MAY 29, 2025

Quarterly Bulk Planning Studies Update: Part 2

South & Central Ontario Bulk Plan

IESO Transmission Planning
Independent Electricity System Operator

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Territory Acknowledgement

The IESO acknowledges the land we are delivering today's webinar from is the traditional territory of many nations including the Mississaugas of the Credit, the Anishnabeg, the Chippewa, the Haudenosaunee and the Wendat peoples and is now home to many diverse First Nations, Inuit and Métis peoples. We also acknowledge that Toronto is covered by Treaty 13 with the Mississaugas of the Credit First Nation.

As we have attendees from across Ontario, the IESO would also like to acknowledge all of the traditional territories across the province, which includes those of the Algonquin, Anishnawbe, Cree, Oji-Cree, Huron-Wendat, Haudenosaunee and Métis peoples.

Agenda

South and Central Bulk Plan Overview

Overview of Portfolio of Transmission Options

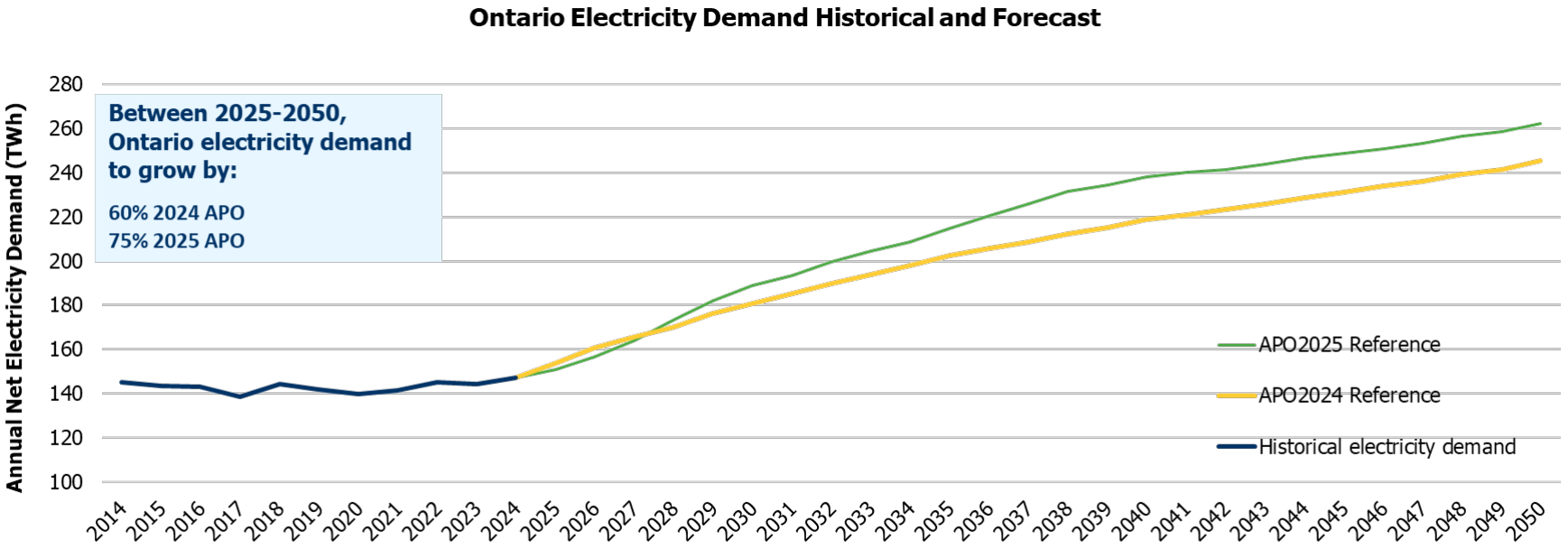
Key Considerations for the Study Modules

Next steps & Opportunities to Engage

Discussion

South and Central Bulk Plan Overview

Ontario's Changing Electricity Landscape



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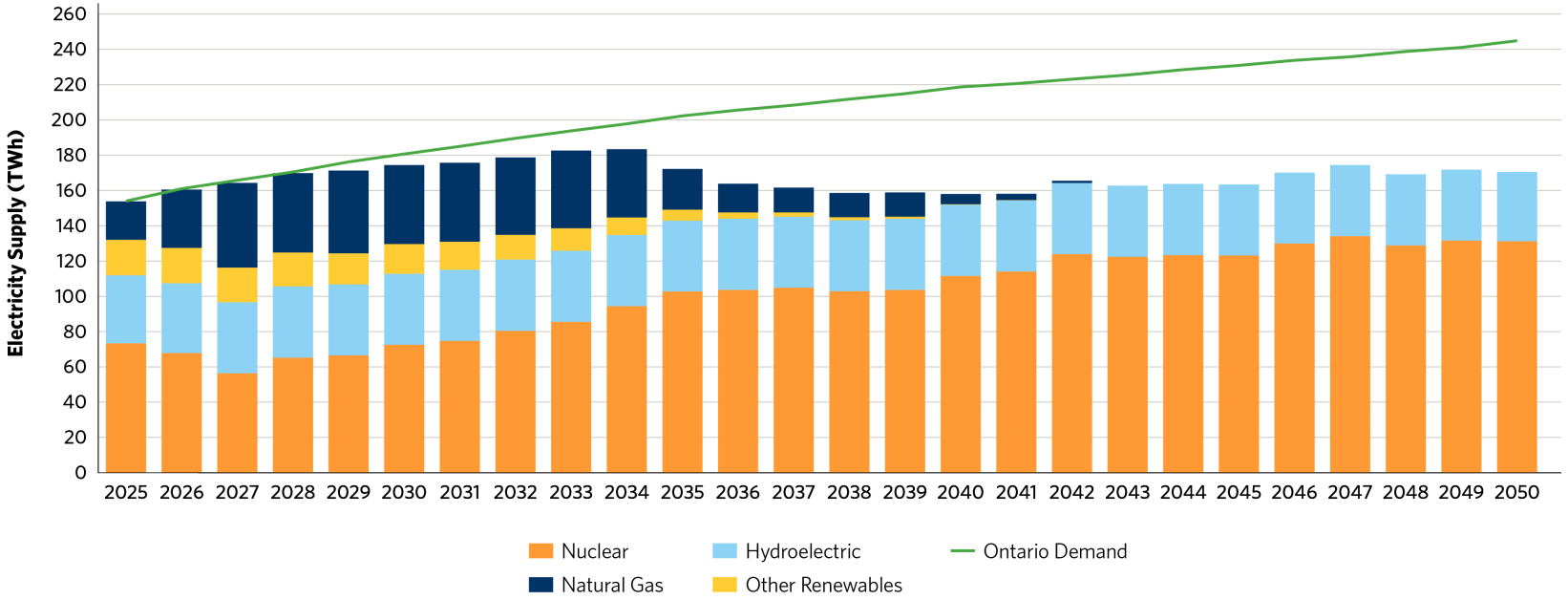
Energy Supply

Energy Adequacy Outlook



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Recap – Objectives of the South and Central Bulk Study

The study focuses on supporting economic growth and enabling new supply resources by:

1. **Confirming transmission reinforcements required to enable the connection of:**
   - Small modular reactors at the existing Darlington nuclear GS and expanded nuclear at Bruce NGS.
   - Considering potential pumped storage at Meaford and Marmora.
2. **Determining transmission required to enable decreased reliance on emitting resources, specifically:**
   - York Energy Center in York Region; Portlands Energy Center in city of Toronto; Halton Hills GS in GTA West; Sithe Goreway GS in GTA West.
3. **Determining transmission required to enable reliable supply under various long-term high growth/ economic development/ electrification scenarios within key growth areas:**
   - Greater Toronto Area.
   - Windsor to Hamilton corridor.
4. **Ensuring transmission reinforcements recommended through the Northern Ontario Bulk Study are coordinated with bulk system improvements in the GTA.**

