

FEBRUARY 23, 2024

Transmission Planning Bulk Study Updates

Independent Electricity System Operator

Objectives of Today's Webinar

- Provide an overview of bulk transmission system planning activities and drivers
- Discuss the scope of upcoming bulk studies and proposed quarterly engagement updates
- Provide an update of on-going bulk studies, i.e., the Central-West Bulk Study, and seek feedback on the proposed recommendations

Seeking Input

Questions to consider when reviewing the Bulk Transmission Study Updates:

- What topics would you find most useful to include as part of the IESO's bulk transmission planning engagements?
- Are there other methods of engagement that would best support your participation in bulk system plans?
- As we integrate the findings of the Central-West bulk study into upcoming broader bulk plans, are there any additional considerations we should be aware of?

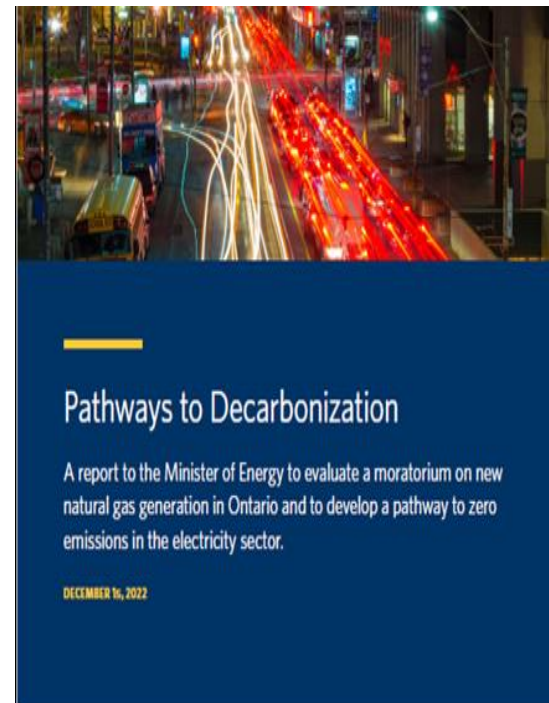
Please submit your written comments by email
to engagement@ieso.ca by **March 8**



Bulk Transmission System Planning Overview

Pathways to Decarbonization (P2D)

- IESO report released in December 2022
- Conducted in response to request by Minister of Energy
- The report highlights potential opportunities and challenges to consider as Ontario's electricity demand and supply mix evolves under two scenarios:
 - Evaluate a moratorium on procurements of new natural gas
 - Develop a pathway to zero emissions in the electricity sector



Pathways to Decarbonization (P2D) Cont'd

- The study found that a moratorium on new gas generation is possible by 2027, if new resources are in place when needed, including storage, nuclear, renewables and conservation efforts
- Decarbonizing the electricity grid by 2050 would require significant investments in capital, resources and labour
 - Requires a system 2x current size with a diverse zero-emissions supply mix, significant transmission and land-use
 - Estimated total costs are ~\$400B through 2050
- P2D identified various "no-regret" actions to ensure a state of readiness, including initiating planning work for new resources and transmission infrastructure

Provincial Response: Powering Ontario's Growth (POG)

- The Ministry of Energy released **Powering Ontario's Growth** on July 10 that sets out a roadmap to a reliable, affordable, and clean energy future.
- Objective is to ensure the province's electricity system is ready to support the growth, electrification and decarbonization of the economy over the next 30 years.
- The report was accompanied by a **letter to the IESO** outlining some of the immediate actions the Minister would like the IESO to take, which includes several report-backs and timelines.
- A **separate letter** outlines next steps on two pumped storage facilities, Ontario Pumped Storage Project and Marmora Pumped Storage Project.

Powering Ontario's Growth Projects

Projects advancing in line with some of the IESO's "no regrets" recommendations in P2D:



- Assessments for new nuclear, Pickering refurbishment; SMRs



- Consider competitive procurement of non-emitting resources to address energy needs



- Supporting the development of local markets for distributed energy resources (DERs)



- Decision making and initiatives to lower costs to consumers



- Advancing assessment of pumped storage projects and preparing for a long duration storage procurement



- Accelerating the development of four transmission projects in Northeast and Eastern Ontario, and identifying new projects for early planning work

Powering Ontario's Growth - Transmission

Additional next steps were outlined to advance no-regrets options related to the transmission system, including:

- Developing transmission reinforcement options and recommendations to advance a number of the “no-regrets” projects
- Identifying new and existing corridors of land that should be protected for future transmission infrastructure and

Planning Approach – Powering Ontario's Growth

The Transmission Planning team is utilizing existing plans and planning processes where possible to address the governments asks from the Powering Ontario's Growth report and associated directive.

