MODULE 3:
Conservation and Demand Response Outlook

August 2016

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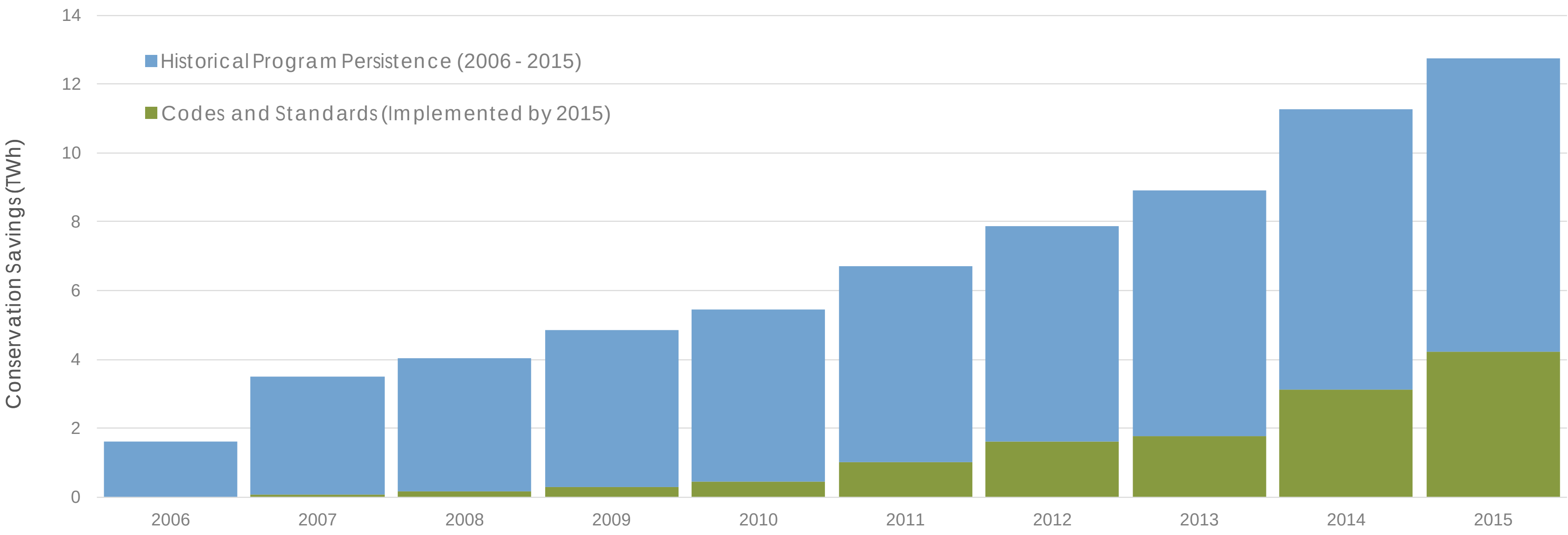
Summary

- In 2015, conservation is estimated to have contributed nearly 13 TWh of energy reductions
- Conservation savings come from energy efficiency programs, behavioural programs, government regulated building codes and minimum equipment efficiency standards and from behind the meter generation projects
- Demand Response resources come from contracted and market programs as well as from price incentives such as Time of Use rates and the Industrial Conservation Initiative
- In the assessments of all demand outlooks, IESO has assumed the achievement of targets set in the LTEP 2013 and in the Conservation First Framework (CFF)
  - 30 TWh energy savings by 2032
  - 7 TWh energy savings through LDC programs and 1.7 TWh energy savings through the Industrial Accelerator Program by 2020
  - Demand Response to be able to meet 10% of peak demand by 2025
- The amount of conservation available will vary with the demand, more analysis is required to determine the amount of variance in each outlook
- To inform policy, and to guide the review of the CFF, an Achievable Potential Study (APS) was completed that confirms that the planned savings are achievable. The study also identified that it would be possible to achieve more savings with an increase in the budgets allocated to conservation.

Conservation

Conservation represents savings from energy efficiency programs, behavioural programs, building codes, and equipment standards and behind the meter generation projects

- Ontario saved about 13 TWh of electricity in 2015, about one third of savings from codes/standards, about two-thirds from conservation programs
- Cumulatively, 67 TWh of electricity was saved between 2005 and 2015



Conservation program savings between 2006 and 2014 have been evaluated, program savings for 2015 and codes and standards savings are estimated.

