SEPTEMBER 24, 2024

Quarterly Bulk Studies Update

Northern Ontario Bulk Study

IESO Transmission Planning
Independent Electricity System Operator

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Agenda

- Background and overview of the Northern Ontario Bulk Study
- Overview of bulk planning process steps
- Demand Forecasts and Generation Assumptions
- Needs Identification
- Evaluation of Options
- Next Steps

IESO Feedback

- Please submit your written comments via email to IESO Engagement at engagement@ieso.ca by **October 15, 2024.**

Questions for participants to help inform feedback on the Bulk Studies:

- Are there any additional considerations we should be aware of in developing the Northern Ontario Bulk Study?
- What feedback do you have regarding the content delivered today?
- Are there specific areas of urgency that should drive the studies to prioritize one need or area above others?

Background – Bulk Plans Engagement

- Public engagement on the South and Central and Northern Ontario Bulk Plans commenced on **June 19, 2024**
- A recording of that session with meeting materials and participant feedback has been posted: https://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/South-and-Central-Bulk-Planning
- That session also included an introduction to the IESO's electricity and transmission system planning for those interested

Our Commitment to Engagement

The IESO's approach to community engagement is based on these key principles:

- Strengthening processes for early and sustained engagements with Indigenous communities, local governments and the public
- Providing Indigenous communities, local governments and the public with greater voice and responsibility
- Bringing communities to the table
- Linking local and provincial planning, and reinforcing the link between planning and procurement
- Enhancing electricity awareness and improved access to information

Communities Have a Key Role

Significant electricity system needs are expected over the next decade, and communities have a key role, including:

- **Informing** electricity planning to ensure a reliable and adequate supply
- **Shaping** the province's energy transition by ensuring the system is prepared for future needs
- **Hosting** new generation, transmission and storage
- **Working** with project developers on the applicable approvals, and partnerships, where applicable

Your Input is Important

Indigenous communities are amongst the most influential voices to advance, manage, and shape the ongoing energy transformation. Through our engagements we've heard that it is important to:

Inform and engage with communities in a timely manner

Consider design requirements that incentivize developers to better understand, interact and collaborate with communities

Keep economic development top of mind to meet future needs

Continue to provide support and guidance for communities on how to work with developers

Support innovative technologies and programs

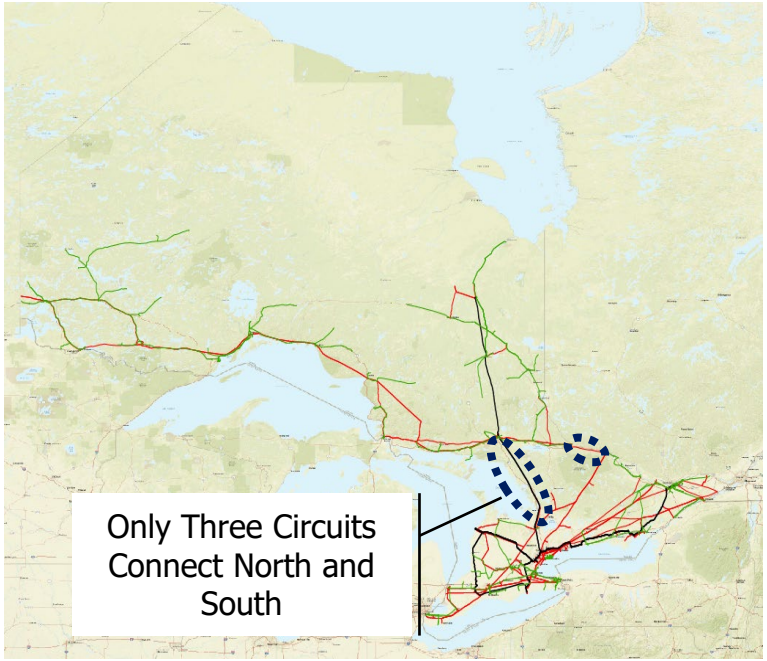
Northern Ontario Bulk Study Updates

Northern Ontario Bulk System Background

Northern Ontario is supplied by:

