MAY 6, 2021

Peel/Halton (GTA W) Integrated Regional Resource Plan (IRRP) Engagement Webinar #3

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Objectives of Today's Webinar

- To provide an update on the electricity planning underway in the Peel/Halton region
- To provide an overview of the options analysis and seek input on draft recommendations
- To outline next steps

Seeking Input

As you listen today, please consider the following questions to guide your feedback on the draft recommended plan for Peel/Halton:

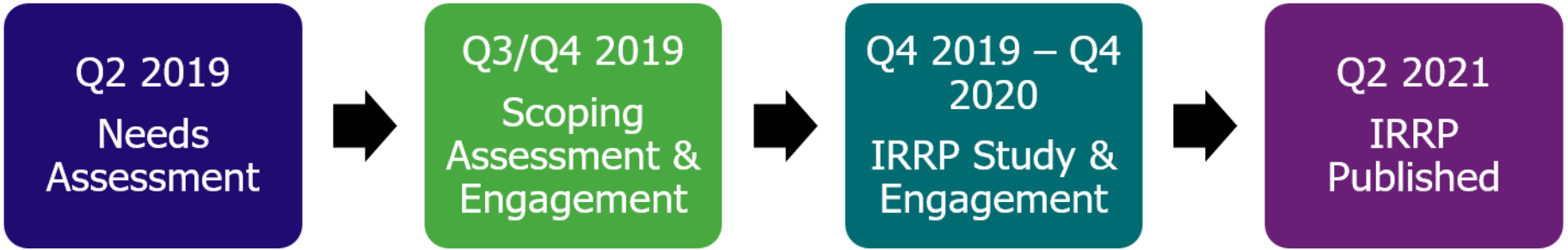
- What information needs to be considered in these recommendations?
- How can the Peel/Halton Technical Working Group continue to engage with communities as these recommendations are implemented, or to help prepare for the next planning cycle?

Please submit your feedback/written comments by email to engagement@ieso.ca by May 20th

IRRP Status Update

Peel/Halton IRRP Status

- IRRP study work began in Q2 2019, and is on track for completion by end of Q2 2021
  - Electricity demand forecast and needs have been determined, potential options identified and evaluated, and draft recommendations developed
  - The next step is to finalize recommendations



Recap: Engagement Activities to Date

- Engagement launched on Peel/Halton GTA West Scoping Assessment:
  - Draft report posted for public comment – June 2019
  - Final report posted with IESO responses to comments received – August 2019
- IRRP Engagement launched – February 2020
- Public webinar to seek input on draft electricity demand forecast and planning engagement activities – March 2020
  - Responses to feedback posted – April 2020
- Public webinar to seek input on early options screening and range of potential solutions to be examined – August 2020
  - Responses to feedback posted – September 2020

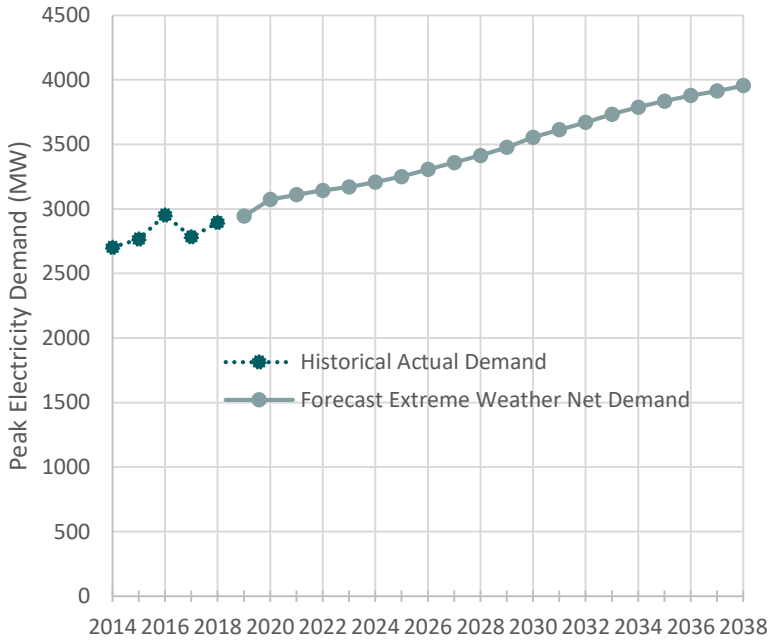
What we've heard so far…

- Growth forecasts should take municipal official plans and secondary plans into account
- There is strong interest for non-wires alternatives but economic growth should not be limited by conservation/demand-side options
- Integrated options that provide both local and broader provincial system benefits should be considered
- Future infrastructure and energy requirements should consider the recommendations of community energy plans regarding alternative energy systems, renewable generation, and electrification

Options Analysis Methodology

What are we studying options for?

