DEMAND OUTLOOK UPDATE

Prepared for discussion with Ministry of Energy

June 20, 2017

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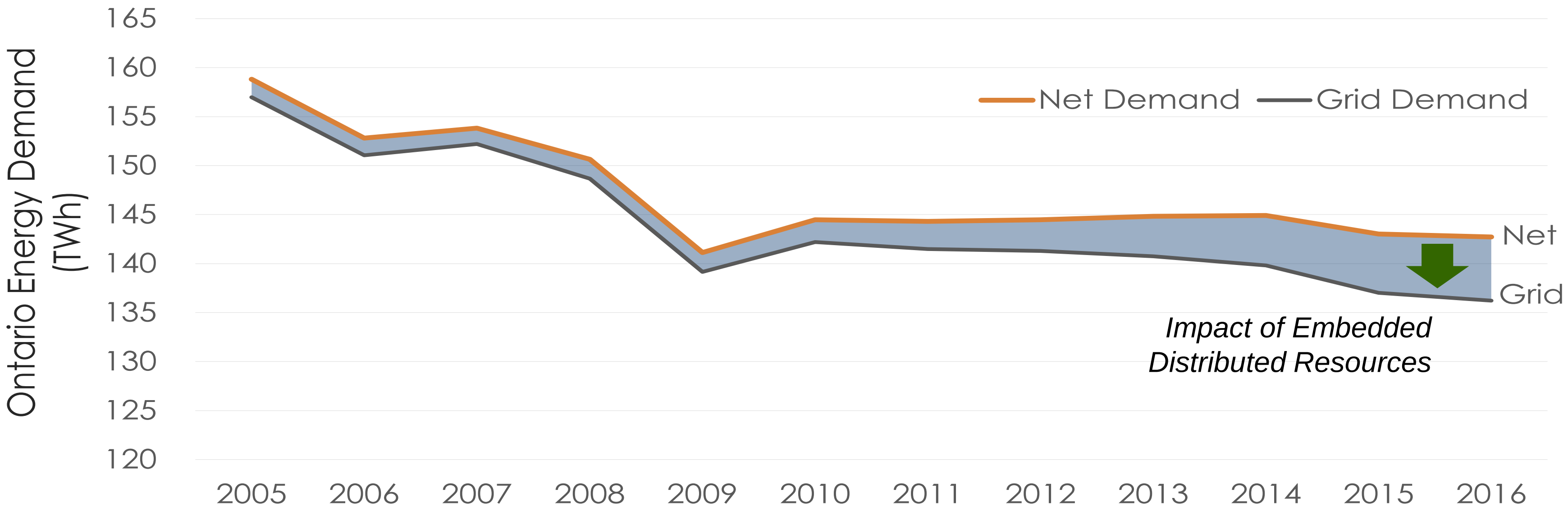
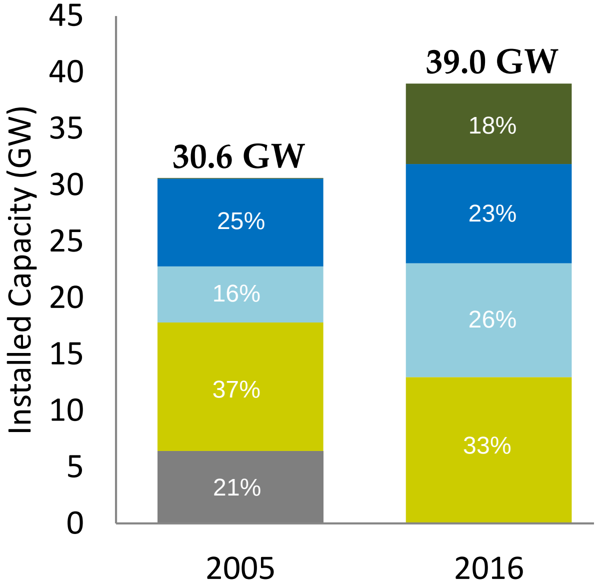
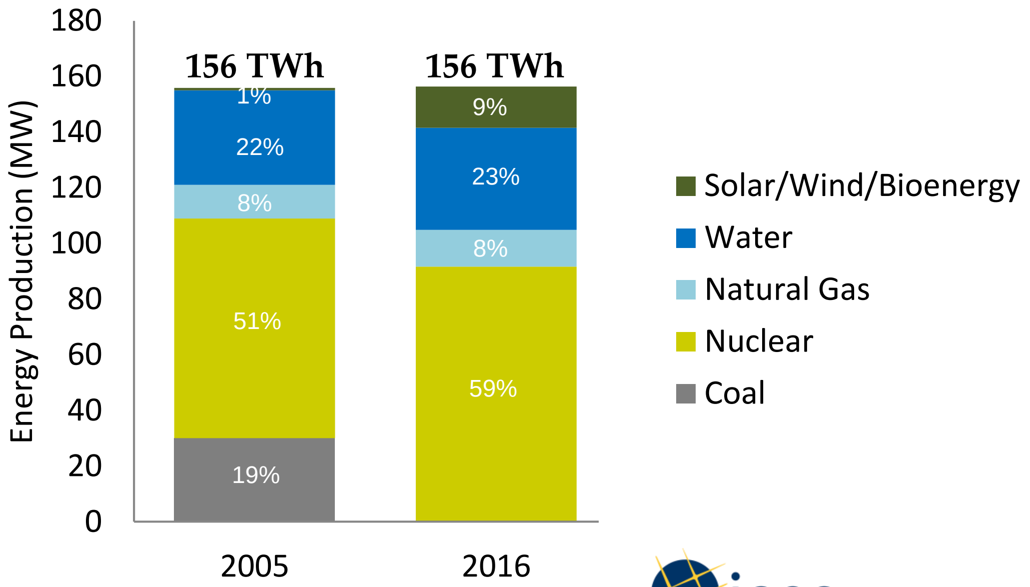
Purpose