- **Three transmission circuits** that make up the North-South Interface, specifically: two 500 kV single circuits from Essa TS (Barrie) to Hanmer TS (Sudbury), and one 230 kV single circuit, from Otto Holden TS (in Mattawa) and Des Joachims TS (in Laurentian Hills)
- **Interconnections** with Manitoba and Minnesota, and a radial connection supplying a small load in Quebec
- **Local generation** comprising mostly of hydroelectric generation

The North-South Interface typically flows southwards during system peak when hydro-electric output is high, and northwards off-peak when hydro-electric output is low to optimize the available energy from the generation



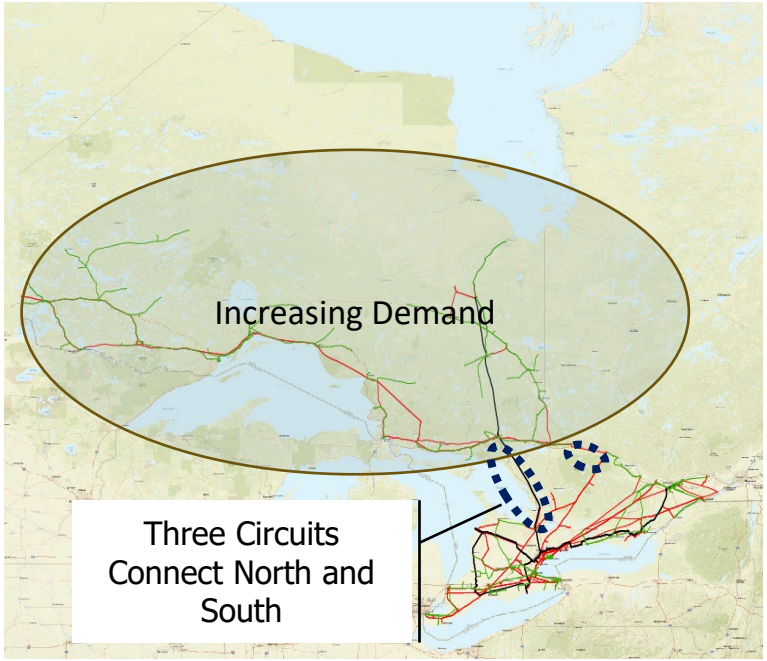
Purpose of Northern Ontario Bulk Study

Forecasts show increasing demand growth in Northern Ontario due to:

- Development of significant potential mineral deposit supplies to support electrification vehicle manufacturing
- Electrification of metal production sub-sector
- Adoption of industrial process electrification in existing mines to improve operational economic efficiencies

Provincial Demand is also increasing driving a need for resources across the province. (I.e. South & Central Bulk Study Module #4)

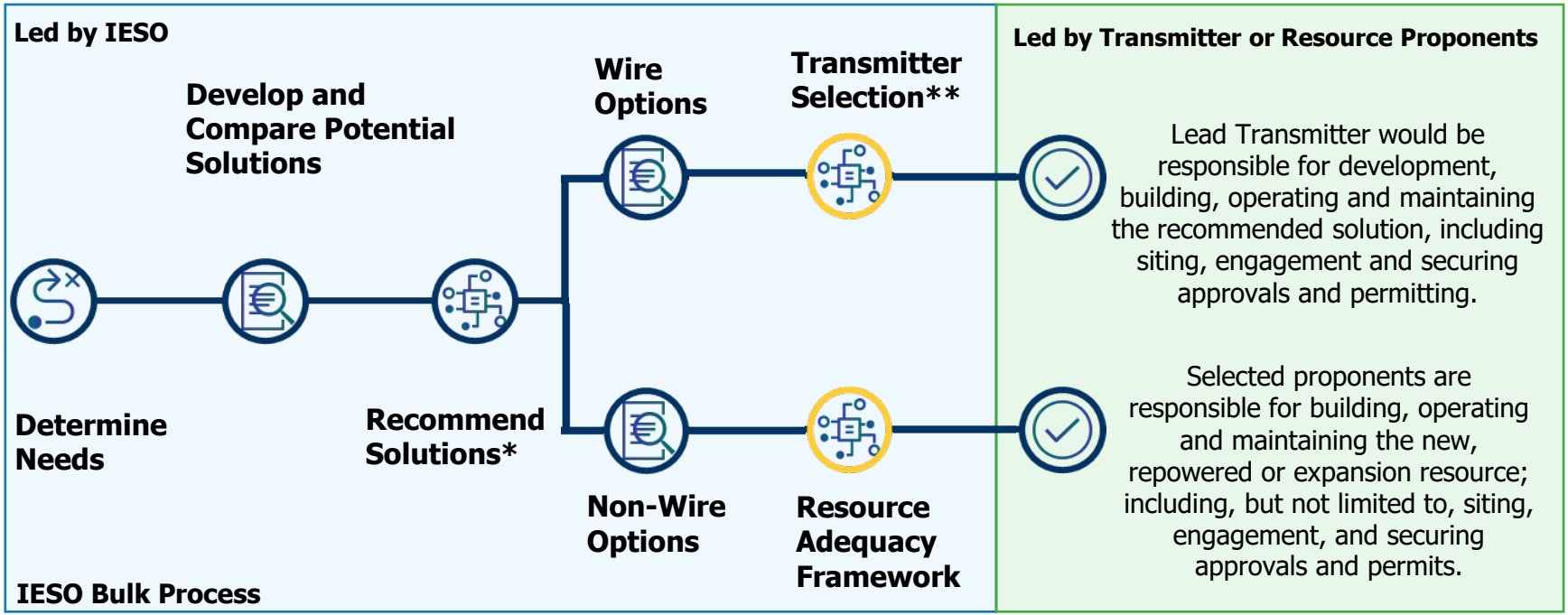
This bulk study will **focus on supporting economic growth and enable non-emitting resources** in Northern Ontario by ensuring the North-South interface has adequate capacity and addressing bottlenecks



