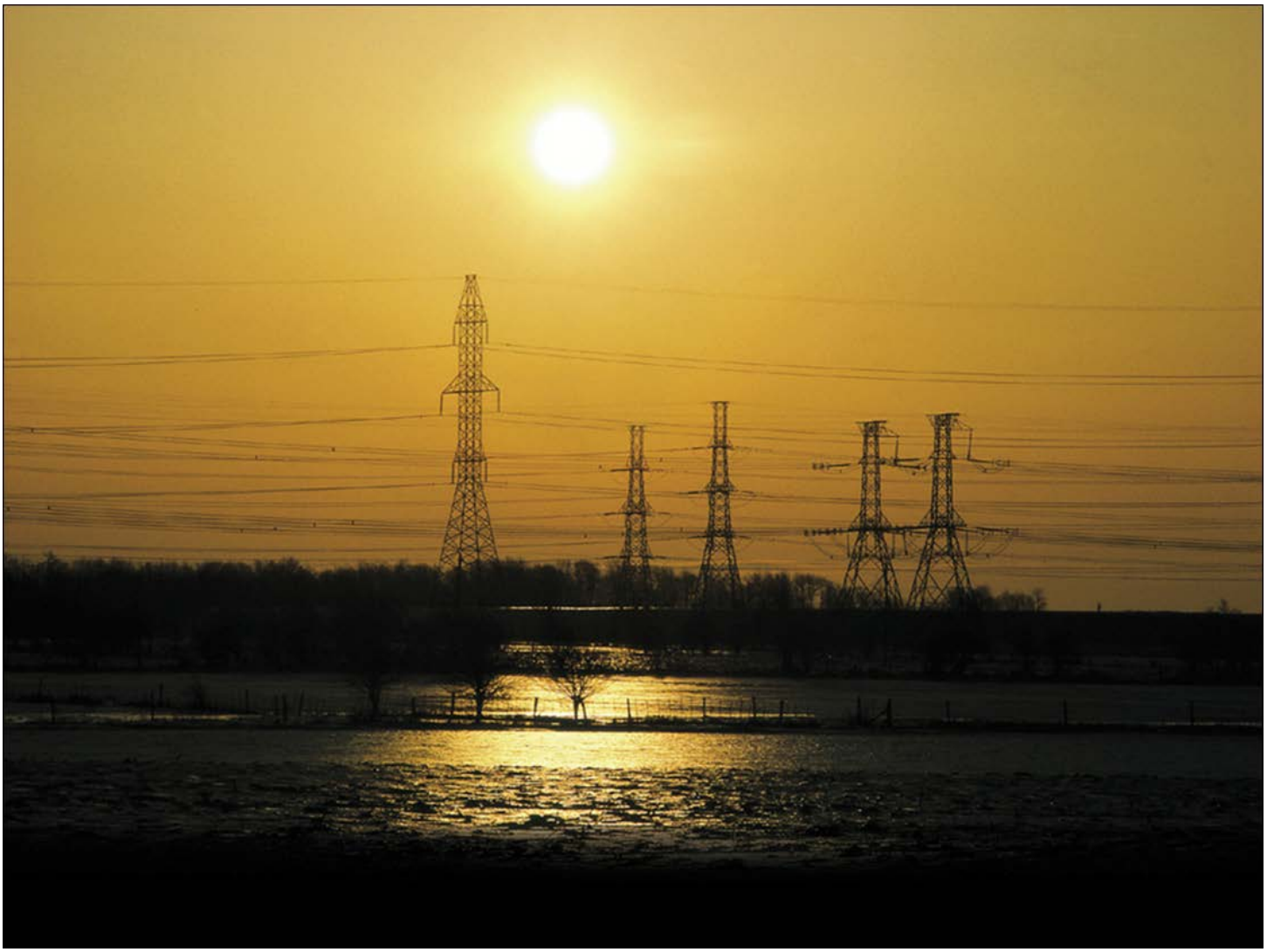

Chatham-Kent / Lambton / Sarnia Regional Infrastructure Plan

August 13, 2022

[This page is intentionally left blank]

Prepared and supported by:

Company
Hydro One Networks Inc. (Lead Transmitter)
Bluewater Power Distribution Corporation
Entegrus Power Lines Inc.
Hydro One Networks Inc. (Distribution)
Independent Electricity System Operator

[This page is intentionally left blank]

Disclaimer

This Regional Infrastructure Plan ("RIP") report was prepared for the purpose of developing an electricity infrastructure plan to address all near and mid-term needs (2021-2030) identified in previous planning phases and any additional needs identified based on new and/or updated information provided by the RIP Working Group.

The preferred solution(s) that have been identified in this report may be re-evaluated based on the findings of further analysis. The load forecast and results reported in this RIP report are based on the information provided and assumptions made by the participants of the RIP Working Group.

Working Group participants, their respective affiliated organizations, and Hydro One Networks Inc. (collectively, "the Authors") make no representations or warranties (express, implied, statutory or otherwise) as to the RIP report or its contents, including, without limitation, the accuracy or completeness of the information therein and shall not, under any circumstances whatsoever, be liable to each other, or to any third party for whom the RIP report was prepared ("the Intended Third Parties"), or to any other third party reading or receiving the RIP report ("the Other Third Parties"), for any direct, indirect or consequential loss or damages or for any punitive, incidental or special damages or any loss of profit, loss of contract, loss of opportunity or loss of goodwill resulting from or in any way related to the reliance on, acceptance or use of the RIP report or its contents by any person or entity, including, but not limited to, the aforementioned persons and entities.

[This page is intentionally left blank]

Executive Summary

THIS REGIONAL INFRASTRUCTURE PLAN ("RIP") WAS PREPARED BY HYDRO ONE AND THE WORKING GROUP IN ACCORDANCE WITH THE ONTARIO TRANSMISSION SYSTEM CODE REQUIREMENTS. IT IDENTIFIES INVESTMENTS IN TRANSMISSION FACILITIES, DISTRIBUTION FACILITIES, OR BOTH, THAT SHOULD BE PLANNED AND IMPLEMENTED TO MEET THE ELECTRICITY INFRASTRUCTURE NEEDS WITHIN THE CHATHAM-KENT / LAMBTON / SARNIA (CKLS) REGION.

The participants of the RIP Working Group included members from the following organizations:

- Hydro One Networks Inc. (Lead Transmitter)
- Bluewater Power Distribution Corporation
- Entegrus Power Lines Inc.
- Hydro One Networks Inc. (Distribution)
- Independent Electricity System Operator

In the first cycle of the Regional Planning ("RP") process for the CKLS Region, a Needs Assessment ("NA") was published in June 2016 and recommended that an Integrated Regional Resource Plan ("IRRP") was not required. The first cycle of the RP process was completed in August 2017 with the publication of the Regional Infrastructure Plan ("RIP") which provided a description of needs and recommendations of preferred wires plans to address near-term needs.

This RIP is the final phase of the second cycle of the regional planning process for the CKLS Region, which follows the completion of the Chatham-Kent/Lambton/Sarnia Region Scoping Assessment Outcome Report in December 2021 and the CKLS Needs Assessment in September 2021. This report provides a consolidated summary of needs and recommended plans for the Chatham-Kent/Lambton/Sarnia Region for the near-term (up to 5 years) and mid-term (5 to 10 years).

Investments planned for the CKLS Region over the near and mid-term, identified in the various phases of the regional planning process, are given in the table below.

No.	Project	In-Service Date	Cost
1	Construct new Lambton-by-Chatham double-circuit line (St. Clair Transmission Line)	2028	$210-290M[1]
2	Build new Dresden TS supplied by LxC corridor	2028	$40M
3	St. Andrews TS refurbishment	2025	$40-50M

[1] Letter: IESO Letter to Hydro One re Transmission Line from Lambton to Chatham [4]

In accordance with the Regional Planning process, the RIP should be reviewed and/or updated at least every five years. The Region will continue to be monitored and should there be a need that emerges earlier due to a change in load forecast or any other reason, the next regional planning cycle will be started to address the need.

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

THIS REPORT PRESENTS THE REGIONAL INFRASTRUCTURE PLAN (“RIP”) TO ADDRESS THE ELECTRICITY NEEDS OF THE CHATHAM-KENT / LAMBTON / SARNIA REGION.

The report was prepared by Hydro One Networks Inc. (“Hydro One”) and documents the results of the joint study carried out by Hydro One, Entegrus Power Lines Inc., Bluewater Power Distribution Corporation, Hydro One Distribution, and the Independent Electricity System Operator (“IESO”), in accordance with the Regional Planning process established by the Ontario Energy Board (“OEB”) in 2013.

The CKLS Region includes the municipalities of Lambton Shores and Chatham-Kent, as well as the townships of Petrolia, Plympton-Wyoming, Brooke-Alvinston, Dawn-Euphemia, Enniskillen, St. Clair, Warwick, and Villages of Oil Springs and Point Edward. The area is bordered by the London area to the east and Windsor-Essex to the southwest. The boundaries of the Region are highlighted in Figure 1-1 below.

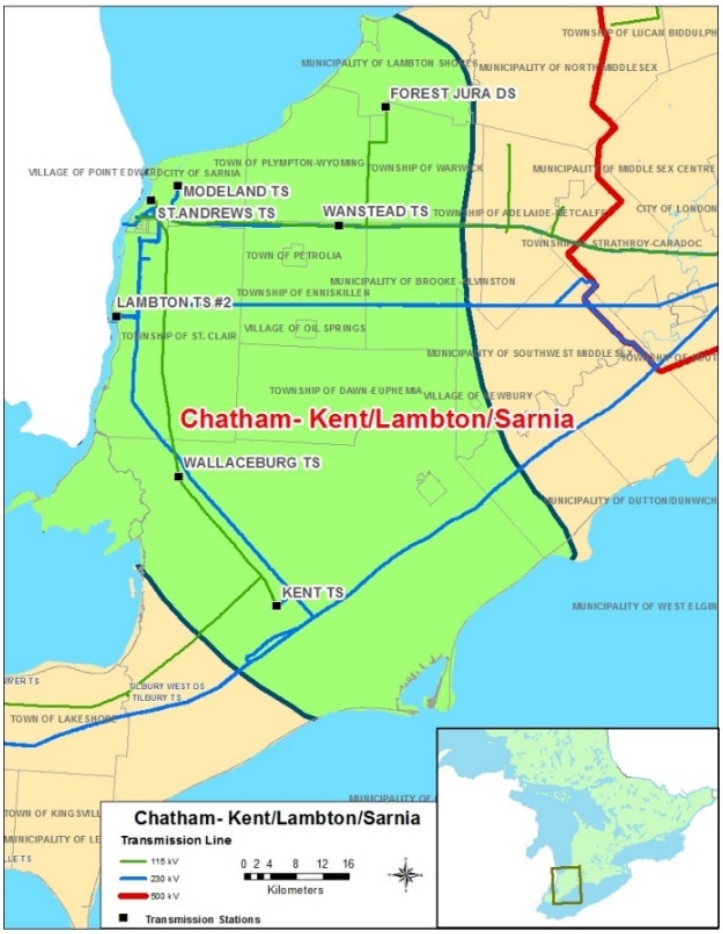

Figure 1-1. Chatham-Kent/Lambton/Sarnia Region

1.1 Objective and Scope

This RIP report examines the needs in the CKLS Region. Its objectives are:

- To develop a wires plan to address needs identified in previous planning phases for which a wires-only alternative was recommended by the Working Group
- To identify new supply needs that may have emerged since previous planning phases (e.g. Needs Assessment, Scoping Assessment, Local Plan, and/or Integrated Regional Resource Plan)
- To provide the status of wires planning currently underway or completed for specific needs
- To identify investments in transmission and distribution facilities or both that should be developed and implemented on a coordinated basis to meet the electricity infrastructure needs within the region

The RIP reviewed factors such as the load forecast, major high voltage sustainment work, transmission and distribution system capability along with any updates with respect to local plans, conservation and demand management (CDM), renewable and non-renewable generation development, and other electricity system and local drivers that may impact the need and alternatives under consideration.

