Greater Toronto Area West (Peel/Halton)

Integrated Regional Resource Plan

July 2021

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List of Acronyms

Acronym	Definition
CCAP	Climate Change Action Plan
CCGT	Combined Cycle Gas Turbine
CDM	Conservation and Demand Management
CEP	Community Energy Plan
DER	Distributed Energy Resource
DG	Distributed Generation
ERP	Enabling Resource Program
FETT	Flow East Towards Toronto
GS	Generating Station
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Plan
LDC	Local Distribution Company
LTE	Long-term Emergency (Equipment Rating)
MTO	Ministry of Transportation
NCM	Lithium Nickel Manganese Cobalt Oxide
NERC	North American Electric Reliability Corporation
OEB	Ontario Energy Board
ORTAC	Ontario Resource and Transmission Assessment Criteria
RIP	Regional Infrastructure Plan
SCGT	Simple Cycle Gas Turbine
STE	Short-term Emergency (Equipment Rating)
TS	Transformer Station

This Integrated Regional Resource Plan (IRRP) was prepared by the Independent Electricity System Operator (IESO) 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 Greater Toronto Area West (GTA West) region which included the following members:

Independent Electricity System Operator

Hydro One Networks Inc. (Distribution)

Hydro One Networks Inc. (Transmission)

Alectra Utilities

Burlington Hydro Inc.

Milton Hydro Distribution Inc.

Oakville Hydro Electricity Distribution Inc.

Halton Hills Hydro

The Working Group assessed the reliability of electricity supply to customers in the GTA West Region over a 20-year period beginning in 2019; developed a plan that considers opportunities for regional 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 GTA West Working Group members agree with the Integrated Regional Resource Plan (IRRP)'s recommendations and support implementation of the plan, subject to obtaining necessary regulatory approvals and appropriate community consultations. The GTA West Working Group members do not commit to any capital expenditures and must still obtain all necessary regulatory and other approvals to implement recommended actions.

1. Introduction

This Integrated Regional Resource Plan (IRRP) addresses the electricity needs of the Greater Toronto Area West region (GTA West) over the next 20 years from 2019 to 2038. The GTA West region is located in central Ontario and includes the Regional Municipalities of Halton and Peel. The region includes the area roughly bordered geographically by Highway 27 to the north east, Highway 427 to the south east, Regional Road 25 to the west, King Street to the north and Lake Ontario to the south. The GTA West region comprises the municipalities of Brampton, Caledon, Halton Hills, Mississauga, Milton, Oakville and portions of Burlington.

During discussions with communities, the IESO received feedback that the name "GTA West Regional Planning" was challenging to differentiate from other initiatives underway in the area with a similar naming convention, thus, the region was changed to "Peel/Halton (GTA West) Region" for engagement purposes. Official planning documents continue to adhere to the regulatory name of "GTA West Region".

The GTA West region is summer peaking and, over the last five years, electrical demand has grown on average by 1.3% per year. Electrical supply to the GTA West region is provided through 500/230 kV autotransformers at Trafalgar TS and at Claireville TS and 230 kV transmission lines and step-down transformation facilities as shown in Figure 1.1. The GTA West Region is defined electrically by the 230 kV transmission circuits bounded by Claireville TS, Richview TS and Manby TS to the east and Burlington TS to the west. Local generation in the area includes two gas fired plants: the 1250 MW Goreway Generating Station (GS) in Brampton and the 600 MW Halton Hills GS in Halton Hills.

The region's electricity is delivered by six local distribution companies (LDCs): Hydro One Networks, Alectra Utilities, Burlington Hydro, Milton Hydro Distribution, Oakville Hydro Electricity Distribution, and Halton Hills Hydro. Hydro One Networks is also the primary transmission asset owner. This IRRP report was prepared by the Independent Electricity System Operator (IESO) on behalf of a Working Group composed of the aforementioned LDCs and transmitter.

Development of the GTA West IRRP was initiated in August 2019 following the publication of the Needs Assessment report in May 2019 by Hydro One and the Scoping Assessment Outcome Report in August 2019 by the IESO. The Scoping Assessment identified needs that should be further assessed through an IRRP. The Working Group was then formed to gather data, identify near- to long-term needs in the region and develop the recommended actions included in this IRRP.

This report is organized as follows:

- A summary of the recommended plan for the 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 region and the study scope are discussed in Section 4;

- Demand forecast scenarios, and conservation and demand management and distributed generation assumptions, are described in Section 5;
- Electricity needs in the region are presented in Section 6
- Alternatives and recommendations for meeting needs are addressed in Section 7
- A summary of engagement to date and moving forward is provided in Section 8; and
- The conclusion is provided in Section 9

Figure 1.1 | Geographical area of the GTA West region with electrical layout

2. The Integrated Regional Resource Plan

This Integrated Regional Resource Plan (IRRP) provides recommendations to address the electricity needs of the GTA West 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) and reliability standards governed by the North American Electric Reliability Corporation (NERC). The IRRP's recommendations are informed by an evaluation of options, representing alternative ways to meet the needs, that consider: reliability, cost, technical feasibility, maximizing the use of the existing electricity system (where economic), and feedback from stakeholders.

The GTA West electricity demand forecast projects sustained growth driven by urbanisation and development particularly in the northern areas of the region. Municipalities have also published community energy plans and/or climate change action plans that call for greater electrification which could drive additional upward pressure on the demand forecast.

The IRRP recommendations below are organized under a near-/medium-term plan and a long-term plan. This distinction reflects the different levels of forecast certainty, lead time for development, and planning commitment required over these time horizons. This approach ensures that the IRRP provides clear direction on investments needed in the near future while remaining flexible to new information as electrification, energy efficiency, and development plans evolve.

2.1 Near-/Medium-Term Plan

The near- and medium-term plan is comprised of several recommendations to accommodate load growth, maintain reliability, and optimize end-of-life asset replacement. The recommendations are summarized in Table 2.1 and further discussed below.

Table 2.1 | Summary of Near-/Medium-term Plan for the GTA West Region

Need Description	Recommendation	Lead Responsibility	Required By
After a loss of either H29 or H30, the remaining circuit will exceed its LTE rating	H29/H30 reconductoring	Hydro One	2025
After a loss of V42H and H29, R19TH will exceed its LTE rating. After a loss of V41H and H30, R21TH will exceed its LTE rating	Control actions and/or load rejection scheme	Hydro One	Today

Need Description	Recommendation	Lead Responsibility	Required By
Transformers T3 and T4 at Palermo TS will reach end-of-life	Upsize transformers at end-of-life to the larger 75/125 MVA transformers	Hydro One	2025
Simultaneous loss of both T38B and T39B would result in over 600MW of load being lost by configuration	Further analysis of wires options including circuit sectionalisation and/or reterminating supply stations	Hydro One	2025
30-minute load restoration following V41H/V42H, R19TH/R21TH, and R14T/R17T6 contingencies	Investigate opportunities to enhance distribution load transfer capabilities	LDCs with loads on impacted circuits	Ongoing

2.1.1 H29/H30 Reconductoring

When load at Pleasant TS exceeds approximately 417 MW and one of the H29/30 circuits that supplies Pleasant TS is out of service, there is a potential for overloads on the companion circuit. This need was originally identified in the 2015 Northwest GTA IRRP and upgrading the H29/H30 circuits with conductors of a higher rating was recommended. At the time, the demand forecast was only expected to reach 417 MW in 2033 but the IRRP recognized that this timing could change significantly if higher growth or lower conservation adoption materialized and consequently recommended that the load at Pleasant TS should be monitored and the reconductoring work should be pursued when demand reaches approximately 400 MW.

As discussed in the 2019 GTA West Scoping Assessment report, the role of the current IRRP is to update the implementation timing of this upgrade, not further investigate alternatives to it, given the relatively straightforward scope. The current forecast for Pleasant TS projects demand to reach 417 MW by 2027. However, the observed 2020 summer peak demand was much higher than anticipated and reached 410 MW during a July heat wave. At this time, it is still unclear whether this is an isolated event related to the ongoing COVID-19 pandemic and associated electricity consumption patterns or if this will be an enduring trend. Given that the lead time required to implement the reconductoring work will be at least three years, the IRRP recommends that Hydro One should begin implementation as soon as possible for a targeted in-service date around 2025.

2.1.2 Pleasant TS Control Actions

Post-contingency thermal violations during outage conditions are expected to occur on the R19TH/R21TH circuits leading into Hurontario SS by 2021. This type of contingency is expected to be very infrequent since it only occurs under the confluence of peak load conditions, hot weather, pre--existing forced outage on one element and a subsequent contingency on another. As a result, this need is most economically managed by control actions or load rejection schemes. Alternative options considered are further discussed in Section 7.2.

In the near- to medium-term, the overloads on R19TH/R21TH are expected to exceed their long-term emergency (LTE) but not their short-term emergency (STE) rating. During this period, manual post--contingency control actions such as unloading one of the two transformers at Jim Yarrow TS can provide relief by reducing circuit loading below the LTE rating provided that such actions can be completed within 15 minutes. As load continues to grow, the overloads are expected to exceed STE by 2038 at which point an automatic load rejection scheme at Pleasant TS will be required. The IRRP recommends that the Regional Infrastructure Plan (RIP) led by Hydro One should develop and implement control actions as soon as possible.

2.1.3 Upsizing Palermo TS at End-of-Life

The existing T3 and T4 transformers at Palermo TS will reach end-of-life in 2025. Palermo TS is fully utilized today and there is no remaining capacity for growth. Tremaine TS, a nearby station, is also expected to exceed capacity in 2033.

Refurbishing Palermo TS with larger 75/125 MVA transformers would require significant station reconfiguration. However, Hydro One indicated that the yard itself is in relatively poor condition, had recently been downgraded, and will likely need to be replaced in less than 10 years regardless of the transformer size chosen. Based on planning-level cost estimates, the cost of upsizing Palermo TS when its transformers reach end-of-life in 2025 is substantially more cost-effective than the alternative of refurbishing Palermo TS like-for-like in 2025 followed by subsequent upsizing or building a new station when capacity needs arise in 2033. This financial analysis is further discussed in Section 7.3. The IRRP recommends that the RIP should perform additional analysis to reaffirm the cost estimate and develop an implementation plan for upsizing Palermo TS in 2025.

2.1.4 Further Wires Analysis for T38B/T39B Load Security

The load security need on T38B/T39B was initially documented in the 2015 Northwest GTA IRRP and was expected to materialized between 2024 and 2026. No firm recommendation was made at the time because the need was still approximately 10 years off and future bulk system reinforcements along the Flow East Towards Toronto (FETT) interface may also address the load security need.

The current IRRP forecast reaffirms that the load security need is expected to materialize in 2025. Furthermore, in December 2020, the IESO determined that the most suitable and cost-effective bulk system FETT interface reinforcement are conductor upgrades to the Richview TS x Trafalgar TS 230 kV transmission lines which does not resolve the load security need on T38B/T39B. The FETT interface bulk study is further discussed in Section 4.2.

The IRRP considered the merits of generation, non-wires options and an integrated transmission option, the Hurontario SS x Meadowvale TS transmission reinforcement, that could simultaneously improve bulk system transfer capabilities and help alleviate the load security need on T38B/T39B. Ultimately, wires options such as reterminating Tremaine TS on the companion T36B/T37B circuits or installing breakers at Lantz Junction to sectionalize T38B/T39B are the most suitable and -cost-effective solution at this time. The options analysis is further discussed in Section 7.4.