- To provide an overview of the IESO's updated electricity demand outlooks developed to inform the preparation of the 2017 Long-Term Energy Plan

Ontario's electricity system over the past decade







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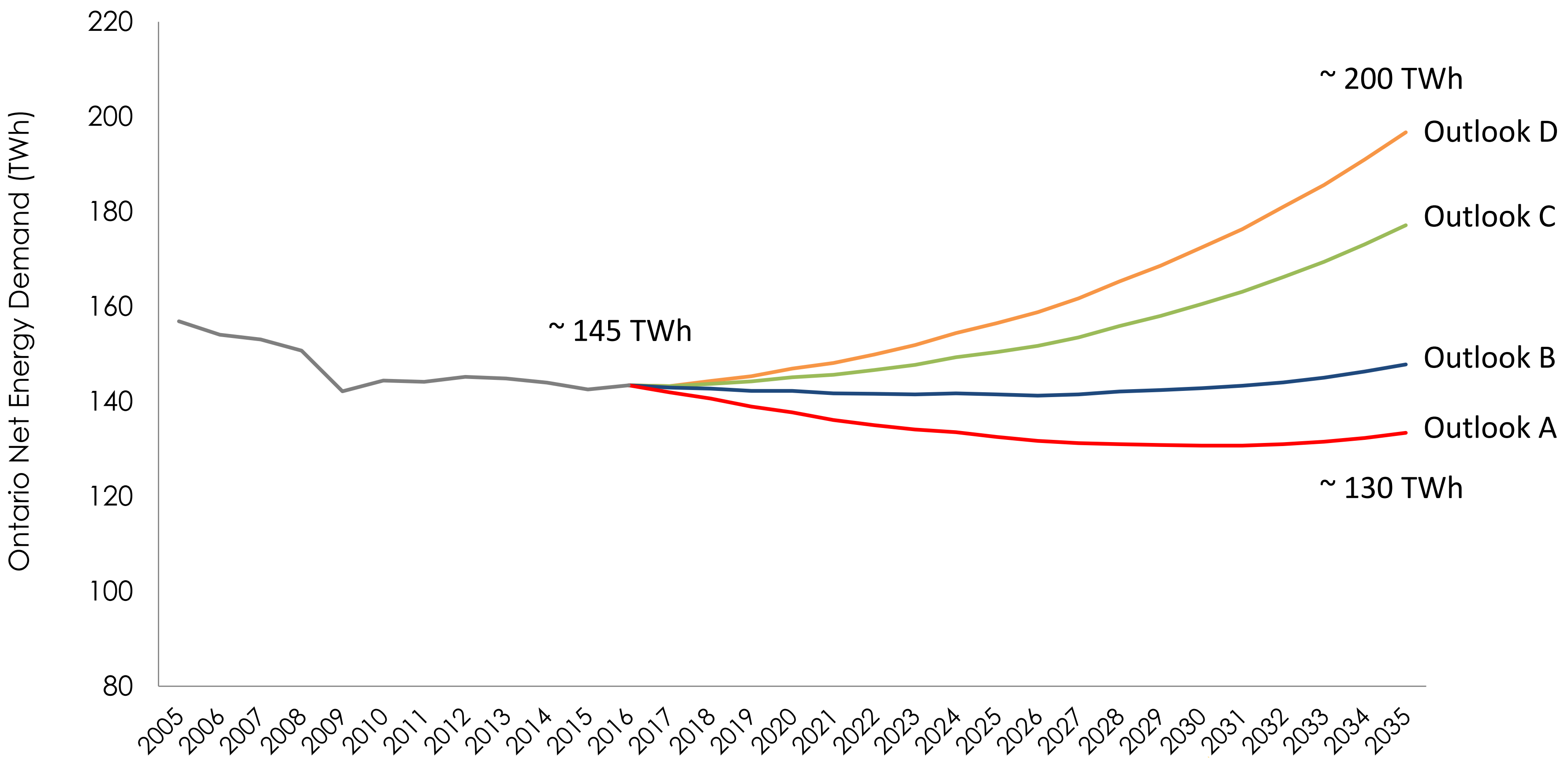
The bar charts include embedded distributed resources.

Four energy demand outlooks considered in the 2016 Ontario Planning Outlook

- Outlook A (or "low demand outlook") explored the implications of lower electricity demand
- Outlook B (or "flat demand outlook") explored a level of long-term demand that roughly matches the level of demand that exists today
- Outlooks C and D (or "higher demand outlooks") explored higher levels of demand



Outlooks A through D per 2016 Ontario Planning Outlook report.