The scope of this RIP is as follows:

- A consolidated report of all the needs and relevant plans to address near and mid-term needs (2021-2030) identified in previous planning phases (Needs Assessment or Local Plan)
- Identification of any new needs over the 2021-2030 period
- Develop a plan to address any longer term needs identified by the Working Group

1.2 Structure

The rest of the report is organized as follows:

- Section 2 provides an overview of the regional planning process
- Section 3 describes the Region
- Section 4 describes the transmission work completed over the last ten years
- Section 5 describes the load forecast and study assumptions used in this assessment
- Section 6 describes the results of the adequacy assessment of the transmission facilities and identifies needs
- Section 7 summarizes the Regional Plan to address the needs
- Section 8 provides the conclusion and next steps

2. REGIONAL PLANNING PROCESS

2.1 Overview

Planning for the electricity system in Ontario is done at essentially three levels: bulk system planning, regional system planning, and distribution system planning. These levels differ in the facilities that are considered and the scope of impact on the electricity system. Planning at the bulk system level typically looks at issues that impact the system on a provincial level, while planning at the regional and distribution levels looks at issues on a more regional or localized level.

Regional planning looks at supply and reliability issues at a regional or local area level. Therefore, it largely considers the 115 kV and 230 kV portions of the power system that supply various parts of the province.

2.2 Regional Planning Process

A structured regional planning process was established by the Ontario Energy Board in 2013, through amendments to the Transmission System Code ("TSC") and the Distribution System Code ("DSC"). The process consists of four phases: the Needs Assessment ("NA"), the Scoping Assessment ('SA"), the Integrated Regional Resource Plan ("IRRP"), and the Regional Infrastructure Plan ("RIP").

The regional planning process begins with the NA phase which is led by the transmitter to determine if there are regional needs. The NA phase identifies the needs and the Working Group determines whether further regional coordination is necessary to address them. If no further regional coordination is required, further planning is undertaken by the transmitter and the impacted local distribution company ("LDC") or customer and develops a Local Plan ("LP") to address them. These needs are local in nature and can be best addressed by a straight-forward wires solution.

In situations where identified needs require coordination at the regional or sub-regional levels, the IESO initiates the SA phase. During this phase, the IESO, in collaboration with the transmitter and impacted LDCs, reviews the information collected as part of the NA phase, along with additional information on potential non-wires alternatives, and makes a decision on the most appropriate regional planning approach. The approach is either a RIP, which is led by the transmitter, or an IRRP, which is led by the IESO. If more than one sub-region was identified in the NA phase, it is possible that a different approach could be taken for different sub-regions.

The IRRP phase will generally assess infrastructure (wires) versus resource options (e.g. CDM, generation and Distributed Energy Resources ("DER")) at a higher or more macro level but sufficient to permit a comparison of options. If the IRRP process identifies that infrastructure

options may be most appropriate to meet a need, the RIP phase will conduct detailed planning to identify and assess the specific wires alternatives and recommend the preferred wires solution. Similarly, resource options which the IRRP identifies as best suited to meet a need are then further planned in greater detail by the IESO. The IRRP phase also includes IESO led stakeholder engagement with municipalities and establishes a Local Advisory Committee in the region or sub-region.

The RIP phase is the final stage of the regional planning process and involves: confirmation of previously identified needs; identification of any new needs that may have emerged since the start of the planning cycle; and development of a wires plan to address the needs where a wires solution was determined to be the best overall approach. This phase is led and coordinated by the transmitter and the deliverable of this stage is a comprehensive report of a wires plan for the region. Once completed, this report can be referenced in rate filing submissions or as part of LDC rate applications with a planning status letter provided by the transmitter. Reflecting the timeliness provisions of the RIP, plan level stakeholder engagement is not undertaken at this stage. However, stakeholder engagement at a project specific level will be conducted as part of the project approval requirement.

To efficiently manage the regional planning process, Hydro One has been undertaking wires planning activities in collaboration with the IESO and/or LDCs for the CKLS Region as part of and/or in parallel with:

- Planning activities that were already underway in the region prior to the new regional planning process taking effect.
- The NA, IRRP, and LP phases of regional planning.
- Working and planning for connection capacity requirements with the LDCs and transmission connected customers

Figure 2-1 illustrates the various phases of the regional planning process (NA, SA, IRRP, and RIP) and their respective phase trigger, lead, and outcome.

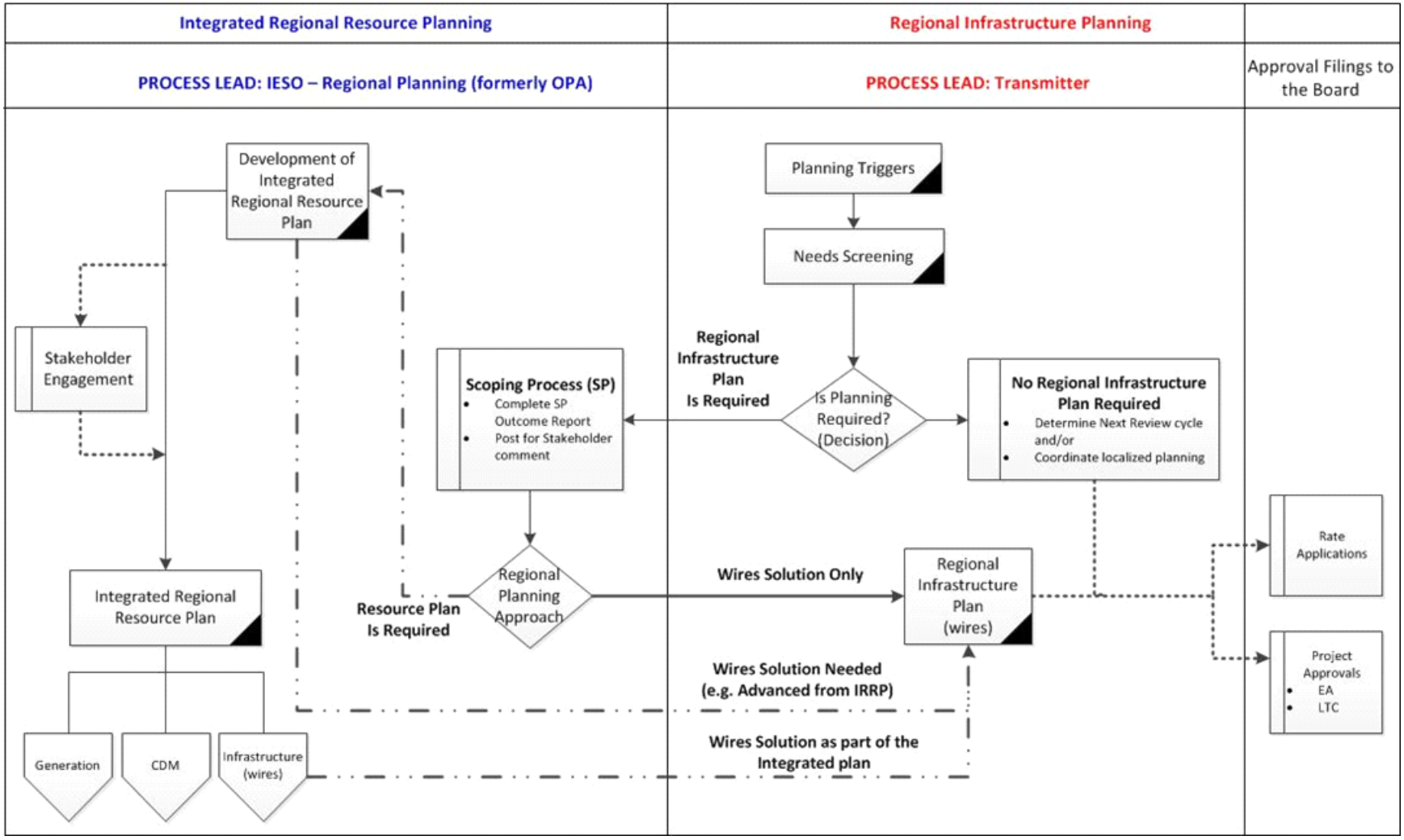

Figure 2-1. Regional Planning Flowchart

2.3 RIP Methodology

The RIP phase consists of four steps (see Figure 2-2) as follows:

1. Data Gathering: The first step of the RIP phase is the review of planning assessment data collected in the previous stages of the regional planning process. Hydro One collects this information and reviews it with the Working Group to reconfirm or update the information as required. The data collected includes:
   - Gross and net peak demand forecast at the transformer station level. This includes the effect of any distributed generation and/or conservation and demand management programs.
   - Existing area network and capabilities including any bulk system power flow assumptions.
   - Other data and assumptions as applicable such as asset conditions; load transfer capabilities, and previously committed transmission and distribution system plans.
2. Technical Assessment: The second step is a technical assessment to review the adequacy of the regional system including any previously identified needs. Additional near and mid-term needs may be identified at this stage.
3. Alternative Development: The third step is the development of wires options to address the needs and to come up with a preferred alternative based on an assessment of technical considerations, feasibility, environmental impact and costs.
4. Implementation Plan: The fourth and last step is the development of the implementation plan for the preferred alternative.