Two bulk planning studies, a Southern and Central Bulk Plan and a North Bulk Plan, will be initiated in 2024 (study timeline ~18 months). The scope of these studies will address a number of areas identified in the POG report.

Planned and ongoing regional planning for Toronto and GTA North (York Region) will also address areas identified in the POG report.

Annual Planning Outlook (APO)

As per the bulk planning process formalized in 2022, the 2024 APO will include an updated Schedule of Planning Activities

- Identifies the IESO's planned bulk system studies for 2024/2025, including those related to POG
- Outlines timelines for the planning activities and a high-level scope of work

Schedule of Planning Activities (1)

Area	Study Name	Start - End (Estimate)	Scope / Considerations
			To assess the bulk transmission system from Hamilton to Windsor, considering the significant potential economic development opportunities in the area.
South and Central Ontario (including the Greater Toronto Area)	Central-West Ontario Bulk Study	2023 to Q1 2024 (underway)	<p>Primary focus is on ensuring a reliable power supply to the London area as committed industrial customers and ancillary loads ramp up.</p> <p>A previously anticipated second stage of this work to proactively assess transmission options to accommodate additional large new load connections (if and when they materialize) will be rolled into the scope of a broader southern and central Ontario study.</p>

Schedule of Planning Activities (2)

Area	Study Name	Start - End (Estimate)	Scope / Considerations
South and Central Ontario (including the Greater Toronto Area)	Southern and Central Ontario Bulk Study (POG Plan)	2024 to 2025	<p>To review the bulk system capability to support future generation connections and demand growth in key areas throughout southern and central Ontario, including the GTA, to enable a decarbonized power system in the future.</p> <p>Includes consideration of:</p> <ul style="list-style-type: none">• Bulk transmission supply to the GTA, given demand growth, and policy-driven decreased reliance on local natural gas-fired generation;• The 500 kV system between Cherrywood TS and Bowmanville to enable additional generation, including SMRs, in eastern Ontario• Continuing the assessment of the bulk transmission system between the Hamilton and Windsor areas to understand future transmission needs that could result from further economic development;• Transmission needed to enable expansion of the Bruce NGS;• Opportunities to preserve new/expanded corridors for future transmission development.

Schedule of Planning Activities (3)

Area	Study Name	Start - End (Estimate)	Scope / Considerations
Northern Ontario	Ontario-Manitoba Intertie Joint Study	2022 to 2024	To proactively plan for the end of life of critical Ontario-Manitoba intertie equipment. Joint study between the IESO, Hydro One, Manitoba Hydro and Minnesota Power. Anticipated to be completed in 2024.
Northern Ontario	Northern Ontario System Bulk Study (POG Plan)	2024 to 2025	To review the bulk transmission system capability between north and south Ontario <ul style="list-style-type: none"> • North-south corridor from Sudbury to the Greater Toronto Area (Flow North/Flow South and CLAN interfaces) To support future generation connection and demand growth to enable a decarbonized system. Consider opportunities to preserve new/expanded corridors for future transmission development.
Northern Ontario	Northern Load Connection Study	2024-2025	To evaluate transmission options for enabling growth and development in remote northwestern Ontario
Eastern Ontario (including Ottawa)	Eastern Ontario Bulk Study	2024 to 2026	To examine bulk system transmission supply to Ottawa, the Lennox Area 230 kV system supplying the municipalities of Belleville and Kingston and a number of other industrial loads, the potential shutdown of natural gas-fired generation in the area, potential for new and/or expanded interties, and opportunities to address other system operability concerns in the area.

Bulk Transmission Planning Engagement

The IESO is proposing quarterly public engagement on bulk transmission studies to improve its consistency and transparency.

- Includes updates, as applicable, on the bulk transmission plans identified in the Schedule of Planning Activities
- Facilitates the sharing of information (e.g., data, assumptions, analytical results, etc.) that is relevant for stakeholders to be informed and provide the desired input to the IESO
- Supplements targeted engagement that may occur as required, i.e., with affected municipalities and communities

Feedback on the delivery mechanism (webinars, emails, etc.), frequency and nature of these updates will inform the engagement approach

Seeking Input

- What topics would you find most useful to include as part of the IESO's bulk transmission planning engagements?
- Are there other methods of engagement that would best support your participation in bulk system plans?