- Electricity demand in the Peel/Halton region is expected to increase by 34% over the next 20 years
- The IRRP identified a number of needs that are expected to emerge between now and the early 2030's
- The draft recommendations discussed today are to ensure that the grid can meet standards and reliably serve the forecast growth in the region



Option Categories

Generally speaking, the IRRP may recommend "wires" options, "non-wires" options, or a combination of both

Option Type	Description
Wires	Traditional transmission assets such as switching stations, transformer stations, or transmission lines; may also include protection schemes and control and operational actions such as load rejection
Non-wires	Local load modifying solutions such as distributed energy resources (including distributed generation/storage and demand response) or energy efficiency measures - and/or - Large utility-scale generation facilities located to alleviate a local reliability need

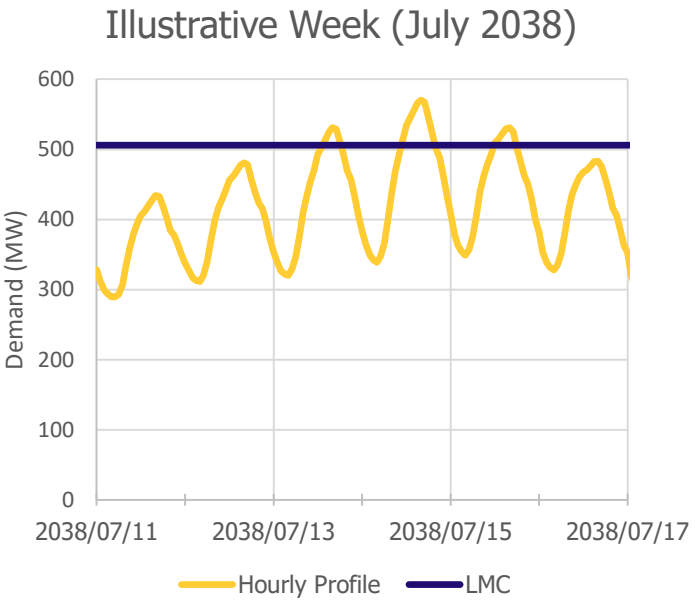
Identifying Wires Options

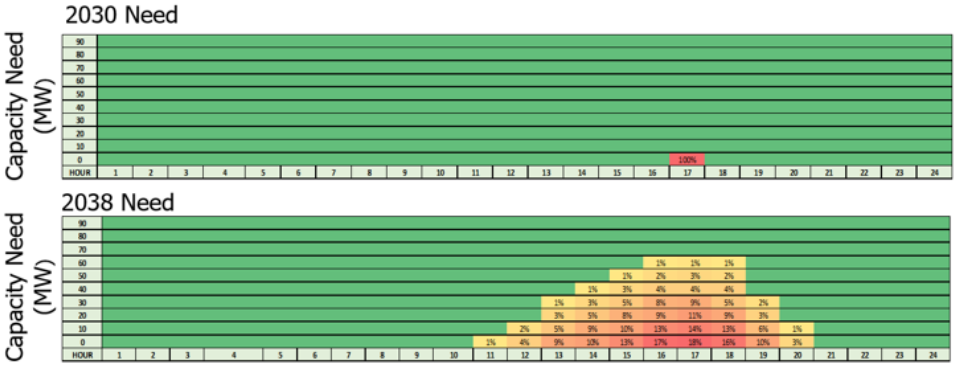
- Wires options are typically used to increase the load meeting capability (LMC) of a given area to meeting forecast demand
- Suitable wires options depends on the:
  - Type of need (capacity, load security/restoration, facilities reaching end-of-life)
  - Limiting phenomenon (thermal, voltage)

Identifying Non-wires Options

- Identifying non-wires options require a more granular approach to understand the hourly characteristics of the need including magnitude, duration, and frequency
- This is accomplished by simulating hourly demand profiles and examining the hours when demand exceeds the LMC
- The technology type and sizing of non-wires options are based on both power and energy requirements
- This allows for a high-level cost estimate to inform whether or not more detailed market sounding or analysis is required

Illustrative Example: Load Profiling & Need Visualization





Heat maps like the one above and key statistics for each of the needs can be found in the appendix of this presentation

Estimating Cost of Generation/Non-wires Options

- Once suitable technologies are chosen and sized according to the characteristics of the need, the capital and operating costs of these options can be estimated based on benchmark costs for a variety of resources including gas generation, storage, demand response, etc.
  - If applicable, these resources are also "credited" with the capacity value they provide the broader system
- Based on the needs of this IRRP, the estimated costs of the generation/non-wires options were far more expensive than the wires options and were thus screened out from further consideration

