Ottawa Sub-Region
2019 Integrated Regional Resource Plan (IRRP)

Engagement Webinar #2

November 13, 2019

Today's Agenda

- Background on the Regional Planning Process
- Options Analysis
- Draft IRRP Recommendations
- Engagement and Next Steps

Purpose and Objective

- The purpose of this material is to:
  - Provide an update on the electricity planning and Integrated Regional Resource Plan (IRRP) development underway for Ottawa
  - Seek input on the analysis of options and draft IRRP recommendations for meeting local electricity needs over the 20-year plan period
- All interested parties are invited to review and provide comment on the proposed recommendations

Send feedback to engagement@ieso.ca by November 27, 2019

Seeking Input

As you listen today, please consider the following questions to guide feedback your feedback on the draft recommendations for the Ottawa Sub-region IRRP:

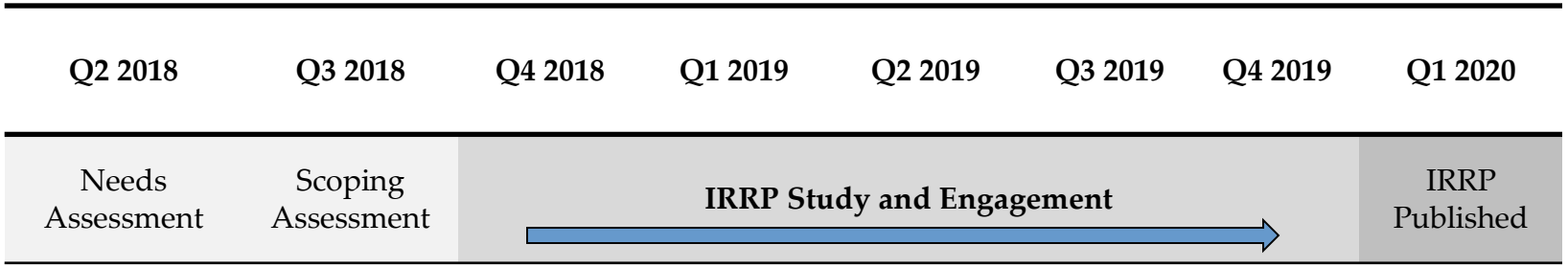
- What information needs to be considered in these recommendations?
- Is there community feedback to the proposed recommendations?
- How can the IRRP Working Group (including the IESO, Hydro Ottawa and Hydro One) continue to engage with the community as these recommendations are implemented, or to help prepare for the next planning cycle?

Please submit your written comments by email to engagement@ieso.ca by **November 27**

BACKGROUND ON THE REGIONAL PLANNING PROCESS

Current Status

- Current planning cycle began in Q3 2018, and an Integrated Regional Resource Plan (IRRP) is on track for completion this winter
- Currently in the recommendations and report drafting stages



2019 Engagement Activities

- Engagement initiative launched – May 9
- Public webinar and comment period on electricity demand forecast and preliminary needs – May 29 / June 12
- Potential solutions identified and studied based on feedback received and local needs; recommendations for IRRP developed – Q2 to present
- Meetings with City Councillors and municipal representatives – August 20 and October 17

How We Look at Local Reliability Needs

The "*Ontario Resource and Transmission Assessment Criteria*" establish typical long-term transmission planning levels

- Adequacy
  - The infrastructure must be capable of supplying the peak demand during extreme weather conditions (e.g., megawatts)
- Supply Security and Restoration
  - The system's ability to withstand a disturbance, such as the loss of a transformer or line
  - A limited amount of load may be disrupted by a disturbance, and must be restored within a specific timeframe

Municipal Issues are Driving Electricity Demand Trends

- Significant growth and development is increasing electricity demand across the City
  - new residential developments in previously agricultural areas, infill and intensification in many established areas, as well as major projects like the Ottawa LRT system.
- The City has supported the Energy Evolution mandate
  - It is too early to forecast specific impacts of related policies and programs
- Hydro Ottawa through its Smart Grid projects such as MiGen is investing to explore tools and market models that support a transactive future marketplace, to support the system and customers needs.

Recap: Local Reliability Needs in Ottawa

Four groups of reliability needs were identified as the focus for the Ottawa IRRP:

1) Supply to Kanata-Stittsville
2) Supply to Southeast Ottawa
3) Supply to East Ottawa
4) Supply to the regional 115 kV system

1) Kanata-Stittsville

- Several stations in the area are operating at or near their planning capacity
- Large commercial and residential developments are driving significant growth in electricity demand in the near- and medium-term (approximately 60 MW by 2037)
  - Including the Kanata-Stittsville North Community, Minto Arcadia, the Broccolini Business Park, and the Fernbank Community
- Hydro Ottawa is planning to implement distribution system upgrades to distribute forecast growth between stations in the area

2) Southeast Ottawa

- Several stations in the area are operating at or near their planning capacity
- Substantial amount of electricity load growth is forecasted (approximately 75 MW by 2037) driven by large residential, mixed, and industrial developments
  - Including the Leitrim Community, Riverside South, the Airport Lands, Hawthorne Industrial Park
- By 2021, Hydro Ottawa is planning to upgrade Limebank MTS and Uplands MTS which are already reaching their planning capacity
  - Preliminary assessment shows the Limebank MTS upgrade will exceed the capacity of the existing 115 kV transmission line, and will trigger the need for a transmission line upgrade

3) East Ottawa

- Bilberry Creek TS came into service in 1976 and is nearing end-of-life
  - The upcoming need for an end-of-life plan was identified in the 2015 IRRP
- Other stations in the area are operating at or near their planning capacity
- Large industrial and residential mixed use developments are forecasted to increase demand over the near- and medium-term (approximately 30 MW by 2037)
  - Including Orléans Industrial Park and the East Urban Community

4) Supply to the Regional 115 kV System

- Two transmission voltage levels are used for supply to Ottawa: 230 kV and 115 kV
- The 115 kV level is primarily used to supply central Ottawa, including the downtown area
- The 115 kV level is supplied from the 230 kV level at two transformer stations: Merivale TS and Hawthorne TS
  - The 230 kV level is part of the 'superhighway' connecting Ottawa to the Ontario bulk transmission system
- Several of the 230/115 kV transformers at Merivale and Hawthorne are operating at or near their capacity