Components of a Bulk Study

Demand Forecasts	Needs	Evaluation of Options	Recommendations
How much electricity demand is forecasted to be needed over the planning timeframe? Key inputs: -Annual Planning Outlook -Mining load forecast -Regional Planning forecasts -System Impact Assessments	Can the electricity system meet customer demand via a combination of local generation and transmission capacity?	What kinds of solutions can meet the future needs for the region? For example: -transmission -generation -storage -conservation	Based on an assessment of potential options, what recommended actions will ensure a reliable and adequate electricity supply over the long-term?

Development and Implementation of Bulk Recommendations



*Recommended solutions can take the form of wire and/or non-wire options. **Currently, no standardized process exists to select a transmitter.

Demand Forecast Scenarios

Key Details:

Two scenarios have been developed, accounting for organic load growth, electrification, industrial development and the impacts of weather:

- **Firm Demand Scenario** includes firm loads: existing and planned projects with a completed System Impact Assessment and customer commitments
- **Potential Growth Scenario** comprises of the Firm Demand scenario ***plus*** planned industrial projects without commitments

Demand Forecast will drive recommended solutions:

- Firm near-term recommendations required to accommodate the near- to med-term demand forecast
- Recommended actions to support potential solutions needed over the long-term

Demand Forecasts

Key takeaways:

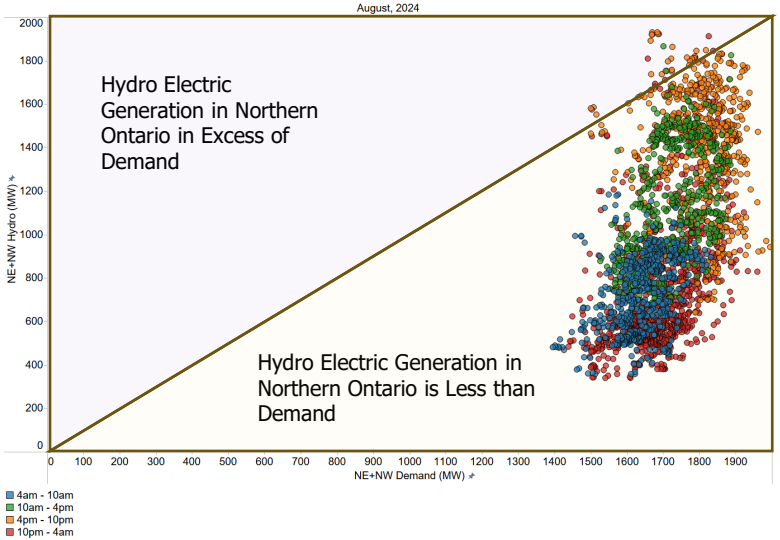
- Peak Demand in Northern Ontario is forecast to increase up to 50% by 2030 and 100% by 2050 (potential growth scenario)
- Growth is primarily driven by the connection of large industrial loads:
  - The development of significant potential mineral deposit supplies in northern Ontario to support electrification vehicle manufacturing
  - Electrification of metal production sub-sector
  - Adoption of industrial process electrification in existing mines to improve operational economic efficiencies

