# Windsor-Essex Region Integrated Regional Resource Plan

September 3, 2019

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# Integrated Regional Resource Plan

# Windsor-Essex

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

The IESO prepared the IRRP on behalf of the Windsor-Essex Regional Planning Technical Working Group (Working Group), which includes the following members:

- Independent Electricity System Operator
- E.L.K. Energy Inc.
- Entegrus Powerlines Inc.
- ENWIN Utilities Ltd.
- Essex Powerlines Corporation
- Hydro One Networks Inc. (Distribution) (Transmission)

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

The Working Group members agree with the IRRP's recommendations and support implementation of the plan through the recommended actions, subject to obtaining all necessary regulatory and other approvals.

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## List of Acronyms

| Acronym/ Alternative | Descriptions |
| --- | --- |
| A | Amp or Ampere |
| ACSR | Aluminum conductor steel-reinforced |
| ASABE | American Society of Agricultural and Biological Engineers |
| BES | Bulk Electric System |
| BPS | Bulk Power System |
| CDM | Conservation and Demand Management |
| CHP | Combined Heat and Power |
| DESN | Dual Element Spot Network |
| DG | Distributed Generation |
| DER | Distributed Energy Resource |
| DLC | DesignLights Consortium |
| DR | Demand Response |
| DS | Distribution Station |
| EA | Environmental Assessment |
| E.L.K. | E.L.K. Energy Inc. |
| Entegrus | Entegrus Powerlines Inc. |
| ENWIN | Enwin Utilities Ltd. |
| EPL | Essex Powerlines Corporation |
| FIT | Feed-in Tariff |
| GIF | Grid Innovation Fund |
| HPS | High Pressure Sodium |
| HV | High Voltage |
| Hydro One | Hydro One Networks Inc. |
| IESO | Independent Electricity System Operator |

| Acronym/ Alternative | Descriptions |
|---|---|
| IRRP | Integrated Regional Resource Plan |
| JCT | Junction |
| kV | Kilovolt |
| LAC | Local Advisory Committee |
| LDC | Local Distribution Company |
| LED | Light Emitting Diode |
| LEI | London Economics International |
| LMC | Load Meeting Capability |
| LTE | Long Term Emergency |
| LTR | Limited Time Rating |
| LV | Low Voltage |
| MVA | Mega Volt Ampere |
| MW | Megawatt |
| NWA | Non-Wires Alternative |
| OEB | Ontario Energy Board |
| ORTAC | Ontario Resource and Transmission Assessment Criteria |
| RIP | Regional Infrastructure Plan |
| SECTR | Supply to Essex County Transmission Reinforcement |
| SIA | System Impact Assessment |
| SPS | Special Protection System |
| SS | Switching Station |
| STE | Short-Term Emergency |
| TS | Transmission Station or Transformer Station |
| TWh | Terawatt-Hour |
| ULTC | Under-load Tap Changer |
| Working Group | Technical Working Group for Windsor-Essex Region IRRP |

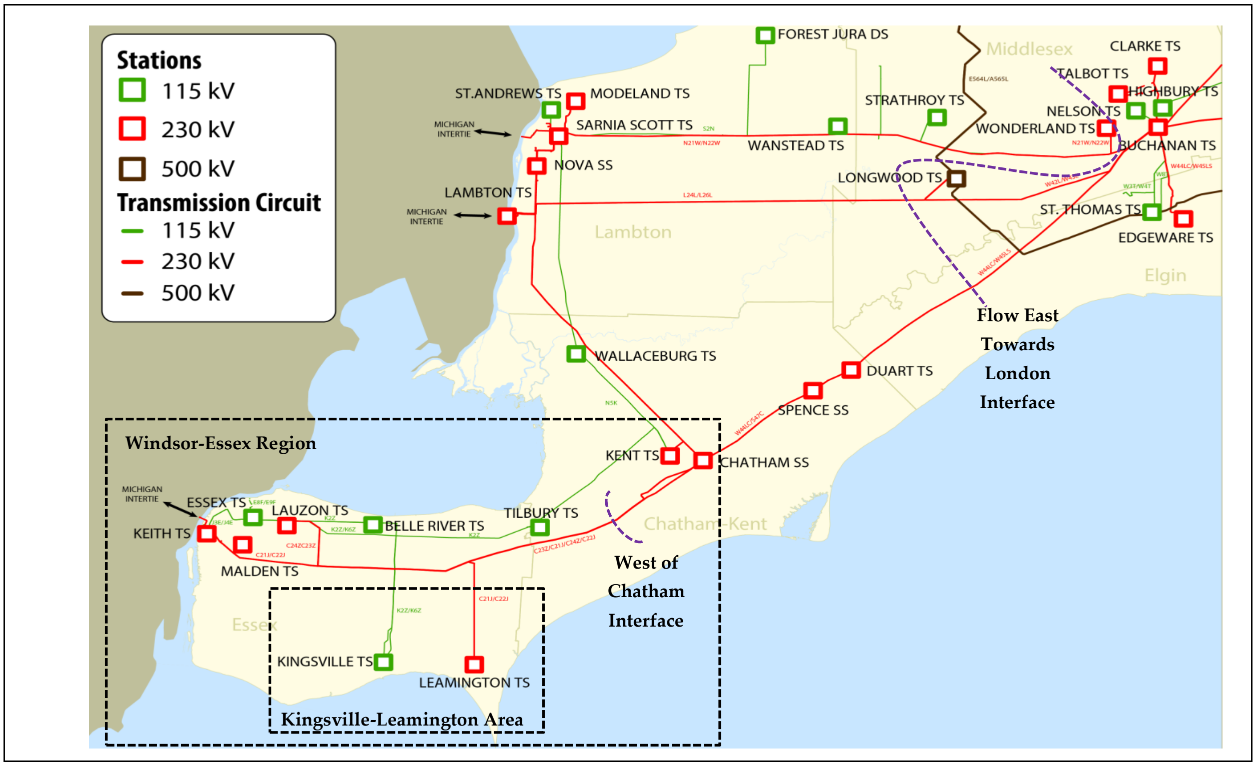
# 1. Introduction

This Integrated Regional Resource Plan (IRRP) considers and develops a plan to address the electricity needs of the Windsor-Essex region over the next 20 years. This report was prepared by the Independent Electricity System Operator (IESO) on behalf of the Working Group composed of the IESO, E.L.K. Energy Inc. (E.L.K.), Entegrus Powerlines Inc. (Entegrus), Enwin Utilities Ltd. (ENWIN), Essex Powerlines Corporation (EPL), and Hydro One Networks Inc. (Hydro One). These five local distribution companies (LDCs) serve customers in the Windsor-Essex region; ENWIN and Hydro One are directly connected to the transmission system, while Entegrus, E.L.K., and EPL have low-voltage connections to Hydro One distribution feeders.

In Ontario, planning to meet the electrical supply and reliability needs of a large area or region is conducted through regional electricity planning, a process that was formalized by the Ontario Energy Board (OEB) in 2013. In accordance with this process, transmitters, distributors and the IESO are required to carry out regional planning activities for each of the province's 21 electricity planning regions, including the Windsor-Essex region, at least once every five years. The Windsor-Essex region includes 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. The Windsor-Essex region also includes Caldwell First Nation. It is one of seven planning regions in Southwest Ontario, adjacent to the Chatham-Kent/Lambton/Sarnia region to the east.

The Windsor-Essex region population of approximately 400,000 people remained relatively flat over the last 10 years. Economic diversification is driving the region's electricity growth and use, specifically agriculture, manufacturing, and entertainment tourism in the city core. While growth in the automotive sector in Windsor-Essex has tempered during this period, Windsor is still the country's manufacturing and automotive powerhouse. Other emerging industries, particularly agriculture, have led to substantial growth in the area. The Kingsville-Leamington area within the Windsor-Essex region is home to North America's largest concentration of greenhouse vegetable production. This rapid expansion, development in cannabis growth operations, and the shift to year-round artificial crop lighting, will continue to increase electricity supply requirements in the Kingsville-Leamington area, which are expected to double over the next five years.

**Figure 1-1: The Windsor-Essex Region (Study Area)**




This IRRP identifies power system capacity, reliability requirements, and end-of-life asset replacement needs and coordinates options to meet customer needs in the area over a 20-year period. Given forecast uncertainty, the longer development lead time and the potential for technological change, the plan does not recommend specific investments or projects to meet mid- and long-term needs, but maintains the flexibility to evolve in step with emerging developments. Instead, this IRRP focuses both on recommendations to meet near-term needs, and on the near-term actions required to lay the groundwork for determining options to meet mid- and long-term needs. Significant consideration was given to the potential for demand-side options to help relieve capacity needs in the Kingsville-Leamington area, with specific recommendations for near-term actions to support projects that reduce electricity demand from indoor agriculture or mitigate market barriers.

The focus of this IRRP is to provide customers in the region with adequate line connection and step-down transformation capacity, and maintain a level of reliability consistent with accepted planning standards. A companion bulk study was completed in June 2019[1] that focused on bulk electricity needs; however, information and recommendations in both studies have been integrated as they impact bulk and regional needs.

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

This report is organized as follows:

- A summary of the recommended plan for the Windsor-Essex region is provided in Section 2;
- The process and methodology used to develop the plan are discussed in Section 3;
- The context for electricity planning in the Windsor-Essex region and the study scope are discussed in Section 4;
- The demand outlook scenarios, and energy efficiency and distributed energy resource (DER) assumptions, are described in Section 5;

[1] Refer to the bulk study for details: http://www.ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/southwest-ontario/Need-for-Bulk-Transmission-Reinforcement-in-Windsor-Essex-Region-June2019.pdf?la=en

- Electricity needs in the Windsor-Essex region are presented in Section 6;
- Alternatives and recommendations for addressing the needs are described in Section 7;
- A summary of engagement activities to date and moving forward, is provided in Section 8; and
- A conclusion is provided in Section 9.

# 2. The Integrated Regional Resource Plan

The Windsor-Essex IRRP provides recommendations to address the electricity needs of the region considering forecast electricity demand over a 20 year period, based on the application of the IESO's Ontario Resource and Transmission Assessment Criteria (ORTAC).[2]

This IRRP identifies three planning horizons: from the base-year (2017)[3] through the near term (up to 2025), medium term (six to 10 years, through to 2030), and longer term (11 to 20 years, or through to 2037). These planning horizons reflect the inverse relationship between the length of time and demand certainty (in that the longer the outlook, the less certain it is), lead time for electricity resource development, and planning commitment required.

The recommendations in the IRRP are focused on four main categories of needs:

1. Customer supply needs in the Kingsville-Leamington area, where demand is expected to grow at an unprecedented rate,
2. Needs in the nested 115 kV sub-systems,
3. Local capacity, reliability, and end-of-life needs identified within the study area, and
4. Long-term needs.

Substantial effort was made to evaluate the potential of non-wires alternatives (NWAs) to compliment other more traditional methods of supplying capacity.

The IRRP was developed based on a set of planning considerations, including reliability, cost, feasibility, and flexibility. In particular, associated projects recommended by the companion Windsor-Essex bulk study were integrated into the plan.

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

[3] Load forecast data and study work were initiated in late 2017 as a result of rapid growth which triggered an early start to the IRRP process, as detailed in Section 4.

Given the significant forecast demand increase, a number of capacity and load restoration needs were identified. For the Kingsville-Leamington area, the IRRP identifies specific investments, both non-wires and wires, some of which are already being implemented to ensure they are in service in time to address the region's urgent needs.

For the 115 kV sub-systems, the IRRP identified options for an integrated solution that addresses multiple needs. This will maximize the use of existing electricity system assets in the context of the forecast conditions for the study area, while enabling the analysis that needs to be completed before further recommendations can be made.

For the near and medium term needs in local areas, specific recommendations are identified to address capacity, end-of-life and restoration needs, as appropriate.

For the long term, the IRRP identified near-term actions required to monitor demand growth, technology adoption, and industry change, and lay the groundwork for exploring future options. As these needs are not expected to emerge until further in the future, it is not necessary (nor would it be prudent given forecast uncertainty and the potential for technology change) to commit to further reinforcements at this time.

A summary of ongoing work, as well as the recommendations to meet capacity, restoration, and asset replacement needs appear below.

## 2.1 ONGOING WORK

Due to the age and condition of the transmission infrastructure in the Windsor-Essex region, a number of plans are already underway to address some of the area's end-of-life asset replacement needs. The previous IRRP, released in 2015, recommended the Supply to Essex County Transmission Reinforcement (SECTR) project – an extension of two existing 230 kV circuits from Chatham SS to Keith TS, south to Leamington TS #1. Hydro One's subsequent Regional Infrastructure Plan (RIP) built on this and recommended several end-of-life replacement projects, which were not part of the scope of the 2015 IRRP.

The status of various regional projects at the start of this IRRP is summarized in chorological order in .

Table 2-1. By the time this IRRP was initiated, significant work had already been completed at these stations, with in-service dates ranging from 2018-2021.

**Table 2-1: Summary of Ongoing and Recently Completed Work in Windsor-Essex**

| Station/Line Section | Need | Proposed In-Service Date |
|---|---|---|
| **Keith TS** | • Reconfiguration of 230 kV and 115 kV circuits and 27.6 kV feeders at Keith TS to allow for the construction of the Gordie Howe Bridge | 2018 (completed) |
| **Leamington TS #1** | • A new 230/27.6 - 27.6 kV 75/100/125 MVA transformer station<br>• A 13 km double circuit 230 kV transmission line south to the new TS from the existing 230 kV circuits from Chatham SS to Keith TS | 2018 (completed) |
| **Malden TS** | • Replacement of end-of-life low voltage breakers. | 2019 (completed) |
| **Kingsville TS** | • Replacement of end-of-life transformers T2/T4 with 83 MVA T6 | 2018 (completed) |
| **Leamington TS Expansion** | • Expansion of Leamington TS to include two new 230/27.6 - 27.6 kV 75/100/125 MVA transformers | 2019 |
| **Tilbury TS** | • Decommissioning of station due to end-of-life and transfer serviced load to Tilbury West DS supply | 2020 |
| **Kingsville TS** | • Replacement of end-of-life transformers T1/T3 with 83 MVA T5 | 2021 |

In addition, the IESO recently completed a companion bulk study of the Windsor-Essex region, which recommended new bulk system facilities – a 230 kV double circuit transmission line from Chatham SS to the Leamington Junction – to address the area's near- and mid-term bulk system needs. A hand-off letter[4] was issued to Hydro One requesting initiation of development work for the transmission circuit, with an expected in-service date of winter 2025/2026.

The impact of these projects in terms of station layout and capacity was incorporated into the assessment of the transmission system capability in the Windsor-Essex region.

## 2.2 KINGSVILLE-LEAMINGTON AREA

The Kingsville-Leamington area is experiencing unprecedented demand growth – approximately 900 MW of new load requests to Hydro One in 2018 alone – driven by rapid expansion in the indoor agriculture and cannabis industries. The recent interest in retrofitting and installing artificial lighting to enhance greenhouse production is driving a large increase in electricity demand in the Kingsville-Leamington area. For this reason, a combination of NWAs and wires options is required to address the significant near-term customer supply needs identified in this area.

1. **Targeted call for innovative projects**

The greenhouse load characteristics in the Kingsville-Leamington area are fairly homogenous but differ significantly from other typical system loads. As a result, they have the potential to fit with demand-side options to manage greenhouse related load growth. Through the Kingsville-Leamington Local Advisory Committee (LAC), a number of potential demand-side solutions were identified, including energy efficiency and demand response (DR). However, a number of factors (i.e., frequency, duration, and magnitude of demand reduction and corresponding impact to crops) pose barriers to their adoption. As a result, the Working Group recommends that the IESO consider a targeted call for applications through the Grid Innovation Fund (GIF)

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[4]Refer to the hand-off letter for details: http://www.ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/southwest-ontario/Leamington-Transmission-Line-Handoff-Letter-June2019.pdf?la=en

for Q4 2019/Q1 2020. To identify and mitigate market barriers, or otherwise accelerate the adoption of competitive cost-effective solutions to rising electricity demand associated with the growth of indoor agriculture. The call should solicit projects that validate the performance and business case of promising new technologies, practices, and services across the province. This should leverage the work already performed for demand-side options in Kingsville-Leamington and LAC discussions to help scope parameters of the targeted call. The lessons learned from these projects will be applicable across the province, starting with areas such as Dresden and Niagara, which are experiencing significant growth in indoor agriculture.

**2. Provincial Energy Efficiency**

Under the Interim Framework (2019-2020), the IESO centrally delivers provincial energy-efficiency programs, including the Retrofit Program, Small Business Lighting, and Energy Manager Program. Last year, updates were made to introduce incentives supporting horticulture light applications. Additionally, the IESO is making approximately $27-million available for LDCs to undertake local energy-efficiency programs through the Local Program Fund with priority given to areas where local needs have been identified. While reliability, crop performance, and technology maturity limited mass uptake of light emitting diode (LED) horticulture lighting technology, existing retrofit programs and future programs beyond the Interim Framework should be evaluated to increase participation in areas with identified local need. The Working Group recommends that the IESO communicate developments of future energy-efficiency programs to the local community, as they arise.

**3. Monitor Local Generation**

To meet supply needs, some load customers are using behind-the-meter generation to offset their baseload consumption and facilitate their supply needs. The amount of generation connected to the electricity grid, whether directly or behind-the-meter, impacts the short-circuit capability of the connecting transformer station. To maintain a holistic view of short circuit limits is maintained, the Working Group recommends ongoing collaboration with the IESO to monitor the growth of local generation in the Kingsville-Leamington area, and inform the next cycle of regional planning.

### 4. Leamington Switching Station (Lakeshore TS)

Aside from the NWAs recommended above, rapid growth in the Kingsville-Leamington area necessitates additional reinforcements. The stations supplying this load – Kingsville TS and Leamington TS – are forecast to reach their station capacity within the next year. A new switching station at or near Leamington Junction to sectionalize and switch the four existing 230 kV circuits from Chatham to the Windsor area (C21J/C22J/C23Z/C24Z) is recommended to increase the capability of the system to supply load in the Kingsville-Leamington area while contributing to improved performance of the bulk system.

The proposed switching station will improve reliability, and provide some additional local supply capability to connect an additional transformer station in the area and continue supplying load in the Kingsville-Leamington area. The switching station also relieves the need for interim measures, recommended as a near-term action to maintain supply prior to constuction. Given the urgent nature of this need, which was identified in the process of conducting IRRP study work, the IESO issued a hand-off letter to Hydro One recommending that development work for this switching station (officially referred to as Lakeshore TS) be initiated.

### 5. Interim Measures

While the above actions are recommended to address the near-term capacity need in Kingsville-Leamington, continued reliance on interim measures is required until those reinforcements are in place. Between the 2015 IRRP and the completion of Leamington TS #1 in 2018, the number of customer connection requests (both transmission and distribution) exceeded the capability of the new station and the total 2015 IRRP load forecast for the area.

In response, Hydro One decided to proceed with an expansion of the recently constructed Leamington TS #1 to double the amount of capacity that can be supplied from the station to 400 MW. To accommodate the expansion and the connection of additional transmission customers starting in early 2020, interim measures, such as load rejection through a Special Protection System (SPS), are required resulting in a lower level of reliability to connecting customers than what is typically provided. The need for interim measures during normal operations is alleviated by the proposed switching station, and will be eliminated when the new line between Chatham TS and the switching station come into service by 2022 and the winter of 2025/2026 respectively.

## 2.3 115 KV SUB-SYSTEMS

A number of capacity, load restoration and asset replacement needs were identified in the 115 kV sub-systems. Given the nested nature of these sub-systems, an integrated solution that considers the broader context of the area and connected 230 kV network would address multiple needs and maximize benefit to the overall system.

1. **Undertake a Comprehensive Study of the 115 kV Sub-system Capacity and Leamington Load Restoration Needs**

Current station capacity needs at Kingsville TS and Lauzon TS, as well as a future supply capacity need in the Lauzon 115 kV sub-system are being managed with interim measures i.e., through an SPS.

Conversion of Kingsville TS from 115 kV to 230 kV may require an integrated option that can address these needs, as well as potentially assisting with Leamington capacity and load restoration needs. Other options include non-wires solutions, or consideration of supply from Keith TS. However, additional supply capability resulting from these options is limited until the completion of the upstream, new 230 kV double-circuit transmission line from Chatham SS to Lakeshore TS, and is impacted by Hydro One Distribution decisions with respect to the schedule and work plan for local customer load connections. For this reason, timing of the solution should occur in the mid-term – 2025/2026 at the earliest, given the expected in-service date of the new 230 kV circuit from Chatham to Lakeshore.