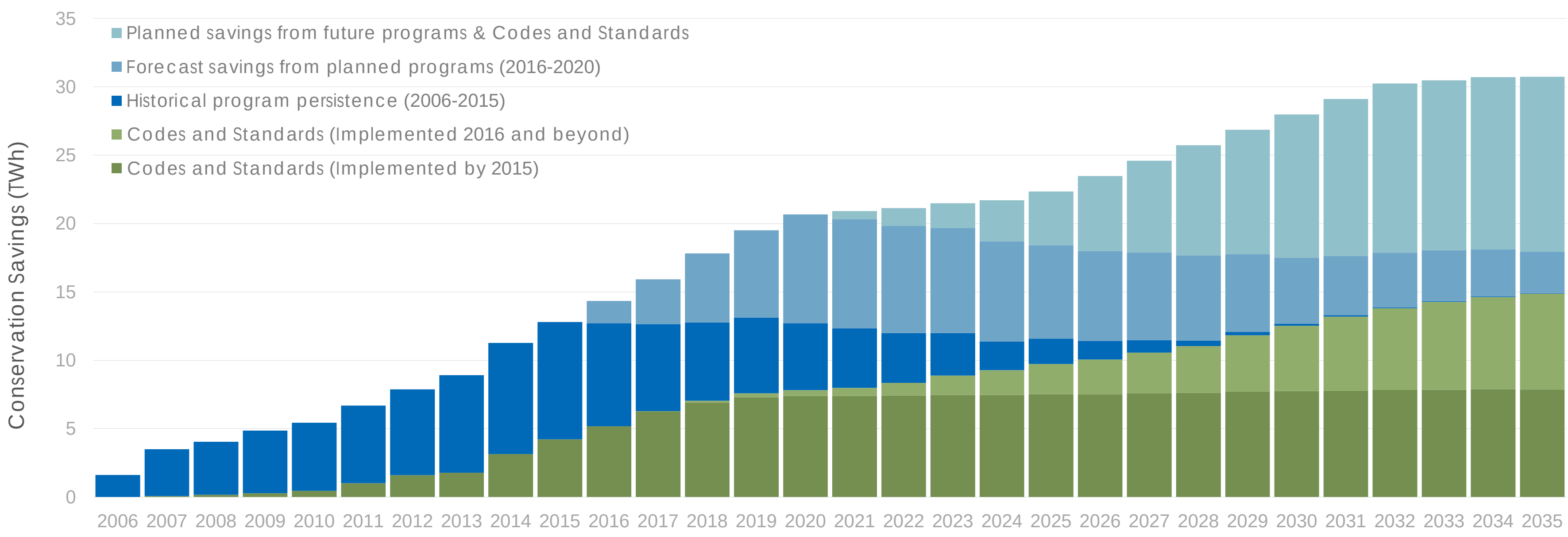
Data: historical conservation savings

Conservation (TWh)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Codes and standards (Implemented by 2015)	0.0	0.1	0.2	0.3	0.5	1.0	1.6	1.8	3.1	4.2
Historical program persistence (2006 - 2015)	1.6	3.4	3.9	4.6	5.0	5.7	6.3	7.1	8.1	8.5
Total	1.6	3.5	4.0	4.9	5.4	6.7	7.9	8.9	11.3	12.8

Conservation is forecast to meet the LTEP 2013 target of 30 TWh in 2032 and grow to approximately 31 TWh saving in 2035

- Planned conservation savings are deducted from the gross demand forecast to derive net demand forecast in all demand outlooks
- About half of savings by 2035 will come from regulations like building codes and equipment standards, which require no ratepayer incentives
- Savings from future programs & Codes and Standards are required to provide about 40% of the savings expected 2035



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Data: conservation savings overview

Conservation (TWh)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Codes and standards (Implemented by 2015)	0.0	0.1	0.2	0.3	0.5	1.0	1.6	1.8	3.1	4.2	5.2	6.3	6.9	7.3	7.4
Codes and standards (Implemented 2016 and beyond)											0.0	0.0	0.2	0.3	0.4
Historical program persistence (2006-2015)	1.6	3.4	3.9	4.6	5.0	5.7	6.3	7.1	8.1	8.6	7.5	6.4	5.7	5.5	4.9
Forecast savings from planned programs (2016-2020)											1.6	3.3	5.0	6.4	7.9
Planned savings from future programs & Codes and Standards															
Total	1.6	3.5	4.0	4.9	5.4	6.7	7.9	8.9	11.3	12.8	14.3	15.9	17.8	19.5	20.7