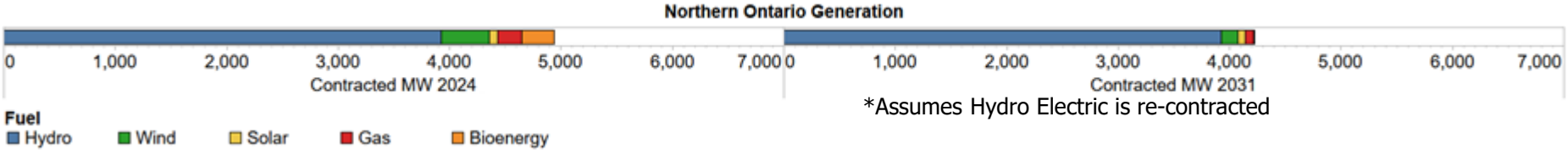
Forecast of Existing Generation

Generation Forecasts

Installed Capacity in Northern Ontario is declining and variable/limited in energy:

- > 500MW of thermal generation contracts ending by 2031
- Wind and Solar resources are variable in nature, and there can be consecutive days of low output from these resources
- Remaining 3900MW of hydro-electric generation is energy limited (unable to run continuously)
- **Future potential generation is considered in the evaluation of options**





*Assumes Hydro Electric is re-contracted

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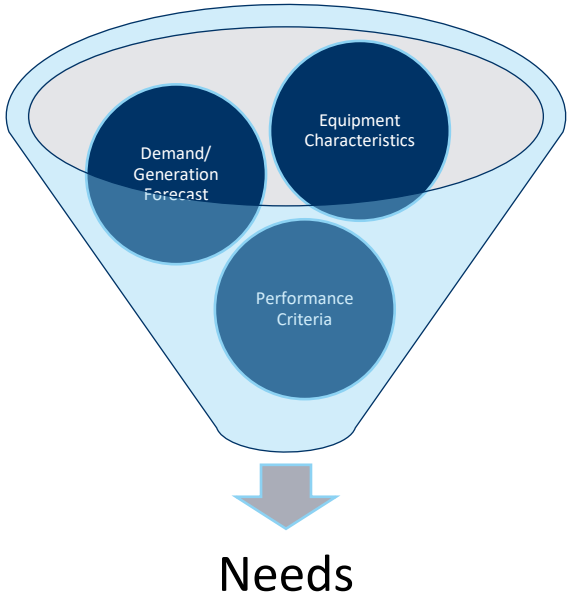
Determining Needs

Needs

Identifying Needs:

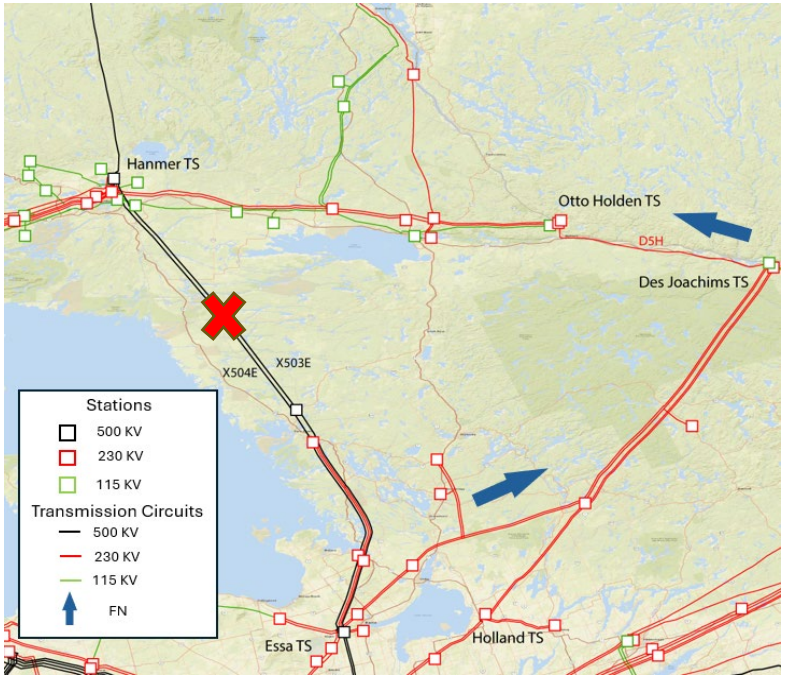
- The transmission system must be planned to satisfy a wide range of planning events and forecast scenarios as identified through various planning standards (ORTAC, NERC, NPCC)
- Power system simulations are run to identify system capacity needs which occur when the existing system is insufficient in accommodating the forecasted demand