Effectively solving the 115 kV sub-system capacity needs and the Leamington capacity and load restoration needs requires a coordinated, integrated approach. The majority of these needs are primarily driven by growth in a single sector, making it prudent at this time to ensure that the recommendations contained in this IRRP address near-term needs, while maintaining options for mid-term solutions. To maximize the effectiveness of this option, numerous factors need to be considered, including which of the existing 230 kV transmission lines (C21J/C22J/C23Z/C24Z) to connect to, whether to move the station from 115 kV to 230 kV or maintain a 230/115 kV connection, upstream system impacts, and reactive requirements. The load security and restoration needs at Leamington TS are impacted by the plan to supply the 115 kV sub-systems or corresponding buildout of load transfer capability between Leamington and Kingsville. In addition, Lauzon upstream supply capability requirements are sensitive to the configuration of the nearby Kingsville TS, which will impact options for the autotransformers (T1/T2) and step-down transformers (T7/T8) reaching end of life.

Given the rapid growth in the area, collecting more information on supply options and monitoring load growth as it continues to materialize, will effectively expedite work required for the next IRRP cycle. With this preparation in mind, in addition to the many considerations described above, the Working Group recommends that a study of the 115 kV sub-system capacity, end-of-life needs, and Leamington load restoration needs, be completed by Q2 of 2020 as an addendum to the IRRP. A plan for the proposed work is provided in Appendix C.

## 2.4 OTHER LOCAL NEEDS

Some independent near- and mid-term needs were identified through this IRRP. Specific recommendations are outlined for capacity, end-of-life and restoration needs, where required.

1. **New DESN station in Chatham-Kent**

A near-term capacity need at Kent TS was identified during the development of this IRRP. While Kent TS is outside the original scope of this IRRP, given the urgency of the need and its proximity to the study area, the Working Group decided to include it in the plan. A customer connection request and forecasted growth would fully utilize capacity at the station by 2020. As a result, the Working Group recommends that a new DESN be built south of Chatham proper, to supply this new load growth and potentially provide load transfer capability for existing loads being supplied out of Kent TS.

2. **Upsize Keith TS Autotransformers (T11/T12)**

The 2015 RIP recommended like-for-like replacement of the aging Keith TS autotransformers. Since then, additional discussions and studies during the Needs Assessment and Scoping Assessment have instead supported an upsizing based on both the minimal incremental cost and the added supply capability to the 115 kV Windsor-Essex network. The Working Group confirms proceeding with the upsizing of the Keith TS autotransformers T11/T12 from 125 MVA to 250 MVA units by 2024.

3. **Decommission Keith Step-Down Transformer (T1)**

In the 2015 RIP, Hydro One recommended a plan to decommission the step-down transformer Keith T1. As the load on this transformer will be moving from the area by mid-2020, the Working Group recommends that this decommissioning work proceed as planned towards its target date of 2024.

4. **Upsize Lauzon Step-Down Transformers (T5/T6)**

Lauzon TS T5/T6 step-down transformers are approaching their end of life and are forecast to exceed their transformer capacity. While Lauzon DESN 1 (T5/T6) has more load connected than DESN 2 (T7/T8), balancing the loads would still not address the Lauzon capacity need. The Working Group recommends that Hydro One proceed with an upsizing of the T5/T6 step-down transformers from 83 MVA to 125 MVA.

5. **Lauzon Load Restoration**

Existing load restoration needs were identified for the loss of the C23Z/C24Z 230 kV supply circuits. In this instance, resupplying Lauzon TS load through the T1/T2 autotransformers and 115 kV network is sufficient to restore the lost load in excess of 150 MW within four hours, satisfying ORTAC planning criteria. The Working Group recommends that no further action be taken with respect to load restoration at Lauzon.

**6. Tilbury Load Security and System Restoration**

Load security and system restoration needs were identified in the Scoping Assessment as areas that would need further assessment. Based on current load forecasts, no reinforcement needs have been identified for Tilbury. Since the transfer of Tilbury TS load to Tilbury West DS in 2020 satisfies ORTAC Section 7 system restoration and load security requirements, the Working Group recommends that no further action be taken with respect to these needs.

## 2.5 LONG-TERM NEEDS

In the long term, the Windsor-Essex region's electricity demand is projected to continue to grow, based on the IRRP planning forecast presented in Section 5.7. This IRRP sets out the near-term actions required to ensure that options remain available to address future needs in the most efficient and cost-effective way, if and when they ultimately arise.

**1. Monitor Load Growth at Belle River TS**

Belle River TS is forecast to experience moderate load growth over the study period, with a transformer capacity need arising in the mid to long term. Considering the sensitivity to energy efficiency and demand management savings for this station, this IRRP recommends monitoring station load growth between planning cycles to determine whether to proceed with options to increase station capacity in the next planning cycle.

**2. Monitor Load Growth in the Kingsville-Leamington Area**

Unprecedented growth in the Kingsville-Leamington area is driven by a single sector presenting a risk for long-term transmission investments. For this reason, the Working Group recommends that the IESO continue to monitor long-term growth in the area between regional planning cycles to determine when decisions on the long-term plan are required, inform the next cycle of regional planning for the area, and trigger the next cycle early, as required.

3. **Monitor Industry Developments**

The agriculture industry and emerging technologies are rapidly evolving. The Working Group recommends that the IESO continue to monitor the status of developments in the indoor agriculture industry through the ongoing Greenhouse Energy Profile Study which will explore greenhouse energy usage trends over the next five to 10 years.

4. **Monitor Regional and Bulk System Transmission Developments**

As identified or recommended in this IRRP, a number of transmission projects are underway in the Windsor-Essex region, both on the regional and bulk level. To ensure that regional and bulk plans adequately meet projected near- and mid-term needs, the Working Group recommends that the IESO monitor and report on the status of Windsor-Essex transmission projects between regional planning cycles.

# 3. Development of the Plan

## 3.1 THE REGIONAL PLANNING PROCESS

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

The current regional planning process was formalized by the OEB in 2013 and is performed on a five year planning cycle for each of the 21 planning regions in the province. The process is carried out by the IESO, in collaboration with the transmitter(s) and LDC(s) in each planning region.

The process consists of four main components:

1. A Needs Assessment, led by the transmitter, which completes an initially screening of a region's electricity needs;

2. A Scoping Assessment, led by the IESO, which identifies the appropriate planning approach for the identified needs and the scope of any recommended planning activities;

3. An IRRP, led by the IESO, which proposes recommendations to meet the identified needs requiring coordinated planning; and/or

4. A RIP which provides further details on recommended wires solutions.

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

The IESO is currently conducting a Regional Planning Review Process[5] to consider lessons learned and findings from the previous cycle of regional planning and other regional planning development initiatives, such as pilots and studies.

## 3.2 WINDSOR-ESSEX REGION WORKING GROUP AND IRRP DEVELOPMENT

Development of the Windsor-Essex IRRP was initiated in late 2017 with the release of the Needs Assessment report[6] for the Windsor-Essex region. This product, prepared by Hydro One Transmission with participation from the IESO, E.L.K., Entegrus, ENWIN, EPL and Hydro One Distribution, identified needs requiring coordinated regional planning. To address these needs and ensure resulting solutions were consistent with the decisions made in the first cycle of regional planning, the subsequent Scoping Assessment report[7] – produced by the IESO – recommended that a number of capacity and restoration needs identified be addressed through an IRRP – a decision that reflected both the significant growth forecast, and the potential for non-wires solutions.

In 2018 the Working Group was formed to develop Terms of Reference for this IRRP, gather data, identify near- to long-term electricity needs in the region, and recommend actions to address them.

In tandem, the IESO undertook a bulk report for the Windsor-Essex region. This report was informed by demand forecasts and plans for new connection facilities developed through this IRRP, and solutions for both were integrated as they impact bulk and regional needs.

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[5] More information can be found on the IESO regional planning review engagement site: http://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Regional-Planning-Review-Process

[6]Refer to the Needs Assessment to learn more: https://www.hydroone.com/about/corporate-information/regional-plans/windsor-essex

[7]Refer to the Scoping Assessment for details: http://ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/Windsor-Essex/2018-Windsor-Essex-Scoping-Assessment-Outcome-Report.pdf?la=en

## 3.3 LOCAL ADVISORY COMMITTEE

The Kingsville-Leamington Local Advisory Committee was formed as a vehicle for targeted engagement on local priorities in the Kingsville-Leamington area and demand-side options in particular. The LAC, which included representation from local municipalities, members of the agricultural industry, and local energy service providers, offered advice on the nature of the load growth and feedback on potential demand-side options that could impact local needs. The LAC met three times during the IRRP phase of regional planning and the outcomes of its discussions helped inform the Working Group and the recommendations in this IRRP.

Subsequently, a sub-working group was formed to investigate demand-side options, to manage continued growth in the greenhouse sector and better utilize facilities that can be connected while transmission reinforcement options are being developed. This sub-working group consisted of representatives from the IESO, E.L.K., Entegrus, ENWIN, EPL, and Hydro One. It leveraged contacts in the local community, technical experts and other interested parties to gather information and propose options to the Working Group for incorporation into the options evaluation process of this IRRP.

# 4. Background and Study Scope

This is the second cycle of regional planning for the Windsor-Essex region. When the OEB formalized the regional planning process in 2013, planning work was already underway in Windsor-Essex. As such, the Needs Assessment and Scoping Assessment phases for the first cycle of the regional planning process were deemed to be complete and Windsor-Essex was identified as a "transitional" region within the Group 1 planning regions, the first group to utilize the formalized regional planning process.

In April 2015, the Windsor-Essex IRRP recommended the SECTR project – an extension of two existing 230 kV circuits from Chatham SS to Keith TS, south to Leamington TS #1 to provide an additional 200 MW of winter local load meeting capability. On the basis of this planning report, Hydro One completed the RIP for Windsor-Essex on December 22, 2015.

Between the 2015 IRRP recommendation and the completion of SECTR in 2018, the number of customer connection requests received by LDCs in the area, particularly Hydro One, exceeded both the capability of the new station and the total 2015 IRRP load forecast. This triggered the second cycle of regional planning for Windsor-Essex in mid-2017. A Needs Assessment was published in October 2017, followed by a Scoping Assessment in March 2018. The Scoping Assessment report identified a number of needs requiring further regional coordination, and recommended that both an IRRP be initiated for the Windsor-Essex region, and a separate bulk planning process occur in parallel with the IRRP. The results contained in the *Need for Bulk Transmission Reinforcement in the Windsor-Essex Region*, which was completed on June 13, 2019, have been incorporated into this plan.

Building on past regional studies and taking into account updates to activities in the region and LDCs' load forecasts, this report presents an integrated regional resource plan for the Windsor-Essex region until 2037. In addition to addressing reliability performance and end-of-life asset replacement needs in the region, the IRRP focuses on identifying recommendations to meet near-term customer supply need through a combination of non-wires and wires options. To set the context for this IRRP, the scope of the planning study and the area's existing electricity system are described in Section 4.1.

## 4.1 STUDY SCOPE

This IRRP develops and recommends options to meet the electricity needs of the Windsor-Essex region in the near, medium, and long term, and assesses any existing or emerging restoration or supply security needs. The plan, prepared by the IESO on behalf of the Working Group, considers the long-term outlook for electricity demand, energy efficiency, transmission and distribution system capability, relevant community plans, development of the regional transmission system, condition of transmission assets, and distributed energy resources.

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

- 230 kV connected stations – Malden TS, Keith TS, Lauzon TS, Leamington TS, Kent TS
- 115 kV connected stations – Crawford TS, Essex TS, Walker TS #1, Walker TS #2, Belle River TS, Tilbury West DS, Tilbury TS, Kingsville TS,
- Five customer owned transformer stations on the 115 kV system
- 230 kV transmission lines – C21J/C22J, C23Z/C24Z, J5D
- 115 kV transmission lines – J3E/J4E, Z1E/Z7E, K2Z/K6Z
- 115 kV transmission cables – E8F/E9F
- 230/115 kV auto-transformers at Keith TS and Lauzon TS
- Existing local generation assets

Electricity to Windsor-Essex is supplied from the rest of the province through two 230 kV double circuits and two 115 kV single circuits. The main 230 kV transmission corridor in the region connects with the rest of the province at Chatham SS in the Municipality of Chatham-Kent. Two 230 kV double-circuit lines, C21J/C23Z and C22J/C24Z, run east-west in this corridor, located south of Highway 401, from Chatham SS to the proposed Lakeshore TS, C21J/C22J continues west to Keith and C23Z/C24Z continue northwest to Lauzon. Keith TS provides an interconnection with the Michigan system via 230 kV circuit J5D and an in-line phase shifter.

In Windsor, Keith TS and Lauzon TS, connect the region's 115 kV network to the 230 kV transmission system via two autotransformers at each station. The main 115 kV transmission corridor runs through Windsor from Keith TS through Essex TS to Lauzon TS. The double-circuit line J3E/J4E located in this corridor connects Keith TS with Essex TS, and the double-circuit line Z1E/Z7E connects Essex TS with Lauzon TS. Other 115 kV transmission corridors provide for circuits K2Z and K6Z; 115 kV circuits E8F and E9F are underground cables and provide supply to four ENWIN-owned stations.

Subsequent to the Scoping Assessment, a near-term capacity need was identified at Kent TS. While this was originally considered to be out of scope, given the urgent nature of the need and its relative proximity to the study area, the scope of this IRRP was extended to include Kent TS.

The Windsor-Essex region is supplied by a mix of internal resources (generation connected within Windsor-Essex) and external resources (generation located outside of Windsor-Essex accessed through transmission infrastructure).[8] The existing 230 kV network through the region provides Windsor-Essex with supply from the rest of Ontario, particularly the wind and gas generation resources located east of Chatham. It also offers a strong link with Michigan, allowing for imports and exports to flow through the region. Windsor-Essex is home to a significant amount of installed gas generation, wind generators, and a large solar installation, as well as a number of distribution-connected wind, solar and combined heat and power (CHP) resources. The majority of generation capacity in the region is located close to Windsor.

The Windsor-Essex region and its supply infrastructure are shown in Figure 4-1 and Figure 4-2.

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[8] The mixture of resources used to supply the region's and the province's energy needs at any time is determined by the real-time energy market.

**Figure 4-1: The Regional Transmission System Supplying Windsor-Essex**

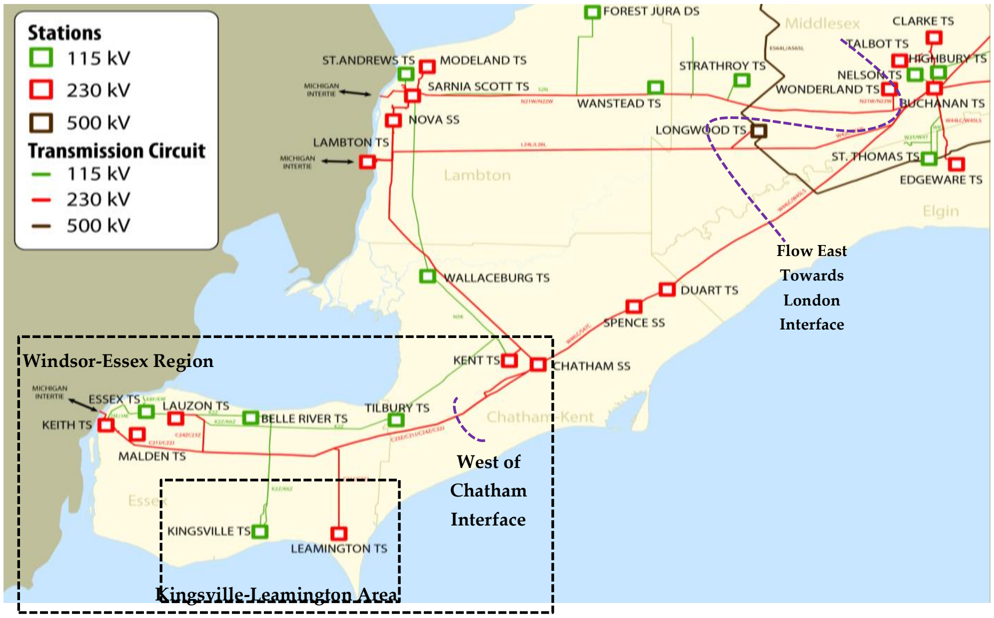
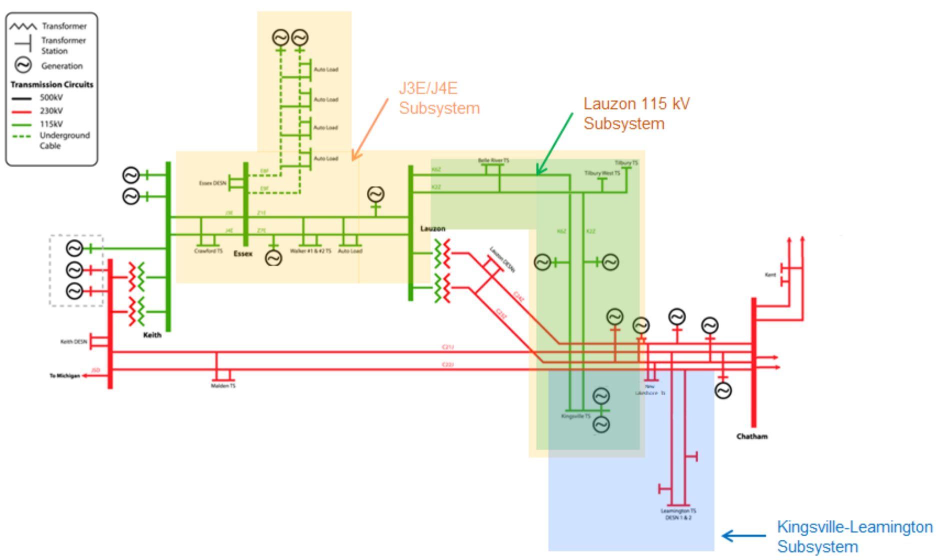



**Figure 4-2: The Windsor-Essex Region Electrical Single Line Diagram**

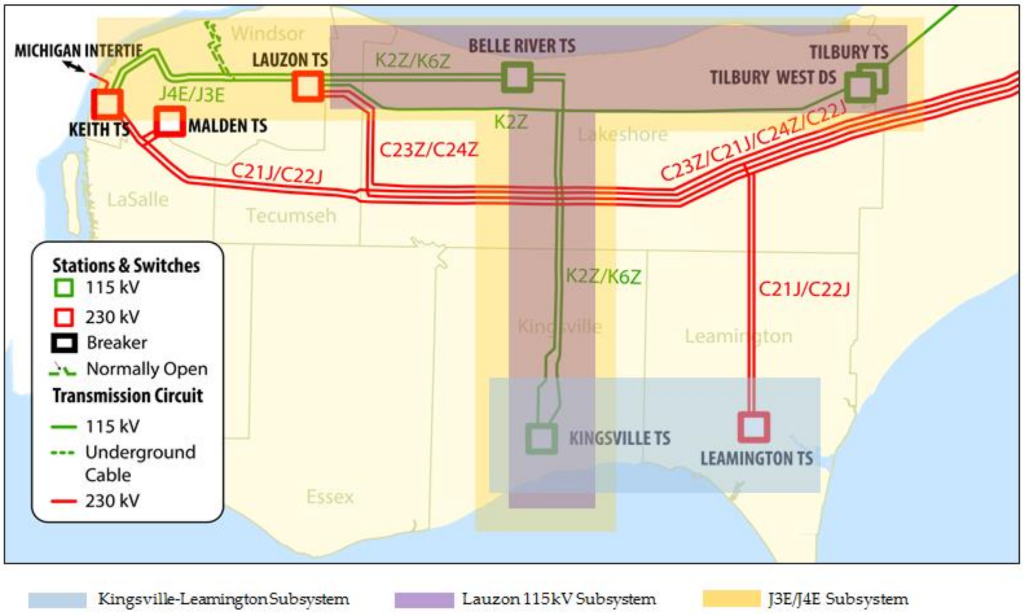


For the purposes of this IRRP, which recommends options to meet the electricity service needs of the Windsor-Essex region, the three nested electrical sub-systems shown in Figure 4-3, are described below:

1. **The J3E/J4E sub-system:** Includes the load that would be supplied via circuits J3E and J4E for the loss of C23Z and C24Z, along with the Lauzon TS DESN loads on C23Z and C24Z which can be resupplied from the 230 kV/115 kV autotransformers post-contingency
2. **The Lauzon 115 kV sub-system:** Includes the transformer stations and generators connected to circuits K2Z and K6Z
3. **The Kingsville-Leamington sub-system:** Includes the load supplied by, and generation connected to, Kingsville TS or the new Leamington TS.