The IRRP recommends that the RIP should perform detailed analysis to further refine the technical feasibility and costs of these wires options. As part of this work, the RIP should update the near-term load forecast for the stations served on T38B/T39B. The IRRP also recognizes that there may be merit in applying to the IESO for an ORTAC exemption to accept a lower performance level for a few years until future FETT transfer capability needs in the late 2020's are known given the potential integrated nature of the solutions that could address these needs. The IESO will continue to participate in the RIP technical working group to provide advice and input on this matter.

2.1.5 Explore Opportunities to Enhance Distribution Transfer Capabilities

All stations in the GTA West region have dual supply meaning that no load would be lost by configuration for any single contingency. However, there are multiple areas in the GTA West region where major transmission contingencies (such as the simultaneous loss of two elements) would interrupt supply to many customers and where full restoration would be delayed until the transmission contingency has been cleared. The GTA West region is a densely populated and well serviced area so it is assumed that all contingencies can be restored within eight hours consistent with ORTAC load restoration criteria. Most major contingencies have historically been of short duration due to close proximity to staffed maintenance centres. Of the remaining restoration criteria, the 30-minute restoration of all load lost above 250 MW is the most limiting since it relies on remote control actions such as emergency distribution load transfers.

As discussed in the Scoping Assessment, major infrastructure solutions such as new transmission facilities are not generally appropriate since the cost of the solution would exceed the expected benefit to customers. However, restoration needs were kept in scope for this IRRP to evaluate if planned infrastructure solutions for other needs can be modified in ways that maximize restoration capability.

Of the double circuit contingencies where the 30-minute restoration criteria cannot be met, infrastructure solutions for H29/H30 was deemed uneconomic in the previous IRRP due to the high cost and low probability of the contingency occurring while T38B/T39B restoration needs can be significantly improved through the wires options discussed in the previous section for addressing load security.

There remain three double contingencies that are at risk of not meeting 30-minute restoration criteria: V41H/V42H, R19TH/R21TH, and R14T/R17T. At this time, there are no planned infrastructure reinforcements for other needs that can also help improve load restoration on these circuits. However, the IRRP recommends that local distributors, in conjunction with Hydro One where appropriate, investigate opportunities to improve distribution load transfer capability from the stations supplied on these circuits to other nearby stations to maximize restoration capability.

In the long term, future transmission reinforcement projects such as the NW GTA Transmission Corridor can help improve load restoration by providing additional supply points from which northern loads can be restored.

2.2 Long-Term Plan

In addition to the near- and medium-term plan above, there are four items to monitor and develop in the long term.

2.2.1 Monitor Halton Pocket Growth and T38B/T39B Reconductoring

During an outage to Halton Hills GS, post-contingency thermal violations on T38B/T39B are expected to occur by 2031. The thermal violation is on a short 400-meter section of T38B/T39B immediately north of Lantz Junction. This radial portion of T38B/T39B serves the Halton Pocket including Trafalgar DESN, Halton TS, Halton TS #2, Halton MTS, and Meadowvale TS.

Reconductoring the limiting section is the most cost-effective option. The options analysis is further discussed in Section 7.5. Given the timing of the need, no firm recommendation is required at this time. The Working Group will continue to monitor load growth in the Halton Pocket and revisit this need, and its potential alternatives, in the next cycle of regional planning.

2.2.2 Monitor Growth at Cardiff TS and Jim Yarrow TS

Cardiff TS and Jim Yarrow TS are expected to reach capacity in 2029 and 2032, respectively. Given the timing of the need, no firm recommendation is required at this time. The Working Group will continue to monitor load growth and revisit this need in the next cycle of regional planning.

2.2.3 Supporting Community Energy Plans and Monitoring Energy Efficiency and Electrification Trends

Most lower- and upper-tier municipalities in the GTA West region have published community energy plans (CEP) or climate change action plans (CCAP) including the:

- Region of Peel's Climate Change Master Plan,
- Town of Oakville's Community Energy Strategy,
- Town of Caledon Community Climate Change Action Plan,
- Town of Halton Hills' Community Energy Plan,
- City of Brampton Community Energy and Emissions Reduction Plan,
- City of Burlington's Climate Action Plan, and
- City of Mississauga Climate Change Action Plan to name a few.

The scope varies by municipality and plan but the general aim is to promote energy efficiency, improve resiliency, lower greenhouse gas emissions, and invest in the local economy.

While the IRRP seeks to align with these plans where possible, not all of the objectives fall within the scope of the regional planning nor the IESO's mandate. For example, absent of provincial government policy, the IESO is technology agnostic and will generally choose the most economic option that adequately resolves the need and meets applicable reliability standards. Greenhouse gas emissions are considered in the IRRP's options analysis by accounting for the carbon price associated with emitting resources, but the IESO does not have emission reduction targets unless directed by government policy. Furthermore, while regional planning is responsible for ensuring electricity ratepayer value and minimizing electricity costs, the IESO relies on government policy for broader socioeconomic considerations.

There are three CEP and CCAP objectives that the IESO and regional planning can play a role in supporting. First, the IESO recognizes that distributed energy resources (DER) are becoming increasingly prevalent and features prominently in many CEPs and CCAPs. DERs can provide benefits to both customers as well as the distribution and transmission systems. By enabling DERs to provide wholesale services, system costs can be reduced and opportunities for customers and investors can be increased. The IESO's Enabling Resources Program (ERP) will produce a 5-10 year plan to enable resources to provide services they cannot or cannot fully currently provide. The ERP has identified storage, hybrids, and DERs as high-priority opportunities. The IESO is developing a DER roadmap which is expected to be shared with stakeholders in the fall of 2021 to provide clarity on IESO objectives, initiatives, and timing for DER integration. More information can be found on the Distributed Energy Resource Roadmap engagement page.

Second, the Working Group will continue to support and monitor energy efficiency uptake. Conservation expected to be achieved through codes, standards, and program delivery has already been included in the planning forecast as described in Section 5.4. On September 30, 2020 the IESO received a Ministerial directive to implement a new 2021-2024 Conservation and Demand Management (CDM) Framework. The new CDM Framework will contribute to lowering the net demand as seen on the transmission system and ensures energy efficiency can continue to play a role in meeting the region's needs. The Working Group will monitor uptake of the CDM framework as well as energy efficiency initiatives in CEPs and assess the impact of these additional savings on the timing of local reliability needs.

Finally, the Working Group will monitor electrification trends and their impact on the demand forecast. The Working Group recognizes that many CEPs and CCAPs are calling for ambitious electrification targets as a means to achieve carbon emission reductions. It is not yet clear how impactful electrification will be to the load forecast in the near-term but it could drive significantly higher demand in the long term that will necessitate new electricity supply into the area. While it is still difficult to establish when firm investments or infrastructure reinforcements will be needed, it is prudent to prepare for a future where electricity demand could potentially be significantly higher than forecast.

The IESO and local distribution companies will continue to participate in local community energy planning initiatives such as the Heritage Heights Community Energy Plan Working Group at the request of municipal staff.

2.2.4 NW GTA Transmission Corridor

While the IRRP has not identified a firm need date for new transmission infrastructure in the northern areas of the region, Halton Hills, Brampton and Caledon are experiencing rapid growth in areas that are increasingly further away from existing transmission infrastructure. As discussed in the previous section, high electrification uptake could also significantly impact electricity demand.

The Ministry of Transportation (MTO) is currently planning for a new 400-series highway in the same approximate area as the anticipated long-term need for new transmission in the region. Provincial policy encourages colocation of linear infrastructure to reduce land use impacts and the IESO and Ministry of Energy are conducting a joint study to ultimately identify a suitable corridor of land that can be preserved for future transmission infrastructure should the need arise. The expectation is that the preferred route for this future transmission corridor will largely align with MTO's highway study area. Although co-location of linear infrastructure provides benefits from a land use perspective, it is important to note that the need associated with future transmission is linked to the size and location of anticipated growth, and not any specific transportation or other infrastructure plan. Protecting land for a future transmission corridor maintains flexibility to accommodate future demand growth in the northern areas beyond what is already captured in the IRRP forecast and mitigates the challenges of needing to build transmission infrastructure through developed land.

3. Development of the Plan

3.1 Regional Planning Process

In Ontario, preparing to meet the electricity needs of customers at a regional level is achieved through regional planning. Regional planning assesses the interrelated needs of a region—defined by common electricity supply infrastructure—over the near, medium, and long term and results in a plan to ensure cost-effective and reliable electricity supply. A regional plan considers the existing electricity infrastructure in an area, forecast growth and customer reliability, evaluates options for addressing needs, and recommends actions.

The current regional planning process was formalized by the OEB in 2013 and is performed on a five-year planning cycle for each of the 21 planning regions in the province. The process is carried out by the IESO, in collaboration with the transmitters and LDCs in each planning region. 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 and determines if there are electricity needs requiring regional coordination;

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 proposes recommendations to meet the identified needs requiring coordinated planning; and/or

4. A RIP, led by the transmitter, which provides further details on recommended wires solutions.

Further details on the regional planning process and the IESO's approach to regional planning can be found in Appendix A.

Regional planning is not the only type of electricity planning in Ontario. Other types include bulk system planning and distribution system planning. 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 GTA West and IRRP Development

The process to develop the GTA West IRRP was initiated in August 2019 following the publication of the Needs Assessment report in May 2019 by Hydro One and Scoping Assessment Outcome Report in August 2019 by the IESO.

In October 2020, the IESO wrote to the Ontario Energy Board (OEB) to provide notice of expected delays in completing three ongoing IRRPs including the GTA West IRRP. The additional time to complete the GTA West IRRP provided the IESO the opportunity to align the timing with that of the bulk system plan for the Flow East Toward Toronto (FETT) and further investigate higher than expected actual demand observed at some of the transformers stations within the region in 2020. The IESO estimated that 3-6 months of additional time was required beyond the original completion date of February 8th, 2021.

4. Background and Study Scope

This is the second cycle of regional planning for the GTA West region. In the first cycle of regional planning, the region was divided into two sub-regions: Northwest GTA and Southwest GTA. The Northwest GTA sub-region roughly encompassed the municipalities of Milton, Halton Hills, Caledon and Brampton while the Southwest GTA sub-region encompassed Mississauga, Oakville, and parts of Burlington. Following a Needs Assessment and Scoping Assessment in 2014, an IRRP was initiated for the Northwest GTA sub-region and subsequently published in 2015. The first cycle concluded in 2016 with the publication of a Regional Infrastructure Plan.

The current cycle of regional planning began in 2019 with the publication of the GTA West Needs Assessment Report where a number of needs requiring further regional coordination was identified. The 2019 GTA West Scoping Assessment recommended an IRRP for the entire region to address needs in a coordinated manner. This report presents an integrated regional electricity plan for the next 20-year period starting from 2019.

4.1 Study Scope

This IRRP develops and recommends options to meet the electricity needs of the GTA West Region in the near, medium, and long term. The plan was prepared by the IESO on behalf of the Working Group. The plan includes consideration of forecast electricity demand growth, conservation and demand management (CDM), distributed generation (DG), transmission and distribution system capability, relevant community plans, condition of transmission assets and developments on the bulk transmission system.

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

- Step-down transformer stations: Halton TS, Halton Hills MTS, Meadowvale TS, Jim Yarrow MTS, Pleasant TS, Cardiff TS, Bramalea TS, Goreway TS, Tremaine TS, Trafalgar TS, Palermo TS, Glenorchy MTS #1, Churchill Meadows TS, Erindale TS, Tomken TS, Oakville TS #2, Lorne Park TS, Cooksville TS
- Transmission lines: H29/H30, R14T/R17T, R19TH/R21TH, T36B/T37B, T38B/ T39B, V41H/V42H, V43/V44, B15C/B16C, K21C/K23C, R24C

The single line diagram of the GTA West region is shown in Figure 4.1 below. Note that the 500 kV circuits and bulk system transfer capabilities through the region is not within the scope of the IRRP and separately studied in the FETT interface bulk transmission study which is discussed further below in Section 4.2.