Needs Study - Findings

Needs

- Supply to Northern Ontario is limited by the capability of the North-South Transmission Interface and generation available in Northern Ontario
  - The Northern generation comprises mainly of energy limited resources that cannot run continuously and is not sufficient in supplying the Northern demand
  - Remaining Northern demand is supplied through the North-South Transmission interface
  - The North-South Interface, plus available Northern generation, cannot accommodate the forecasted demand for Northern Ontario, with the loss of both 500 kV circuits between Hanmer TS and Essa TS, unacceptable voltages and thermal overloading of equipment is observed



Needs Study-Findings

Needs

Needs Study Outcomes:

- Demand growth in Northern Ontario is forecasted to result in transmission supply capacity issues as early as 2024 and growing to upwards of 1000 MW by the 2030s

Capacity and energy needs are present due to:

- Increased demand that is driven by mining and metal processing sectors
- Gas and Biofuel resource contract expiration
- Energy limited hydro-electric resources are unable to produce sufficient energy to meet the forecast demand

Evaluating Options

Evaluation of 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?

Preliminary Options Screening

Evaluation of Options

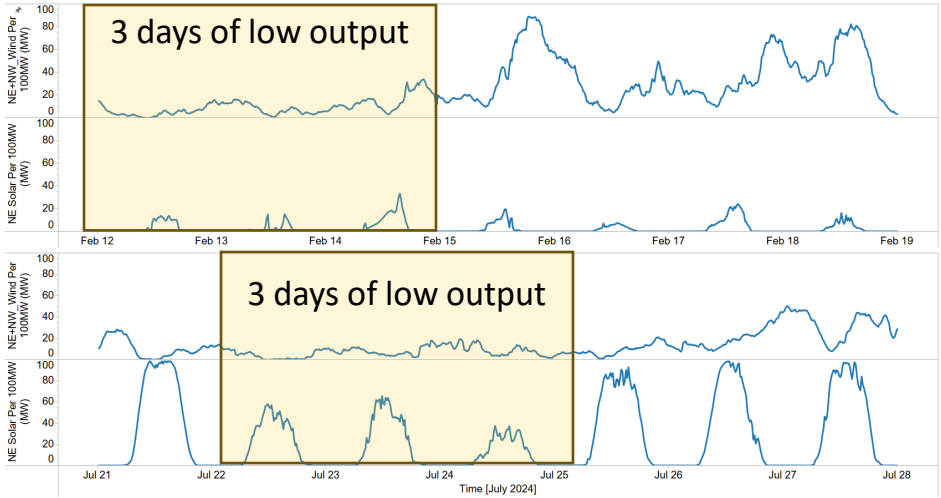
Option	Considerations
Interconnections	• Existing interconnections in Northern Ontario do not have sufficient capacity to accommodate the capacity needs identified • New interconnections would require significant transmission buildouts as the load centers/strong transmission system are sufficiently far away from the border • Long lead times for specialized HVDC technologies to transfer large amounts of power
Non-wires such as generation and storage	• Still under evaluation, IESO's guidance for the Long Term 2 Procurement has indicated technical challenges with connecting >1200MW renewable inverter-based generation in Northern Ontario • Storage can only provide energy over so many hours after which it must consume energy from the grid to be recharged. This recharging can exacerbate the need • To ensure a reliable energy supply with renewables, we need much more installed capacity than our actual capacity needs because their variable nature means they don't produce consistent power at all times
Wires such as reinforcing existing or building new lines within Ontario	• Wire options can be sized to meet the need and serve multiple additional purposes: (1) Increasing resiliency (2) Enabling additional generation in the future to meet local and global needs

Challenges with NWA

Evaluation of Options

Periods of multiple day low wind and Solar production do occur.