Since the three sub-systems are overlapping, with the Lauzon 115 kV sub-system nested within the J3E/J4E sub-system, the demand for the J3E/J4E sub-system is inclusive of the demand in the Lauzon 115 kV sub-system for the purposes of this plan. Similarly, as the Kingsville-Leamington sub-system partly overlaps both of the other sub-systems, increasing supply to the Kingsville-Leamington sub-system will impact the supply and demand balance in the J3E/J4E and Lauzon 115 kV sub-systems.

**Figure 4-3: Windsor-Essex Region Sub-systems**




The Windsor-Essex IRRP was developed by completing the following steps:

- Preparing a 20-year electricity demand outlook (forecast) and establishing needs over this time frame;
- Examining the load meeting capability (LMC) and reliability of the existing transmission system supplying the Windsor-Essex region, specifically to meet pent-up electrical demand from greenhouse growers in the region, taking into account facility ratings and performance of transmission elements, transformers, local generation, and other facilities such as reactive power devices;
- Assessing system needs by applying a contingency-based assessment and the reliability performance standards for transmission supply described in Section 7 of ORTAC;
- Confirming identified end-of-life asset replacement needs and timing with the transmitter;

- Establishing feasible integrated alternatives to address needs, including a mix of energy efficiency, generation, transmission and distribution facilities, and other electricity system initiatives;
- Engaging with the community on needs, findings, and possible alternatives;
- Evaluating options using decision-making criteria that include: technical feasibility, cost, reliability performance, flexibility, environmental and social factors; and
- Developing and communicating findings, conclusions and recommendations within a detailed plan.

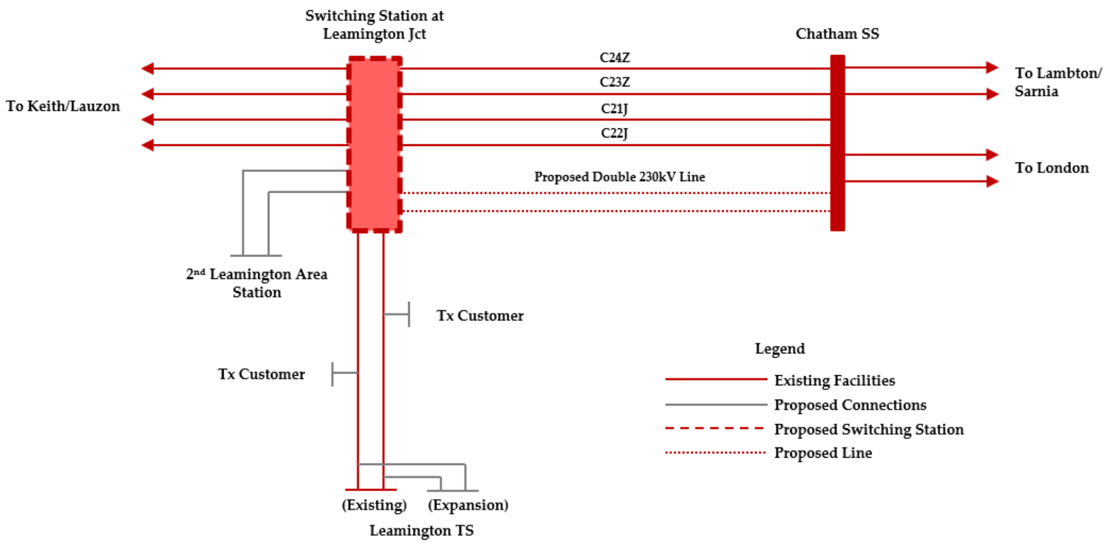
## 4.2 RECENT, PLANNED, AND COMMITTED RESOURCES

### 4.2.1 Transmission and Distribution Facilities

In April 2015, the IESO published an IRRP for the Windsor-Essex region, which recommended the SECTR project, which came into service in early 2018. In response to the subsequent number of customer connection requests, Hydro One expanded Leamington TS #1 (Leamington TS #2, with a targeted in-service date of early 2020), to double the amount of capacity that can be supplied from the station to 400 MW. Concurrently, the IESO and Hydro One also received a number of requests – totaling about 100 MW – from larger customers wanting to connect to the new Leamington transmission line. The existing transmission system is unable to accommodate these requests while meeting required planning criteria. Interim measures have been identified to allow the connection of some new facilities and will be included as part of the recommendations of the System Impact Assessments (SIAs) for these projects.

Published in June 2019, a companion report on the bulk transmission system for the Windsor-Essex region recommended a new 230 kV double circuit transmission line from the existing Chatham SS to the new switching station at the Leamington Junction, as shown in Figure 4-4.

**Figure 4-4: Single Line Diagram of Existing and Proposed Facilities in the Leamington Area**

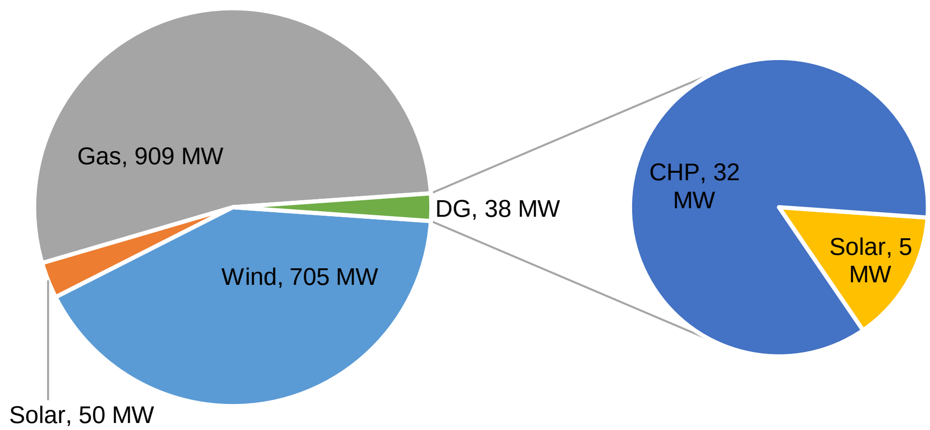



This line will increase the overall transfer capability of the bulk transmission system west of Chatham to reliably supply the forecast load growth in the Kingsville-Leamington area and the broader Windsor-Essex region in the near- to mid-term, permit the resources and bulk facilities in this region to operate efficiently for local and system needs, and maintain existing interchange capability on the Ontario-Michigan interconnection between Windsor and Detroit.

### 4.2.2 Generation Resources

The region is home to a significant amount of large natural gas generation (including a large combined-cycle plant and a number of CHP generators), wind generators, and a large solar installation in the region, as well as some distributed generation (DG) – primarily CHP and solar. These resources represent a combined total of 1,700 MW of installed generation capacity. Figure 4-5 shows the installed resource mix (transmission-connected and distribution-connected) in the Windsor-Essex region in 2020.

**Figure 4-5: Installed Resources in the Windsor-Essex Area for 2020 by Resource Type (Type, MW)**

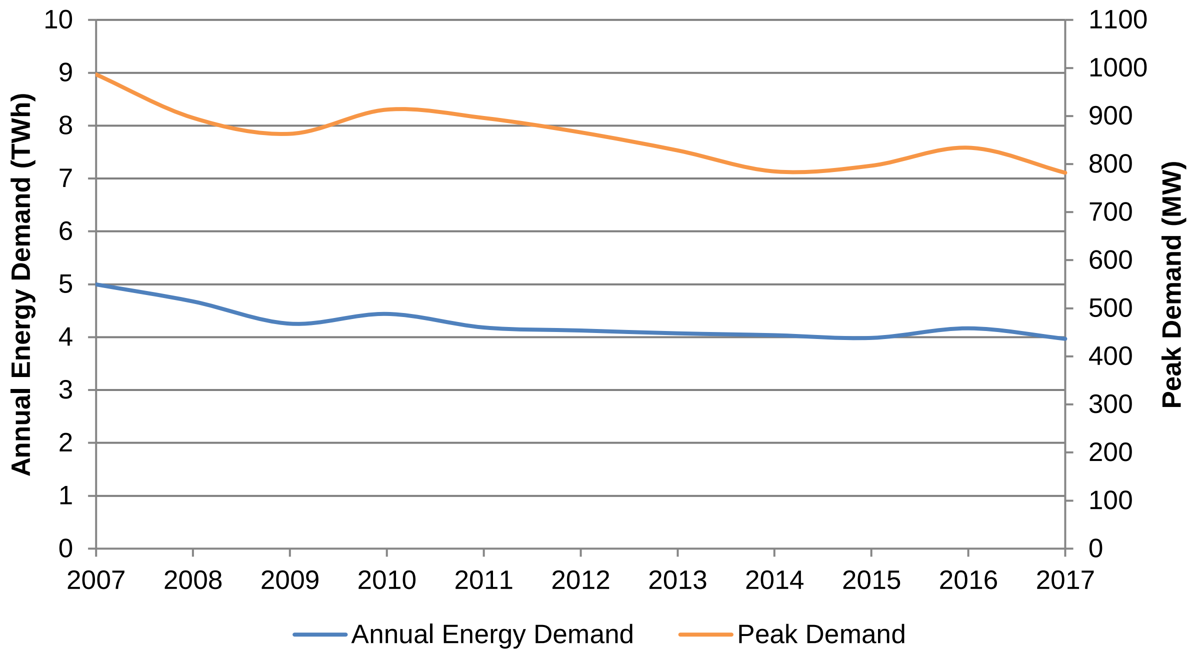


# 5. Demand Outlook

## 5.1 HISTORICAL DEMAND

Historically, the electric system in the Windsor-Essex region has been summer-peaking, with the primary load centre being the city of Windsor. Over the past five years, the annual energy requirements and coincident peak demand in the region were around 4 TWh and 800 MW, respectively. As seen in Figure 5-1, prior to 2008 and the subsequent transition from heavy manufacturing to less energy-intensive industries, demand peaked at around 1,000 MW, before decreasing to current levels (less than 800 MW).

**Figure 5-1: Historical Summer Demand and Energy Consumption for the Windsor-Essex Region**




While the city of Windsor and surrounding municipalities constitute the majority of the geographical area covered by the Windsor-Essex planning region, their loads continue to exhibit relatively flat load growth. In contrast, demand in the Kingsville-Leamington area has increased at an unprecedented rate. As explained in more detail in Section 5.2, this growth has been driven by expansion of the greenhouse sector, which was the key trigger for this planning cycle. Because of the magnitude, geographical concentration, and unique and winter-peaking nature of this load growth, this IRRP distinguishes the planning forecast for the Kingsville-Leamington area from the planning forecast for the broader Windsor-Essex region. Further greenhouse load growth occurring in the Kent area has also been included in this IRRP due to its near-term timing and proximity to the Windsor-Essex region.

## 5.2 CURRENT DRIVERS OF LOAD GROWTH

The growth in Kingsville-Leamington is driven by rapid expansion in the indoor agriculture and cannabis industries. An understanding of the economic and technological drivers of this growth is important to both manage the build-out of infrastructure reinforcements, and to evaluate potential demand-side options. Additionally, indoor agriculture loads are significantly different from other industrial, commercial, and residential loads in the province. Their unique characteristics, which are described in greater detail below, offer both opportunities for greater efficiency and challenges for the electricity system.

The concentration of indoor agriculture in Windsor-Essex owes much to the region's natural advantages. Its proximity to the Windsor-Detroit border crossing is ideal for supplying both the Canadian and U.S. markets, and its southern latitude and climate provide optimal conditions for agricultural activities. Windsor-Essex also hosts an established ecosystem of support industries and partners, including agriculture research and greenhouse fabrication facilities, which further encourage greenhouse growth in the area.

In recent years, economic factors such as rising consumer demand for year-round local produce and supply disruptions in other markets, have paved the way for an extension of the crop growing season into the winter months. This has led to the proliferation of artificial horticulture lighting, the primary driver for electricity demand growth in Kingsville-Leamington. Rapid local expansion of the cannabis industry, which typically requires energy-intensive lighting and

HVAC systems, following legalization has coincided with the agricultural industry's winter lighting growth.

High-pressure sodium (HPS) lamps are the dominant artificial horticulture lighting technology in agricultural applications driving this load growth. Typical lighting intensity requirements result in an energy intensity of approximately 0.5 MW per crop acre with some variation between crops. Non-lighting loads, such as motorized equipment, make up a very small share of the overall electricity usage. LED lamps have seen limited adoption in agricultural and cannabis applications. Typical cannabis energy intensity is approximately 1 MW per acre and includes significantly higher non-lighting loads such as HVAC and other climate control systems.

## 5.3 DEMAND FORECAST METHODOLOGY

For the purpose of the IRRP, a 20-year planning forecast was developed to assess electricity supply and reliability needs. Transmission infrastructure supplying an area is sized to meet peak-demand requirements (rather than energy demand requirements). Peak demand requirements are first determined at the station or DESN[9] level, allowing capability in pockets where there is load growth, or where existing equipment has been historically close to its load supply capability, to be more accurately assessed. These forecasts are then aggregated to understand the limits of the transmission system and identify overall regional electricity needs during regional coincident peak times.

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

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

to mid-term (five to 10 years), since lead times to develop and incorporate these options depend on the size of the need.

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

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

Additional details on the demand outlook assumptions can be found in Appendix B. The demand outlook was used to assess any growth-related electricity needs in the region.

## 5.4 GROSS DEMAND FORECAST

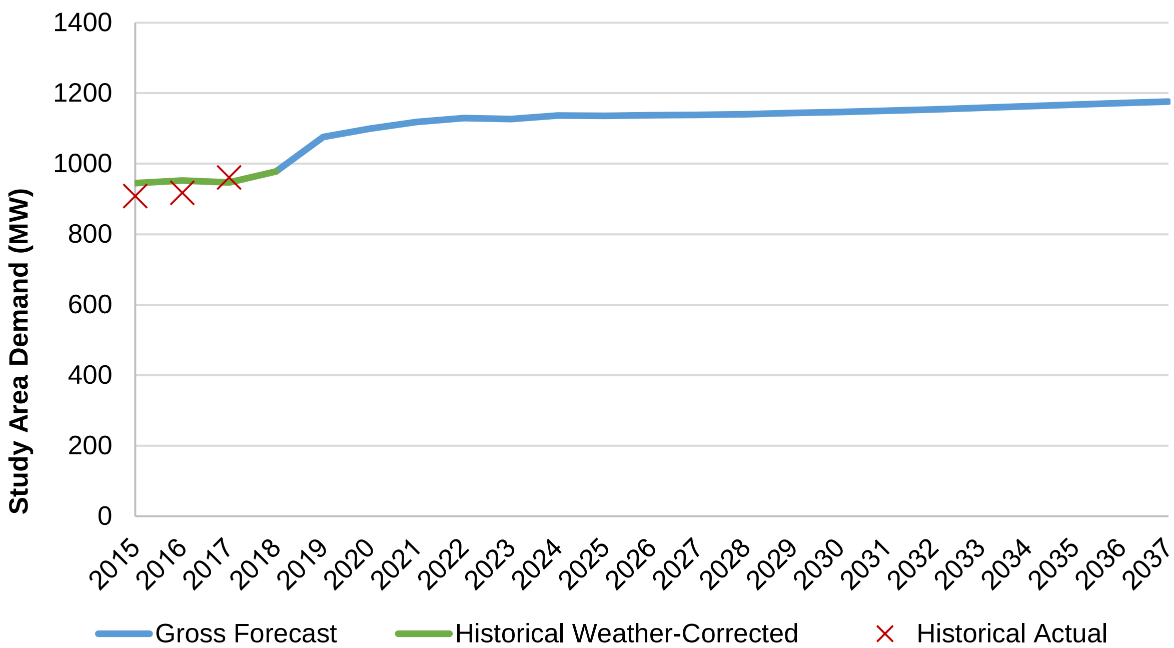
The Working Group prepared a gross demand outlook for each of their service areas within the Windsor-Essex region at the transformer station level, or at the station bus level for multi-bus stations.[10] Gross demand forecasts account for increases in demand from new or intensified development, but not for the full impact of future energy-efficiency measures such as codes and standards and DR programs. However, LDCs are expected to account for changes in consumer demand resulting from typical energy efficiency improvements and response to increasing electricity prices, which is known as "natural conservation."

[10] Often transformers will supply multiple buses at a station. As the amount of load that a transformer can supply will vary based on how load is shared between buses, it can often be useful to have a bus level forecast depending on the nature of the capacity needs in an area.

Thanks to their direct relationship with customers, LDCs have the best information on customer and regional growth expectations in the near and medium term. Other common considerations include known connection applications and typical electrical demand for similar customer types. More details on demand outlook assumptions can be found in Appendix B.

The graph in Figure 5-2 shows the gross demand outlook for the Windsor-Essex region under median weather conditions. This was developed through forecasts provided by the Working Group up to Leamington DESN 1 and 2, combined with historical data points for comparison. The planning forecasts in Section 5.7 break this forecast into smaller areas, as appropriate.

**Figure 5-2: Windsor-Essex Region Demand Outlook (Summer Gross Forecast)**




These forecasts are based upon the best available information at the time of this IRRP and will be updated going forward as appropriate. The gross demand forecast by station is provided in Appendix B.

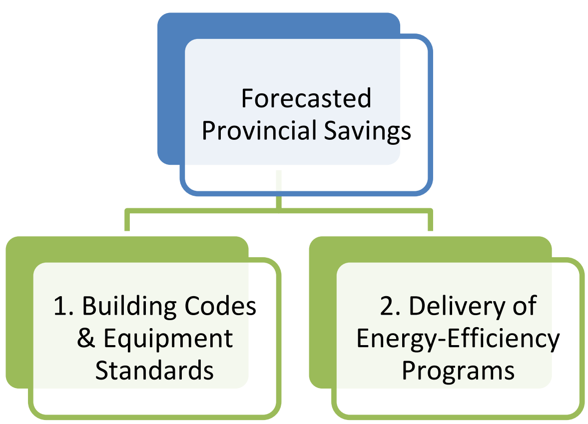
## 5.5 ENERGY EFFICIENCY ASSUMED IN THE FORECAST

Energy efficiency is achieved through a mix of program-related activities, and mandated efficiencies from building codes and equipment standards. It plays a key role in maximizing the use of existing assets and maintaining reliable supply by offsetting a portion of a region's growth, and helping to ensure demand does not exceed equipment capability. The energy efficiency savings forecast for the Windsor-Essex region have been applied to the gross peak-demand forecast for median weather, along with DG resources (described in Section 5.5), to determine the net peak demand for the sub-region.

Future energy-efficiency savings for the Windsor-Essex region have been applied to the gross peak-demand forecast to take into account both policy-driven and funded energy efficiency through the Interim Framework (estimated peak demand impacts due to program delivery to the end of 2020), as well as expected peak demand impacts due to building codes and equipment standards for the duration of the forecast. As policy related to future provincial energy-efficiency activities changes, the forecast assumptions will be updated accordingly.

To estimate the peak-demand impact of energy-efficiency savings in the sub-region, the forecast provincial savings were divided into two main categories:

**Figure 5-3: Categories of Energy Efficiency Savings**




1. *Savings due to building codes & equipment standards*
2. *Savings due to the delivery of energy-efficiency programs*

For the Windsor-Essex region, the IESO worked with the LDCs to establish a methodology to assess the estimated savings for each category, which were further subdivided by customer sector: residential, commercial and industrial. This provides a better resolution for the forecast energy efficiency, as energy efficiency potential estimates vary by sector due to differing energy consumption characteristics and applicable measures.

For the Windsor-Essex region, LDCs provided both their gross-demand forecast and a breakdown of electrical demand by sector for each TS. Once sectoral gross-demand at each TS was estimated, peak-demand savings were assessed for each energy efficiency category – codes and standards, and energy-efficiency programs. Due to the unique characteristics and available data associated with each group, estimated savings were determined separately. The final estimated energy efficiency peak-demand reduction, 46 MW by 2037, was applied to the gross demand to create the planning forecast. Table 5-1 provides the peak-demand savings for a selection of the forecast years.

