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NEEDS ASSESSMENT REPORT

Windsor-Essex Region

Date: February 15, 2023

Prepared by: Windsor-Essex Technical Working Group



Disclaimer

This Needs Assessment Report was prepared for the purpose of identifying potential needs in the Windsor-Essex Region and to recommend which needs may require further assessment and/or regional coordination. The results reported in this Needs Assessment are based on the input and information provided by the Technical Working Group (TWG).

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Executive Summary

REGION	Windsor-Essex		
LEAD	Hydro One Networks Inc. (“HONI”)		
START DATE	October 23, 2022	END DATE	February 15, 2023
1. INTRODUCTION			
<p>The second cycle of the regional planning process in the Windsor-Essex region was completed in March 2020, with the publication of the Windsor-Essex Regional Infrastructure Plan (RIP). As a result of the very significant load growth in the region and associated supply needs, regional planning was continued via an Integrated Regional Resource Plan (IRRP) Addendum study. The addendum report was published in February 2022, with recommendations of wires solution for load growth and load restoration.</p> <p>This is the third cycle of regional planning for the region, which begins with the Needs Assessment (NA) phase. The purpose of this NA is to:</p> <ol style="list-style-type: none"> a) Identify any new needs and reaffirm needs identified in the previous regional planning cycle; and, b) Recommend which needs: <ol style="list-style-type: none"> (i) require further assessment and regional coordination; and, ii) do not require further regional coordination. 			
2. REGIONAL ISSUE/TRIGGER			
<p>In accordance with the regional planning process, a regional planning cycle should be triggered every five years, or less if there is/are emerging need(s). The Needs Assessment report of the second cycle of Regional Planning for the Windsor-Essex region was published in October 2017, and given that five years have elapsed, the third Regional Planning cycle for the region was officially initiated in October 2022.</p>			
3. SCOPE OF NEEDS ASSESSMENT			
<p>The scope of this Needs Assessment covers the Windsor-Essex region, and includes:</p> <ol style="list-style-type: none"> a) Reaffirm and update needs/plans identified in the previous regional planning cycle; b) Identify any new needs resulting from this assessment; c) Recommend which need(s) require further assessment and regional coordination in the next phases of the regional planning cycle; and, d) Recommend which needs do not require further regional coordination (i.e., can be addressed directly between Hydro One and the impacted LDC(s) to develop a preferred plan and/or no regional investment is required at this time and the need may be reviewed during the next regional planning cycle). <p>The Technical Working Group (TWG) may also identify additional needs during the next phases of the planning process, namely Scoping Assessment (SA), Integrated Regional Resource Plan (IRRP) and RIP, based on updated information available at that time.</p> <p>The planning horizon for this NA assessment is 10 years.</p>			
4. INPUTS/DATA			
<p>The Technical Working Group (TWG), including representatives from Local Distribution Companies (LDCs), the Independent Electricity System Operator (IESO) and Hydro One (lead transmitter), provided inputs and any</p>			

relevant information for the Windsor-Essex region regarding system reliability, capacity needs, operational issues, and major high-voltage (HV) transmission equipment/facilities requiring replacement over the planning horizon. Municipal/Community Energy Plans were accounted for where these impacted capacity needs.

5. ASSESSMENT METHODOLOGY

The assessment's primary objective is to identify the electrical infrastructure needs in the region over the study period 2023 - 2032. The assessment reviewed available information including historical loading, future load forecast, conservation and demand management (CDM) forecast, expected distributed generation (DG) capacity, system reliability and operation issues, and major high voltage transmission assets requiring replacement/refurbishment over the study period.

A technical assessment of needs was undertaken based on:

- a) Station capacity and transmission adequacy;
- b) System reliability and any operational concerns;
- c) Major HV transmission equipment requiring replacement with consideration to “right-sizing”; and,
- d) Sensitivity analysis to capture uncertainty in the load forecast as well as variability of demand drivers such as electrification.

6. NEEDS

I. Update on needs identified during the previous regional planning cycle

The following needs and projects discussed in the Windsor-Essex 2nd cycle RIP have been completed:

1. Kingsville-Leamington supply capacity need: Built new switching station (Lakeshore TS) at Leamington Junction in 2022;
Build two new DESNs (South middle road TS T3/T4 DESN completed in 2022).
2. Kent TS station capacity: The second cycle RIP proposed to evaluate a plan to construct a new DESN in south of Chatham. In 2nd cycle RIP of Chatham-Kent Lambton Sarnia region, a new 230 kV Dresden TS was proposed with expected I/S date 2028.

The following needs and projects discussed in the Windsor-Essex 2nd cycle RIP are currently underway:

3. Kingsville-Leamington supply capacity need: Build new Chatham SS x Lakeshore 230 kV double-circuit transmission line (expected I/S 2025);
4. Build two new DESNs (South middle road TS second DESN expected I/S 2025);
5. Lauzon TS: Replacement of T5 and T6 with larger 75/125 MVA units (expected I/S 2026);
6. Keith TS: Replace T11 and T12 with larger 250 MVA units (T12 I/S 2022, T11 expected I/S 2023);
7. Belle River TS: Re-evaluated station capacity in third regional planning cycle.

The following needs and projects were discussed in West of London Bulk study by the IESO in 2021:

8. Recommended to construct new single circuit 500 kV line between Longwood TS and Lakeshore TS to enable additional capacity within the focus area (expected I/S 2030). Development is currently underway.
9. Recommended to construct a new double circuit 230 kV line between Lambton TS and Chatham SS to enable additional capacity and load security in focus area (expected I/S 2028). Development is currently underway.

10. Recommended to reacquire 550 MW of local resources whose contracts are expiring, or to acquire new resources before 2035.

The following needs and projects were discussed in IRRP Addendum published by IESO in 2022:

11. In the near term, recommended two additional 230 kV DESN stations in the Kingsville-Leamington area, supplied through a new double-circuit line from Lakeshore SS, as well as the offloading of Kingsville TS.
12. In the long term, recommended further analysis between Hydro One and its customers in Kingsville-Leamington to determine cost-justified measures, such as a new 230 kV line between Leamington TS and the new DESNs, to be implemented for load restoration purposes.

As per Order in Council 875/2022 and the subsequent Transmission License Amendment issued under OEB Case Number EB-2022-0142, Hydro One is required to develop and seek approvals for the following projects:

13. A second 500 kV transmission line between Longwood TS and Lakeshore TS.
14. A 230 kV transmission line from Windsor to Lakeshore TS.

II. Newly identified needs

The following new needs were identified as part of this NA based on the new and updated information, :

1. Autotransformer and Transmission Line Capacity Needs

- The loss of any 230 kV circuit results in thermal overload. As a result, all 230 kV circuits in the region are included in the Lakeshore Remedial Action Scheme. All 115 kV circuits, except the radial circuits E8F/E9F, are included in the Windsor Area SPS to manage thermal overload following the loss of each circuit.

2. Station Capacity Needs

- **Kingsville TS** could exceed the supply capacity (LTR) and the station loading limit, over the study period, based on the summer and winter net load forecasts.
- **Belle River TS and Lauzon TS (T7/T8 DESN)** could exceed their station supply capacity, over the study period, based on their net summer load forecasts.
- **Leamington TS (T1/T2, T3/T4 DESNs) and South Middle Road TS (T1/T2, T3/T4 DESNs)** could exceed their supply capacity, over the study period, based on their summer and winter net load forecasts.

3. Load Restoration Needs

- There is need to meet the load security and restoration requirements for South Middle Road TS load for loss of H75 and/or H76.

- There is need to meet the load security and restoration requirements for stations connected to circuits H38 and/or H39 for the loss one or both circuits.

4. System Operational Issues

- The IESO raised some system operational items relating to load restoration, line protection, load management, circuit monitoring, bus over-voltage, and Lakeshore remedial action scheme. The TWG agrees that no further action is required at this time, but will consider opportunities through subsequent studies.

5. Asset Renewal for Major HV Transmission System Equipment

Based on asset condition assessment, the following asset renewal needs have been identified over the planning horizon:

- Keith TS: T11/T12 auto-transformers and PSR5 phase angle regulator
- Lauzon TS: T1/T2 auto-transformers and T5/T6/T7/T8 Step down transformers

Note: The planned in-service year for the above projects is tentative and is subject to change.

