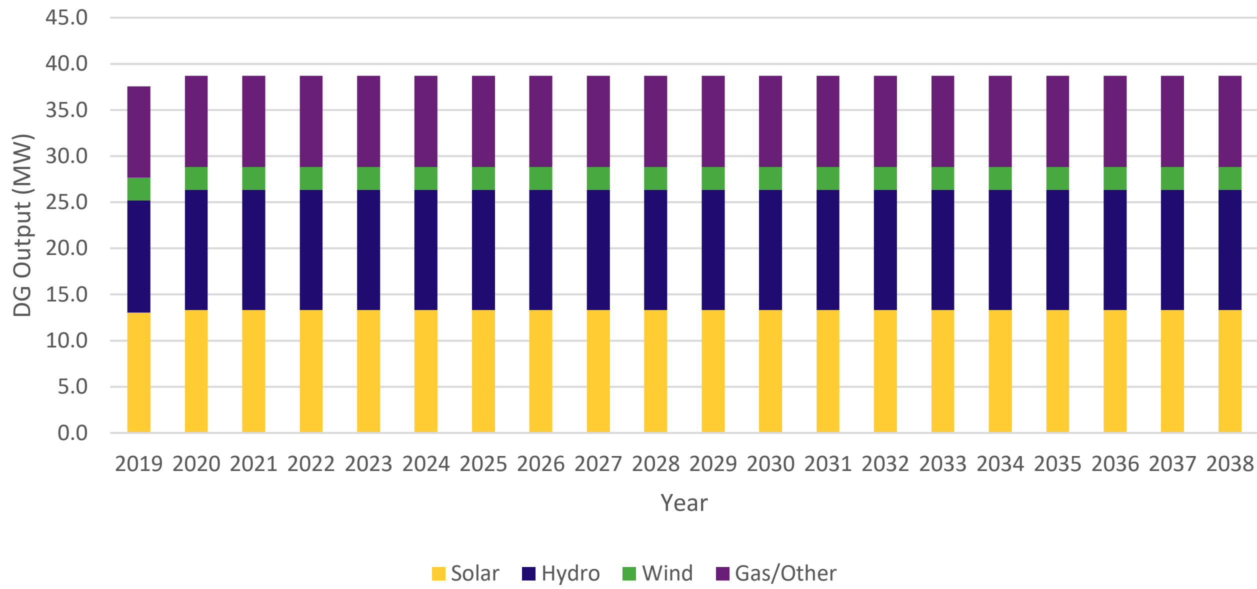
**Figure 5-6 | Installed DG Capacity (MW,%) in the Peterborough to Kingston Region (2019) by Resource Type**




The resources that were included in the DG forecast were comprised of a mix of solar, wind, hydroelectric and other (biogas, landfill gas and natural gas) projects. The majority of distributed generation in the region consists of solar resources (75% of total contracted installed DG capacity in 2019). Specific capacity contribution factors were attributed to each resource type in order to estimate the effective capacity that would be available to shave load during the regional peak hours. Upon applying the associated capacity contribution factors to each resource in the DG list, the data was then aggregated on a station level in order to put together a forecast specifying the estimated peak load reduction due to DG output. Figure 5-7 shows the contribution of DG output at the time of region's peak in the Peterborough to Kingston region by Resource Type.

Various DG contracts that have been administered by the IESO are set to expire during the 20-year planning horizon with the majority of those that will expire coming off contract in the final five years of the forecast period. For the purposes of the planning demand forecast, the Working Group decided to assume that contracts coming to the end of their terms will be reacquired by the IESO. Thus, the planning demand forecast assumed that all contracts will persist throughout the planning horizon. However, it was also deemed beneficial to create a sensitivity forecast scenario to explore how the needs identified through the technical study would evolve if all contracts did truly expire and behind the meter generation was not accounted for in the planning forecast. The sensitivity forecast is outlined in section 5.9.

**Figure 5-7 | Contribution of DG output at the time of region's peak in the Peterborough to Kingston Region by Resource Type**




## 5.7 Planning Demand Forecast

The final planning demand forecast was used to carry out system studies, and was the primary input for identifying potential needs. It was prepared by first taking the gross median weather demand forecasts prepared by LDCs and adjusting them to account for the expected impact of extreme weather conditions (as described in section 5.5), thereby increasing demand. Furthermore, the impacts of CDM savings and DG were added (as described in the sections 5.6 and 5.7), which resulted in reducing the demand.  The outcome of these steps results in the final planning demand forecast, which is an extreme weather net demand forecast. For a more detailed look into each LDCs forecast methodology see Appendix A - Methodology and Assumptions for Demand Forecast.

Figure 5-8 and Figure 5-9 shows the summer and winter planning demand forecast, aggregated for the entire Peterborough to Kingston region. For comparison, the figure also shows the net metered historical peaks from 2015-2018, the 2018 median weather corrected starting point, the gross median weather forecast and the gross extreme weather forecast.

**Figure 5-8 | Summer, Extreme Weather, Net Demand Forecast**

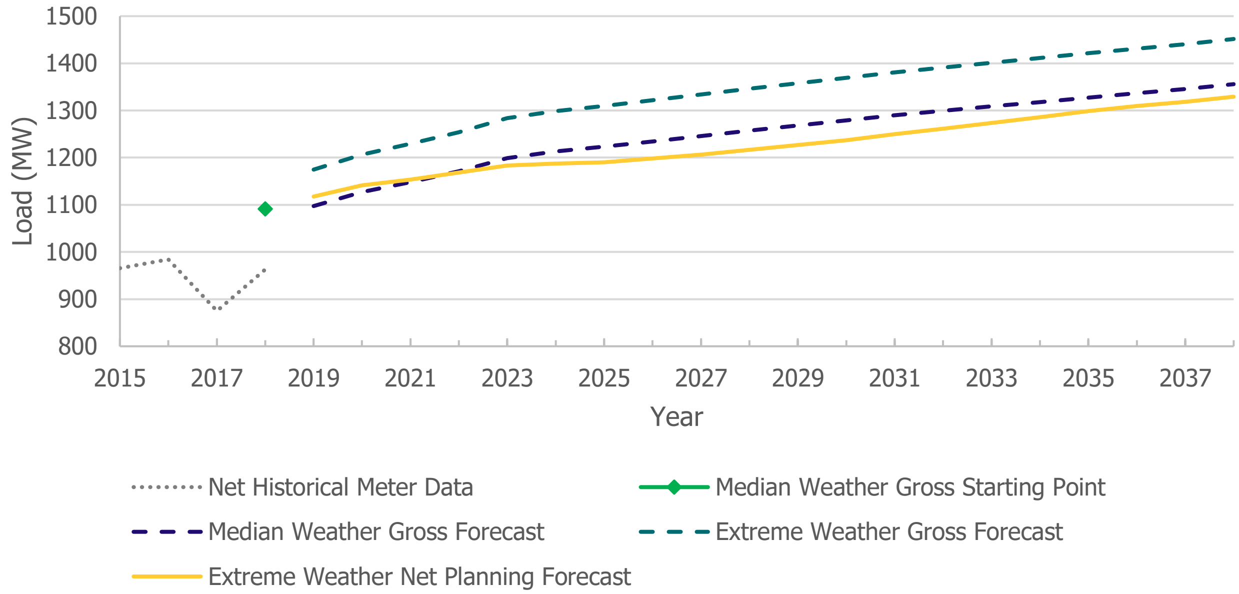
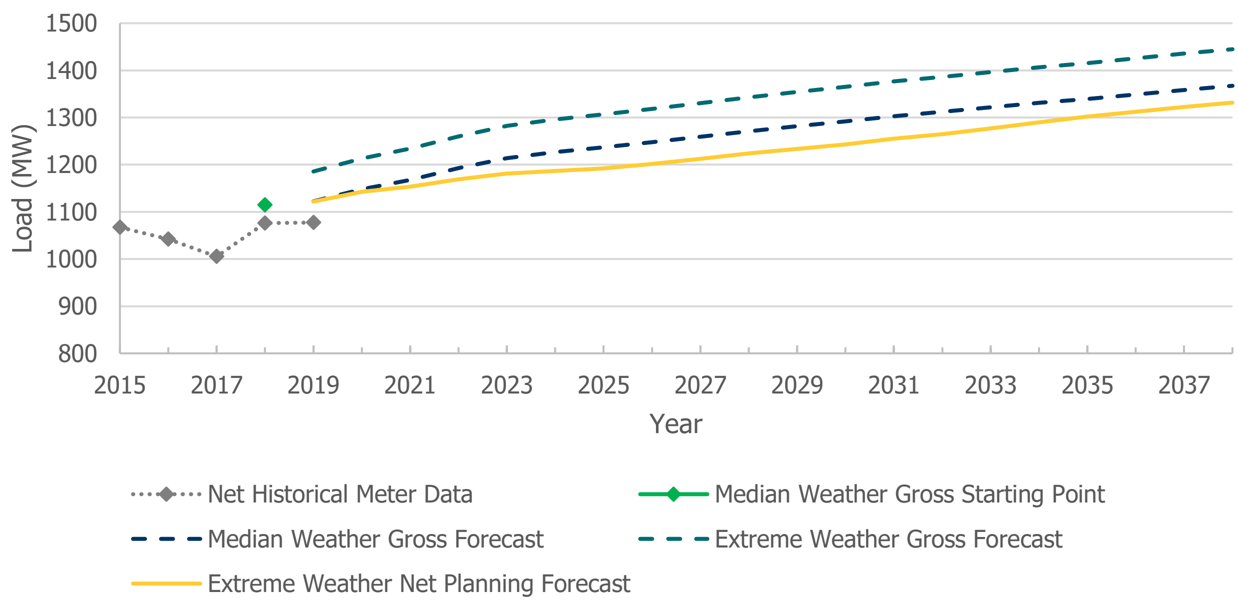



**Figure 5-9 | Winter, Extreme Weather, Net Demand Forecast**

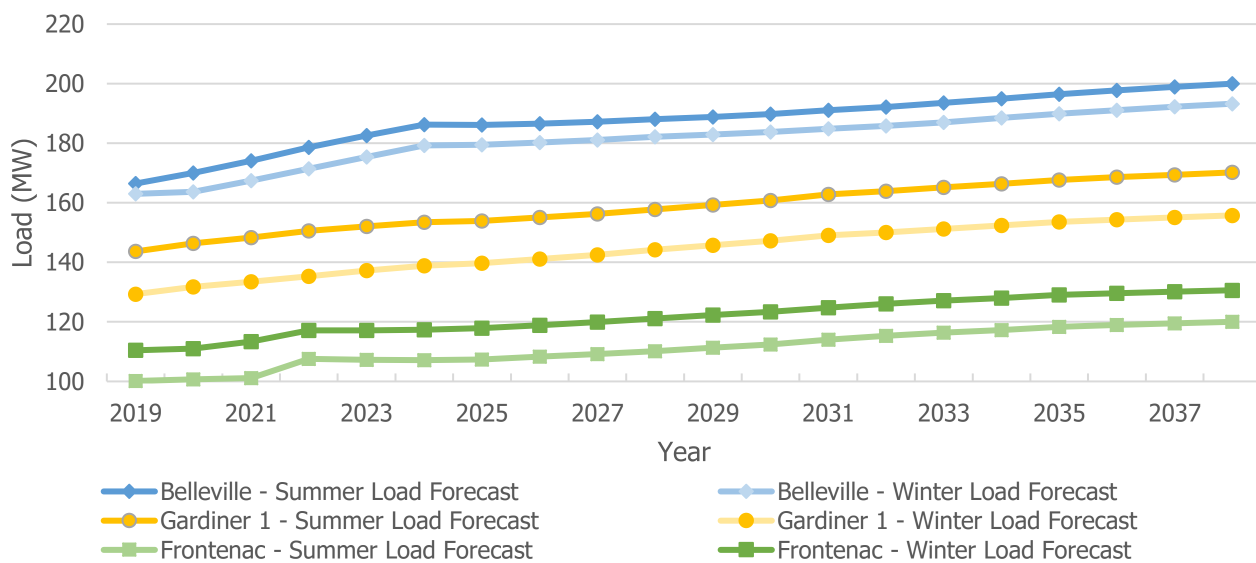


## 5.8 Non-Coincident Station Forecasts

To evaluate the adequacy of the electric system, the regional planning process involves measuring the demand observed at each station for the hour of the year when overall demand in the study area is at a maximum, also called the coincident peak demand. This differs from a non-coincident peak, which refers to each station's individual peak, regardless of whether the stations' peaks occur at different times. Apart from assessing the adequacy of the electrical grid, the adequacy of each station is assessed as part of the regional planning process. For this assessment, non-coincident forecasts is created, as shown in Figure 5-10. If a station's non-coincident forecast loading exceeds the capability of each transformer at the station, this is indication of a station capacity need.