Recap – Early Actions

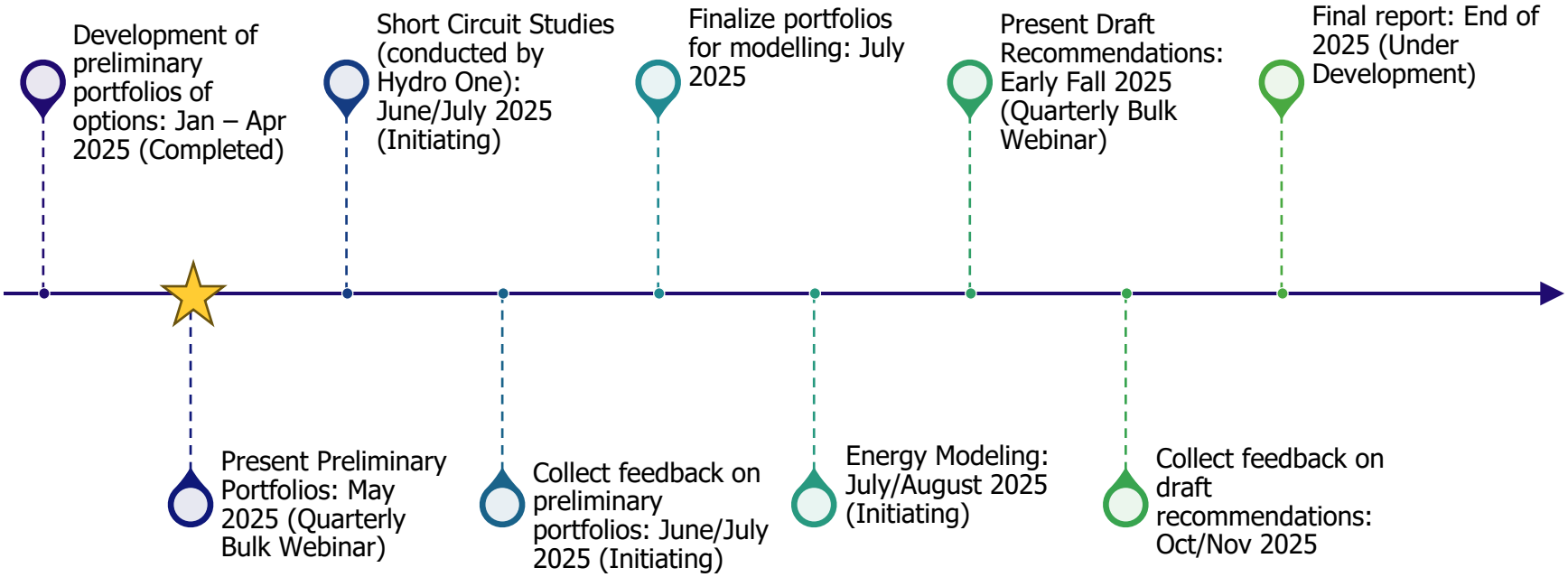
In Q4 2024, the IESO recommended a set of Early Actions to accelerate the pace of future upgrades by reducing development lead times for new projects when there is sufficient confidence in their necessity and/or risk in delaying implementation. Based on the South and Central Bulk Plan, two actions were proposed and included in the IESO report to the government in December 2024:

1. A new double-circuit 500 kV transmission line from Bowmanville to Toronto
2. Corridor studies within the GTA

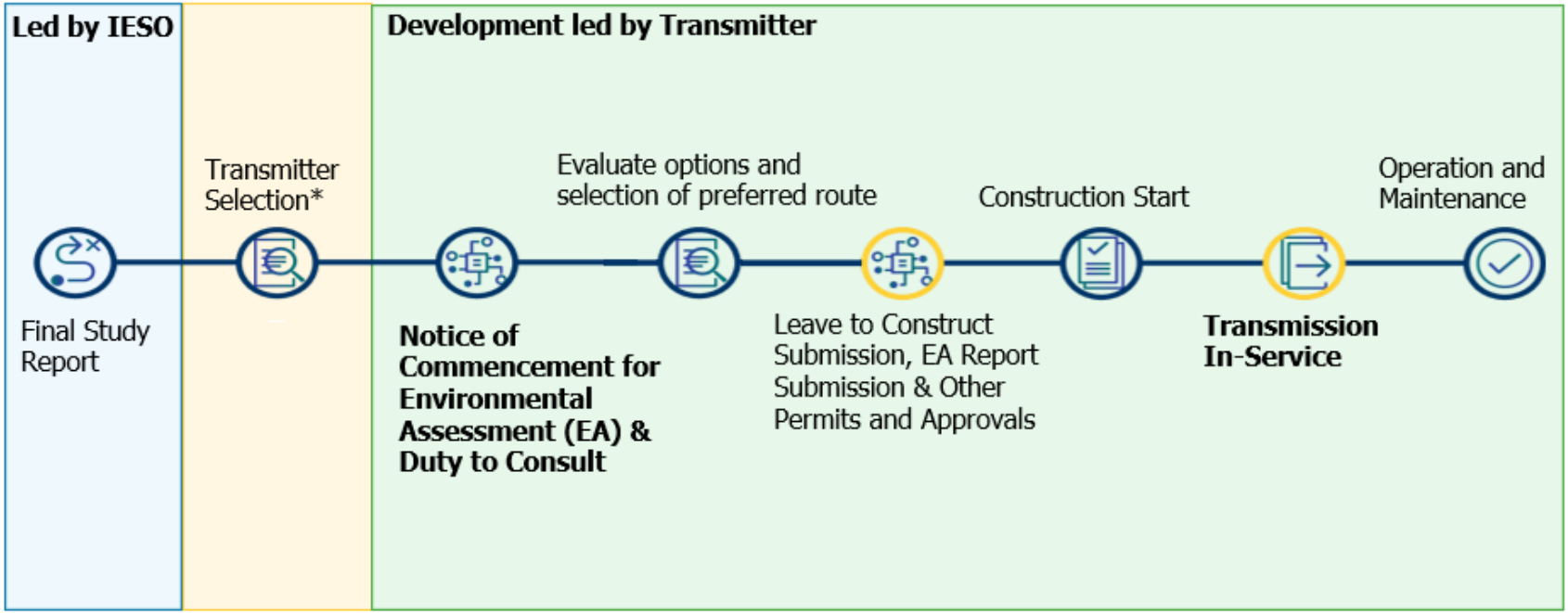
Since the report back, progress has been made on the detailed study of the needs and options in each of the four study modules (Bruce, GTA, East of Toronto, and Windsor to Hamilton).

This led to the development of portfolios of options, which refine the scope of the original early actions (i.e. termination for the Bowmanville line and early uses for the corridors under study) and identify additional reinforcements critical to ensuring the system is future-ready.