- This would result in a requirement to construct more nameplate capacity as compared to the size of the need
- This would then result in congestion on days that are sunny and windy
- Example:
  - 10,000 MWh are needed in February.
  - Using Historical production values shown from Feb 12- Feb 15
  - ~6000MW of Wind and Solar would be needed
    - This quantity could result in excessive congestion on sunny, windy days

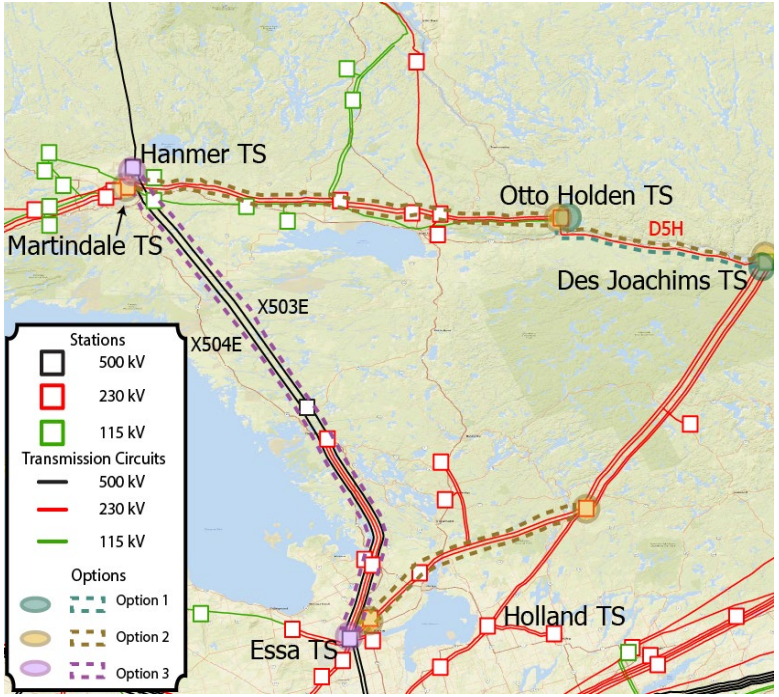


Preliminary Wire Options

Evaluation of Options

The following wire options are being considered:

- **Option 1:** Reinforce the existing 230 kV circuit between Otto Holden TS (Mattawa) and Des Joachims TS (Laurentian Hills)
- **Option 2:** Reinforce the existing 230 kV circuits between:
  - Martindale TS (Sudbury) and Otto Holden TS (Mattawa)
  - Otto Holden (Mattawa) and Des Joachims (Laurentian Hills),
  - Essa TS (Barrie) and Minden TS (Minden),
- **Option 3:** Reinforce the existing 500 kV system between Essa TS (Barrie) and Hanmer TS (Sudbury)



Preliminary Wire Options Analysis

Evaluation of Options

Option	Outcome
Option 1: Reinforce the existing 230 kV circuit D5H between Otto Holden and Des Joachims:	• **Unable to meet the need** as the performance of the power transmission system does not meet established reliability, safety and/or operational standards. This option would require significant additional upstream (Barrie to Mattawa) and downstream (Mattawa to Sudbury) transmission upgrades • **Provides little benefit in terms of enabling more generation** in Northern Ontario
Option 2: Reinforce the existing 230 kV circuit between Otto Holden and Des Joachims, Essa TS and Minden TS, Otto Holden TS and Martindale TS	• **Unable to meet the need** as the performance of the power transmission system does not meet established reliability, safety and/or operational standards. This option would require significant additional upstream (Barrie to Mattawa) and downstream (Mattawa to Sudbury) transmission upgrades • **Provides little benefit in terms of enabling more generation** in Northern Ontario
Option 3: Reinforce the existing 500 kV system between Essa TS and Hanmer TS	• **Able to provide significant increases in Northward flow (1500MW)**, accommodating the forecast up to year 2044 (under firm demand forecast), and 2029 (under potential demand forecast). Where small overnight needs are still present. • **Provides significant benefits in terms of enabling more generation** in Northern Ontario