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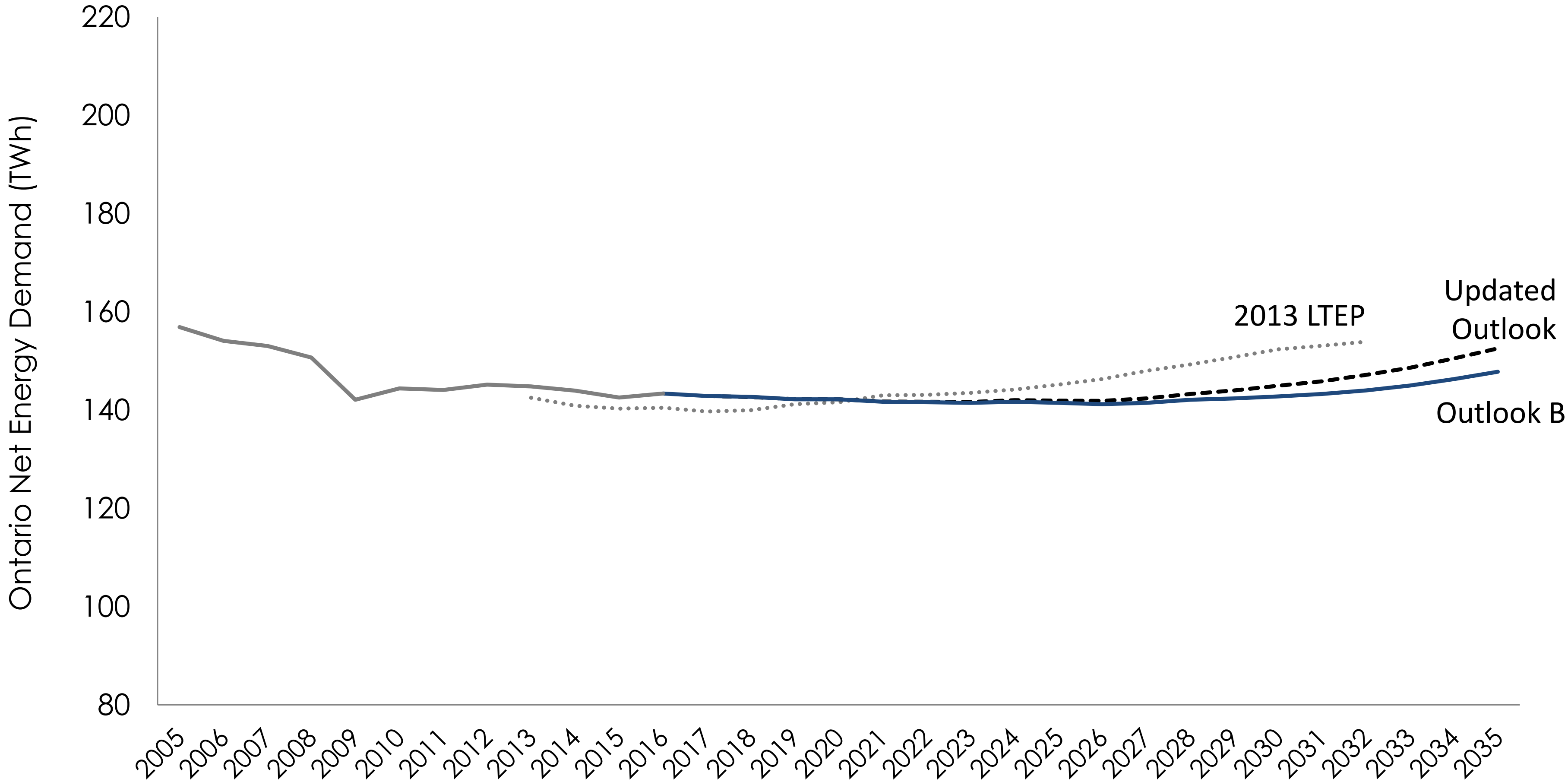
Updated energy demand outlooks

- Updated energy demand outlook is about 5 TWh higher than the OPO Outlook B, by 2035. The updated outlook reflects an accelerated increase in electric vehicles.



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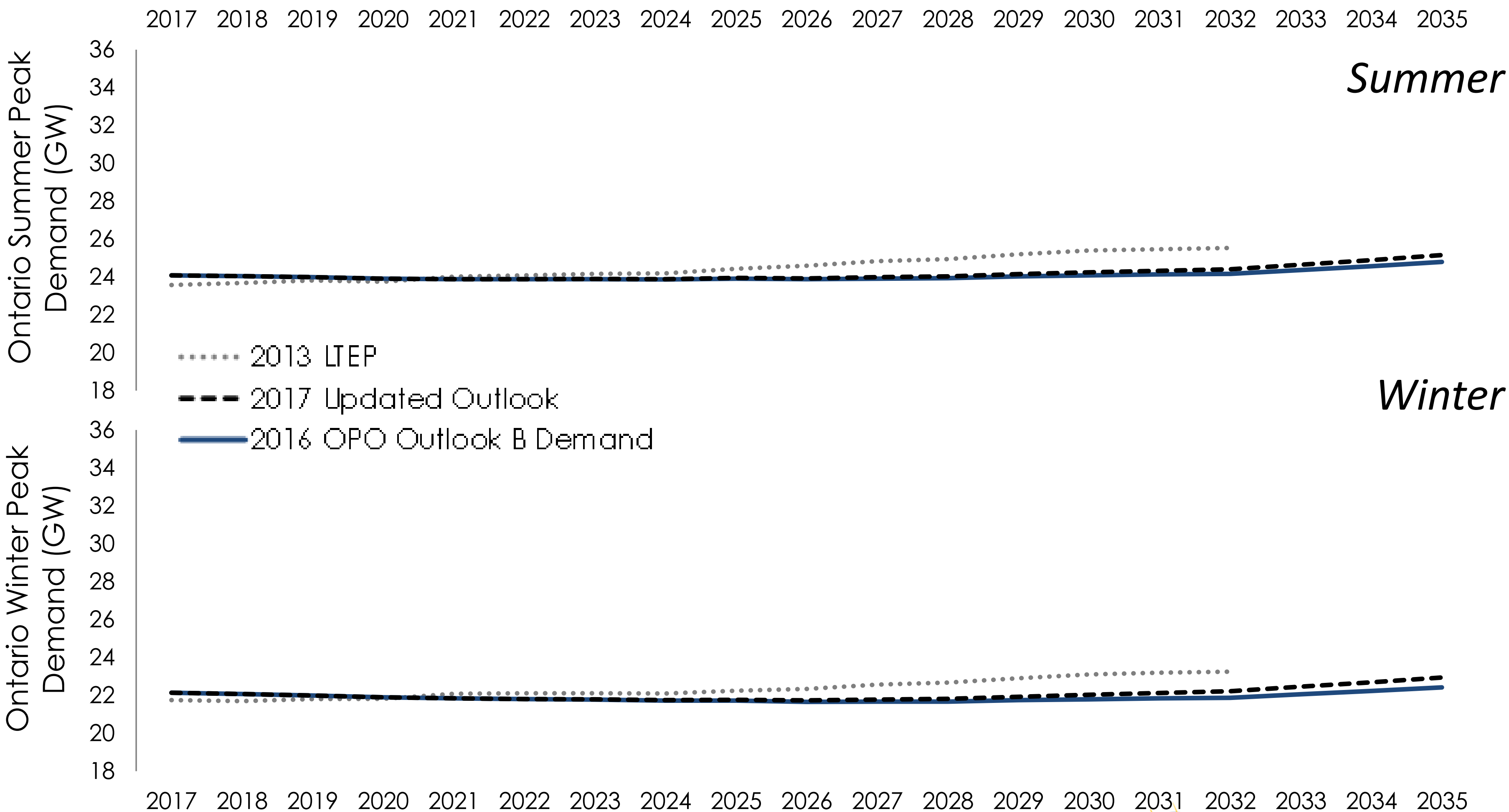
Updated peak demand outlooks