What We Heard

- Feedback received* from a number of interested parties and several key themes emerged:
  - Strong interest in examining non-wires alternatives and importance of outlining analysis of options
  - Optimizing land use
  - Maintaining cost effectiveness
  - Reducing GHG emissions
  - Importance of alignment with municipal energy plans and other local initiatives

* http://www.ieso.ca/-/media/Files/IESO/Document-Library/engage/ottawa/Ottawa-IRRP-20190621-IESO-Responses.pdf?la=en

OPTIONS ANALYSIS

Identifying Options in the IRRP

- The Technical Working Group, led by the IESO, considers a range of options to address the identified needs:
  - Transmission expansion (e.g. a new or modified transformer station and transmission line)
  - Distribution solutions (e.g. transferring demand between transformer stations)
  - Distributed energy resources (e.g. distribution connected generation or storage)
  - Other demand-side options (e.g. energy efficiency measures, demand response, etc.)
- The appendix to these slides describes the non-wires resources considered in the Ottawa IRRP

Assessing Options

- Wires solutions are the traditional approach to supply planning, which didn't consider non-wires options
  - Proven, feasible means of achieving reliable electricity supply
  - 'Lumpy', as opposed to readily scalable
    - Providing a step change of capability, with a high up-front cost
  - Lock-in infrastructure that has a multi-decade useful life
- The IESO is developing methods for assessing the feasibility of non-wires options and their cost effectiveness relative to wires options
  - Non-wires resources can offer a more diverse set of services but usually cannot fully meet planning needs individually - must be combined into a package solution
- Current implementation of non-wires options through policy initiatives makes it challenging to target these resources to a location with a reliability need
  - The Ontario Energy Board is currently undertaking a policy consultation in response to significant stakeholder interest in regulatory changes

Assessing Options: Technical Ability to Address the Need

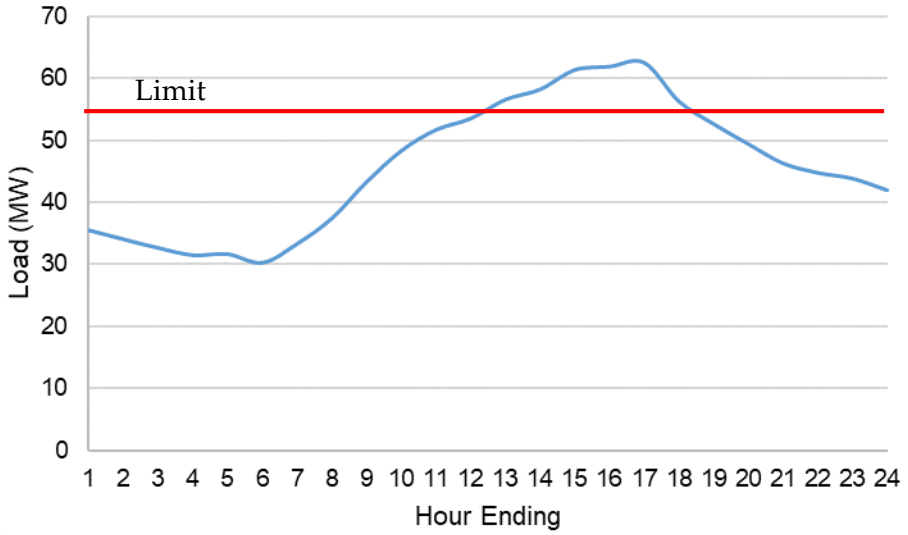
First and foremost, the Ottawa Sub-Region IRRP will prioritize options that can (either alone or in combination) provide the peak capacity (MW) needed and allow the transmission system to fulfill planning criteria.

- Traditionally, needs are identified based upon reliability planning criteria, peak demand forecasts, and the existing system load supply capability
- Non-wires options evaluation involves assessment of technical potential and the technology's ability to meet capacity requirements rather than energy needs

Assessing Options: Technical Ability to Address the Need (Cont'd)

- Nonetheless, additional work (hourly forecasts for multiple stations) was done during this IRRP to better understand the probabilistic nature of needs and how non-wires options might be called upon to fulfill these needs

Sample Hourly Profile for a Summer Peak Day in 2037 at Uplands MTS



Hourly forecasts can help answer questions such as:

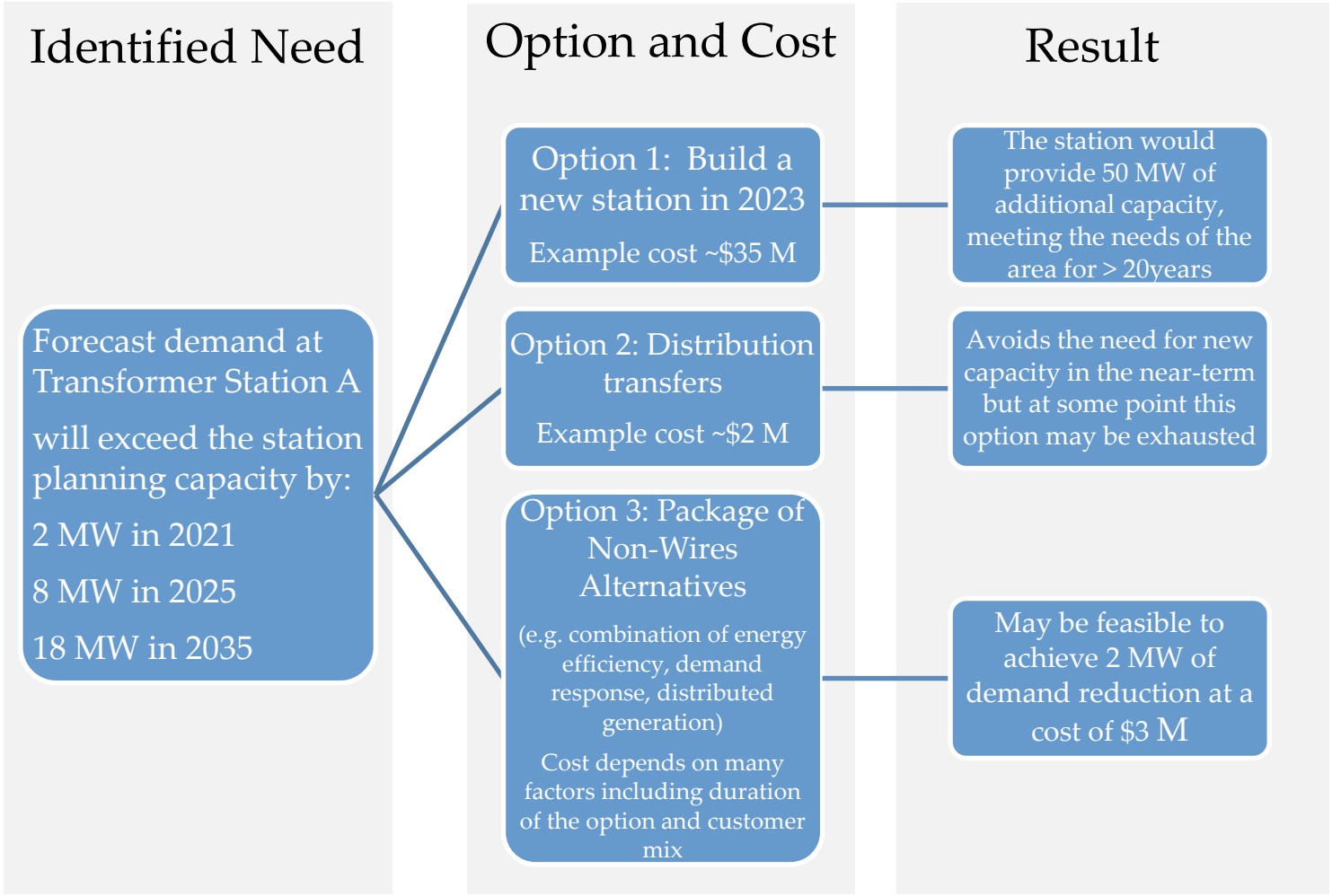
- How might energy efficient air conditioners translate to a local Ottawa peak demand reduction?
- If energy storage is installed, how should it be optimally sized?
- If demand response is recommended, how often would we call upon it? During what hours?

Assessing Options: Economic Considerations

Once a portfolio of feasible options is identified, cost is the main criteria used to select preferred option(s).

- Economic viability of an option is the cost-effective subset of its technical feasibility
- Discounted Cash Flow (DCF) analysis determines net present value (NPV) of annual net consumer costs
  - Options are "stacked" in order of cost-effectiveness and compared on an equivalent reliability basis until the MW need is solved
- Factors limiting economic potential can include: lack of benefits to the bulk or local system, customer response to payback, market barriers, and technological barriers
- Even as only preliminary estimates, this assessment approach considers different value streams to help more fairly compare, at a high level, the relative cost between all options

Example: Decision Tree



DRAFT IRRP RECOMMENDATIONS

Evaluating Options:
1) Kanata-Stittsville Area

1) There is insufficient station capacity to supply this area over the long-term – a plan for reliable long-term supply to the area is required

2) Non-wires alternatives have been evaluated as part of an integrated solution however the forecast supply gap is too large for non-wires solutions to entirely address
   - Demand growth in the area includes new customers who will require some amount of supply, notwithstanding efficiency

Evaluating Options:
1) Kanata-Stittsville Area (cont.)

3) Hydro Ottawa is planning to implement distribution system upgrades to distribute forecast growth between stations in the area

4) A new station will likely be required to provide reliable long-term supply in the area

- A high level screening has found that potential connection points on the existing transmission system are sub-optimal
- The IESO is currently developing a bulk transmission plan that may include transmission expansion in Kanata-Stittsville, resulting in a preferable connection option for a new supply station

IRRP Recommendations:
1) Kanata-Stittsville Area

- In the near-term, it would be beneficial to target system cost-effective energy efficiency and pursue other cost-effective non-wires alternatives to this area in order to reduce reliability the risk arising from heavily loaded stations
- The Working Group will monitor demand growth in the Kanata-Stittsville area and initiate the next regional planning cycle early, if required
- A plan for reliable long-term supply in the Kanata-Stittsville area will be confirmed in the next regional planning cycle
  - Will consider potential new supply options that may result from the IESO's ongoing bulk transmission planning study for the area that is expected to be completed in 2020

Evaluating Options:
2) Southeast Ottawa

1) There is insufficient station capacity to supply this area over the long-term – a plan for reliable long-term supply to the area is required
   - Existing supply infrastructure in this area is relatively sparse

2) Non-wires alternatives have been evaluated as part of an integrated solution however the forecast supply gap is too large for non-wires solutions to entirely address
   - Demand growth in the area includes new customers who will require some amount of supply, notwithstanding efficiency

Evaluating Options:
2) Southeast Ottawa (cont.)

3) Hydro Ottawa is planning to increase the supply capacity of two stations in the area: Uplands MTS and Limebank MTS

- In order to utilize the increased capacity at Limebank MTS the 115 kV supply circuit will likely need to be upgraded
  - The specific requirements for this line upgrade will be confirmed in subsequent planning and approval steps to implement this project

4) Planning must begin for a new supply station due to the timing and magnitude of growth

- Demand growth at Uplands MTS is forecast to exceed the expanded station planning capacity by 2025
- Demand growth at Limebank MTS is forecast to exceed the expanded station planning capacity by 2028

IRRP Recommendations:
2) Southeast Ottawa

- Hydro Ottawa will proceed with a plan to build a new 230 kV connected supply station in the southeast part of the City
  - In addition to capacity increases and transfers between existing stations
  - This will provide a new supply station in an area of the City that doesn't have a lot of station capacity, reducing distribution distances

Evaluating Options:
3) East Ottawa

1) With the station end-of-life approaching, the Working Group has been monitoring demand trends in the Bilberry Creek/Orléans area since the last IRRP
   - A decision on the future of the station must be made several years ahead of the end-of-life date in order to ensure continuous reliable supply