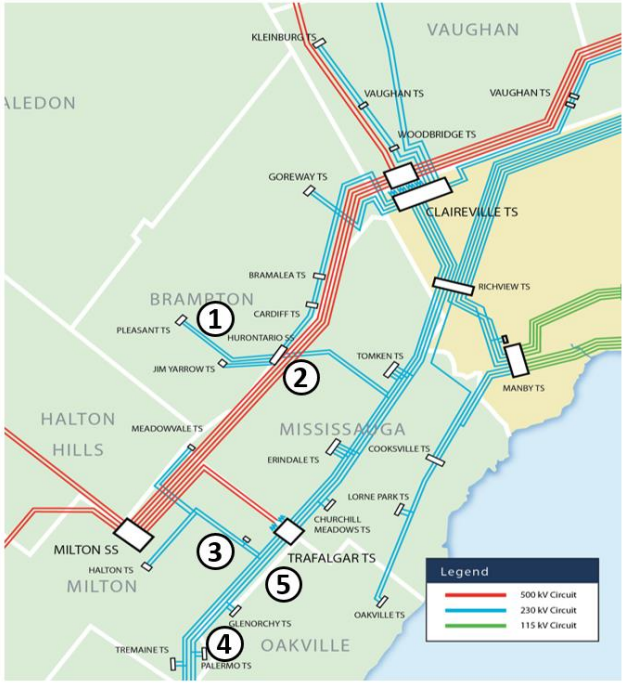
Evaluating Options

- Plan recommendations are informed by:
  - The technical ability of the option to address the need
  - The cost of the option; preference is generally given to the most economic alternative that meets the identified need
  - Opportunities to address multiple needs with a single solution
  - Input from community engagement

Needs & Draft Recommendations

High-level Picture: Five Recommendations

- The Peel/Halton region has several local reliability needs emerging between today and the early 2030's
- Generally speaking, the wires options are inexpensive and minor in nature
  - Non-wires options were screened out due to cost and are not recommended
- Although an integrated solution to address local needs together was considered, it is more cost effective to address the needs individually in this case



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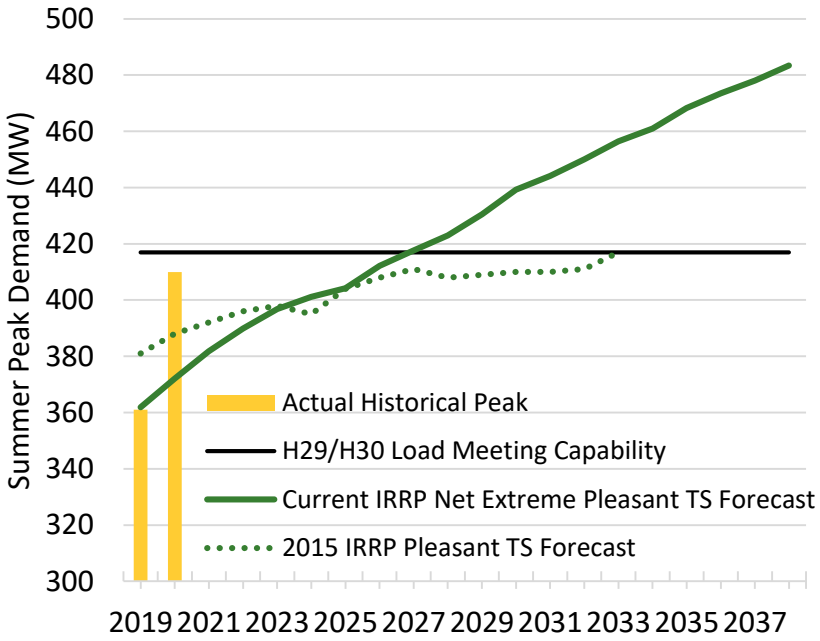
Monitoring Mid- to Long-term Needs

- Regional planning for Peel/Halton will be triggered again in five years or sooner if needed
- Generally speaking, the IRRP will only make firm recommendations on the needs that emerge in the near-term but will also document options for needs that emerge later on
- This approach ensures that there is enough lead time to implement solutions while remaining flexible to new developments and uncertainty in the load forecast

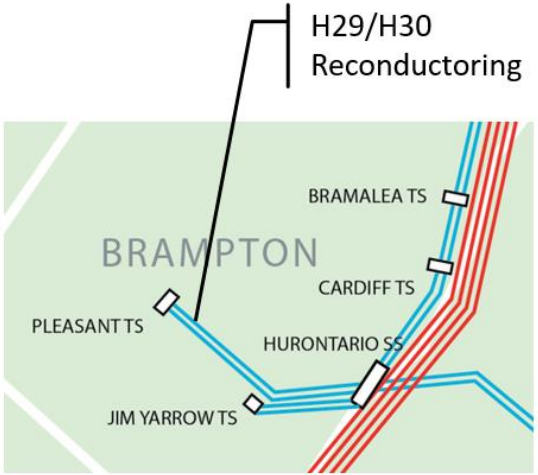
1. H29/H30 Reconductoring (1/2)