**Table 5-1: Peak Demand Savings from Energy Efficiency, Select Years, in MW**

| Year | 2020 | 2025 | 2030 | 2037 |
|---|---|---|---|---|
| Savings (MW) | 27 | 38 | 44 | 46 |

Additional energy efficiency forecast details are provided in Appendix B.

## 5.6 DISTRIBUTED GENERATION ASSUMED IN THE FORECAST

There are several DG resources in the Windsor-Essex region and that number increased with the introduction of the *Green Energy and Green Economy Act, 2009*, and the associated development of Ontario's Feed-in Tariff (FIT), MicroFIT, and CHP Programs.

The effects of projects that were already in-service prior to the base year of the forecast were not included as they are already embedded in the actual demand, which is the starting point for the forecast. Potential future (but uncontracted) DG uptake was not included and is instead considered as an option for meeting identified needs.

Based on the IESO contract list as of May 31, 2018, new DG projects are expected to offset an incremental 34 MW of peak demand within the Windsor-Essex region by 2020. The distribution-connected contracted generators included in the forecast comprise a mix of solar and CHP. The majority of these generators in the region are CHP (86% of contracted capacity), with solar accounting for 14% of the remaining contracted capacity. Capacity contribution factors of 98% and 37% (CHP and solar respectively) to the regional peak have been assumed to account for the expected output of the mix of local generation resources during summer peak conditions.

Additional information on the regional demand impacts from DG are provided in Appendix B.

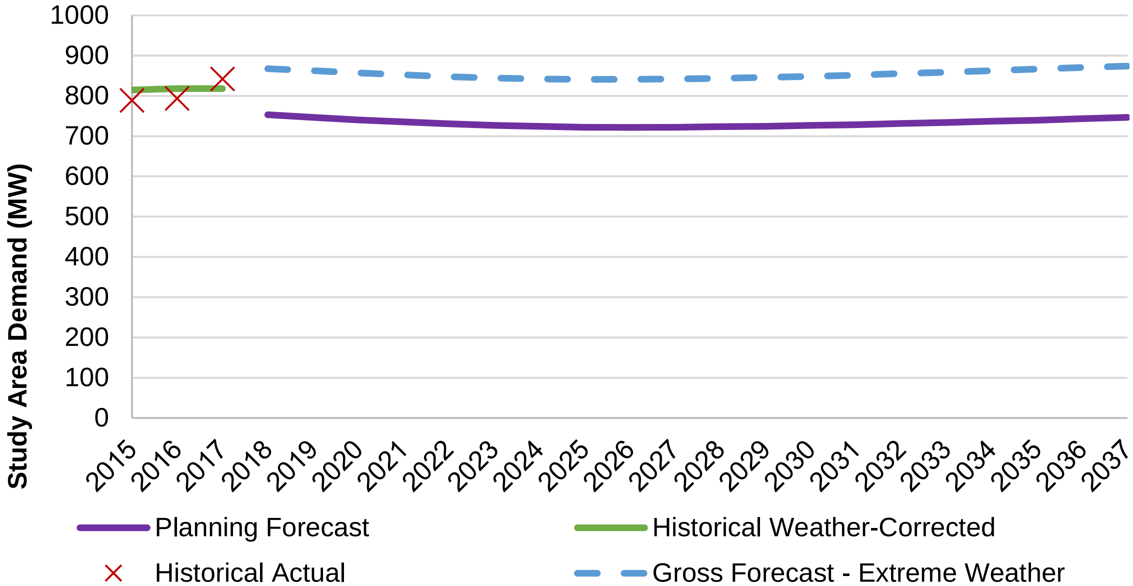
## 5.7 PLANNING FORECASTS

After taking into consideration the combined impacts of energy efficiency and DG, a 20-year planning forecast was produced for the Windsor-Essex region excluding the Kingsville-Leamington area. The following subsections also describe the demand outlook separately for the Kingsville-Leamington and Kent areas due to the significant and unique nature of load growth.

### 5.7.1 Windsor-Essex Region

Overall, recent historical demand in the traditionally summer-peaking Windsor-Essex region has been relatively flat, with the majority of the load continuing to exhibit modest growth. Figure 5-4 illustrates the planning forecast, along with historic demand in the area. This planning forecast and for comparison, the gross-demand forecast, have been adjusted for extreme weather conditions. Further information on the planning forecast scenarios are provided in Appendix B.

**Figure 5-4: Windsor-Essex Region Summer Planning Forecast (Excluding Kingsville TS and Leamington TS)**



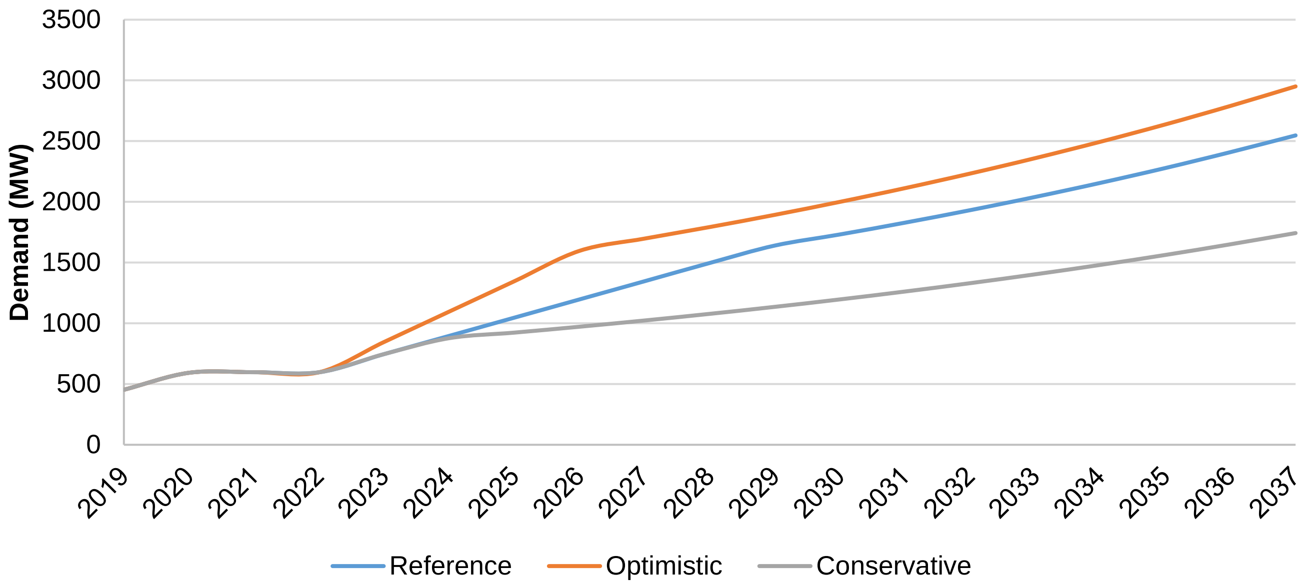

### 5.7.2 Kingsville-Leamington Area

For loads in the Kingsville-Leamington area, the winter peak forecast is expected to approximately double within the next five years. This is related to the rapid expansion of agricultural businesses, as described in detail in Section 5.2. Highlighting this unique growth separately from the rest of the Windsor-Essex region, three load growth scenarios are shown in Figure 5-5 for the Kingsville-Leamington area. These scenarios were developed based on a number of considerations:

- Customer connection requests to the distribution system received by area LDCs;
- Historical rate of acreage expansion of greenhouses;
- Customers requesting a connection to the transmission system;
- Expansion of other necessary infrastructure to support greenhouse growth in the area (e.g. gas infrastructure, water and waste water servicing); and

– Rate at which new transmission infrastructure can be built.

**Figure 5-5: Kingsville-Leamington Area Demand Forecast (Winter-Peaking)[11]**




Indoor agricultural and cannabis electricity load profiles differ greatly from historical provincial electricity consumption patterns. Figure 5-6 and

Figure 5-7 illustratively show the forecast agricultural and cannabis load profiles compared with the rest of the Windsor-Essex region in the summer and winter, respectively.

[11] For the purpose of assessing incremental need in the Kingsville-Leamington area, the proposed switching station at the Leamington Junction is assumed to be in place. This switching station relieves the need for interim measures and allows additional load connections to be accommodated up to the capability of the bulk system to supply. For all scenarios in Figure 5-7, the load forecast plateaus until 2022, after which the switching station is presumed to be in service.

**Figure 5-6: Sample Hourly Profile for Winter Peak Day**

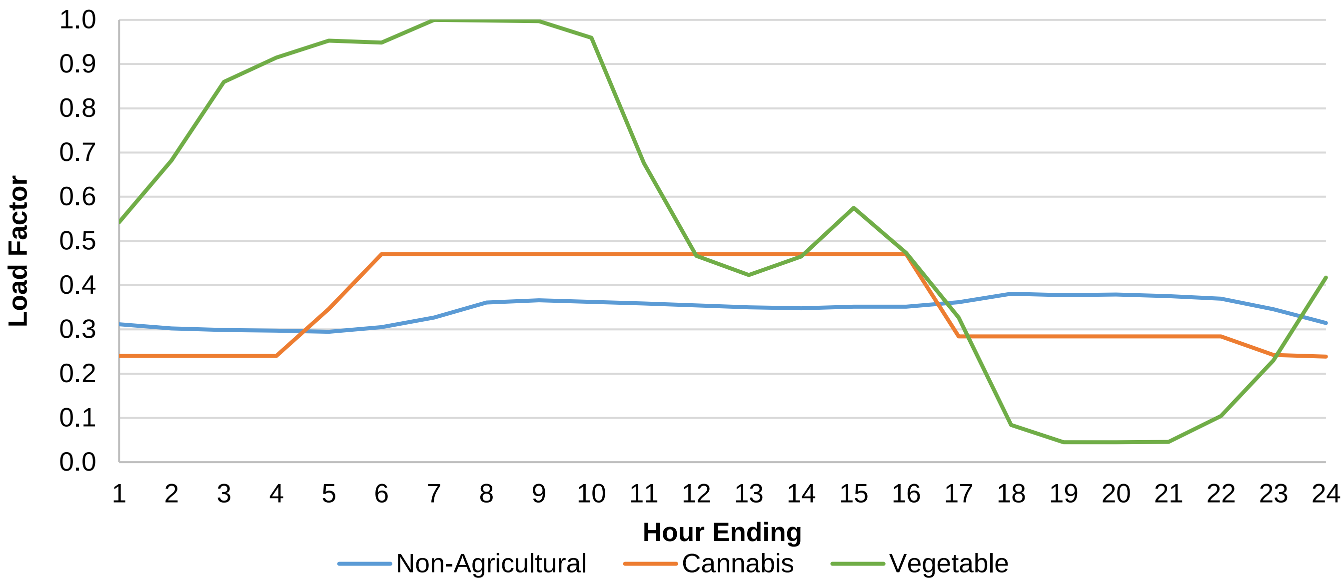
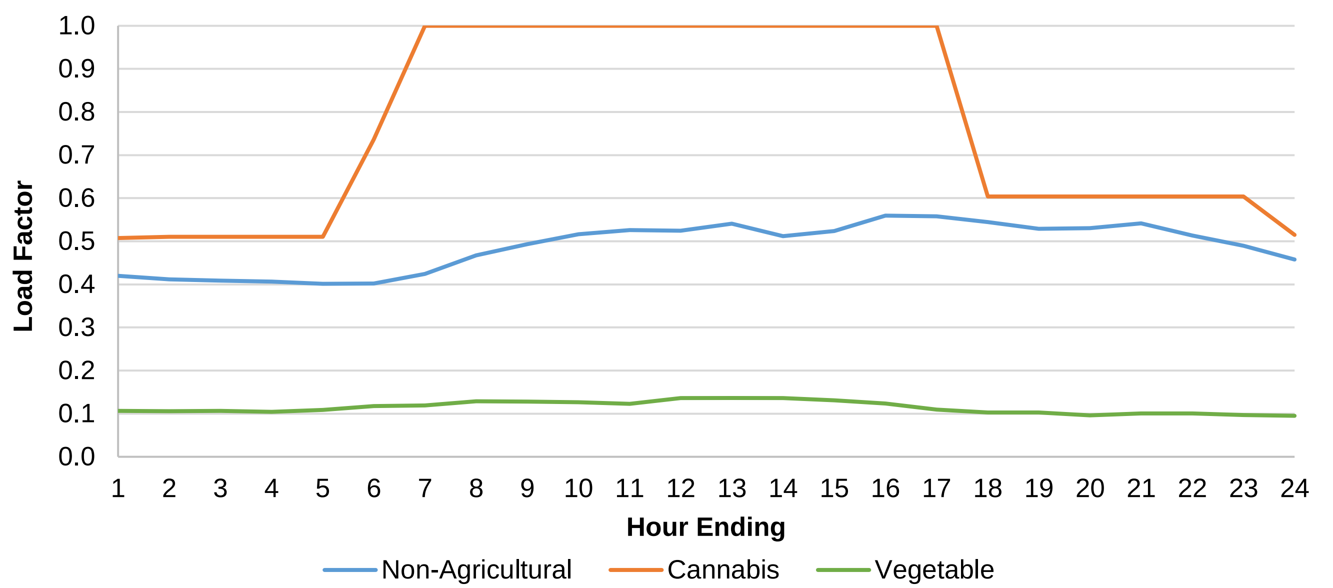



**Figure 5-7: Sample Hourly Profile for Summer Peak Day**



Indoor agriculture loads are typically winter-peaking, generally from September to April, when artificial lighting is employed to compensate for lower solar insolation during the day and extend lighting hours into the early morning and late evening. While lighting schedules vary among agricultural facilities, the aggregate load profile for all agricultural loads in the area peaks in the winter morning hours between 6 a.m. to 10 a.m.

Cannabis loads peak uniformly throughout the year and exhibit stepwise jumps in load. Cannabis lighting schedules, in combination with HVAC and other non-lighting loads, result in relatively flat daily load profiles with sustained demand for approximately 18-hour intervals.

The energy profiles shown in Figure 5-6 and

Figure 5-7 were used to better understand the local supply requirements and potential to use demand-side options. Further details on the development of an hourly forecast are provided in Appendix B.

### 5.7.3 Kent Area

Load in the Kent area has been relatively flat over the last several years. However, recently a new 55 MW load approximately 6 km southwest of Kent TS has requested to be connected. Aside from this, growth in public facilities, housing, and the small commercial sector is occurring at a higher rate than recent years, which is projected to result in an additional 12.5 MW of load growth over the next five years.

# 6. Needs

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

## 6.1 NEEDS ASSESSMENT METHODOLOGY

ORTAC, the provincial standard for assessing the reliability of the transmission system, was applied to assess supply capacity and reliability needs. ORTAC includes criteria related to the assessment of the bulk transmission system, as well as local or regional reliability requirements (see Appendix C for more details).

In applying these criteria, three broad categories of needs were identified:

- **Station Capacity** describes the electricity system's ability to deliver power to the local distribution network through regional step-down transformer stations. The capacity rating of a transformer station is the maximum demand that can be supplied by the station and is limited by the station equipment. Station ratings are often determined based on the 10-day limited time rating (LTR) of a station's smallest transformer(s), under the assumption that the largest transformer is out of service.[12]
- **Supply Capacity** is the electricity system's ability to provide continuous supply to a local area. This is limited by the LMC of the transmission supply to the area. The LMC is determined by evaluating the maximum demand that can be supplied to an area accounting for limitations of the transmission element(s) (e.g., a transmission line, group of lines, or autotransformer), when subjected to contingencies and criteria prescribed by ORTAC. LMC studies are conducted using power system simulations analysis (see

[12] A transformer station can also be limited when downstream or upstream equipment (e.g., breakers, disconnect switches, low voltage bus, high voltage circuits) are undersized relative to the transformer rating.

Appendix C for more details). Supply capacity needs are identified when the peak demand for the area exceeds the LMC.

- **Load Security and Restoration** is the electricity system's ability to minimize the impact of potential supply interruptions to customers in the event of a major transmission outage, such as the loss of a double-circuit tower line resulting in the loss of both circuits. Load security describes the total amount of electricity supply that would be interrupted in the event of a major transmission outage. Load restoration describes the electricity system's ability to restore power to those affected by a major transmission outage within reasonable timeframes. The specific load security and restoration requirements prescribed by ORTAC are described in Appendix C.

The Needs Assessment also identifies requirements related to equipment end-of-life activities. End-of-life asset replacement needs are identified by the transmitter and consider a variety of factors, such as asset age, the asset's expected service life, risk associated with the failure of the asset, and its condition. Replacement needs identified in the near and early mid-term timeframe would typically reflect the assessed condition of the assets, while replacement needs identified in the medium to long term are often based on the equipment's expected service life. As such, any recommendations for medium- to long-term needs should reflect the potential for the need date to change as condition information is routinely updated.

## 6.2 POWER SYSTEM NEEDS

During completion of the Needs Assessment for the Windsor-Essex region IRRP, the Working Group identified three main categories of needs: (1) local station supply capacity needs, (2) local load security and reliability needs, and (3) end-of-life asset replacement needs. The station supply capacity needs are further characterized within Section 6.2.1.6 in order to properly assess non-wires options.

### 6.2.1 Local Supply Capacity Needs

Capacity needs, both existing and in the long-term, were identified in the Windsor-Essex region at the station level. These are summarized in Table 6-9, and described in detail in the sub-sections below.

#### 6.2.1.1 Kingsville-Leamington Sub-system Capacity Needs

The Kingsville-Leamington sub-system is experiencing rapid electricity demand growth greatly exceeding both transformer capacity at Kingsville TS and Leamington TS as well as the transmission supply capability into the area. At the time of writing, there is more than 1,300 MW of load seeking connection in this sub-system above the fully utilized Kingsville TS and Leamington TS. Due to the nature of the load growth, the sub-system is expected to be winter peaking; all loading and capacity values below refer to the winter peak.

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

(1) Kingsville TS is supplied from 115 kV circuits extending radially from the Lauzon sub-system.
(2) Leamington TS is supplied from the radial 230 kV circuits at the Leamington Junction connected to the upstream C21J/C22J 230 kV circuits.

Kingsville TS loading is already beyond its LTR and is further limited by the Lauzon sub-system LMC. Kingsville TS capacity needs will be described in further detail in Section 6.2.1.2.

The capacity needs in the Leamington area have three nested levels. First, there is a station capacity need, which refers to capacity constraints at the step-down transformer station. Leamington TS has been fully allocated from its in-service date up to the transformer LTR of 200 MW. The Leamington TS expansion, scheduled to be completed by 2020, will increase the LTR to 400 MW but is expected to be fully allocated on its in-service date. Second, there is a supply capacity need on the Leamington “tap,” which refers to local transmission constraints that limit the amount of load served from the circuits between Leamington Junction and Leamington TS. The LMC of the tap is 370 MW and is limited by voltage change and decline issues[13] at Leamington TS. Additionally, there are two transmission connected customers

[13] See Appendix C.9.2 for details

seeking connection on the Leamington tap totaling approximately 100 MW. Lastly, there is bulk system capacity need which, in the context of the Windsor-Essex region, refers to the capability of the four 230 kV bulk system circuits westward from Chatham to deliver power to the entire region. The identification and study of bulk system needs include other considerations such as generation behaviour, flow distribution, and imports/exports patterns that are broader than the scope of this IRRP. For more information on the bulk system need, please refer to the *Need for Bulk Transmission Reinforcement in the Windsor-Essex Region* report.

**Table 6-1: Kingsville-Leamington Sub-system Capacity Needs**

| Station(s) | Description | Timing |
|---|---|---|
| Kingsville-Leamington Sub-system | A supply capacity need was identified for the load cumulatively supplied by the 115 kV circuits extending radially from the Lauzon sub-system and the radial Leamington tap connected to the upstream C21J/C22J 230 kV circuits. | Today |

#### 6.2.1.2 Lauzon Sub-system Capacity Needs

Several local capacity needs were identified in, or related to, the Lauzon 115 kV sub-system within the Windsor-Essex region. These needs are summarized in Table 6-2 and described in detail in the sub-section that follows.