2) Several stations surrounding Bilberry Creek TS are at or near their planning capacity, leaving limited potential to transfer customers currently supplied by Bilberry Creek TS if the station were retired
   - In order to retire Bilberry Creek a new station would need to be built in the area

IRRP Recommendations:
3) East Ottawa

- Hydro One will refurbish Bilberry Creek TS, including like-for-like transformer replacement
  - Refurbishing Bilberry Creek TS is less impactive and less costly than building a new station to replace the capacity if Bilberry Creek TS were retired
- Hydro One will expand the station to provide two additional breaker positions to supply Hydro Ottawa customers
- Based on the IRRP forecast, this station will provide adequate capacity in East Ottawa until the early 2030s

Evaluating Options:
4) Supply to the Regional 115 kV System

1) One of the two existing 230/115 kV transformers at Merivale TS has a lower rating than the other
   - This imbalance is currently limiting the supply to the 115 kV system
   - Replacing the most limiting transformer will provide a small increase to supply capacity, but is not a long-term solution

2) The regional pressure on the 115 kV system has been factored into recent supply station planning decisions
   - New South Nepean station and planned southeast station will both be connected to the 230 kV system

3) More analysis is required before committing to a long-term solution, which may have a high cost

IRRP Recommendations:
4) Supply to the Regional 115 kV System

- Hydro One will replace the more limiting of the 230/115 kV transformers at Merivale TS in the near-term so that the two Merivale transformers have similar capacity
  - This transformer came into service in 1978
  - Once the above transformer is upgraded, demand on the 115 kV system is expected to exceed the supply capability of the six 230/115 kV transformers by the mid 2020s

Supply to the Regional 115 kV Transmission System: IRRP Addendum Study

- Subsequent to the release of this IRRP, the Working Group will undertake an IRRP Addendum Study
  - The Addendum Study will be completed in mid-2020
  - Will be integrated with the IESO's ongoing bulk transmission planning study
  - Planning large and growing regions of the province is an ongoing activity
- The Addendum Study will include an evaluation of the potential benefit of non-wires options to manage future demand growth in central Ottawa

Summary of Key IRRP Recommendations

Kanata-Stittsville: Target system cost-effective energy efficiency and pursue other cost-effective non-wires alternatives; monitor demand growth in the area and evaluate connection options for a new supply station once the bulk transmission plan for the area is complete

South East Ottawa: Build a new 230 kV connected supply station

East Ottawa: refurbish and expand Bilberry Creek TS

Supply to the Regional 115 kV System: replace the more limiting of the 230/115 kV transformers at Merivale TS; undertake an IRRP Addendum Study to confirm a plan for reliable long-term supply to the 115 kV system, including potential of non-wires alternatives to manage future demand growth

ENGAGEMENT AND NEXT STEPS

Next Steps

- Feedback due on draft IRRP recommendations – November 27, 2019
- IESO responses to feedback received posted – December 6, 2019
- Final IRRP posted – January 2020

Seeking Input

As you listen today, please consider the following questions to guide feedback your feedback on the draft recommendations for the Ottawa Sub-region IRRP:

- What information needs to be considered in these recommendations?
- Is there community feedback to the proposed recommendations?
- How can the IRRP Working Group (including the IESO, Hydro Ottawa and Hydro One) continue to engage with the community as these recommendations are implemented, or to help prepare for the next planning cycle?

Please submit your written comments by email to engagement@ieso.ca by **November 27**

Continuing the Dialogue

- A series of five Regional Electricity Networks will be launched this fall to enable ongoing dialogue with communities
  - Membership is open to all interested parties
  - Join discussions and provide input on key electricity matters affecting them and their community
- Participants who join can count on the IESO to provide information on a regular basis, and to host an annual regional electricity forum
- To learn more or join your network, please visit http://www.ieso.ca/Get-Involved/Regional-Planning/Electricity-Networks/Overview

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APPENDIX

Overview of All Options Considered

Resource Type	Description	Levelized Unit Energy Cost ($/kW-yr)	Potential Implementation Lead or Host
Energy Efficiency	Technologies and operational measures that increase the efficiency of electricity usage at the end-use level. Examples include programs for high-efficiency HVAC equipment or LED lighting.	$85 - $240*	Varies; IESO, LDCs, customers, third-party service providers. Province-wide programs centrally delivered by IESO until end of 2020.
Lithium Battery Energy Storage	Energy is stored and then dispatched during times of need.	$379 - $555	Varies; LDCs, third-party service providers, customers.
Demand Response	Curtailment of electricity consumption targeting specific hours when a need occurs; considered to be a dispatchable resource that responds to price signals or is implemented through contractual obligations.	$50 - $60**	Varies; LDCs, customers, third-party service providers, IESO.

*Based upon the 2019 Achievable Potential Study

**Based upon 2019 demand response auction clearing prices

Overview of All Options Considered (Cont'd)

Resource Type	Description	Levelized Unit Energy Cost ($/kW-yr)	Potential Implementation Lead or Host
Solar Generation	Solar panels (typically rooftop or ground-mounted) installed to provide electricity.	$165	Varies
Distribution-Level Load Transfers	Distribution feeders that are built to redistribute the LDC's load supply in a local area and relieve station-specific capacity needs.	Varies*	LDC
Natural Gas Generation	Simple Cycle Gas Turbine (SCGT): natural gas power plant whose waste heat is not used; best for peak power needs on the electric grid. Combined Heat and Power (CHP): gas generation providing both electricity and heat (for end-use).	$160 - $235 $290 - $400	Varies
Transmission Facilities	"Wires" reinforcements (transformer stations, lines, etc) on the higher-voltage transmission system.	$2 - $6	Transmitter