The Scoping Assessment completed prior to the start of the IRRP had identified three stations which were likely to have station capacity needs over the course of the planning horizon; Belleville TS, Frontenac TS and Gardiner TS DESN #1. A further screening was completed by the Working Group during the IRRP to establish these needs.

**Figure 5-10 | Summer and Winter Non-coincident Station level Planning Demand Forecast**




## 5.9 Sensitivity Scenario: Retirement of Distributed Generation Resources

The development of the planning demand forecast assumed that contracts coming to the end of their terms will be reacquired by the IESO. The Working Group identified the need to look at the other bookend scenario; i.e., creating a sensitivity forecast which assumes that all DG resources are taken out of service following the expiry of their contracts. This scenario also assumed that non-IESO contracted behind the meter generators, accounted for by LDCs in the planning forecast, would not contribute towards reducing the gross demand forecast. This was due to the fact that there was little to no certainty with regards to the operation of these resources during times of regional peak.

With the assumption that expired contracts will retire, it was determined that it will not have a significant impact to region's demand as the DG contribution at the time of region's peak is approximately 40 MW as shown in Figure 5-7.

## 5.10 Sensitivity Scenario: High Growth Forecasts

The Working Group, in consultation with key customers, developed a high demand scenario. While the scenario developed is most impacted by the incorporation of potential impacts of electrification in the Kingston area (identified through stakeholder feedback), the rest of the region was also reviewed by the applicable LDCs to capture any relevant long-terms growth plans or any currently foreseeable electrification impacts for their areas.

The City of Kingston had many stakeholders who were able to provide input into high growth forecast scenarios. This included projects ranging from electric vehicle charging infrastructure to electrified space heating installations. High growth forecasts for the City of Kingston thus added considerable load to the reference forecast.

Two high growth scenarios were developed, with high growth scenario 1 representing a more moderate impact from electric heating than high growth scenario 2. To develop the high growth scenario 2 winter demand scenario, the rated output of existing natural gas heating appliances (BTUh) was converted to the equivalent electric resistive heating demand (kW). For the high growth scenario 1 winter demand scenario the electric resistive heating demand of high growth scenario 2 was converted to an equivalent electric heat pump demand. Since the differentiating factor between high growth scenario 1 and 2 was the assumption on the efficiency of conversion to electric space heating, only one high growth scenario (scenario 1) was developed for summer demand. Further details of the input to both forecast scenarios are presented in Appendix A.

Stakeholders serviced from Belleville TS were not able to provide detailed load growth information pertaining to electrification projects. As such, industry reports and data pertaining to electric vehicle demand as well as city growth statistics were used to create a high growth forecast resulting in an increase of another 3 MW by the year 2038. Further details on the high growth scenario for Belleville TS can also be found in Appendix A.

**Table 5-2 | Different Forecast Scenarios - Summer**

| Summer Load Forecast | 2020 | 2030 | 2038 |
|---|---|---|---|
| Belleville - Reference Forecast | 170 | 190 | 200 |
| Belleville - High Growth Forecast | 170 | 191 | 203 |
| Kingston - Reference Forecast | 247 | 273 | 290 |
| Kingston - High Growth 1 Forecast | 247 | 297 | 332 |

**Table 5-3 | Different Forecast Scenarios - Winter**

| Winter Load Forecast | 2020 | 2030 | 2038 |
|---|---|---|---|
| Belleville - Reference Forecast | 164 | 184 | 193 |
| Belleville - High Growth Forecast | 164 | 185 | 196 |
| Kingston - Reference Forecast | 243 | 270 | 287 |
| Kingston - High Growth 1 Forecast | 243 | 296 | 329 |
| Kingston - High Growth 2 Forecast | 243 | 347 | 415 |

## 5.11 Load Profiling

In addition to the annual peak forecast, hourly load profiles (8,760 hours per year over the 20 year forecast horizon) for certain stations or group of stations with identified needs were developed to characterize their needs with finer granularity. The profiles are based on historical data adjusted for variables that impact demand such as calendar day (e.g. holidays and weekends) and weather (e.g. extreme weather events like ice storms or heat waves) impacts. The profiles are then scaled to match the annual peak forecast for each year. As described in section 7.1, these profiles are used to quantify the magnitude, frequency, and duration of needs to better evaluate the suitability of generation and distributed energy resource options.

Note that this data is used to roughly inform the overall energy requirements that a non-wire alternative would need to meet for the purposes of evaluating alternatives; the intent in this application is not to deterministically specify the precise hourly energy requirements. Further, the purpose of this data is to enable the selection of suitable technology types and roughly estimate operating costs. Demand patterns can change significantly as consumer behaviour evolves, new industries emerge, and trends like electrification achieve greater adoption. The Working Group will continue to monitor these changes as part of plan implementation.

# 6 Power System Needs

Based on the demand outlook, system capability, application of provincial planning criteria, and the transmitter's identified end-of-life asset replacement needs, the Peterborough to Kingston IRRP Working Group determined electricity needs in the near, medium, and long term. This section describes end-of-life, capacity, and reliability needs in the Peterborough to Kingston region.

## 6.1 Needs Assessment Methodology

Based on the application of ORTAC[9] and North American Electric Reliability Corporation (NERC) TPL 001-4 Standard[10], the Working Group identified electricity needs local or regional reliability requirements for the following categories:

- **Station Capacity Needs** describe the electricity system's inability to deliver power to the local distribution network through the regional step-down transformer stations at peak demand. The capacity rating of a transformer station is the maximum demand that can be supplied by the station and is limited by station equipment. Station ratings are often determined based on the 10-day LTR of a station's smallest transformer under the assumption that the largest transformer is out of service. A transformer station can also be limited when downstream or upstream equipment, e.g., breakers, disconnect switches, low-voltage bus or high voltage circuits, is undersized relative to the transformer rating.
- **Supply Capacity Needs** describe the electricity system's inability to provide continuous supply to a local area at peak demand. This is limited by the LMC of the transmission supply to an area. The LMC is determined by evaluating the maximum demand that can be supplied to an area accounting for limitations of the transmission elements, e.g., a transmission line, group of lines, or autotransformer, when subjected to contingencies and criteria prescribed by ORTAC and TPL 001-4. LMC studies are conducted using power system simulations analysis.
- **End-of-life Asset Replacement Needs** are identified by the transmitter with consideration to a variety of factors such as asset age, the asset's expected service life, risk associated with the failure of the asset, and its condition. Replacement needs identified in the near- and early mid-term timeframe would typically reflect more condition-based information, while replacement needs identified in the medium to long term are often based on the equipment's expected service life. As such, any recommendations for medium- to long-term needs should reflect the potential for the need date to change as condition information is routinely updated.

[9] https://www.ieso.ca/-/media/Files/IESO/Document-Library/Market-Rules-and-Manuals-Library/market-manuals/connecting/IMO-REQ-0041-TransmissionAssessmentCriteria.pdf

[10] https://www.nerc.com/files/TPL-001-4.pdf

- **Load Security and Restoration Needs** describe the electricity system's inability to minimize the impact of potential supply interruptions to customers in the event of a major transmission outage, such as an outage on a double-circuit tower line resulting in the loss of both circuits. Load security describes the total amount of electricity supply that would be interrupted in the event of a major transmission outage. Load restoration describes the electricity system's ability to restore power to those affected by a major transmission outage within reasonable timeframes. The specific load security and restoration requirements are prescribed by Section 7 of ORTAC. No load security and restoration needs were identified as part of this IRRP.

## 6.2 Near/Medium-Term Needs

### Station Capacity Needs

Station capacity needs have been identified for Belleville TS, Frontenac TS and Gardiner TS DESN #1 in the near or medium term. The following sections describe these capacity needs, along with the sensitivity of the need date to high growth forecasts (as described in section 5.10).

### Belleville TS Station Capacity Need

Belleville TS consists of one DESN connected to the 230 kV system. The station has a summer capacity of 130 to 161 MW[11], depending on the load composition when transmission circuit H23B and the companion transformer are both lost. Currently, the station has reached the capability of the existing station transformers, be it 130 MW or 161 MW. Furthermore, the station's load is similar in summer and winter seasons, however, the transformer's summer ratings are lower than winter.

While the Belleville TS transformers are currently undergoing an end-of-life replacement, targeted in-service 2022, this refurbishment is not expected to result in a material improvement to the station's capacity. Based on historical and forecast demand, there is a capacity need at Belleville TS today.

Another 30 MW of load is forecast to connect to Belleville TS over the next 20 years. Figure 6-1 and Figure 6-2 show the various non-coincident forecast scenarios that were developed for Belleville TS for the summer and winter, respectively, along with the current capacity of the station. If a high growth scenario materializes, this capacity need would worsen.

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[11] The 130 MW is a voltage limitation, while the 161 MW is a thermal limitation, and which one becomes more limiting is subject to the load composition.