7. RECOMMENDATIONS

The TWG recommendations are as follows:

1. The TWG will consider if there are opportunities to address system operational issues through subsequent studies.
2. Hydro One will develop an implementation plan for the following:
Asset renewal needs at Keith TS and Lauzon TS.
3. Further assessment and regional coordination is required for the following needs via the coordinated regional planning process:
 - Station capacity needs identified at Belle River TS, Kingsville TS, Lauzon T7/T8 DESN, Leamington T1/T2 DESN and T3/T4 DESN, and South Middle Road T1/T2 DESN and T3/T4 DESN. (The station capacity need at Lauzon T7/T8 may result in a configuration change at the station rather than the preferred like-for-like replacement of T7/T8 transformers.)
 - Restoration need identified for South Middle Road TS load for loss of H75 and/or H76.

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1 INTRODUCTION

The second cycle of the regional planning process in the Windsor-Essex region was nominally completed in March 2020, with the publication of the Windsor-Essex Regional Infrastructure Plan (“RIP”). The RIP provides description of the identified needs and recommendations of preferred wires plans to address near-term and mid-term needs. As a result of the continuing expansion of the greenhouse sector in the region with consequent load growth and associated transmission requirements, the Technical Working Group (TWG) recommended a continuation of regional planning via an IRRP Addendum with input from the TWG and public engagement. This phase of studies ended with the publication of the IRRP Addendum on February 10, 2022, with recommendations for wires solutions for load growth and load restoration. The IESO also carried out Bulk Planning studies: [2019 Windsor-Essex Bulk Plan](#) (June 2019) and [2021 West of London Bulk Plan](#) (September 2021). The studies recommended wires and resources solutions to meet the load growth needs in the region.

The purpose of this Needs Assessment (“NA”) is to identify new needs, update and confirm the needs and/or plans identified in the previous planning cycle.

This report was prepared by the Windsor Essex Region TWG, led by Hydro One Networks Inc. Participants of the TWG are listed below in Table 1. The report presents the results of the assessment over the 2023 – 2032 period, based on information provided by Hydro One, the Local Distribution Companies (“LDC”) and the Independent Electricity System Operator (“IESO”).

Table 1. Windsor-Essex TWG Participants

Company
Hydro One Networks Inc. (Lead Transmitter)
Independent Electricity System Operator (“IESO”)
E.L.K. Energy Inc.
Entegrus Powerlines Inc.
EnWin Utilities Ltd.
Essex Powerlines Corporation
Hydro One Networks Inc. (Distribution)

2 REGIONAL ISSUE/TRIGGER

In accordance with the regional planning process, the regional planning cycle should be triggered at least every five years, or when a new need emerges. This third cycle NA was triggered on the basis of the five-year cycle given that the second cycle NA report was published in October 2017.

3 SCOPE OF NEEDS ASSESSMENT

The scope of this NA covers the Windsor Essex region and includes:

- Reaffirm and update needs/plans identified in the previous regional planning cycle RIP;
- Identify any new needs resulting from this assessment;
- Recommend which need(s) require further assessment and regional coordination in the next phases of the regional planning cycle; and,
- Recommend which needs do not require further regional coordination (i.e., can be addressed directly between Hydro One and the impacted LDC(s) to develop a preferred plan and/or no regional investment is required at this time and the need may be reviewed during the next regional planning cycle).

The planning horizon of this NA assessment is 10 years.

The TWG may identify additional needs over the next phases of regional planning, i.e., Scoping Assessment (SA), Integrated Regional Resource Plan (IRRP) and Regional Infrastructure Plan (RIP) (Figure 1).

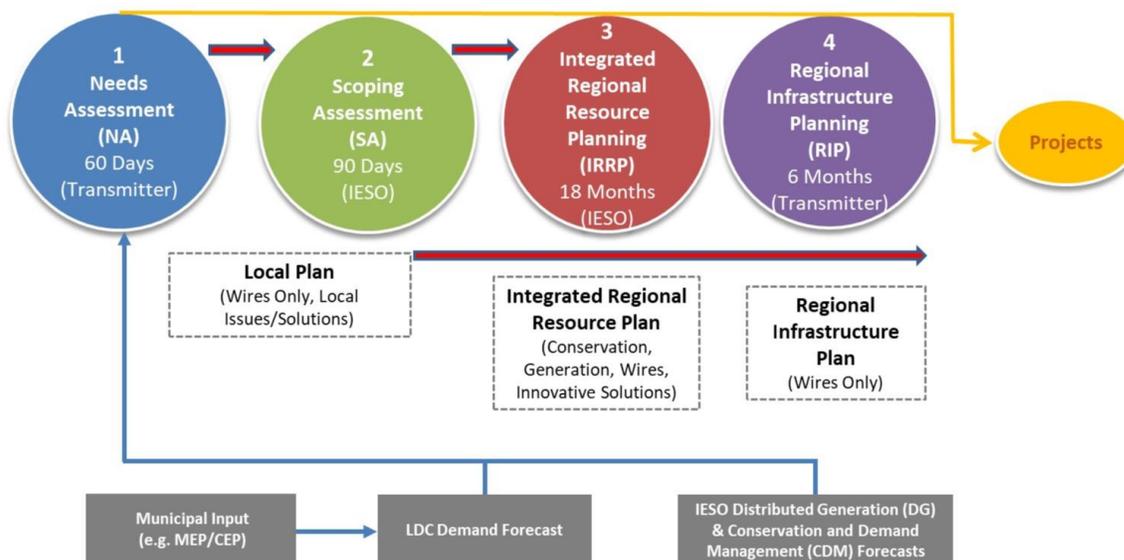


Figure 1. Regional Planning Steps

4 REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

The Windsor-Essex Region comprises the City of Windsor, Town of Amherstburg, Town of Essex, Town of Kingsville, Town of Lakeshore, Town of LaSalle, Municipality of Leamington, Town of Tecumseh, the

western portion of the Municipality of Chatham-Kent and the Township of Pelee Island. A map of the region is shown in Figure 2 below, and a single line diagram is shown in Figure 3.

The region's 115 kV network connects to the 230 kV transmission system at Keith TS and Lauzon TS via two auto-transformers in each station. With the incorporation of Leamington TS in December 2017, the percentage of the region load supplied, at time of the region peak, by the six step-down transformer stations connected to the 230 kV network increased from about 40% to about 60% of the region load in 2021, with the balance supplied by the twelve step-down transformer stations connected to the 115 kV network. This percentage would increase as more stations are connected to the 230 kV network.

The transmission system in the region can be divided into two “nested” subsystems:

- The Kingsville-Leamington subsystem: customers supplied from Kingsville TS, Leamington TS and the recently incorporated South Middle Road TS; and
- The J3E-J4E subsystem: customers supplied from stations connected to the Windsor-Essex 115 kV system, as well as customers supplied from the two 230/27.6 kV Lauzon TS DESNs. Following the loss of circuits H53Z and H54Z, and the resupply of the Lauzon DESNs via the Lauzon 230/115 kV autotransformers, the stations in this subsystem would be supplied via 115 kV circuits J3E and J4E.

Most of the load growth in the region is in the Kingsville-Leamington subsystem, and this is largely driven by expansion in the greenhouse sector and the increased use of grow lights in the sector. The stations in this subsystem supplied about 42% of the region load at the time of the region peak in 2021 (up from about 16% in 2020). A consequence of this use of grow lights is that both Kingsville TS and Leamington TS are winter peaking stations: Kingsville since 2020, and Leamington since inception. South Middle Road TS is expected to be winter peaking also.

As of 2021 the region was summer peaking, and so were all the stations in the region except those in the Kingsville-Leamington subsystem. The region may become winter peaking with increasing load in the Kingsville-Leamington subsystem.