Please submit your written comments by email to engagement@ieso.ca by March 8



Central-West Bulk Plan Update

Scope of Central-West Study

- 1. Firm recommendations for planned development:** To ensure continued reliable electricity supply to support the Volkswagen EV plant plus spin-off and associated growth in the London Area region.
- 2. Conditional recommendations for long-term potential economic development:** A set of reinforcement options to enable further growth within regions identified. The timing for development work/implementation would depend on when growth materializes.

Firm and conditional recommendations for the London Area region to be finalized Q1 2024

Remaining considerations of long-term potential economic development in the other regions considered will be integrated in the Southern and Central Ontario bulk study, as identified in the previous section

Scope of Bulk Transmission Studies

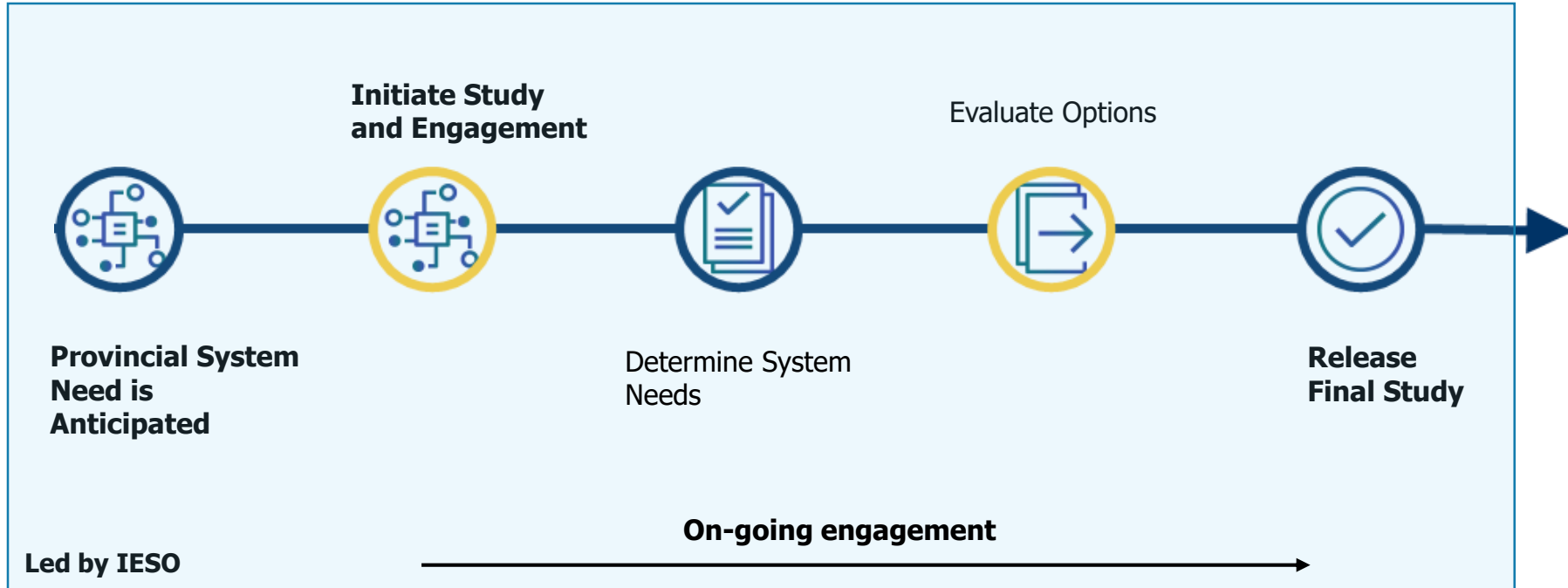
In Scope of Bulk Study

- Study and recommendations will focus on bulk system limitations, i.e., if generation or transmission reinforcement is needed to increase bulk transfer to an area
- Bulk implications of the load connection were considered, i.e., optimal configuration of the load connection line to the bulk system.

Out of Scope of Bulk Study

- Load connection details and associated local concerns will be out of scope
- Firm Load location and connection line path were determined by the customer and transmitter and taken as inputs
- Local issues will be flagged for consideration in local/regional planning
- Breakdown of the potential load blocks; these represent overall economic development and associated spin-off investments in neighboring municipalities

Typical Bulk Planning Milestones



Recap: Engagement Activities to Date

- August 16, 2023 – public webinar to provide an overview of the electricity planning initiatives and seek input on key considerations for the scope and forecast assumptions
- December 2023/January 2024 – outreach/meetings with local communities and stakeholders to inform of Central-West scope and assumptions
- February 2024, ongoing – outreach/meetings with local communities and stakeholders to inform of Central-West options
- February 23, 2024, today – public webinar to provide an overview of the Central-West needs and options being considered

What we've heard so far



Alignment and coordination with municipal and community planning, local developments, growth plans and decarbonization