Study Timeline



Typical Process for Transmission Development



*Currently, no standardized process exists to select a transmitter

Feedback Received on South and Central Bulk Plan

Key Areas of Feedback	IESO Response
Need for Additional Data and Transparency	Key planning data is available through the Annual Planning Outlook, Data Directory, and bulk study webpages, while ongoing engagement opportunities facilitate dialogue related to system expansion and planning methodologies.
Reducing Development Time is Important	In November 2024, the IESO shared Early Actions to reduce development lead time for new infrastructure projects, when there is sufficient confidence in its need and/or risks associated with delaying implementation.
Evaluation of non-wire alternatives is important	This study was initiated to review the capability of the bulk system to support future generation connections and demand growth in key areas throughout southern and central Ontario, including the GTA and Hamilton to Windsor, to enable a decarbonized power system in the future. The options under evaluation will improve deliverability of new resources in key areas. Further details on the 2035 and 2050 needs, and linkages to ongoing regional plans that would inform the impact of non-wires alternatives on the timing and magnitude of the needs, will be addressed in upcoming engagements for the South and Central Bulk plan and provided in the final report.

Webpage to view all feedback received and the IESO's responses can be found here.

Overview of Portfolio of Transmission Options

Portfolios Overview

- The IESO has developed three distinct preliminary portfolio of options, representing different approaches to meeting the study objectives. Each portfolio addresses the identified needs emerging between 2035 and the early 2040s (later dates tied to the timing of Bruce C). Study of 2050 needs and options will be studied in Phase 2 in 2026.
- Portfolios of options were used due to the volume of system changes being contemplated. Assessing the costs and benefits of a portfolio of options that meet the plan's objectives allows the evaluation of alternatives to better consider the impact of the uncertainties in how the power system will evolve (e.g., the impact of different load and generation futures on overall system costs for the different transmission build out options).
- Each portfolio shares a common backbone (i.e., strategic, future-ready investments), critical for achieving key plan objectives under several futures. In each portfolio, these "future-ready" investments are paired with additional reinforcements to meet the overall objectives of the South and Central bulk plans. Variations between portfolios are focused on different options for supporting growth (e.g., economic development) in the load centres.

Note: All portfolios assume POG early actions for Sudbury to Barrie 500 kV line and Barrie to Orangeville reconductoring proceed.

Portfolio A Map

New 500 kV Transmission Lines (grey):

- Bruce to Essa double-circuit (potential bypass to Kleinburg)
- Bruce to Longwood double-circuit (potential bypass to Lakeshore)
- Potential Longwood to Nanticoke single-circuit
- Bowmanville to Parkway double-circuit
- Essa to Kleinburg single-circuit

New 230 kV Transmission Lines (red):

- Trafalgar to Oakville
- Meadowvale to Hurontario
- Potential Orangeville to Detweiler

New Stations (blue):

- Kleinburg TS and potential St. Thomas TS

Station Upgrades (purple)

Portfolio B Map

New 500 kV Transmission Lines (grey):

- Bruce to Essa double-circuit (potential bypass to Kleinburg)
- Bruce to Longwood double-circuit
- Potential Longwood to Detweiler to Milton
- Bowmanville to Parkway double-circuit
- Essa to Kleinburg single-circuit

New 230 kV Transmission Lines (red):

- Trafalgar to Oakville
- Meadowvale to Hurontario

New Stations (blue):

- Kleinburg TS and St. Thomas TS

Station Upgrades (purple)

Portfolio C Map

New 500 kV Transmission Lines (grey):

- Bruce to Essa double-circuit (potential bypass to Kleinburg)
- Bruce to Longwood double-circuit
- Potential Longwood to Detweiler to Milton
- Bowmanville to Parkway double-circuit
- Essa to Kleinburg single-circuit

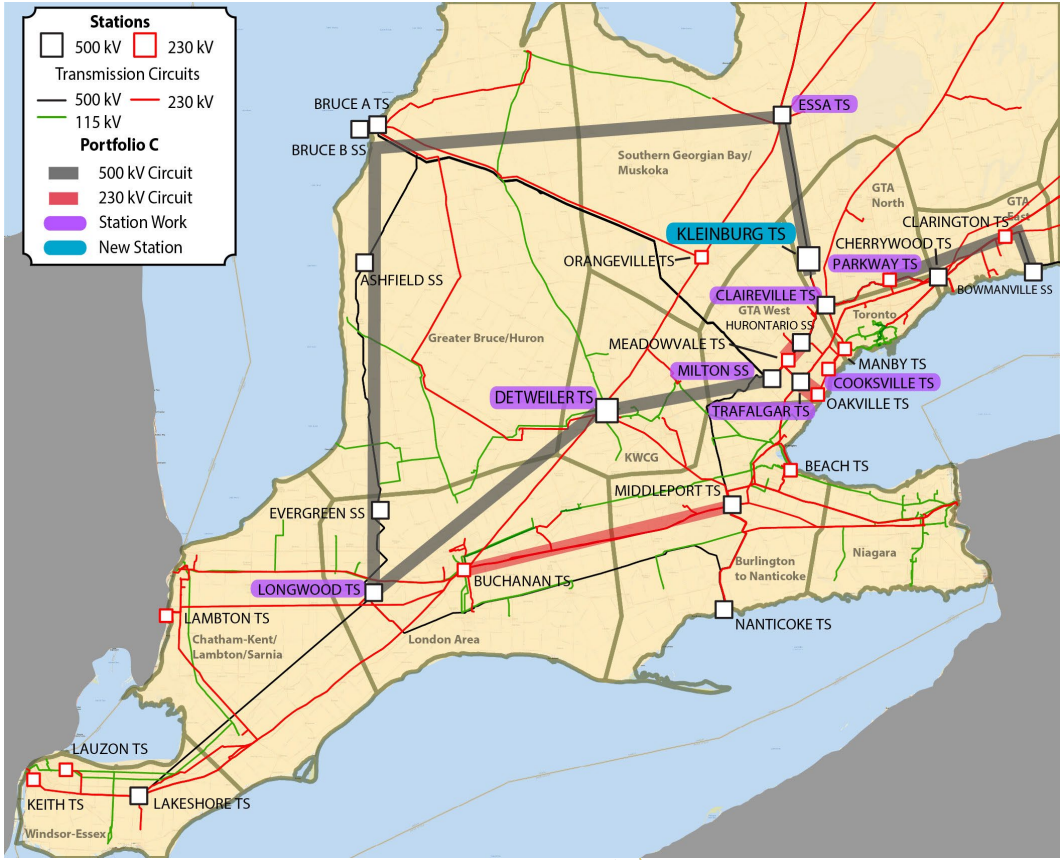
New 230 kV Transmission Lines (red):

- Trafalgar to Oakville
- Meadowvale to Hurontario
- Potential Buchanan to Middleport

New Stations (blue):

- Kleinburg TS

Station Upgrades (purple)



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Future-Ready Reinforcements – Considerations

The identified backbone of future-ready reinforcements will enable load growth in York/Toronto/GTA West and facilitate the build out of Bruce C and Darlington SMRs. Key considerations include:

Future-Ready Reinforcements	Considerations
Bruce to Longwood and Bruce to Essa	To facilitate the addition of up to 4,800 MW of new nuclear generation at Bruce, transmission reinforcements are needed between Bruce and the major load centers, i.e., • West to London, and potentially further to Lakeshore • Towards the GTA, aligned with the need for a new supply station at Kleinburg • North via Barrie (Essa)
Essa to Kleinburg, sectionalizing existing circuits and new station	A new supply point/station (Kleinburg TS) enables strong forecast growth in GTA North/GTA West and reduces reliance on local gas resources. An additional circuit from Essa to Kleinburg can serve multiple futures, by supplying the GTA from Bruce (via Essa) or strengthening flows north/south for high load or generation futures for Northern Ontario.
Bowmanville to Parkway and switchyard work	To increase transfer capability from eastern Ontario to enable generation connections (i.e. SMR project) and increase supply in the GTA to meet growing demand. Expansion at Parkway TS was identified due to space and technical limitations at the other 500 kV stations.
230 kV lines & station work	To enable forecast GTA West load (in line with IRRP and with consideration of data centers).