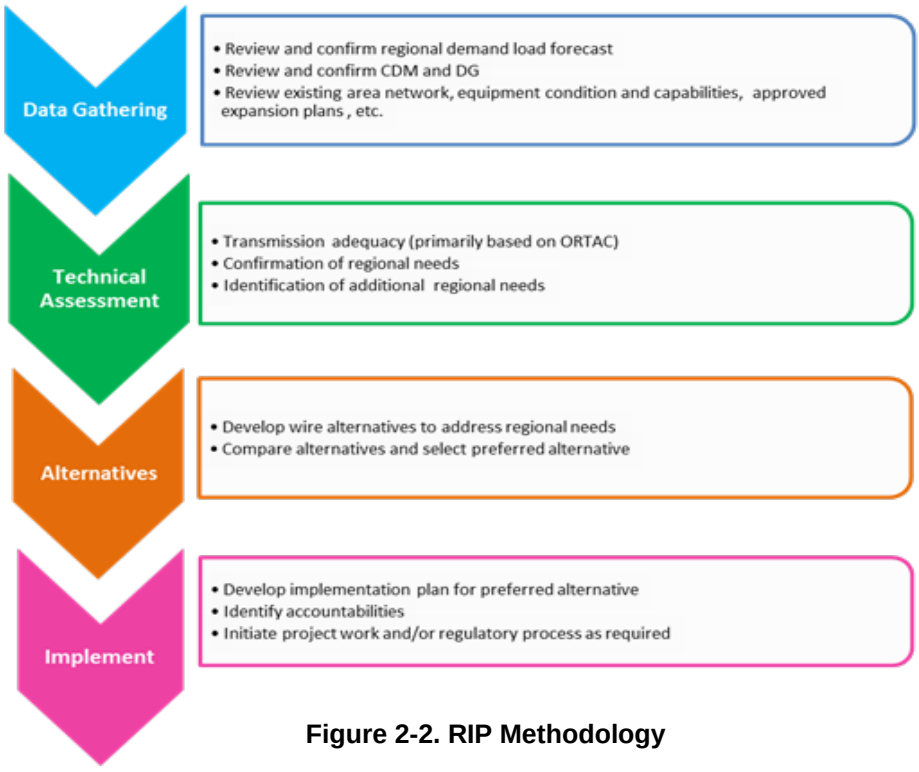

Figure 2-2. RIP Methodology

3. REGIONAL CHARACTERISTICS

THE CHATHAM-KENT / LAMBTON / SARNIA REGION COMPRISES THE MUNICIPALITIES OF LAMBTON SHORES AND CHATHAM-KENT, AS WELL AS THE TOWNSHIPS OF PETROLIA, PLYMPTON-WYOMING, BROOKE-ALVINSTON, DAWN-EUPHEMIA, ENNISKILLEN, ST. CLAIR, WARWICK, AND VILLAGES OF OIL SPRINGS AND POINT EDWARD. THE AREA IS BORDERED BY THE LONDON AREA TO THE EAST AND WINDSOR-ESSEX TO THE SOUTHWEST AS SHOWN IN FIGURE 1-1.

Electricity supply for the Region is provided through a network of 230 kV and 115 kV transmission lines. The bulk of the electrical supply is transmitted through 230 kV circuits (N21W, N22W, L24L, L26L, W44LC and W45LS) between Longwood TS and Buchanan TS and Lambton TS/Scott TS/Chatham SS, and 230 kV circuits L28C and L29C towards Chatham SS. This Region also contains a number of interconnections with neighboring Michigan State (B3N, L4D and L51D).

Within the Region, electricity is delivered to the end users of LDCs and direct-connected industrial customers by eight Hydro One step-down transformation stations, as well as nine customer-owned transformer or distribution stations supplied directly from the transmission system. Large gas-fired generators in the region include: Greenfield Energy Centre CGS, TransAlta Sarnia CGS, St. Clair Power CGS, North Kent 1 CGS, and Greenfield South Power Corporation (GSPC) CGS. Appendix A lists all step-down transformer stations in the Region. Appendix B lists all transmission circuits and Appendix C lists LDCs in the Region. The Single Line Diagram for the CKLS Region transmission system facilities is shown below in Figure 3-1.

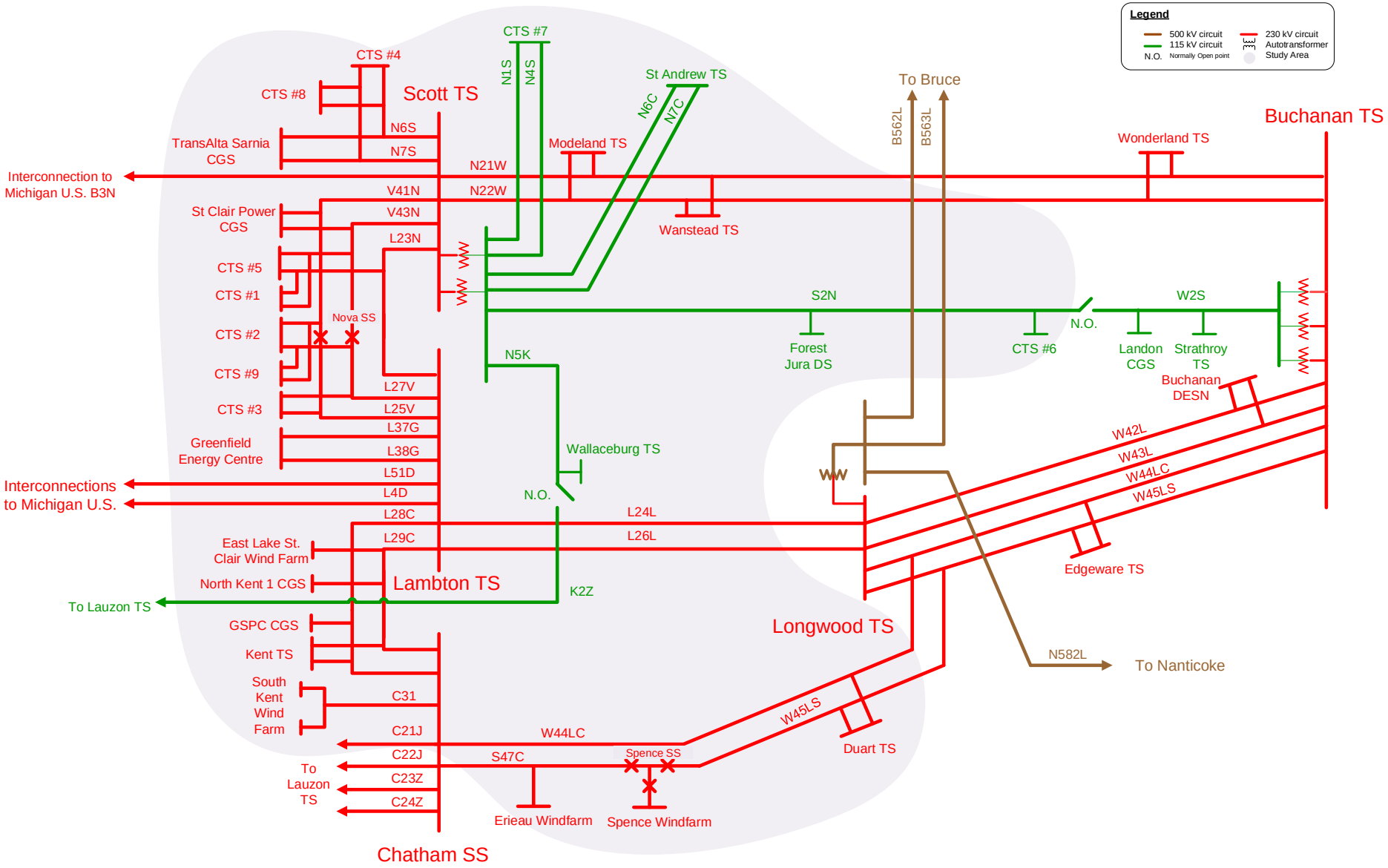

Figure 3-1. Chatham-Kent / Lambton / Sarnia Region Single-Line Diagram

4. TRANSMISSION FACILITIES COMPLETED OVER LAST TEN YEARS OR CURRENTLY UNDERWAY

OVER THE LAST 10 YEARS A NUMBER OF TRANSMISSION PROJECTS HAVE BEEN PLANNED AND COMPLETED BY HYDRO ONE, OR ARE UNDERWAY, AIMED AT IMPROVING THE SUPPLY TO THE CHATHAM-KENT / LAMBTON / SARNIA REGION.

In addition to Hydro One's ongoing transmission station and line sustainment programs, specific projects were identified as a result of joint planning studies undertaken by Hydro One, IESO and the LDCs; or initiated to meet the needs of the LDCs; and/or to meet Provincial Government policies. A brief listing of the completed projects is given below.

For bulk power system transfer needs:

- 230 kV Capacitor Bank replacement at Chatham SS in 2020

For major station refurbishment needs based on asset condition assessment:

- Wanstead TS in 2018

For renewable generation connection needs:

- 230 kV North Kent 1 Wind Farm onto circuit L29C in 2017
- 230 kV East Lake St. Clair Wind Farm onto L29C in 2012
- 230 kV Erieau Wind Farm onto circuit S47C in 2012

The following projects are underway:

- Lambton TS switchyard is currently undergoing major station refurbishment work with a projected in-servicing by 2023
- Scott TS switchyard is currently undergoing major station refurbishment work with a projected in-servicing by 2024
- New Lambton by Chatham transmission line is currently under development with a projected in-servicing by 2028

5. LOAD FORECAST AND STUDY ASSUMPTIONS

5.1 Load Forecast

The load in the CKLS Region is forecast to increase annually between 2021 and 2030. The growth rate varies across the Region with most of the growth concentrated in the Municipality of Chatham-Kent and more specifically in the Dresden area. The Region's 2022 RIP load forecasts, including the Dresden Area forecast, are provided in Appendix D and were prepared by the Working Group upon initiation of the RIP phase. The RIP forecasts are identical to the Needs Assessment forecast except as otherwise noted in Appendix D.

As per the load forecasts in Appendix D, the winter *gross* coincident load in the Region is expected to grow at an average rate of approximately 2.7% annually from 2021-2030 and the summer *gross* coincident load in the Region is expected to grow at an average rate of approximately 2.4% from 2021-2030.

As per the load forecasts in Appendix D, the winter *net* coincident load in the Region is expected to grow at an average rate of approximately 2.5% annually from 2021-2030 and the summer *net* coincident load in the Region is expected to grow at an average rate of approximately 2.2% from 2021-2030.

For both winter and summer coincident load, the strongest growth is expected between 2021 and 2025, tapering off to an average of 1% annual growth over the last 5 years of the study period.

Figure 5-1 shows the Region's gross and net *winter* coincident forecasts while Figure 5-2 shows the Region's gross and net *summer* coincident forecasts. The regional-coincident (at the same time) forecast represents the total peak load of all 18 step-down transformer stations in the Region.