Integrated options that provide both local and broader provincial system benefit should be considered



Consideration should be given to non-wires alternatives, and shifting economies, in particular for different resource types



Integration with energy procurements, and government policy and directives, like the province's plan for a Clean Energy Future

Growth Scenarios

The study considered two blocks of load:

Firm Load: VW EV plant in St Thomas as well as additional ancillary and spin-off loads totalling 620 MW

Potential Load: 500-650* MW of potential development in each of the planning regions:

- London Area
- Waterloo/Kitchener/Cambridge/Guelph
- Windsor-Essex
- Chatham/Lambton/Sarnia, and
- Burlington to Nanticoke



*Based on feedback received, the magnitude of growth considered increased.

Critical Bulk Interfaces

Bulk studies seek to identify concerns on the key bulk interfaces within the study area

The Firm Load is directly connected to circuits comprising the (Negative) Buchanan-Longwood Input interface; BLIP/NBLIP

NBLIP is important for delivering power from the West to the rest of the province

- This includes generation and Ontario-Michigan imports in the Lambton-Sarnia area, as well as load in the Windsor-Essex region and Chatham-Kent area



Resource Scenarios

To stress the critical bulk interface, BLIP/NBLIP, two resource scenarios were used, as well as sensitivities for imports/exports:

- **Base Generation:** Expected BLIP flow, achieved through expected contribution of available resources to summer/winter peak
- **High Generation:** High NBLIP flow, achieved through maximum expected capability of available resources

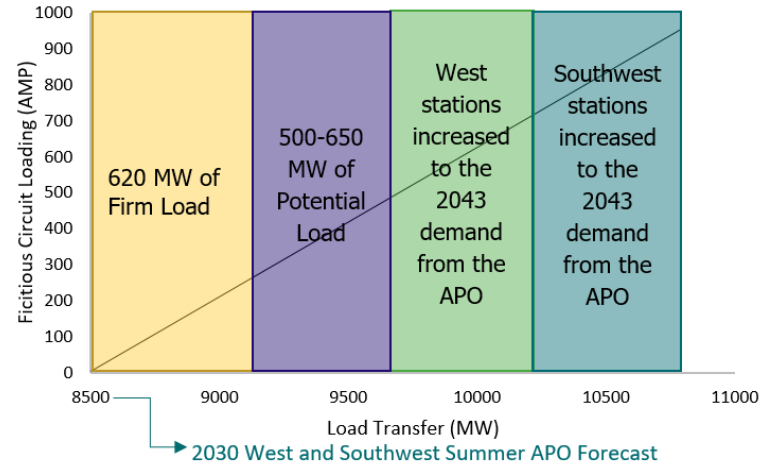
Needs Identification Process

Various cases were evaluated based on permutations of season, growth scenario and generation scenario

For each case, load transfers were used to steadily increase demand, as illustrated in the diagram to the right

The most limiting cases were the summer, base/high generation

If a restriction was identified limiting the load supply, a supply capacity need was identified, based on a load (MW) threshold



Central-West Bulk Study - Needs

Based on the growth scenarios, the following reliability issues were identified:

1. Unacceptable impact to the transfer capability of the NBLIP interface after 600 MW of major economic development is added, on top of forecast annual growth
 - Options to address this are discussed in upcoming slides
2. Dynamic voltage support need after 1,000 MW of major economic development is added in the London Area region.
 - Since this is a long-term need, firm recommendations are not being made at this time, to be responsive to when and where load materializes

Interdependencies Between Other Plans



- Other potential bulk reliability concerns and Potential Loads for the Kitchener-Waterloo/Cambridge/Guelph, Chatham-Kent/Lambton/Sarnia, and Burlington x Nanticoke regions will be integrated with upcoming bulk studies for POG
- Regional concerns identified for Windsor-Essex and Kitchener-Waterloo/Cambridge/Guelph will inform on-going or upcoming regional planning
 - Thermal and voltage limitations in Kitchener-Waterloo/Cambridge/Guelph region
 - Voltage limitations in the Windsor-Essex region
 - Conditional need for transmission projects undergoing early development work in Windsor-Essex, dependent on load materializing

Central-West Bulk Study - Options

To defer the thermal supply need, the following options are being considered:

- **Option 1: Reinforce the existing transmission supply circuit** – M31W, between Buchanan TS and the Firm Load tap point, 2-5 km; 300MW supply transfer increase
- **Option 2: Local resources** – addition of the least-cost, non-emitting resource alternative, capable of increasing the supply capability by 300 MW.