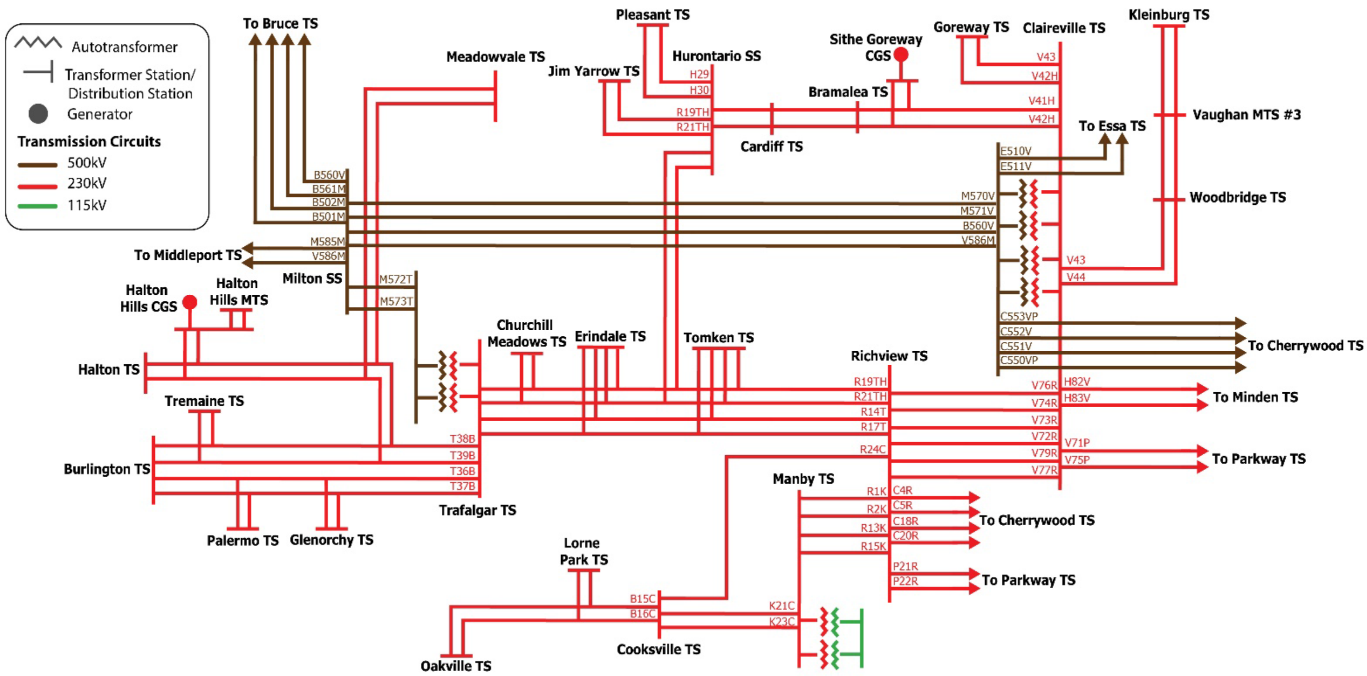

Figure 4.1 | Single Line Diagram of the GTA West Region

The GTA West IRRP was developed by completing the following steps:

- Preparing a 20-year electricity demand forecast and establishing needs over this timeframe (as described in the following steps);
- 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 criteria;
- Assessing system needs by applying a contingency-based assessment and reliability performance standards for transmission supply in the IESO-controlled grid;
- Confirming identified end-of-life asset replacement needs and timing with LDCs;
- Establishing alternatives to address system needs including, where feasible and applicable, generation, transmission and/or distribution, and other approaches such as non-wires alternatives including conservation and demand management;
- Engaging with the community on needs and possible alternatives;

- Evaluating alternatives to address near- and long-term needs; and
- Communicating findings, conclusions, and recommendations within a detailed plan.

4.2 FETT Interface Bulk Transmission Study

Flow East Towards Toronto (FETT) is a transmission interface that delivers electricity from western to eastern Ontario and consists of three paths: (a) four 500 kV circuits into Claireville TS from the west, (b) four 230 kV circuits between Trafalgar TS and Richview TS, and (c) two 230 kV circuits between Orangeville TS and Essa TS.

Supply capacity in eastern Ontario is expected to decline over the next decade, which contributes to a provincial need for capacity and, because of limits on the transfer capability of the FETT interface, ~2000 MW of that capacity will have to be sited east of the FETT interface by 2026. To reduce the amount of capacity that must be sited in eastern Ontario, the IESO issued a letter in December 2020 recommending that Hydro One proceed with conductor upgrades to the R14T/R17T and R19TH/R21TH circuits between Trafalgar TS and Richview TS as a first stage to increase the FETT transfer capability.

Future FETT interface needs beyond these conductor upgrades are not known at this time and will depend on the future resources acquisition framework and availability of potential resources east of FETT. The IESO will continue participate in the Working Group during the RIP to 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. This section describes the development of the demand forecast for the GTA West Region. It highlights the assumptions made for peak demand forecasts including weather correction and the contribution of CDM and DG. The resulting net extreme weather demand forecast is used in assessing the electricity needs of the area over the planning horizon.

5.1 Historical Demand

Growth within the GTA West region has been steady over the last five years, largely driven by expanding urban boundaries and intensifying urban areas. Figure 5.1 below shows the net actual (as observed at metering point), net median weather corrected (adjusted to reflect median on peak weather conditions), and gross median weather corrected (impact of DG removed) historical demand. The gross median weather corrected electrical demand has grown at an average rate of 1.3% over the past five years, representing an increase of approximately 150 MW for the study area. The peak demand hour for each year occurs in the summer from approximately 3 PM to 7 PM.

Generally speaking, the 2018 gross median weather corrected peak at each station was used as the starting point for the forecast unless adjustments were necessary to remove outliers.

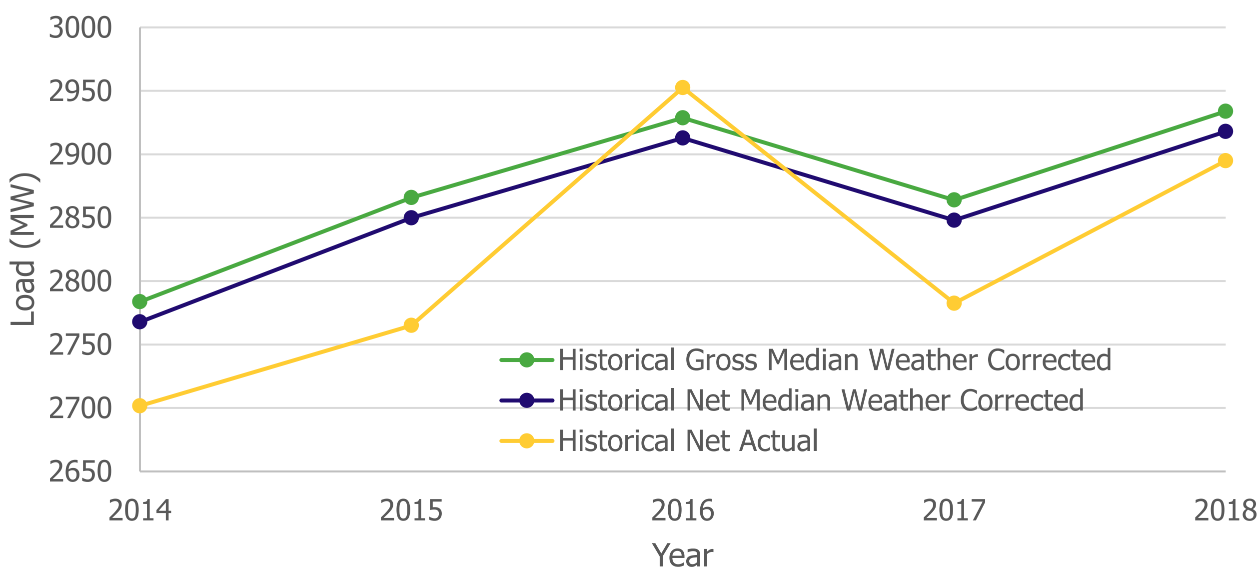

Figure 5.1 | Historical Demand in the GTA West Region

5.2 Demand Forecast Methodology

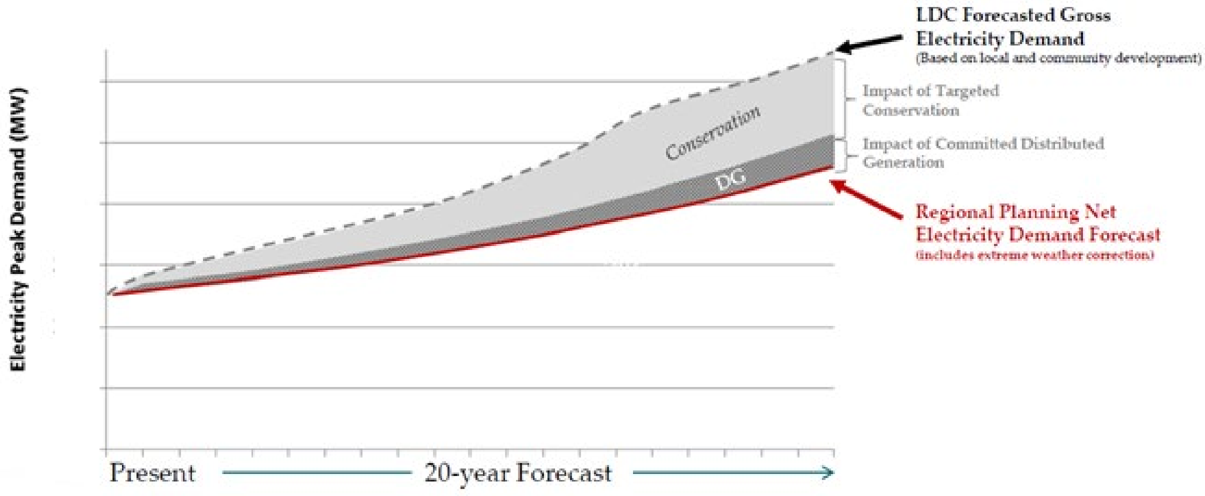

Figure 5.2 | Illustrative Development of Demand Forecast

For the purpose of this IRRP, a 20-year regional peak demand forecast was developed to assess reliability needs for GTA West. The steps taken to perform this are depicted in Figure 5.2. Gross demand forecasts, which assume the weather conditions of an average year based on historical weather conditions and referred to as normal weather, were developed by the LDCs. These forecasts were then modified to reflect the peak demand impacts of provincial conservation targets and DG contracted through previous provincial programs such as FIT and microFIT, and adjusted to reflect extreme weather conditions in order to produce a reference forecast for planning assessments. This net forecast was then used to assess the electricity needs in the region. Additional details related to the development of the demand forecast are provided in Appendix B.

5.3 Gross LDC Forecast

Each participating LDC in the GTA West Region prepared gross demand forecasts at the station level, or at the station bus level for multi-bus stations. These gross demand forecasts account for increases in demand from new or intensified development and known connection applications. Most LDCs cited alignment with municipal and regional official plans and credited them as a primary source for input data. LDCs are also expected to account for changes in consumer demand resulting from typical efficiency improvements and response to increasing electricity prices, i.e., "natural conservation", but not for the impact of future DG or new conservation measures, such as codes and standards and CDM programs, which are accounted for by the IESO as discussed in Section 5.4 below. The gross LDC forecast assumes median on-peak weather conditions.