**Figure 6-1 | Summer Non-Coincident Demand Forecast Scenarios for Belleville TS**

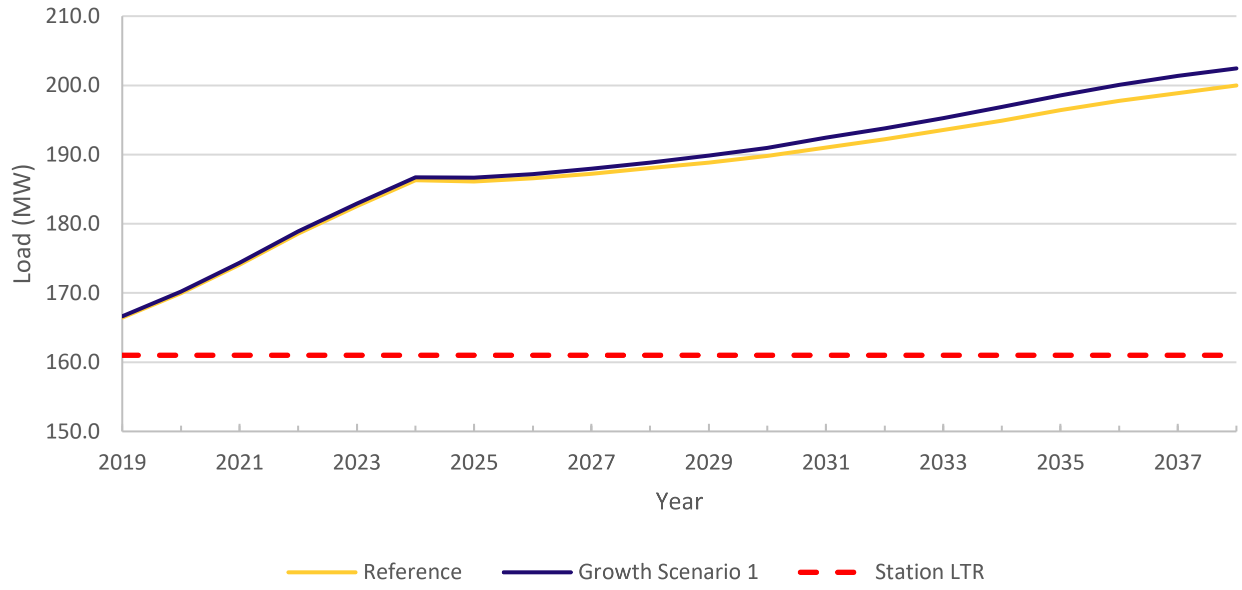
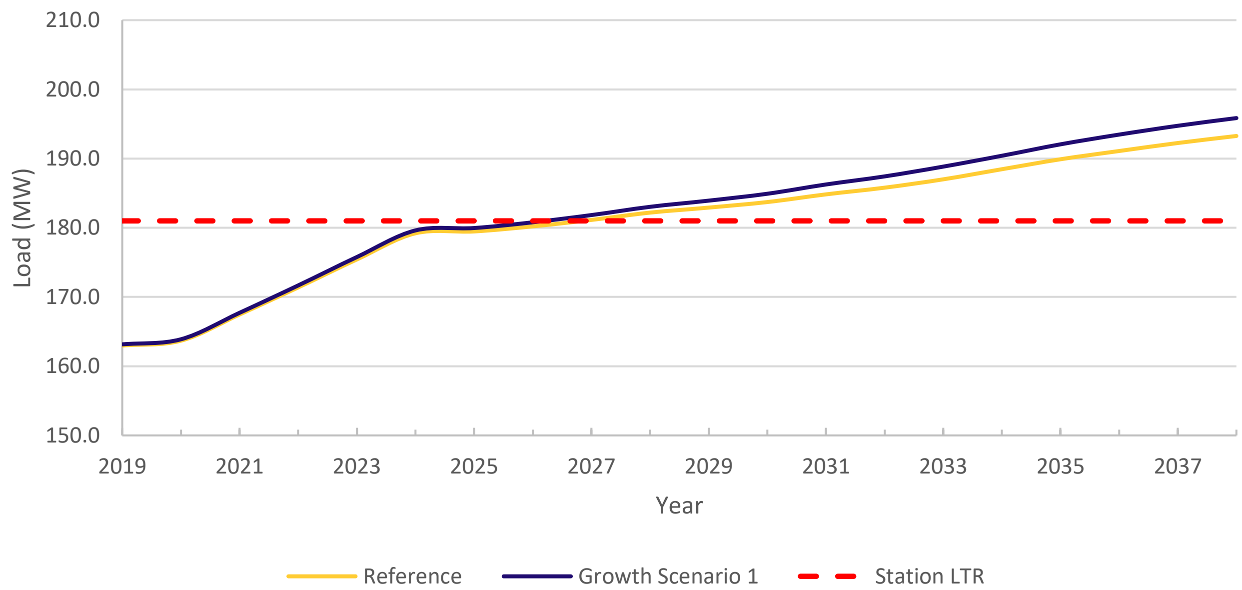



**Figure 6-2 | Winter Non-Coincident Demand Forecast Scenarios for Belleville TS**



### Station Capacity Needs in the Kingston area

The City of Kingston is supplied by two station sites, Frontenac TS and Gardiner TS (which contains two DESNs, #1 and #2). These stations have overlapping service territories, and so, capacity needs in the region should be looked at holistically. There is significant growth forecast within the City of Kingston over the 20 year planning horizon, however, the magnitude varies considerably based on the forecast scenario considered – reference, high growth 1, and high growth 2. As can be expected, the station capacity needs can arise earlier under the high growth scenarios than for the reference forecast. The next two sections provide further details on the Frontenac TS and Gardiner TS station capacity needs.

### Frontenac TS Station Capacity Need

The Kingston area distribution system is divided into two territories supplied by two different LDCs. The central area that contains the Kingston downtown core is supplied by Utilities Kingston while the remaining area to the west of Kingston's downtown core, as well as area the developments east of the Cataraqui River, are supplied by Hydro One (Distribution).

While the load growth is distributed throughout the area, the system is electrically supplied from two separate paths:

(1) Frontenac TS is supplied from the 115 kV circuits B5QK and Q3K; and
(2) Gardiners TS DESN #1 and #2 are supplied from the 230 kV circuits X2H and X4H.

The forecast load for Frontenac TS and Gardiner TS DESN #1 are both expected to exceed the stations' respective LTR in the near to mid term. The configuration of the distribution system in Kingston is such that there are frequent load transfers between Frontenac and Gardiner TS DESN #1 via 44 kV feeder ties which allow for added reliability during planned and emergency work. This flexibility will become more rigid if either Frontenac TS or Gardiner TS DESN #1 are loaded to their maximum capability. As a result, the reliability benefits of timely load restoration, the operational benefits for outage planning, and the identified capacity needs have to be balanced when planning an adequate system for the long term.

Throughout the planning process it became evident that the potential for rapid load growth is a risk for the area as a whole. High growth scenarios were developed which include the impact of future electrification programs such as electrification of fleet vehicles, thermal heat pumps, and fuel switching incentives. These high growth scenarios advance and amplify the two major capacity needs in the area.

Frontenac TS is supplied by two transformers with a total summer capacity of 111 MW. Figure 6-3 and Figure 6-4 show the various non-coincident demand forecast growth scenarios developed for Frontenac TS for the summer and winter seasons, respectively. The station's capacity (LTR) is included in the figure to identify the need. The figures illustrate the area is anticipated to exceed the current capacity by between 10 to 110 MW by 2038, depending on the forecast scenario. The station capacity need is anticipated to materialize as late as 2029 or as early as 2022, depending on the forecast scenario.

**Figure 6-3 | Summer Non-Coincident Demand Forecast Scenarios for Frontenac TS**

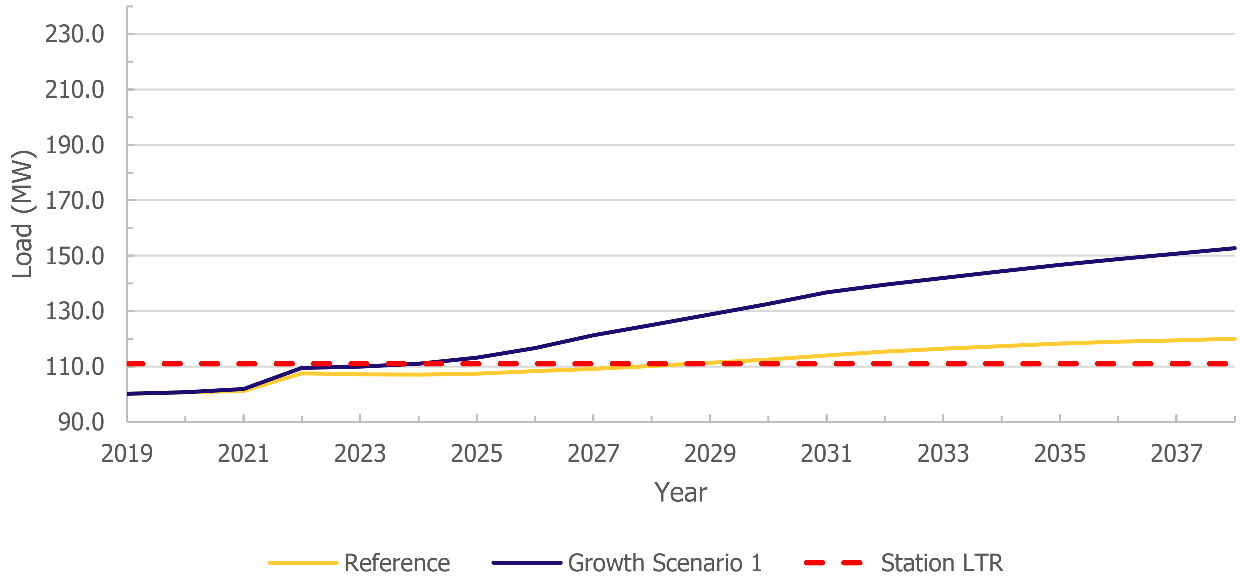
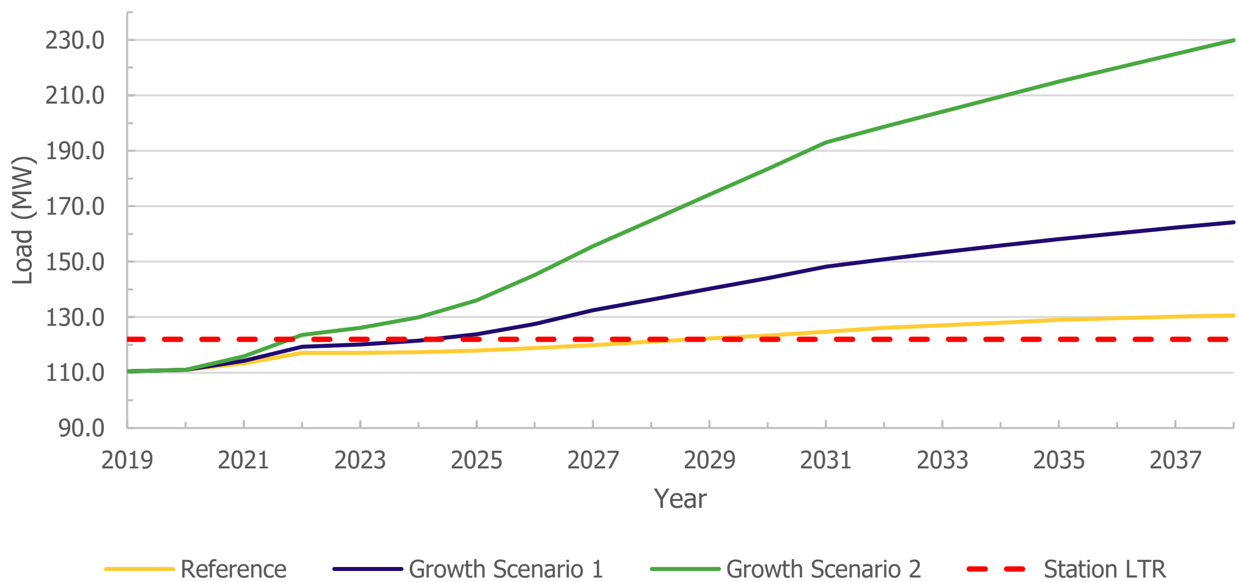



**Figure 6-4 | Winter Non-Coincident Demand Forecast Scenarios for Frontenac TS**




### Gardiner TS (DESN #1) Station Capacity Need

A local capacity need was identified at the Gardiner TS DESN #1 within the Peterborough to Kingston region. Gardiner TS currently consists of two DESNs connected to the 230 kV system. The T1/T2 DESN (#1) has a summer capacity of 125 MW, while the T3/T4 DESN (#2) has a summer capacity of 85 MW. Gardiner TS DESN #2 is the newer of the two DESNs and has ample station capacity, while Gardiner TS DESN #1 has reached its capacity. Another 25 to 50 MW of load growth is forecast for Gardiner TS DESN #1, depending on the forecast scenario. Figure 6-5 and Figure 6-6 show the various forecast scenarios developed for Gardiner TS DESN #1 for the summer and winter, respectively. The station's capacity (LTR) is included in the figure to identify the need. It is also to be noted that Hydro One Transmission has identified that Gardiner TS DESN #1 is approaching end-of-life.

The figures illustrate that Gardiner TS DESN #1 has a summer capacity need today, and the magnitude of need increases for the high growth scenarios.