Portfolio Considerations

Options	Considerations
Portfolio A	• Enables an additional source of supply to GTA West at Hurontario; informed by GTA West load growth • Enables an alternate path of supply towards the GTA via Nanticoke; informed by southwestern generation levels • Considers load growth in KWCG • Enables large, transmission-connected loads in the London Area region
Portfolio B	• Enables transfer of southwestern resources to load growth in KWCG • Enables an alternate path of supply GTA West via Milton • Enables large, transmission-connected loads in the London Area region
Portfolio C	• Enables transfer of southwestern resources to load growth in KWCG • Enables an alternate path of supply GTA West via Milton • Enables a range of load sizes and types in the London Area region

Coordinating Between IRRPs & Other Bulk Studies

1. **Alignment with Other Bulk Plans.** The scope of both the South & Central and Northern Ontario System Bulk studies contain several points of overlap which require coordination, such as ensuring common assumptions between the study areas, particularly for the Barrie (Essa) area.

2. **Integration with IRRPs.** Regional needs can trigger requirements for bulk system upgrades and bulk plans can impact needs and options considered in regional plans:

   - Regional needs identified as part of the Toronto, KWCG, GTA North, GTA West Integrated Regional Resource Plans (IRRPs) may trigger major supply requirements.
   - Similarly, bulk system upgrades will be incorporated when assessing needs and options for ongoing and future regional plans.

Evaluation of Portfolios

- Work from the four ongoing modules of study (Bruce, GTA, East of Toronto and Windsor-Hamilton) informed the development of three preliminary portfolios.
- There are critical studies that can only be carried out with a full set of system assumptions:
    1. System short circuit level assessments
    2. Assessment of overall system costs/system efficiency (i.e., economic evaluation of the different options using an energy production cost model).
- Based on the short circuit studies, findings from the module level studies, and engagement feedback, the preliminary portfolios will be modified ahead of carrying out the economic evaluation (energy modelling). It is expected that multiple iterations may be required before the portfolios are finalized.
- Overall evaluation of the final portfolios will include a full set of decision-making criteria beyond technical feasibility and system economics (e.g., ability to accommodate different load scenarios at a module level, system resiliency, land-use impacts, community input, and long-term flexibility).

Preview: Energy Modelling (1)

- A production cost model will be used to simulate the hourly dispatch of resources to meet electricity demand in the South and Central area.
- Both **unconstrained** (i.e., no transmission limits) and **constrained** cases (i.e., with transmission limits) will be studied, based on both the existing transmission system and with each portfolio of options.
- These cases enable the economic evaluation between portfolios.
- Generation assumptions will be consistent with the 2025 Annual Planning Outlook and will include existing and committed resources in 2035, plus future resources identified through the Capacity Expansion model.
- If needed for the purpose of the bulk study, these resources will be modelled and sited on a more granular level (i.e., sub-zonal).

Preview: Energy Modelling (2)

- Generation sensitivities will also be considered to explore the performance between portfolios under different future conditions.
- This can include:
  - High generation sited east of Toronto
  - High generation sited in the Southwest/West, such as Windsor and Lambton-Sarnia
  - High generation in Northern ON, to simulate higher Flow South conditions

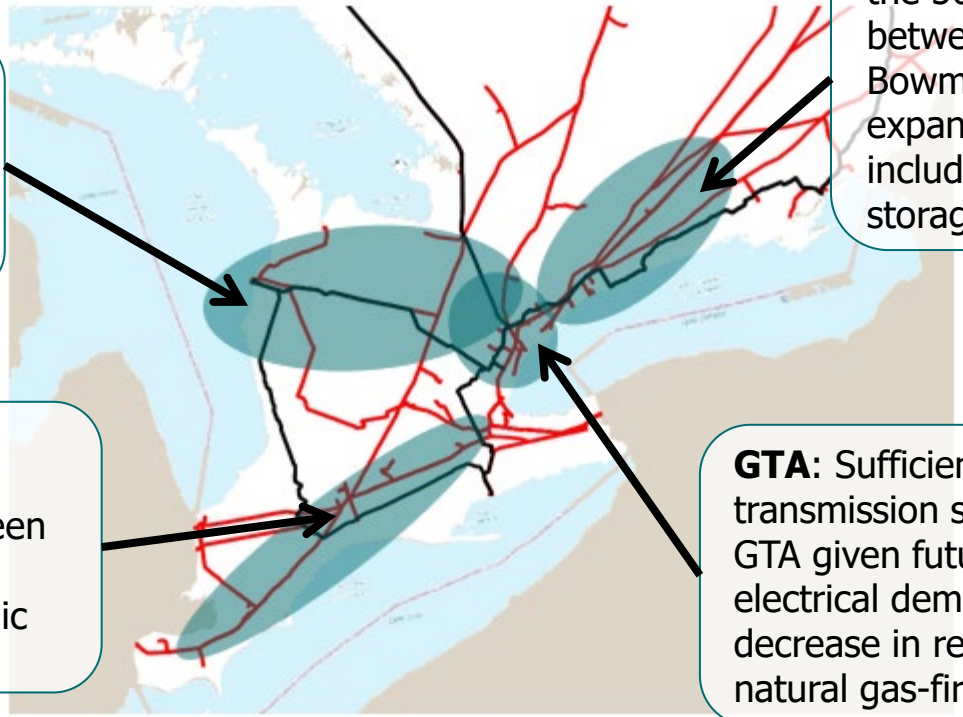
- Which future resource locations should be explored during the energy modelling? i.e., how might new resources be distributed zonally?

Key Considerations for Modules

Re-cap - Four Modules for Study

Bruce: Transmission expansion to enable Bruce C NGS, considering potential Meaford PS

East of Toronto: Expansion of the 500 kV transmission system between Cherrywood TS and Bowmanville to enable expansion of generation, including SMRs and potential storage, in eastern Ontario



Windsor to Hamilton: Sufficiency of the bulk transmission system between the Windsor and Hamilton areas given future economic development

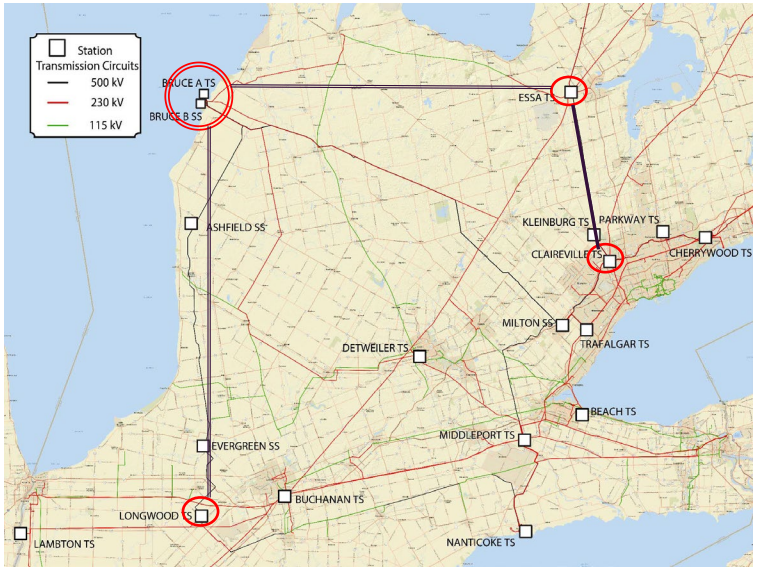
GTA: Sufficiency of the bulk transmission system to the GTA given future growth in electrical demand, and decrease in reliance on local natural gas-fired generation

Bruce Module (1)

Primary focus on enabling new 4,800 MW Bruce C nuclear generator.