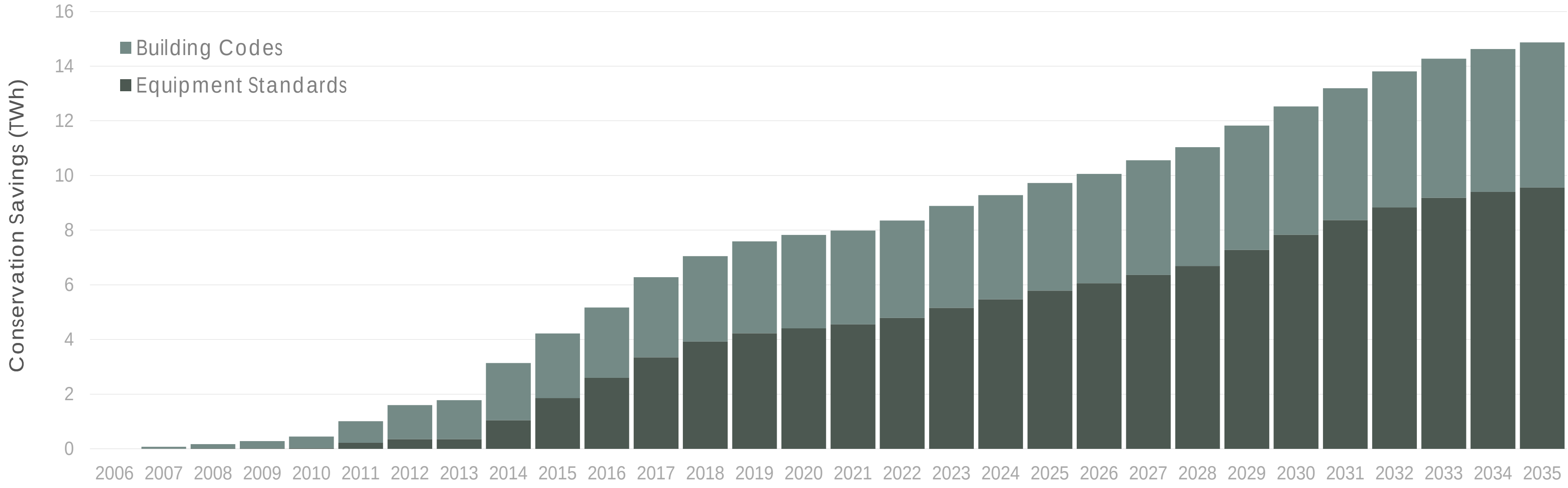
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Codes and standards (Implemented by 2015)	7.4	7.4	7.5	7.5	7.5	7.5	7.6	7.6	7.7	7.8	7.8	7.8	7.8	7.9	7.9
Codes and standards (Implemented 2016 and beyond)	0.6	0.9	1.4	1.8	2.2	2.6	3.0	3.4	4.1	4.8	5.4	6.0	6.4	6.7	7.0
Historical program persistence (2006-2015)	4.4	3.6	3.1	2.1	1.9	1.4	0.9	0.4	0.3	0.1	0.1	0.1	0.0	0.0	0.0
Forecast savings from planned programs (2016-2020)	8.0	7.8	7.7	7.3	6.8	6.6	6.4	6.2	5.7	4.8	4.3	4.0	3.7	3.4	3.0
Planned savings from future programs & Codes and Standards	0.6	1.3	1.8	3.0	3.9	5.5	6.7	8.1	9.1	10.5	11.5	12.4	12.4	12.6	12.8
Total	20.9	21.1	21.5	21.7	22.3	23.5	24.6	25.7	26.9	28.0	29.1	30.2	30.5	30.7	30.7

Electricity savings from codes and standards

- Codes and Standards savings estimates are based on the expected improvement in the codes for new and renovated buildings and for specified end uses through the regulation of minimum efficiency standards for equipment.
  - Codes and standards implemented to date will continue generating savings going forward as equipment reaches the end of life and is replaced and through new construction. The expected savings will grow from 4.2 TWh in 2015 to about 7.9 TWh in 2035.
  - It is estimated that the planned and anticipated codes and standards will save an additional 7 TWh by 2035.
- Codes and Standards are an effective means to deliver energy efficiency with a high level of certainty.
- The majority of Codes and Standards savings will come from the commercial and residential sectors. Industrial savings are assumed to be negligible.
  - The Ontario Building Code requires new buildings to be built to a certain energy efficiency level
  - The minimum energy performance standards requires all products sold to comply with a minimum energy efficiency level
- The IESO estimates savings to be attributed to Codes and Standards by comparing the gross forecast to the forecast adjusted for the impacts of regulations. The gross forecast includes assumptions as to how customers may adopt more efficient technologies in the absence of any new Codes and Standards. The IESO methodology will attribute less savings to Codes and Standards than a methodology that considers all savings from Codes and Standards regardless of other factors such as energy prices and other behavioural drivers.

Ongoing improvement of building codes and equipment standards contributes about half of planned savings by 2035.

- Both existing and anticipated building codes and equipment standards are projected to yield approximately 14.9 TWh of savings by 2035
  - About 9.6 TWh from equipment efficiency standards
  - About 5.3 TWh from building codes
- While there is a societal cost to implementing Codes and Standards, there is typically not a ratepayer cost as customers are required to comply with the regulation



The energy efficiency impacts of Ontario Building Codes 2017 and 2022 are considered to come into effect around 2022 and 2027.