Enabling of Generation In Northern Ontario (1)

- Provincial demand is expected to grow significantly over the next 25 years resulting in a need to procure significant amounts of capacity and energy
- Siting generation in Northern Ontario helps meet provincial needs
- However, the existing North South Interface can be an barrier to siting materially large amounts of generation in Northern Ontario
  - IESO's guidance for the Long Term 2 Procurement has indicated technical challenges with connecting >1200MW renewable inverter-based generation in Northern Ontario
  - Previous assessments have indicated that 500kV circuits between Barrie and Sudbury would be required to enable generation in Northern Ontario

Figure 24 | Summer Capacity Surplus/Deficit

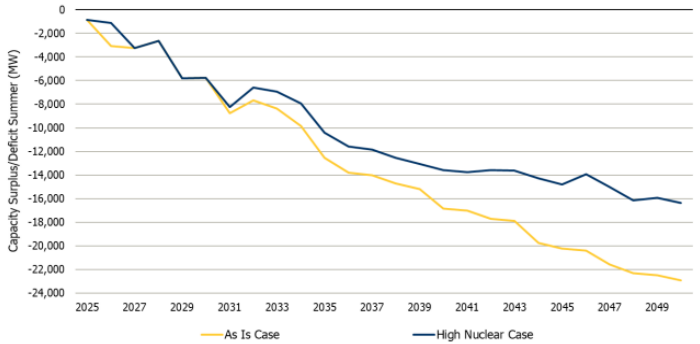
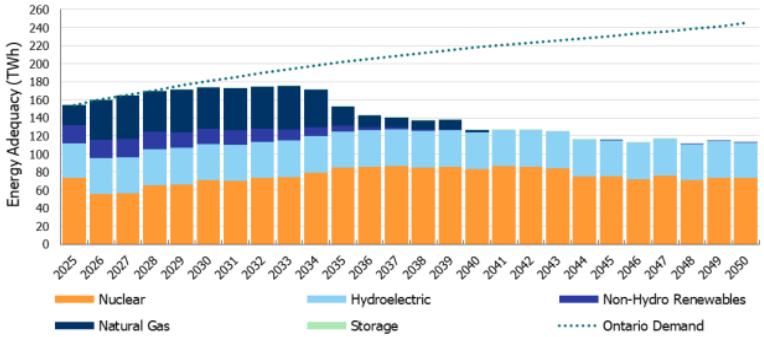


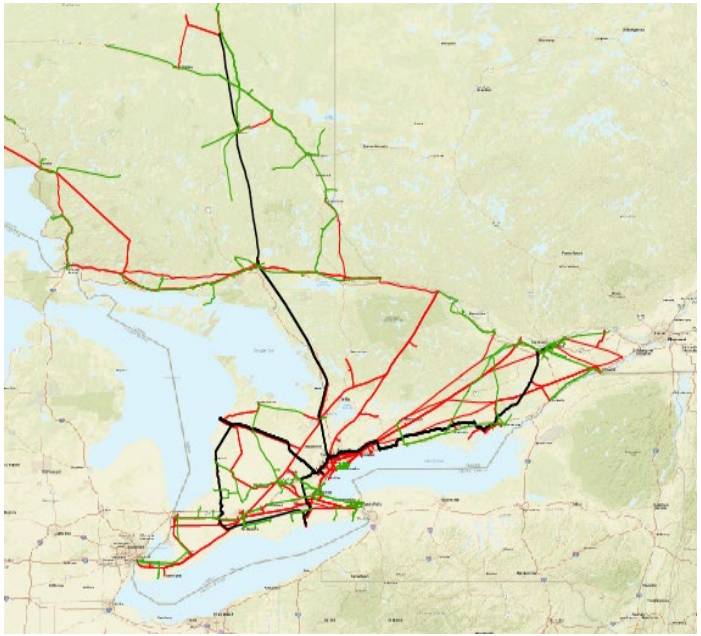
Figure 26 | Energy Adequacy Outlook (As Is Case)



Enabling of Generation In Northern Ontario (2)