Transmission reinforcements will:

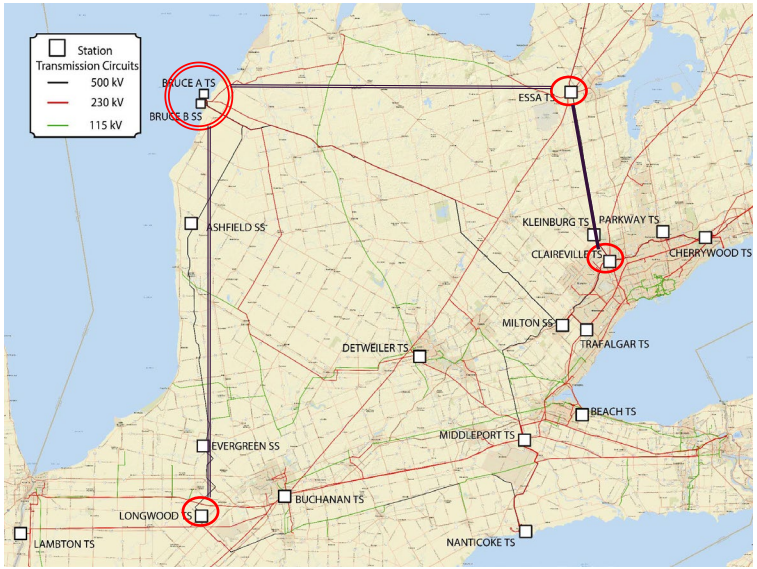
- Enable additional supply to serve load growth in southwestern Ontario and the GTA.
- Improve deliverability for southwestern resources in future procurements.
- Support load growth in Northern Ontario when paired with the previous recommendations for new 500 kV transmission from Essa to Sudbury.



Bruce Module (2)

Transmission reinforcements to enable load growth and improve deliverability for resources include:

- 500 kV double-circuit line between Bruce C and Longwood (One may be bypassed to Lakeshore).
- 500 kV double-circuit line between Bruce C and Essa/Kleinburg.
- 500 kV single-circuit line between Essa and Kleinburg.
- Connection into Kleinburg of the existing 500 kV lines from Essa to Claireville.



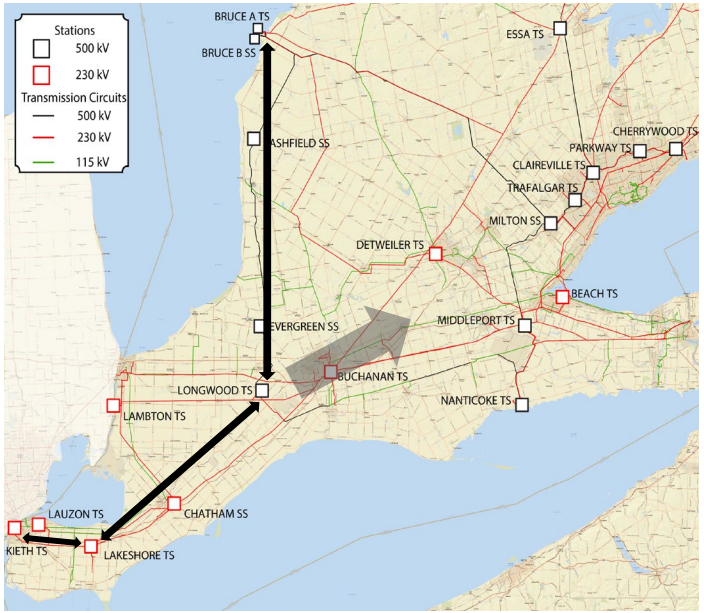
Windsor to Hamilton Module (1)

Primary focus: reliable supply of long-term demand growth, economic development, and electrification.

Transmission reinforcements are required to enable potential future growth of over 6,000 MW beyond the 2025 APO's 2035 forecast within Windsor to Hamilton.

This may include additional bulk supply between:

- The large generation source in Bruce to the London Area (Longwood)
- The London Area and Lakeshore, and possibly Windsor to bring that generation source further west
- The London Area and Milton/Orangeville via Detweiler, to supply KWCG and provide an alternate path to the GTA



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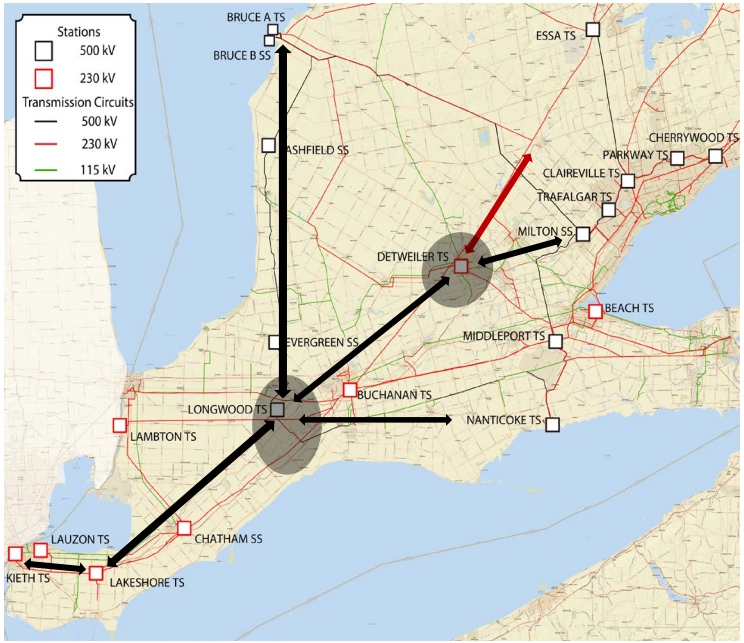
Windsor to Hamilton Module (2)

Options to supply growth in the London Area and Kitchener/Waterloo/Cambridge/Guelph (KWCG) include:

- 500 kV supply to the London Area region, via a new Longwood to Nanticoke single-circuit line and autotransformer station in St. Thomas.
- 230 kV supply to the London Area region, via reinforcement of the existing 230 kV corridors and autotransformer stations.
- 500 kV supply to the KWCG region, via a new Detweiler to Milton single-circuit line and autotransformer station in Kitchener or Waterloo.
- 230 kV supply to the KWCG region, via reinforcement of the 230 kV corridor between Detweiler and Orangeville.



GTA Module

The primary objective is to increase supply into the GTA area, while managing space constraints for new infrastructure.

- Coordination with other bulk study modules was required to understand availability of new capacity and feasibility of new transmission routes to deliver supply to the GTA.
- Coordination with regional plans in the GTA was required to understand constraints on the local system which may trigger upgrades to ensure supply into the GTA can be delivered to customer growth pockets.