Based on historical load and on the coincident load forecasts, the Region's summer coincident peak load is larger than its winter coincident peak load. Based on historical load and the non-coincident load forecasts, the Region contains most stations that are summer peaking and a few that are winter peaking. Equipment ratings are normally higher in winter than summer due to ambient temperature. Based on these factors, assessment for this Region was conducted for summer peak load.

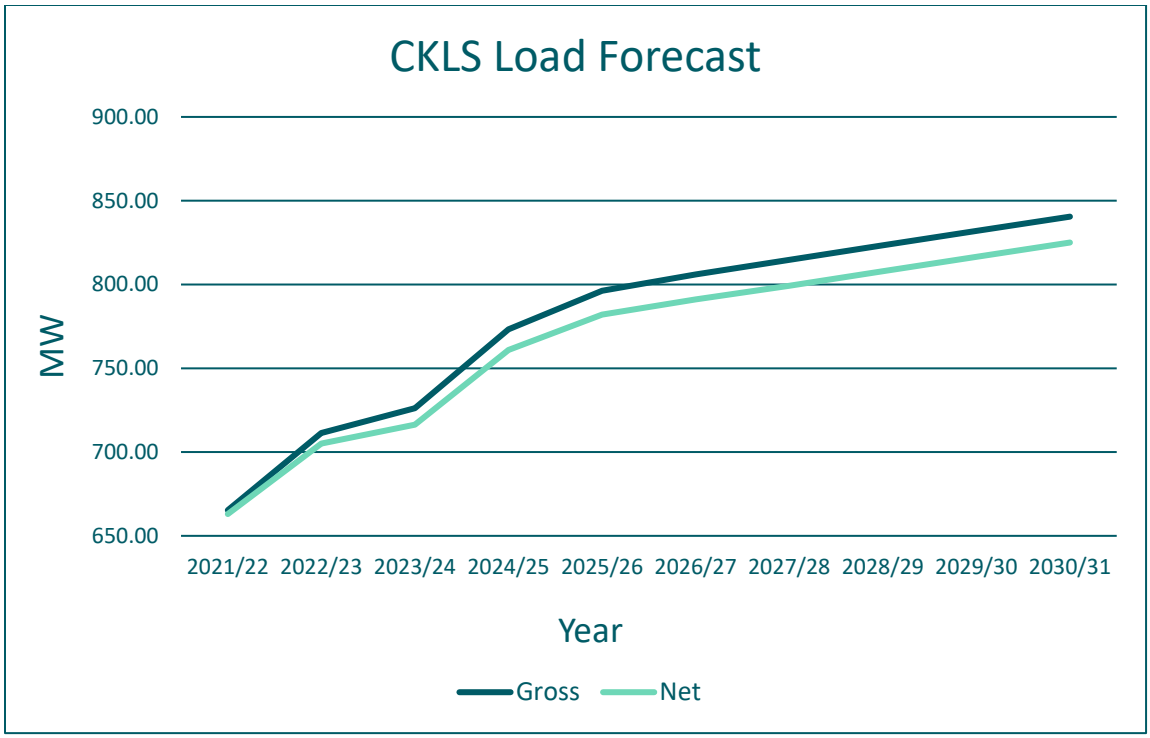

Figure 5-1. Chatham-Kent/Lambton/Sarnia Region Winter Coincident Forecast

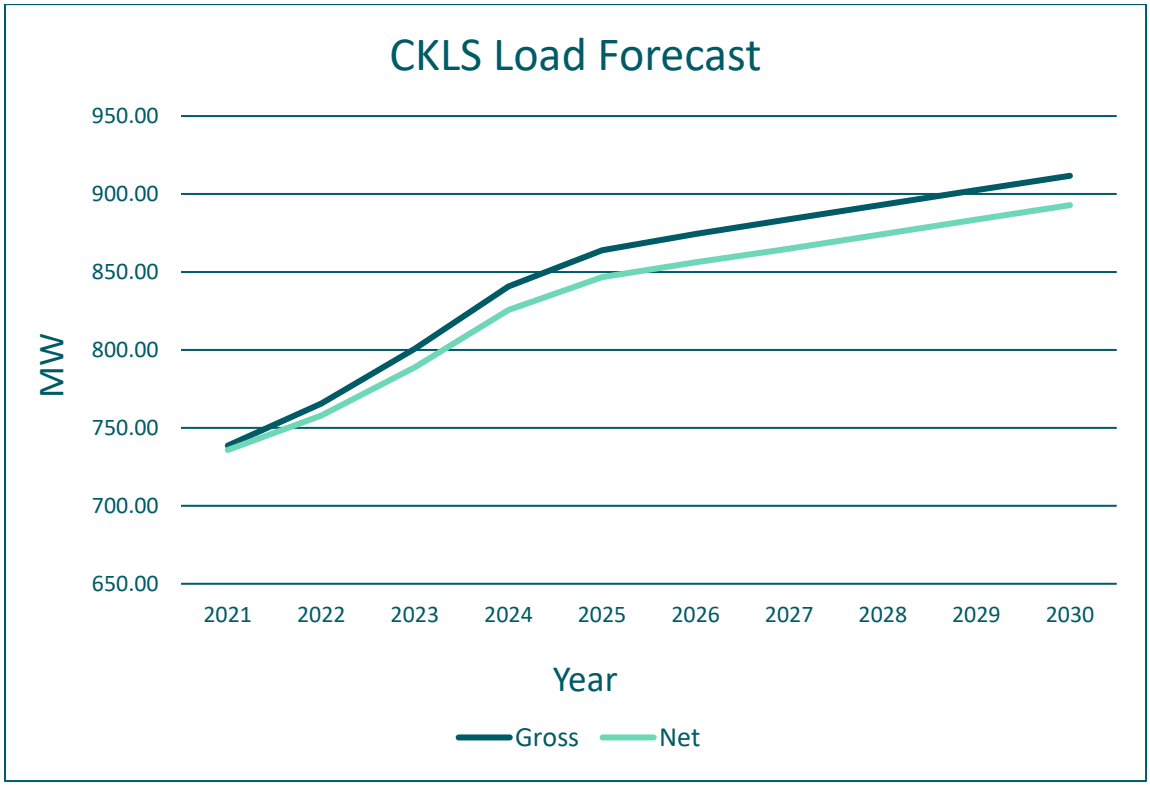

Figure 5-2. Chatham-Kent/Lambton/Sarnia Region Summer Coincident Forecast

5.2 Study Assumptions

The following assumptions are made in this report.

1) The study period for the RIP assessments is 2021-2030.

2) The Region contains most stations that are summer peaking and some that are winter peaking. The assessment is therefore based on summer peak loads.

3) Station capacity adequacy is assessed by comparing the non-coincident peak load with the station's normal planning supply capacity by assuming a 90% lagging power factor for stations without low-voltage capacitor banks or the historical low voltage power factor, whichever is more conservative. Normal planning supply capacity for transformer stations in this Region is determined by the summer and winter 10-Day Limited Time Rating (LTR), as appropriate.

4) Adequacy assessment is conducted as per Ontario Resource Transmission Assessment Criteria (ORTAC).

6. ADEQUACY OF FACILITIES AND REGIONAL NEEDS OVER THE 2021-2030 PERIOD

THIS SECTION REVIEWS THE ADEQUACY OF THE EXISTING TRANSMISSION SYSTEM AND STEP-DOWN TRANFORMATION STATION FACILITIES SUPPLYING THE CHATHAM-KENT / LAMBTON / SARNIA REGION AND LISTS THE FACILITIES REQUIRING REINFORCEMENT OVER THE NEAR AND MID-TERM.

Within the current regional planning cycle, two regional assessments have been conducted for the Chatham-Kent/Lambton/Sarnia Region. The findings of these studies are input to the RIP. The studies are:

1) Needs Assessment Report – Chatham-Kent/Lambton/Sarnia Region, September 2021
2) Chatham-Kent/Lambton/Sarnia Region Scoping Assessment Report, December 2021

This RIP reviewed the loading on transmission lines and stations in the Chatham-Kent/Lambton/Sarnia Region based on the RIP load forecast. Sections 6.1-6.5 presents the results of this review and Table 6-1 lists the Region's needs identified in both the Needs Assessment and the SA phases.

In addition, this RIP reviewed an updated list of Hydro One transmission lines and station major sustainment work over the next several years to determine if there are opportunities to consolidate with any emerging development needs within the Region. Section 7.5 presents the results of this review.

Table 6-1: Near and Mid-term Regional Needs

Type	Section	Needs	Timing
Needs and Timing Identified in the Needs Assessment Report and the Scoping Assessment [1]			
Transmission Circuit Capacity	6.2.2	Post-contingency overload and voltage violations on L28C/L29C due to strong load growth in neighbouring Windsor-Essex region	Medium-Term
Transformation Capacity	6.2.3	Transformation capacity need in the Wallaceburg TS and Kent TS area (Dresden area) due to new load connection requests	Short- to Medium-Term
		St. Andrews TS	2024
		Forest Jura HVDS	2030
Voltage Performance	6.3.3	Voltage violations on 115kV N5K circuit in the absence of new Dresden area station due to new load connection requests	Short- to Medium-Term
Bulk System Performance	6.3.4	Bulk system performance need on circuits L28C/L29C due to strong load growth in neighbouring Windsor-Essex region	Medium-Term
End-Of-Life Equipment Needs	6.4	Lambton TS	2023
		Scott TS	2024
		St. Andrews TS	2025
		Kent TS	2027
	SA	N1S/N4S	2027
		N6C/N7C	2027
		S2N	2025
		N5K*	2027

*subject to final routing selection for the Lambton by Chatham (St. Clair) transmission line [5]

6.1 230 kV Transmission Facilities

Half of the 230 kV transmission circuits in the CKLS Region are classified as part of the Bulk Electricity System ("BES"). They connect the Region to the rest of Ontario's transmission system and are also part of the transmission path from generation in Southwestern Ontario to the load centers in the London and Windsor-Essex areas. These circuits also serve local area stations within the Region and the power flow on them depends on the bulk system transfer as well as local area loads. These circuits are as follows (refer to Figure 3-2):

1) Scott TS to Buchanan TS 230kV transmission circuits N21W/N22W – supplies Modeland TS, Wanstead TS, and Wonderland TS (London Area)
2) Lambton TS to Longwood TS 230kV transmission circuits L24L/L26L
3) Chatham SS to Buchanan TS 230kV transmission circuits W44LC/W44LS/S47C – supplies Duart TS, and generation connections for Erieau Wind Farm and Spence Wind Farm
4) Lambton TS to Chatham SS 230kV transmission circuits L28C/L29C – supplies Kent TS, and generation connections for East Lake St. Clair Wind Farm, North Kent 1 CGS, and GSPC CGS

The RIP review shows that, based on current forecast station loadings, bulk transfers, and IESO's West of London Bulk Study [3], 230 kV circuits L28C/L29C are expected to exceed their post-contingency thermal limits and experience voltage violations over the study period. Supply capacity of all other 230kV transmission circuits is adequate over the study period.