**Table 6-2: Lauzon 115 kV Sub-system and Lauzon TS Capacity Needs**

| Station(s) | Description | Timing |
|---|---|---|
| Kingsville TS | An existing station capacity need was identified for the load served by Kingsville TS | Today |
| Lauzon DESN 1 | An existing transformer capacity need was identified for the load supplied by Lauzon DESN 1 | Today |
| Lauzon TS (DESN 1 and 2) | An existing station capacity need was identified for the total load supplied by Lauzon TS | Today |
| Lauzon 115 kV Sub-system | A supply capacity need was identified for the load cumulatively supplied by Kingsville TS, Belle River TS, and Tilbury West DS | 2023 |

Following its end-of-life refurbishment by 2021, Kingsville TS will comprise two 115 kV/27.6 kV transformers supplying low-voltage switchgear at a distribution voltage of 27.6 kV. With this configuration, the station has a total load meeting capability of 95 MW, limited by voltage change violations of ORTAC Section 4.3 for the loss of the upstream K2Z circuit. According to the winter planning forecast, this station capability is exceeded today and is currently managed by an SPS.

The limiting contingency and phenomenon described above also restricts the LMC of the previously-defined Lauzon 115 kV sub-system that encompasses the loads served collectively by Kingsville TS, Belle River TS, and Tilbury West DS. Assessing these stations served by the K2Z and K6Z circuits together, the sub-system capacity is 157 MW, and according to the planning forecast, is exceeded in 2023.

Related, though supplied by the 230 kV C23Z and C24Z circuits rather than the 115 kV sub-system, are the current capacity needs at Lauzon TS. In addition to the end-of-life needs for all Lauzon TS step-down transformers (further described in Section 6.2.3.1), there is a capacity need specifically for the T5/T6 step-down transformers at Lauzon DESN 1. Moreover, the total station capability for Lauzon TS is further restricted to 190 MW – beyond this cumulative load level, the contingency of a loss of a CxZ circuit results in voltage change violations at

Lauzon TS. These load meeting capabilities reveal station capacity needs that exist today according to the planning forecast, also currently managed by the SPS.

#### 6.2.1.3 J3E/J4E Sub-system Supply Capability

Several local capacity concerns were assessed in the J3E/J4E sub-system within the Windsor-Essex region. While no needs were found during the study period, key issues are summarized in Table 6-3, and described in detail in the sub-section that follows.

**Table 6-3: J3/4E Sub-system Supply Capability**

| Circuit | Description | Timing |
|---|---|---|
| J4E | Load supply to all stations in the J3E/J4E sub-system is thermally limited by flow on the J4E circuit | N/A |

Currently serving 415 MW and exhibiting less than a 1% year-over-year growth rate, the summer peak for all loads served in the J3E/J4E sub-system reaches 432 MW by the end of the study period. The reliability of supply to this sub-system is especially impacted by the capability of the double-circuit 230 kV circuits J3E and J4E connecting Keith TS and Essex TS, as well as local gas generation east of this transmission corridor in the city of Windsor.

Supply capability to the J3E/J4E sub-system is most limited in two scenarios:

(1) A C23Z/C24Z outage, in which the entire 115 kV network must be supplied through the J3E/J4E circuits, or
(2) A contingency of J3E, in which J4E (which has a lower LTE) is thermally overloaded.

In both scenarios, because the LMC of the sub-system is greater than the planning forecast load, no need is indicated during the IRRP study period.

Closely related to the J3E/J4E supply capability is the load restoration capability to Lauzon TS, as elaborated on in Section 6.2.2.2.

#### 6.2.1.4 Kent Transformer Capacity Needs

A local capacity need was identified in the Kent TS within the Windsor-Essex region. Kent TS currently consists of two DESNs connected to the 230 kV system, which supply load at 27.6 kV. The T1/T2 DESN has a summer capacity of 153 MVA, while the T3/T4 DESN is 58.7 MVA. Based on historical non-coincident loading, the Kent TS currently has approximately 30 MW of capacity remaining. A new 55 MW load approximately 6 km from Kent TS is requesting connection and a SIA has been submitted for the part of this load that can be connected to the existing station. Hydro One and Entegrus are currently working through feeder and protection setting changes required to accommodate the additional loading at Kent TS up to the current capability of the station. Aside from this, growth in public facilities, housing, and small commercial is happening at a higher rate, which is projected to result in an additional 12.5 MW of load growth over the next five years. As a result, Kent TS will be fully committed by the end of 2020, with a capacity need of 31-37 MW remaining, between 2020 and 2027.

**Table 6-4: Kent TS Capacity Needs**

| Station(s) | Description | Timing |
|---|---|---|
| Kent TS | A new supply capacity need was identified for additional load to be served by Kent TS | 2020 |

#### 6.2.1.5 Belle River Transformer Capacity Needs

Belle River TS currently consists of a single DESN (T1/T2) connected to the 115 kV circuits K2Z and K6Z, supplying low-voltage switchgear at a distribution voltage of 27.6 kV. This station has a total capacity of 60 MVA or approximately 54 MW. Supplying a peak summer demand of around 45 MW today, Belle River TS is expected to serve a moderately increasing load with a yearly growth rate of up to 2.5 per cent throughout the study period. While sensitive to power factor assumptions and the energy-efficiency forecast, the T1/T2 transformer capacity is expected to be exceeded by approximately 10 MW by 2037, with a need first arising in 2028.

**Table 6-5: Belle River TS Capacity Needs**

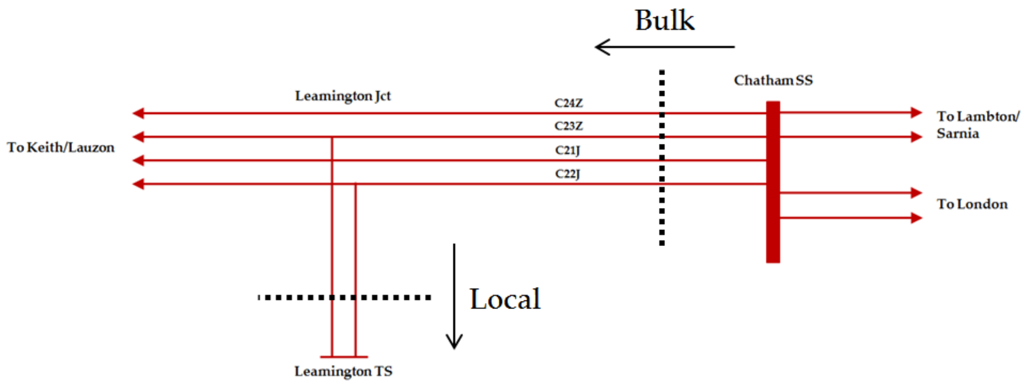
| Station(s) | Description | Timing |
|---|---|---|
| Belle River TS | A potential supply capacity need was identified for the load served by Belle River TS | 2028 |

#### 6.2.1.6 Non-Wires Characterization

In contrast to the rest of the region where load forecast is relatively flat over the planning horizon, the Kingsville-Leamington area is experiencing sudden and unprecedented demand growth. In 2018 alone, Hydro One Distribution, the main distributor in the areas experiencing growth, received approximately 900 MW of new load requests with in Kingsville-Leamington– an amount comparable to the entire Windsor-Essex regional summer peak of approximately 960 MW in 2017. In light of this unique situation, the Working Group explored opportunities for demand-side options to maximize usage of existing infrastructure while concurrently developing transmission reinforcement options.

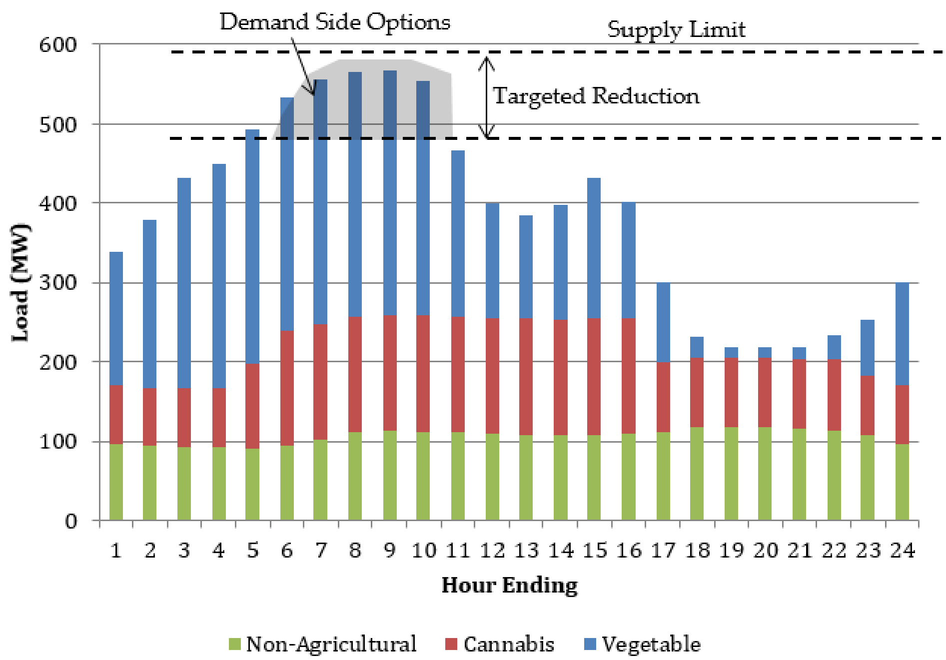
The system supply capability for the Kingsville-Leamington area is limited, as shown in Figure 6-1, by the lower of (1) the Leamington tap LMC and (2) upstream bulk transfer limits on the 230 kV circuits from Chatham SS. Demand-side options should be targeted differently depending which limitation is being addressed. To relieve Leamington tap LMC constraints, demand-side options must target the local Kingsville-Leamington peak as this is the only load downstream of the constraint. In contrast, the bulk circuits from Chatham SS serve more than just Kingsville-Leamington loads. To relieve bulk transfer limitations, demand-side options must target the portion of Kingsville-Leamington loads that is coincident with the overall bulk transfer interface peak. Since the Leamington tap LMC constraint is the most immediate limit, analysis of demand-side options in this IRRP focuses on reducing the Kingsville-Leamington local peak only. If the most limiting constraint changes in the future, further studies will be required to target demand-side options accordingly.

**Figure 6-1: System Supply Capability for Kingsville-Leamington Area**




The Kingsville-Leamington load profile is the summation of indoor agricultural load, cannabis loads and preexisting residential and commercial loads. The overall forecast winter load profile is shown in Figure 6-2.

**Figure 6-2: Illustrative Kingsville-Leamington Area Winter Load Profile**



The need in peak load hours that demand-side options seeks to address usually refers to the hours during which Kingsville-Leamington loads exceed the system's supply capability. In this context, where pent up demand already greatly exceeds the system supply capability, demand-side options can offer a way to manage existing agricultural and cannabis demand in hours approaching the supply capability limit by enabling more customers to connect, as illustrated in Figure 6-2. Given the magnitude of pent demand, demand-side options are not expected to replace or defer the need for infrastructure reinforcements, but rather maximize the utilization of existing assets.

The need is defined by three characteristics:

1. the magnitude (MW) over the supply limit or desired reduction in peak,
2. the duration (consecutive hours) that demand must be manage to achieve the desired magnitude of reductions, and
3. the frequency at which the need occurs per year or season.

The magnitude of the desired peak reduction will determine the duration and frequency of the need. The relationship between these variables is inherently probabilistic since the load profile varies daily and seasonally. As an example, Figure 6-3 visualizes the duration and frequency requirement for a desired peak reduction of 15 MW in 2021 using a heat map that shows the probability of a need arising in a given time of year and hour of day.

**Figure 6-3: Heat Map Showing Need for 15 MW Reduction**

| MW Range | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % Probability of Demand Reduction Needed at the given MW Range or Greater | | | | | | | | | | | |
| 14-15 | 0% | 3% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% |
| 12-14 | 2% | 3% | 1% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% |
| 11-12 | 5% | 6% | 2% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 2% |
| 9-11 | 7% | 12% | 2% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 2% |
| 8-9 | 9% | 14% | 2% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 4% |
| 6-8 | 15% | 22% | 3% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% |
| 5-6 | 21% | 26% | 4% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 8% |
| 3-5 | 23% | 32% | 4% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 9% |
| 2-3 | 28% | 36% | 6% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 14% |
| 0-2 | 35% | 40% | 8% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 17% |
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |

| Key Statistics | |
|---|---|
| Forecast Year | 2021 |
| Peak Reduction Targeted | 15MW |
| Total Hours Requiring Demand Reduction per Year | 95 |

% Probability of Demand Reduction Needed at the given MW Range or Greater

| MW Range | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM | 12PM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14-15 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 3% | 0% | 0% | 0% |
| 12-14 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 2% | 3% | 1% | 1% | 0% |
| 11-12 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 6% | 2% | 2% | 0% |
| 9-11 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 8% | 7% | 4% | 3% | 0% |
| 8-9 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 9% | 12% | 4% | 4% | 0% |
| 6-8 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 14% | 19% | 7% | 4% | 1% |
| 5-6 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 16% | 23% | 12% | 8% | 1% |
| 3-5 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 19% | 25% | 14% | 8% | 2% |
| 2-3 | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 21% | 33% | 17% | 11% | 2% |
| 0-2 | 0% | 0% | 0% | 0% | 0% | 0% | 2% | 26% | 35% | 19% | 13% | 2% |
| Hour Ending | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM | 12PM |

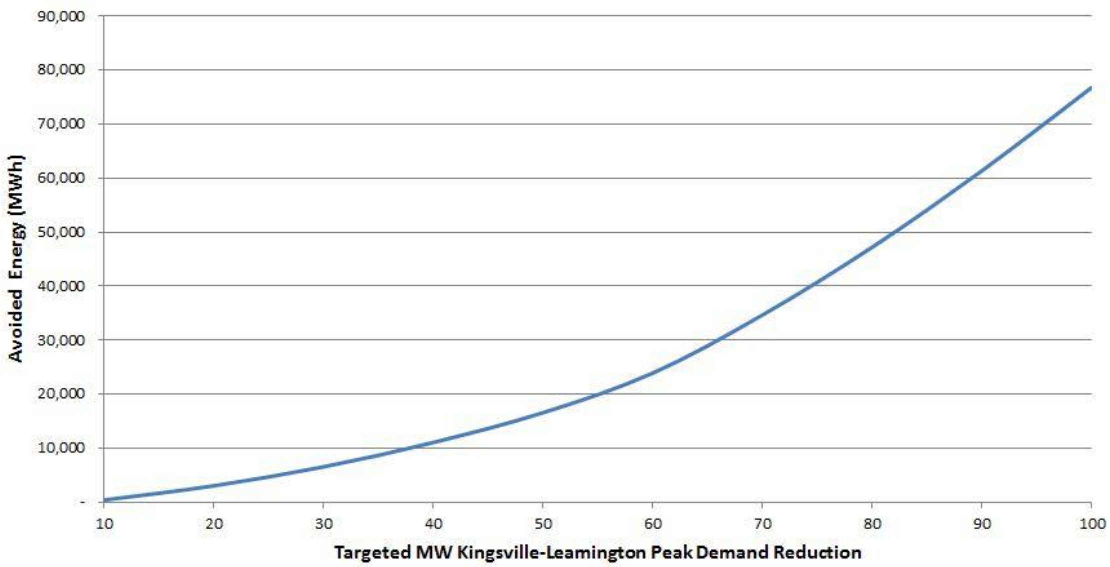
| MW Range | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | 12AM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14-15 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 12-14 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 11-12 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 9-11 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 8-9 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 6-8 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 5-6 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 3-5 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 2-3 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 0-2 | 2% | 1% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Hour Ending | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | 12AM |

Each cell in the heat map shows the probability that, of the total hours requiring demand reductions, the hour or month shown on the x-axis will require the given magnitude range shown on the y-axis or greater. The heat map demonstrates that:

- A total of 95 hours in 2021 require some degree of demand reduction between 0 and 15 MW.
- These 95 hours are distributed in December, January, February, and March between the hours of 7 a.m. to 2 p.m.
- February mornings at 9 a.m. exhibit the greatest probability of requiring demand reductions. Over the year, it is statistically expected that approximately 35 of the 95 hours requiring demand reductions will occur at 9 a.m. Approximately 3 hours of the 35 will require a demand reduction in the 14 to 15 MW range.

The frequency and duration requirement increase non-linearly with the desired magnitude of peak reduction. Appendix C shows the heat maps for 2021 with 5 MW, 10 MW, 15 MW, 50 MW and 100 MW peak reductions. Figure 6-4 shows the relationship between the desired magnitude of peak reduction and the total avoided energy required. The relationship is roughly quadratic in the range between a 0 and 100 MW reduction in 2021.

**Figure 6-4: Relationship Between the Avoided Energy and Peak Demand Reduction in the Kingsville-Leamington Area**




### 6.2.2 Local Load Security and Reliability/Resilience

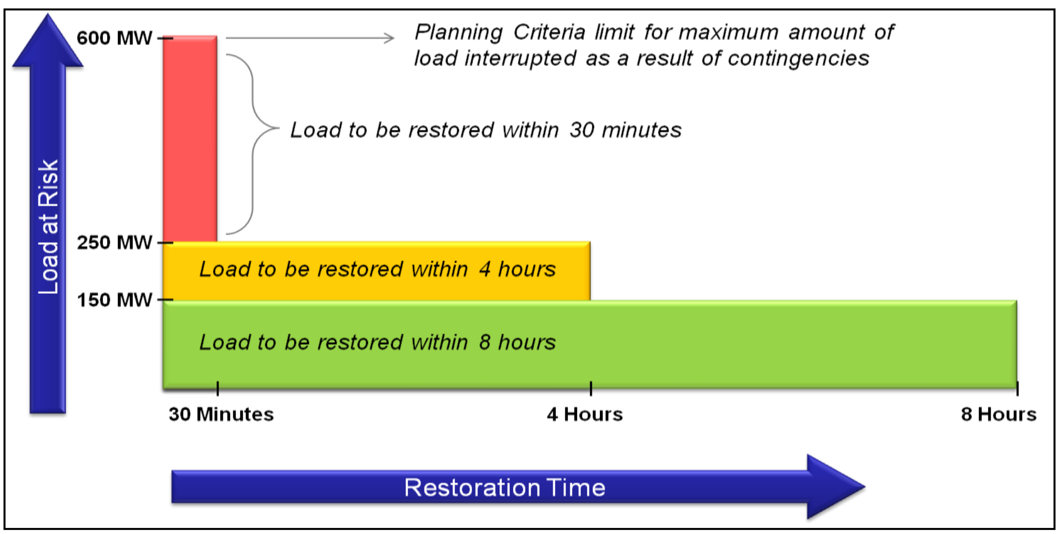
The transmission system must exhibit acceptable performance following specified design criteria contingencies. The load security criteria can be found in Section 7.1 of the ORTAC, and a summary of the load security criteria shown in Table 6-6.

**Table 6-6: Load Security Criteria**

| Number of transmission elements out of service | Local generation outage? | Amount of load allowed to be interrupted by configuration | Amount of load allowed to be interrupted by load rejection or curtailment | Total amount of load allowed to be interrupted by load curtailment, rejection, and curtailment |
|---|---|---|---|---|
| One | No | ≤ 150 MW | None | ≤ 150 MW |
| | Yes | ≤ 150 MW | ≤ 150 MW | ≤ 150 MW |
| Two | No | ≤ 600 MW | ≤ 150 MW | ≤ 600 MW |
| | Yes | ≤ 600 MW | ≤ 600 MW | ≤ 600 MW |

ORTAC Section 7.2 further specifies that all interrupted load must be restored within approximately eight hours; interrupted load above 150 MW must be restored within four hours and interrupted load above 250 MW must be restored within 30 minutes. Figure 6-5 provides a visual representation of the load restoration criteria.

**Figure 6-5: Load Restoration Criteria**



Load security and restoration needs identified in the Windsor-Essex region for certain transmission outage conditions are described in Table 6-7.

**Table 6-7: Windsor-Essex Region Load Security and Restoration Needs**

| Transmission Outage | Impacted Transformer Stations | Description | Timing |
|---|---|---|---|
| K6Z | Tilbury West DS | No need identified. | N/A |
| C23Z and C24Z | Lauzon TS | No need identified. | N/A |
| C21J and C22J | Leamington TS<br>Malden TS | Interrupted load for the loss of both C21J and C22J exceeds load security and restoration criteria.<br>Interrupted load for the loss of either C21J or C22J exceeds load security. | Today |

#### 6.2.2.1 K6Z (Tilbury)

When it reaches end of life in 2020, Tilbury TS will be decommissioned and load transferred to Tilbury West DS. The Scoping Assessment identified that analysis is required to determine whether additional reinforcements to the supply to Tilbury West DS are required to respect relevant planning criteria. The proposed system design satisfies ORTAC Section 7.2, for capacity, system restoration and load security. No further system reinforcements have been identified at this time.