- Relative to OPO Outlook B, the updated outlook sees peak increase by about 400 MW in the summer and 500 MW in the winter due to higher demand from electric vehicles



Energy demand by sector for each outlook, with key assumptions

Sector	Outlook A	Outlook B	2017 Updated Outlook	Outlook C	Outlook D
Residential (52 TWh in 2015)	48 TWh in 2035	51 TWh in 2035	Same as Outlook B	Oil heating switches to heat pumps, electric space and water heating gain 25% of gas market share (58 TWh in 2035)*	Oil heating switches to heat pumps, electric space and water heating gain 50% of gas market share (64TWh in 2035)
Commercial (51 TWh in 2015)	49 TWh in 2035	54 TWh in 2035	Same as Outlook B	Oil heating switches to heat pumps, electric space and water heating gain 25% of gas market share (63 TWh in 2035)	Oil heating switches to heat pumps, electric space and water heating gain 50% of gas market share (69 TWh in 2035)
Industrial (35 TWh in 2015)	29 TWh in 2035	35 TWh in 2035	Same as Outlook B	5% of 2012 fossil energy switches to electric equivalent (43 TWh in 2035)	10% of 2012 fossil energy switches to electric equivalent (51 TWh in 2035)
Electric Vehicles (<1 TWh in 2015)	2 TWh in 2035	3 TWh in 2035	Same as Outlook C and D	2.4 million electric vehicles (EVs) by 2035 (8 TWh in 2035)	2.4 million EVs by 2035 (8 TWh in 2035)
Transit (<1 TWh in 2015)	1 TWh in 2035	1 TWh in 2035	Same as Outlook B	Planned projects, 2017-2035 (1 TWh in 2035)	Planned projects, 2017-2035 (1 TWh in 2035)
Other**	5 TWh	5 TWh	Same as Outlook B	5 TWh	5 TWh
Total* (143 TWh in 2015)**	**133 TWh in 2035**	**148 TWh in 2035**	**153 TWh in 2035**	**177 TWh in 2035**	**197 TWh in 2035**

Note: Outlooks C and D assume the same economic drivers as Outlook B.
* By 2035, of the number of natural gas fuelled space and water heating equipment being sold in Outlook B (due to existing equipment reaching end of life and new additions driven by growth in the residential and commercial sectors), 25 percent of this stock in Outlook C and 50 percent in Outlook D is replaced with air-source heat pumps.
** Others = Agriculture, Remote Communities, Generator Demand, IEI and Street Lighting
*** Total may not add up due to rounding

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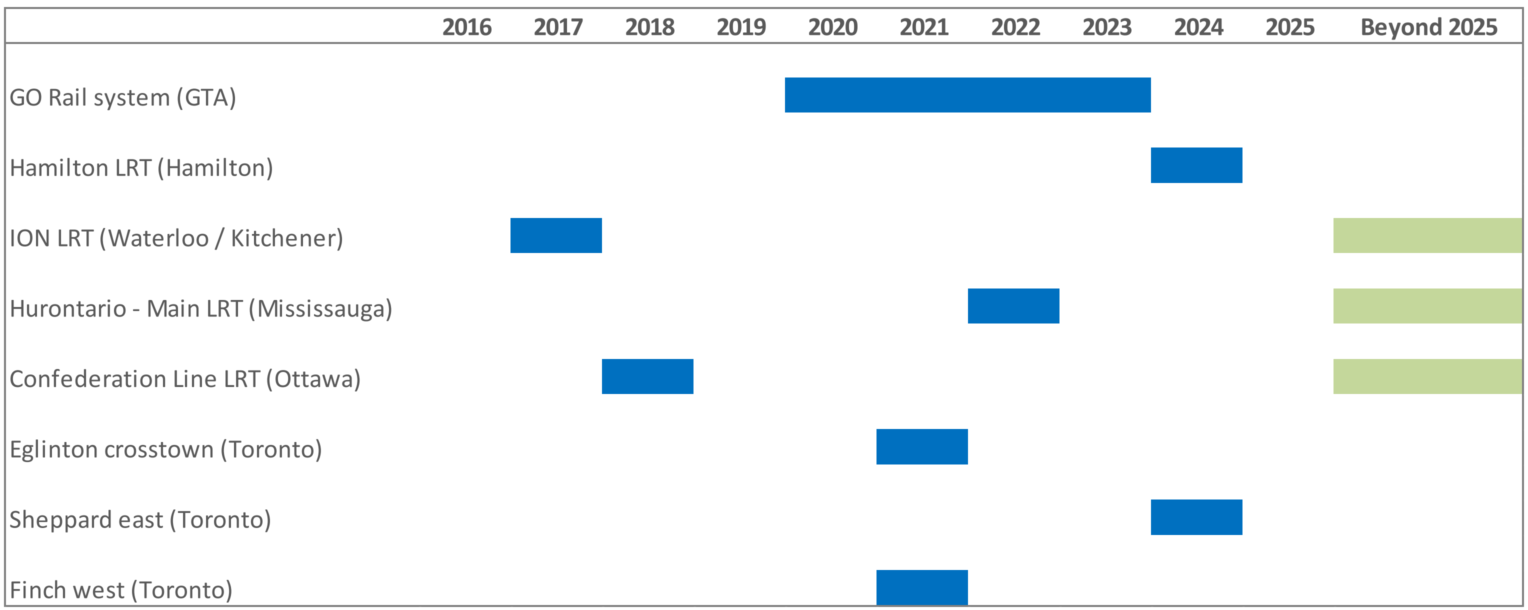
Electrification of Transportation