LDCs have a better understanding of future local demand growth and drivers than the IESO, since they have the most direct involvement with their customers, connection applicants and municipalities and communities which they serve. The IESO typically carries out demand forecasting at the provincial level. More details on the LDCs' load forecast assumptions can be found in Appendix B.2 to B.7. Figure 5.3 below shows the total gross LDC forecast for the GTA West region.

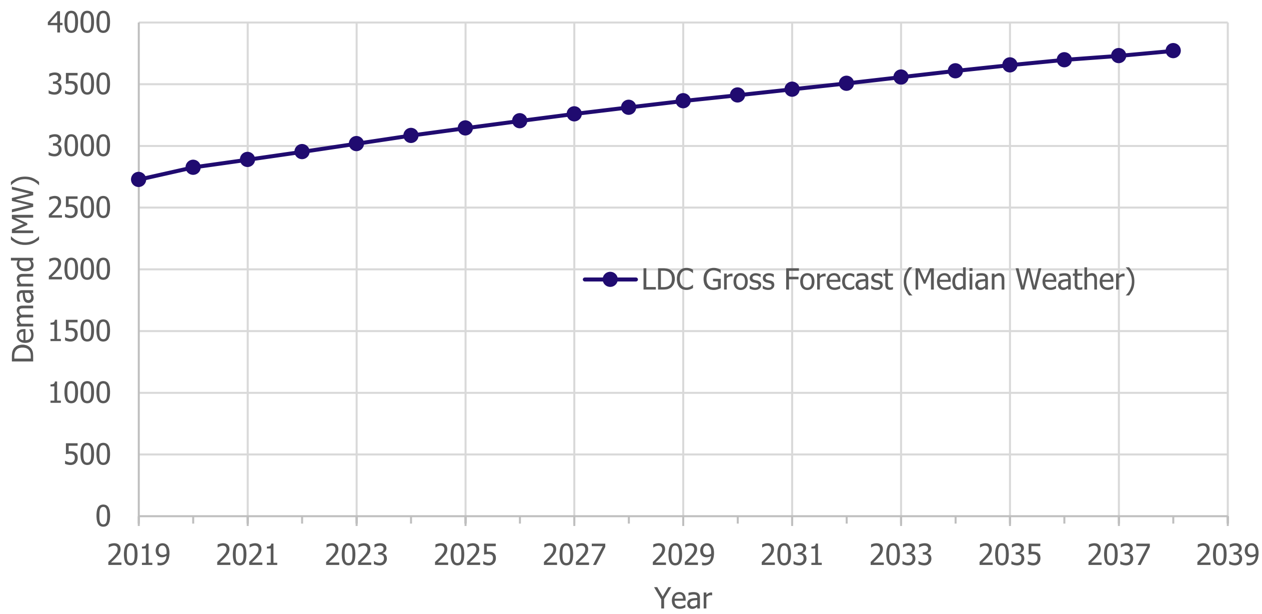

Figure 5.3 | Total Gross LDC Forecast (Median Weather)

5.4 Contribution of Conservation to the Forecast

Conservation and demand management, is a clean and cost-effective resource that helps meet Ontario's electricity needs and has been an integral component of provincial and regional planning. Conservation is achieved through a mix of codes and standards amendments as well as CDM program-related activities These approaches complement each other to maximize conservation results.

The estimate of demand reduction due to codes and standards are based on expected improvement in the codes for new and renovated buildings and through regulation of minimum efficiency standards for equipment used by specified categories of consumers, i.e. residential, commercial and industrial consumers.

The estimates of demand reduction due to program-related activities account for Save on Energy[1] programs, as well as those that will be implemented as part of the 2021-2024 CDM Framework, which started in January 2021. The IESO centrally delivers programs on a province-wide basis to serve business and low-income customers, as well as Indigenous communities.

[1] https://www.saveonenergy.ca/

Figure 5.4 shows the estimated total yearly reduction to the demand forecast due to conservation (from codes, standards and CDM programs) for each of the residential, commercial and industrial consumers. Additional details are provided in Appendix B.8.

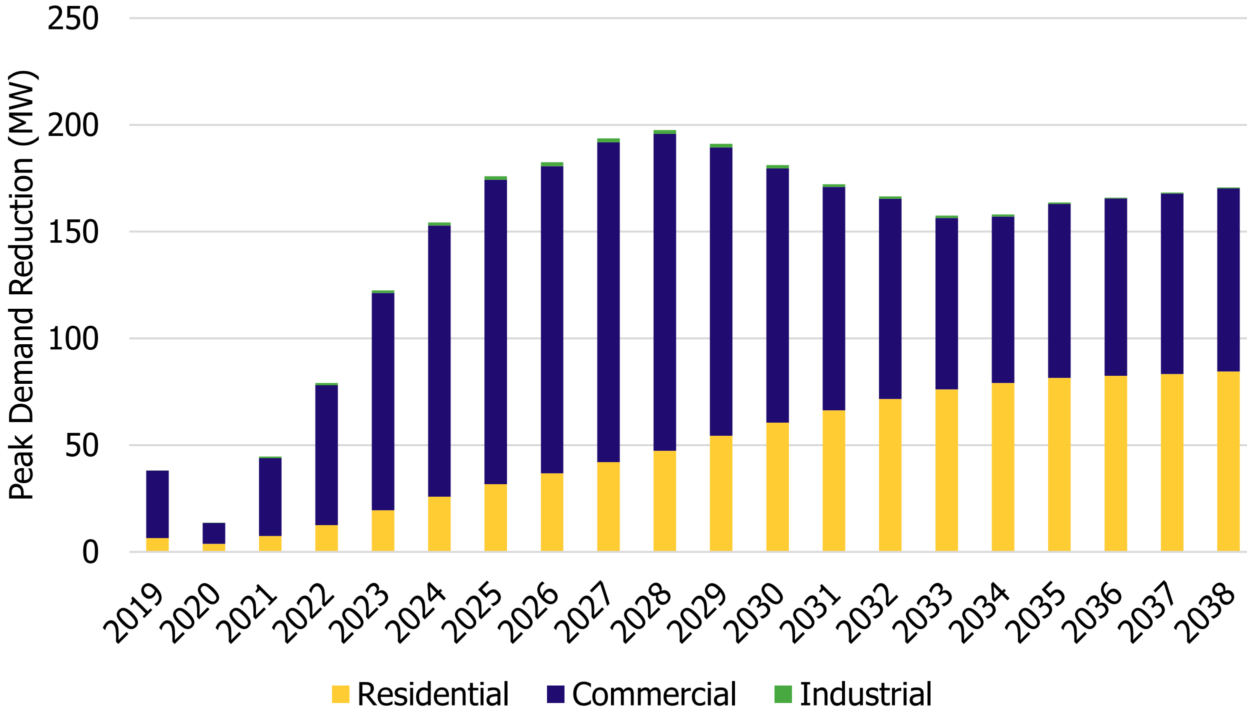

Figure 5.4 | Total Forecast Peak Demand Reduction (Codes, Standards, and CDM Programs)

5.5 Contribution of Distributed Generation to the Forecast

In addition to conservation resources, DG in the GTA West Region is also forecast to offset peak-demand requirements. The introduction of the Green Energy and Green Economy Act, 2009, and the associated development of Ontario's FIT Program, has increased the significance of distributed renewable generation which, while intermittent, contributes to meeting the province's electricity demands. The installed DG capacity by fuel type and contribution factor assumptions can be found in Appendix B.9.

After reducing the demand forecast due to conservation as described above, the forecast is further reduced by the expected contribution from contracted DG in the region. Figure 5.5 shows the impact of DG on reducing the demand forecast. In the long term, the contribution of DG is expected to diminish as these contracts expire. Additionally, any facilities without a contract with the IESO are not currently included in the DG peak demand reduction forecast.

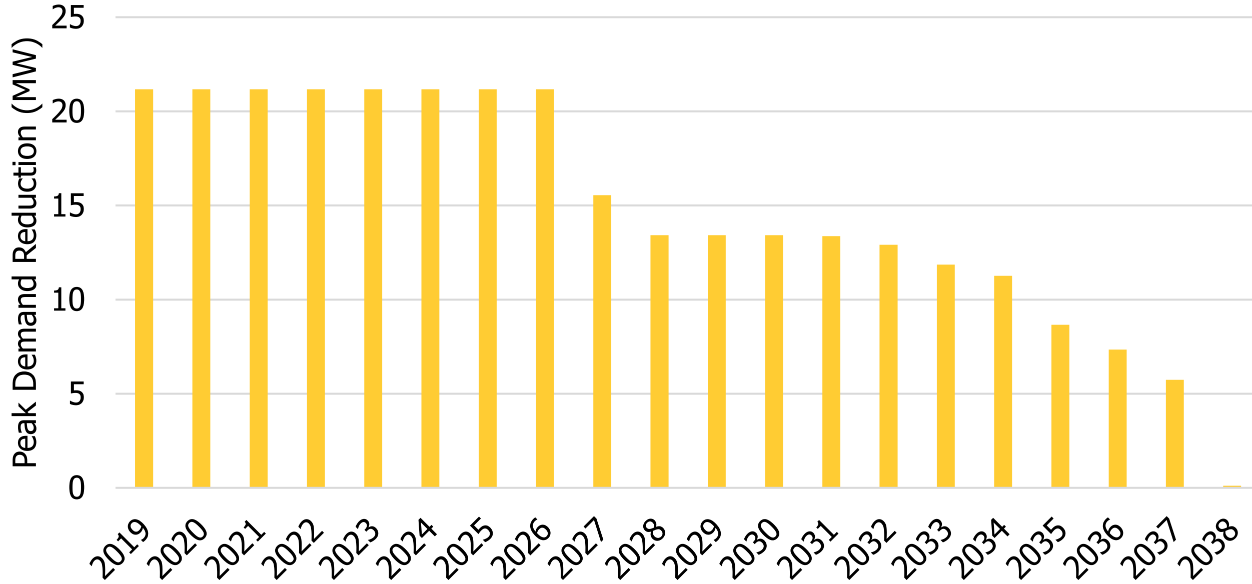

Figure 5.5 | Peak Demand Reduction to Demand Forecast due to DG

5.6 Net Extreme Weather ("Planning") Forecast

The net extreme weather forecast, as known as the "planning" forecast, is created in two steps. First the gross LDC median weather forecast is adjusted for extreme weather conditions according to the methodology described in Appendix B.1. This results in the gross extreme weather forecast. The net extreme weather forecast is then obtained by adding in the forecast DG and conservation impacts described in Section 5.4 and 5.5 above. Note that this planning forecast is non-coincident meaning that each station in the region is forecast separately at their own peak demand.