Figure 2. Windsor-Essex Region Map

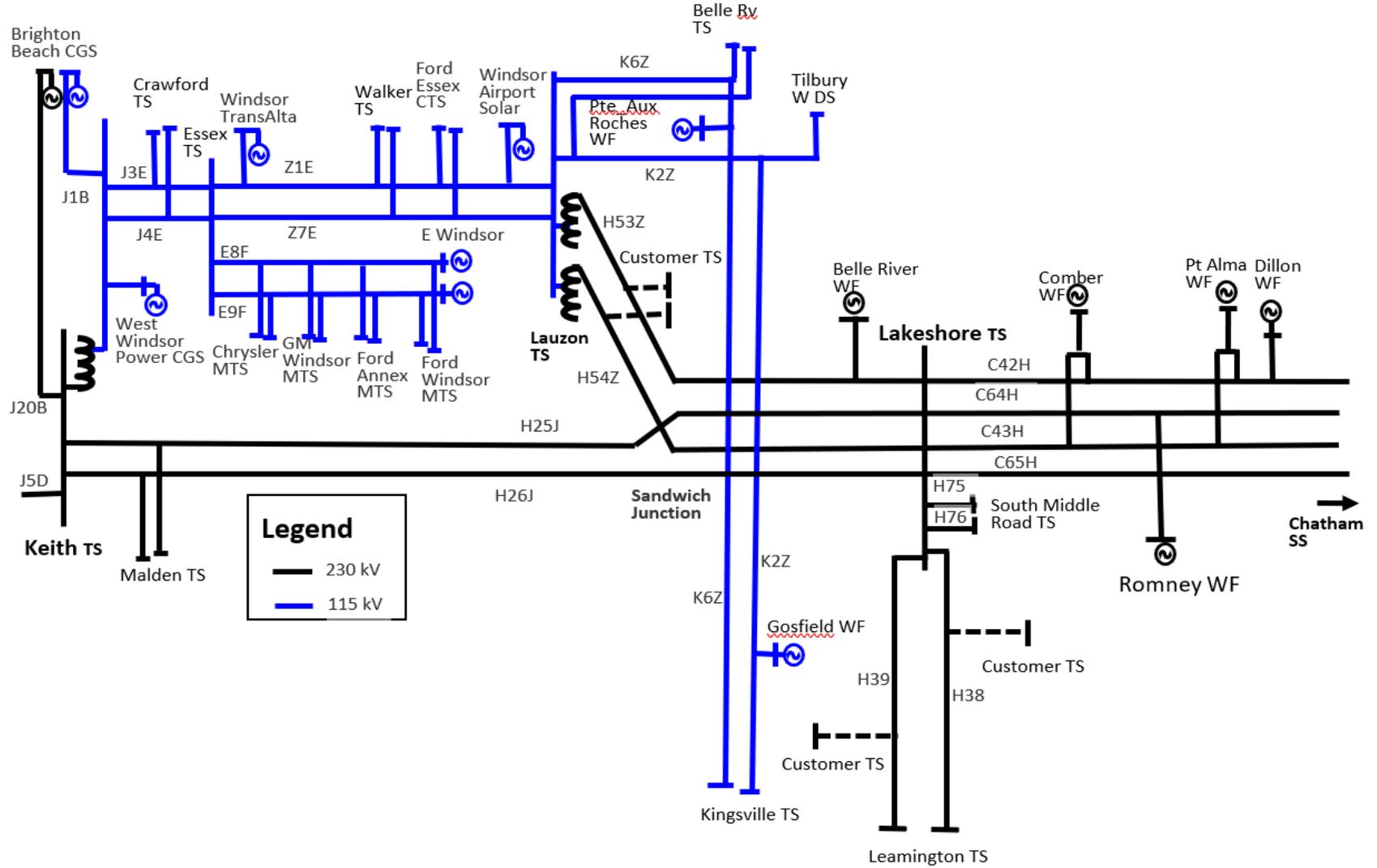


Figure 3. Windsor-Essex Region Single Line Diagram

5 INPUTS AND DATA

TWG participants, including representatives from LDCs, IESO, and Hydro One provided information and input for the Windsor-Essex Region NA. The information provided includes the following:

- Gross load forecast for each station as provided by the LDCs with due consideration for Municipal/Community Energy Plans where available.
- Distributed generation, and conservation and demand management data as provided by the IESO
- System reliability and operational issues as provided by the IESO.
- Extreme weather correction and mild weather correction data as provided by Hydro One.
- Major HV transmission equipment requiring replacement/refurbishment as provided by Hydro One.

With respect to the load forecast information, the OEB Regional Planning Process Advisory Group (RPPAG) recently published a document called “Load Forecast Guideline for Ontario” in Oct. 2022. The objective of this document is to provide guidance to the TWG in the development of the load forecasts used in the various phases of the regional planning process with a focus on the NA and the IRRP. One of the inputs into the LDC’s load forecast that is called for in this guideline is information from Municipal Energy Plans (MEP) and/or Community Energy Plans (CEP). Accordingly, the OEB RPPAG also recently developed a guideline called “Improving the Electricity Planning Process in Ontario: Enhanced Coordination between Municipalities and Entities in the Electricity Sector”, which lists the key MEP/CEP outputs to improve LDC load forecasts going forward. Hydro One reached out to municipalities in the region and undertook a screening of MEP/CEPs in the area (e.g. [Windsor CEP](#)) and found some high-level visionary information related to adoption of EVs, electrification of public transport, creating a net-zero neighbourhood, etc. Currently, the information is not in a format that can be translated into a load forecast for the purpose of this NA. The evolution of MEP/CEP information for electricity planning purposes is a gradual process and we hope to see the full transition over the next few years. At this time, the TWG recommends that further engagement and analysis be undertaken during the next phases of regional planning.

The NA also states the recommended needs and solutions for the region from the IESO bulk planning studies.

6 ASSESSMENT METHODOLOGY

Technical assessment of needs is based on:

Station capacity and Transmission Adequacy Assessment

- The assessment is based on summer and winter peak load forecasts over the period 2023 to 2032.
- Transmission adequacy needs were assessed using station loads coincident with the region peak.
- Station capacity adequacy was assessed using non-coincident peak station loads.

- For each station’s normal planning supply capacity, a 90% lagging power factor was assumed. Normal planning supply capacity for Hydro One transformer stations is the 10-Day Limited Time Rating (LTR); some LDCs may use different methodologies for determining transformer station LTR.
 - a) 2021 was considered as reference year for load forecast preparation except for the stations within the city of Windsor for which the reference year was 2019. For each of these stations, a 2021 load estimate, was obtained based on the load growth rate between station 2019 peak load and the 2022 load forecast provided by the LDC. For each station in the region, the 2021 load, or load estimate for Windsor stations, was considered as the starting point load. This starting point load was then adjusted for weather (extreme and mild).
 - b) The growth rate obtained from the LDC load forecast was then applied to the weather-adjusted starting point load to develop the 2023 – 2032 gross load forecast.
 - c) For each station and year, the applicable Distributed generation (DG) and conservation & demand management (CDM) were subtracted from the gross load forecast to obtain the station net load forecast (coincident and non-coincident).
 - d) For sensitivity considerations, a growth rate of +/- 5% was applied to the extreme weather adjusted base non-coincident load forecast.
 - e) The various net load forecasts obtained from the gross load forecasts provided by the LDCs are shown in Appendix A. These include:
 - For extreme weather: a non-coincident load forecast (this is the base load forecast), a +5% sensitivity non-coincident load forecast, a -5% sensitivity non-coincident load forecast, and a coincident load forecast (for existing stations only).
 - For mild weather: a non-coincident load forecast.

System reliability and operational issues assessment.

Review and address identified system reliability and operational issues.

Major HV Transmission asset replacement

List of major HV transmission equipment planned and/or identified to be replaced based on asset condition assessment, and relevant for regional planning purposes. The scope of equipment considered is given in section 7.5.

Development Projects

Review of planned/on-going development projects over the study period.

7 NEEDS

This section identifies any new emerging needs in the Windsor Essex Region, and reaffirms and provides an update on near, and mid-term needs identified in the previous regional planning cycle.

Needs that were identified and discussed in the previous regional planning cycle with associated projects that were recently completed or underway were reaffirmed and are briefly described below with relevant updates. Asset renewal projects took “right-sizing” into consideration. These projects include:

1. Kingsville- Leamington supply capacity need: Built new switching station (Lakeshore TS) at Leamington Junction in 2022;
 - Build two new DESNs (South middle road TS T3/T4 DESN completed in 2022 & second DESN expected I/S 2025), and;
 - Build new 230 kV double-circuit transmission line (expected I/S 2025)
2. Kent TS station capacity: The second cycle RIP proposed to evaluate a plan to construct a new DESN south of Chatham. In 2nd cycle RIP of Chatham-Kent Lambton Sarnia region, a new 230 kV Dresden TS was proposed with expected I/S date of 2028.
3. Lauzon TS: Replacement of T5 & T6 with larger 75/125 MVA units (expected I/S 2026)
4. Keith TS: Replacement of T11 and T12 with larger units (T12 completed in 2022, T11 expected I/S 2023).
5. Belle River TS: Re-evaluated station capacity in this NA report.

The following needs and projects were discussed in West of London Bulk study by IESO in 2021:

1. Recommended to construct new single circuit 500 kV line between Longwood and Lakeshore to enable additional capacity within the focus area (expected I/S 2030)
2. Recommended to construct a new double circuit 230 kV line between Lambton and Chatham to enable additional capacity and load security in focus area (expected I/S 2028)
3. Recommended to reacquire 550 MW of local resources whose contracts are expiring or to acquire new resources before 2035.