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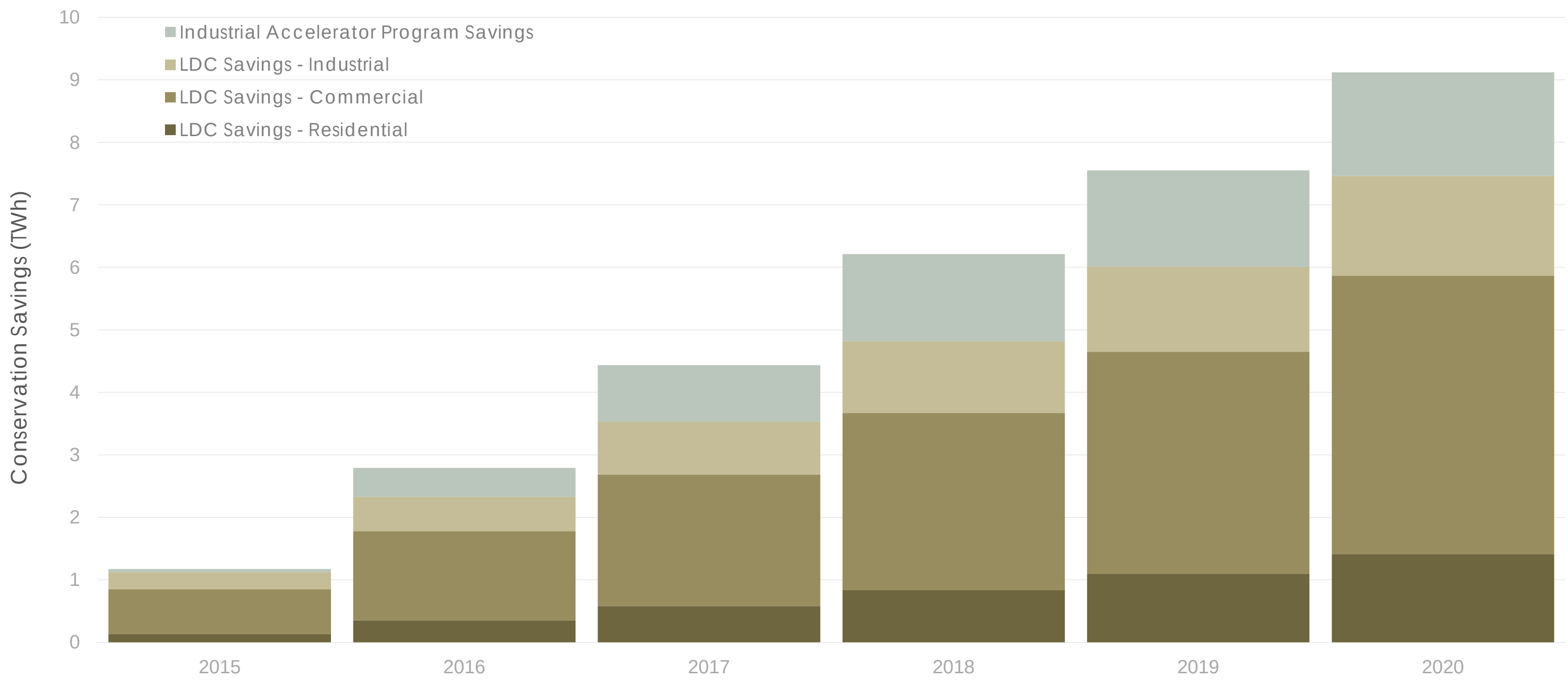
Data: codes and standards savings overview

Codes and Standards Savings (TWh)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Equipment standards	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	1.0	1.9	2.6	3.3	3.9	4.2	4.4	4.6	4.8	5.2	5.5	5.8	6.1	6.4	6.7	7.3	7.8	8.4	8.8	9.2	9.4	9.6
Building codes	0.0	0.1	0.2	0.3	0.4	0.8	1.3	1.4	2.1	2.4	2.6	2.9	3.1	3.4	3.4	3.4	3.6	3.7	3.8	3.9	4.0	4.2	4.3	4.6	4.7	4.8	5.0	5.1	5.2	5.3
Total	0.0	0.1	0.2	0.3	0.5	1.0	1.6	1.8	3.1	4.2	5.2	6.3	7.0	7.6	7.8	8.0	8.4	8.9	9.3	9.7	10.1	10.6	11.0	11.8	12.5	13.2	13.8	14.3	14.6	14.9

The Conservation First Framework (2015-2020) is being implemented by the IESO and by LDCs

- The Conservation First Framework and the Industrial Accelerator Program have an overall goal of achieving 8.7 TWh of electricity savings by 2020
  - LDCs are assigned a combined savings target of 7 TWh at a budget of $2.2 billion
  - The IESO also delivers the Industrial Accelerator Program to customers connected directly to the transmission system, not served by LDCs, to achieve the 1.7 TWh saving target in 2020



LDCs' targets are at customer level (excluding line losses) while savings shown in the chart are at generator level (including line losses)