#### 6.2.2.2 C23Z/C24Z (Lauzon)

Subsequent to an outage of the C23Z and C24Z circuits, load supply to Lauzon TS is entirely interrupted. According to summer planning forecasts, this load is approximately 210 MW, of which 150 MW can be assumed restored within eight hours. As stipulated in ORTAC Section 7.2, the remaining 60 MW expected during peak hours at Lauzon TS must be restored within four hours.

Existing transmission reconfiguration options are sufficient to restore the interrupted load beyond 150 MW, as Lauzon TS can be resupplied through the 115 kV network and from the 230 kV/115 kV T1/T2 autotransformers. Through conversations with the transmitter and in consideration of typical circuit outage restoration timelines for the Windsor-Essex region, restoration of the remaining load under 150 MW is expected to occur within eight hours. As such, there are no additional load restoration requirements at Lauzon TS for the study period of this IRRP.

#### 6.2.2.3 C21J/C22J (Leamington)

Subsequent to an outage of both C21J and C22J, approximately 510 MW of load on the Leamington tap will be interrupted by configuration. This includes 400 MW at the expanded Leamington TS and 110 MW at two transmission-connected customers all of which are expected to materialize before the in-service date of Lakeshore TS. In addition, approximately 140 MW of load will be interrupted by configuration at Malden TS. While the Malden TS load is not coincident with the winter peaking Leamington TS loads, the C21J/C22J double contingency outage will result in approximately 650 MW of load interrupted. This is in violation of ORTAC Section 7.1 for load security which only allows 600 MW of load interruption by configuration for two elements out of service. The existing transmission system also cannot meet the requirement (ORTAC Section 7.2) that load in excess of 250 MW to be restored within 30 minutes.

Subsequent to an outage on either C21J or C22J, one of the two transmission-connected customers on the Leamington tap will be interrupted by configuration resulting in a load loss of approximately 60 MW, which is within the acceptable amount of load allowed to be interrupted by configuration, as per ORTAC Section 7.1. An additional 120 MW at Leamington TS must also be rejected to bring the total load on the Leamington tap below its LMC of 370 MW. This is in violation of ORTAC Section 7.1, which does not allow any load to be interrupted by load rejection following a single element contingency.

In terms of load restoration for either a C21J or C22J outage, of the 180 MW of load interrupted; 30 MW must be restored within four hours and the remaining within eight hours. It can be reasonably assumed that the 30 MW can be transferred to Kingsville TS within four hours, while the rest can be restored within eight hours, in compliance with the restoration criteria stipulated by ORTAC Section 7.2.

### 6.2.3 End-of-life Asset Replacement Needs

The transmitter identified some end-of-life asset replacement needs for the Windsor-Essex region, with several needs arising in the near to medium term. These needs are summarized in Table 6-8.

Since end-of-life needs are based on the best available asset condition information at the time of each stage of the planning cycle, timing of asset needs can change as new information becomes available. As a result, the scope and timing of some asset needs has been revised since the Needs Assessment and Scoping Assessment were completed.

**Table 6-8: Windsor-Essex Region End-of-life Asset Replacement Needs**

| Facilities | Need | Expected Timing |
|---|---|---|
| Lauzon TS | ▪ End-of-life step-down transformers T6 and T8 | 2024 |
| | ▪ End-of-life step-down transformers T5 and T7<br>▪ End-of-life autotransformers T1/T2 | 2029 |
| Keith TS | ▪ End-of-life 230/115 kV autotransformers T11/T12 | 2024 |
| | ▪ End-of-life 115 kV/27.6 kV transformer T1 | 2024 |

#### 6.2.3.1 Lauzon Transformers

Lauzon TS currently consists of two 230 kV/115 kV autotransformers (T1/T2) and four step-down transformers: T5 and T6 (which supply DESN 1), and T7 and T8 (which supply DESN 2).

Both DESN stations are supplied at 230 kV and both supply two low-voltage switchgears at a distribution voltage of 27.6 kV.

During the Needs Assessment, Hydro One identified that the T1 and T2 autotransformers and the T6 and T7 step-down transformers would be reaching their end of life within the next 10 years. During the development of the IRRP, Hydro One refined its original estimate, finding that the T6 and T8 step-down transformers will be reaching their end of life by 2024, while the remaining transformers (T1, T2, T5 and T7) have potential end-of-life needs within the next decade. Given that these transformers have been in service for between 40-49 years, they will all require replacement for safety, reliability, and maintainability purposes shortly.

Lauzon TS currently supplies 220 MW of load in the summer. With a planning forecast year-over-year growth rate between -1.2% and +0.3%, the load at the Lauzon TS is expected to remain fairly flat. However, DESN 1 currently supplies 40 MW more than DESN 2, about 130 MW and 90 MW respectively. Consequently, there is also a current and continuing transformer capacity need at DESN 1, whose current rating is 112 MVA or approximately 100 MW.

The total load connected on the Windsor-Essex region 115 kV system is supplied by both the Lauzon TS autotransformers and the Keith T11/T12 autotransformers. This load is also projected to be relatively flat over the study period, with a yearly growth rate ranging from -1.5% to +0.7%. There is currently no foreseeable need to uprate the Lauzon autotransformers.

#### 6.2.3.2 Keith Transformers

Keith TS is currently composed of:

- Two 230 kV/115 kV autotransformers T11 and T12,
- One DESN supplied by two 230 kV/27.6 kV transformers T22/T23, and
- One DESN supplied by one 115 kV/27.6 kV transformer T1.

During regional coincident peak demand, approximately 60 MW of total load is currently served by Keith TS in the summer, with about 90 MW served during non-coincident peak times.

ENWIN, Hydro One Distribution, and EPL (as an embedded customer) constitute this load, which exhibits a yearly growth rate of less than 1% throughout the study horizon.

Decommissioning of the end-of-life T1, which historically supplied approximately 7 MW during times of regional coincident peak demand, directly impacts ENWIN load. This industrial customer is shifting its operations; as such, by 2020 the corresponding load will no longer be connected to Keith TS, so there is no additional capacity need.

Keith TS T11/T12 autotransformers currently connect the Windsor-Essex 230 kV network with the 115 kV network. The 2015 IRRP did not identify additional capacity requirements through T11/T12, but recognized the need for a like-for-like replacement of these autotransformers. However, subsequent discussions between Hydro One and IESO confirmed that the incremental cost to upgrade the units from 115 MVA to 250 MVA would be justified. This upsizing is supported through studies preceding the IRRP, which assessed scenarios varying local generation and loads under CxZ circuit outages and the impact on power flow through T11/T12. Considering the exceedance of transformer capacity under some of these scenarios before an upsizing occurs, this IRRP is in agreement with the Needs Assessment and Scoping Assessment regarding the Keith T11/T12 autotransformer findings and recommendations. No further needs have been identified for the Keith transformers.

## 6.3 NEEDS SUMMARY

The majority of needs in the Windsor-Essex region focus on addressing the growing station capacity shortfalls which exist today and into the long term, to ensure adequate load restoration, and some replacement of assets when they reach their end of life.

Table 6-9 provides a brief summary of needs considered during the development of options for the plan in chronological order of need date.

**Table 6-9: Summary of Needs in Windsor-Essex Sub-Region**

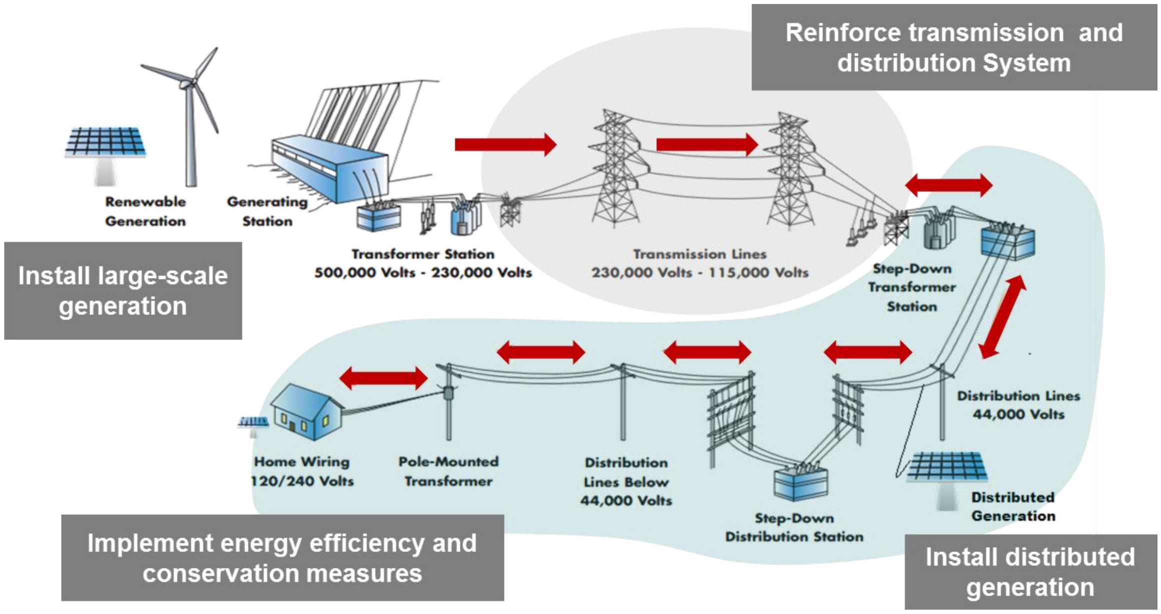
| Area | Need | Description | Need Date |
|---|---|---|---|
| Kingsville TS | Supply Capacity | A supply capacity need was identified for the load served by Kingsville TS. | Today |
| Kingsville-Leamington Sub-system | Supply Capacity | A supply capacity need was identified for the load cumulatively supplied by the 115 kV circuits extending radially from the Lauzon sub-system and the radial Leamington tap connected to the upstream C21J/C22J 230 kV circuits. | Today |
| Leamington (C21J/C22J) | Load Security and Restoration | Interrupted load for the loss of both C21J and C22J exceeds load security and restoration criteria.<br>Interrupted load for the loss of either C21J or C22J exceeds load security. | Today |
| Lauzon DESN 1 | Station Capacity | A station capacity need was identified for the load supplied by the T5/T6 DESN 1 at Lauzon TS. | Today |
| Lauzon TS (DESN 1 and 2) | Station Capacity | An existing station capacity need was identified for the total load supplied by Lauzon TS | Today |
| Kent TS | Station Capacity | A supply capacity need was identified for the load served by Kent TS. | 2020 |
| Lauzon 115 kV Sub-system | Supply Capacity | A supply capacity need was identified for the load cumulatively served by Kingsville TS, Belle River TS, and Tilbury West DS. | 2023 |
| Lauzon TS Transformers | End of Life | Hydro One has identified the step-down transformers (T6 and T8) to be at end of life. | 2024 |

| Area | Need | Description | Need Date |
| --- | --- | --- | --- |
| Belle River TS | Station Capacity | A transformer capacity need was identified for the load supplied by T1/T2 at Belle River TS. | 2028 |
| Lauzon TS Transformers | End of Life | Hydro One has identified the autotransformers (T1/T2) and step-down transformers (T5 and T7) to be nearing end of life. | 2029 |

# 7. Options and Recommended Plan to Address Regional Electricity Needs

As shown in Figure 7-1, power has traditionally been generated from large, centralized generation sources. To provide electricity supply to the various communities across Ontario, power has been delivered through transmission and distribution infrastructure. To address regional and local electricity needs one approach is, therefore, to reinforce the transmission and distribution infrastructure supplying the local area. In recent years, however, communities and customers have been exploring opportunities to reduce their reliance on the provincial electricity system by meeting their electricity needs with local, distributed energy resources and community-based solutions. This approach includes a combination of emerging technologies and energy-efficiency programs, such as targeted DR and energy-efficiency programs, DG and advanced storage technologies, micro-grid and smart-grid technologies, and more efficient and integrated process systems combining heat and power.

**Figure 7-1: Options to Address Electricity Needs**



## Options Evaluation

When evaluating alternatives, the Working Group considered a number of factors, including technical feasibility, cost, flexibility, alignment with planning policies and priorities and consistency with long-term needs and options. Solutions that maximized the use of existing infrastructure were given priority.

Investing in new electricity infrastructure, such as a new transmission line or a generation facility requires substantial capital investment, has environmental/land-use impacts and has a long service life. As such, it is important to take into the consideration the longer-term cost implications, value and potential risks (e.g., stranded or underutilized assets) when recommending an investment. Furthermore, these facilities typically require long lead times to obtain approvals and complete construction. Decisions on new facilities must take into account these considerations and be made with sufficient lead time to ensure they are available when needed.

When assessing the need for infrastructure investments, it is important to strike a balance between overbuilding infrastructure (e.g., committing to infrastructure when there is insufficient demand to justify the investment) and under-investing (e.g., avoiding or deferring investment despite insufficient infrastructure to support growth in the region). Typically, demand management and energy-efficiency programs can be implemented within six months, or up to two years for larger projects, whereas transmission and distribution facilities can take five to seven years to come into service. The lead time for generation development is typically two to three years, but could be longer depending on the size and technology type.

Finally, the issue of how much is appropriate to invest and who pays needs to be addressed. In regional planning, depending on the type and classification of assets, the costs may be shared by all provincial ratepayers or recovered only by the specific customers they serve (e.g., LDC, industrial customers). In some cases, a combination of cost-sharing may occur when there are both provincial and local benefits.

**Near-Term Actions and Long-Term Planning Considerations**

For the near and medium term, the IRRP identifies specific actions and investments for immediate implementation. This ensures that necessary resources will be in-service in time to address more pressing needs. For the long term, the IRRP identifies potential options to meet needs that may arise in 10 to 20 years. It is not necessary to recommend specific projects at this time (nor would it be prudent given forecast uncertainty and the potential for technological change). Instead, the long-term plan focuses on developing and maintaining the viability of long-term options, engaging with communities, and gathering information to lay the groundwork for making decisions on future options.

As discussed in Section 5.7.2, actions need to be taken to address (1) local transformer station and supply capacity needs, (2) local load security and restoration needs, and (3) asset replacement needs. Given the significant and diverse capacity needs identified, this is further broken down into three areas: (1) the Kingsville-Leamington area, (2) 115 kV sub-systems, and (3) other local capacity needs. In developing the 20-year plan, the Working Group examined a wide range of integrated solutions to address local and regional needs and recommended additional studies that to inform mid- and long-term plans and actions. These options are discussed in the following section.

## 7.1 OPTIONS FOR ADDRESSING KINGSVILLE-LEAMINGTON AREA CAPACITY NEEDS

In contrast to the rest of the region where load forecast is relatively flat over the planning horizon, the Kingsville-Leamington area is experiencing sudden and unprecedented demand growth, comparable to the entire Windsor-Essex regional summer peak. Capacity needs in the Kingsville-Leamington area are currently being addressed through interim measures, which results in a lower level of reliability. Various options to address this, along with the rapid load growth forecast for the area were considered, including non-wires options and other wires solutions as described in this sub-section.

### 7.1.1 Non-Wires Options

In light of the unique load profile in this area, the Working Group explored opportunities for demand-side options to maximize usage of existing infrastructure while concurrently developing transmission reinforcement options.

Demand-side options can be categorized as dispatchable or non-dispatchable solutions. Dispatchable solutions are measures that actively reduce the demand in response to dispatch signals targeting the specific hours when the need occurs. Non-dispatchable solutions are measures that broadly reduce electricity consumption to address the need without requiring active management. This section documents LAC discussions on two options:

(1) Dispatchable – Lighting load demand response, and
(2) Non-dispatchable – Lighting technology energy efficiency.

<u>Lighting Load Demand Response</u>

Demand response is a dispatchable solution involving loads that can be reduced or avoided during hours when the need occurs. Since lighting comprises the vast majority of load in agricultural and cannabis facilities, DR targeting lighting schedules would have the most impact on peak reductions. This can be accomplished through either lighting load curtailment or local behind-the-meter generation and storage.

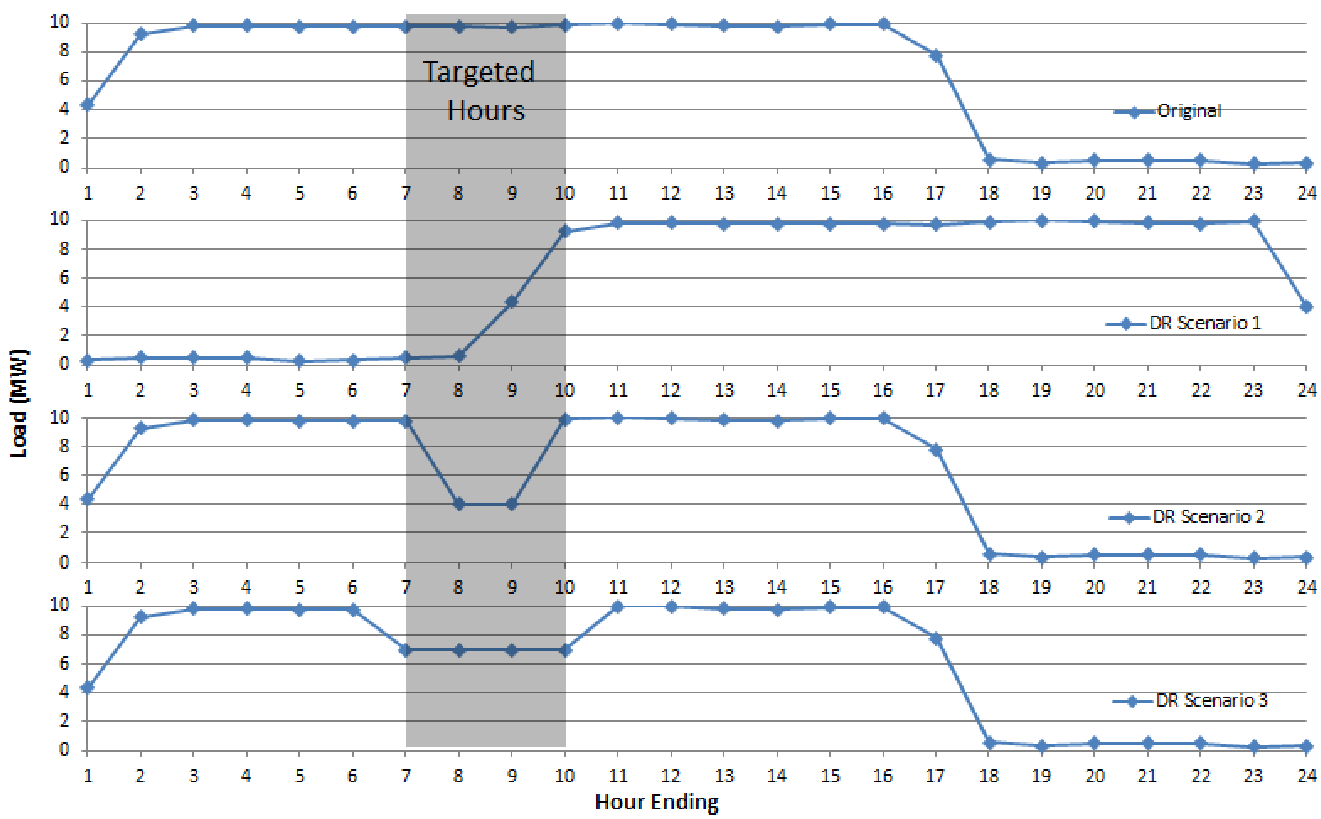
The existing provincial DR auction, as detailed in the IESO's Market Manual 12, typically consists of procuring DR resources zonally with a $/MW-day clearing price for summer or winter commitment periods. Successful DR resources are then required to participate in the energy market during all availability windows with a bid ($/MWh) greater than a DR bid price threshold. The LAC identified three broad barriers that prevent the direct application of the provincial DR program in relieving the Leamington tap LMC constraint:

- The provincial DR program specifications are designed to address the provincial seasonal peak which typically occurs on summer afternoons and winter evenings and do not align with the local Kingsville-Leamington peak,

- Zonal procurement is not granular enough to target the select stations downstream of the Leamington tap LMC constraint, and
- The requirement to participate in the energy market may not accommodate artificial horticulture lighting constraints such as maximum seasonal frequency and duration of curtailment.

The last barrier, the accommodation of horticulture lighting constraints, may be the most challenging to address due to the lack of industry knowledge and comfort around quantifying the specific agricultural and cannabis constraints. The LAC explored possible variations of lighting DR, examples of which are illustrated in Figure 7-2, but no consensus was reached on which variations were acceptable to local growers and facility operators.