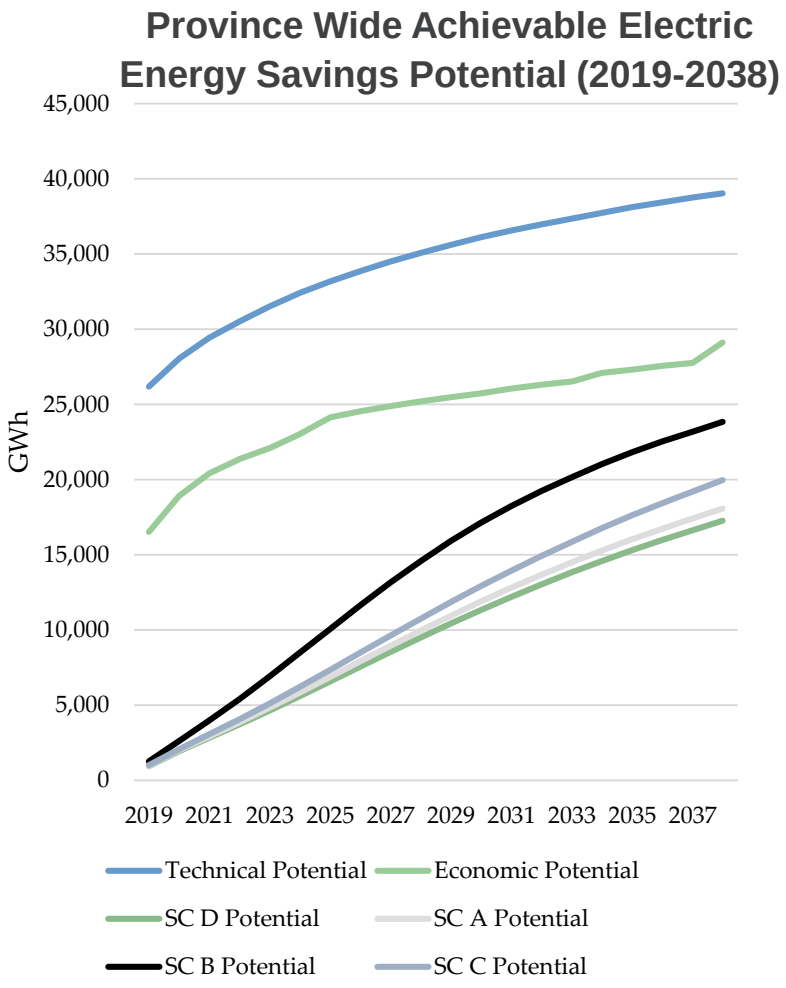
*Likely more comparable to cost of transmission facilities

Calculating Energy Efficiency Potential

- The IESO and the Ontario Energy Board have recently completed the first integrated electricity and natural gas achievable potential study in Ontario (2019 APS)

- The main objective of the APS is to identify and quantify energy savings (electricity and natural gas), GHG emission reductions and associated costs from demand side resources for the period from 2019-2038.

- The study shows a significant and sustained potential for energy and efficiency across all sectors and is used to inform:
  - future energy efficiency policy and/or frameworks
  - program design and implementation
  - long-term resource planning



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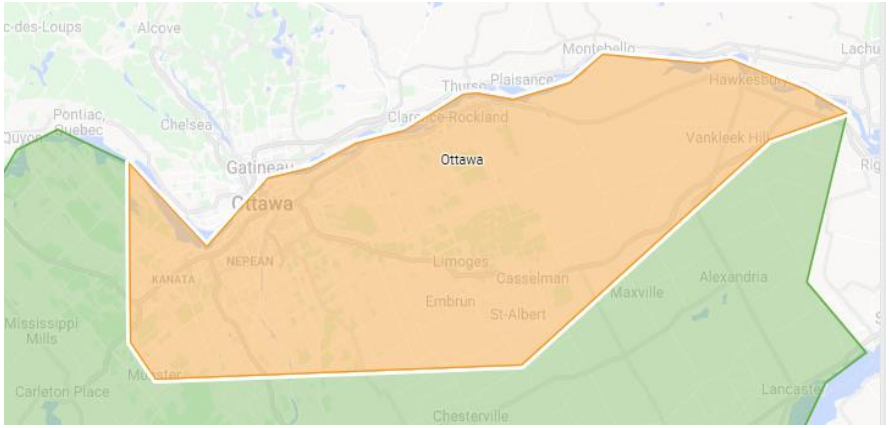
Calculating Energy Efficiency Potential

- 2019 APS results are broken out by IESO transmission zone, customer segment (e.g., single family dwellings, multi unit residential buildings, large commercial office, restaurant, school, warehouse, etc.) as well as by end use (e.g., lighting, space heating, space cooling, plug load, etc.).
- Using local data (i.e., MPAC, Broader Public Sector energy use database, Dunn and Bradstreet) energy and demand savings for the Ottawa transmission zone can be allocated to the IRRP study area to reflect the customer base located in the region.
- The analysis on subsequent slides shows the amount of energy efficiency potential that can likely be achieved in the area along with associated costs.
- A next step will be to identify the proportion of this savings that is cost effective considering province wide as well as local system benefits to inform future resource planning.