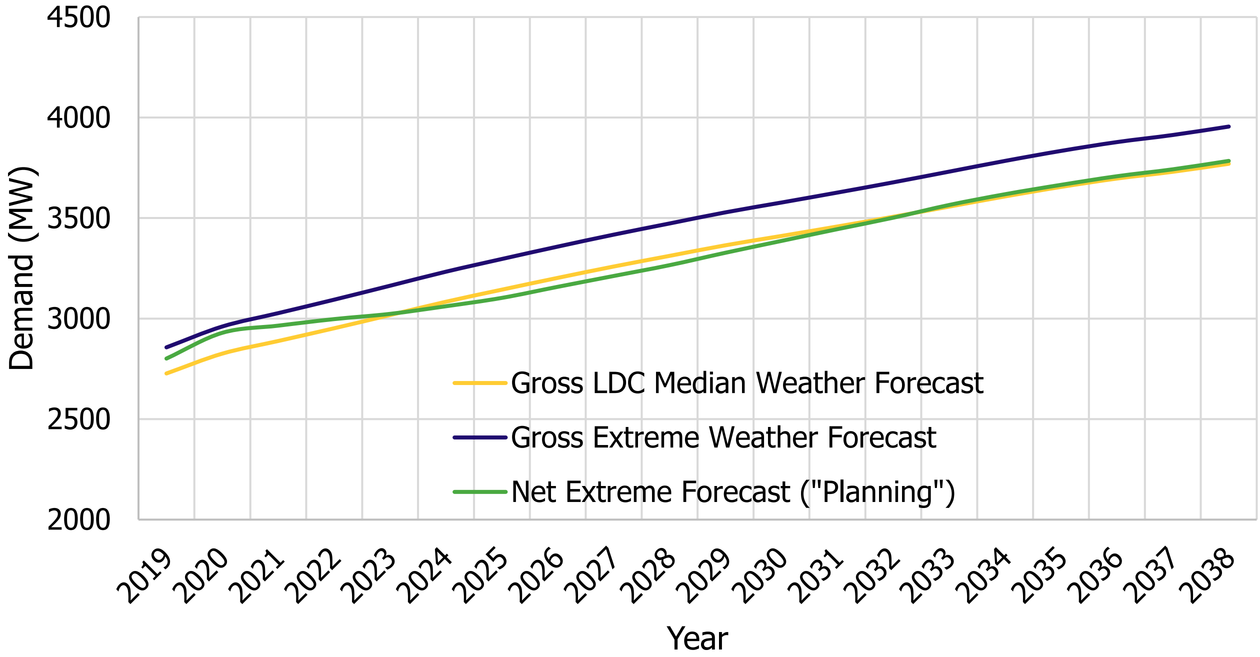

Figure 5.6 | Net Extreme Weather ("Planning") Forecast for the GTA West Region

To determine the need date for needs that are driven by more than one station, the coincident planning forecast for the relevant group of stations are found by applying a coincidence factor. The coincidence factor is based on the contribution of each station to the group's coincident peak over the past five years. The net extreme weather forecast for the GTA West region is shown in Figure 5.6 below.

5.7 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.

Additional load profile details including summary tables and hourly heat maps for each need can be found in Appendix D. 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; it cannot be used to deterministically specify the precise hourly energy requirements. Further, this data is only used to select 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 implementation of the plan.

6. Needs

6.1 Needs Assessment Methodology

Based on the planning demand forecast (extreme weather, net demand), system capability, the transmitter's identified end-of-life asset replacement plans, and the application of ORTAC and North American Electric Reliability Corporation (NERC) TPL-001-4 Standard, the Working Group identified electricity needs in the near-, medium- and long-term timeframe 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 Limited Time Rating (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 Refurbishment 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.

- **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.

Technical study results can be found in Appendix C. The needs identified are discussed in Sections 6.2 and 6.3 below.

6.2 Near-/Medium-Term Needs Identified

Table 6.1 below summarizes the near- and medium-term needs identified by this IRRP.

Table 6.1 | Summary of Near and Medium-Term Needs

Need	Need Description	Need Date
H29/H30 Supply Capacity	After a loss of either H29 or H30, the remaining circuit (i.e. H30 or H29) will exceed its LTE rating.	2027[2]
R19TH/R21TH Supply Capacity	After a loss of V42H and H29, R19TH will exceed its LTE rating. After a loss of V41H and H30, R21TH will exceed its LTE rating.	Today
Palermo TS End-of-Life Refurbishment	Transformers T3 and T4 at Palermo TS will reach end-of-life.	2025
T38B/T39B Load Security	Simultaneous loss of both T38B and T39B would result in over 600 MW of load being lost by configuration.	2025
Load Restoration Needs	30-minute restoration of all load lost above 250 MW not achievable with current load transfer capabilities after select N-2 contingencies	Ongoing

[2] Note that the "Required By" date for this need in Section 2.1 is 2025. This reflects the recommendation to advance the H29/H30 work to help mitigate the risk of high than anticipated growth.

6.2.1 Station Capacity Needs

There are no station capacity needs in the near term.

6.2.2 Supply Capacity Needs

6.2.2.1 H29/H30 Supply Capacity Need

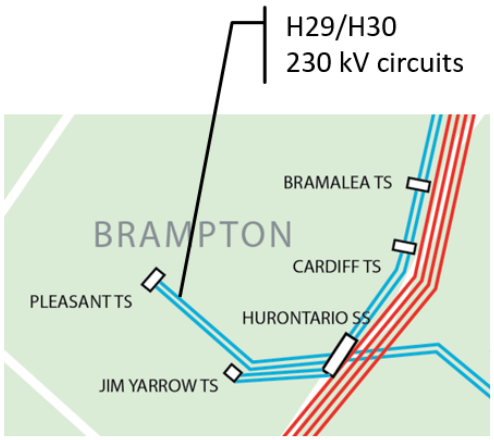

Figure 6.1 | H29/H30 230 kV Circuits

The circuits identified as H29 and H30 form an 8.5 km, 230 kV double-circuit supplying Pleasant TS, as shown in Figure 6.1 above.

According to the demand forecast, this need is expected to exceed the identified LMC of 417 MW by 2027. It is important to note that the 2020 actual peak demand at Pleasant TS reached 410 MW during the July 2020 summer peak. This is shown in Figure 6.2 below. However, it may be too early to conclude if this was an isolated event related to the COVID-19 pandemic or an enduring trend. This need was also identified in the 2015 GTA West IRRP.

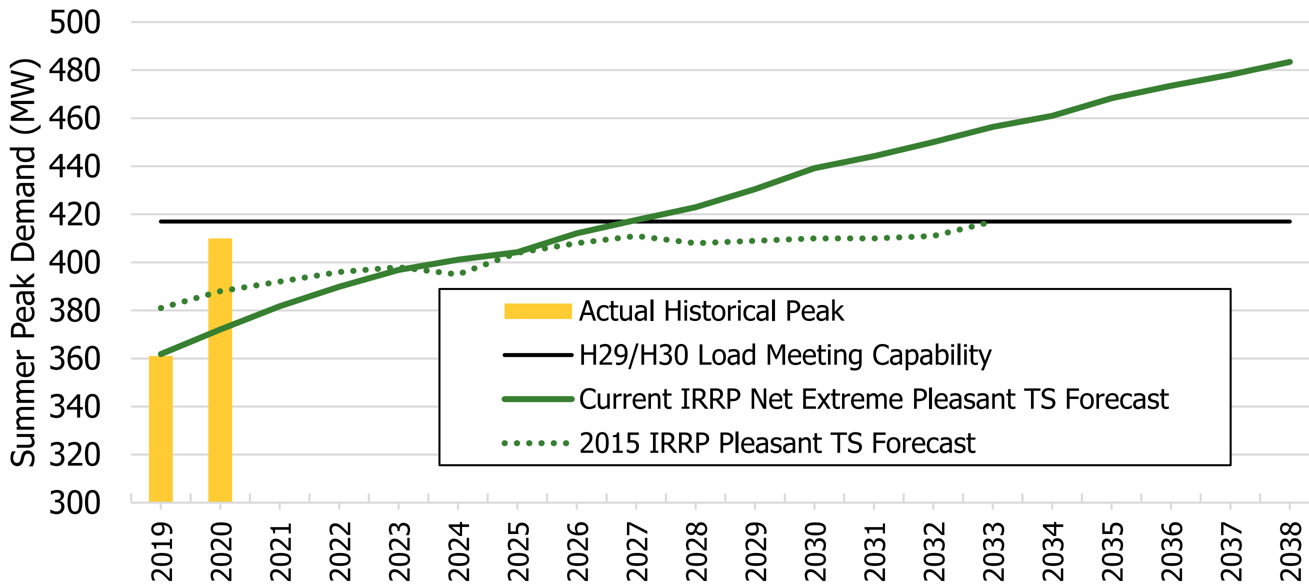

Figure 6.2 | Pleasant TS Historical and Forecast Demand

6.2.2.2 R19TH/R21TH[3] Supply Capacity Need

The circuits R19TH and R21TH form a 230 kV double-circuit from Richview TS to Trafalgar TS. These circuits also extend from Hanlan JCT northward towards Hurontario SS. These circuits provide a supply path to Jim Yarrow MTS, Pleasant TS, Cardiff TS, and Bramalea TS. Figure 6.3 below shows an overview of the area.

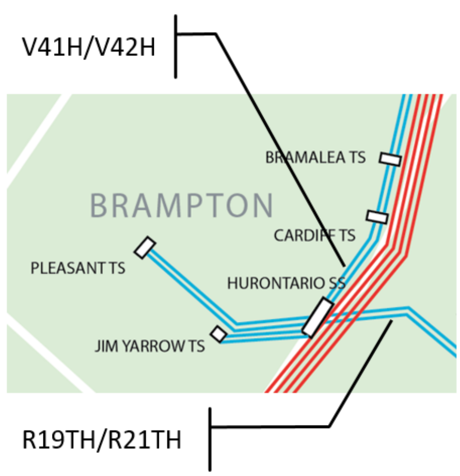

Figure 6.3 | R19TH and R21TH 230 kV Circuits

[3] The limiting sections of R19TH/R21TH referred to here are different from the ones that will be upgraded as the result of the FETT Interface Bulk Transmission Study (Section 4.2).

This need occurs only for specific contingencies during a pre-existing outages (N-1-1 contingency). When V42H is experiencing an outage followed by an H29 contingency, the circuit section of R19TH from Hanlan JCT to Hurontario SS will start to exceed its LTE rating by 2021 and will exceed its STE rating by 2038. The need is primarily driven by growth at Pleasant TS. This is also true for the circuit section of R21TH from Hanlan JCT to Hurontario SS when V41H is experiencing an outage followed by an H30 contingency. The need is illustrated in Figure 6.4 below.

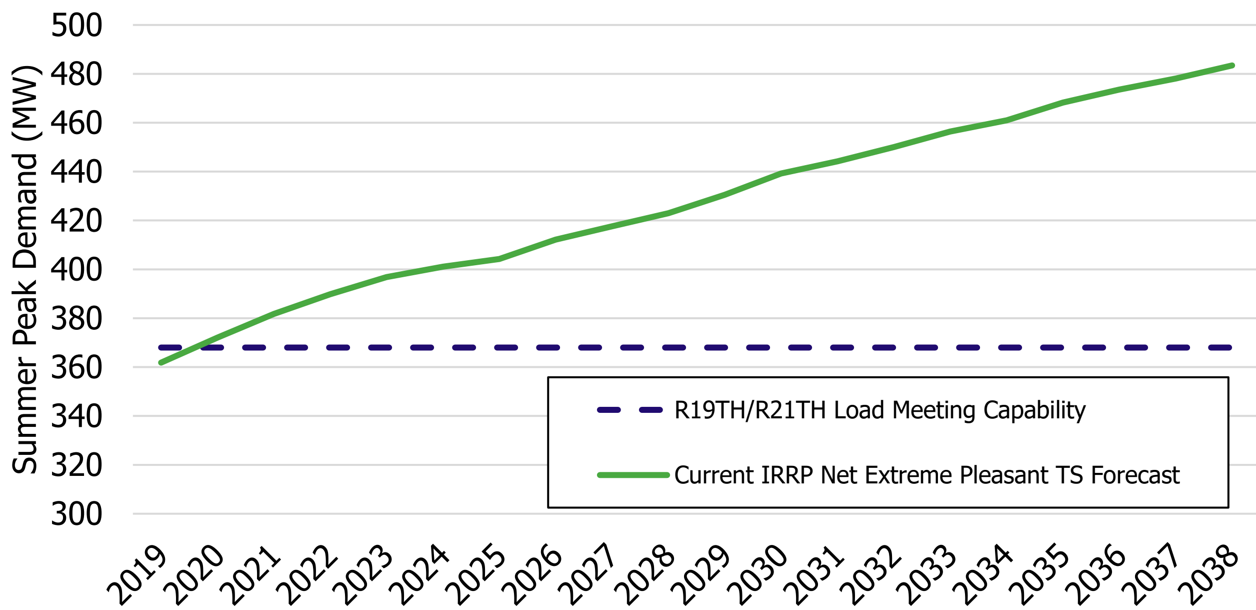

Figure 6.4 | R19TH/R21TH Supply Capacity Need

6.2.3 End-of-Life Refurbishment Needs

6.2.3.1 Palermo TS

Palermo TS is a transformer station that serves load of Burlington Hydro Inc., Milton Hydro Inc. and Oakville Hydro in the municipalities of Burlington, Milton, and Oakville. The transformers at Palermo TS (T3 and T4) are sized up to 83 MVA and will reach end-of-life in 2025.