- A N-1 thermal need on H29/H30, the circuits supplying Pleasant TS, is expected to arise in 2027 according to the current forecast
- This need date is sooner than projected in the previous 2015 IRRP (2033)
- The 2020 peak demand at Pleasant TS reached 410 MW during the July heat wave but it is still to early to definitively tell if this was an isolated event related to COVID-19 or an enduring trend



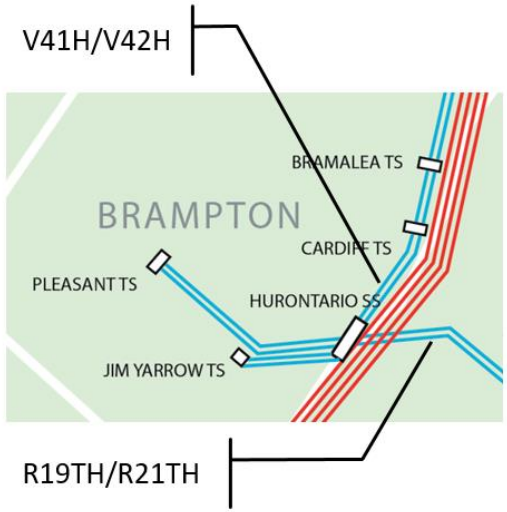
1. H29/H30 Reconductoring (2/2)

- Previous IRRP recommended reconductoring H29/H30 at the cost of ~$6.5MM; this IRRP is only updating the timing of this solution
- Given that the lead time required will be at least three years, it is prudent to begin implementation today for a targeted in-service date around 2025
- This slight advancement of work will help mitigate the risk that the 2020 increase in peak demand persists



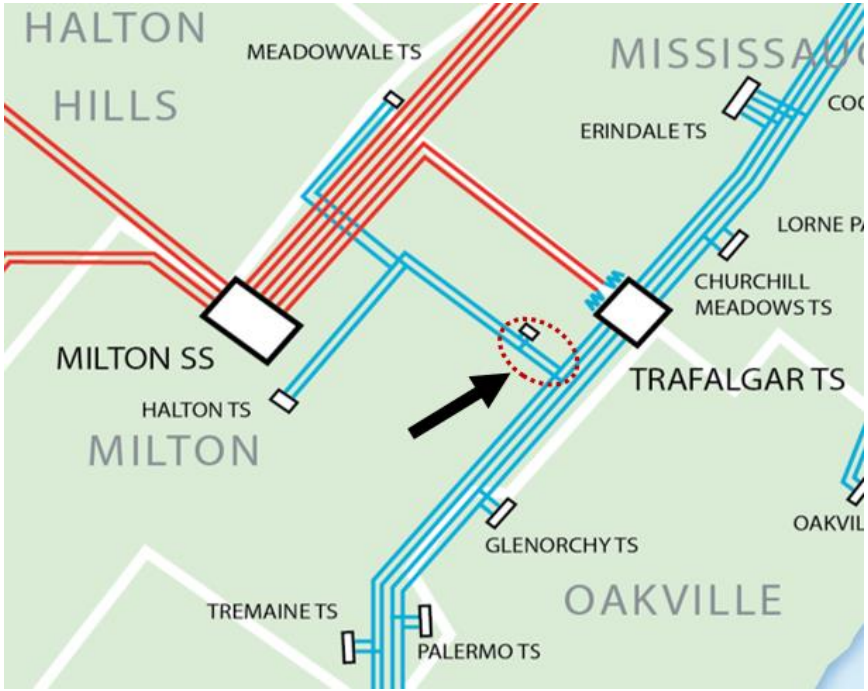
2. Control Actions and/or Load Rejection Scheme

- N-1-1 conditions would thermally overload the 4 circuits (V41H/V42H/R19TH/R21TH) leading into Hurontario SS
- Control actions or a protection scheme (<$5MM) is the most cost-effective option for this need
- Other options like line upgrades, reconfiguring Hurontario SS, or additional local generation are not cost-effective to address a need that occurs infrequently only in very specific conditions



3. Monitoring Halton Pocket Growth

- N-1 conditions during an outage to Halton Hills GS would overload circuits T28B/T39B starting in 2031
- Limiting equipment is a short (~400m) section of T38B/T39B
- Reconductoring this section (~$1MM) is the most cost-effective option
- Next cheapest option is battery storage at ~$50MM
- Given the timing of the need, no firm recommendation is required for this IRRP