Ottawa Transmission Zone



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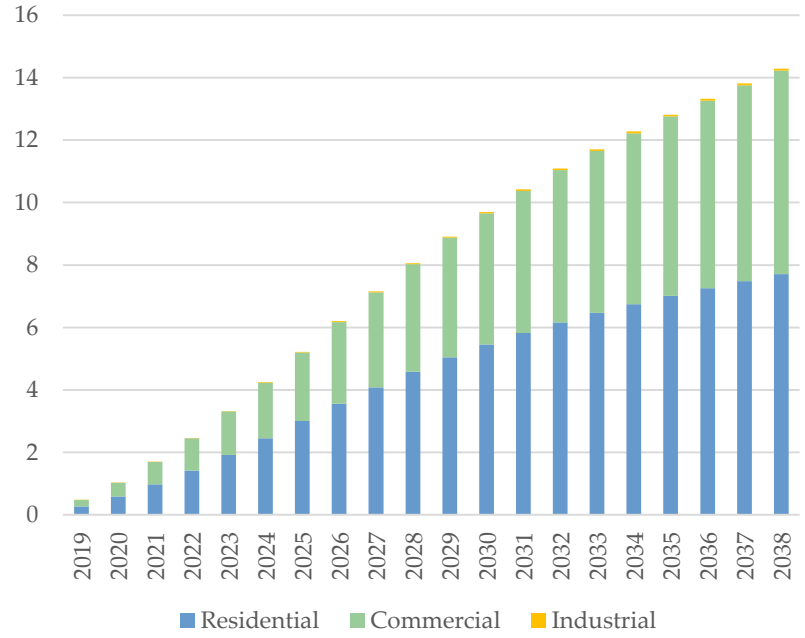
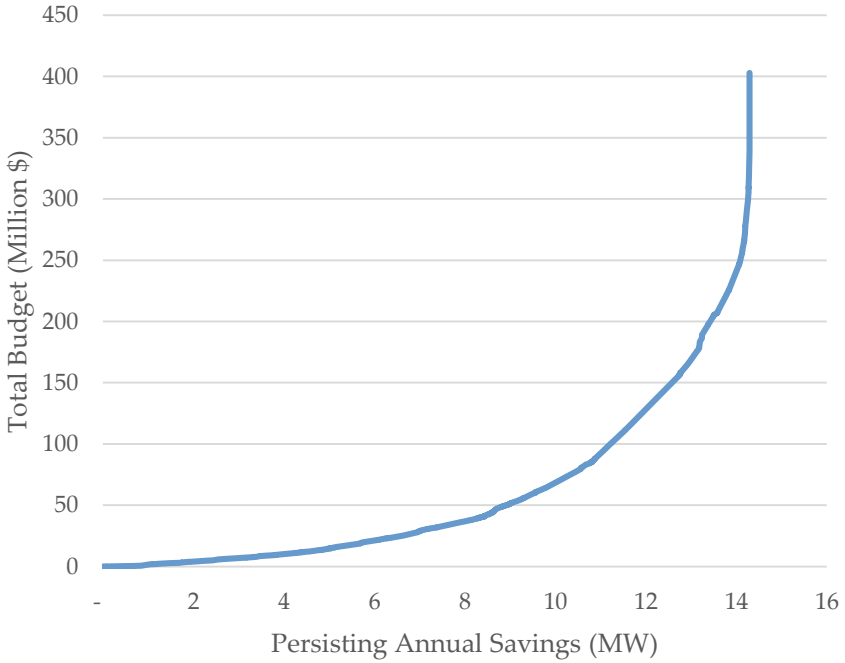
West Region Potential

West Cumulative Summer Peak Demand Saving Potential (MW)



West Cost Curve in 2038 Summer Peak Demand Potential



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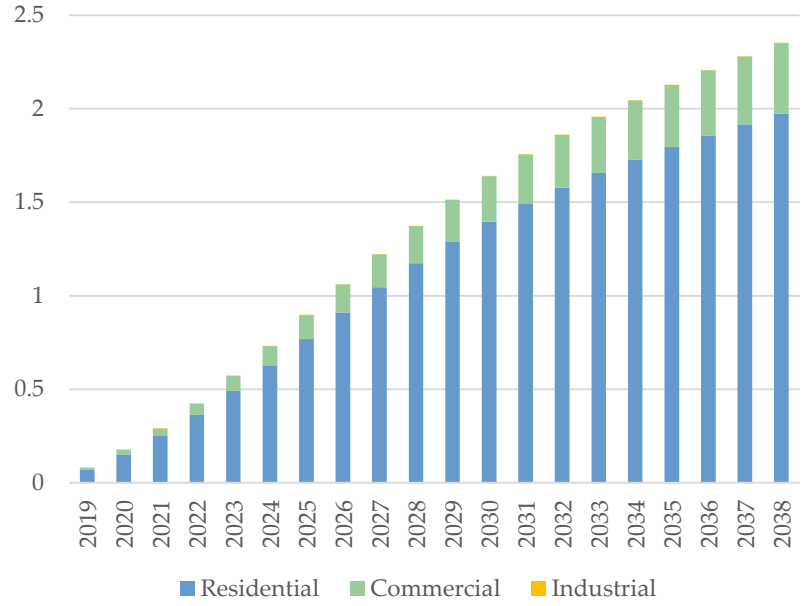
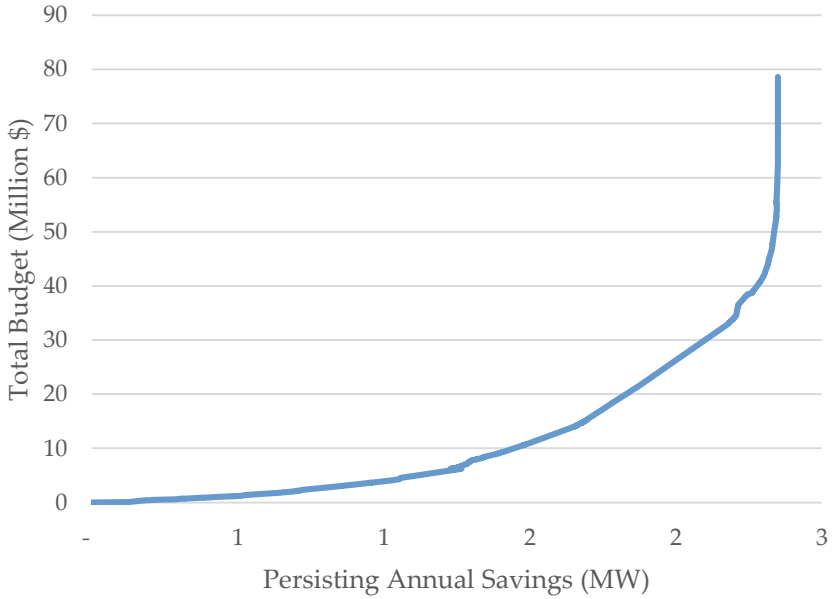
Uplands Potential

Uplands Cumulative Summer Peak Demand Saving Potential (MW)