It is important to note that the nearby Tremaine TS is expected to exceed its station supply capacity limits by 2033 (details of which are found in Section 6.3.2 below). Therefore, it is prudent to consider the needs of Tremaine TS when addressing the end-of-life issues at Palermo TS. Figure 6.5 below shows a geographical overview of Palermo TS and Tremaine TS within the GTA West system.

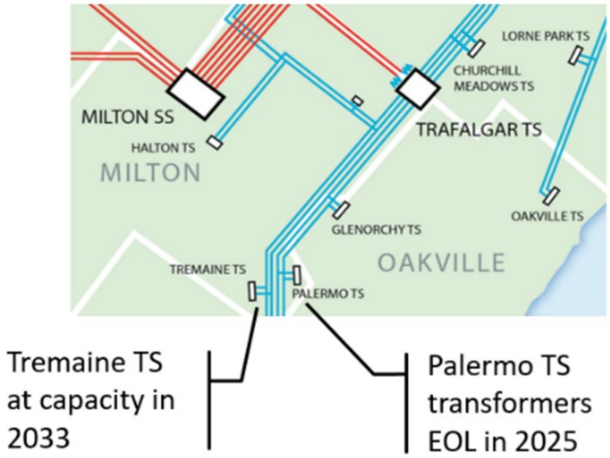

Figure 6.5 | Overview of Palermo TS and Tremaine TS

6.2.4 Load Security

6.2.4.1 T38B/T39B Load Security Need

The circuits designated as T38B/T39B form a 230 kV double-circuit from Burlington TS to Trafalgar TS. These circuits serve numerous transformer stations including Tremaine TS, Trafalgar DESN, Meadowvale TS, Halton TS, Halton #2 TS (future), and Halton Hills MTS. The local 683 MW gas-powered Halton Hills Generating Station also provides power to the province via these two circuits. The area served by this double-circuit is often referred to as the "Halton Pocket". Figure 6.6 provides an overview of the Halton Pocket.

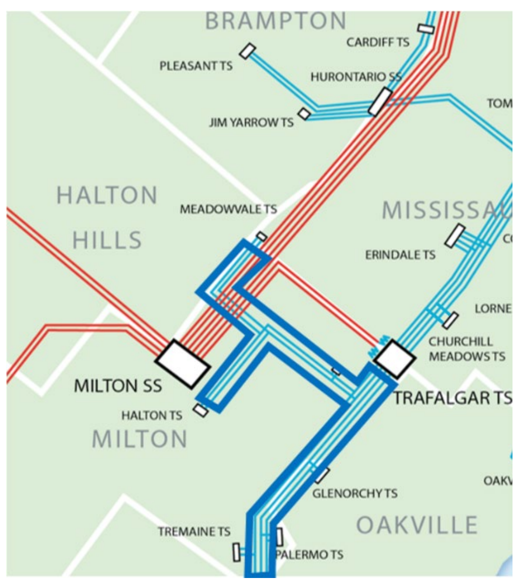

Figure 6.6 | Overview of the Halton Pocket

Starting in 2025, the loss of both T38B and T39B circuits will result in over 600 MW of load being disconnected from the system, and is a violation of Section 7.1 of the ORTAC. This is due to all the aforementioned stations being served solely by these two circuits. The load of at the Halton pocket is expected to grow throughout the study period (i.e. 2020 to 2038). By 2038, it is expected that up to 775 MW of coincident load will be lost following the loss of both these circuits. This is shown in Figure 6.7.

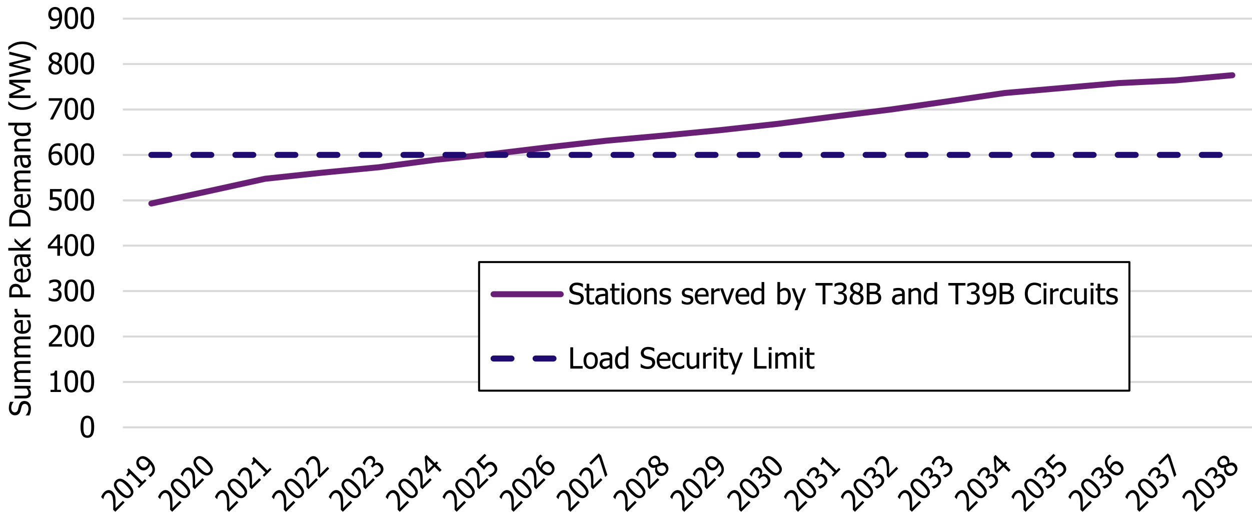

Figure 6.7 | T38B and T39B Load Security Need

6.2.5 Load Restoration

The Needs Assessment and Scoping Assessment reports both identified several load restoration needs in the GTA West Region, as outlined below:

1. Kleinburg Radial Pocket (V43/V44)
2. Halton Radial Pocket (T38B/T39B)
3. Pleasant Radial Pocket (H29/H30)
4. Cardiff/Bramalea Supply (V41H/V42H)
5. West of Cooksville (B15C/B16C)
6. Richview X Trafalgar (R19TH/R21TH)
7. Richview X Trafalgar (R14T/R17T)

For the load restoration needs #1 and #5, it is found that the 4-hour and 8-hour load restoration can be substantially met throughout the forecast. The load serving West of Cooksville and Kleinburg Radial Pocket circuits do not exceed 250 MW throughout the forecast and so the 30-minute requirement does not apply. In addition, need #2 will also be investigated in the RIP in conjunction with the load security need identified above.

In the 2015 GTA West IRRP, addressing the load restoration need #3 (Pleasant Radial Pocket) was ruled out as a cost justification assessment revealed that mitigating solutions were estimated to be significantly costlier to customers in the area than the status quo. This is primarily due to the low probability of the event (loss of H29/H30) occurring and the high cost of building a third supply circuit to Pleasant TS. The 2020 GTA West IRRP takes the same position; it is still not economically prudent to pursue a transmission- or distribution-based solution at this time.

Therefore, for the purposes of this IRRP, the outstanding restoration needs in this IRRP are the Cardiff/Bramalea Supply, and the two Richview x Trafalgar supplies (needs #4, #6, and #7). The 30-minute restoration of all load lost above 250 MW is the most limiting restoration criteria since it relies on remote control actions such as emergency distribution load transfers. 30-minute restoration needs in these pockets existing today and will persist throughout the forecast horizon as demand grows.

6.3 Long-Term Needs Identified

Table 6.2 below summarizes the long-term needs identified by this IRRP:

Table 6.2 | Summary of Long-Term Needs

Need	Need Description	Need Date
Halton Pocket Supply Capacity	Under outage conditions of the local generator, loss of T38B or T39B will lead to the remaining T39B or T38B to exceed its LTE rating	2031
Station Capacity Needs	Cardiff TS, Jim Yarrow MTS, and Tremaine TS are expected to exceed their station capacity limits	2029, 2032, and 2033, respectively
NW GTA Transmission Corridor	There is an anticipated need for future transmission in the GTA West area. This is linked to expected population and employment growth projections.	N/A

6.3.1 Halton Pocket Supply Capacity Need

The load growth at the Halton Pocket is expected to introduce supply capacity needs in the area. Under an outage condition at the Halton Hills Generating Station, the loss of T38B or T39B is expected to cause its remaining companion circuit (i.e. either T39B or T38B, respectively) to exceed its LTE rating. Specifically, this limiting portion of T38B and T39B is a 400-meter section from Lantz JCT to the Trafalgar DESN JCT. This is expected to occur starting in 2031. Figure 6.8 below shows an overview of the limiting section on T38B and T39B. Figure 6.9 shows the limit vs. the forecasted demand in the area.