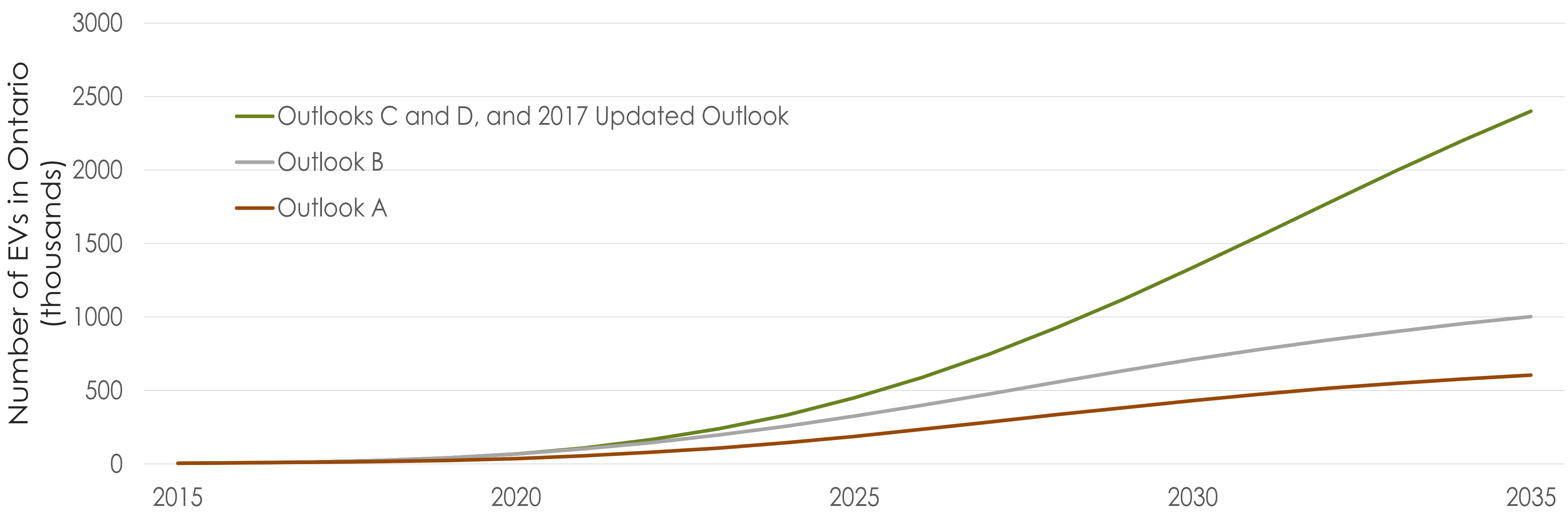
- All four demand Outlooks anticipate significant electricity demand growth in the transportation sector as part of Ontario's climate change strategy
- A number of action items have been identified in the Climate Change Action Plan in relation to transport electrification, including incentives for electric vehicles (EVs), free overnight charging, and regional express rail deployment
- By the end of the first quarter of 2016, there were approximately 6,500 EVs registered in Ontario. Although this represents significant annual sales growth, energy demand from these EVs is still less than 0.1% of total energy delivered
  - Energy requirements for vehicle charging are influenced by factors such as the number of EVs, driving distance, and fuel efficiency
  - Impact on peak demand is affected by technology, price signals, and policy. Increases in system cost and emissions can be mitigated if EV charging takes place primarily in off-peak hours
- Three EV penetration scenarios were developed by the IESO to inform the demand outlooks
  - There is uncertainty in the pace and level of EV uptake over the planning outlook. A wide range of EV adoption and market share projections produced by various organizations exist.
  - These EV penetration scenarios were informed by experience with EV uptake to date, the EV target in the CCAP (5% of new vehicles on the road by 2020), and publicly available projections.“
- In addition to electric vehicles, some public transit systems are expected to be electrified
  - Metrolinx is planning for the electrification of GO rail corridors
  - A number of new Light Rail Transit (LRT) systems are underway or being planned across the province

Assumptions for Transit Electrification

- Electricity demands serving GO rail system electrification and LRT projects are estimated
  - Expected in service date is summarized in the chart below. In service dates are based on publicly announced project plans
  - The 2017 updated demand includes 0.55 TWh from transit projects (blue).
- Electricity demand estimates were based on Metrolinx's GO electrification study and traction power consumption of existing transit systems such as TTC and CTrain



Forecasts for Electric Vehicle Stock



Thousands of EVs	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Outlook A	5	8	11	17	25	37	55	80	109	145	187
Outlook B	5	9	15	24	41	68	104	146	197	257	325
Outlooks C & D	5	9	15	24	41	68	109	166	241	334	450

Thousands of EVs	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Outlook A	237	286	336	385	432	476	515	549	579	605
Outlook B	399	477	557	637	712	781	843	902	955	1,003
Outlooks C & D	588	749	929	1,126	1,336	1,554	1,775	1,993	2,202	2,401