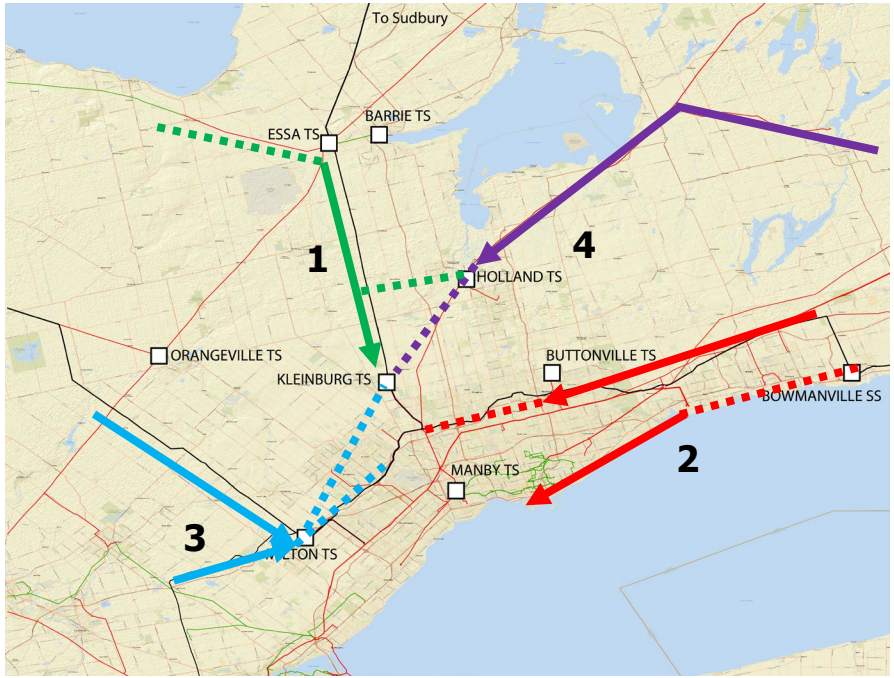
Long term growth in the GTA is expected to be high, driven by continued strong population and employment growth, electrification, and industrial electricity use. However, the pace of growth is difficult to predict with confidence due to uncertainty surrounding:

- Uptake related to electrification and decarbonization initiatives, primarily for transportation and home heating.
- Growth from new, major, electricity intensive industrial loads.

GTA Module - Possible New Bulk Routes

Transmission reinforcements to enable load growth involved examining possible new bulk routes into the GTA:

1. From north-west: Essa – Kleinburg (green)
2. From east: Parkway and/or underwater to Downtown (red)
3. From west: Milton (blue)
4. From north-east: North of Holland (purple)

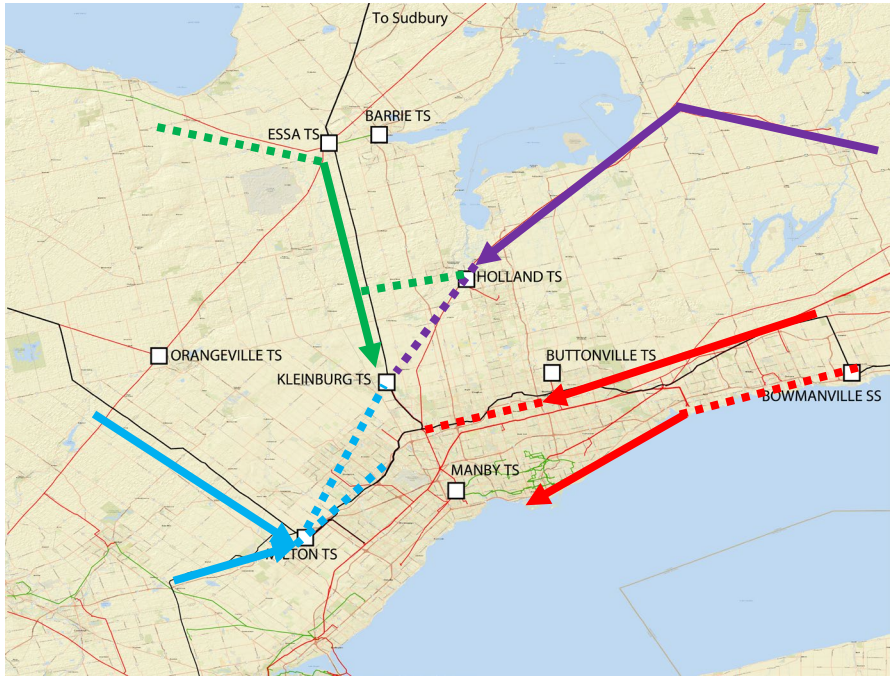


North-West (Essa – Kleinburg) Option

Option is flexible in supporting different future scenarios, including load growth in Northern Ontario driven by mining/resource development and/or in Northern/Western GTA, while also addressing one bottle neck to further generation development in the North.

Key Details

- Assume retermination of existing Kleinburg to Claireville circuits, with 2 autos at Kleinburg.
- Build out of Kleinburg subsystem required to meet capacity needs in GTA West, can be leveraged for York region as well.
- Future expansion could include an additional Essa to Kleinburg circuit, or new circuits from Milton to Kleinburg to enable Bruce C generation.
- Long term (2040+) options could also include supply to new northern GTA bulk stations.

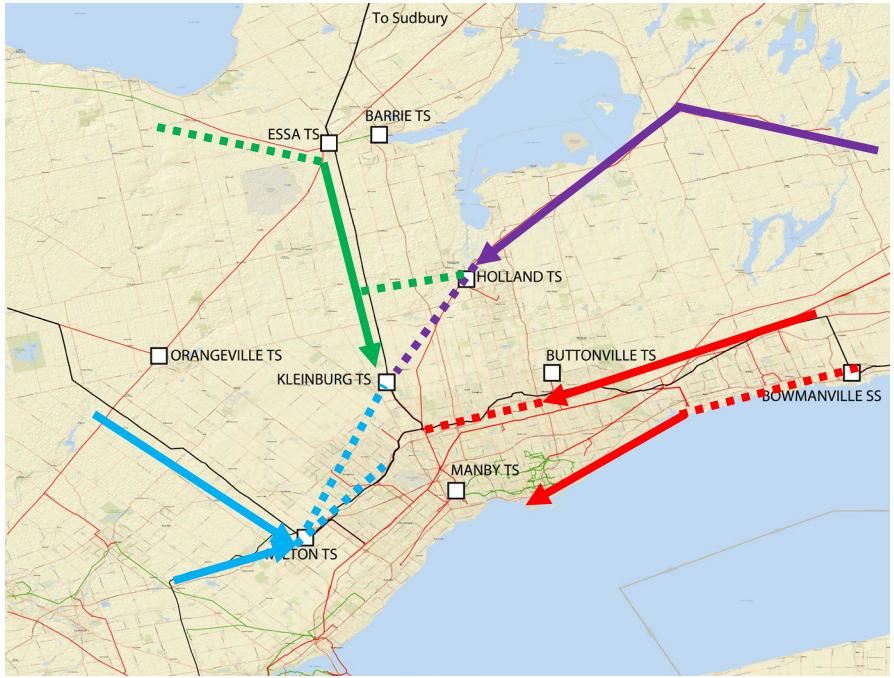


Essa – Kleinburg Option

West (Milton) Option

Key Details

- Build out of Milton SS with autos always contemplated as long-term way of increasing supply into area.
- Major data centers possible in area, increasing potential need, but also potential uncertainty of forecast.
- Supply into Milton dependent on Bruce and southwestern resource development
- Possible transmission build out could include Meadowvale to Hurontario, and expansion along Highway 413 corridor.
- Prepares the system for reduced reliance on local GTA gas.