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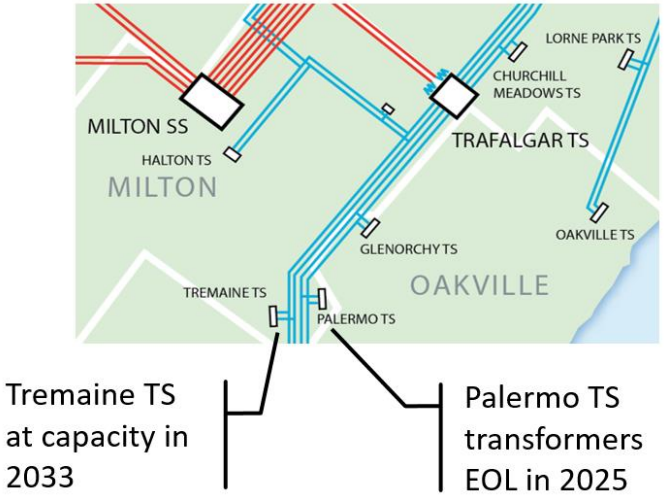
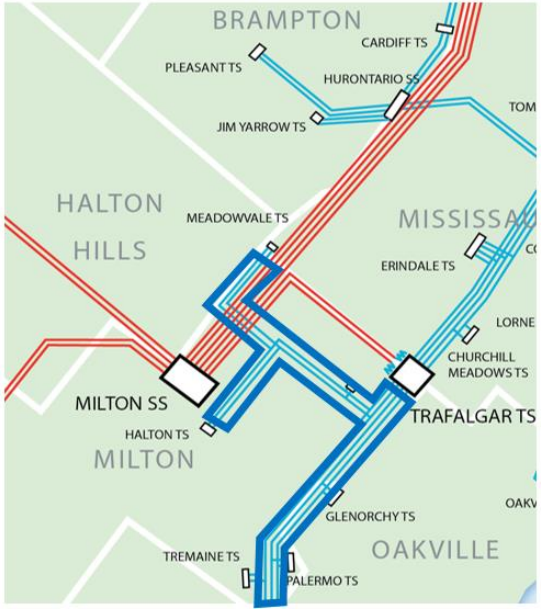
4. Upsizing Palermo TS at End-of-Life

- Transformers at Palermo TS will reach end-of-life in 2025
- Palermo TS is fully loaded today and this load level is expected to persist
- Tremaine TS, a nearby station, is expected to reach capacity in 2033
- Upsizing Palermo TS for an incremental cost of ~$10MM is prudent to avoid the more costly option of refurbishing Palermo TS like-for-like in 2025 followed by a subsequent upsizing or new station in 2033



5. Further Wires Analysis for Load Security (1/2)

- T38B/T39B circuits serves a number of transformer stations
- Load security criteria is meant to limit the maximum amount of customer interruptions for any given contingency
  - Also helps maintains resiliency to unlikely but disruptive events
- By 2025, the simultaneous loss of both T38B/T39B would result in over 600MW of load lost by configuration, which exceeds criteria

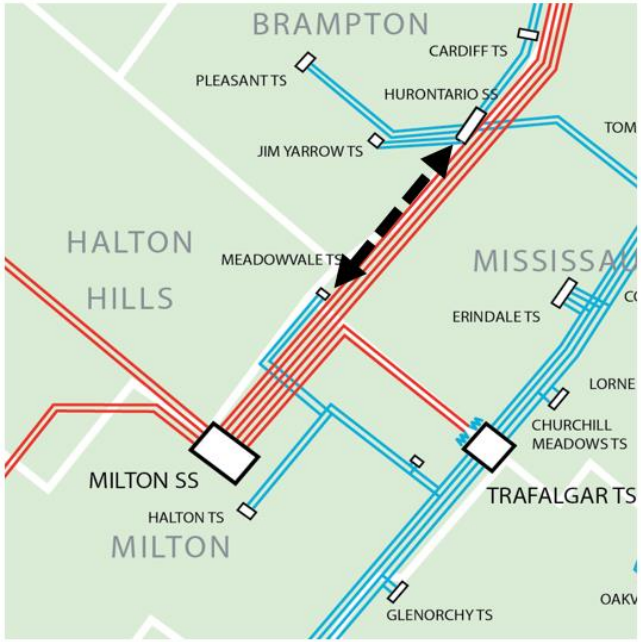


5. Further Wires Analysis for Load Security (2/2)

- There are several wires options for reducing the load lost including installing breakers to sectionalize the circuit or reterminating stations to other nearby circuits
  - These options would cost on the order of $5MM
- Generation/non-wires options are not suitable because, while they do lower net demand, they do not reduce the total amount of customer load disconnected from the grid by configuration
- The Regional Infrastructure Plan (RIP) led by Hydro One immediately following this IRRP will further study these wires options to refine cost estimates and identify any additional operational challenges
- There may be merit in seeking approval to temporarily accept a lower level of performance for a few years to determine whether there are opportunities to integrate this need with future bulk system needs and potential reinforcements in the late 2020's