**Figure 6-5 | Summer Non-Coincident Demand Forecast Scenarios for Gardiner TS DESN#1**

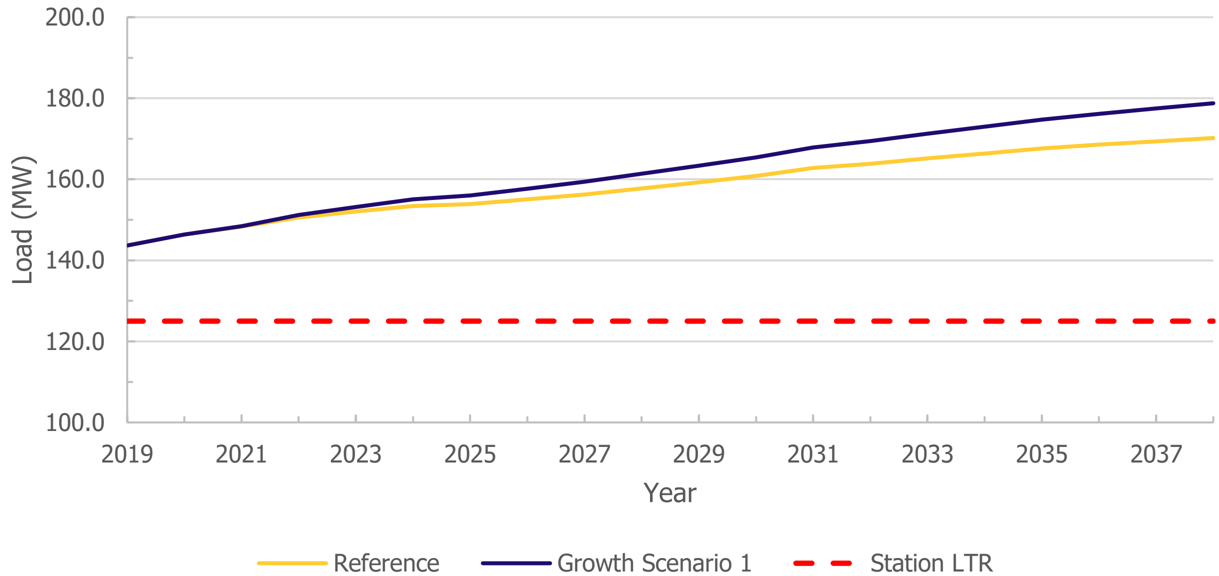
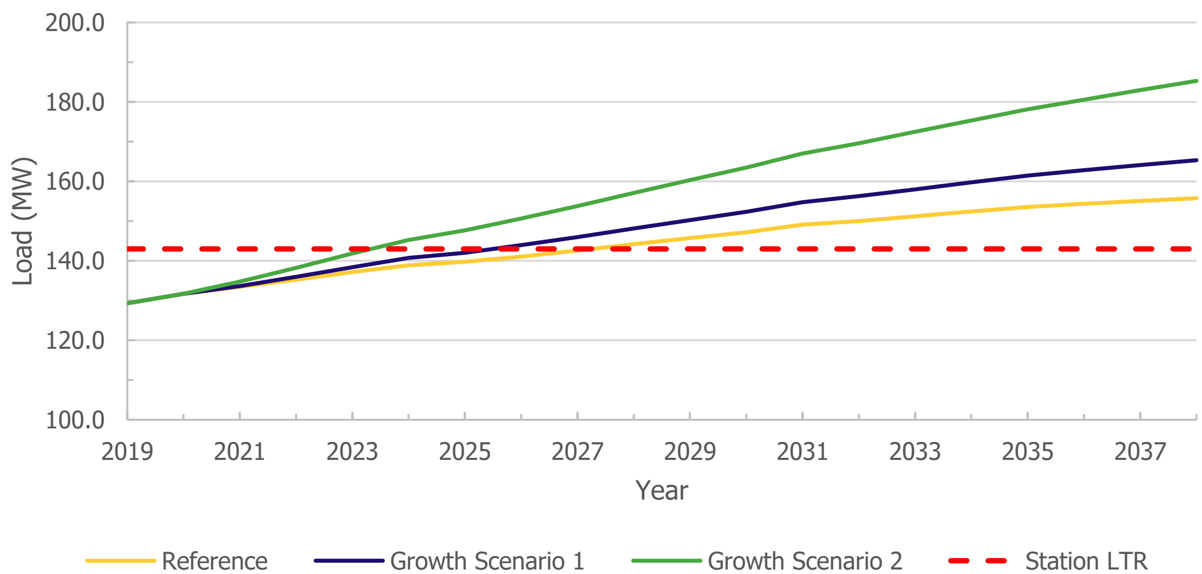



**Figure 6-6 | Winter Non-Coincident Demand Forecast Scenarios for Gardiner TS DESN#1**




## Supply Capacity Needs

The Peterborough to Kingston region's electricity demand growth affects the 230 kV transmission supply capability to serve the 115 kV local area. While load growth is distributed throughout the area, two bulk supply capacity needs were observed, these are:

1. Supply lines affecting Peterborough to Quinte West load

2. Cataraqui autotransformer capability to support Frontenac and other 115 kV loads

These two bulk supply needs observed are described next.  The impact of DG retirement is negligible as the region's demand increases slightly – ~40 MW.

### Peterborough to Quinte West Supply Capacity needs

The load growth in the Peterborough to Quinte West sub-system is expected to introduce supply capacity needs in the area. There are 230 kV and 115 kV supply lines that serve load in that pocket. Specifically, P15C, a 230 kV single circuit from Cherrywood TS to Dobbin TS, and Q6S, a 115 kV single circuit supplying Sidney TS from Cataraqui TS, are two critical circuits supplying this load pocket. The limitation on these two circuits dictates a Load Meeting Capability (LMC) of 270 MW for the sub-system, shown on Figure 6-8.  As shown in this figure, the sub-system load is expected to increase by approximately 60 MW over the 20-year planning horizon.

This need is being coordinated with bulk planning system study activities in the area to ensure impacts from the broader system are considered when reviewing and resolving this need.

**Figure 6-7 | Critical Supply to Dobbin by Sidney (P15C and Q6S)**

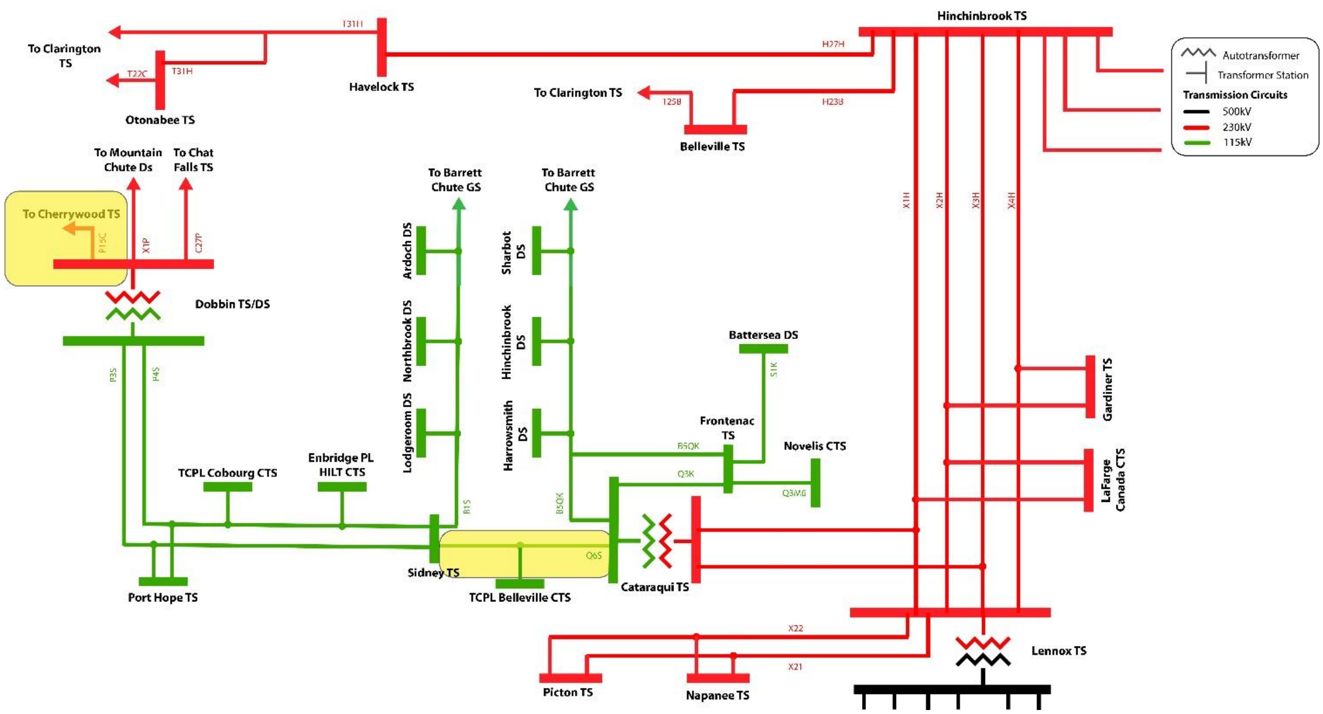
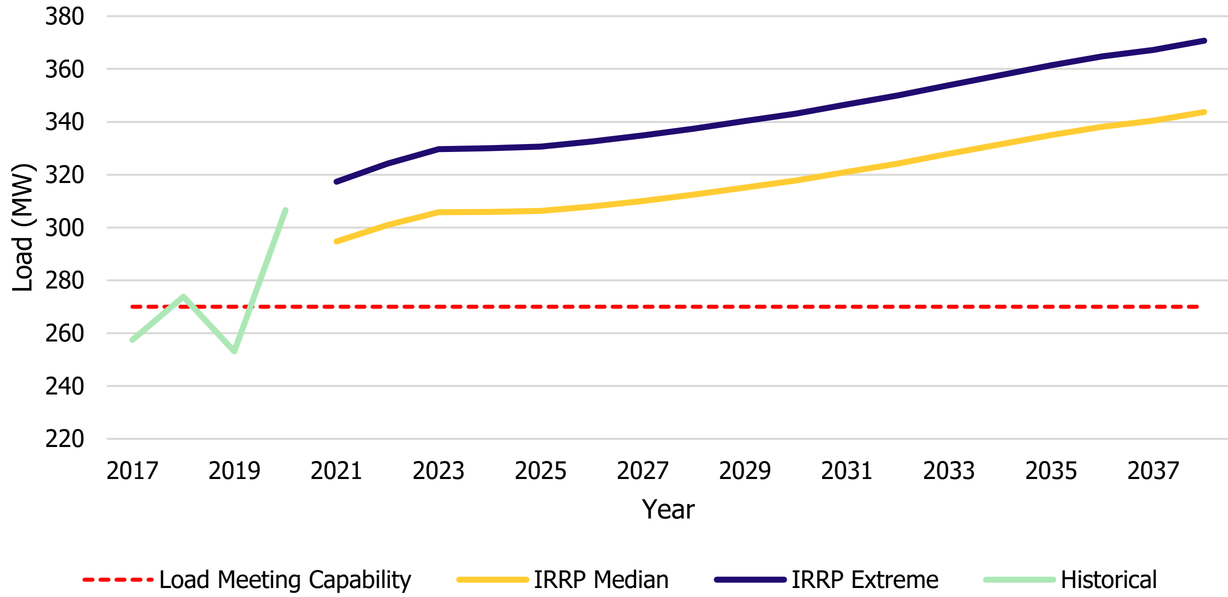