The following needs and projects were discussed in IRRP Addendum published by the IESO in 2022:

1. In the near term, recommended two new 230 kV DESNs in the Kingsville-Leamington area, supplied through a new double-circuit line from Lakeshore TS, as well as the offloading of Kingsville TS.
2. In the long term, recommended further analysis between Hydro One and its customers in Kingsville-Leamington to determine when additional 230 kV circuits between Leamington TS and new TSs would be implemented for load restoration purposes for loads connected to the Lakeshore TS x Leamington TS line.

In 2022, the following needs and projects were specified in a Hydro One Transmission License Amendment issued under OEB Case Number EB-2022-0142 after Order in Council 875/2022:

1. A second 500 kV transmission line between Longwood TS and Lakeshore TS.
2. A 230 kV transmission line from Windsor area to Lakeshore TS.

Note: The planned in-service year for the above projects is tentative and is subject to change.

All other near- and mid-term needs are summarized in Table 2 below:

Table 2. Near/Medium Term Needs Identified in Previous RIP and/or this NA

Need Description	Recommended Plan/Update	Previous RIP Report Section	NA Report Section
Transformer Station Capacity Needs			

Belle River TS Capacity	Further evaluation is needed to develop a preferred plan	6.4.1	7.2.1
Lauzon TS (T7/T8) Capacity	Further evaluation is needed to develop a preferred plan	6.2	7.2.2
Kingsville TS Capacity	Further evaluation is needed to develop a preferred plan	6.1	7.2.3
Leamington TS Capacity	Further evaluation is needed to develop a preferred plan	6.1	7.2.3
South Middle Road TS Capacity	Further evaluation is needed to develop a preferred plan	N.A.	7.2.3
Load Security and Restoration Needs			
H75/H76 Load security and Restoration	Further evaluation is needed to develop a preferred plan	N.A.	7.3.1
Asset Renewal Needs			
Keith TS - T11/T12 replacement	Planned to be replaced with upgraded 125 MVA transformers	4	7.5.1
Keith TS PSR5 replacement	Planned to replace Phase angle regulator in J5D interconnection.	N.A.	7.5.1
Lauzon TS - T1/T2/T7/T8 replacement	Planned to replace all with similar size transformers, but T7/T8 may be upsized based on further evaluation.	6.2	7.5.2

7.1 Transmission System Capacity Needs

The 230/115 kV autotransformers at Keith TS (to be upgraded by 2023) and Lauzon TS, providing supply to the J3E/J4E subsystem, are adequate over the study period for the loss of a single autotransformer.

The 230 kV and 115 kV transmission lines in the region are adequate over the study period for the loss of a single circuit. Load and generation rejection are used to manage overload of these circuits following a circuit contingency, except for circuits E8F and E9F which do not have post contingency overload.

Four new load station connections are being planned in the region: one to circuit H38, another to circuit H39, another (battery energy storage system) to circuits H38 and H39, and the fourth to circuits H53Z and H54Z.

7.2 Transformer Station Capacity Needs

Assessment of needs for transmission station capacity was based on the non-coincident net load forecast of a station exceeding the station LTR. Each station LTR and load forecast are listed in the forecast Tables in Appendix A. These Tables indicate that, over the study period, station LTRs are expected to be exceeded

at the following stations: Belle River TS, Kingsville TS, Lauzon TS T7/T8, Leamington TS T1/T2 and T3/T4, South Middle Road TS T1/T2 and T3/T4.

From the forecast Tables of Appendix A, Tables 3 to 6 (below) are obtained showing the following data regarding station forecast exceeding station LTR for the above stations: first year of exceedance, MW of exceedance, and MW of exceedance in 2032. Table 3 provides this information for the base load forecast and the +5% sensitivity forecast for the summer, while Table 4 provides these for the winter. Tables 5 and 6 provide corresponding data for the -5% sensitivity forecast and mild weather corrected load forecast.

The load forecast Tables (in Appendix A) indicate that the Lauzon T5/T6 DESN forecasted load exceeds the station LTR only prior to the upsizing of the transformers in 2026. Hence, the overload information for this DESN is not included in Tables 3 to 6.

Table 3. Station Summer LTR MW Exceedance: Base Forecast and +5% Sensitivity

Station	Base Forecast		+5% Sensitivity of Base Forecast	
	First Year Overload (MW)	2032 O/L	First Year Overload (MW)	2032 O/L
Belle River TS	2023 (3.6)	6.8	2023 (6.4)	9.8
Kingsville TS	2023 (3.4)	12.7	2023 (8.7)	18.4
Lauzon TS T7/T8	2023 (11.3)	45.3	2023 (17.0)	52.6
Leamington TS T1/T2	2023 (1.2)	6.7	2023 (10.1)	15.9
South Middle Rd TS T3/T4	2024 (4.5)	4.8	2024 (13.9)	14.1
South Middle Rd TS T1/T2	No overload	No O/L	2029 (5.5)	2.2

Table 4. Station Winter LTR MW Exceedance: Base Forecast and +5% Sensitivity

Station	Base Forecast		+5% Sensitivity of Base Forecast	
	First Year Overload (MW)	2032 O/L	First Year Overload (MW)	2032 O/L
Kingsville TS	2023 (5.8)	18.4	2023 (12.3)	25.5
Leamington TS T1/T2	2023 (3.9)	11.7	2023 (13.8)	22.0
Leamington TS T3/T4	2023 (4.5)	19.8	2022 (14.5)	30.5
South Middle Rd TS T3/T4	2023 (1.4)	0.9	2023 (11.9)	11.4
South Middle Rd TS T1/T2	No overload	No O/L	2028 (2.5)	No O/L

Table 5. Station Summer LTR MW Exceedance: Mild Weather Forecast and -5% Sensitivity

Station	Mild Weather Forecast		-5% Sensitivity of Base Forecast	
	First Year Overload (MW)	2032 O/L	First Year Overload (MW)	2032 O/L
Belle River TS	2027 (0.1)	1.9	2023 (0.8)	3.9

Kingsville TS	2024 (0.5)	9.0	2026 (0.4)	6.9
Lauzon TS T7/T8	2023 (1.9)	33.0	2026 (2.3)	37.9
Leamington TS T1/T2	No overload	No O/L	No overload	No O/L
South Middle Rd TS T3/T4	2025 (2.6)	No O/L	2025 (3.0)	No O/L
South Middle Rd TS T1/T2	No overload	No O/L	No overload	No O/L

Table 6. Station Winter LTR MW Exceedance: Mild Weather Forecast and -5% Sensitivity

Station	Mild Weather Forecast		-5% Sensitivity of Base Forecast	
	First Year Overload (MW)	2031 O/L	First Year Overload (MW)	2032 O/L
Kingsville TS	2023 (1.7)	13.9	2024 (0.1)	11.3
Leamington TS T1/T2	2031 (0.2)	1.0	2031 (0.6)	1.4
Leamington TS T3/T4	2026 (0.9)	8.6	2026 (1.3)	9.0
South Middle Rd TS T3/T4	No overload	No O/L	No overload	No O/L
South Middle Rd TS T1/T2	No overload	No O/L	No overload	No O/L

7.2.1 Belle River TS

As per Table 3, Belle River TS is forecast to exceed the summer LTR by 3.6 MW in 2023, and by 6.8 MW in 2032. The corresponding overload numbers are 6.4 MW and 9.8 MW at +5% sensitivity. There also overloads at -5% sensitivity and for mild weather. This is a relatively new station with transformers built in 2005. The TWG recommends further evaluation of this need to develop a preferred plan.

7.2.2 Lauzon TS (T7/T8)

As per Table 3, Lauzon TS T7/T8 DESN is forecast to exceed the summer LTR by 11.3 MW in 2023, and by 45.3 MW in 2032. The corresponding overload numbers are 17 MW and 52.6 MW at +5% sensitivity. (Overloads are also present at -5% sensitivity and for mild weather.) The existing transformers were built in 1972 and are planned to be replaced in 2029 based on asset condition assessment. Upsizing the transformers may be a solution to the capacity need at this station upsizing the transformers would require a reconfiguration of the DESN). The TWG recommends further evaluation of this need to develop a preferred plan.