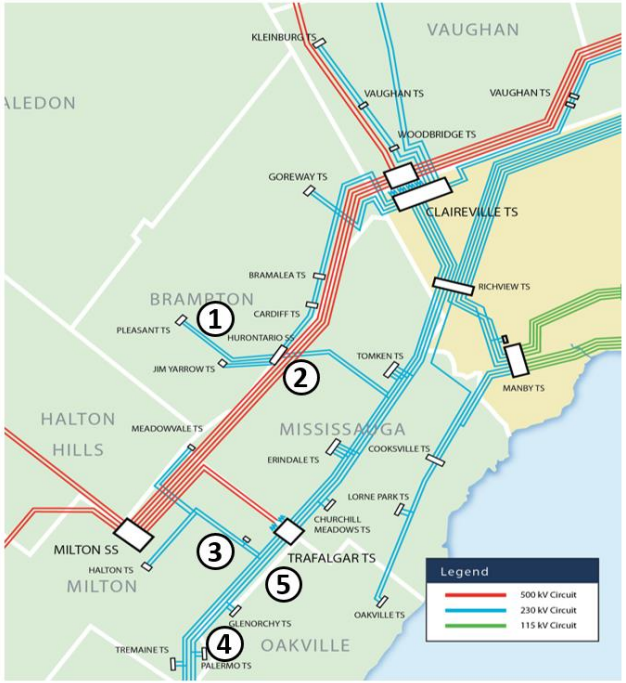
Integrated Option: Meadowvale x Hurontario

- Building a new 230 kV double circuit line from Meadowvale TS to Hurontario SS can replace recommendations #2-5 while also improving bulk system transfer capability
- In some cases, an integrated solution can be more cost effective than individually addressing needs
- In this case, recommendations #2-5 are all minor in nature and collectively are more cost effective than a new transmission circuit of this length



Summary

1. H29/H30 Reconductoring
2. Control Actions and/or L/R at Pleasant TS
3. Monitoring Halton Pocket Growth
4. Upsizing Palermo TS at End-of-Life
5. Further Wires Analysis for Load Security in RIP



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NW GTA Transmission Corridor

- The Ministry of Transportation is currently conducting an EA for a new 400-series highway in the same approximate area as anticipated long term need for new transmission
- Provincial policy encourages colocation of linear infrastructure to reduce land use impact
- The IESO and Ministry of Energy, Northern Development and Mines are conducting a joint study mirroring the highway EA to protect land for a potential future transmission corridor
- The anticipated need for future transmission is linked to population and employment growth projections

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Coordinating NW GTA Transmission Corridor Plans

Integrated Regional Resource Plans

- Lead by the IESO
- Involves forecasting, needs identification/timing, and options analysis for a local area (GTA West)

NW GTA Corridor Study

- Joint study with the IESO and Ministry of Energy, Northern Development and Mines
- Identify land to be protected for a future transmission corridor to ensure that the longer-term needs can be accommodated if and when they arise

If/when a need materializes and transmission is recommended

Detailed Transmission Engineering & Design + Environmental Assessment

- Lead by the transmitter selected for the project
- Includes detailed considerations such as tower design, conductor selection, potential underground sections, etc.
- EA process will have significant engagement to determine 'environmental criteria' such as the proximity to an airport and apply mitigation measures

Benefits of Protecting Land for Future Transmission

- This IRRP has not identified a firm need for new transmission infrastructure in the northern areas of the region; however, these areas are experiencing rapid growth and are located further away from existing infrastructure
- Protecting land for a future transmission corridor:
  - Maintains flexibility to accommodate future demand growth in the northern areas beyond what is already captured in forecasts (e.g. more aggressive electrification)
  - Mitigates the risk of needing to build transmission through already built up land

Next Steps

Your Feedback is Important

As you prepare your feedback, consider the following questions to guide feedback your feedback on the draft recommended plan for the Peel/Halton IRRP:

- What information needs to be considered in these recommendations?
- How can the Peel/Halton Technical Working Group continue to engage with communities as these recommendations are implemented, or to help prepare for the next planning cycle?