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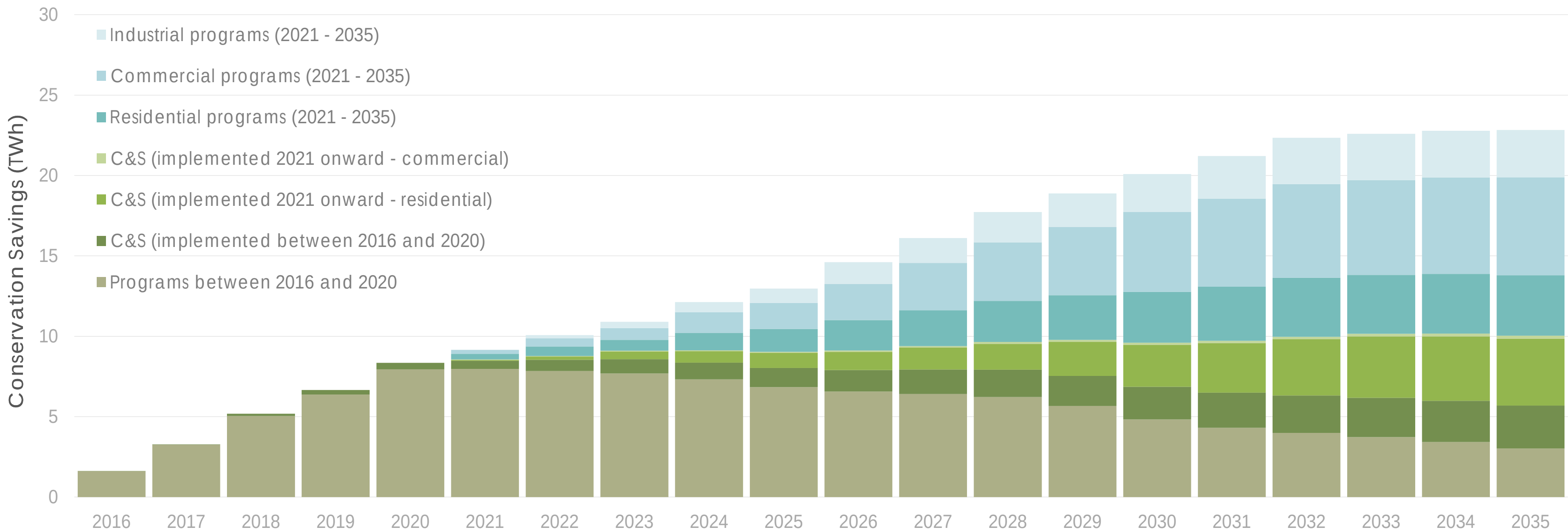
Data: planned conservation savings through Conservation First Framework (2015 - 2020)

Planned Savings through Conservation First Framework (2015-2020, TWh)

	2015	2016	2017	2018	2019	2020
Industrial Accelerator Program savings	0.0	0.5	0.9	1.4	1.5	1.7
LDC savings - residential	0.1	0.4	0.6	0.8	1.1	1.4
LDC savings - commercial	0.7	1.4	2.1	2.8	3.6	4.5
LDC savings - industrial	0.3	0.6	0.8	1.1	1.4	1.6
Total	1.2	2.8	4.4	6.2	7.5	9.1

New programs, to be developed for the period after 2020, combined with the savings from programs in place and codes and standards are forecast to contribute about 22 TWh by 2035

- Nearly 13 TWh of savings are planned through new programs between 2021 and 2035. About half is expected to come from the commercial sector.
- Product Standards are assumed to contribute primarily to savings in the residential sector while Codes are assumed to contribute to electricity savings in the commercial sector.
- These savings are incremental to savings from the period 2005-2015.
- Programs for period after 2020 are yet to be developed.



Data: planned conservation savings (2016 – 2035)