6.2 230/115 kV Transformation Facilities

Bulk power supply to the CKLS Region is provided by Hydro One's 230 kV to 115 kV and 230kV to 345kV autotransformers. The number and location of these autotransformers are as follows:

1) Two (2) 230/115kV autotransformers at Scott TS
2) Two (2) 230/345kV autotransformers at Lambton TS (interconnection to Michigan)

The RIP review shows that based on current forecast station loadings and bulk transfers, the auto-transformation supply capacity is adequate over the study period.

6.3 Supply Capacity of the 115 kV Network

The CKLS Region contains two (2) double-circuit and two (2) single circuit 115 kV lines. These 115 kV circuits radially supply local area load. These circuits are as follows (see Figure 3-2):

1) Scott TS TS to CTS #7 115 kV double-circuit transmission line N1S/N4S – radially supplies CTS
2) Scott TS TS to St. Andrews TS 115 kV double-circuit transmission line N6C/N7C – radially supplies St. Andrews TS
3) Scott TS to Adelaide JCT 115 kV transmission circuit S2N – radially supplies Forest Jura HVDS and CTS #6
4) Scott TS to Kent TS TS 115 kV transmission circuit N5K with normally-open point at Wallaceburg TS – radially supplies Wallaceburg TS

The RIP review shows that based on current forecast station loadings, the supply capacity of the 115 kV network is adequate over the study period.

6.4 Step-down Transformer Stations

There are 18 step-down transformer stations within the CKLS Region. Nine supply electricity to LDCs and nine are transmission-connected industrial customer stations. These stations are listed in Appendix C. One of the 18 stations is owned and operated by an LDC.

As part of the Needs Assessment, as well as this RIP, step-down transformation station capacity was reviewed. Since the September 2021 Needs Assessment, the load forecasts at stations in the region remained unchanged; refer to Appendix D for the forecasts. Based on new customer connection requests, there is a potentially strong capacity need in the Dresden area, which is currently supplied by Kent TS and Wallaceburg TS. If the need materializes, additional capacity would be required in the next 3-6 years. The analysis also showed that the net load forecast at St. Andrews will reach the station's summer LTR in 2024, however, the planned like-for-like replacement of the transformers and switchyard (2025) will increase the station capacity and address the capacity need. Likewise, the net load forecast at Forest Jura HVDS is expected to reach the stations summer LTR in 2030 – the station owner, Hydro One Distribution, will continue to monitor the station loading and develop a plan to address the capacity need that is forecasted towards the end of the study period. The gross load forecast at all remaining stations can be accommodated over the study period.

6.5 Other Items Identified During Regional Planning

6.5.1 End-Of-Life Equipment Replacement Needs

Lambton TS – T7/T8, T5/T6 and Component Replacement

Lambton TS has two 230kV/345 kV 600MVA auto-transformers (T7/T8) that facilitate the interconnection to Michigan and two 230kV/27.6kV 56/75/93MVA step-down transformers (T5/T6) that supply Hydro One Distribution via six 27.6 kV feeders.

The current scope of this project is to replace the T7/T8 transformers with a single 1000MVA auto-transformer, the T5/T6 transformers like-for-similar with 50/83MVA capacity, the 27.6kV switchyard and associated equipment.

Based on the load forecast, similar equipment ratings are required for the EOL replacement. The new step-down transformers will increase the capacity of the station by 20 MVA. This project is underway and the planned in-service date for the project is in year 2023.

Scott TS – T5 and 115kV Switchyard Replacement

Scott TS has two 230kV/115kV 150/200/250 MVA auto-transformers (T5/T6) that supply the 115kV system in the CKLS region. Transformer T5 has been in service since 1958 as well as the 115 kV switchyard.

The current scope of this project included the like-for-like replacement of the T5 auto-transformer and the 115kV switchyard including associated equipment.

Based on the load forecast, similar equipment ratings are required for EOL replacement. The planned in-service date for the project is in year 2024.

St. Andrews TS – T3/T4 and Component Replacement

St. Andrews TS is transformer station that was built in 1964. The station consists of two 115kV/27.6 kV 56/74/93 MVA step-down transformers (T3/T4) supplied radially by 115 kV circuits N6C/N7C. The station supplies Bluewater Power Distribution Corporation via six feeders and an industrial customer via two feeders.

The current scope of this project is to replace T3/T4 transformers like-for-similar with 50/83MVA capacity and the 27.6kV switchyard along with associated equipment.

Based on the load forecast for the station, similar equipment ratings are required for EOL replacement of all equipment discussed above. The new transformers will increase the capacity of the station by 20MVA. The planned in-service date for the project is in year 2025.

Kent TS – T2 and Component Replacement

Kent TS consists of two 230kV/27.6 kV, 75/100/125 MVA step-down transformers (T1/T2) supplied by 230 kV circuits L28C/L29C (Lambton x Chatham). The station supplies Hydro One Distribution and Entegrus Powerlines Inc. T1 was replaced on demand due to a transformer failure in 2020.

The scope of this project includes the like-for-like replacement of transformer T2 along with the 27.6kV switchyard and associated equipment.

Based on the load forecast, similar equipment ratings are required for EOL replacement. Once T2 is replaced, the capacity of the station will increase by 35-40MVA. The planned in-service date for the project is in year 2027.

N1S/N4S – Transmission Line Refurbishment

End-of-life refurbishment of 115kV double-circuit transmission line is planned for the section between Scott TS and Vidal JCT and is expected to be completed in 2027.

N6C/N7C – Transmission Line Refurbishment

End-of-life refurbishment of 115kV double-circuit transmission line is planned for the section between Scott TS and St. Andrews TS, and is expected to be completed in 2027.

S2N – Transmission Line Refurbishment

End-of-life refurbishment of 115kV transmission line is planned for the section between Scott TS and Adelaide JCT and is expected to be completed in 2025.

N5K – Transmission Line Refurbishment

End-of-life refurbishment of 115kV transmission line is planned for the section between Scott TS and Kent TS and is expected to be completed in 2027. Depending on the route selection for the new Lambton-by-Chatham transmission line (referred to as the St. Clair Transmission Line project), this refurbishment may not be required as the N5K circuit may be decommissioned.

7. REGIONAL PLANS

THIS SECTION DESCRIBES THE NEEDS FROM TABLE 6-1 AND SUMMARIZES THE REGIONAL PLANS FOR ADDRESSING THE NEEDS.

7.1 Transmission Circuit Capacity

7.1.1 Circuits L28C/L29C

The L28C/L29C double-circuit transmission line will start to experience capacity issues and voltage violations in the medium term due to significant capacity needs in the neighbouring Windsor-Essex region as well as the demand for potential new connections in Dresden Area. The need for reinforcement of this corridor was documented in IESO's West of London Bulk System Study which recommended the construction of a new 230kV double-circuit transmission line between Lambton and Chatham.

Recommended Plan and Current Status

To address the potential need for additional capacity and improved voltage performance along this corridor, Hydro One has agreed with IESO's recommendation to construct the new 230kV double-circuit transmission line which is expected to be in-serviced in 2028. Three of the five routes that are currently under study involve the decommissioning of circuit N5K and a voltage conversion of Wallaceburg TS from 115kV to 230kV. The selection of the preferred route for the new double-circuit line is anticipated in Q2 2023.

7.2 Transformation Capacity

7.2.1 Wallaceburg TS and Kent TS Area (Dresden Area)

There is potentially a strong need for capacity in the Dresden Area which is currently supplied by Wallaceburg TS and Kent TS. The demand for new customer connections in the area has the potential of exceeding 100 MW by 2025 and upwards of 130 MW by the end of the study period – a capacity need that cannot be wholly supplied by the available capacities at Wallaceburg TS and Kent TS. Wallaceburg TS has approximately 5-10 MW of available capacity, whereas the existing Kent TS (T1/T2) has about 30-35 MW of spare capacity which will increase to roughly 65 MW once T2 is replaced in 2027, and the need for new capacity in this area remains in high demand. This need was also documented in IESO's Dresden Load Connection Study (included in Appendix 3 of the CKLS Scoping Assessment Outcome Report [2]) which recommended the construction of a new station supplied by the 230kV Lambton by Chatham corridor. If Wallaceburg TS is converted to 230kV supply as a result of the new Lambton by Chatham transmission line routing, additional transformation capacity of 30-40 MW would become available.

Recommended Plan and Current Status

Subject to the confirmation of the load materializing in the Dresden Area, Hydro One would move forward with IESO's recommendation of constructing a new station (proposed to be named Dresden TS) on the Lambton by Chatham corridor. Due to the existing limitations on the L28C/L29C circuits the construction of the new Dresden TS would be aligned with the construction of the new Lambton by Chatham transmission line with the intention of being ready connect new customers at the same time that the new double-circuit line is complete, in 2028. The immediate capacity needs of new customers can be supplied by the limited capacities available at Kent TS (T1/T2 DESN) and Wallaceburg TS until the proposed Dresden TS is placed in service. The need for Dresden TS may possibly be delayed if the Lambton by Chatham routing results in additional capacity becoming available at Wallaceburg TS.

7.2.2 St. Andrews TS

St. Andrews TS will reach its LTR in 2024, from which point it will continue to grow at an average rate of less than 0.5% towards the end of the study period. As the station is expected to slowly start exceeding its LTR, additional capacity is required.

Recommended Plan and Current Status

To address the capacity need at St. Andrews, it is recommended that Hydro One proceed with the sustainment plan to replace the end-of-life transformers and switchyard which will increase the LTR of the station by 20 MVA and provide sufficient capacity for the long-term. The replacement of the EOL assets is expected to be completed in 2025. Capital contribution from customers is not anticipated at this time as this a like-for-like sustainment project.

Additionally, if more capacity is requested in the local area of St. Andrews TS, the nearby Modeland TS will still have approximately 30MVA of spare capacity by the end of the study period. The existing Modeland TS also has the potential for future expansion should capacity need arise in the area.

7.2.3 Forest Jura HVDS

Forest Jura HVDS, a station owned by Hydro One Distribution, is expected to reach its LTR in 2030, with and average growth rate of 1.2% over the study period. If the forecast materializes as expected, additional capacity will be required in the long-term.

Recommended Plan and Current Status

To address the potential capacity need at Forest Jura HVDS, Hydro One Distribution will monitor the loading and determine a plan to ensure the station can meet the capacity demand.