Generation sited in Northern Ontario will increase the flow southwards on the North South Interface during periods of system peak

- The existing 500kV system acts like a 'superhighway' for power to flow South
  - When one of the two existing 500kV circuits is lost, most of the power will want to flow on the remaining 500kV circuit
  - The addition of new 230kV circuits does not significantly offload the 500kV circuit due to it being a higher impedance path and therefore the total Southward transfer will not materially increase
  - The addition of a new 500kV circuit will result in a 50% offloading of the 500kV circuit thus increasing the southward transfer substantially



Northern Ontario Study - Next Steps

Evaluation of Options

Continue to investigate wires options:

- In conjunction with feedback continue to evaluate options capable of meeting forecast needs

Complete NWA analysis Economic analysis:

- Determine planning level estimates for transmission options that are feasible and can meet the forecasted needs
- Complete feasibility of study of NWAs as well as economic comparison to transmission options.

Engagement - Next Steps

- Participant **Feedback** is being requested on the information shared today by **October 15, 2024**
    - As we continue develop a plan for the Northern Ontario Bulk Study, are there any additional considerations the IESO should be aware of?
- Participant Feedback can be directed to IESO Engagement at engagement@ieso.ca utilizing the **Feedback Form** provided on the Northern Ontario Bulk Study engagement webpage

Questions?

Questions of clarification on the material presented today?

Submit additional questions to engagement@ieso.ca

Thank You

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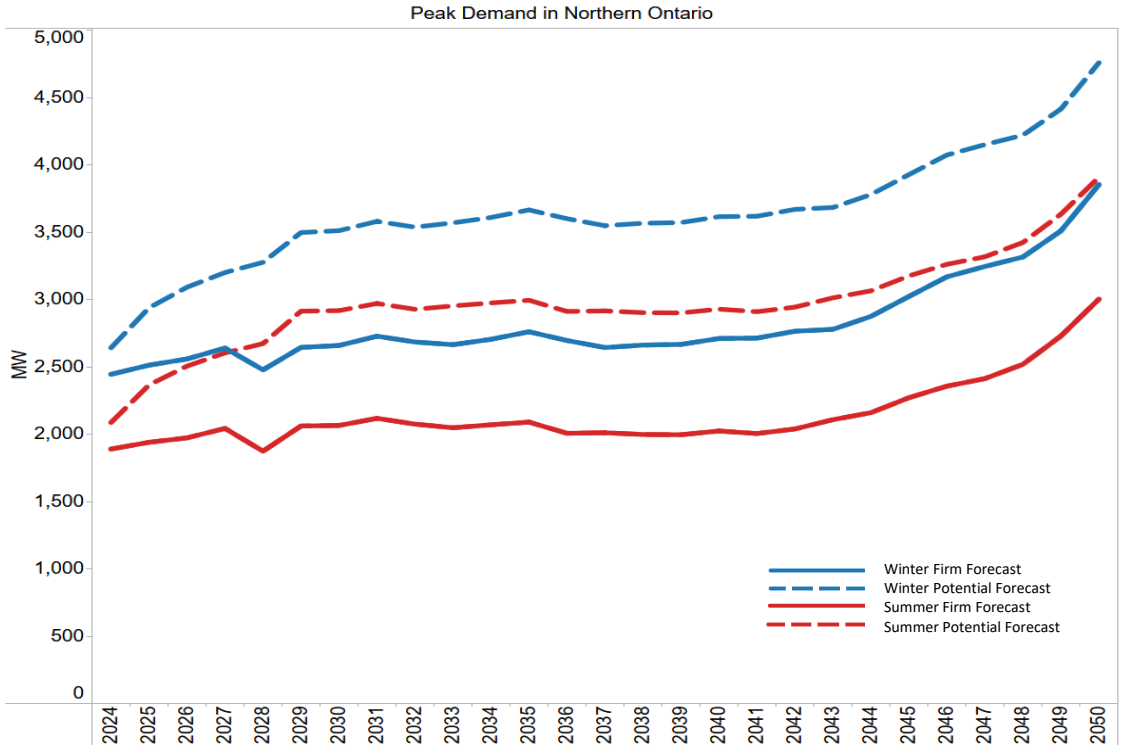
Appendix

Demand-Forecasts



Needs Study – Findings