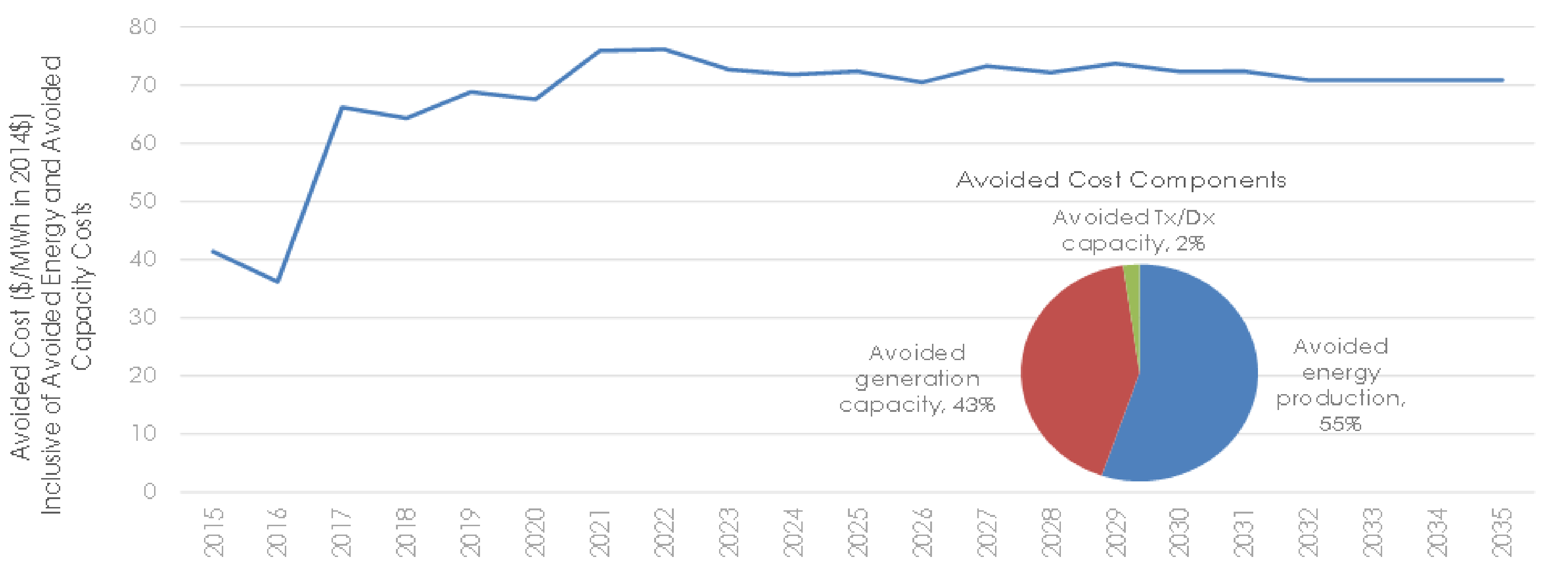
Planned Conservation (2016-2035, TWh)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Codes and standards (implemented between 2016 and 2020)	0.0	0.0	0.1	0.3	0.4	0.5	0.7	0.9	1.0	1.2	1.3	1.5	1.7	1.9	2.0	2.2	2.3	2.5	2.6	2.7
Programs between 2016 and 2020	1.6	3.3	5.0	6.4	7.9	8.0	7.8	7.7	7.3	6.8	6.6	6.4	6.2	5.7	4.8	4.3	4.0	3.7	3.4	3.0
Codes and standards (implemented 2021 onward - residential)						0.1	0.2	0.5	0.7	0.9	1.1	1.4	1.6	2.1	2.6	3.1	3.5	3.8	4.0	4.2
Codes and standards (implemented 2021 onward - commercial)						0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Residential programs (2021 - 2035)						0.3	0.6	0.7	1.1	1.4	1.9	2.2	2.6	2.8	3.2	3.4	3.7	3.7	3.7	3.8
Commercial programs (2021 - 2035)						0.3	0.5	0.7	1.3	1.6	2.2	2.9	3.6	4.3	5.0	5.5	5.8	5.9	6.0	6.1
Industrial programs (2021 - 2035)						0.0	0.2	0.4	0.6	0.9	1.4	1.5	1.9	2.1	2.4	2.7	2.9	2.9	2.9	2.9
Total	1.6	3.3	5.2	6.7	8.4	9.2	10.1	10.9	12.1	13.0	14.6	16.1	17.7	18.9	20.1	21.2	22.3	22.6	22.8	22.8