7.3 Voltage Performance

7.3.1 Circuit N5K

Assuming a large load growth at Wallaceburg TS in the absence of the proposed Dresden TS, there would be voltage violations on the 115kV N5K circuit. This violation is mitigated with the new Dresden TS in place and Wallaceburg loaded within its LTR. Also, if the Lambton by Chatham line routing results in the decommissioning of N5K and Wallaceburg TS being supplied at 230kV, the violation is mitigated.

Recommended Plan and Current Status

It is recommended to maintain loading at Wallaceburg within its capacity limit and wait for the Lambton by Chatham line routing to be established, anticipated in Q2 2023, which will determine if the supply voltage to Wallaceburg TS is increased to 230kV. The line routing selection will also help determine the urgency in constructing the new Dresden TS.

7.4 Bulk System Performance

7.4.1 Circuits L28C/L29C

Based on the study assumptions listed in Section 5.2, and accounting for needs in neighbouring Windsor-Essex Region, there is a bulk system need to reinforce the 230kV corridor between Lambton and Chatham. There are a number of large-scale combined-cycle gas plants in the Sarnia-Lambton area and gas-fired generation output could vary depending on broader system conditions such as expected load growth in the province or availability of other generation resources. Moreover, the Chatham-Kent/Lambton/Sarnia Region is connected to the US market through interconnections in Sarnia and Lambton. Import and export generation levels on the interties have a significant impact on the bulk transmission system. Generation output and import/export levels were parameters considered for the bulk system performance for this Region as well as to serve the growing needs in neighbouring regions (Windsor-Essex region and Chatham-Kent area). The IESO undertook a study to assess the bulk system adequacy for the West of London area, under different system conditions. As a result, the need to reinforce the Lambton-by-Chatham corridor was identified to increase supply capacity into Windsor-Essex region and Chatham-Kent area to meet the mid-term capacity need, and improve the deliverability of resources in Lambton-Sarnia.

Recommended Plan and Current Status

As recommended in IESO's West of London Bulk System Study, Hydro One will proceed with the construction a new double-circuit transmission line between Lambton and Chatham to address bulk system reinforcement needs. The project is expected to be completed in 2028.

7.5 Transmission Sustainment Plans

As part of Hydro One's transmitter requirements, Hydro One continues to ensure a reliable transmission system by carrying out maintenance programs as well as periodic replacement of equipment based on their condition. Table 7-1 lists Hydro One's major transmission sustainment *projects* in the Region that are currently planned or underway. Maintenance *programs* such as insulator, shield wire, structure replacements will continue to be carried out in the Region as required based on equipment/asset condition assessments.

Table 7-1: Hydro One Transmission Major Sustainment Initiatives[2]

Station/Lines	General Description of Work	Planning In-Service Date
Lambton TS	• Replacement of T7/T8 auto-transformers and associated switches • Replacement of T5/T6 DESN transformers and associated switches • Replacement 27.6kV switchyard and associated equipment	2023
Scott TS	• Replacement of T5 auto-transformer • Replacement of 115kV switchyard and associated equipment	2024
St. Andrews TS	• Replacement of T3/T4 DESN transformers and associated switches • Replacement of 27.6kV switchyard and associated equipment	2025
Kent TS	• Replacement of T2 DESN transformers and associated switch • Replacement of 27.6kV switchyard and associated equipment	2027
N1S/N4S	• Refurbishment of circuit section between Scott TS and Vidal JCT	2027
N6C/N7C	• Refurbishment of circuit section between Scott TS and St. Andrews TS	2027
S2N	• Refurbishment of circuit section between Scott TS and Adelaide JCT	2025
N5K	• Refurbishment of circuit section between Scott TS and Kent TS*	2027

*subject to final routing selection for the Lambton by Chatham (St. Clair) transmission line

[2] Scope and dates as of August 2022 and are subject to change

Based on the needs identified in the region thus far and the transmission sustainment plans listed in Table 7-1, consolidation of sustainment and development needs is not necessary at this time.

8. CONCLUSION

THIS REGIONAL INFRASTRUCTURE PLAN REPORT CONCLUDES THE REGIONAL PLANNING PROCESS FOR THE CHATHAM-KENT / LAMBTON / SARNIA REGION.

Six near and mid-term needs were identified for the CKLS Region. They are:

I. Transmission Circuit Capacity on Lambton by Chatham Corridor (mid-term)

II. Transformation Capacity in Dresden Area (mid-term)

III. Transformation Capacity at St. Andrews TS (short- to mid-term)

IV. Transformation Capacity at Forest Jura HVDS (mid-term)

V. Voltage Performance on N5K (mid-term)

VI. Bulk System Performance on Lambton by Chatham Corridor (mid-term)

This RIP report addresses six needs and has concluded that regional plans are required. Next Steps, Lead Responsibility, and Timeframes for implementing the regional plans to address needs I through VI are summarized in the Table 8-1 below.

Table 8-1: Regional Plans – Next Steps, Lead Responsibility and Plan In-Service Dates

No.	Project	Next Steps	Lead Responsibility	In-Service Date	Cost	Needs Mitigated
1	Construct new Lambton by Chatham double-circuit line (St. Clair Transmission Line)	Project Under Development	Hydro One Transmission	2028	$210-290M	I,VI
2	Build new Dresden TS supplied by Lambton by Chatham corridor	Initiate project	Hydro One Transmission	2028*	$40M	II,V
3	St. Andrews TS Refurbishment	Detailed Estimate	Hydro One Transmission	2025	$40-50M	III
4	Monitor growth at Forest Jura HVDS	Monitor & Determine Plan	Hydro One Distribution	--	--	IV

*may be delayed if Lambton by Chatham route selection results in additional capacity available at Wallaceburg TS

In accordance with the Regional Planning process, the Regional Plan should be reviewed and/or updated at least every five years. The region will continue to be monitored and should there be a need that emerges due to a change in load forecast or any other reason, the next regional planning cycle will be started earlier to address the need.

9. REFERENCES

[1] Hydro One, “Needs Assessment Report, Chatham-Kent/Lambton/Sarnia Region”, 30 September 2021. https://www.hydroone.com/abouthydroone/CorporateInformation/regionalplans/chathamlambtonsarnia/Documents/ChathamAreaRegion-NeedsAssessmentReport-Final.pdf

[2] IESO, “Chatham-Kent/Lambton/Sarnia Scoping Assessment Outcome Report”, 30 December 2021. https://www.ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/Chatham-Kent-Lambton-Sarnia/CKLS-Scoping-Assessment-Outcome-Dec-2021.ashx

[3] IESO, “Need for Bulk System Reinforcements West of London”, September 2021. https://ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/southwest-ontario/WOL_Bulk_Report_Final_20210923.ashx

[4] IESO, “Letter: IESO Letter to Hydro One re Transmission Line from Lambton to Chatham”, March 2021. https://ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/southwest-ontario/WOL-Stage-1-Handoff-Letter-Final-Signed.ashx

[5] Hydro One, “Hydro One Website: Saint Clair Transmission Line Project Page”. https://www.hydroone.com/abouthydroone/CorporateInformation/majorprojects/saint-clair/

APPENDIX A: STEP-DOWN TRANSFORMER STATIONS IN THE CHATHAM-KENT / LAMBTON / SARNIA REGION

Station	Voltage (kV)	Supply Circuits
Duart TS	230 kV	W44LC/W45LS
Forest Jura HVDS	115 kV	S2N
Kent TS	115 kV	L28C/L29C
Lambton TS	230 kV	N/A
Modeland TS	230 kV	N21W/N22W
Scott TS	230/115 kV	N/A
St Andrews TS	115 kV	N6C/N7C
Wallaceburg TS	115 kV	N5K
Wanstead TS	230 kV	N21W/N22W
Customer CTS #1	230 kV	V43N/L23N
Customer CTS #2	230 kV	V41N/L27V
Customer CTS #3	230 kV	L25V/L27V
Customer CTS #4	230 kV	N6S/N7S
Customer CTS #5	230 kV	V43N/L23N
Customer CTS #6	115 kV	S2N
Customer CTS #7	115 kV	N1S/N4S
Customer CTS #8	230 kV	N6S/N7S
Customer CTS #9	230 kV	V41N/L27V

APPENDIX B: REGIONAL TRANSMISSION CIRCUITS IN THE CHATHAM-KENT / LAMBTON / SARNIA REGION

Location	Circuit Designation	Voltage (kV)
Scott TS – TransAlta Sarnia CGS	N6S/N7S	230 kV
Scott TS – Nova SS	V41N/V43N	230 kV
Scott TS – Lambton TS	L23N	230 kV
Lambton TS – Nova SS	L25V/L27V	230 kV
Lambton TS – Greenfield Energy Centre CGS	L37G/L38G	230 kV
Lambton TS – Chatham SS	L28C/L29C	230 kV
Chatham SS – South Kent Wind Farm CGS	C31	230 kV
Buchanan TS – Longwood TS – Chatham SS	W44LC	230 kV
Buchanan TS – Longwood TS – Spence SS	W45LS	230 kV
Spence SS – Chatham SS	S47C	230 kV
Lambton TS – Longwood TS	L24L/L26L	230 kV
Scott TS – Buchanan TS	N21W/N22W	230 kV
Scott TS – CTS	N1S/N4S	115 kV
Scott TS – St. Andrews TS	N6C/N7C	115 kV
Scott TS – CTS	S2N	115 kV
Scott TS – Wallaceburg TS	N5K	115 kV
Kent TS – Lauzon TS	K2Z	115 kV

APPENDIX C: DISTRIBUTORS IN THE CHATHAM-KENT / LAMBTON / SARNIA REGION

Distributor Name	Station Name	Connection Type
Hydro One Networks Inc.	Duart TS	Tx
	Forest Jura HVDS	Tx
	Kent TS	Tx
	Lambton TS	Tx
	Wallaceburg TS	Tx
	Wanstead TS	Tx
Bluewater power Distribution Corp.	Modeland TS	Tx
	St. Andrews TS	Tx
	Wanstead TS	Dx
Entegrus Powerlines Inc.	Kent TS	Tx, Dx
	Wallaceburg TS	Dx

APPENDIX D: REGIONAL LOAD FORECAST (2021-2030)

Table D-1. Gross Winter Regional-Coincident Forecast (MW)