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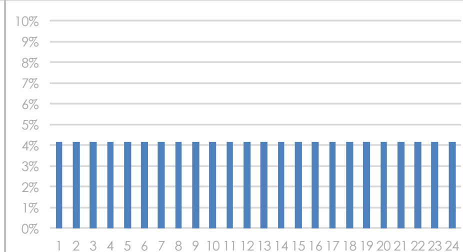
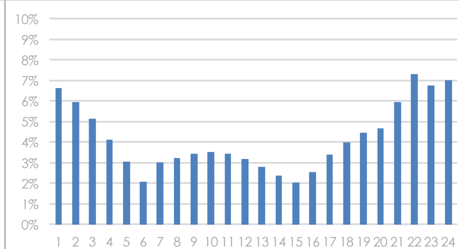
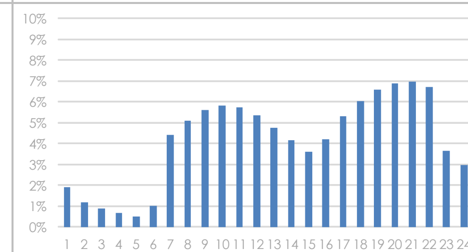
EV Charging Impact on Ontario's Peak Demand

	Evenly distributed 24/7	Effective load management with some convenience	Convenience dominant with minimal load management
Charger type	All types of chargers	20% level-1	10% level-1
		60% level-2	50% level-2
		20% level-3	40% level-3
Charging pattern	Throughout a day	20% daytime	40% daytime
		30% evening	50% evening
		50% night	10% night
Daily load profile			
Impact on grid peak demand (MW)	342	328	496

- This table shows the possible peak impact of charging one million electric vehicles
- Key factors that impact peak demand include time of charging, type of charger and status of battery
- It will be important to maintain tools to assist in managing the timing of charging loads as impact on peak demand can vary substantially under different customer behavior scenarios

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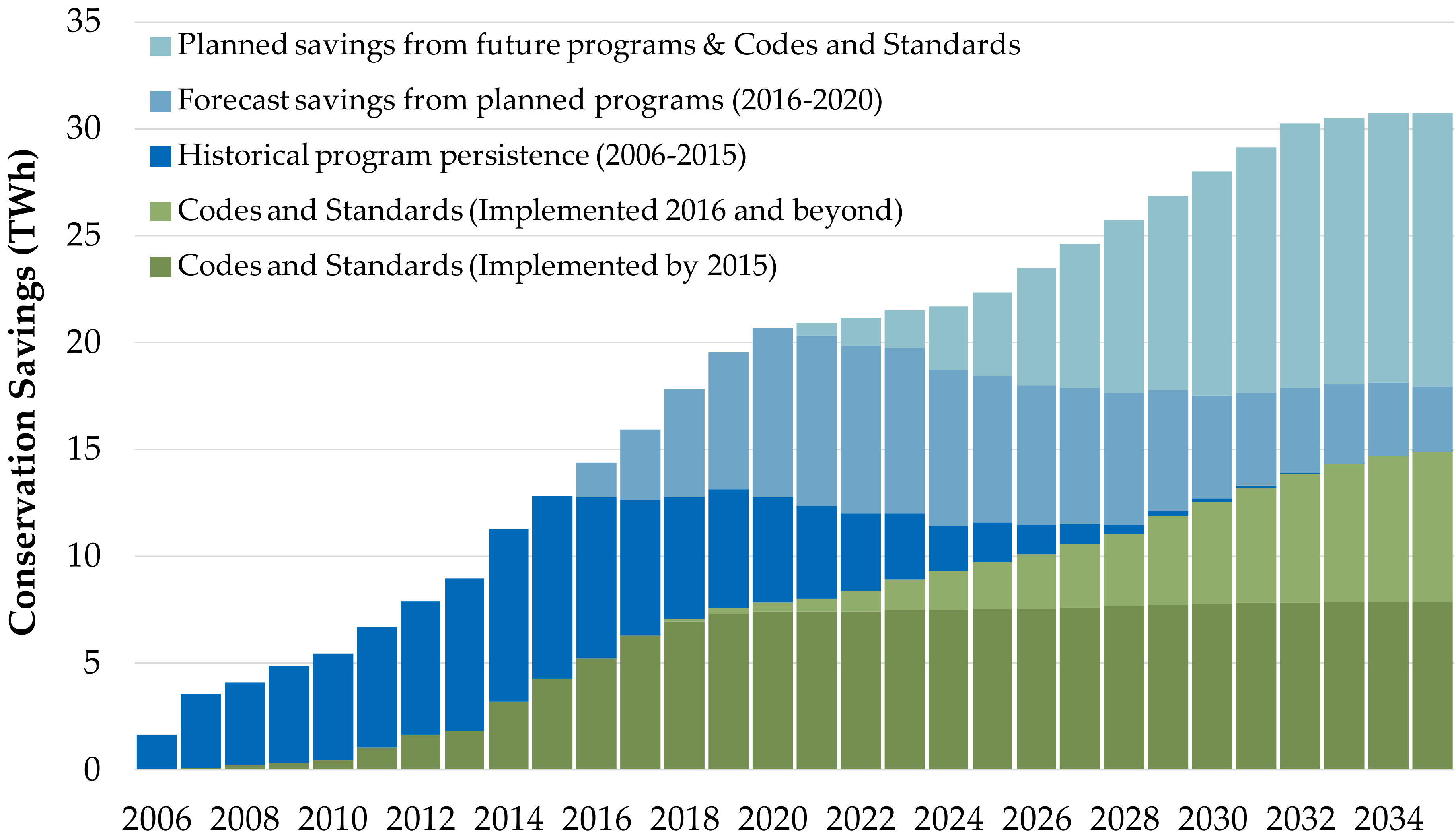
Ontario electricity conservation outlook