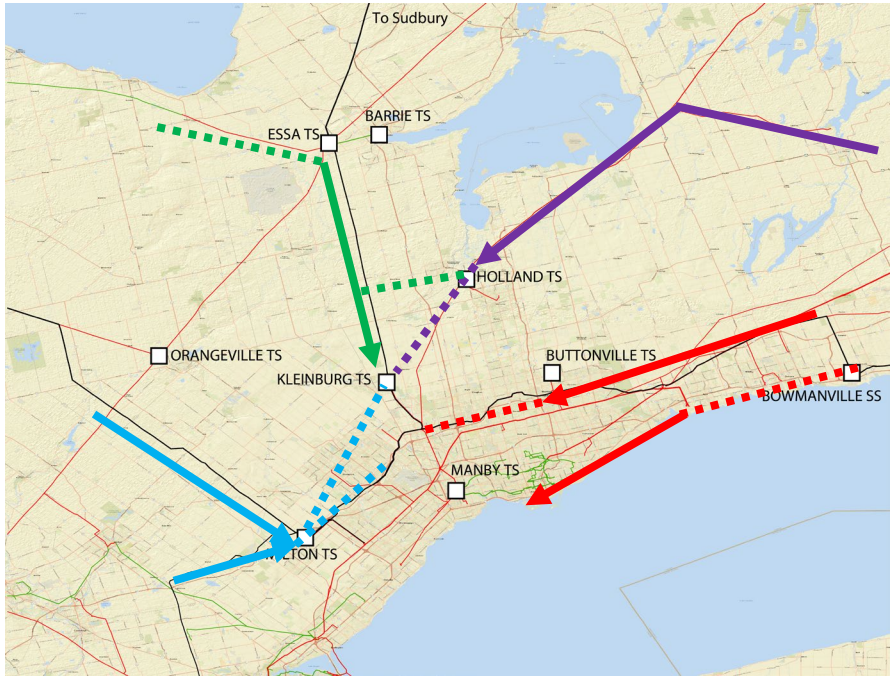


North-East (North of Holland TS) Option

In the long term (2040+), continued load growth into GTA may require identification of new 500 kV corridor into GTA.

Key Details

- Lack of available lands makes new route identification challenging
- New routes from north may pose fewer challenges than East or West, due to less existing development/build out
- Fewer existing routes from the east may preference a north-east supply path, to enable long-term generation in Eastern Ontario. One possible route is shown notionally via existing Claireville-Minden corridor



North of Holland TS Option

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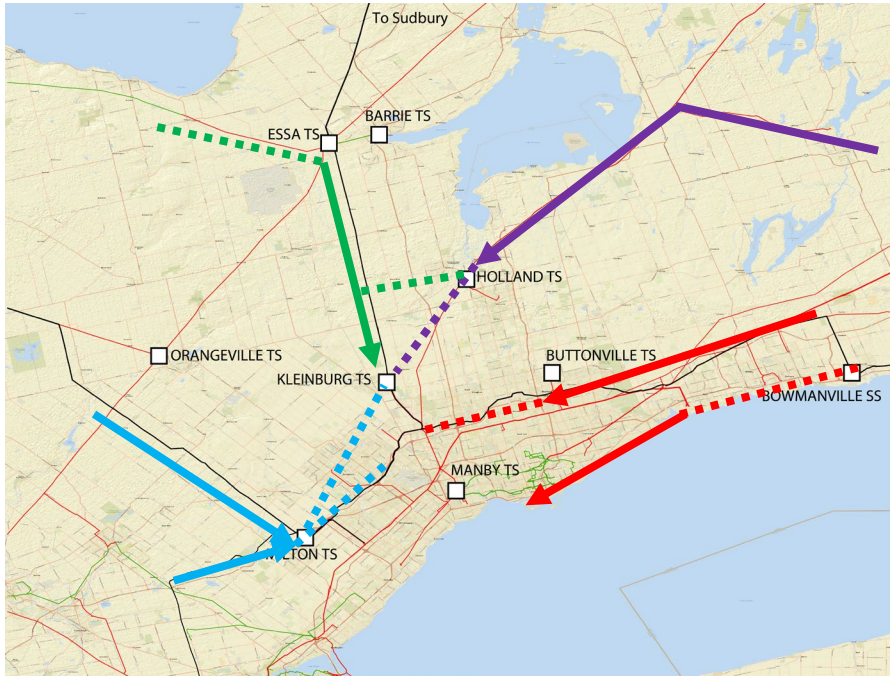
East (Parkway and/or Underwater) Option

Key Details

- New capacity East of GTA requires transmission upgrade from Bowmanville into Toronto.
- Possible terminations at Cherrywood, Parkway, or Claireville have different implications for local supply.
- Moderate potential exists to deliver new supply from "outer ring" of GTA into downtown. However, significant supply increases would require a new transmission path. Limited available space for overhead transmission increases viability of underwater cable as a cost-effective solution.



Parkway and/or Underwater Option

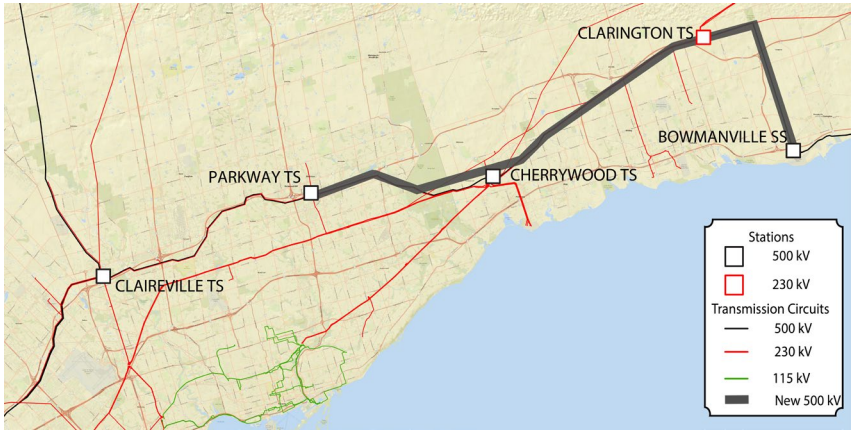
East of Toronto Module

Primary focus of module is enabling the connection of future resources in eastern Ontario, including the full build out of the Small Modular Reactor (SMR) project at Darlington nuclear generation station.

Transmission upgrades include:

- Expansion of Bowmanville SS required to accommodate the new SMRs (required for SMR 2 to connect).
- Two new 500 kV lines west of Bowmanville into Toronto required to enable supply west. Multiple termination points were reviewed: Bowmanville SS X Cherrywood TS, Bowmanville SS X Parkway TS, Bowmanville SS X Claireville TS and Bowmanville SS X Cherrywood TS X Parkway TS.

Bowmanville SS to Parkway TS Upgrade



Transmission upgrade details:

- **Bowmanville to Parkway:** New 500kV double circuit (~65 km), corridor highlighted in grey on the map.
- **Parkway Expansion:** New 500kV bus at Parkway and at least one new auto.

Transmission upgrade benefits:

- Makes best use of available space in the GTA.
- Allows for reconfiguration of existing loads between key GTA stations to manage short circuit levels which hinder connection of supply resources and maximizes the supply capability at these stations.
- Further reinforcements to downstream system may be required to accommodate additional supply.

Further module considerations:

- Linkages with third supply options for Toronto IRRP
- Configuration of 500 kV bus at Parkway and downstream GTA 230 kV system

Next Steps

Shaping Bulk Studies Through Engagement

Input from the many voices and various perspectives across the electricity sector is essential to the IESO's decision-making process. Several tools are available to enable public feedback including:

- Announcements on upcoming webinars are shared through the bulletin, subscribe at www.ieso.ca/subscribe. Updates are shared on a quarterly basis.
- Engagement webpages for the South and Central Bulk Plan, Northern Ontario Bulk Plan and Eastern Ontario Bulk Plan include webinar recordings and materials.
- Feedback on the information shared is welcomed. The IESO will consider all feedback received and post a response shortly after.