Please submit your feedback/written comments by email to engagement@ieso.ca by May 20th

Next Steps for Engagement

- Written feedback on options analysis and draft recommendations – due May 20th
  - *Reponses to be posted on IESO's website, with permission*
- IESO responses to feedback received – June 3
- Final Peel/Halton IRRP posted – end of Q2
- Ongoing discussion is encouraged through GTA/Central Regional Network to prepare for the next planning cycle and to facilitate monitoring

Keeping in Touch

- **Subscribe** to receive updates on the Peel/Halton regional electricity planning initiatives on the IESO website – select 'GTA West
- **Follow** the Peel/Halton regional planning activities on the dedicated engagement webpage
- **Join** the GTA/Central Regional Electricity Network on IESO Connects, providing a platform for ongoing engagement on electricity issues

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

Seeking Input on the Webinar

- Tell us about today
- Was the material clear? Did it cover what you expected?
- Was there enough opportunity to ask questions?
- Is there any way to improve these gatherings, e.g., speakers, presentations or technology?

Chat section is open for comments

Thank You

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Appendix: Glossary and Hourly Need Characterization

Glossary

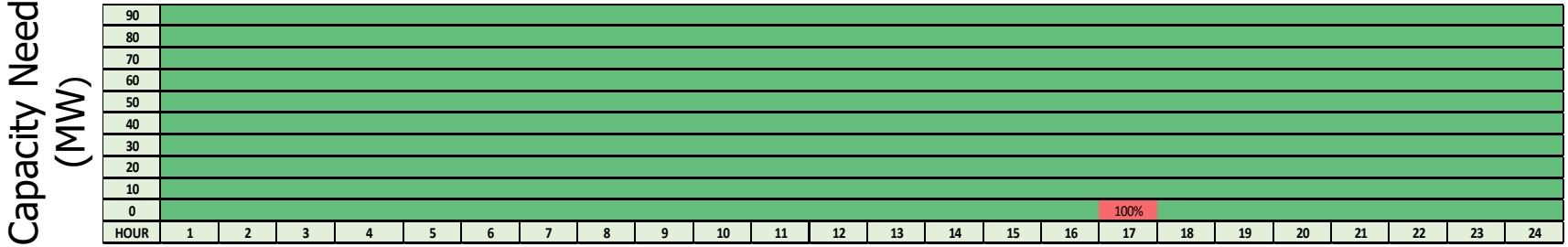
- N-1: A contingency involving the loss of any single element
- N-2: A contingency involving the simultaneous loss of 2 elements
- N-1-1: An outage on a single element followed by a subsequent contingency on another element
- Thermal Need: A limitation caused by high power flow beyond applicable equipment ratings
- Load Security Need: A limitation due to exceeding the maximum allowable loss of load by configuration or planned load curtailment
- Reconductoring: Replacing the conductors from an existing circuit with new, possibly higher rated, conductors

T38B/T39B N-G-1 Thermal Need

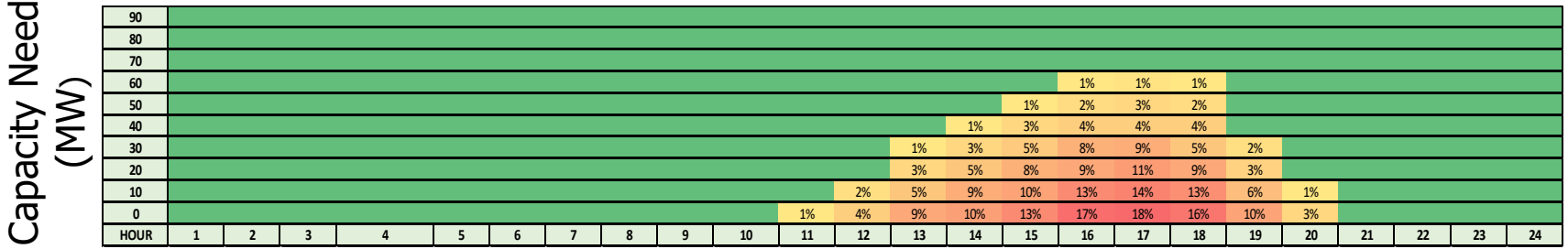
Key Metrics	2030	2038
Pocket	Halton Pocket excluding Tremaine TS	
LMC	506 MW	
Capacity Need (MW)	0.1	64.5
Number of Events per Year	1	31
Maximum Energy per Event (MWh)	0.1	370.7
Maximum Event Length (Hours)	1	10
Average Event Length (Hours)	1.0	5.6
Total Energy (MWh)	0.1	3915.7

T38B/T39B N-G-1 Thermal Need cont’