Sensitivities to assess the rate of load growth on cost and build out of Option 2:

-  **Sensitivity A:** Resources are staged in with an assumed gradual ramp up over five years to meet incremental load requirements, and
-  **Sensitivity B:** The full amount of resources are in-service from the start of the need, paralleling the transmission reinforcement supply.

Evaluating Options

Potential solutions are evaluated based on the following key considerations:

Technical Feasibility

- Can the option actually be executed? i.e., proximity to customers, routing and spacing considerations, operations

Ability to Address Needs

- Are the number, magnitude, and diversity of needs adequately addressed?

Integration & Cost-Effectiveness

- What is the lowest cost solution considering the possibility that one option may be able to address multiple needs simultaneously?
- Would a combination of option types be most effective?

Lead Time

- New transmission infrastructure or resource procurement/development could take 4-10 years – how does this compare to the timing of needs?

Central West Options Cost Considerations

Option	Net Present Value of Costs (\$B)
M31W reinforcement between Buchanan TS and Firm Load tap	3
Combination of Wind and Battery Energy Storage System (BESS) Resources	7-20

- Values are the net present value (2023 \$CAD) of capital, O&M, and energy costs, as well as the Clean Investment Tax Credit for Option 2. It considers provincial capacity value and a 4% social discount rate
- The life of the transmission was assumed to be 70 years; generation/storage 20 years.
- Capital cost of transmission was based on a range of circuit costs, \$4.5-8M/km; for a total of \$9-40M
- Estimated levelized cost of capital and fixed operating costs assumed is \$150-380k/MW for wind and \$210-270k/MW for storage
- Two load sensitivities considered for rate of growth

Specific Considerations for Transmission Options

The towers between Buchanan TS and the tap would need to be rebuilt to accommodate higher capacity conductors.

- Buchanan TS is space-limited by existing infrastructure and proximity to Highway 401, so the option to construct a new 230 kV circuit was both technically and financially prohibitive.

To support significant load growth beyond 900 MW along the broader London area supplied from the MxW corridor, this option includes rebuilding with double circuit towers.

- Marginal cost difference between single and double circuit towers, potential long-term benefits, and utilizes available space at the connecting station.

Approximate area of circuit reinforcement



Specific Considerations for Resource Options

- Due to the significant energy requirements of an industrial load, both the wind capacity and BESS energy requirement is very high
 - Requires approximately 2,800 MW of wind, in combination with 1,800 MWh of storage
- Specific siting requirements at the Firm Load tap point, or between the tap and supply station, would be challenging due to the immense land requirements (approximately 850 hectares) and uncertain community acceptance
- Coordination with provincial resource capacity needs

Preferred Central-West Bulk Option

- Relying on benchmark costs, Option 1 is preferred – rebuilding a section of the existing M31W circuit from Buchanan TS (near the City of London) to the Firm Load tap, 2-5 km to the east of the station
- Furthermore, rebuilding the section with double circuit towers, maximizes use of the limited space at Buchanan TS and provides long-term flexibility if load continues to grow

Seeking Input

- As we integrate the findings of the Central-West bulk study into upcoming broader bulk plans, are there any additional considerations we should be aware of?

Please submit your written comments by email to engagement@ieso.ca by March 8



Next Steps

Next Steps

- Feedback due to engagement@ieso.ca by **March 8**
- IESO to post and respond to feedback by **March 29**
- Publish Central-West bulk plan report by end the of March
- Stay tuned for quarterly engagement on upcoming bulk studies

Questions?

Do you have any questions for clarification on the material presented today?

Submit questions via the web portal on the webinar window, or by email to engagement@ieso.ca

Thank You

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Appendix

Electricity Planning in Ontario



Provincial/Bulk System Planning

Addresses provincial electricity system needs and policy directions to ensure bulk system is adequate to support projected growth.

Underway: Central-West Bulk Study



Regional Planning

Addresses local electricity system needs at the transmission system level, includes addressing local reliability and customer connection issues.



Distribution Planning

Addresses local electricity system needs and priorities at the distribution system level.

Led by local distribution companies.

Central-West Bulk Plan Process Overview

Needs Identification

What bulk system needs emerge as a result of growth in the Central-West area (Volkswagen EV Plant and other potential loads)?

Potential Options

Given the interconnected nature of the electricity system and geographic distribution of potential load growth in the Central-West area, are there common limitations and interdependencies between individual regions?

Are there options that establish an optimized and cohesive plan considering the broader bulk system as a whole?



Recommendations

Based on an assessment of potential options, what recommended actions will ensure a reliable and adequate electricity supply after the Volkswagen EV plant connects in the near-term and the Central-West area over the long-term?