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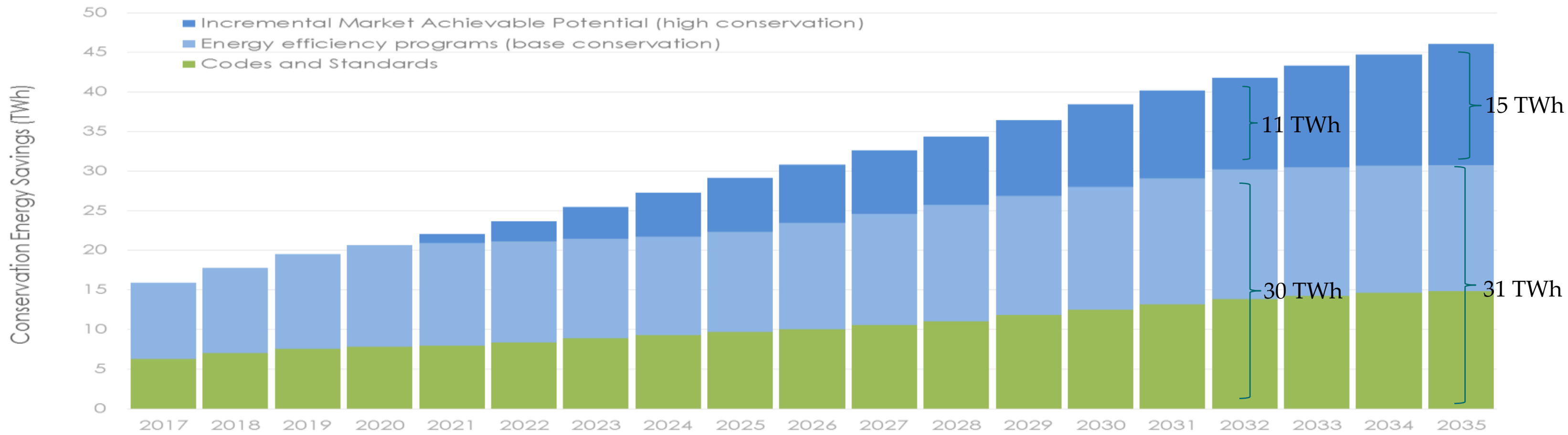
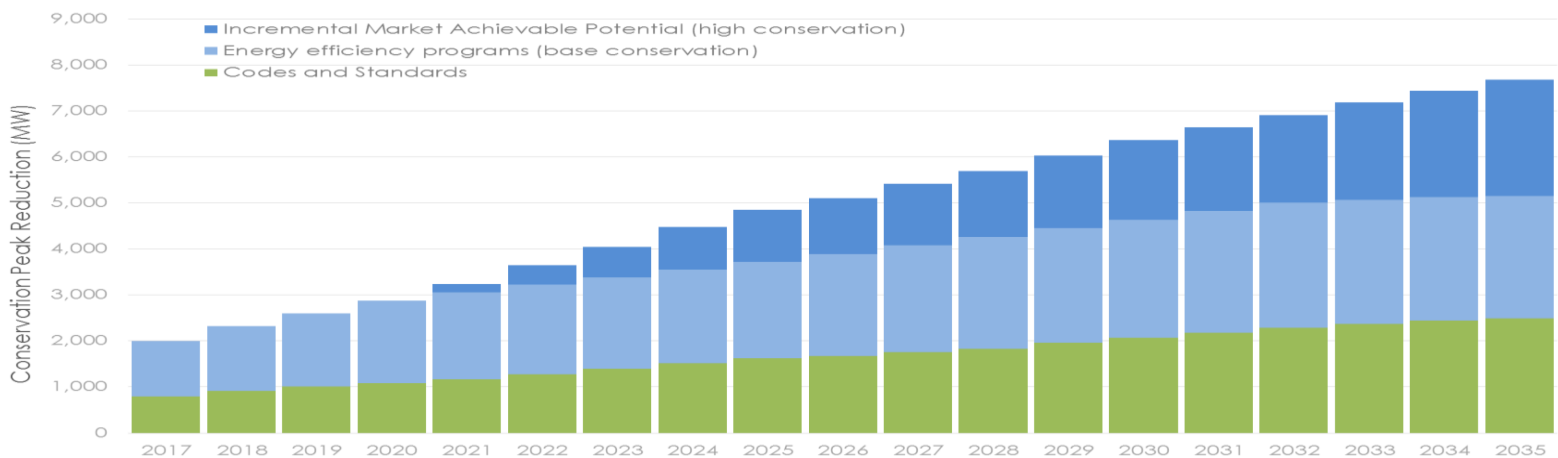
The 2013 LTEP established an energy savings target of 30 TWh by 2032 (31 TWh by 2035). The 2016 Market Achievable Potential identified an additional 11 TWh of savings potential (15 TWh by 2035).





- Savings identified in 2013 LTEP could be achieved through a combination of programs and codes/standards.
- The 2016 Market Achievable Potential study ("MAP") assumed incremental savings would be achieved through programs only.
- Incremental MAP savings would begin in 2021, following the end of the current CDM Framework