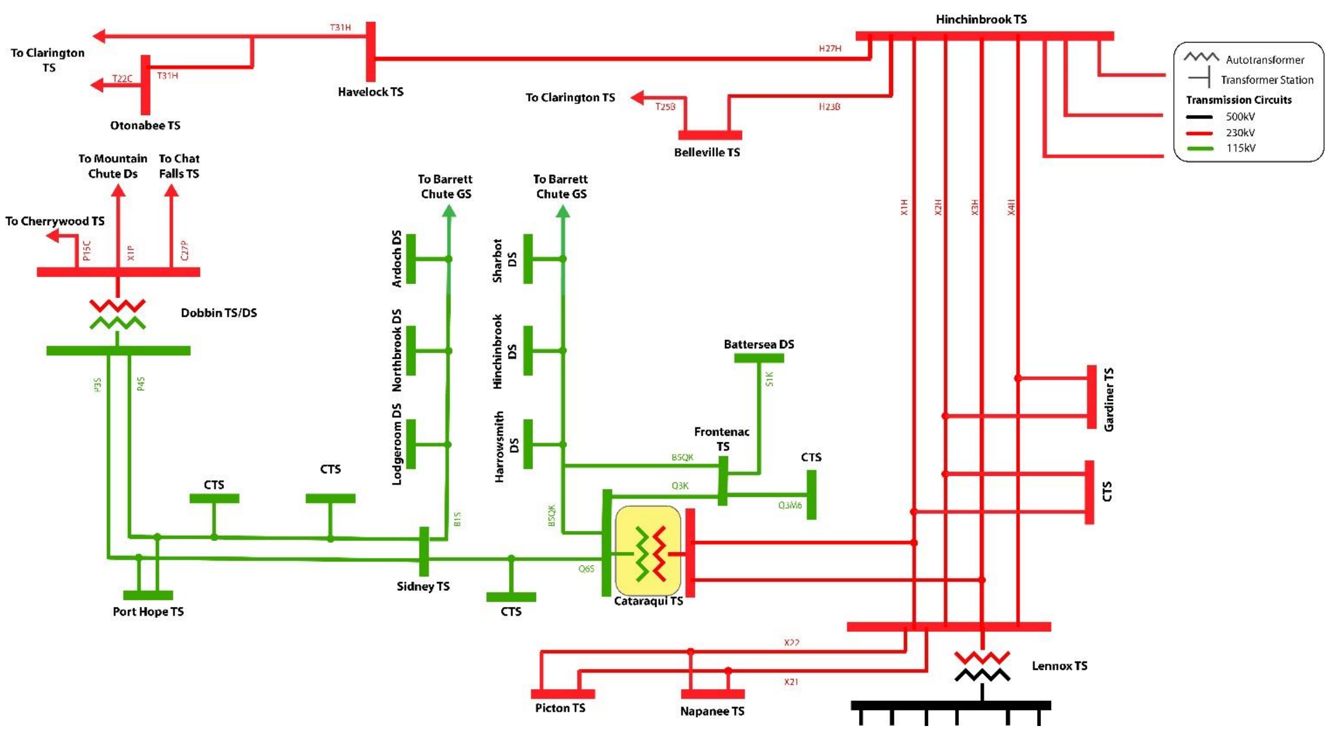
**Figure 6-8 | Peterborough to Quinte West Forecast and LMC**




### Cataraqui Autotransformers Supply Capacity Need

The load growth at Frontenac TS and other 115 kV supply stations is expected to result in a supply capacity need at Cataraqui TS in 2023. The load is expected to continue to increase over the 20-year planning horizon.

**Figure 6-9 | Cataraqui Autotransformers**



### End-of-Life Refurbishment Needs

The transmitter identified some end-of-life asset replacement needs for the Peterborough to Kingston region, with several needs arising in the near to medium term. These consisted of station transformer replacement needs. Based on the outcomes of the Needs Assessment and the Scoping Assessment, only one end-of-life need was identified as requiring further coordinated planning in the IRRP. Port Hope TS T3/T4 transformer replacement, currently expected to be needed in 2025 based on the latest asset condition information, was included in the IRRP. The end-of-life needs are based on the best available asset condition information at the time of each stage of the planning cycle, timing of asset needs can change as new information becomes available.

### Summary of Near/Medium-Term Needs

| | Needs | Location | Need Date[12] |
|---|---|---|---|
| 1 | Station Capacity | Belleville TS | Today |
| 2 | Station Capacity & End-of-Life Refurbishment | Gardiner TS DESN #1 | Today |
| 3 | Supply Capacity | Peterborough to Quinte West | Today |
| 4 | Supply Capacity | Cataraqui Autos | 2023 |
| 5 | End-of-Life Refurbishment | Port Hope TS | 2025 |
| 6 | Station Capacity | Frontenac TS | 2029 |

## 6.3 Long-Term Needs

### Supply Capacity Needs

The long-term load growth for the Peterborough to Kingston region results in supply capacity needs on the 115 kV system. While load growth is distributed throughout the area, the sub-system is electrically supplied from two separate paths:

1. 115 kV circuits supplying the Port Hope, Sidney, Lodgeroom DS area
2. B5QK circuit supplying the Frontenac TS area.

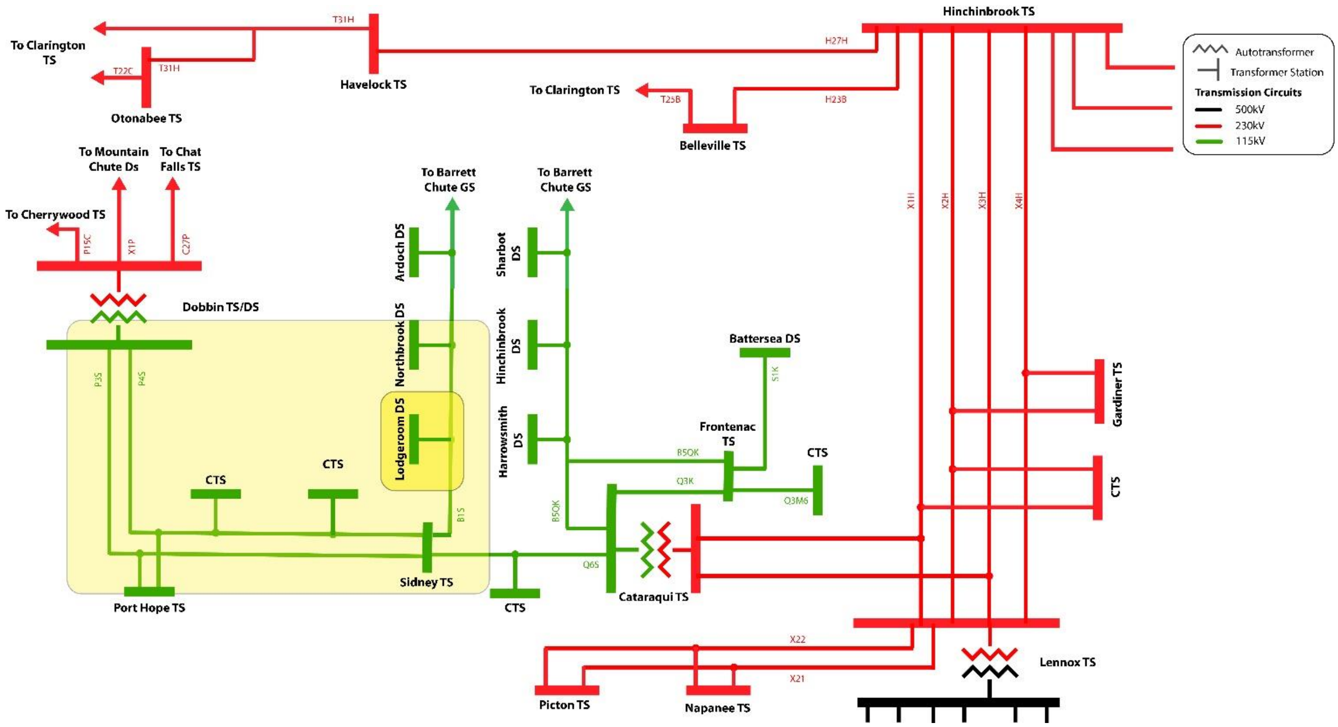
The local supply needs observed are described next. The impact of DG retirement is negligible as the region's demand increases slightly ~40 MW.

[12] Based on reference forecast. Impact of high growth is discussed within the relevant section.

## Peterborough to Quinte West Voltage Need

The load on the 115 kV system is expected to grow by 60 MW over the 20 year planning horizon. It is expected to introduce voltage criteria violations in the area. During a pre-existing outage on circuit C27P, the loss of circuit P15C will result in under-voltage violations starting in 2033 at Lodgeroom DS. These conditions worsen and appear at additional stations on the 115 kV system in later years as load continues to grow, as depicted in Figure 6-10.

**Figure 6-10 | 115 kV Pocket Voltage Need**



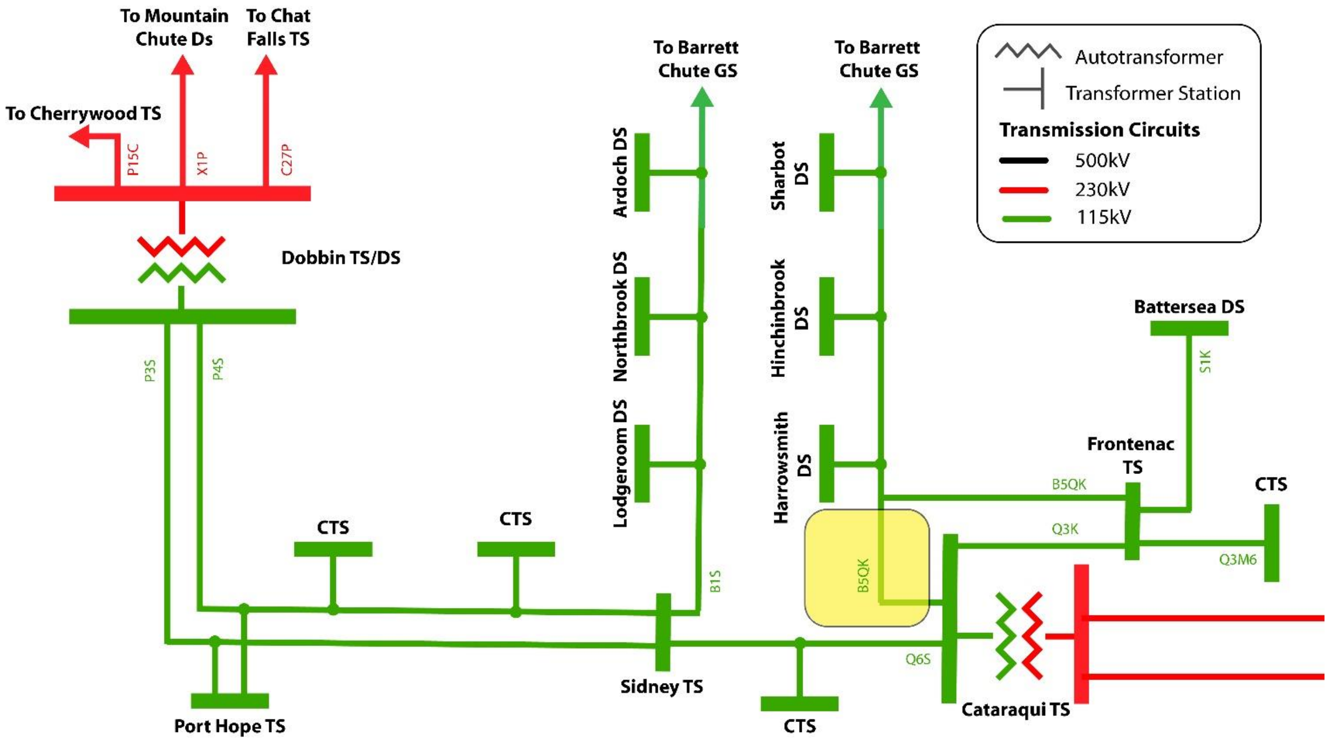

## Kingston Transmission Supply Capacity Needs

The forecast load growth in Kingston, specifically at Frontenac TS, is expected to introduce supply capacity needs in the area. There are two upstream 115 kV supply lines serving Frontenac TS and one of them – B5QK[13] highlighted on Figure 6-11– is forecast to exceed its capacity in the long term as the load grows by 27 MW to 165 MW[14]. This limit isn't expected to be exceeded until the end of the planning horizon for the reference forecast, but a need can emerge as early as 2027 or 2025, for high growth scenarios 1 and 2, respectively.