7.2.3 Kingsville TS, Leamington TS, South Middle Road TS

As per Tables 3 and 4, the following five DESNs show some overload in the summer and winter: Kingsville TS, Leamington T1/T2 and T3/T4 DESNs and South Middle Road T1/T2 and T3/T4 DESNs. For example, in 2032, the Kingsville overload is forecast to be 12.7 MW in the summer and 18.4 MW in the winter. The corresponding overloads at the +5% sensitivity level are 18.4 MW and 25.5 MW.

The Kingsville forecast peak load exceeds 120 MW which is the station voltage decline based loading limit with load rejection (the station limit without load rejection is 96 MW).

The TWG recommends further evaluation of the needs at Kingsville TS, Leamington TS (T1/T2 and T3/T4) and at South Middle Road TS (T1/T2 and T3/T4) to develop preferred plans.

7.3 Load Security and Restoration Needs

As per the load security criteria (ORTAC Section 7.1), with one element out of service, planned load curtailment or load rejection is permissible only to account for local generation outages; and not more than 150 MW of load may be interrupted by configuration, planned load curtailment or rejection. With two elements out of service, not more than 600 MW of load may be interrupted by configuration, planned load curtailment or rejection

As per the load restoration criteria (ORTAC Section 7.2), interrupted load must be restored within the following timelines:

- Load above 250 MW, within 30 minutes;
- Load above 150 MW, within 4 hours; and
- All load, with 8 hours.

All circuits in the region, except the radial circuits E8F/E9F, are included in a load rejection scheme (Lakeshore Remedial Action Scheme or Windsor Area SPS) to manage thermal overload following the loss of each circuit. Some circuits outside the region are also included in the Lakeshore Remedial Action Scheme as their loss would require the rejection of load in the region to manage the resulting thermal overload. This is the consequence of the limited transmission system in the region relative to the requirement.

The requirement for load rejection or load curtailment in the Windsor-Essex region are beyond the ORTAC load security/restoration criteria. Consequently, Hydro One applied for, and was granted, an exemption from these requirements. The exemption expires at the end of 2028 by which time both the planned Chatham SS x Lakeshore TS 2-circuit 230 kV line and the Lambton TS x Chatham SS 2-circuit 230 kV line would be placed in-service.

The restoration needs associated with loss of H38/H39 and H75/H76 would not be affected by the incorporation of the above new 230 kV lines. These needs are described below.

7.3.1 H38/H39

Up to 170 MW of load would be lost by both configuration (up to 50 MW at a customer station) and load rejection (up to 120 MW at Leamington TS) for the loss of H38 or H39, in violation of the security criteria. Following the loss of the double-circuit H38/H39, up to 520 MW of load would be lost by configuration (Leamington DESN1, DESN2, and two customer stations). The corresponding number at the +5% sensitivity load forecast level would be 541 MW. The system cannot meet the requirement to restore 270 MW (the load amount over 250 MW) in 30 minutes. Further, the requirement to restore 370 MW (the load

amount over 150 MW) in 4 hours cannot be met as only about 30 MW of the load may be restored by transfer to Kingsville TS. All load can be restored within 8 hours through maintenance crew work.

Two new 230 kV DESNs and their associated new 2-circuit 230 kV lines were proposed in IRRP addendum, would be routed southwest from Lakeshore TS. It would then be connected to Leamington TS for load restoration for the two new DESNs and the stations connected to circuits H38 and H39. The project for the two DESNs is currently on hold, awaiting customer commitment.

7.3.2 H75/H76

Up to 120 MW of load would have to be rejection at South Middle Road TS for the loss of H75 or H76, in violation of the security criteria. Following the loss of the double-circuit H75/H76, up to 365 MW of load would be lost by configuration at South Middle Road TS (DESN1 and DESN2). The corresponding number at the +5% sensitivity load forecast level would be 384 MW. The system cannot meet the requirement to restore 115 MW (the load amount over 250 MW) in 30 minutes. Further, the requirement to restore 215 MW (the load amount over 150 MW) in 4 hours cannot be met as there is no capability to transfer load out of the station. All load can be restored within 8 hours through maintenance crew work.

The TWG recommends further evaluation of the load security and restoration needs to develop a preferred plan.

7.3.3 Other Security/Restoration Needs

The loss of K2Z would result in the loss of Tilbury West DS by configuration. Also, if Kingsville TS load is above 96 MW, load rejection would be required for the loss of K2Z or K6Z. While each of these is a violation of the load security requirement, no action is recommended to address this violation. There is no restoration violation as the total load lost due to configuration and rejection would be less than 150 MW, and all load can be restored in 8 hours through maintenance crew work.

7.4 System Operational Issues

The IESO discussed some system operational items during the development of this Needs Assessment. Identified items relate to load restoration, differential protection of the Chatham SS x Lakeshore TS circuits, load management at Leamington TS and South Middle Road TS, monitoring issues on circuits J3E/J4E, operational complexity of the Lakeshore RAS, and voltage issues at Lakeshore TS, Lauzon TS and Keith TS. The TWG agrees that no further action is required at this time. The TWG will consider if there are opportunities to address this issue through subsequent studies.

7.5 Asset Renewal Needs for Major HV Transmission Equipment

In addition to the previously identified asset renewal needs from the second regional planning cycle RIP report, Hydro One and the TWG have identified some new major HV equipment replacement needs over the next 10 years in the Windsor Essex Region (shown in Table 7 below). These needs are determined by asset condition assessment, which is based on a range of considerations such as equipment deterioration; technical obsolescence due to outdated design; lack of spare parts availability or manufacturer support; and/or potential health and safety hazards, etc. The scope, timing, and prioritization of these replacement needs are based on current available information and are subject to change.

The major high voltage transmission equipment considered in this assessment includes the following:

1. 230/115 kV autotransformers;
2. 230 kV and 115 kV load serving step-down transformers;
3. 230 kV and 115 kV breakers where:
 - Replacement of six breakers or more than 50% of station breakers, the lesser of the two
4. 230 kV and 115 kV transmission lines requiring refurbishment where:
 - Leave to Construct (i.e., section 92) approval is required for any alternative to like-for-like.
5. 230 kV and 115 kV underground cable requiring replacement where:
 - Leave to Construct (i.e., section 92) approval is required for any alternative to like-for-like.

The asset renewal assessment considers options for “right-sizing” the equipment such as:

1. Maintaining the status quo;
2. Replacing equipment with similar equipment with *lower* ratings and built to current standards;
3. Replacing equipment with similar equipment with *lower* ratings and built to current standards by transferring some load to other existing facilities;
4. Eliminating equipment by transferring all the load to other existing facilities;
5. Replacing equipment with similar equipment and built to current standards (i.e., “like-for-like” replacement); and,
6. Replacing equipment with higher ratings and built to current standards.

Table 7. Asset Renewal Needs in the Next 10 Years

Equipment	Replacement/ Refurbishment Timing
Keith TS: T11 auto transformer	2023
Keith TS: PSR5 phase angle regulator	2026
Lauzon TS: T5/T6 step-down transformers	2026
Lauzon TS: T1/T2 autotransformers, T7/T8 step-down transformers	2029

7.5.1 Keith TS

Keith TS is a major station in the City of Windsor and has been service since 1952. Station facilities include two 230/115 kV 125 MVA autotransformers (T11/T12) connecting Malden TS and Essex TS. Keith TS has one 230/27.6 kV DESN with two power transformers (T22/T23) supplying Hydro One Distribution, EnWin

Utilities Ltd., and embedded customer, Essex Powerlines Cooperation. The 230kV J5D circuit connects Hydro One with the International Transmission Company in Michigan across the Detroit River.

It was identified in the previous RIP that the autotransformers required replacement. Due to lack of self-cooled rating of the Keith autotransformers, they present operating flexibility limitations as they would have to be taken out of service following the loss of station service. The TWG recommended in the previous RIP to replace the existing units with upsized units of 250 MVA, with consideration to “right-sizing”. The upgrade will provide long-term value at minimal cost increase. T12 was replaced in 2022, and T11 would be replaced in 2023.

On the basis of asset condition assessment, the existing phase angle regulator, PSR5, installed in the J5D interconnection is planned to be replaced in 2026.

7.5.2 Lauzon TS

Lauzon TS is a major station located in the North East of Windsor and comprised of two 230/115 kV autotransformers (T1/T2), and two 230/27.6 kV DESNs T5/T6 and T7/T8, rated at 83 MVA with 10-day LTR of 112 MVA and 113 MVA, respectively. This station supplies Hydro One Distribution and EnWin Utilities Ltd, and embedded customers include E.L.K Energy Inc. and Essex Powerlines Corporation.