Conservation uncertainty

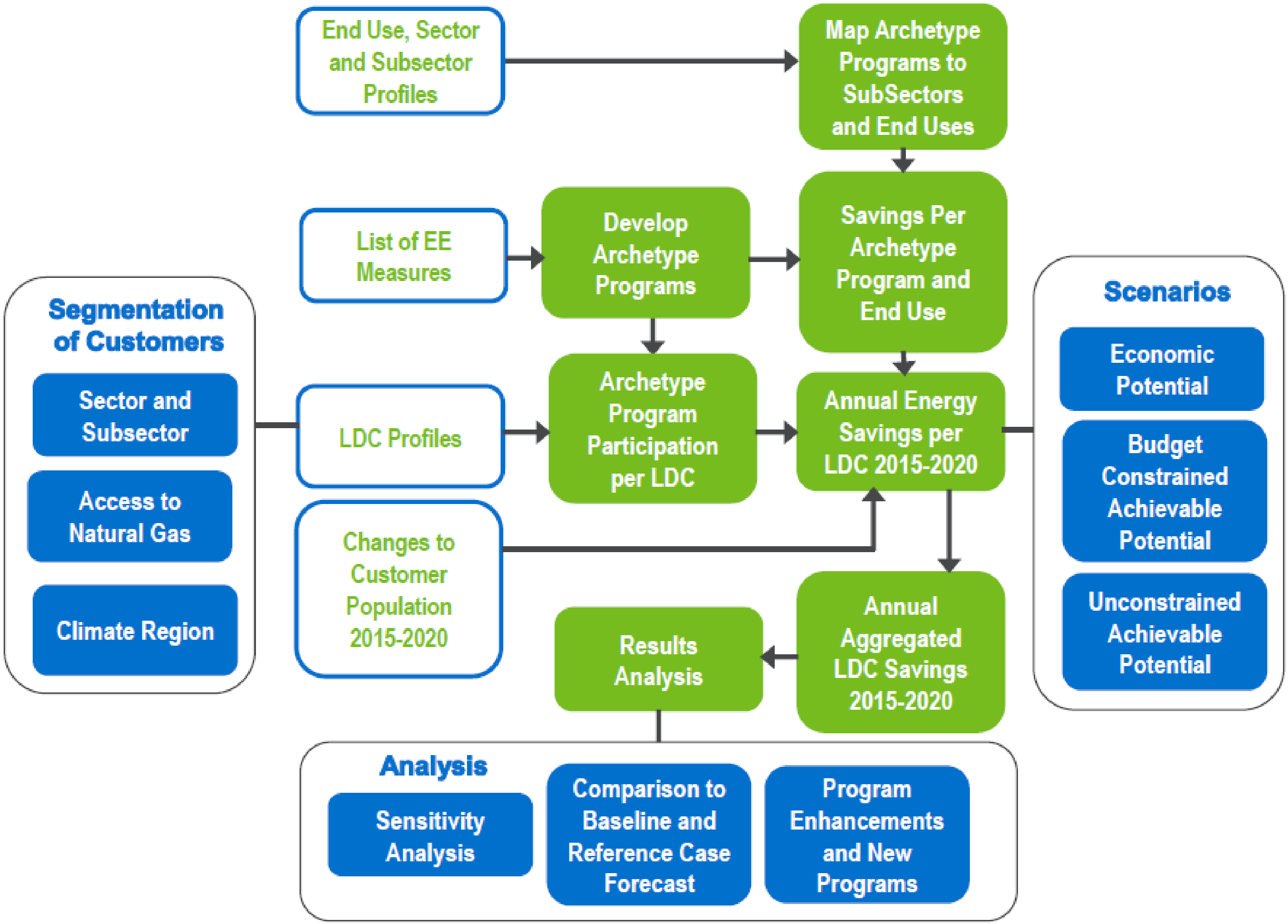
- Savings from regulation, i.e. codes and standards, have high certainty . The regulation that is actually implemented may differ from the assumptions made in the plan.
- The uncertainty is higher for programs that are currently running and to be designed. Studies and past experience indicate that the planned savings can be achieved.
- The uncertainty also acknowledges that opportunities for additional conservation also exist.
- Changes in demand could also create conservation implementation risks or opportunities.
- Different energy efficiency measures have different impacts on peak demands. In practice, peak contributions of adopted efficiency measures might differ from initial projections, which could result in higher or lower levels of peak demand than expected.
- A variety of activities will help manage uncertainty, both downside and upside, related to conservation implementation. These and other activities will help guide conservation target setting, planning and risk management activities.
  - Annual program evaluations will allow for continued monitoring of the progress towards achieving targets.
  - The mid-term review process allows for adjustments, if necessary, to be made to near-term conservation plans.
  - Conservation potential assessments will be updated on a regular basis to inform plans

The benefits of conservation are represented by the avoided costs of electricity infrastructure that would be required in the absence of conservation.



- Avoided costs currently being used to guide conservation programs were published in 2014 and are based on the policy objectives outlined in LTEP 2013.
- Conservation is considered to be cost-effective when the lifecycle costs of implementing conservation programs and actions are less than the benefits (avoided costs)
- The additional benefits of conservation (non-energy benefits) are considered by increasing the avoided costs by 15%
- In integrated regional planning, some regions may require targeted infrastructure investments to meet local reliability needs, these local investments may justify higher levels of conservation investment in those areas. Local avoided costs would help identify the added value of conservation in some regional plans

An updated energy efficiency achievable potential study was completed in June 2016



The Achievable Potential Study results identify that the conservation targets and planned savings are feasible

- Technical potential scenario: savings potential when all technically feasible energy-efficiency measures are implemented at their full market potential, disregarding all non-engineering constraints
- Economic potential scenario: a subset of technical potential; the savings potential when only the economically feasible energy efficiency measures are implemented

Year	2016 Achievable Potential Study Results					
	TWh Savings at the end-use level, for programs implemented between 2015 -2035					
	Technical Potential Energy efficiency only	Economic Potential Energy efficiency only	Achievable: Unconstrained Energy efficiency only	Achievable: Budget Constrained Energy efficiency only	Achievable: Budget Constrained Behind the Meter Generation only	Achievable: Budget Constrained Energy efficiency + Behind the Meter
2020	33.1	23.4	6.8	6.4	1	7.4
2025	55.7	33	10.8	10.7	1.6	12.3
2030	71.9	41.7	14.8	14.7	1.6	16.3
2035	78.5	45.5	17.8	17.7	1.6	19.3