[13] 1.1 KM section of B5QK from Cataraqui TS to the Railton JCT

[14] Battersea DS, Frontenac TS, Harrowsmith DS, Hinchinbrooke DS, Sharbot DS, and 1 CTS

**Figure 6-11 | B5QK overloaded section**




### Summary of Long-Term Needs

| | Needs | Location | Need Date[12] |
|---|---|---|---|
| 1 | Supply Capacity | Peterborough to Quinte West | 2033 |
| 2 | Supply Capacity | Kingston Area | 2038 |

## 6.4 Needs Summary

The majority of the needs in the region are near- and medium-term station and supply capacity needs. Station capacity needs occur in the Belleville and Kingston areas and the supply capacity needs present on multiple portions of the 115 kV system in the region. The table below provides an overview of the needs considered in the development of options for the plan.

**Table 6-1 | Summary of Needs**

| Area/Facility | Need | Description | Need Date[12] |
|---|---|---|---|
| Belleville TS | Station Capacity | An existing capacity need was identified for Belleville TS, limited by voltage issues for the loss of one transmission supply as well as transformer capacity. | Today |
| Gardiner TS | Station Capacity & End-of-Life Refurbishment | An existing transformer capacity need was identified for DESN #1 (T1/T2) as well as an End-of-Life refurbishment need | Today |
| Peterborough to Quinte West | Supply Capacity | The load meeting capability of the system is currently exceeded. The outcomes of the Gatineau Corridor End-of-Life Study are forecast to address this need. | Today |
| Cataraqui TS | Supply Capacity | The autotransformers at Cataraqui is currently forecast to be exceeded. | 2023 |
| Port Hope TS | End-of-life | The station transformers at Port Hope TS have been identified as reaching end-of-life in 2025 and requiring replacement. | 2025 |
| Frontenac TS | Station Capacity | The transformers at Frontenac TS are forecast to exceed their capability. | 2029 |
| Peterborough to Quinte West | Supply Capacity | The load meeting capability of the system is currently exceeded. The outcomes of the Gatineau Corridor End-of-Life Study are forecast to address this need. | 2033 |
| Kingston Area | Supply Capacity | The thermal capability of B5QK, which supplies Frontenac TS, is forecast to be exceeded. | 2038 |

# 7 Plan Options and Recommendations

In developing the plan, the Working Group considered a range of integrated options. Considerations in assessing alternatives included maximizing use of existing infrastructure, provincial electricity policy, feasibility, cost, and consistency with longer-term needs in the area.

Generally speaking, there are two approaches for addressing regional needs that arise as electricity demand increases:

1. Build new infrastructure to increase the load meeting capability of the area. These are commonly referred to as "wires" options and can include things like new transmission lines, autotransformers, step-down transformer stations, voltage control devices or upgrades to existing infrastructure. Wires options may also include control actions or protection schemes that influence how the system is operated to avoid or mitigate certain reliability concerns.
2. Install or implement measures to reduce the net peak demand to maintain loading within the system's existing load meeting capability. These are commonly referred to as "non-wires" alternatives and can include things like local utility scale generation, distributed energy resources, or conservation and demand management.

The IESO utilized a screening approach for assessing which needs would be best suited to undergoing a detailed assessment for non-wires alternatives, including CDM. The initial screening exercise examined the duration, frequency, timing, and magnitude of the need, as well as cost of traditional wires solutions, for each identified need.

Through this initial screening exercise, it was determined that non-wires alternatives should be assessed for the Frontenac TS capacity need.

## 7.1 Options for Meeting Near- to Medium-Term Needs

### Options for Meeting Station Capacity Needs

#### Options for Meeting the Belleville TS Station Capacity Need

The options that were considered for Belleville included but were not limited to the following:

1. An addition of a third transformer and station bus at Belleville TS,
2. A new Dual Element Spot Network (DESN) transformer station at Belleville, or
3. Load Transfers

Since Belleville TS does not currently have any distribution load transfer capability, due to a lack of adjacent stations, distribution load transfers were not explored further.

Each of the first two options are estimated to cost approximately $30-35 M. For a similar cost, option 2 provides more long-term capability and would also perform better under outage conditions.

The high-level cost estimates for wires options are provided by the transmitter, Hydro One. The intention of these high-level (or "planning") estimates are to enable comparison between options and are typically within an accuracy of +100%/-50%. The Regional Infrastructure Plan (RIP) following the IRRP will perform additional detailed analysis and refine these cost estimates before implementation work begins. The IESO will continue to participate in the Working Group during the RIP and revisit these recommendations if costs estimates differ significantly.

Installing a second DESN at Belleville TS will resolve the need until the end of the planning horizon (20 years). To fully utilize the additional capacity beyond the planning horizon, new supply lines into Belleville would be required. A reinforcement option considered beyond the 20 year planning horizon is to extend X21/X22 (radial lines to Picton/Napanee from Lennox) to Belleville. An initial network study was performed to assess the feasibility of this option and the results of the preliminary study showed that the new station's capacity can be fully utilized following this reinforcement. However, there might be upstream bulk system impacts with this option, therefore a full bulk planning study is needed to identify any impacts.

### Options to Meet the Kingston Area Station Capacity Needs

The Working Group has determined that the limitations of the existing supply to the area poses a risk to accommodating future load growth in the Kingston area. There is a risk that load will materialize sooner than expected as the Working Group is aware of several electrification initiatives on the horizon, identified by both the City and the LDCs for the area. There is also a risk that some of these initiatives may not take place or that they may not have as large an impact as forecast. In either scenario, there is a need for additional capacity at Gardiner TS DESN #1 and Frontenac TS.

Many options and combinations of options were explored by the Working Group and the most relevant ones will be described here.

- Non-wires alternatives: Simple Cycle Gas Turbine (SCGT) generator, Battery Storage
- Distribution load transfers - Permanent load transfers to a station with available capacity
- Increase capacity of the existing station(s) – through asset refurbishment and/or uprates
- A new station (new or existing site)

The capacity at Gardiner TS DESN #1 has already been exceeded today. However, Gardiner TS DESN #2 is adjacent to the station which allows for less complicated load transfers. It is important to note that Gardiner TS DESN #2 is a new transformer station, built in the last 15 years, and has capacity available on the order of 40 MW. The option of load transfers is usually the first avenue pursued as it is preferable to building additional transmission assets.

Hydro One Distribution has identified two load transfer options from Gardiner TS DESN #1 to Gardiner TS DESN #2, each transferring up to 11 MW of load. The first is relatively simple and low in cost while the second load transfer would require a new feeder position, increasing the relative cost.

Hydro One Transmission has identified a replacement plan for Gardiner TS DESN #1 as it is approaching end-of-life. The transformers will be replaced for a like to like replacement with new transformers however, the new transformer units will have a higher LTR and as such, will increase the capacity at the Gardiner TS DESN #1. The simpler 11 MW load transfer, paired with an uprate resulting from a "like-for-like" replacement of the station at Gardiner TS DESN #1, would completely address the reference forecast need over the 20-year planning horizon. With the second 11 MW load transfer the high growth forecast need can be met as well.

Turning to the need at Frontenac TS, the load transfer options available would be to transfer load from Frontenac TS to either Gardiner TS DESN #1 to Gardiner TS DESN #2. Currently, the distribution system in Kingston is operated in such a way that temporary load transfers between stations, ranging from 5 to 20 MW, are regularly utilized as a part of planned and emergency work. Performing a 10 MW load transfer to alleviate the need at Frontenac TS would compromise this flexibility and reduce the reliability of the system. Furthermore, net present value analysis suggests the load transfer would have to delay the need for a new transmission station by at least four years in order for this option to be economically favourable. Therefore, load transfer is an unfavorable option.

This IRRP maintains the long-term flexibility to respond to changes in demand for electricity in the future using cost-effective solutions, such as non-wires alternatives. In particular, smaller scale initiatives could have the potential to cost-effectively defer the need for a conventional solution (i.e. "wires" options), especially when paired with other measures such as energy efficiency. These cost-effective solutions can also be deployed to help delay or reduce large capital investments in transmission and distribution infrastructure. Value is created by delaying the date at which transmission and distribution equipment needs to be expanded, providing optionality. Timing permitting, optionality value allows more time to understand load growth and emerging trends prior to making significant infrastructure investments which reduces the risk of underutilized and/or stranded assets.

The Working Group also examined the feasibility of implementing non-wires resources to reduce the forecast demand in the area and defer the need for a new station or existing station expansion. These potential resources were considered both on an individual basis and as a package of solutions. Figure 7-1 shows that a capacity need exists at all times in the year 2038 at Frontenac station which means the solution will need to address a large scale need.

**Figure 7-1 | Need Characterization Heat Map Frontenac 2038**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 3% | 0% | 0% | 0% |
| 8 | 3% | 5% | 0% | 0% | 0% | 0% | 0% | 0% | 3% | 0% | 0% | 0% |
| 7 | 3% | 5% | 0% | 0% | 0% | 0% | 0% | 3% | 3% | 0% | 0% | 0% |
| 6 | 3% | 10% | 0% | 0% | 0% | 0% | 0% | 3% | 8% | 0% | 0% | 0% |
| 5 | 5% | 10% | 0% | 0% | 0% | 0% | 3% | 3% | 8% | 0% | 0% | 5% |
| 4 | 5% | 10% | 0% | 0% | 0% | 0% | 3% | 3% | 8% | 0% | 0% | 8% |
| 3 | 8% | 13% | 0% | 0% | 0% | 0% | 3% | 3% | 13% | 0% | 0% | 10% |
| 2 | 10% | 15% | 0% | 0% | 0% | 0% | 3% | 3% | 13% | 0% | 0% | 15% |
| 1 | 15% | 23% | 0% | 0% | 0% | 0% | 8% | 5% | 13% | 0% | 0% | 18% |
| 0 | 15% | 25% | 0% | 0% | 0% | 0% | 10% | 5% | 20% | 0% | 0% | 25% |
| MNTH | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

The analysis for non-wires alternatives identified that an SCGT, battery storage, and energy efficiency as viable solutions for the reference scenario need at Frontenac station. In the year 2038, there is a 10 MW need at Frontenac station under reference forecast, and the station capacity need starts to arise in the year 2029.

Cost estimates for generation and other non-wires alternatives are based on benchmark capital and operating cost characteristics for each resource type and size. Generally speaking, the most cost-effective transmission-connected options for meeting local needs in this region are resources with performance and costs on par with SCGT generators, depending on the relative size of the capacity versus energy requirements. New natural gas-fired generation was considered in the economic analysis for illustrative purposes to represent the cost of new generation. In some cases, battery storage such as lithium nickel manganese cobalt oxide (NMC) batteries are also becoming competitive due to declining technology costs and the expectation of carbon prices increasing in line with federal policy. Other distributed energy resources, which are typically distribution-connected are also considered. The most cost-effective distributed options are typically a combination of smaller-scale storage and demand response. For each of the above options, the system capacity value is "credited" back to arrive at the net cost to meet local reliability needs. This is done to ensure a level playing field comparison between resources that provide capacity and wires options that address the local need but do not provide system capacity benefits.

Both the upfront and operating cost of the wires options, generation, and distributed energy resources are compiled to generate levelized annual capacity costs ($/kW-yr) over the lifespan of the asset in question for each option. The net present value (NPV) of these levelized costs are the primarily basis through which options are compared.

The costs to implement an SCGT (10 MW) is on the order of $20 M and would defer the need by 10 years, if implemented in 2029. A battery storage solution (10 MW) could defer the need by 10 years as well at an estimated cost of $7 M[15]. After which, a new station is needed. Further, results show that targeted incremental energy efficiency in the area could provide upwards of 15 MW of peak capacity savings by 2030. The costs mentioned here are inclusive of system benefits and present the net value and cost.

To evaluate the combination of these alternatives to delay larger investments, the Working Group considered costs, in terms of NPV. The outcome, in order of highest cost to lowest cost of the combinations are as follows: SCGT [2029] & Station [2038] ($42M), Station [2029] ($30M), Battery [2029] and Station [2038] ($28M). Non-wires solutions for the reference scenario may be useful in addressing the mid-term need and delaying the need for a station, however, barriers exist to both implementation and appropriate allocation of costs to ensure these solutions are cost effective for the local area.