All the transformers at this station require replacement based on asset condition assessment. It was decided in the second regional planning cycle to upsize the T5/T6 transformers to 125 MVA units to meet the increased demand forecast. This upsizing entails a new DESN configuration and hence the replacement of the entire DESN yard. This work is planned to be completed in 2026.

The current plan is to replace T1/T2/T7/T8 with units of same size. This work is planned to be completed in 2029. As stated in Section 7.2.2, upsizing the T7/T8 transformers may be considered as a solution to the capacity need of the T7/T8 DESN.

8 CONCLUSION AND RECOMMENDATIONS

Based on the findings and discussions of Section 7, the TWG recommendations are as follows:

1. No further regional coordination is required for the following needs:
 - With respect to system operational items raised by IESO, the TWG indicated no further action is required at this time. The TWG will monitor and consider if there are opportunities to address system operational items through subsequent studies.
 - Hydro One will continue the implementation plan for the asset renewal needs identified at Keith TS and Lauzon TS in coordination with impacted LDC(s). As noted in section 7.5.2, upsizing the Lauzon TS T7/T8 transformers may be considered to address the capacity need that also exists (the capacity need will be reviewed further as part of the next phases of regional planning).

2. Further regional coordination and assessment is required for the following needs:
 - Station capacity needs identified at Belle River TS, Kingsville TS, Lauzon T7/T8 DESN, Leamington T1/T2 DESN and T3/T4 DESN, and South Middle Road T1/T2 DESN and T3/T4 DESN. (The station capacity need at Lauzon T7/T8 may result in a configuration change at the station rather than like-for-like replacement of transformers T7/T8.)
 - Restoration need identified for South Middle Road TS load for loss of H75 and/or H76.

9 REFERENCES

- [1] Planning Process Working Group (PPWG) Report to the Board: The Process for Regional Infrastructure Planning in Ontario. May 2013.
- [2] IESO Ontario Resource and Transmission Assessment Criteria (ORTAC) – Issue 5.0.
- [3] IESO Windsor-Essex Integrated Regional Infrastructure Planning, September 2019.
- [4] Hydro One Networks Inc. Windsor-Essex Regional Infrastructure Plan, March 2020.
- [5] IESO Windsor-Essex Integrated Regional Infrastructure Planning (Addendum), February 2022.
- [6] IESO West of London Bulk Planning Report, September 2021.
- [7] Hydro One Networks Inc. Chatham-Kent/Lambton/Sarnia Regional Infrastructure Plan, August 2022.
- [8] Windsor’s Community Energy Plan, July 2017.
- [9] Essex County Regional Energy Plan, May 2021.

APPENDIX A: NON-COINCIDENT NET LOAD FORECAST (MW)**A1: Non-Coincident Load Forecast - Extreme Weather Corrected**

Station/DESN	LTR (MW)	Historical* (MW)	Summer Net Forecast (MW)									
			2021	2023	2024	2025	2026	2027	2028	2029	2030	2031
Belle River TS	52.4	48.9	56.0	56.4	56.6	57.0	57.3	57.7	58.1	58.5	58.8	59.2
Crawford TS	90.9	64.1	67.5	66.9	66.7	66.6	66.4	66.2	66.2	66.1	66.0	65.9
Essex TS	106.7	63.7	67.0	66.5	66.2	66.0	65.8	65.7	65.6	65.5	65.3	65.2
Kingsville TS	102.7	80.6	106.1	106.5	107.4	108.5	109.6	110.7	112.0	113.2	114.3	115.4
Lauzon TS T5/T6	180**	104.9	124.6	124.3	124.4	124.8	125.0	119.9	120.5	120.9	121.2	121.7
Lauzon TS T7/T8	101.7	82.7	113.0	101.1	104.8	109.5	114.0	118.5	123.1	127.6	136.9	147.0
Malden TS	179.4	110.1	126.1	126.5	127.4	128.6	129.7	131.0	132.4	133.6	134.9	136.2
Tilbury West DS	30.6	19.1	20.0	19.8	19.6	19.5	19.4	19.2	19.2	19.0	18.9	18.8
Walker MTS #2	89.1	68.2	71.8	71.3	71.1	71.1	70.9	70.8	70.8	70.8	70.7	70.6
Walker TS #1	88.9	52.1	55.0	54.7	54.5	54.5	54.5	51.4	51.5	51.5	51.5	51.5
Keith TS	102.7	58.0	58.8	60.1	60.1	60.2	60.1	60.0	60.1	60.0	60.0	60.0
Leamington TS T1/T2	177.5	172.5	178.7	178.4	178.6	179.4	180.2	181.0	182.0	182.8	183.5	184.2
Leamington TS T3/T4	177.6	128.1	149.0	153.5	157.6	158.7	159.7	160.9	162.2	163.3	164.2	165.2
South Middle Road TS T1/T2	182.5	0.0	0.0	0.0	0.0	145.9	162.9	170.8	179.0	178.0	176.9	175.9
South Middle Road TS T3/T4	182.5	0.0	159.4	187.0	195.3	194.1	192.7	191.4	190.6	189.5	188.3	187.3
Industrial Customer 1	58.5	29.5	29.3	28.9	28.7	28.5	28.3	28.1	28.0	27.8	27.7	27.5
Industrial Customer 2	38.7	9.1	9.0	8.9	8.8	8.8	8.7	8.6	8.6	8.6	8.5	8.5
Industrial Customer 3	38.7	9.9	9.9	9.7	9.7	9.6	9.5	9.5	9.4	9.4	9.3	9.3
Industrial Customer 4	58.5	15.7	1.7	1.6	1.6	1.6	1.6	9.9	9.9	9.8	9.8	9.7
Industrial Customer 5	38.7	16.8	16.8	16.6	16.6	16.5	16.4	16.4	16.4	16.3	16.3	16.3
Future Leamington 1	180	0.0	0.0	0.0	0.0	0.0	0.0	128.7	147.6	155.0	162.8	171.0
Future Leamington 2	180	0.0	0.0	0.0	0.0	0.0	0.0	0.0	128.7	147.6	155.0	162.7

Station/DESN	LTR (MW)	Historical (MW)	Winter Net Forecast (MW)									
			2021	2023	2024	2025	2026	2027	2028	2029	2030	2031
Kingsville TS	123.9	91.3	129.7	130.5	131.8	133.3	134.9	136.5	138.0	139.5	140.9	142.3
Leamington TS T1/T2	194.4	185.8	198.3	198.2	198.9	200.0	201.1	202.3	203.5	204.4	205.2	206.1
Leamington TS T3/T4	195.7	148.6	200.2	202.9	206.0	207.4	208.9	210.5	212.0	213.2	214.3	215.5
South Middle Road TS T1/T2	208.6	0.0	0.0	0.0	163.4	182.9	192.0	201.1	200.1	199.0	197.9	196.8
South Middle Road TS T3/T4	208.6	0.0	210.0	218.7	217.5	216.3	215.1	214.0	213.0	211.9	210.7	209.5
Future Leamington 1	200	0.0	0.0	0.0	0.0	0.0	157.8	180.9	190.0	199.5	210.4	221.9
Future Leamington 2	200	0.0	0.0	0.0	0.0	0.0	0.0	157.8	180.9	190.0	199.5	209.4

Notes:

*: The 2021 historical load for Windsor stations was estimated based on the 2019 historical load and the growth rate between 2019 and 2022.