Uplands Cost Curve in 2038 Summer Peak Demand Potential



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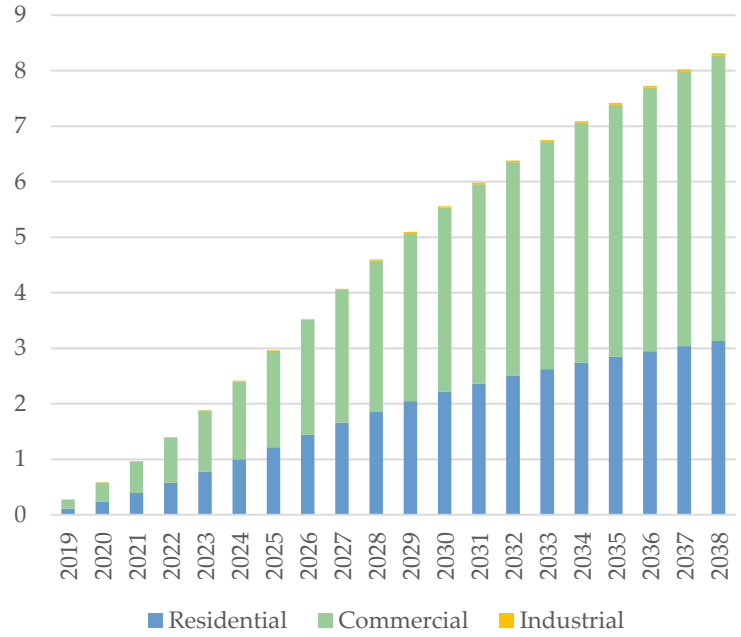
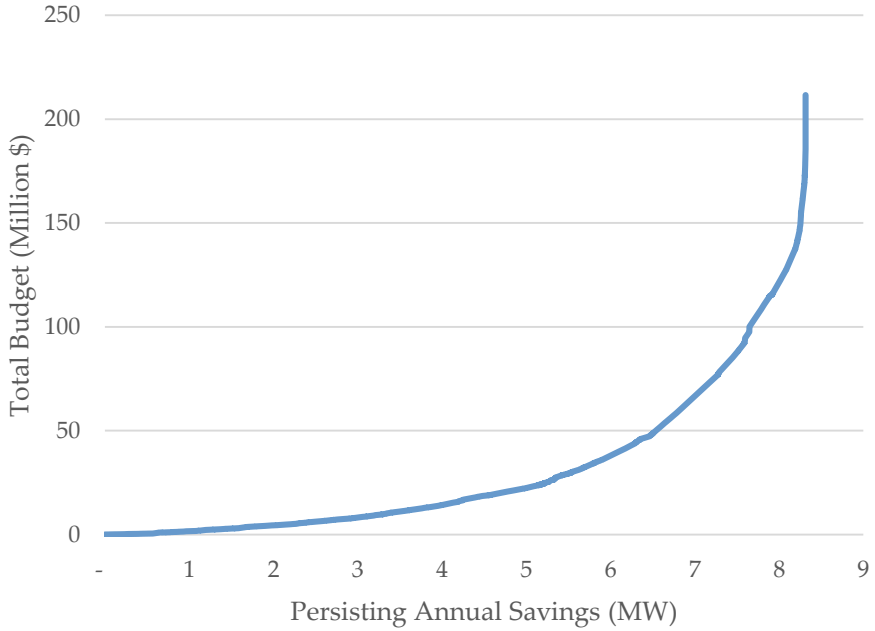
Orleans Potential

Orleans Cumulative Summer Peak Demand Saving Potential (MW)



Orleans Cost Curve in 2038 Summer Peak Demand Potential



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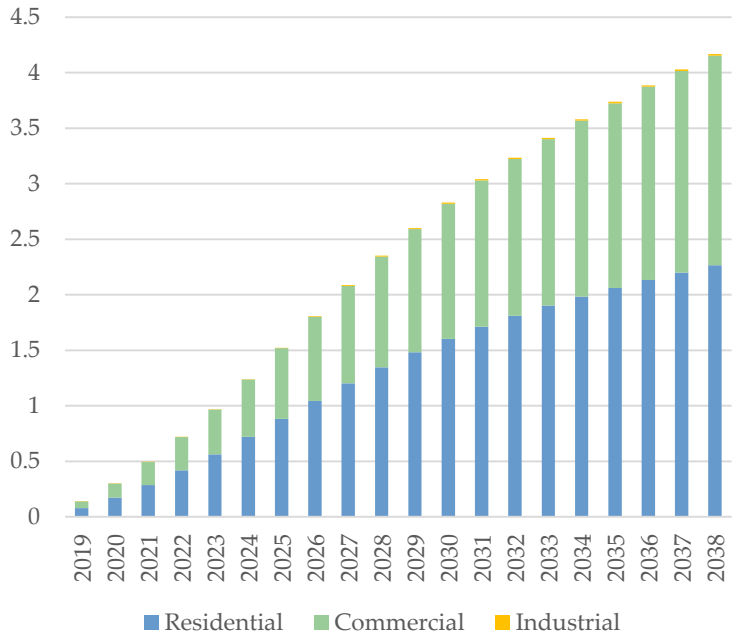
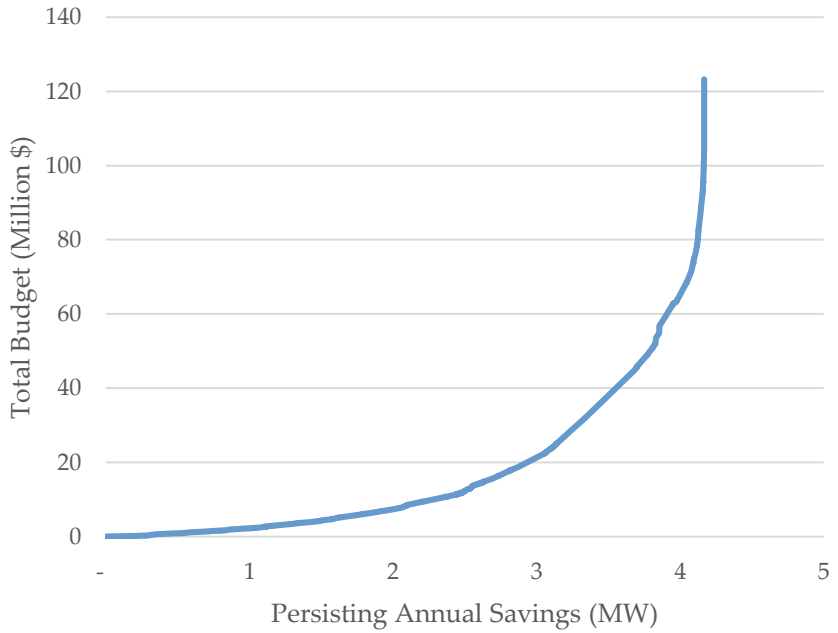
Bilberry Potential