The discussion above only applies to the reference scenario and if a higher growth scenario were to occur then the individual non-wires solutions would no longer be sufficient to meet the need. For the high growth scenarios, the SCGT option was screened out due to high costs. Two different approaches were considered for the high growth scenario in terms of battery solutions: the longest possible deferral of need and the maximised ratio between cost and time of deferral. The order according to cost, from highest to lowest, for combinations of options is: 26 MW Battery [2025] and Station [2032] ($50M), 10 MW Battery [2025] and Station [2027] ($43M), and Station [2025] ($35M).

The Working Group acknowledges that the deferment benefit that a non-wires alternative could provide is highly dependent on how load growth materializes. For the reference forecast, the non-wires alternatives are close in cost to the traditional wires option but if a high growth scenario materializes overall cost would then increase.

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[15] After accounting for system benefit achieve by providing support to meet system adequacy/capacity needs

The Working Group next considered some high level review of how a new transformer station should be supplied. In the vicinity, there are two stations – Frontenac TS supplied from the 115 kV system and Gardiner TS supplied from the 230 kV. Frontenac TS is supplied by two 115 kV circuits on separate tower lines. Frontenac TS supplies the Central downtown Kingston area south of Highway 401 as well as the area north of Highway 401 and East of the Cataraqui River. Gardiner TS (DESN #1 & #2) is supplied by the 230 kV system via a double circuit tower line. Gardiner TS supplies the area east of Cataraqui River as well as the area north of Highway 401 and west of the Cataraqui River.

When assessing the options for a new 115 kV supplied station versus a new 230 kV supplied station the analysis showed the 230 kV station to be more favourable for the following reasons. First, in order to build a 115 kV station the two circuits would need to be reinforced in order to meet transmission criteria and ensure load can be supplied during a contingency event. Second, due to upstream constraints on the 115 kV system, it would not be possible to supply the load of an uprated Frontenac TS or a new 115 kV station without considerable upgrades to the Cataraqui autotransformers. Third, building a new 230 kV station in close proximity to the existing 230 kV double circuit tower line may require less additional transmission line work than the 115kV system and also, the 230 kV system can fully supply a new station, without capacity constraints.

The Working Group has confirmed that a new 230 kV station site west of Frontenac TS appears to be the most cost effective option that could help meet the identified needs into the long term, however this option will require Hydro One Distribution to build long feeders to supply customers east of the Cataraqui River. The Working Group has also confirmed that a new 230 kV station east of Frontenac TS would be preferable from a distribution upgrade perspective, however this option has high cost of transmission line extensions within the urban area of Kingston. The Working Group acknowledges that the citing of a new station requires a consideration to balance the cost required to extend 230 kV transmission lines to supply the station versus extending distribution lines required to serve the load. The timing and citing of the station is to be coordinated between the transmitter and the LDCs at which point the trade offs, which could include consideration of how to distribute load between the new and existing stations to manage overall distribution costs, will be considered.

## Options for Addressing Supply Capacity Needs

### Options for Addressing the Peterborough to Quinte West Supply Capacity Need

The IRRP considered a number of options to address the Peterborough to Quinte West supply capacity need that included and were not limited to the following:

1. Building new transmission supply capacity supplying Dobbin TS
2. Building new transmission supply capacity supplying Sidney TS
3. Siting a new generating resource at Sidney TS

However, this need requires a coordination with the Gatineau Corridor End-of-Life Study to ensure the broader system is considered when reviewing and resolving this need and will be addressed through that study.

### Options for Addressing the Cataraqui Autotransformers Supply Capacity Need

The Cataraqui autotransformers have a summer long-term emergency rating of 250 MW. This rating is currently limited by the transformer secondary conductors. A cost effective way to increase the thermal ratings on these autotransformers is to upgrade the transformer secondary conductors, improving the long-term emergency rating without having to upgrade the autotransformers. Upgrading the transformer secondary conductor increases the long-term emergency rating to 285 MW for an estimated cost of $0.5M.

Non-wires alternatives were screened out at an early stage due to the low cost and low impact of the identified secondary conductor replacement solution. Therefore, this IRRP recommends upgrading the transformer secondary conductors and reassessing whether additional capacity will be required as part of the Lennox to St. Lawrence bulk system study.

## End-of-Life Refurbishment Options and Recommendations

Port Hope TS is supplied by the 115 kV system between Dobbin TS and Frontenac TS. Port Hope TS is reaching end-of-life in 2025. Generally, options considered for end-of-life replacements include:

- Replacement of the assets "like-for-like" or with the closest available standard;
- Reconfiguration of the existing assets to "right-size" the replacement option based on: the forecast load growth, changes to the use of the asset since it was originally installed, and reliability or other system benefits that an alternate configuration may provide; or
- Retirement of a facility, considering the impact on load supply and reliability.

Working Group assessments indicated that there are no opportunities for end-of-life optimization at this time and like-for-like replacements with the closest available standard can best address the End-of-Life need at Port Hope TS Recommended Near- to Medium-Term Plan

To address the needs identified, the Working Group recommends the actions described below to meet the near-and medium-term electricity needs of the Peterborough to Kingston region. Successful implementation of these actions, in addition to achievement of existing targeted conservation measures, is expected to address the region's electricity needs until the late 2020s /early 2030s under the reference forecast.

## Build a new 230 kV DESN transformer station at Belleville TS and monitor load growth

To address today's station capacity need at Belleville TS, as well as serve the growing electricity demand in the region, Elexicon and Hydro One (Transmission) are to initiate the development of a new DESN transformer station at Belleville, with an expected in-service date of 2025. This will increase the supply capacity to the region and will resolve the capacity need at Belleville TS until the end of the planning horizon.

Between planning cycles, the Working Group will continue to monitor the load growth at Belleville TS and re-visit the capacity need in the next regional planning cycle, in order to re-assess whether/when a re-enforcement to Belleville is required. Non-wires alternative such as energy efficiency can delay the implementation, and will be reviewed as part of the next regional planning cycle.

Furthermore, before the next planning cycle, the IESO should assess the bulk system impact of transmission reinforcement to Belleville TS should be included in the scope of a relevant individual bulk planning study for the area.

### Hydro One (Distribution) load transfer and advance end-of-life replacement at Gardiner TS DESN #1

To address the near-term capacity need at Gardiner TS DESN #1, Hydro One (Distribution) will complete a relatively low cost and low lead-time load transfer of 11 MW between Gardiner TS DESN #1 and Gardiner TS DESN #2 by 2022 as a first step.

In addition, Hydro One will explore advancing the end-of-life replacement of Gardiner TS DESN #1 transformers to increase the station capacity. Advancing the replacement date, combined with the load transfer, will address the Gardiner TS DESN #1 capacity need for the duration of the planning horizon for the reference load forecast.

The Working Group will continue to monitor load growth in the area to evaluate if a second 11 MW load transfer to Gardiner TS DESN #2 is required.

### Monitor load growth and initiate development and siting work to build a new 230 kV DESN transformer station in Kingston when needed

Building a new 230 kV station in Kingston, supplied by 230 kV circuits X2H and X4H, will address the local need for station capacity at both Frontenac TS and Gardiner TS over the long term and for multiple growth scenarios. Due to the uncertainty in the forecast, the timing of the need for the new station could be in the near to medium term, as late as 2029. Hence, Hydro One Distribution and Utilities Kingston will work together to monitor the load growth in the area, and trigger the development work, and ultimately the construction, of a new 230 kV supply station when there is sufficient certainty in the timing of new demand materializing.

### Address implementation and cost allocation barriers to cost-effectively deploying non-wires alternatives to defer needs

The development of a non-wire alternative, specifically additional energy efficiency or a local storage solution, could defer the new station ultimately required to accommodate load growth in the City of Kingston. This is cost-effective, under the reference load growth scenario, if cost-allocation can reflect the system benefits the non-wires alternative would provide. Additional barriers to implementation also exist around who would implement the solution and how they would seek cost-recovery, particularly if both benefiting LDCs were to implement a part of the solution. The IESO will work with impacted LDCs between regional planning cycles to address these barriers to implementation and cost allocation for a non-wires alternative, in tandem with developing plans for a new transformer station.

### Complete the ongoing Gatineau Corridor End-of-Life Study and implement recommendations

The outcomes of the Gatineau Corridor End-of-Life Study will improve the supply capability in the Peterborough to Kingston region. Namely, addressing the identified supply capacity need to Peterborough and Quinte West. By implementing the recommendations of the Gatineau Corridor End-of-Life study this need should be addressed.

### Upgrade Cataraqui autotransformers' secondary conductors and reassess as part of the Lennox to St. Lawrence bulk system study

Upgrading the autotransformers' secondary conductors will increase the thermal capacity of these autotransformers from 250 MW to 285 MW and will resolve the thermal violation after losing one of the autotransformers. A future Lennox to St. Lawrence bulk system study will reassess the need with this solution in place and study if additional capacity is required.

### Replace Port Hope TS T3/T4 with the closest available standard size transformers

Port Hope TS T3/T4 are reaching end-of-life and there are no opportunities for end-of-life optimization at this time. This IRRP recommends like-for-like replacements with the closest available standard size transformers of equal or greater capacity.

## 7.2 Options for Meeting Long-Term Needs

For needs appearing in the long term, there is an opportunity to develop and explore options, as specific projects do not need to be committed immediately. This approach is designed to: maintain flexibility; avoid committing ratepayers to investments before they are needed; provide adequate time to assess the success of current and future potential conservation measures in the study area; test emerging technologies; engage with communities and stakeholders; and lay the foundation for informed decisions in the future.

### Option for Meeting Supply Capacity Needs

#### Options for Meeting the Peterborough to Quinte West Supply Capacity Needs

Similar to the Cataraqui autotransformers need, the Peterborough to Quinte West pocket voltage need relates to the Peterborough to Quinte West supply need where it is expected that any reinforcement made to the Peterborough to Quinte West area supply, such as those contemplated in the Gatineau Corridor End-of-Life Study, will naturally resolve the under voltage violations observed in this pocket.

#### Options for Meeting the Kingston Transmission Supply Capacity Needs

Since this need starts to substantiate beyond the planning horizon following the reference forecast, early development work for a transmission line upgrade is not required at this time.

There may be opportunities for the Working Group to work with communities and local utilities to manage future electricity demand through the development of community-based solutions under the IESO's new CDM Framework or other mechanisms or opportunities that may evolve between planning cycles.

## 7.3 Recommended Long-Term Plan

A number of alternatives are possible to meet the region's long-term needs. While specific solutions do not need to be committed to today, it is appropriate to begin work now to gather information, monitor developments, engage the community, and develop alternatives to support decision making in the next iteration of the IRRP. The long-term plan sets out the near-term actions required to ensure that options remain available to address future needs if and when they arise.

The recommended actions for the long-term plan are outlined below.

### Monitor the Peterborough to Quinte West 115 kV system voltage performance following the recommendations of the Gatineau Corridor End-of-Life Study

Low voltage violations are observed in the long-term planning horizon in the Peterborough to Quinte West 115 kV pocket. These violations may naturally be resolved by the outcome of the Gatineau Corridor End-of-Life Study; therefore, this need will be monitored and re-assessed following the Gatineau Corridor End-of-Life Study plan during the next planning cycle.

### Monitor Kingston Area Transmission Supply Capacity Needs

The IESO should re-evaluate the capacity need on B5QK periodically and explore non-wire solutions with the Working Group and communities as appropriate.

### Monitor demand growth, conservation achievement and distributed generation uptake

On an annual basis, the IESO, with the Working Group, will review CDM achievement, the uptake of provincial distributed generation (DG) projects, and actual demand growth in the Peterborough to Kingston Region. This information will be used to determine when decisions on the long-term plan are required, and to inform the next cycle of regional planning for the area. Information on CDM and DG is also a useful input into the ongoing development of non-wires alternatives as potential long-term solutions.