Station	Limited-Time Rating (MVA)	Historical (MW)	Forecast (MW)									
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Duart TS	215.2	14.97	15.68	15.88	21.29	21.51	21.72	21.95	22.19	22.44	22.67	22.89
Forest Jura DS	31.25	18.84	19.12	19.40	19.69	19.98	20.28	20.58	20.88	21.19	21.50	21.82
Kent TS (T1/T2)	171.2*	59.51	61.12	68.36	66.17	68.00	72.65	74.54	75.22	75.91	76.58	77.24
Kent TS (T3/T4)	65.8	31.57	31.98	32.39	32.81	33.24	33.67	34.11	34.55	35.00	35.45	35.91
Lambton TS	114.1**	56.80	57.19	57.59	57.99	58.40	58.80	59.21	59.63	60.04	60.46	60.88
Modeland TS	214.8	66.30	70.00	76.91	83.81	90.72	97.63	100.85	104.08	107.30	110.52	113.75
St. Andrews TS	110.9***	62.10	65.97	66.48	66.98	101.49	102.00	102.50	103.01	103.52	104.03	104.53
Wallaceburg TS	63	26.84	27.10	27.37	27.64	27.91	28.19	28.46	28.74	29.03	29.31	29.60
Wanstead TS	128.8	37.39	38.71	39.65	40.37	40.98	48.63	49.35	50.11	50.86	51.59	52.31
CTS #1	N/A	28.20	28.43	28.67	28.91	29.14	29.39	29.63	29.88	30.12	30.37	30.63
CTS #2	N/A	16.42	16.63	16.85	17.07	17.29	17.52	17.75	17.98	18.22	18.45	18.69
CTS #3	N/A	33.36	33.36	33.36	33.36	33.36	33.36	33.36	33.36	33.36	33.36	33.36
CTS #4	N/A	40.06	40.30	40.55	40.79	41.04	41.29	41.54	41.80	42.05	42.31	42.57
CTS #5	N/A	9.47	9.47	9.47	9.47	9.47	9.47	9.47	9.47	9.47	9.47	9.47
CTS #6	N/A	1.45	1.46	1.47	1.48	1.49	1.50	1.51	1.52	1.53	1.54	1.55
CTS #7	N/A	47.46	47.79	48.12	48.45	48.79	49.13	49.47	49.82	50.16	50.51	50.87
CTS #8	N/A	49.27	98.00	98.88	99.87	100.49	101.05	101.71	102.46	103.16	103.83	104.42
CTS #9	N/A	0.00	3.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

* LTR will increase to approximately 210 MVA after T2 is replaced (2027)

** LTR will increase to approximately 135 MVA after T5/T6 are replaced (2023)

*** LTR will increase to approximately 135 MVA after T1/T2 are replaced (2025)

Table D-2. Gross Summer Regional-Coincident Forecast (MW)

Station	Limited-Time Rating (MVA)	Historical (MW)	Forecast (MW)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Duart TS	200	15.00	15.65	15.88	20.68	20.89	21.09	21.31	21.55	21.78	22.01	22.22
Forest Jura DS	31.25	19.82	20.12	20.43	20.74	21.06	21.38	21.70	22.03	22.37	22.71	23.06
Kent TS (T1/T2)	155.6*	88.60	90.17	95.73	93.78	94.63	99.41	101.60	102.55	103.51	104.46	105.39
Kent TS (T3/T4)	59.8	41.83	42.36	42.89	43.43	43.97	44.53	45.09	45.65	46.23	46.81	47.40
Lambton TS	103.8**	58.25	58.68	59.11	59.55	59.99	60.44	60.88	61.34	61.79	62.25	62.71
Modeland TS	196.5	98.97	102.99	109.95	116.90	123.86	130.82	134.07	137.32	140.56	143.81	147.06
St. Andrews TS	101.8***	60.67	63.86	64.32	64.78	92.55	93.01	93.47	93.94	94.40	94.86	95.33
Wallaceburg TS	51.8	33.91	34.25	34.74	35.26	35.58	35.88	36.21	36.56	36.92	37.24	37.55
Wanstead TS	118.9	39.25	40.69	41.66	42.65	43.49	51.03	51.97	52.95	53.92	54.87	55.80
CTS #1	N/A	26.67	26.90	27.14	27.37	27.61	27.85	28.10	28.34	28.59	28.84	29.09
CTS #2	N/A	17.80	18.01	18.22	18.43	18.65	18.86	19.09	19.31	19.53	19.76	19.99
CTS #3	N/A	34.16	34.16	34.16	34.16	34.16	34.16	34.16	34.16	34.16	34.16	34.16
CTS #4	N/A	44.34	44.63	44.92	45.22	45.51	45.81	46.11	46.41	46.71	47.02	47.32
CTS #5	N/A	8.53	8.53	8.53	8.53	8.53	8.53	8.53	8.53	8.53	8.53	8.53
CTS #6	N/A	2.69	2.71	2.73	2.75	2.77	2.79	2.81	2.83	2.85	2.87	2.89
CTS #7	N/A	53.79	54.19	54.59	54.99	55.40	55.81	56.22	56.64	57.06	57.48	57.90
CTS #8	N/A	29.57	79.73	80.62	81.57	82.08	82.54	83.07	83.68	84.25	84.80	85.27
CTS #9	N/A	0.00	1.00	10.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

* LTR will increase to approximately 195 MVA after T2 is replaced (2027)

** LTR will increase to approximately 120 MVA after T5/T6 are replaced (2023)

*** LTR will increase to approximately 120 MVA after T1/T2 are replaced (2025)

Table D-3. Gross Winter Non-Coincident Forecast (MW)

Station	Limited-Time Rating (MVA)	Historical (MW)	Forecast (MW)									
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Duart TS	215.2	15.62	16.36	16.57	22.21	22.43	22.65	22.89	23.15	23.40	23.65	23.88
Forest Jura DS	31.25	18.84	19.12	19.40	19.69	19.98	20.28	20.58	20.88	21.19	21.50	21.82
Kent TS (T1/T2)	171.2*	67.94	69.78	78.05	75.54	77.63	82.95	85.10	85.88	86.67	87.43	88.18
Kent TS (T3/T4)	65.8	36.64	37.11	37.59	38.08	38.58	39.08	39.58	40.10	40.62	41.14	41.68
Lambton TS	114.1**	61.93	62.37	62.80	63.24	63.68	64.12	64.57	65.02	65.47	65.93	66.39
Modeland TS	214.8	73.93	78.06	85.76	93.46	101.16	108.87	112.46	116.06	119.65	123.25	126.84
St. Andrews TS	110.9***	64.73	68.76	69.29	69.82	105.78	106.31	106.84	107.37	107.90	108.43	108.96
Wallaceburg TS	63	32.37	32.69	33.01	33.33	33.66	33.99	34.33	34.67	35.01	35.35	35.70
Wanstead TS	128.8	39.16	40.54	41.52	42.28	42.92	50.93	51.69	52.48	53.26	54.03	54.78
CTS #1	N/A	31.78	32.04	32.31	32.58	32.85	33.12	33.39	33.67	33.95	34.23	34.51
CTS #2	N/A	17.04	17.26	17.49	17.72	17.95	18.18	18.42	18.66	18.91	19.15	19.40
CTS #3	N/A	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60
CTS #4	N/A	47.22	47.50	47.79	48.09	48.38	48.67	48.97	49.27	49.57	49.87	50.18
CTS #5	N/A	10.64	10.64	10.64	10.64	10.64	10.64	10.64	10.64	10.64	10.64	10.64
CTS #6	N/A	3.04	3.06	3.08	3.10	3.12	3.14	3.16	3.18	3.21	3.23	3.25
CTS #7	N/A	53.71	54.08	54.46	54.84	55.22	55.60	55.99	56.38	56.77	57.17	57.57
CTS #8	N/A	51.40	102.23	103.15	104.17	104.82	105.41	106.10	106.88	107.61	108.31	108.92
CTS #9	N/A	0.00	3.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

* LTR will increase to approximately 210 MVA after T2 is replaced (2027)

** LTR will increase to approximately 135 MVA after T5/T6 are replaced (2023)

*** LTR will increase to approximately 135 MVA after T1/T2 are replaced (2025)

Table D-4. Gross Summer Non-Coincident Forecast (MW)

Station	Limited-Time Rating (MVA)	Historical (MW)	Forecast (MW)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Duart TS	200	17.52	18.28	18.55	24.15	24.39	24.63	24.89	25.17	25.44	25.71	25.96
Forest Jura DS	31.25	26.60	27.00	27.41	27.83	28.26	28.69	29.13	29.57	30.02	30.48	30.95
Kent TS (T1/T2)	155.6*	105.10	106.96	113.55	111.24	112.25	117.92	120.52	121.65	122.78	123.90	125.01
Kent TS (T3/T4)	59.8	46.81	47.40	48.00	48.60	49.21	49.83	50.46	51.09	51.73	52.38	53.04
Lambton TS	103.8**	65.41	65.90	66.39	66.88	67.37	67.87	68.37	68.88	69.39	69.90	70.42
Modeland TS	196.5	114.81	119.46	127.53	135.60	143.68	151.75	155.51	159.28	163.05	166.81	170.58
St. Andrews TS	101.8***	65.06	68.48	68.98	69.47	99.25	99.74	100.24	100.74	101.23	101.73	102.23
Wallaceburg TS	51.8	39.11	39.50	40.07	40.67	41.04	41.39	41.77	42.18	42.58	42.96	43.32
Wanstead TS	118.9	46.42	48.13	49.27	50.45	51.44	60.36	61.47	62.63	63.77	64.90	66.00
CTS #1	N/A	32.20	32.48	32.76	33.05	33.34	33.63	33.92	34.22	34.51	34.82	35.12
CTS #2	N/A	19.35	19.57	19.80	20.03	20.27	20.51	20.75	20.99	21.23	21.48	21.73
CTS #3	N/A	35.75	35.75	35.75	35.75	35.75	35.75	35.75	35.75	35.75	35.75	35.75
CTS #4	N/A	48.71	49.02	49.34	49.67	49.99	50.32	50.64	50.98	51.31	51.64	51.98
CTS #5	N/A	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96
CTS #6	N/A	2.77	2.79	2.81	2.83	2.85	2.87	2.89	2.91	2.93	2.95	2.97
CTS #7	N/A	56.08	56.50	56.92	57.34	57.76	58.19	58.62	59.05	59.49	59.93	60.37
CTS #8	N/A	112.89	113.74	114.59	115.45	116.32	117.19	118.07	118.96	119.85	120.75	121.66
CTS #9	N/A	0.00	1.00	10.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

* LTR will increase to approximately 195 MVA after T2 is replaced (2027)

** LTR will increase to approximately 120 MVA after T5/T6 are replaced (2023)

*** LTR will increase to approximately 120 MVA after T1/T2 are replaced (2025)

Table D-5. Net Winter Regional Coincident Forecast (MW)