** : Lauzon T5/T6 LTR: 101.7 MW before replacement in 2026, 180 MW after.

A2: Coincident Load Forecast for Existing Stations - Extreme Weather Corrected

(Windsor-Essex region is summer peaking)

Station/DESN	LTR (MW)	Historical*	Net Forecast (MW)									
		2021	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Belle River TS	52.4	33.4	38.1	38.3	38.5	38.7	39.0	39.2	39.5	39.8	40.0	40.3
Crawford TS	90.9	54.0	56.5	56.1	55.9	55.8	55.6	55.5	55.5	55.4	55.3	55.2
Essex TS	106.7	56.8	59.5	59.0	58.7	58.6	58.4	58.3	58.2	58.1	58.0	57.9
Kingsville TS	102.7	79.9	107.9	108.4	109.2	110.4	111.5	112.6	113.9	115.1	116.2	117.3
Lauzon TS T5/T6	180**	77.8	92.0	91.8	91.9	92.1	92.3	88.5	89.0	89.3	89.5	89.8
Lauzon TS T7/T8	101.7	55.9	75.9	67.9	70.4	73.5	76.5	79.6	82.7	85.7	92.0	98.7
Malden TS	179.4	73.5	83.8	84.1	84.6	85.4	86.2	87.0	87.9	88.8	89.6	90.5
Tilbury West DS	30.6	14.4	15.0	14.8	14.7	14.6	14.5	14.4	14.3	14.3	14.2	14.1
Walker MTS #2	89.1	66.2	69.3	68.9	68.7	68.6	68.4	68.3	68.4	68.3	68.2	68.2
Walker TS #1	88.9	45.5	47.7	47.5	47.4	47.4	47.3	44.6	44.7	44.7	44.7	44.7
Keith TS	102.7	35.5	35.7	36.5	36.5	36.6	36.5	36.5	36.5	36.5	36.5	36.5
Leamington TS T1/T2	177.5	152.1	158.1	157.8	158.1	158.8	159.4	160.1	161.1	161.7	162.3	163.0
Leamington TS T3/T4	177.6	120.7	140.9	145.1	149.0	150.1	151.1	152.1	153.4	154.4	155.3	156.2
Industrial Customer 1	58.5	28.8	28.6	28.2	28.0	27.8	27.6	27.5	27.3	27.2	27.0	0.0
Industrial Customer 2	38.7	8.1	8.0	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.6	0.0
Industrial Customer 3	38.7	7.6	7.5	7.5	7.4	7.3	7.3	7.2	7.2	7.2	7.1	26.9
Industrial Customer 4	58.5	9.6	1.0	1.0	1.0	1.0	1.0	6.0	6.0	6.0	6.0	7.5
Industrial Customer 5	38.7	15.0	15.0	14.8	14.8	14.7	14.7	14.6	14.6	14.6	14.5	7.1

Notes:

*: The 2021 historical load for Windsor stations was estimated based on the 2019 historical load and the growth rate between 2019 and 2022.

**: Lauzon T5/T6 LTR: 101.7 MW before replacement in 2026, 180 MW after.

A3: +5% Sensitivity Non-Coincident Load Forecast - Extreme Weather Corrected

Station/DESN	LTR (MW)	Summer Net Forecast (+5% Sensitivity) (MW)									
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Belle River TS	52.4	58.8	59.2	59.4	59.8	60.2	60.6	61.0	61.4	61.8	62.2
Crawford TS	90.9	70.8	70.3	70.0	69.9	69.7	69.5	69.5	69.4	69.3	69.2
Essex TS	106.7	70.3	69.8	69.5	69.3	69.1	68.9	68.9	68.7	68.6	68.5
Kingsville TS	102.7	111.4	111.9	112.8	113.9	115.1	116.3	117.6	118.8	120.0	121.1
Lauzon TS T5/T6	180**	130.8	130.5	130.6	131.0	131.3	125.9	126.5	126.9	127.3	127.7
Lauzon TS T7/T8	101.7	118.7	106.2	110.1	114.9	119.7	124.4	129.3	134.0	143.8	154.3
Malden TS	179.4	132.4	132.9	133.8	135.0	136.2	137.5	139.0	140.3	141.6	143.0
Tilbury West DS	30.6	21.0	20.8	20.6	20.5	20.3	20.2	20.1	20.0	19.9	19.8
Walker MTS #2	89.1	75.4	74.9	74.7	74.6	74.4	74.3	74.4	74.3	74.2	74.1
Walker TS #1	88.9	57.7	57.4	57.3	57.3	57.2	54.0	54.1	54.1	54.1	54.1
Keith TS	102.7	61.7	63.1	63.1	63.2	63.1	63.0	63.1	63.0	63.0	63.0
Leamington TS T1/T2	177.5	187.6	187.3	187.6	188.4	189.2	190.0	191.1	191.9	192.6	193.4
Leamington TS T3/T4	177.6	156.5	161.2	165.5	166.6	167.7	168.9	170.3	171.5	172.4	173.5
South Middle Road TS T1/T2	182.5	0.0	0.0	0.0	153.1	171.1	179.4	188.0	186.9	185.8	184.7
South Middle Road TS T3/T4	182.5	167.3	196.4	205.0	203.8	202.3	201.0	200.1	198.9	197.7	196.6
Industrial Customer 1	58.5	30.7	30.4	30.1	29.9	29.7	29.5	29.4	29.2	29.0	28.9
Industrial Customer 2	38.7	9.4	9.3	9.3	9.2	9.1	9.1	9.0	9.0	8.9	8.9
Industrial Customer 3	38.7	10.4	10.2	10.2	10.1	10.0	10.0	9.9	9.8	9.8	9.7
Industrial Customer 4	58.5	1.8	1.7	1.7	1.7	1.7	10.4	10.4	10.3	10.3	10.2
Industrial Customer 5	38.7	17.6	17.5	17.4	17.3	17.3	17.2	17.2	17.2	17.1	17.1
Future Leamington 1	180	0.0	0.0	0.0	0.0	0.0	135.1	155.0	162.7	170.9	179.6
Future Leamington 2	180	0.0	0.0	0.0	0.0	0.0	0.0	135.1	155.0	162.7	170.9

Station/DESN	LTR (MW)	Winter Net Forecast (+5% Sensitivity) (MW)									
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Kingsville TS	123.9	136.2	137.0	138.4	140.0	141.6	143.3	144.9	146.4	147.9	149.4
Leamington TS T1/T2	194.4	208.2	208.1	208.9	210.0	211.2	212.5	213.7	214.6	215.5	216.4
Leamington TS T3/T4	195.7	210.2	213.0	216.3	217.7	219.3	221.0	222.6	223.9	225.0	226.2
South Middle Road TS T1/T2	208.6	0.0	0.0	171.6	192.0	201.6	211.1	210.1	209.0	207.8	206.7
South Middle Road TS T3/T4	208.6	220.5	229.7	228.3	227.1	225.9	224.8	223.7	222.5	221.2	220.0
Future Leamington 1	200	0.0	0.0	0.0	0.0	165.7	190.0	199.5	209.4	220.9	233.0
Future Leamington 2	200	0.0	0.0	0.0	0.0	0.0	165.7	190.0	199.5	209.4	219.9

Note:

** : Lauzon T5/T6 LTR: 101.7 MW before replacement in 2026, 180 MW after.

A4: -5% Sensitivity Non-Coincident Load Forecast - Extreme Weather Corrected

Station/DESN	LTR (MW)	Summer Net Forecast (-5% Sensitivity) (MW)									
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Belle River TS	52.4	53.2	53.5	53.8	54.1	54.4	54.8	55.2	55.6	55.9	56.3
Crawford TS	90.9	64.1	63.6	63.4	63.2	63.1	62.9	62.9	62.8	62.7	62.6
Essex TS	106.7	63.6	63.1	62.9	62.7	62.5	62.4	62.3	62.2	62.1	61.9
Kingsville TS	102.7	100.8	101.2	102.0	103.1	104.1	105.2	106.4	107.5	108.5	109.6
Lauzon TS T5/T6	180**	118.3	118.0	118.2	118.5	118.8	113.9	114.4	114.8	115.2	115.6
Lauzon TS T7/T8	101.7	107.4	96.1	99.6	104.0	108.3	112.5	117.0	121.2	130.1	139.6
Malden TS	179.4	119.8	120.2	121.0	122.2	123.2	124.4	125.7	126.9	128.1	129.4
Tilbury West DS	30.6	19.0	18.8	18.6	18.5	18.4	18.3	18.2	18.1	18.0	17.9
Walker MTS #2	89.1	68.2	67.8	67.6	67.5	67.4	67.2	67.3	67.2	67.1	67.1
Walker TS #1	88.9	52.2	51.9	51.8	51.8	51.7	48.9	48.9	48.9	48.9	49.0
Keith TS	102.7	55.8	57.1	57.0	57.1	57.0	57.0	57.0	57.0	57.0	57.0
Leamington TS T1/T2	177.5	169.7	169.4	169.7	170.5	171.1	171.9	172.9	173.6	174.3	175.0
Leamington TS T3/T4	177.6	141.6	145.8	149.7	150.8	151.8	152.8	154.1	155.1	156.0	157.0
South Middle Road TS T1/T2	182.5	0.0	0.0	0.0	138.6	154.8	162.3	170.1	169.1	168.1	167.1
South Middle Road TS T3/T4	182.5	151.4	177.7	185.5	184.4	183.1	181.9	181.0	180.0	178.9	177.9
Industrial Customer 1	58.5	27.8	27.5	27.2	27.1	26.9	26.7	26.6	26.4	26.3	26.1
Industrial Customer 2	38.7	8.5	8.4	8.4	8.3	8.3	8.2	8.2	8.1	8.1	8.0
Industrial Customer 3	38.7	9.4	9.3	9.2	9.1	9.1	9.0	9.0	8.9	8.9	8.8
Industrial Customer 4	58.5	1.6	1.6	1.6	1.5	1.5	9.4	9.4	9.3	9.3	9.2
Industrial Customer 5	38.7	15.9	15.8	15.7	15.7	15.6	15.6	15.6	15.5	15.5	15.4
Future Leamington 1	180	0.0	0.0	0.0	0.0	0.0	122.3	140.2	147.2	154.7	162.5
Future Leamington 2	180	0.0	0.0	0.0	0.0	0.0	0.0	122.3	140.2	147.2	154.6