**Figure 7-2: Illustrative Lighting Demand Response Scenarios**



In DR Scenario 1, the entire lighting period shifted by eight hours; DR Scenario 2, depicts a large magnitude, short duration lighting load reduction; and DR Scenario 3 shows a low-magnitude, long duration lighting load reduction.

While there are broad indications that short, infrequent lighting curtailment may be acceptable, there remain a number of questions which remain unanswered due to the lack of industry experience with DR including:

- What specific actions can be taken or technologies employed to reduce load during the hours when need arises?
- What operational or economic barriers exist for behind-the-meter generation or storage?
- What is the cost associated with taking DR actions including the impacts on crop productivity?
- What are the maximum duration and frequency of lighting curtailment in a growing season?
- What procurement constraints such as commitment period, forward period and activation lead time exist and how would they impact participation?
- Are there variations between crop types that would impact the answers to any of the above questions?

Lighting Technology Energy Efficiency

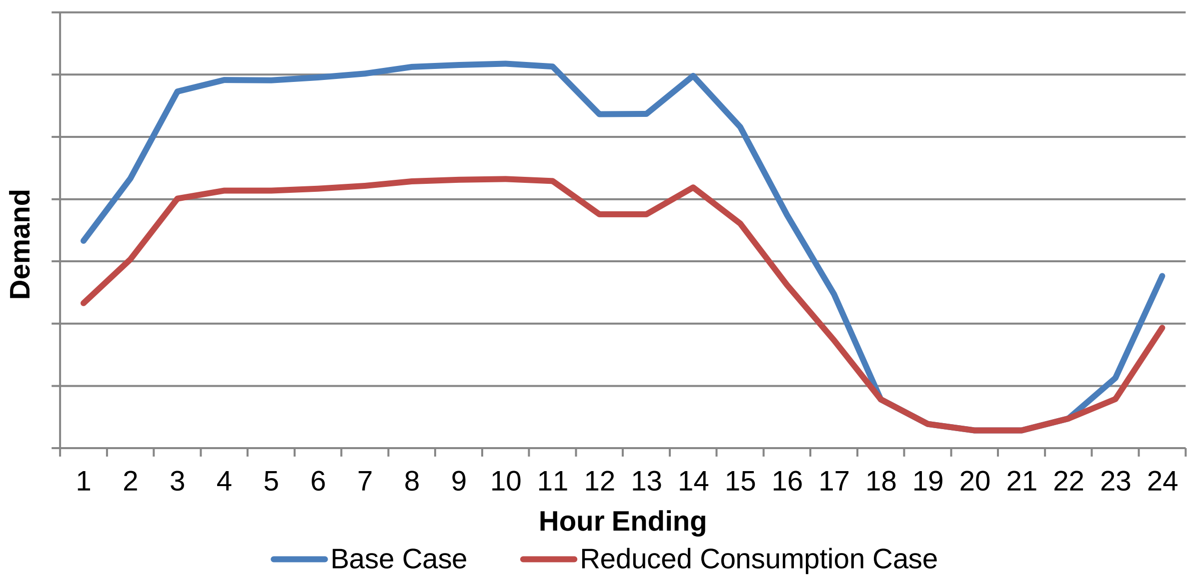
As with demand-response solutions, since the overwhelming majority of the demand growth is driven by lighting loads, discussions of energy-efficiency measures have been focused on lighting technologies. Energy-efficiency measures are non-dispatchable solutions that help address the need by reducing the overall energy and demand consumption, but do not require signals or instructions to activate.

The primary artificial lighting technology used in agricultural applications is the HPS lamp with an energy intensity of approximately 1 kW lamp per square meter. The LAC confirmed that LED horticulture lighting technology offers approximately 20-40%[14] improved energy efficiency

[14] Anticipated efficiency improvement varies widely depending on light spectrum requirements and layout design.

but with a four to five fold increase in capital cost compared with HPS lamps. LED lighting minimizes waste heat which enables higher density vertical farming but may be disadvantageous in winter operations when heating is required. Figure 7-3 visualizes the anticipated load profile impact of LED lighting at a generic agricultural facility. Note that the improved efficiency impacts all hours with the exception of 6 p.m. to 10 p.m. when no lighting is anticipated. This impact profile makes lighting energy-efficiency well suited to address local capacity constraints.

**Figure 7-3: Sample Agricultural Load - Winter Day Profile**




The LAC clearly indicated that the primary barrier to date for LED proliferation is technology maturity risk. The LED horticulture lighting industry is still in a high degree of flux. The rate of change in LED technology means subsequent product iteration in the near future will likely outperform any LED lighting investments made today at lower cost. The LAC raised concerns about warranty dependability due to high turnover in suppliers coupled with performance reliability issues significantly hinders LED technology investments. The LAC also expressed concerns regarding the impact of LED lighting on crop productivity and the difficulty in testing LED products that lack industry standards and are prone to rapid iterative changes.

Despite concerns raised by the LAC, there are indications that the horticultural lighting industry is evolving to address the need for standardization, which may improve current and future LED products. In late 2018, the American Society of Agricultural and Biological Engineers (ASABE) published new lighting standards that enables standardized product testing and facilitates comparison of products between manufacturers. The DesignLights Consortium (DLC) is also updating their testing and technical requirements for products to be qualified in a new DLC Horticultural Lighting Qualified Products List.

Currently under the Interim Framework, and previously the Conservation First Framework, there is a retrofit program to incentivize adoption of LED lighting for existing facilities. Since this change was recently implemented, it is too early to determine the impact on the uptake of LED technology with agricultural loads. Previously, there was also a High Performance New Construction program under which incentives were available for new indoor agriculture facilities. With the cancellation of that program in April 2019, the ability to incent the installation of LEDs is reduced, but is still applicable for new installations under the Retrofit Program.

#### 7.1.1.1 Targeted Call for Innovative Projects

Given the barriers to demand-side options identified above and the gaps in industry knowledge regarding the feasibility of these options with the unique end use applications driving load growth in Kingsville-Leamington, further work is recommended to explore the potential of demand-side options with agricultural loads.

The IESO will consider a targeted call for innovative projects under the Grid Innovation Fund in Q1 2020. The GIF advances innovative opportunities to achieve electricity bill savings for Ontario ratepayers by funding projects that enable customers to better manage their energy consumption or that reduce the costs associated with maintaining reliable operation of the province's grid. The IESO will leverage LAC discussions and the work already performed to date for demand-side options in Kingsville-Leamington to help scope parameters of the targeted call. The call will solicit projects related to indoor agriculture that validates the performance and business case of promising new technologies, practices, and services. Since other areas of the province such as Dresden and Niagara are experiencing similar agricultural sector growth, the call will open to projects across the province.

#### 7.1.1.2 Provincial Energy-Efficiency Programs

While concerns such as technology maturity, reliability, and crop performance will likely limit uptake of LED horticulture lighting technology with additional programs or incentives, the IESO will evaluate existing and any future energy-efficiency programs beyond the Interim Framework to increase participation in areas with identified local need. There is an opportunity for energy-efficiency programs to influence the technologies used while the indoor agriculture and cannabis industries rapidly expand. Given the magnitude of growth forecast in Kingsville-Leamington, there remains a need to manage the growth in the long term even after the implementation of the wires reinforcements in Section 7.1.3. The IESO will notify relevant communities of any future energy-efficiency opportunities that may arise.

#### 7.1.1.3 Continued Monitoring of Industry Developments

The IESO will continue monitoring the status of indoor agriculture industry developments through the ongoing Greenhouse Energy Profile Study. This study forecasts energy use for the greenhouse sector over the next five to 10 years and quantifies the potential for energy and water savings, and is anticipated to conclude in Q3 of 2019.

### 7.1.2 Local Generation

While there are off-grid generation assets owned and operated by customers in the Kingsville-Leamington area, the need for grid-supplied capacity persists. Customer owned generation assets such as CHP facilities are generally sized to fulfill thermal or $CO_2$ requirements. Facilities of this size may be sufficient to meet baseload electricity requirements but are not suited to supply highly energy-intensive lighting demand. Meeting the entire electricity requirements of lighting loads with behind-the-meter generation would entail either the installation of dedicated electricity generation assets such as a simple-cycle gas turbine or drastically oversizing CHP facilities. These strategies are typically cost-prohibitive compared to grid supply unless there are additional revenue streams aside customer load supply.

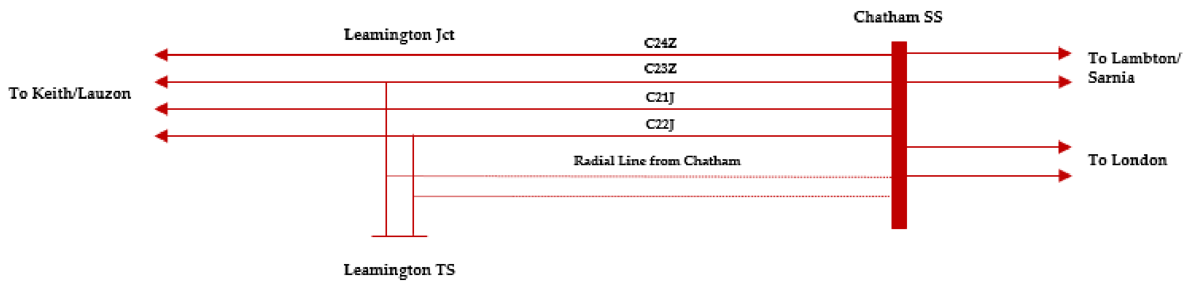
Grid-connected behind-the-meter generation assets are also an option, but existing facilities are expected to take up the bulk of the remaining short circuit limitation at the expanded Leamington TS, with some room remaining at Kingsville TS. The IESO, with the Working Group, will monitor the growth of local generation in the Kingsville-Leamington area. This information will be used to update the forecast net demand which may impact the timing of future transmission and distribution infrastructure plans and inform the next cycle of regional planning for the area.

### 7.1.3 Leamington Switching Station (Lakeshore TS)

Due to the magnitude and timing of the requirement, non-wires options alone are not sufficient to meet the identified needs. A grid-supplied generation option located at Leamington Junction was considered but was impractical due to the technical infeasibility and high anticipated cost. A new generator would need to be connected close to the load centre, near Leamington Junction, and a 230 kV bus would be required to accommodate the size of that facility. This bus would essentially be the equivalent of a 230 kV switching station, which negates the value of generation, since this option would provide the same benefits described later for the switching station, but with the additional cost of building generation.

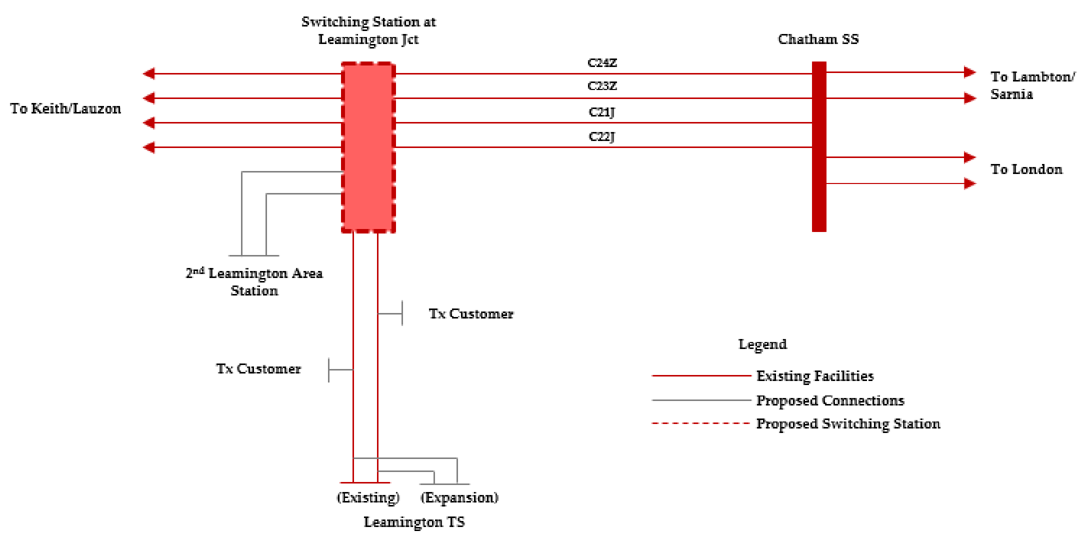
An option to build a new radial 230 kV line from Chatham SS to Leamington TS, as shown in Figure 7-4, was also considered. The LMC would be insufficient to meet the forecasted growth, since it would be limited by voltage concerns as is typical of a radial line connected to a large load. In addition, the solution would not provide the flexibility to supply future growth beyond the Leamington TS expansion.

**Figure 7-4: Configuration of Option for a Radial line from Chatham**




Another option is a switching station at or near the Leamington Junction, north of the municipality of Leamington, which would sectionalize and switch the four existing 230 kV circuits going west from Chatham SS to the Windsor area (C21J/C22J/C23Z/C24Z). This option is shown in Figure 7-5. The switching station would improve reliability, and provide some additional local supply capability to connect an additional transformer station and continue supplying load in the Kingsville-Leamington area. See Appendix C.9.2 for details. Upstream transmission limitations are still anticipated but can potentially be mitigated by interim congestion management strategies.

**Figure 7-5: Configuration of Option for a Switching Station at Leamington**



In addition to improving load supply capability in the Kingsville-Leamington area, the proposed switching station will improve the performance of the bulk system by balancing the flow on the existing transmission circuits from Chatham, thus enhancing transfer capability. The switching station will also reduce exposure to outages by allowing the existing 230 kV circuits to be sectionalized and switched independently, as outlined in Section 7.4. Furthermore, it will allow for future transmission reinforcements to increase the transfer capability west of Chatham which will maintain existing export capability to Michigan while enabling additional load growth throughout the Windsor-Essex region.

### 7.1.4 Interim Measures

The Windsor-Essex region already has a number of interim measures in place. These include existing special protection systems – originally designed to address automotive industry loads – to help improve reliability to the region. These SPSs are still used today in some scenarios, such as under high import or export conditions.

Load in the Kingsville-Leamington area has also historically exceeded the capability of existing local transmission infrastructure. Summer-peaking load at Kingsville TS has ranged from 120 to 130 MW, and SPSs have been used to accommodate this demand by interrupting load in the Kingsville area following recognized contingencies. While this enabled higher load connection than the Kingsville TS capability, local customers experience reduced reliability compared to that provided in the rest of the province.

Load growth in the area will increase the frequency of the SPS use mentioned above and require new interim protection measures for customers connecting prior to the in-service date of the switching station and new line from Chatham SS to the switching station (outlined in the bulk Windsor-Essex report). The interim measures address both thermal and voltage limitations for a range of recognized contingencies to allow loads to connect on the Leamington tap above its current load meeting capability. Interim measures include both contingency- and voltage-based SPSs enabling load and capacitor rejection at Leamington TS.[15]

### 7.1.5 Continued Monitoring of Kingsville-Leamington Load Growth

Given the rapid growth and changing nature of load in the Kingsville-Leamington area, changes to the assumptions for demand in this region could significantly impact the suitability of the recommended plan. To mitigate this, on an annual basis, the IESO, with the Working Group, will review actual load growth in the Kingsville-Leamington area, the queue of load customers requesting connection from LDCs, transmitter or the IESO, and factors driving growth of the sector. This information will be used to determine when decisions on the long-term plan are required, inform the next cycle of regional planning for the area, and trigger a cycle early, as required.

## 7.2 OPTIONS FOR ADDRESSING THE 115 KV SUB-SYSTEM CAPACITY NEEDS

In addition to a supply capacity need in the Lauzon 115 kV sub-system starting in 2023, multiple present-day capacity needs in the current nested 115 kV sub-systems have been identified. These include a station capacity need at Kingsville TS, transformer capacity need at Lauzon DESN 1, and station capacity need at Lauzon TS (DESNs 1 and 2). Currently, existing capacity needs are being managed with SPSs.

In light of these supply requirements, the IRRP considered the option of converting Kingsville TS from its 115 kV supply to 230 kV, non-wires options, and supply from Keith TS. These options have many implications, requiring an integrated and coordinated evaluation that prevents recommendations for numerous needs from occurring in isolation. Conversion of Kingsville to 230 kV would effectively solve the Kingsville station capacity need, as well as remove it entirely from the Lauzon 115 sub-system, eliminating the sub-system's supply capacity need. Depending on which 230 kV circuits ultimately supply the reconfigured

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[15] Interim measures will be specified in detail in the Leamington TS expansion SIA.

Kingsville TS, the conversion could also relieve the voltage violations that characterize the Lauzon station capacity need.

There are two options for staging this conversion, considering the ongoing transmission developments in the area:

**Option One: Build Lakeshore DESN 1, convert Kingsville from its 115 kV supply to 230 kV, and then build Lakeshore DESN 2.** This would allow for an equitable load connection sequence based on the chronological order of customer requests. While there is load growth near both the proposed Lakeshore TS and existing Kingsville TS, customers earlier in the connection queue are geographically closer to the Kingsville station. However, Kingsville TS is currently fully utilized, with interim measures being used to supply existing customers beyond the capability of the station. In Option One, therefore, the initial DESN station at Lakeshore would first supply new loads in its proximity, followed by the 230 kV Kingsville conversion to supply loads closer to Kingsville and relieve the interim measures at Kingsville TS. The second Lakeshore DESN would subsequently enable remaining customer connections in the area.

**Option Two: Build Lakeshore DESN 1 and DESN 2 before converting Kingsville to 230 kV.** This would better align with Hydro One's preliminary implementation plan, which includes timelines for design, construction, and environmental assessments (EAs). Hydro One has already begun the EA for the two Lakeshore DESNs, with construction scheduled for early 2020 and an expected in-service date of 2023. The conversion of Kingsville from 115 kV to 230 kV would also require its own EA, Section 92, and construction of transmission infrastructure to the existing 230 kV system, which would take five to seven years.

Based on these timelines, Option Two would connect more customers in a shorter timeframe than Option One. However, if adhering to the chronological order of the customer connection application queue, new customers near Kingsville TS would be supplied from the more electrically-distant Lakeshore TS with long distribution feeders, resulting in approximately $20-million in additional distribution costs. One benefit of this option, though, would be the potential for load restoration capability between Kingsville and Lakeshore stations under the final distribution network configuration. Option Two would also allow the IESO additional time to assess the firmness of load growth in the area, given that it is largely driven by a single sector. Moreover, until upstream bulk transmission reinforcements are in-service (specifically the new 230 kV circuit from Chatham to Lakeshore), any additional supply capability resulting from the 230 kV conversion of Kingsville TS cannot be fully utilized.

As the load in the Kingsville-Leamington area continues to materialize and stations are constructed to provide local supply, converting Kingsville to 230 kV could also provide the long-term flexibility to address Leamington load security and restoration needs after the switching station is in-service, as identified in Section 7.4. Final distribution system build-out between Kingsville and Lakeshore in Option Two would also be a factor to consider in this regard.

Beyond the ability to address multiple capacity needs, this study would inform the end-of-life needs at Lauzon TS. As explained in Section 7.5.1, end-of-life transformers T5/T6 at Lauzon TS could be addressed through an upsizing rather than a more straightforward like-for-like replacement. However, the justification for increased transformer capacity of T7/T8 and step-down transformer capacity of T1/T2 must align with the ability to first relieve Lauzon station capacity needs – which, in turn, must align with the potential 115 kV sub-system capacity and Leamington restoration study.

Ultimately, optimizing the configuration of Kingsville to address the multiple needs identified requires careful consideration, at a minimum, of which of the existing 230 kV transmission lines (C21J/C22J/C23Z/C24Z) to connect to, whether to move the station from 115 kV to 230 kV or maintain a 230/115 kV connection, and reactive requirements. Given the study work that is required to be completed and the implementation timelines of Hydro One, the Working Group recommends that the 115 kV sub-system capacity and Leamington restoration needs be examined in detailed through IESO-led studies undertaken subsequent to this IRRP, and expected to be completed by Q2 of 2020. A plan for the proposed work is provided in Appendix C.