Station	Limited-Time Rating (MVA)	Historical (MW)	Forecast (MW)									
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Duart TS	215.2	14.97	15.59	15.63	20.90	21.02	21.15	21.35	21.58	21.82	22.05	22.27
Forest Jura DS	31.25	18.84	19.00	19.08	19.19	19.36	19.56	19.83	20.10	20.41	20.73	21.05
Kent TS (T1/T2)	171.2*	59.51	60.76	67.36	64.61	66.03	70.40	72.17	72.77	73.45	74.12	74.78
Kent TS (T3/T4)	65.8	31.57	31.78	31.86	31.99	32.20	32.47	32.85	33.25	33.70	34.15	34.61
Lambton TS	114.1**	56.80	56.84	56.63	56.50	56.52	56.65	56.95	57.28	57.70	58.12	58.54
Modeland TS	214.8	66.30	69.59	75.79	82.08	88.53	95.12	98.21	101.34	104.56	107.79	111.01
St. Andrews TS	110.9***	62.10	65.59	65.43	65.36	99.44	99.64	100.03	100.45	100.96	101.46	101.97
Wallaceburg TS	63	26.84	26.94	26.92	26.94	27.03	27.17	27.40	27.64	27.92	28.21	28.50
Wanstead TS	128.8	37.39	38.48	39.02	39.39	39.75	47.21	47.86	48.57	49.32	50.05	50.76
CTS #1	N/A	28.20	28.43	28.67	28.91	29.14	29.39	29.63	29.88	30.12	30.37	30.63
CTS #2	N/A	16.42	16.63	16.85	17.07	17.29	17.52	17.75	17.98	18.22	18.45	18.69
CTS #3	N/A	33.36	33.36	33.36	33.36	33.36	33.36	33.36	33.36	33.36	33.36	33.36
CTS #4	N/A	40.06	40.30	40.55	40.79	41.04	41.29	41.54	41.80	42.05	42.31	42.57
CTS #5	N/A	9.47	9.47	9.47	9.47	9.47	9.47	9.47	9.47	9.47	9.47	9.47
CTS #6	N/A	1.45	1.46	1.47	1.48	1.49	1.50	1.51	1.52	1.53	1.54	1.55
CTS #7	N/A	47.46	47.79	48.12	48.45	48.79	49.13	49.47	49.82	50.16	50.51	50.87
CTS #8	N/A	49.27	98.00	98.88	99.87	100.49	101.05	101.71	102.46	103.16	103.83	104.42
CTS #9	N/A	0.00	3.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

* LTR will increase to approximately 210 MVA after T2 is replaced (2027)

** LTR will increase to approximately 135 MVA after T5/T6 are replaced (2023)

*** LTR will increase to approximately 135 MVA after T1/T2 are replaced (2025)

Table D-6. Net Summer Regional Coincident Forecast (MW)

Station	Limited-Time Rating (MVA)	Historical (MW)	Forecast (MW)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Duart TS	200	15.00	15.56	15.63	20.28	20.39	20.52	20.71	20.93	21.16	21.39	21.61
Forest Jura DS	31.25	19.82	20.00	20.09	20.22	20.40	20.63	20.91	21.22	21.55	21.89	22.24
Kent TS (T1/T2)	155.6**	88.60	89.63	94.23	91.46	91.71	96.05	98.07	98.90	99.85	100.80	101.74
Kent TS (T3/T4)	59.8	41.83	42.10	42.18	42.33	42.59	42.94	43.42	43.93	44.50	45.08	45.67
Lambton TS	103.8***	58.25	58.32	58.13	58.03	58.07	58.23	58.56	58.93	59.39	59.84	60.30
Modeland TS	196.5	98.97	102.38	108.27	114.31	120.60	127.07	130.13	133.23	136.48	139.73	142.97
St. Andrews TS	101.8****	60.67	63.49	63.30	63.19	90.55	90.71	91.06	91.43	91.90	92.36	92.82
Wallaceburg TS	51.8	33.91	34.04	34.16	34.37	34.46	34.59	34.86	35.17	35.52	35.85	36.15
Wanstead TS	118.9	39.25	40.45	40.99	41.62	42.20	49.54	50.41	51.33	52.30	53.25	54.18
CTS #1	N/A	26.67	26.90	27.14	27.37	27.61	27.85	28.10	28.34	28.59	28.84	29.09
CTS #2	N/A	17.80	18.01	18.22	18.43	18.65	18.86	19.09	19.31	19.53	19.76	19.99
CTS #3	N/A	34.16	34.16	34.16	34.16	34.16	34.16	34.16	34.16	34.16	34.16	34.16
CTS #4	N/A	44.34	44.63	44.92	45.22	45.51	45.81	46.11	46.41	46.71	47.02	47.32
CTS #5	N/A	8.53	8.53	8.53	8.53	8.53	8.53	8.53	8.53	8.53	8.53	8.53
CTS #6	N/A	2.69	2.71	2.73	2.75	2.77	2.79	2.81	2.83	2.85	2.87	2.89
CTS #7	N/A	53.79	54.19	54.59	54.99	55.40	55.81	56.22	56.64	57.06	57.48	57.90
CTS #8	N/A	29.57	79.73	80.62	81.57	82.08	82.54	83.07	83.68	84.25	84.80	85.27
CTS #9	N/A	0.00	1.00	10.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

* LTR will increase to approximately 195 MVA after T2 is replaced (2027)

** LTR will increase to approximately 120 MVA after T5/T6 are replaced (2023)

*** LTR will increase to approximately 120 MVA after T1/T2 are replaced (2025)

Table D-7. Net Winter Non-Coincident Forecast (MW)

Station	Limited-Time Rating (MVA)	Historical (MW)	Forecast (MW)									
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Duart TS	215.2	15.62	16.26	16.30	21.80	21.92	22.06	22.27	22.50	22.76	23.00	23.23
Forest Jura DS	31.25	18.84	19.00	19.08	19.19	19.36	19.56	19.83	20.10	20.41	20.73	21.05
Kent TS (T1/T2)	171.2*	67.94	69.37	76.90	73.76	75.39	80.37	82.40	83.08	83.86	84.63	85.38
Kent TS (T3/T4)	65.8	36.64	36.89	36.97	37.12	37.37	37.69	38.12	38.58	39.10	39.63	40.17
Lambton TS	114.1**	61.93	61.99	61.76	61.62	61.64	61.78	62.10	62.47	62.92	63.38	63.84
Modeland TS	214.8	73.93	77.60	84.51	91.52	98.72	106.06	109.52	113.01	116.60	120.19	123.79
St. Andrews TS	110.9***	64.73	68.36	68.19	68.12	103.65	103.86	104.26	104.70	105.23	105.76	106.28
Wallaceburg TS	63	32.37	32.49	32.46	32.49	32.59	32.77	33.04	33.33	33.67	34.02	34.37
Wanstead TS	128.8	39.16	40.30	40.86	41.25	41.63	49.44	50.13	50.86	51.65	52.42	53.16
CTS #1	N/A	31.78	32.04	32.31	32.58	32.85	33.12	33.39	33.67	33.95	34.23	34.51
CTS #2	N/A	17.04	17.26	17.49	17.72	17.95	18.18	18.42	18.66	18.91	19.15	19.40
CTS #3	N/A	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60
CTS #4	N/A	47.22	47.50	47.79	48.09	48.38	48.67	48.97	49.27	49.57	49.87	50.18
CTS #5	N/A	10.64	10.64	10.64	10.64	10.64	10.64	10.64	10.64	10.64	10.64	10.64
CTS #6	N/A	3.04	3.06	3.08	3.10	3.12	3.14	3.16	3.18	3.21	3.23	3.25
CTS #7	N/A	53.71	54.08	54.46	54.84	55.22	55.60	55.99	56.38	56.77	57.17	57.57
CTS #8	N/A	51.40	102.23	103.15	104.17	104.82	105.41	106.10	106.88	107.61	108.31	108.92
CTS #9	N/A	0.00	3.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

* LTR will increase to approximately 210 MVA after T2 is replaced (2027)

** LTR will increase to approximately 135 MVA after T5/T6 are replaced (2023)

*** LTR will increase to approximately 135 MVA after T1/T2 are replaced (2025)

Table D-8. Net Summer Non-Coincident Forecast (MW)

Station	Limited-Time Rating (MVA)	Historical (MW)	Forecast (MW)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Duart TS	200	17.52	18.17	18.25	23.69	23.81	23.96	24.19	24.44	24.72	24.98	25.23
Forest Jura DS	31.25	26.60	26.84	26.97	27.14	27.38	27.68	28.07	28.47	28.92	29.38	29.85
Kent TS (T1/T2)	155.6**	105.10	106.31	111.78	108.49	108.78	113.94	116.33	117.31	118.45	119.57	120.68
Kent TS (T3/T4)	59.8	46.81	47.11	47.21	47.37	47.67	48.05	48.59	49.16	49.80	50.45	51.11
Lambton TS	103.8***	65.41	65.50	65.28	65.16	65.21	65.39	65.77	66.18	66.69	67.20	67.72
Modeland TS	196.5	114.81	118.76	125.59	132.60	139.89	147.40	150.94	154.54	158.31	162.08	165.84
St. Andrews TS	101.8****	65.06	68.08	67.88	67.77	97.10	97.28	97.65	98.05	98.55	99.04	99.54
Wallaceburg TS	51.8	39.11	39.26	39.41	39.65	39.75	39.91	40.21	40.56	40.97	41.35	41.70
Wanstead TS	118.9	46.42	47.84	48.49	49.23	49.91	58.60	59.63	60.71	61.86	62.98	64.09
CTS #1	N/A	32.20	32.48	32.76	33.05	33.34	33.63	33.92	34.22	34.51	34.82	35.12
CTS #2	N/A	19.35	19.57	19.80	20.03	20.27	20.51	20.75	20.99	21.23	21.48	21.73
CTS #3	N/A	35.75	35.75	35.75	35.75	35.75	35.75	35.75	35.75	35.75	35.75	35.75
CTS #4	N/A	48.71	49.02	49.34	49.67	49.99	50.32	50.64	50.98	51.31	51.64	51.98
CTS #5	N/A	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96
CTS #6	N/A	2.77	2.79	2.81	2.83	2.85	2.87	2.89	2.91	2.93	2.95	2.97
CTS #7	N/A	56.08	56.50	56.92	57.34	57.76	58.19	58.62	59.05	59.49	59.93	60.37
CTS #8	N/A	112.89	113.74	114.59	115.45	116.32	117.19	118.07	118.96	119.85	120.75	121.66
CTS #9	N/A	0.00	1.00	10.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

* LTR will increase to approximately 195 MVA after T2 is replaced (2027)

** LTR will increase to approximately 120 MVA after T5/T6 are replaced (2023)

*** LTR will increase to approximately 120 MVA after T1/T2 are replaced (2025)

Table D-9. Dresden TS Net Summer Non-Coincident Forecast

	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load (MW)	33.45	45	43	56.3	59	59	59	59	59

Table D-10. Dresden TS Net Winter Non-Coincident Forecast

	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load (MW)	50.6	60.6	80.6	109.6	128.6	128.6	128.6	128.6	128.6

APPENDIX E: 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
DER	Distributed Energy Resources
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