Station/DESN	LTR (MW)	Winter Net Forecast (-5% Sensitivity) (MW)									
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Kingsville TS	123.9	123.2	124.0	125.2	126.7	128.1	129.6	131.1	132.5	133.8	135.2
Leamington TS T1/T2	194.4	188.4	188.3	189.0	190.0	191.1	192.2	193.3	194.2	195.0	195.8
Leamington TS T3/T4	195.7	190.2	192.8	195.7	197.0	198.5	199.9	201.4	202.6	203.6	204.7
South Middle Road TS T1/T2	208.6	0.0	0.0	155.2	173.7	182.4	191.0	190.1	189.1	188.0	187.0
South Middle Road TS T3/T4	208.6	199.5	207.8	206.6	205.5	204.4	203.3	202.4	201.3	200.1	199.1
Future Leamington 1	200	0.0	0.0	0.0	0.0	149.9	171.9	180.5	189.5	199.9	210.8
Future Leamington 2	200	0.0	0.0	0.0	0.0	0.0	149.9	171.9	180.5	189.5	199.0

Note:

** : Lauzon T5/T6 LTR: 101.7 MW before replacement in 2026, 180 MW after.

A5: Non-Coincident Load Forecast – Mild Weather Corrected

Station/DESN	LTR (MW)	Historical* (MW)	Summer Net Forecast (Mild Weather Corrected) (MW)									
			2021	2023	2024	2025	2026	2027	2028	2029	2030	2031
Belle River TS	52.4	48.9	51.3	51.7	51.9	52.2	52.5	52.9	53.3	53.6	54.0	54.3
Crawford TS	90.9	64.1	61.9	61.4	61.2	61.0	60.9	60.7	60.7	60.6	60.5	60.4
Essex TS	106.7	63.7	61.4	60.9	60.7	60.6	60.4	60.2	60.2	60.0	59.9	59.8
Kingsville TS	102.7	80.6	102.7	103.2	104.0	105.1	106.1	107.2	108.5	109.6	110.6	111.7
Lauzon TS T5/T6	180**	104.9	114.2	113.9	114.1	114.4	114.6	109.9	110.5	110.8	111.2	111.5
Lauzon TS T7/T8	101.7	82.7	103.6	92.7	96.1	100.4	104.5	108.6	112.9	117.0	125.5	134.7
Malden TS	179.4	110.1	115.6	116.0	116.8	117.9	118.9	120.1	121.4	122.5	123.7	124.9
Tilbury West DS	30.6	19.1	18.4	18.1	18.0	17.9	17.8	17.6	17.6	17.5	17.4	17.3
Walker MTS #2	89.1	68.2	65.9	65.4	65.2	65.2	65.0	64.9	64.9	64.9	64.8	64.7
Walker TS #1	88.9	52.1	50.4	50.1	50.0	50.0	49.9	47.2	47.2	47.2	47.2	47.3
Keith TS	102.7	58.0	53.9	55.1	55.1	55.2	55.1	55.0	55.1	55.0	55.0	55.0
Leamington TS T1/T2	177.5	172.5	169.4	169.1	169.4	170.1	170.8	171.6	172.6	173.3	173.9	174.6
Leamington TS T3/T4	177.6	128.1	141.3	145.5	149.4	150.5	151.5	152.5	153.8	154.8	155.7	156.7
South Middle Road TS T1/T2	182.5	0.0	0.0	0.0	0.0	138.3	154.5	162.0	169.7	168.8	167.7	166.8
South Middle Road TS T3/T4	182.5	0.0	151.1	177.3	185.1	184.0	182.7	181.5	180.7	179.6	178.6	177.5
Industrial Customer 1	58.5	29.5	28.9	28.5	28.3	28.1	27.9	27.7	27.6	27.5	27.3	27.1
Industrial Customer 2	38.7	9.1	8.9	8.8	8.7	8.6	8.6	8.5	8.5	8.4	8.4	8.3
Industrial Customer 3	38.7	9.9	9.7	9.6	9.5	9.5	9.4	9.4	9.3	9.3	9.2	9.1
Industrial Customer 4	58.5	15.7	1.6	1.6	1.6	1.6	1.6	9.8	9.7	9.7	9.6	9.6
Industrial Customer 5	38.7	16.8	16.5	16.4	16.3	16.3	16.2	16.2	16.2	16.1	16.1	16.0
Future Leamington 1	180	0.0	0.0	0.0	0.0	0.0	0.0	122.0	139.9	146.9	154.4	162.2
Future Leamington 2	180	0.0	0.0	0.0	0.0	0.0	0.0	0.0	122.0	139.9	146.9	154.3

Station/DESN	LTR (MW)	Historical (MW)	Winter Net Forecast (Mild Weather Corrected) (MW)									
			2021	2023	2024	2025	2026	2027	2028	2029	2030	2031
Kingsville TS	123.9	91.3	125.6	126.4	127.7	129.1	130.6	132.1	133.7	135.1	136.4	137.8
Leamington TS T1/T2	194.4	185.8	188.0	187.9	188.6	189.6	190.7	191.9	192.9	193.8	194.6	195.4
Leamington TS T3/T4	195.7	148.6	189.8	192.4	195.3	196.6	198.1	199.6	201.0	202.2	203.2	204.3
South Middle Road TS T1/T2	208.6	0.0	0.0	0.0	155.0	173.4	182.1	190.7	189.7	188.7	187.7	186.6
South Middle Road TS T3/T4	208.6	0.0	199.2	207.4	206.2	205.1	204.0	203.0	202.0	200.9	199.8	198.7
Future Leamington 1	200	0.0	0.0	0.0	0.0	0.0	149.6	171.6	180.1	189.1	199.5	210.4
Future Leamington 2	200	0.0	0.0	0.0	0.0	0.0	0.0	149.6	171.6	180.1	189.1	198.6

Notes:

*: The 2021 historical load for Windsor stations was estimated based on the 2019 historical load and the growth rate between 2019 and 2022.

** : Lauzon T5/T6 LTR: 101.7 MW before replacement in 2026, 180 MW after.

APPENDIX B: LIST OF ACRONYMS

Acronym	Description
A	Ampere
BES	Bulk Electric System
BPS	Bulk Power System
CDM	Conservation and Demand Management
CIA	Customer Impact Assessment
CGS	Customer Generating Station
CSS	Customer Switching Station
CTS	Customer Transformer Station
DCF	Discounted Cash Flow
DESN	Dual Element Spot Network
DG	Distributed Generation
DSC	Distribution System Code
GATR	Guelph Area Transmission Reinforcement
GS	Generating Station
GTA	Greater Toronto Area
HV	High Voltage
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Plan
kV	Kilovolt
LDC	Local Distribution Company
LP	Local Plan
LTE	Long Term Emergency
LTR	Limited Time Rating
LV	Low Voltage
MTS	Municipal Transformer Station
MW	Megawatt
MVA	Mega Volt-Ampere
MVAR	Mega Volt-Ampere Reactive
NA	Needs Assessment
NERC	North American Electric Reliability Corporation
NGS	Nuclear Generating Station
NPCC	Northeast Power Coordinating Council Inc.
NUG	Non-Utility Generator
OEB	Ontario Energy Board
OPA	Ontario Power Authority
ORTAC	Ontario Resource and Transmission Assessment Criteria
PF	Power Factor
PPWG	Planning Process Working Group
RIP	Regional Infrastructure Plan
ROW	Right-of-Way
SA	Scoping Assessment
SIA	System Impact Assessment
SPS	Special Protection Scheme
SS	Switching Station
TS	Transformer Station
TSC	Transmission System Code
UFLS	Under Frequency Load Shedding
ULTC	Under Load Tap Changer
UVLS	Under Voltage Load Rejection Scheme