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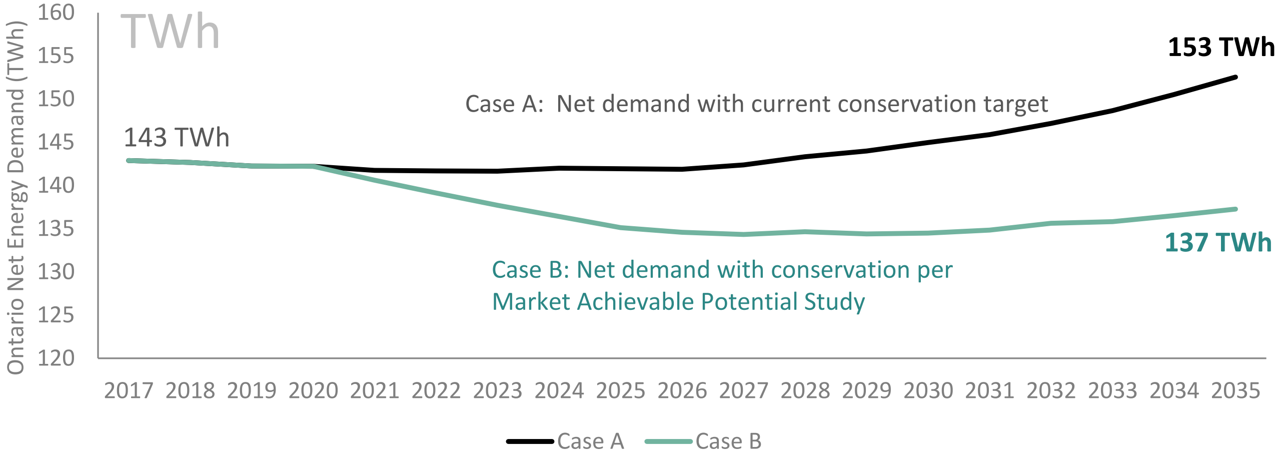
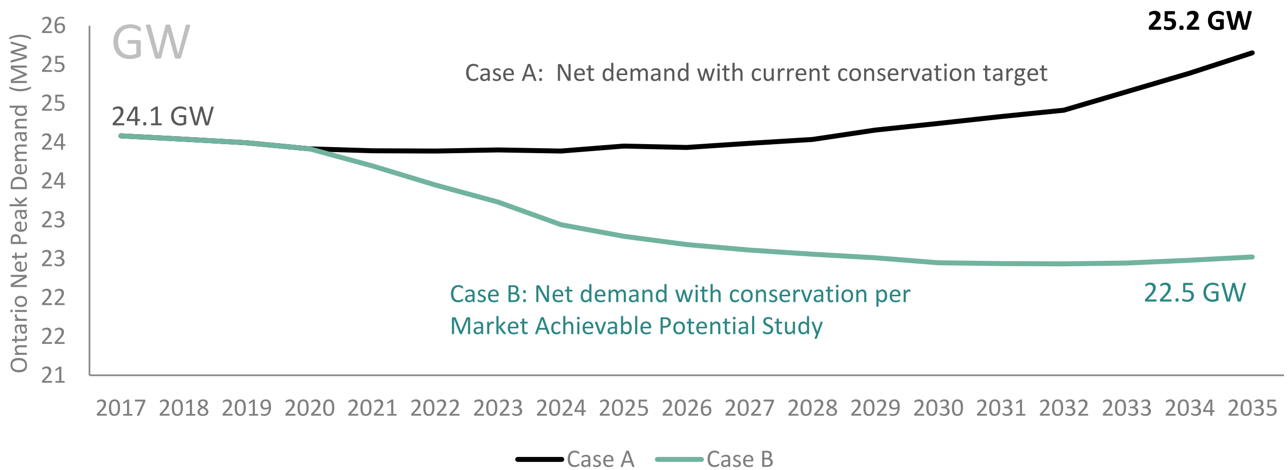
By 2035, additional conservation per the Market Achievable Potential study would reduce electricity consumption and peak demand by about 10% compared to demand net of current conservation targets. Electricity demand would be less than what it is today, if the higher conservation amounts were achieved. Ontario would continue to remain a summer peaking jurisdiction in both demand outlooks.



Case A: Consumption increases by 0.4% annually

Case B: Consumption decreases by 0.2% annually



Case A: Peak demand increases by 0.2% annually

Case B: Peak demand decreases by 0.4% annually

The 2016 Ontario Planning Outlook was the starting point for the Case A net demand forecast and the outlook was updated to reflect the assumptions in accordance with the "Ministry of Energy's 2017 Long-Term Energy Plan Modelling Assumptions, April 6 2017" document, attached in the Appendix.

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Summary of the IESO's assessment of higher levels of conservation: Pursuing all of the CDM identified in the MAP study under the current framework for conservation delivery would result in higher electricity costs. Further work is needed to improve understanding of conservation potential and to enhance the value of this resource in long-term electricity system plans. *See Appendix for further information.*

- Higher levels of conservation savings per the Market Achievable Potential (MAP) as compared to current levels of targeted conservation result in:
  - Generally no change in the timing of capacity needs but a reduction in longer-term resource needs
  - Reduction in greenhouse gas emissions by an average of about 0.7 MT per year between 2017 and 2035
  - Average cost for incremental greenhouse gas emission reduction ranging from $100 - $200/tonne
  - Increases in surplus energy by an average of about 2 TWh per year starting in 2021
  - Increases in total system costs by an annual average of about $100M to $200 M per year, but ranges from an increase of $600 M per year in the earlier years of 2021 to a decrease of $300 M per year by 2035
  - Increase in average residential bills by $11/month and industrial rates by $1/MWh to $3/MWh

- Opportunities exist to improve understanding of CDM potential and enhance value of this resource:
  - Better targeting and right-sizing conservation could help improve cost-effectiveness and reduce surpluses
  - Better optimizing supply system adaptations to higher levels of conservation could help improve cost-effectiveness and reduce surpluses
  - Opportunities exist to enhance value of conservation by pursuing additional savings through codes/standards and improving allocation/funding of program budgets/expenditures

- The Ministry of Energy could consider reaffirming commitments to current conservation targets in the 2017 LTEP but continue to explore options to best realize higher levels of conservation in view of opportunities for reductions in electricity costs and emissions

Looking Ahead: Continue to monitor trends and developments and update demand outlooks accordingly.

- Distributed resources
- Economic drivers/structural change
- Conservation impacts
- ICI/Time of Use
- Storage
- Disruptive technologies/behavioral changes