### Initiate the next regional planning cycle early, if needed

Along with the indices outlined above, the Working Group will monitor changes in growth targets, progress in electrification in the region, and any significant changes in forecast growth. If monitoring activities determine that the region's growth is exceeding the load forecast (the high demand forecast in Belleville and Kingston, or the reference demand forecast in the remainder of the region), it may be necessary to initiate the next iteration of the regional planning process earlier than 2024 given the lead time for the long-term supply options.

## 7.4 Summary of Recommended Actions and Next Steps

Table 7-1, below, summarizes the specific recommendations that should be implemented immediately to address the most imminent electricity supply needs in the Peterborough to Kingston region.

**Table 7-1 | Summary of 2021 Peterborough to Kingston IRRP Recommendations**

| Need | Recommendation | Lead Responsibility | Estimated Cost | Timeline |
|---|---|---|---|---|
| Belleville Station Capacity | Build a new Dual Element Spot Network (DESN) transformer station at Belleville | Elexicon and Hydro One Transmission | ~$30-35M | Beginning in 2021 |
| Kingston Area Station Capacity – Frontenac TS | Monitor load and trigger development work, and ultimately construction, for a new 230 kV transformer station, when required.<br>Continue development of energy efficiency programs for the area | Utilities Kingston, Hydro One Distribution, Hydro One Transmission<br>IESO | ~$30-35M | Station needed between 2025 and 2029 depending on forecast scenario. |
| Kingston Area Station Capacity – Gardiner TS DESN #1 | Perform permanent 11 MW load transfer to Gardiner TS DESN #2. Hydro One transmission to perform end-of-life refurbishment of the station, therby increasing LTR. LDCs to monitor load and evaluate the second 11 MW load transfer, if required, as it has a high cost ($5.5M), which is not included in the estimate). | Hydro One Distribution, Hydro One Transmission | ~$0.5M | First Load transfer: 2022<br>Refurbishment: as soon as possible (2024-2025)<br>Second Load Transfer: explore it, if required |
| Port Hope TS | Replace Port Hope TS T3/T4 with the closest available standard size transformers | Hydro One Transmission | Cost of refurbishment incurred by Hydro One Transmission | Beginning in 2025 |
| Cataraqui Autos Supply Capacity | Upgrade Cataraqui Autotransformers' secondary conductors | Hydro One Transmission | ~$0.5M | Early 2024 |

The Working Group has also identified the following additional planning activities to address ongoing regional planning needs

| Need | Recommendation | Lead Responsibility | Timeline |
|---|---|---|---|
| Peterborough to Quinte West Area | Complete the ongoing Gatineau Corridor End-of-Life Study and implement recommendations | IESO | Early 2022 |
| Cataraqui Autos Supply Capacity | Following the conductor upgrade, review this need in further detail as part of Lennox to St. Lawrence bulk study. | IESO | 2023 |

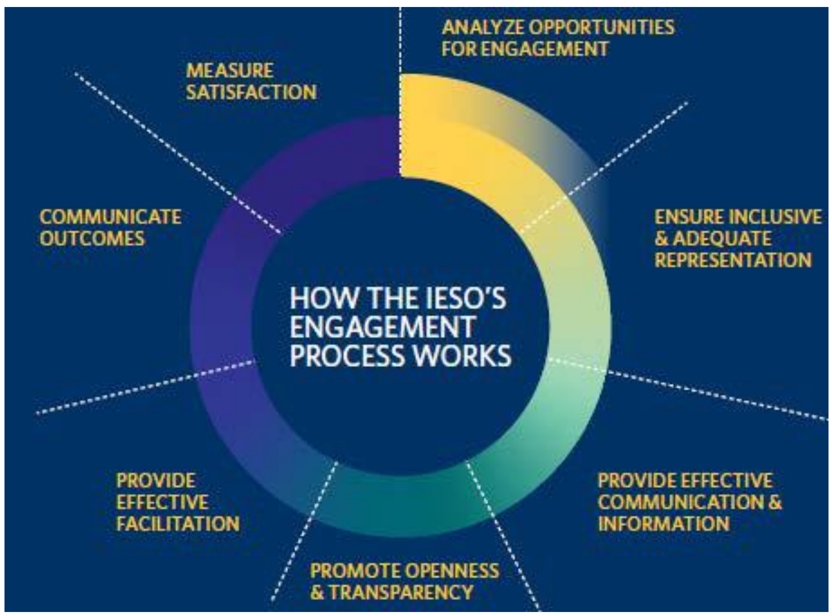
# 8 Engagement

Engagement is critical in the development of an IRRP. Providing opportunities for input in the regional planning process enables the views and preferences of communities to be considered in the development of the plan, and helps lay the foundation for successful implementation. This section outlines the engagement principles as well as the activities undertaken to date for the Peterborough to Kingston IRRP.

## 8.1 Engagement Principles

The IESO's engagement principles[16] help ensure that all interested parties are aware of and can contribute to the development of this IRRP. The IESO uses these principles to ensure inclusiveness, sincerity, respect and fairness in its engagements, striving to build trusting relationships as a result.

**Figure 8-1 | The IESO's Engagement Principles**




## 8.2 Creating an Engagement Approach for Peterborough to Kingston

The first step in ensuring that any IRRP reflects the needs of community members and interested stakeholders is to create an engagement plan to ensure that all interested parties understand the scope of the IRRP and are adequately informed about the background and issues in order to provide meaningful input on the development of the IRRP for the region. Creating the engagement plan for this IRRP involved:

- Discussions to help inform the engagement approach for the planning cycle;
- Communications and other engagement tactics to enable a broad participation, using multiple channels to reach audiences; and

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[16] https://www.ieso.ca/en/sector-participants/engagement-initiatives/overview/engagement-principles

- Identifying specific stakeholders and communities who may have a direct impact on this initiative and that should be targeted for further one-on-one consultation, based on identified and specific needs in the region

As a result, the engagement plan[17] for this IRRP included:

- A dedicated webpage[18] on the IESO website to post all meeting materials, feedback received and IESO responses to the feedback throughout the engagement process;
- Regular communication with interested communities, rights-holders and stakeholders by email or through the IESO weekly Bulletin;
- Public webinars;
- Web-conferencing meetings; and
- One-on-one outreach with specific stakeholders to ensure that their identified needs are addressed (see Section 8.4 Bringing Municipalities to the Table).

## 8.3 Engage Early and Often

Early communication and engagement activities began with invitations to all subscribers, municipalities, Indigenous communities and rights-holders in the Peterborough to Kingston Region to learn about and provide comments on the draft Scoping Assessment Outcome Report. The IESO also held preliminary discussions to help inform the engagement approach for this first active cycle of formal regional planning. This started with an invitation to targeted municipalities, Indigenous communities, rights-holders and those with an identified interest in regional issues to help inform the engagement approach and. learn more about how to provide comments on the Peterborough to Kingston Scoping Assessment Report before it was finalized.

Feedback was received and focused on the need to consider local economic development and impacts to service when undertaking planning activities as part of implementation of recommended work. Feedback in early discussions also emphasized the importance of aligning community energy and climate action plans, electrification targets and other planning initiatives in the development of the IRRP. Along with a response to the feedback received, the final Scoping Assessment was posted in May 2020 which identified the need for a coordinated regional planning approach done through an IRRP for the Peterborough to Kingston Region. The final Scoping Assessment, identified the need for an IRRP for the Peterborough to Kingston Region. Following a written comment window, the final Scoping Assessment Outcome Report was published in May 2020.

[17] https://www.ieso.ca/-/media/Files/IESO/Document-Library/engage/KWCG-Region/KWCG-Engagement-Plan.ashx

[18] https://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Integrated-Regional-Resource-Plan-Kitchener-Waterloo-Cambridge-Guelph

Outreach then began with targeted communities to inform early discussions for the development of the IRRP including the IESO's approach to engagement. The launch of a broader engagement initiative followed with an invitation to subscribers of the Peterborough to Kingston region to ensure that all interested parties were made aware of this opportunity for input. Three public webinars were held at critical stages during the IRRP development to give interested parties an opportunity to hear about progress and provide comments on key components of the plan. All webinars received strong participation with cross-representation of stakeholders and community representatives attending the webinar, and submitting written feedback during a 21-day comment period.

The three stages of engagement invited input on:

1. The draft engagement plan, the electricity demand forecast and the early identified needs to set the foundation of this planning work.

2. The defined electricity needs for the region and potential options to meet the identified needs.

3. The analysis of options and draft IRRP recommendations.

Comments received during this engagement focused on the following major themes:

• Consideration should be given to local developments and growth plans

• Alignment and coordination is needed with other community planning and projects in the region. Future infrastructure and/or electricity supply should consider the priorities of energy and climate action plans and, in particular, plans for fuel switching in the municipal, commercial and residential sector, as well as vehicle electrification

• Incorporate shifting economies into planning assumptions and cost benefit analysis

• Integrated options that provide both local and broader provincial system benefit should be considered

• Recommendations for the near and mid term should be based on a high demand growth scenario, and provide flexibility for the long term should additional increased demand materialize as a result of electrification plans

Feedback received during the written comment periods for these webinars helped to guide further discussion throughout the development of this IRRP as well as add due consideration to the final recommendations. This includes using a high-demand forecast scenario to shape the development of the IRRP as a result of community feedback on local plans for electrification.

All interested parties were kept informed throughout this engagement initiative via email to Peterborough to Kingston region subscribers, municipalities and communities as well as the members of the East Regional Electricity Network.

Based on the discussions both through the Peterborough to Kingston IRRP engagement initiative and broader network dialogue, it is clear that there is broad interest in several East Ontario communities to further discuss the potential for alternative energy solutions. The near- to medium-term nature of the Peterborough to Kingston region's future electricity needs presents a valuable opportunity for communities to mobilize projects and initiatives to meet local growth targets and energy priorities. To that end, ongoing discussions will continue through the IESO's East Regional Electricity Network to keep interested parties engaged on local developments, priorities and planning initiatives.

All background information, including engagement presentations, recorded webinars, detailed feedback submissions, and responses to comments received, are available on the IESO's Peterborough to Kingston IRRP engagement web page.

## 8.4 Bringing Municipalities to the Table

The IESO held meetings with municipalities to seek input on their planning priorities and to ensure that these plans were taken into consideration in the development of this IRRP. At major milestones in the IRRP process, meetings were held with municipalities in the region to discuss: key issues of concern, including forecast regional electricity needs; community energy and climate action plans, options for meeting the region's future needs; and, broader community engagement. These meetings helped to inform the municipal/community electricity needs and priorities and provided opportunities to strengthen this relationship for ongoing dialogue beyond this IRRP process.

## 8.5 Engaging with Indigenous Communities

To raise awareness about the regional planning activities underway and invite participation in the engagement process, regular outreach was made to Indigenous communities and rights-holders within the Peterborough to Kingston electricity planning region throughout the development of the plan. This includes the communities of Alderville First Nation, Hiawatha First Nation, Curve Lake First Nation, Mohawks of the Bay of Quinte, Tyendinaga Mohawk, Kawartha Nishnawbe and the traditional territory of the Huron Wendat.

The IESO remains committed to an ongoing, effective dialogue with communities and First Nation rights-holders to help shape long-term planning in regions all across Ontario.

# 9 Conclusion

This report documents an IRRP that has been developed for the Peterborough to Kingston region, and identifies regional electricity needs and opportunities to preserve or enhance electricity system reliability for the next 20 years. The IRRP makes recommendations to address near- to medium-term issues, and lays out actions to monitor, defer, and address long-term needs.

To support the development of the plan, this IRRP includes recommendations with respect to developing alternatives, and monitoring load growth and efficiency achievements. Responsibility for these actions will be undertaken by the appropriate members of the Working Group.

The Working Group will continue to meet at regular intervals to monitor developments and track progress toward plan deliverables. In the event that underlying assumptions change significantly, local plans may be revisited through an amendment, or by initiating a new regional planning cycle sooner than the five-year schedule mandated by the OEB.

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