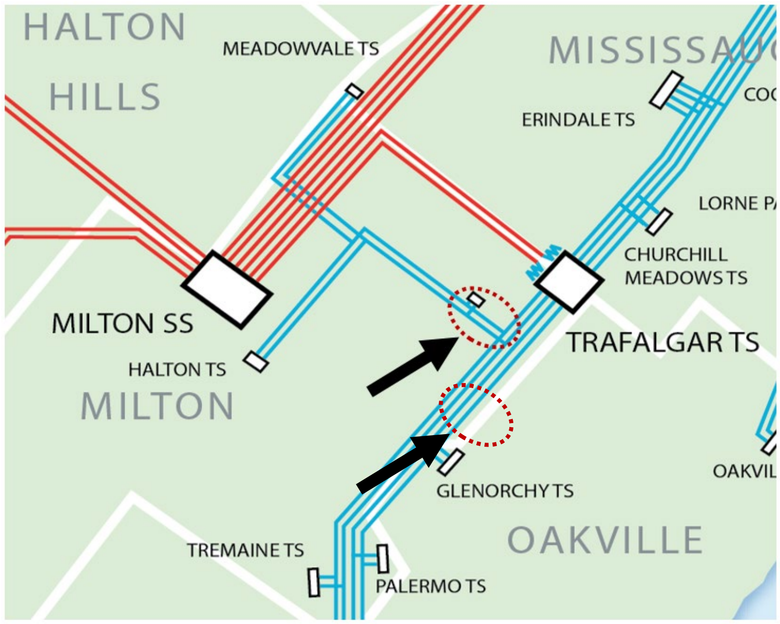

Figure 6.8 | Overview of limiting section on T38B and T39B

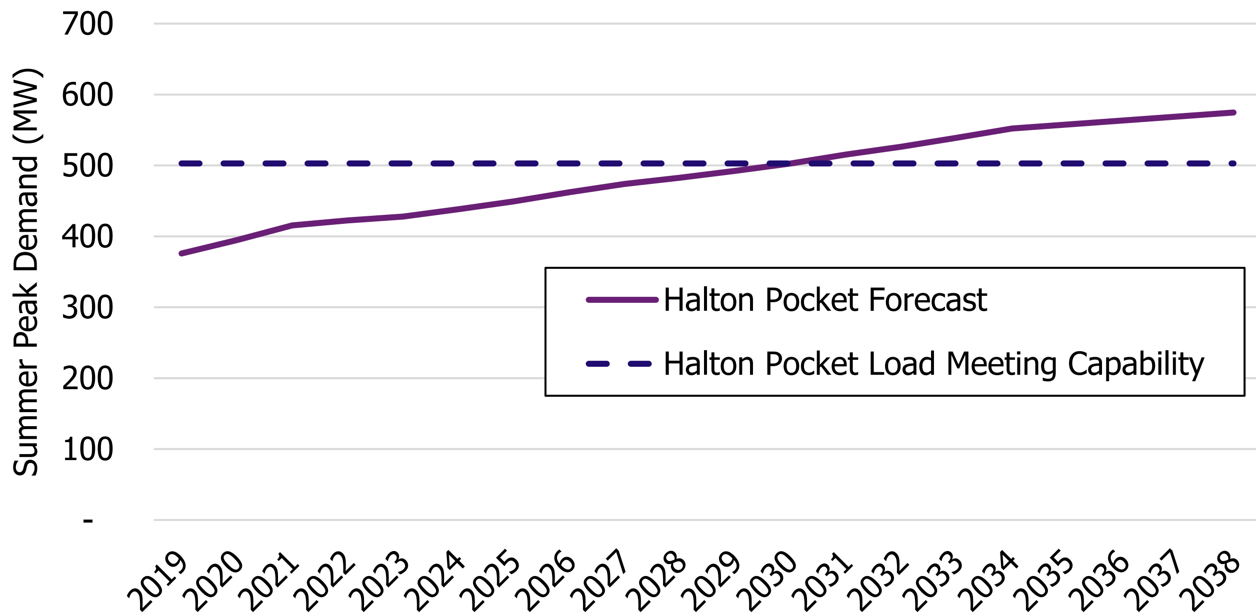

Figure 6.9 | Halton Pocket Supply Capacity Need

6.3.2 Station Capacity Needs

The growth at Cardiff TS is driven mainly by the expansion of a large customer. This expansion was initially slated for mid-2020s but has been put on hold until 2029 due to the effects of the COVID-19 pandemic. Similarly, the growth at Jim Yarrow MTS is primarily driven by load transfers from other stations in Mississauga to Jim Yarrow MTS. However, these load transfers have been delayed to 2032 due to the effects of the COVID-19 pandemic.

The growth at Tremaine TS is expected to exceed station capacity by 2033. A nearby station, Palermo TS, is expected to reach end-of-life by 2025. It is prudent planning practice to consider the needs of both stations when addressing the station capacity needs at Tremaine TS.

7. Plan Options and Recommendations

This section describes the options considered to address system needs in the GTA West region. Section 7.1 to 7.5 documents alternatives to the recommendations described in Section 2 and the rationale for choosing these recommendations. Note that H29/H30 reconductoring is not further discussed here because this recommendation was made in the previous regional planning cycle and this IRRP is only updating the need date. Section 7.6 discusses the Hurontario x Meadowvale transmission option which had the potential to address multiple needs and provide bulk system benefits but was ultimately not selected.

7.1 Options Development and Cost Estimates

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

- Build new infrastructure to increase the LMC 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.

- Install or implement measures to reduce the net peak demand to maintain loading within the system's existing LMC. These are commonly referred to as "non-wires" options and can include things like local utility scale generation, distributed energy resources, or conservation and demand management.

Wires options are developed by designing transmission reinforcements or control actions that are appropriate for the specific limiting phenomenon (voltage, thermal, stability, etc.) of each need. These options are developed through discussions with the Working Group.

To select and size suitable generation and other non-wires options, an hourly load profile is first created as described in Section 5.6. The most suitable technology type and capacity is chosen by examining the "unserved energy" profile which is the hourly demand above the existing LMC. The profile indicates the duration, frequency, magnitude, and total energy associated with each need. These characteristics are shown visually in Appendix D.

The high-level cost estimates for wires options are provided by the transmitter, Hydro One. There is a significant error margin around these estimates as they are only intended to enable comparison between options during the IRRP. As a standard practice, the IRRP performs sensitivity analysis (-25% to +50% costs) to ensure that the recommendations are robust. 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.

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 GTA West are resources with performance and costs on par with simple cycle gas turbines (SCGT) or combined cycle gas turbines (CCGT) 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, energy 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.

CDM measures can also help decrease the net electricity demand. Centrally delivered energy efficiency measures under the 2021-2024 Conservation and Demand Management framework are already included in the load forecast as discussed in the Section 5.4. Incremental CDM measures are suitable for needs where growth is slow and the magnitude of the overload relative to the total demand is very small (e.g. on the order of few percent per year). Given the timing, high rate of growth, and MW magnitude of the needs observed, incremental CDM measures are not suitable for the needs identified in this IRRP.

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 (typically 70 years for transmission infrastructure) for each option. The net present value of these levelized costs are the primarily basis through which options are compared below. Unless stated otherwise, the net present values discussed in the following sections are in 2020 CAD dollars. The list of assumptions made in the economic analysis can be found in Appendix E.

7.2 Alternatives to Pleasant TS Control Actions

Post-contingency thermal violations during outage conditions are expected to occur on the R19TH/R21TH circuits leading into Hurontario SS by 2021. The magnitude of the need is expected to reach 115 MW by 2038. Since this is a post-contingency limitation during pre-existing outage conditions (referred to as an N-1-1 contingency), a load rejection scheme or manual control actions are permitted by ORTAC load security criteria. While a number of stations contribute to this overload, a load rejection scheme at Pleasant TS is most effective to manage this need and is expected to be relatively simple since it is limited to monitoring the immediate circuits (H29/H30) supplying Pleasant TS. As noted in Section 2.1.2, manual control actions are also feasible in the near- to medium-term when overloads exceed long-term emergency (LTE) but not short-term emergency (STE) ratings. For the purpose of comparing the costs of alternative options, this section will assume that a load rejection scheme is installed today at the cost of $5MM.

In most cases where control actions are sufficient to meet the need, other options will typically be orders of magnitude more expensive. Other transmission, generation, and distributed energy resource options do exist and they are included here for completeness. Table 7.1 summarizes the options considered and the net present value of the their levelized costs. A load rejection scheme is the most cost-effective option and the IRRP recommends that the Regional Infrastructure Plan (RIP) led by Hydro One should develop and implement control actions by 2023.

Table 7.1 | Alternatives to Pleasant TS Control Actions and Costs

Option	Cost NPV
Pleasant TS load rejection scheme	$5MM
Install bus at Hurontario SS to maintain dual supply to Pleasant TS during V42 outage/H29 contingency and V41H outage/H30 contingency N-1-1 combinations	$52MM
Local generation portfolio made up of SCGT generation and demand response installed in three phases between today and 2030 as demand increases[4]	$200MM
Distributed energy resource portfolio made up of NMC batteries installed in three phases between today and 2030 as demand increases	$368MM

[4] As discussed in Section 7.1, the cost of new natural gas-fired generation was considered in the economic analysis for illustrative purposes to represent the cost of new generation.

7.3 Alternative to Upsizing Palermo TS at End-of-Life

The 83 MVA transformers at Palermo TS (T3 and T4) will reach end-of-life in 2025 and will need to either be replaced either like-for-like or upsized to 75/125 MVA transformers. Today, Palermo TS is able to supply a maximum of 110 MW and is fully loaded with no room for additional growth. Upsizing the transformers and reconfiguring the station will allow Palermo TS to serve approximately 40-50 MW of additional load. Note that the station yard is in relatively poor condition, had recently been de-rated in 2019, and will likely need to be replaced in less than 10 years regardless of the transformer size chosen. The approximately cost of a like-for-like replacement is $30MM. Upsizing will cost approximately $5MM more for a total cost of $35MM. These costs can vary significantly depending on the extent to yard work needed so the IRRP uses $25MM and $35MM for the like-for-like and upsized costs, respectively. This is a more conservative assumption with a higher incremental cost of upsizing.

Tremaine TS, a nearby station 3 km from Palermo TS, can serve a maximum of 190 MW and is forecast to reach capacity in 2033. This is a good opportunity to look at the Palermo TS end-of-life need and Tremaine TS capacity need together and select an optimal refurbishment option to serve regional needs at the lowest cost to ratepayers.

The first option is to refurbish Palermo TS like-for-like in 2025 followed by a subsequent upsizing or new station in 2033 when the capacity need arises. The second option is to upsize Palermo TS at a higher cost when it reaches end-of-life in 2025 and simultaneously resolve the capacity need albeit earlier than necessary. Table 7.2 below summarizes these two options and the associate net present value of the costs. Option 2 is significantly more cost-effective than Option 1 and the IRRP recommends that the RIP should perform additional analysis to reaffirm the cost estimates and develop an implementation plan for upsizing Palermo TS in 2025.

Table 7.2 | Alternatives to Upsizing Palermo TS at End-of-Life and Costs

Option	2025 Action	2033 Action	NPV
Option 1	Refurbish Palermo TS like-for-like - $25MM	Upsize Palermo TS - $35MM	$47MM
Option 2	Upsize Palermo TS - $35MM	None	$32MM

7.4 Alternatives to Local Wires Solutions for T38B/T39B Load Security

Starting in 2025, the loss of both T38B and T39B circuits will result in over 600 MW of load being disconnected from the system, and is a violation of Section 7.1 of the ORTAC. By 2038, it is expected that up to 775 MW of coincident load will be lost following the loss of both these circuits.

The purpose of ORTAC load security criteria is to specify the maximum permitted amount of load lost following recognized contingencies which limits the magnitude of customer interruptions. Installing incremental generation and distributed energy resources are not considered suitable options for addressing the load security need because, while they can reduce the net demand (loading observed on the transmission system), they do not reduce the gross demand (actual electricity consumption) that is interrupted post-contingency. For example, the existing Halton Hills GS has a capacity of 640 MW which is more than the combined coincident peak load of all the stations served on T38B/T39B today. However, in the event of a common tower contingency, all load stations and Halton Hills GS would be interrupted by configuration regardless of the generator's output. The same logic applies to distributed energy resources connected on the distribution system. While it is possible to configure some distributed resources like batteries to provide backup power when grid supply is lost, that is a matter of load restoration rather than load security.

The IRRP considered options to either resupply the Trafalgar DESN at Trafalgar TS or to reconfigure the radial portion of T38B/T39B so that it is supplied directly from Trafalgar TS rather than branching northward at Lantz Junction. This would sectionalize T38B/T39B and reduce the total load lost during double circuit contingencies. These options were ruled out because Trafalgar TS is a gas insulated station with large SF_6 insulated ducts which makes additional connections to the bus impractical. Supplying the Trafalgar DESN or additional circuits would require adding new diameters which would cost on the order of $40MM to $50MM based on previous study estimates.

The IRRP also considered opportunities to align with the FETT bulk study and select a common solution to meeting both regional and bulk system needs simultaneously. This is further discussed in Section 7.6 but ultimately, the most capable and cost-effective solution for addressing bulk system needs at this time, the R14T/R17T/R19TH/R21TH conductor upgrades, will not resolve the T38B/T39B load security need.