More information on how the IESO engages can be found on the External Relations Engagement Framework and Indigenous Engagement Framework.

Next Steps

Upcoming milestones for the South and Central Bulk Plan:

- Feedback due to engagement@ieso.ca by June 19, 2025.
- Final webinar to share draft recommendations in Q3 2025. Report will:
  - Identify actions to be taken to initiate development work, as required, to address transmission needs, particularly to enable connection or phase out of resources identified in the Scope.
  - Identify transmission corridors, new or existing, whose development or preservation should be prioritized to ensure short-, medium-, and long-term options remain viable.
  - Highlight needs that are still unmet (where applicable), and what additional steps may be required to identify solutions or meet needs.
- Final report to released and published in Q3 2025.

Learn more about this plan by:

Visiting the engagement webpage and subscribing to receive updates.

Discussion

Local considerations and feedback are a critical component to the development of the South and Central Bulk Plan. The IESO wants to hear your perspectives about:

- What feedback is there on the preliminary portfolios?
- What information needs to be considered regarding the preliminary portfolios?
- What additional information should be provided in future engagements to help share perspectives and insights?
- What feedback is there on interest in future resource locations or future zonal distribution of incremental resources?

The IESO welcomes written feedback until June 19.
Please submit feedback to engagement@ieso.ca using feedback form posted on the engagement page.

Thank You

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Appendix

Powering Ontario's Growth Report Back Early Actions

A summary of recommended Early Actions is provided below:

1. Initiate early development work for two new single-circuit 500 kV transmission lines from Sudbury (Hanmer TS) to Barrie (Essa TS) and associated station facilities to enable economic development and renewable generation in Northern Ontario. One single-circuit 500 kV transmission line should proceed to construction in the near-term.

2. Proceed with reconductoring the existing E8V/E9V 230 kV transmission lines, between Barrie (Essa) and Orangeville, using advanced conductors to enable connection of the new Honda facility in Alliston, renewable generation, and economic development in northern Ontario.

3. Support Hydro One in the advanced procurement of up to five 750 MVA 500/230 kV autotransformers to reduce future lead times to meet near-term needs driven by forecast economic development and data centre connections in the southwest, GTA, and northern Ontario.

Powering Ontario's Growth Report Back Early Actions

A summary of recommended Early Actions continued:

4. Communicate the need for a new double-circuit 500 kV transmission line from Bowmanville to Toronto to enable the connection of additional generation in eastern Ontario, including the Darlington Small Modular Reactor (SMR) project.

5. Support Hydro One on the development work to reconductor 115 kV circuits from Manby TS to Riverside Junction to higher-ampacity conductors without replacing the existing towers to enable growth in downtown Toronto.

Powering Ontario's Growth Report Back Early Actions

A summary of recommended Early Actions continued:

6. Work with the Ministry of Energy and Electrification to initiate/continue three studies of land required for future transmission infrastructure to support growth, economic development and data centres in the GTA while lowering long term cost and land use impact:

a) Parkway Belt West

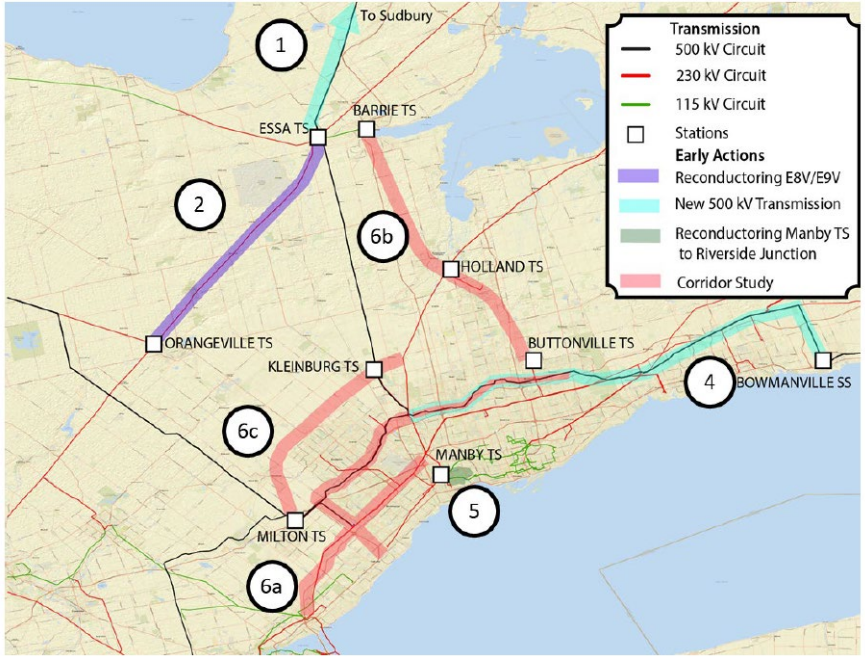
b) Existing (idle sections) 115 kV corridor from Barrie TS to Buttonville TS

c) Northwest GTA Transmission Corridor Study

7. Work with Hydro One to understand current and potential space provisions for expansion at existing strategic station sites to inform and preserve options for ongoing and future planning activities.

Powering Ontario's Growth Report Back Early Actions Map

Figure 1 | Early Actions with Known Sites



Future-Ready Reinforcements

Building upon the backbone of the transmission system, the following actions were found to be common to all portfolios, and considered "future-ready" reinforcements to enable load growth in York/Toronto/GTA W, and facilitate the build out of Bruce C and Darlington SMRs:

New 500 kV Transmission Lines:

- Bruce to Essa double-circuit (potential bypass to Kleinburg)
- Bruce to Longwood double-circuit (potential bypass to Lakeshore)
- Bowmanville to Parkway double-circuit
- Essa to Kleinburg single-circuit

New 230 kV Transmission Lines:

- Trafalgar x Oakville
- Meadowvale to Hurontario
- Expansion from Kleinburg

New Station:

- Kleinburg TS

Station/Line Upgrades:

- HxV sectionalizing at Claireville TS
- ExV sectionalizing at Kleinburg TS
- New Parkway 500 kV switchyard and at least one autotransformer
- Splitting Cooksville TS
- New Milton TS 230 kV switchyard and at least two autotransformers
- Trafalgar TS bus work

Portfolio Comparison

Three portfolios of options have been developed, each with a set base of future-ready reinforcements. This structure enables us to evaluate cost-effectiveness, performance outcomes and practical feasibility - helping to identify the most balanced and impactful path forward.

Future-Ready Reinforcements + Portfolio A Alternatives	**Future-Ready Reinforcements + Portfolio B Alternatives**	**Future-Ready Reinforcements + Portfolio C Alternatives**
• Hurontario Switching Station • Longwood to Nanticoke 500 kV (single) • Detweiler to Orangeville 230 kV (double) • St Thomas 500/230 kV station (tapping off Longwood to Nanticoke circuits) • Second 500 kV circuit between Longwood and Lakeshore (possible extension to Windsor)	• Longwood to Detweiler 500 kV (single) • Detweiler to Milton 500 kV (single) • 500/230 kV station at Detweiler (or intersection with 500 kV before going to Milton) • 500/230 kV station at St Thomas (tapping off Longwood to Nanticoke or the new Longwood x Detweiler circuits)	• Longwood to Detweiler 500 kV (single) • Detweiler to Milton 500 kV (single) • 500/230 kV station at Detweiler (or intersection with 500 kV before going to Milton) • Autotransformers at Longwood TS and 230 kV supply stations and reinforcement between Buchanan and Middleport