## 7.3 OPTIONS FOR ADDRESSING LOCAL SUPPLY CAPACITY NEEDS

### 7.3.1 New DESN Station in Chatham-Kent

Four options were considered to supply the capacity need at Kent TS:

1. Upsize the existing T3/T4 DESN transformers at Kent TS from 25/42 MVA single winding transformers to 50/83 MVA dual winding transformers,
2. Add two additional 230/27.6 kV DESN transformers at Kent TS,
3. Build a new DESN station west of Kent TS connecting to the idle Section K6Z, and
4. Build a new DESN station south of Chatham proper connecting to the 230 kV circuits between Chatham and Keith/Lauzon

With the existing Kent TS fully loaded by 2020, and without the ability to transfer load, supply could not be maintained during outages to the existing transformers required for the replacement. In addition, the new capacity need is located south of Chatham, requiring long feeders from Kent to the load, which would add significant distribution costs. Existing station egress and feeder routing challenges have also been identified through the feeder work required to utilize the remaining capacity at Kent TS to supply part of this new load.

Option Two would add two additional 230/27.6 kV DESN transformers to Kent TS, with a capacity of 150 MW. This option could be implemented in two to three years, which would address the short-term need and future load growth in the Chatham-Kent area, but not resolve the distribution, egress, and feeder routing challenges as identified above.

The option to site a new DESN station west of Kent TS, connecting to the idle Section K6Z was ruled out for timing and economic reasons. Since the existing easement is too crowded to add more feeders, the approximately 4.5 km of idle K6Z would need to be rebuilt to a double 230 kV circuit from Kent TS to the new site and would require an EA and Section 92, increasing both implementation timelines and project costs. In addition, this option is not supported by the Municipality of Chatham-Kent due to concerns regarding construction through residential areas.

The option to site a new DESN station south of Chatham proper, is preferred due to comparable or lower costs and potential for load transfer capability between the proposed site and existing loads that are in closer proximity but currently being fed from Kent TS. Implementation times for this option may be slightly longer since an EA may be required, but given the proximity to existing 230 kV circuits, connection will not require a Section 92. If this station is constructed prior to the proposed switching station at Leamington Junction, connection to the CxJs would be restricted given the amount of load already supplied through these circuits. After the switching station, the limiting factor would be potential supply issues east of Chatham. To mitigate the capacity need at Kent TS, the Working Group recommends that a new DESN station be built south of Chatham proper.

### 7.3.2 Continued Monitoring at Belle River TS

While Belle River TS is forecast to experience moderate load growth over the study period, its transformer capacity need (as described in Section 6.2.1.5) does not arise until 2028.

The implementation of provincial energy-efficiency initiatives will continue to offer benefits into the mid to long term for the Windsor-Essex region. In developing the demand forecast, peak-demand impacts associated with meeting provincial targets through the Interim Framework were assumed before identifying residual needs, consistent with the approach taken in all IRRPs. Meeting provincial energy-efficiency targets will address approximately 22% of the total forecast demand growth by the end of the study period. Implementation of the existing target will help to address the future capacity need at Belle River TS and maintain load levels below the available station capacity into the mid and long term based on the forecast.

Absent of provincial targets, or if the forecast load were to increase for this station, the Working Group should reevaluate the capacity need. In accordance with its recommendation, the Working Group and the IESO will monitor Belle River TS load, before making a final determination on whether to proceed with options to increase station capacity in the next planning cycle.

### 7.3.3 Continued Monitoring of Regional and Bulk Transmission Projects

The implementation of a number of transmission projects underway in the Windsor-Essex region, will significantly impact the ability to meet the capacity needs identified in this IRRP.

On the bulk system, the new transmission line from Chatham SS to Lakeshore TS is targeted to be in-service by the winter of 2025/2026. While this line was primarily designed to increase the overall transfer capability of the bulk transmission system west of Chatham, it supports the reliably supply of the forecast load growth in the Kingsville-Leamington area.

On the regional system, the new switching station (Lakeshore TS), various DESN stations at Leamington TS and Lakeshore TS, and transmission-connected customers are scheduled for the near to medium term. The implementation of these projects will directly affect the rate of load growth in the region and the feasibility of proposed mid-term options.

To ensure that regional and bulk plans adequately meet projected near- and mid-term needs, the IRRP recommends that the IESO, with the Working Group, monitor and report the status of Windsor-Essex transmission projects between regional planning cycles on an annual basis. This information will be used to determine when decisions on the long-term plan are required, and to inform the next cycle of regional planning for the area.

## 7.4 OPTIONS FOR ADDRESSING LOCAL SECURITY AND LOAD RESTORATION NEEDS

Of the three load security and restoration needs evaluated in Section 6.2.2, only the C21J/C22J outage need at Leamington persists and cannot be met by the existing transmission system.

The switching station, as specified in Section 7.1.3, alleviates some but not all load security and restoration needs. Prior to the switching station, an outage on both C21J and C22J would result in the loss of all load on the Leamington tap as well as Malden TS. The switching station sectionalizes the C21J/C22J/C23Z/C24Z circuits into two sections east and west of the switching station. A double contingency on C21J/C22J west of the switching station only results in the loss of Malden TS which is below 150 MW and can be restored within the mandatory eight-hour time limit. Contingencies on any of the four existing circuits east of the switching station will not result in load interrupted by configuration. However, prior to the in-service date of the new line from the Chatham TS to the switching station, interim measures including load rejection at Leamington TS will be required for certain contingencies. These interim measures will require exemptions from ORTAC load security and restoration criteria.

While the switching station insulates the Leamington tap loads from C21J/C22J contingencies, a contingency on either or both of the tap circuits will still result in load security and restoration needs. Addressing these needs will depend heavily on the amount of transfer capability on the distribution system in the area as well as the Kingsville reconfiguration which may provide a restoration path. The remaining load security and restoration needs on the Leamington tap should therefore be examined in the 115 kV sub-system studies subsequent to the IRRP as specified in Section 7.2.

### 7.5 OPTIONS FOR ADDRESSING ASSET REPLACEMENT NEEDS

When a piece of equipment reaches end of life and requires replacement, a number of alternatives often warrant consideration. The transmission or distribution system will likely have changed over the decades the equipment has been in service, community needs may have evolved, equipment standards changed, and opportunities for non-traditional options, such as CDM, may increasingly play a role in determining the future of a specific asset when it comes to time for renewal.

In developing options, three main alternatives were considered:

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

Most of the asset replacement needs identified for the Windsor-Essex sub-region impact transmission assets are critical to maintaining a reliable and sufficient supply of electricity. As such, complete retirement of these assets identified as replacement candidates was ruled out as a feasible alternative, even with consideration of existing CDM and DG forecasts or capacity that may exist at adjacent stations. Further to the replacement options above, the Working Group determined that since these needs are related to asset age and condition, non-wires alternatives are not a viable option.

For end-of-life replacement needs identified in the mid to long term, particularly Lauzon TS T5/T8 step-down transformers, near-term options were identified to help better inform replacement decisions in the next planning cycle or closer to when these facilities require a decision to be made on the scope of reinvestment.

### 7.5.1 Lauzon Transformers

Prior to June 2019, the T1/T2 autotransformers and T6 and T7 step-down transformers were identified in the Needs Assessment as reaching end of life within the study period. During development of the IRRP, Hydro One informed the IESO of potential additional end-of-life needs at the T6 and T8 step-down transformers – thereby emphasizing the need to consider total station configuration and supply capability at Lauzon TS. The timing of all these end-of-life needs was ultimately redefined (as outlined previously in Section 6.2.3.1). A number of replacement solutions were considered for these transformers, including a complete like-for-like replacement option, as well as a mixture of options that included upsizing.

Lauzon TS currently has four 230 kV/27.6 kV step-down transformers that can supply up to 100 MW of load at each of its two DESNs. Since the higher load (both current and forecast) on DESN 1 results in the existing transformer capacity need for T5/T6, an option to balance loads between DESN 1 and DESN 2 through distribution feeders was considered. This would allow both DESNs to be fully and evenly loaded without a transformer upsizing. This option is ultimately not recommended due to the following considerations:

- 200 MW cannot currently be supplied without interim measures, as identified through the Lauzon TS supply capacity need described in Section 6.2.1.2;
- The demand forecast for Lauzon TS (total) exceeds 200 MW in every year of the study period regardless; and

- The required transfer of approximately 30 MW from DESN 1 to DESN 2 cannot be addressed solely by EPL and/or Hydro One Distribution (who, together, serve less than 30 MW in total from DESN 1), and would require ENWIN to obtain new feeder positions at DESN 2 (from which its customers are not currently supplied by).

If continuing the loading at the two DESNs as is, upsizing T5/T6 would be an option to solve both the existing DESN 1 capacity and part of the Lauzon TS end-of-life needs. No capacity need was identified for T7/T8, however, to provide justification for their upsizing at this time. Simultaneously, regardless of any action to replace the end-of-life transformers, any benefit of additional transformer capacity would still be limited by the overall Lauzon TS supply capacity need. Because the voltage phenomenon that restricts supply capability to Lauzon TS may potentially be improved by the nearby Kingsville TS and its final reconfiguration (as identified in Section 7.2), recommendations for the T7/T8 step-down transformers would be better informed by the upcoming detailed 115 kV sub-system capacity and Leamington restoration study.

Consequently, this IRRP recommends that Hydro One proceed with an upsizing of the T5/T6 step-down transformers from 83 MVA to 125 MVA. Determination of the replacement options for the T7/T8 step-down transformers will follow the 115 kV sub-system capacity and Leamington restoration study.

Finally, with the timing of the end-of-life needs for the Lauzon autotransformers redefined to be 2029, this IRRP recommends that the potential to right-size T1/T2 be considered within the 115 kV sub-system capacity and Leamington restoration study, which addresses supply into the 115 kV sub-system as a whole.

## 7.6 RECOMMENDED PLAN AND IMPLEMENTATION TO ADDRESS LOCAL NEEDS

The Working Group recommends the actions described below to meet identified needs in the Windsor-Essex region. Successful implementation of these actions, in addition to achievement of targeted energy-efficiency measures, is expected to address the region's near- to mid-term electricity needs.

### 7.6.1 Implementation of Recommended Plan

To address the near-term electricity needs of the Windsor-Essex region are addressed, it is important that the plan recommendations be implemented as soon as possible. Specific actions and deliverables are outlined in Table 7-1, along with the recommended timing.

**Table 7-1: Summary of Needs and Recommended Actions in Windsor-Essex Region**

| Need(s) | Item # | Recommended Action(s)/Deliverable(s) | Lead Responsibility | Timeframe for Recommendation |
|---|---|---|---|---|
| Kingsville-Leamington sub-system supply and station capacity need | 1 | Initiate engagement and approvals for a new switching station at the Leamington Junction | Hydro One | 2022 |
| | 2 | Collect information on future DR opportunities through a potential targeted call focused on reducing electricity demand from indoor agriculture | IESO | 2020 |
| | 3 | Monitor growth; regional and bulk transmission projects; behind-the meter generation; DERs and energy efficiency, and gather information on developments in the agriculture industry and emerging technologies, to inform next planning cycle; trigger next planning cycle early if required | IESO | Annually |
| | 4 | Employ interim measures to maintain current load capability | IESO | Immediate |
| | 5 | Refer to item #6 | - | - |
| Kingsville TS station capacity need | 6 | Monitor growth, and develop high-level options for the 115 kV sub-system capacity and Leamington restoration needs | IESO | 2020 |

| Need(s) | Item # | Recommended Action(s)/Deliverable(s) | Lead Responsibility | Timeframe for Recommendation |
|---|---|---|---|---|
| Lauzon 115 kV sub-system supply capacity need | 7 | Refer to item #1 and 6 | - | - |
| Lauzon TS DESN 1 transformer capacity needs | 8 | Upsize end-of-life stepdown transformers T5/T6 | Hydro One | 2020 |
| Lauzon TS station capacity needs | 9 | Refer to item #6 | - | - |
| Kent TS station capacity need | 10 | Initiate engagement and approvals for a new DESN station | Entegrus | 2023 |
| Belle River TS station capacity need | 11 | Monitor load growth and impact of energy efficiency until the next planning cycle | IESO | Annually |
| Leamington load restoration need | 12 | Refer to item #6 | IESO | 2020 |
| Lauzon TS end-of-life asset replacement needs | 13 | Replacement of end-of-life stepdown transformers T5/T6, as per item #8 | - | - |
| | 14 | Determine replacement of end-of-life stepdown transformers T7/T8, according to findings from item #6 | IESO | 2020 |
| | 15 | Determine replacement of end-of-life autotransformers T1/T2, according to findings from item #6 | Hydro One | 2020 |
| Keith TS end-of-life asset replacement needs | 15 | Upsize end-of-life 230/115 kV autotransformers T11/T12 from 125 MVA to 250 MVA | Hydro One | 2024 |
| | 16 | Decommission the end-of-life T1 (115 kV/27.6 kV) transformer | Hydro One | 2024 |

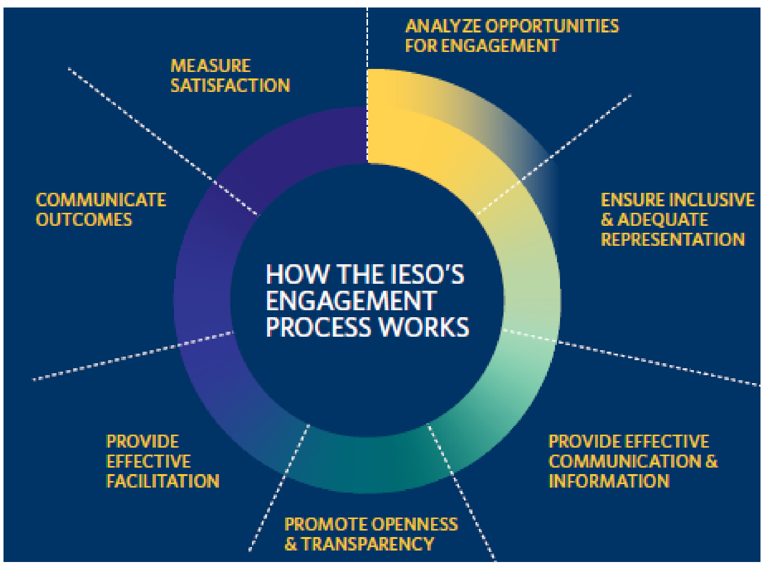
# 8. Community and Stakeholder Engagement

Community engagement is an important aspect of the regional planning process. Providing opportunities for input in regional planning enables the views and preferences of the community to be considered in the development of an IRRP and help to lay the foundation for successful implementation. This section outlines the IESO's engagement principles as well as the engagement activities undertaken for the Windsor-Essex IRRP.

## 8.1 ENGAGEMENT PRINCIPLES

IESO Engagement Principles[16] guide the process to ensure that all interested parties are aware of and can contribute to the development of this IRRP. The IESO uses these principles to ensure inclusiveness, sincerity, respect and fairness in its engagements, and build trusted relationships.

**Figure 9-1: IESO Engagement Principles**




[16] http://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Overview/Engagement-Principles

## 8.2 CREATING OPPORTUNITIES FOR ENGAGEMENT

The dialogue on the Windsor-Essex IRRP commenced in January 2018. A dedicated IRRP Windsor-Essex engagement web page[17] on the IESO website included rationale for the development of the Windsor-Essex IRRP, Terms of Reference and a listing of the organizations involved. In addition to providing an inventory of all engagement activities in a transparent manner, the webpage provides background information, presentations, public webinars and meeting notes and feedback received.

A dedicated email subscription service for the broader Windsor-Essex planning region was used to send information to interested communities and stakeholders who subscribed to receive email updates. Targeted outreach to municipalities, Indigenous communities and other business sectors in the region was conducted at the outset of this engagement and throughout the planning process.

In addition, regular updates on the plan were included in the IESO's weekly e-bulletin, which reaches interested parties from across Ontario's electricity sector.

## 8.3 ENGAGE EARLY AND OFTEN

Early communication and engagement activities for the Windsor-Essex IRRP began with invitations to learn more about the draft Windsor-Essex region Scoping Assessment Outcome Report, and to provide comments before it was finalized in March 2018. This feedback was considered in the final Scoping Assessment, which identified the need for an IRRP for the Windsor-Essex region. And included Terms of Reference for the development of the IRRP.

To begin the development of the IRRP, an engagement plan was prepared to outline the background, objectives and proposed timelines and seek input from communities to inform the final IRRP. The engagement plan included the formation of a local advisory committee to better inform forecast demand and energy needs for the continued growth of the greenhouse sector in

[17] http://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/Integrated-Regional-Resource-Plan-Windsor-Essex

the Leamington/Kingsville area, particularly with respect to load profile characteristics and potential non-wires solutions in this area. Membership consisted of representation from local municipalities, associations and businesses including: the Municipality of Leamington and Town of Kingsville, the growers' association, local growers of different scales, and local boards of trade and chambers of commerce.

Broader engagement efforts for the Windsor-Essex region were also incorporated into the engagement plan which included webinars to facilitate access to information and provide opportunities to submit feedback.

## 8.4 BRINGING COMMUNITIES TO THE TABLE

As key parties in the development of this IRRP, targeted invitations went out to communities including the Municipality of Leamington, Town of Kingsville, City of Chatham-Kent, City of Windsor, and the Caldwell First Nations to present an overview of the IRRP and invite opportunities to provide input for consideration. Meetings and regular communications were held throughout the IRRP process.

In addition, detailed discussions with the Kingsville-Leamington LAC were conducted throughout the development of the IRRP and were paramount to informing and identifying potential solutions for this targeted study area. Membership in this committee was voluntary and participants (including observers) devoted significant time and effort to providing input for consideration in the recommendations targeted for this area.

In the final phase of the IRRP, individual follow-up meetings were held with four municipalities to discuss the draft plan and proposed approaches for near-term options. A public webinar was also held to further expand the discussion, invite opportunity for feedback and facilitate broader awareness of the regional plan at a local level.

All background information as well as engagement presentations and recorded webinars are available on the Windsor-Essex IRRP engagement webpage.[18]

## 8.5 SUMMARY OF ENGAGEMENT FEEDBACK

More than 100 individuals actively participated in this IRRP engagement initiative and over 1,000 elected to receive regular updates throughout the process. In addition, nine outreach meetings were held with various representatives from four municipalities. This resulted in valuable input in the development of this IRRP, including:

- A fulsome understanding of the needs and priorities of the targeted areas within this planning region;
- Information to explore options to alleviate capacity constraints in the Kingsville/Leamington area;
- Identification of barriers and opportunities for potential demand-response options within the greenhouse industry;
- Feedback on the design of potential demand-response pilot projects to explore;
- Opportunities to present the draft recommendations for review and consideration in this final IRRP; and
- Opportunities to strengthen relationships with all interested parties for ongoing dialogue beyond this IRRP.

The IESO received a lot of support from the agricultural sector throughout the process and looks forward to continuing to work with the industry as part of the implementation of applicable recommendations and future plans.

[18] http://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/Integrated-Regional-Resource-Plan-Windsor-Essex

# 9. Conclusion

This report documents an IRRP that has been carried out for the Windsor-Essex region. The IRRP identifies electricity needs in the Windsor-Essex region over a 20-year period, recommends options to address near-term needs, and lays out actions to evaluate, monitor, and address needs that may arise in the long term.

To further review "wires" solutions that address end-of-life asset replacement and other transmission supply needs, the IRRP recommends that Hydro One initiate a RIP. The IESO will continue to provide input and support throughout the RIP process, and assist with any regulatory matters that may arise during plan implementation.

Multiple actions are recommended to address near- to mid-term needs through a combination of non-wires and wires options. Near-term actions are recommended to determine mid-term solutions, in particular the study of the 115 kV sub-system capacity and Leamington load restoration needs, and to monitor developments required to inform the long-term plan.

To support the development of the plan, the IRRP recommends a number of actions, including a Grid Innovation Fund targeted call focused on reducing electricity demand from indoor agriculture, the ongoing development of alternatives for mid-term actions, and continued monitoring of load growth and energy-efficiency activities and results. Responsibility for these actions has been assigned to the appropriate members of the Working Group. Information gathered and lessons learned as a result of these activities will inform development of the next iteration of the IRRP for the Windsor-Essex region.

The Windsor-Essex region Working Group will continue to meet at regular intervals to complete the recommended 115 kV study, monitor developments in the sub-region, and track progress toward plan deliverables. In particular, actions and deliverables associated with the medium and long term will require an annual review of system demand and generation, as well as development of ongoing transmission reinforcements to determine whether recommendations require further review by the Working Group. In the event that underlying assumptions change significantly, local plans may be revisited through an amendment, or by initiating a new regional planning cycle sooner than the OEB-mandated five-year schedule.