The remaining options are local transmission solutions like reterminating supply stations on lighter loaded circuits or installing breakers to sectionalize T38B/T39B. The cost of installing breakers to sectionalize T38B/T39B at Tremaine TS or Lantz Junction is approximately $5MM. For the same cost, Tremaine TS can also be reterminated from T38B/T39B to the companion T36B/T37B circuits since the station sits immediately under the transmission corridor. More detailed wires analysis is needed to refine these cost estimates and further study the technical feasibility of installing breakers or reterminating stations at various points along the circuits. The IRRP recommends that the RIP should carry out detailed wires analysis including updating the near-term demand forecast for the stations served on T38B/T39B. As additional bulk system needs on the FETT interface in the late 2020's become more clear, the IESO will continue to provide input on the Working Group to help ensure that the RIP recommendations are aligned with the latest bulk system information.

7.5 Alternatives to T38B/T39B Reconductoring for Halton Pocket Supply

During an outage to Halton Hills GS, post-contingency thermal violations on T38B/T39B are expected to occur by 2031. The thermal violation is on a short 400-meter section of T38B/T39B immediately north of Lantz Junction. This radial portion of T38B/T39B serves the Halton Pocket including Trafalgar DESN, Halton TS, Halton TS #2, Halton MTS, and Meadowvale TS. By 2038, the coincident demand at these stations will exceed the LMC by approximately 70 MW.

The transmission, utility generation, and distributed energy resource options considered are shown in Table 7.3. Upgrading the conductors on the limiting section of T38B/T39B is the most cost-effective option to meet the supply capacity need in the Halton Pocket. Although load rejection is permitted to account for local generation outages, upgrading T38B/T39B is still cheaper due to the short length of the limiting section. A load rejection scheme would also be more complex to operate and reduce reliability for local customers. Note that if Halton Hills GS were to not continue operation after its contract expiry, load rejection would also no longer be an option. Given the timing of the need, no firm recommendation is required at this time. The Working Group will continue to monitor load growth in the Halton Pocket and revisit this need in the next cycle of regional planning.

Table 7.3 | Alternatives to T38B/T39B Reconductoring and Costs

Option	NPV of Levelized Cost Net of System Capacity Value (if applicable)
Upgrade limiting section of T38B/T39B	<$1MM
Local generation portfolio made up of SCGT generation and demand response installed in two phases between 2030 and 2036 as demand increases[5]	$97MM
Distributed energy resource portfolio made up of NMC batteries installed in two phases between 2030 and 2034 as demand increases	$50MM

7.6 Hurontario SS x Meadowvale TS Transmission Option

The Meadowvale SS x Hurontario TS (MxH) transmission option is a new double 230 kV circuit line from Meadowvale TS to Hurontario SS along the existing transmission corridor. This is an integrated option that has potential benefits for both bulk and regional needs. The MxH option is estimated to cost $47MM. This includes the cost of the 8 km line between Meadowvale TS and Hurontario SS as well as an additional 5 km of transmission between Meadowvale TS and Halton TS to allow for a connection to Milton SS if 500-230 kV autotransformers are installed in the future.

From a regional perspective, the MxH option can address the R19TH/R21TH supply capacity, T38B/T39B load security, and T38B/T39B supply capacity needs. The cost of addressing these needs separately through the recommendations above is $5MM in 2023 (Pleasant TS load rejection scheme), $5MM in 2025 (retermination/sectionalisation for T38B/T39B load security), and $1MM in 2033 (T38B/T39B reconductoring) for a total net present value of $10MM. On regional needs alone, it is more cost-effective to address each need separately rather than together through the MxH option.

[5] As discussed in Section 7.1, the cost of new natural gas-fired generation was considered in the economic analysis for illustrative purposes to represent the cost of new generation.

From a bulk perspective, the MxH option introduces a new path along the FETT interface which would improve transfer capability. However, the MxH option alone would not provide sufficient additional transfer capability. The FETT interface is currently thermally limited by the Richview TS x Trafalgar TS circuits. Upgrading the conductors on these circuits (R14T/R17T/R19TH/R21TH) yields an approximately three-fold higher incremental transfer capability increase than the MxH option would provide.

Furthermore, even after discounting the cost of the MxH option by the avoided regional reliability costs, the per MW capability cost of the MxH option is still roughly double that of the Richview TS x Trafalgar TS conductor upgrades. The IESO issued a letter in December 2020 recommending that Hydro One should proceed with conductor upgrades to the R14T/R17T/R19TH/R21TH circuits between Trafalgar TS and Richview TS as a first stage to increase the FETT transfer capability.

Future FETT interface needs beyond these conductor upgrades are not known at this time and will depend on the future resources acquisition framework and availability of potential resources east of FETT. The IESO will continue to participate in the Working Group during the RIP to help ensure recommendations are aligned with the latest bulk system information.

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 GTA West IRRP.

8.1 Engagement Principles

The IESO's engagement principles[6] 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.

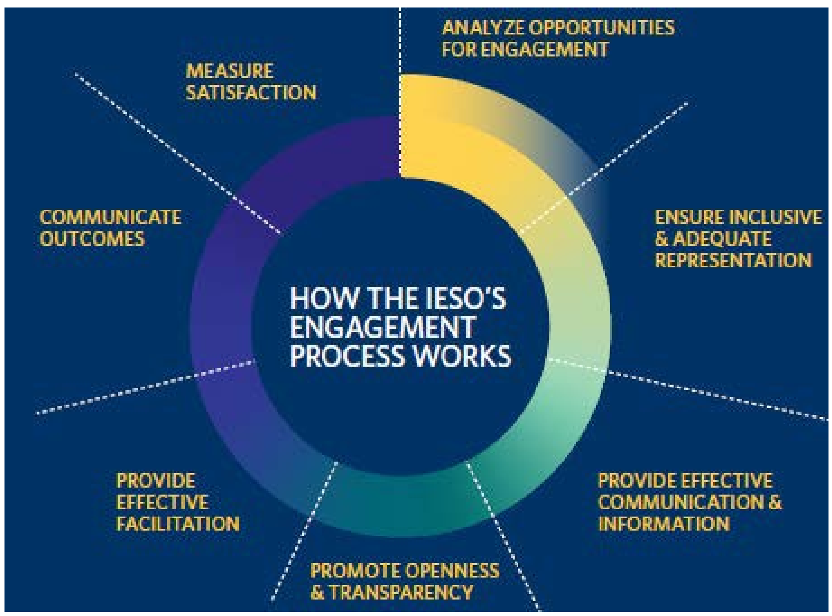

Figure 8.8.1 | The IESO's Engagement Principles

8.2 Creating an Engagement Approach for GTA West (Peel/Halton)

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.

6 https://www.ieso.ca/en/sector-participants/engagement-initiatives/overview/engagement-principles

Creating the engagement plan for this IRRP involved:

- Targeted discussions to help inform the engagement approach for this planning cycle;
- Communications and other engagement tactics to enable a broad participation, using multiple channels to reach audiences; and
- Identifying specific stakeholders and communities who may have a direct impact in 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 for this IRRP included:

- A dedicated webpage[7] 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 and stakeholders by email or through the IESO weekly Bulletin;
- Public webinars;
- Face-to-face meetings; and
- One-on-one outreach with specific stakeholders to ensure that their identified needs are addressed (see Section 8.4 Bringing Communities to the Table).

8.3 Engage Early and Often

The IESO held preliminary discussions to help inform the engagement approach for this second round of planning, leveraging existing relationships built through the previous planning cycle. This started with the Scoping Assessment Outcome Report for the GTA West region. An invitation to targeted municipalities, Indigenous communities and those with an identified interest in regional issues to announce the commencement of a new regional planning cycle and invite interested parties to provide input on the GTA West Scoping Assessment Report before it was finalized.

Feedback was received and focused on the need to align community energy plans and other planning initiatives in the development of the IRRP, and for the final plan to consider designated land use in the region including a recreational aircraft flying space in the event of any potential infrastructure siting recommendations. Along with a response to the feedback received, the final Scoping Assessment was posted in August 2019 which identified the need for a coordinated regional planning approach done through an IRRP for the GTA West Region.

[7] Regional Electricity Planning - Peel/Halton (GTA West) Region (ieso.ca)

Following the finalization of the Scoping Assessment, outreach then began with targeted municipalities 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 IESO subscribers of the GTA West planning region to ensure that all interested parties were made aware of this opportunity for input. Three public webinars were held at major stages during the IRRP development to give interested parties an opportunity to hear about progress and provide comments on key components of the plan. These webinars received strong participation with a cross-representation of stakeholders and community representatives. Written feedback was received as a result during a 21-day comment period following each webinar.

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, alternative energy systems, renewable generation and 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
- Consideration should be given to non-wires alternatives as part of the recommended solutions in the IRRP

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.

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

Based on the discussions both through the GTA West IRRP engagement initiative and broader network dialogue, there is a clear interest to further discuss the potential for alternative energy solutions as a way to meet local needs particularly as communities shift towards electrification. This insight has been valuable to the IESO and will help to inform future discussions to examine and consider these types of initiatives and the opportunities that they may present in future planning efforts. To that end, ongoing discussions will continue through the IESO's GTA/Central Regional Electricity Network to keep interested parties engaged in a two-way dialogue on local developments, priorities and planning initiatives to prepare for the next planning cycle.

All background information, including engagement presentations, recorded webinars, detailed feedback submissions, and responses to comments received, are available on the IESO's Peel/Halton (GTA West) IRRP engagement webpage.

8.4 Bringing Municipalities to the Table

The IESO held meetings with municipalities to seek input on their planning 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 the upper- and lower-tier municipalities in the region to discuss: key issues of concern, including forecast regional electricity needs; options for meeting the region's future needs; and, broader community engagement. Meetings were also held to discuss the joint NW GTA Corridor Study underway by the IESO, Ministry of Energy, Northern Development and Mines; coinciding with the Ministry of Transportation's Transportation Corridor Study that is also underway. 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.

During discussions with communities, the IESO received feedback that the name "GTA West Regional Planning" was challenging to differentiate from other initiatives underway in the area with a similar naming convention, thus, the region was changed to "Peel/Halton (GTA West) Region" for engagement purposes. Official planning documents continue to adhere to the regulatory name of "GTA West Region".

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 within the GTA West electricity planning region throughout the development of the plan. This includes the communities of Alderville First Nation, Curve Lake First Nation, Haudenosaunee Confederacy Chiefs Council, Hiawatha First Nation, Huron-Wendat, Kawartha Nishnawbe First Nation, Mississaugas of Scugog Island First Nation, Mississauagas of the Credit First Nation, and Six Nations of the Grand River.

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

9. Conclusion

The GTA West IRRP identifies electricity needs in the region over the 20-year period from 2019 to 2038, recommends a plan to address immediate and near-term needs, and lays out actions to monitor long-term needs. The IESO will continue to participate in the Working Group during the next phase of regional planning, the Regional Infrastructure Plan, to provide input and ensure a coordinated approach with bulk system planning where such linkages are identified in the IRRP.

In the near term, the IRRP recommends the implementation of control actions at Pleasant TS to manage overloads during outage conditions, upsizing Palermo TS at end-of-life, and further wires analysis for T38B/T39B load security needs during the Regional Infrastructure Plan. Responsibility for these actions has been assigned to the appropriate members of the Technical Working Group.

In the long term, the IRRP recommends that the Working Group monitor growth in the Halton Pocket and at Cardiff TS and Jim Yarrow TS to determine when further reinforcements will be needed. The IESO and the Working Group will also continue to monitor community energy planning and monitor electrification trends. The IESO and the Ministry of Energy will continue the NW GTA Transmission Corridor study to identify a suitable corridor of land that can be preserved for future transmission infrastructure should the need arise.

The Technical Working Group will 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.

Independent Electricity System Operator
1600-120 Adelaide Street West
Toronto, Ontario M5H 1T1

Phone: 905.403.6900
Toll-free: 1.888.448.7777
E-mail: customer.relations@ieso.ca

ieso.ca

@IESO_Tweets
linkedin.com/company/IESO

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