Bilberry Cumulative Summer Peak Demand Saving Potential (MW)



Bilberry Cost Curve in 2038 Summer Peak Demand Potential



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Top Commercial Demand Reducing Measures in 2023 (Ottawa Zone)

Measure Name	Demand Reduction Potential (MW)	Energy Savings Potential (GWh)	Levelized Unit Energy Cost ($/kWh)	Levelized Unit Demand Cost ($/kW)
Com | Building Recommissioning, Operations and Maintenance (O&M) Improvements	27.7	228	$0.02	$187
Com | Education and Capacity Building/Energy Behavior	20.4	70	$0.07	$231
Com | Variable Refrigerant Flow Heat Pump	18.5	64	$0.08	$272
Com | LED Low/High Bay	16.3	113	$0.03	$231
Com | LED Troffer/Surface/Suspended	10.8	82	$0.02	$141
Com | Central Lighting Control System	10.0	71	$0.53	$3,934
Com | ENERGY STAR LED LAMPS (REFLECTOR LAMPs/MR16/PAR 16)	9.6	73	$0.02	$175
Com | Advanced BAS/Controllers	7.4	26	$0.02	$83
Com | High Efficiency Air Source Heat Pump	6.2	21	$0.00	$13
Com | Furnace Tune-Up	4.7	92	$0.00	$32
Com | Unitary Air-Conditioning Unit	4.4	7	$0.07	$106
Com | Smart Strip Plug Outlets	3.8	31	$0.14	$1,131
Com | Adaptive Thermostats	3.2	11	$0.04	$131
Com | Strip Curtains	2.5	20	$0.00	$21
Com | Data Center Storage/Server Virtualization	2.2	18	-$0.06	-$485
Com | Demand Control Ventilation	2.1	19	$0.16	$1,436
Com | Adding reflective (White) roof treatment or a green roof	2.0	7	$2.60	$8,939
Com | LED or Equivalent Sign Lighting	2.0	12	$0.01	$67
Com | Refrigerated Display Case Doors	1.9	16	$0.05	$369
Com | Refrigerated Display Case LED	1.8	8	$0.04	$207

Top Residential Demand Reducing Measures in 2023 (Ottawa Zone)

Measure Name	Demand Reduction Potential (MW)	Energy Savings Potential (GWh)	Levelized Unit Energy Cost ($/kWh)	Levelized Unit Cost Savings ($/kW)
Res | Energy Star Central Air Conditioner	18	30	$0.36	$625
Res | Adaptive Thermostat	12	42	$0.10	$331
Res | Smart Power Bar	7	149	$0.04	$969
Res | Variable Speed Pool Pump Motor	6	40	$0.03	$156
Res | Ductless Mini-Split Heat Pump	6	20	$0.01	$26
Res | Building Recommissioning, Operations and Maintenance (O&M) Improvements	4	14	$0.01	$19
Res | Basement Wall Insulation	4	14	$0.01	$47
Res | Smart Burners	4	21	$0.05	$289
Res | Basement or Crawlspace Insulation	4	12	$0.44	$1,511
Res | Attic Insulation	3	11	$0.08	$258
Res | Energy Star Refrigerator	3	25	$0.22	$1,717
Res | Energy Star Clothes Washer	3	22	$0.03	$266
Res | Wall Insulation	3	9	$0.44	$1,522
Res | Energy Star LED Bulbs General Purpose LEDs	2	44	$0.01	$183
Res | Duct Insulation	2	7	$0.17	$586
Res | Ductless Mini-Split Air Conditioner	2	3	$0.22	$369
Res | Variable Refrigerant Flow Heat Pump	1	5	$0.08	$277
Res | Lighting Motion Sensors, Timers, Dimmers	1	6	$0.13	$542
Res | Central Air Conditioner Maintenance	1	2	$2.55	$4,370
Res | Energy Star Ground Source Heat Pump	1	4	$0.16	$544

Top Industrial Demand Reducing Measures in 2023 (Ottawa Zone)

Measure Name	Demand Reduction Potential (MW)	Energy Savings Potential (GWh)	Levelized Unit Energy Cost ($/kWh)	Levelized Unit Demand Cost ($/kW)
Ind | Pump System Optimization	1.3	12	$0.04	$360
Ind | HE Lighting	1.2	9	$0.05	$398
Ind | Air Leak Survey and Repair	1.1	9	$0.02	$134
Ind | SEM	1.0	8	$0.01	$54
Ind | Recommissioning	1.0	8	$0.02	$162
Ind | Air Compressor Optimization	0.9	7	$0.00	$32
Ind | Pump Equipment Upgrade	0.9	8	$0.04	$366
Ind | Efficient Compressed Air Nozzles	0.6	5	$0.00	$22
Ind | Process Optimization (Elec)	0.4	3	$0.02	$162
Ind | Greenhouse Grow Lights	0.4	3	$0.05	$342
Ind | Fan System Optimization	0.3	1	$0.04	$148
Ind | Premium Efficient Motors	0.2	2	$0.13	$1,073
Ind | High Efficiency HVAC Fans	0.2	2	$0.01	$126
Ind | Improved Controls - Process Cooling	0.2	0	$0.02	$29
Ind | HE HVAC Controls	0.2	1	$0.17	$1,525
Ind | HVLS Fans	0.1	0	$0.15	$427
Ind | Ventilation Optimization	0.1	0	$0.08	$264
Ind | HE HVAC Units	0.1	1	$0.68	$6,151
Ind | Free Cooling	0.1	0	$0.07	$111
Ind | Material Handling Improvements	0.1	1	$0.01	$53