2030 Need



2038 Need



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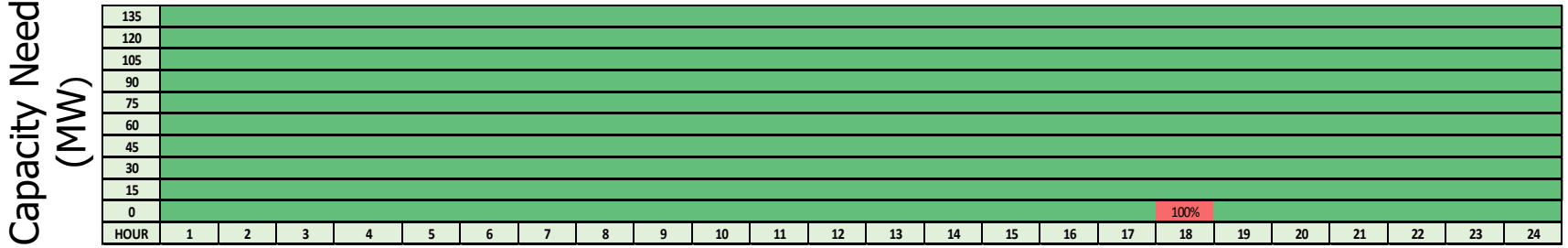
R19TH/R21TH N-1-1 Thermal Need

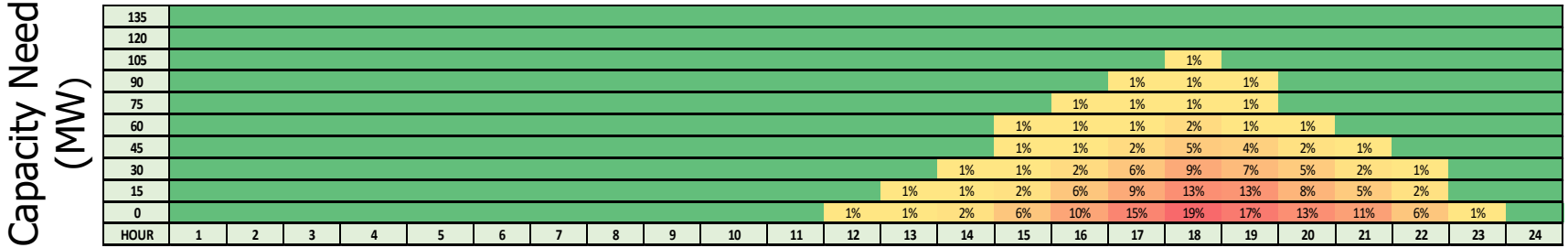
Key Metrics	2021	2038
Pocket	Pleasant Pocket	
LMC	368 MW	
Capacity Need (MW)	9.9	110.3
Number of Events per Year	2	24
Maximum Energy per Event (MWh)	9.9	693.2
Maximum Event Length (Hours)	1	12
Average Event Length (Hours)	1.0	5.3
Total Energy (MWh)	15.9	3154.4

R21TH/R19TH N-1-1 Thermal Need cont'

2021 Need



2038 Need



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T38B/T39B N-2 Load Security

Key Metrics	2025	2038
Pocket	Halton Pocket	
LMC	600 MW	
Capacity Need (MW)	9.0	170.0
Number of Events per Year	2	64
Maximum Energy per Event (MWh)	27.3	1481.1
Maximum Event Length (Hours)	4	14
Average Event Length (Hours)	3.5	7.0
Total Energy (MWh)	50.8	18340.9

Note: Hourly characterization of this need is included for completeness. NWAs/generation is not considered a suitable option for addressing this load security need.

T38B/T39B N-2 Load Security cont’

2025 Need

Capacity Need (MW)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
180																								
160																								
140																								
120																								
100																								
80																								
60																								
40																								
20																								
0															14%	29%	29%	29%						
HOUR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

2038 Need

Capacity Need (MW)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
180																								
160																0.2%	0.2%	0.2%						
140															0.2%	0.2%	0.2%	0.2%	0.2%					
120														0.2%	0.2%	0.4%	0.4%	0.4%	0.2%					
100													0.2%	0.2%	0.4%	1%	2%	2%	0.4%	0.2%				
80												0.2%	0.4%	1%	1%	2%	3%	3%	1%	0.2%				
60											0.2%	0.4%	1%	2%	3%	5%	6%	6%	2%	0.4%	0.2%			
40											0.4%	1%	2%	5%	6%	7%	9%	8%	4%	1%	0.4%	0.2%		
20										0.4%	1%	2%	5%	7%	9%	10%	11%	11%	7%	3%	1%	0.4%		
0										1%	2%	6%	8%	9%	11%	13%	14%	14%	10%	6%	3%	1%	0.2%	
HOUR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24