- Achievable potential scenario: a subset of economic potential; the savings potential that further considers the rate of adoption of measures (i.e., even though energy efficiency measures may be cost-effective, they aren't acquired by the whole population all at once). The adoption rates used for this study were based on historic experience in Ontario. Adoption rates can be increased by increasing program incentive rates.
- Budget-constrained achievable potential scenario: a subset of achievable potential; this savings potential is limited to what can be obtained within a limited budget, prioritizing the most cost-effective savings. The budget limits set for this study were consistent with what was provided for the Conservation First Framework.

Achieving conservation beyond the planned savings is possible but at a greater cost

- The identified conservation potentials are saving projections based on a number of assumptions.
  - Economic potential applies benefit/cost tests to determine which measures would be cost-effective to implement from societal perspective and is a more theoretical exercise.
  - Achievable potential analyzes what level of savings could actually be attained, given the practical realities and market barriers that must be overcome to implement effective energy efficiency programs and convince customers to participate in them.
- Directionally, an increased investment on conservation will lead to higher savings. The incremental savings will not be directly proportional to the magnitude of the change in the portfolio budget as it is assumed that the cost per kWh will increase as more conservation is pursued.
- The recent achievable potential study provided some insight into the cost curve for conservation savings, more quantitative analyses will be required to fully understand conservation cost curves under various demand and supply outlooks

Initial conservation cost curve

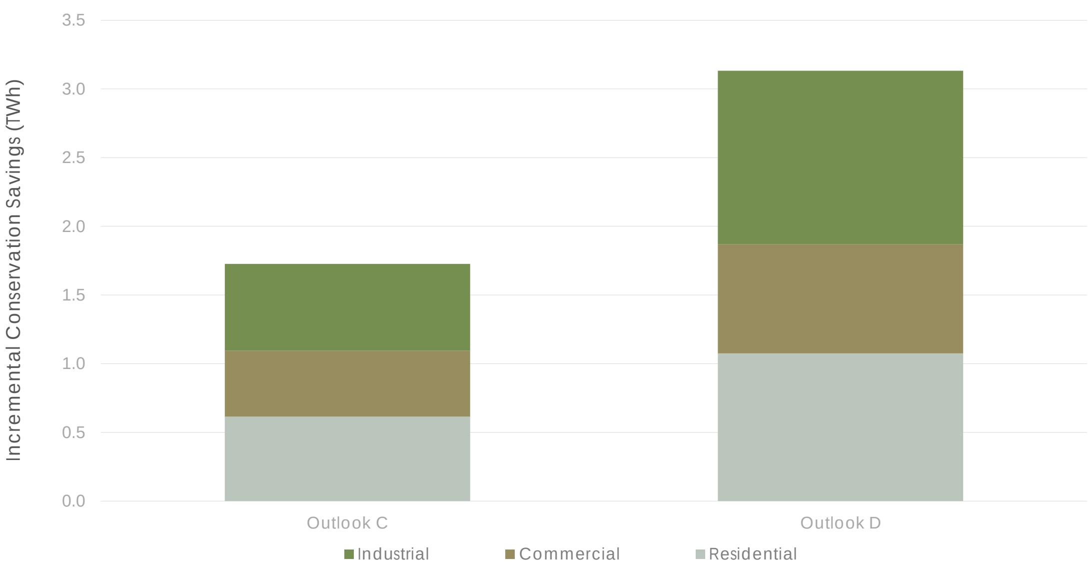
- The cost of procuring energy efficiency will change depending on the amount targeted, it will cost more per kWh to target higher proportions of the economic potential. This is because higher incentive levels and larger marketing and education budgets are required to achieve higher levels of savings
- The achievable potential study developed an estimated cost curve for incremental amounts of conservation, this estimate was developed under one scenario of avoided costs. In future studies, estimates will account for various scenarios of avoided costs

Additional conservation savings would contribute as well as new supply resources to meet demand in the higher demand outlooks

- The electrification in demand outlooks C and D raises their gross electricity demand significantly. As a result, more resources are required and the avoided costs of conservation increase.
  - The higher avoided costs would support higher spending on conservation while maintaining cost effectiveness
  - More conservation can be pursued with a larger ratepayer investment
- The recent electricity achievable potential study was carried out with a gross demand forecast similar to demand outlook B and the avoided costs developed after LTEP 2013. Further studies are needed to estimate avoided costs and achievable potential associated with demand outlooks C and D.
- The additional conservation in demand outlooks C and D may come from two sources of loads.
  - Existing electric loads (those already in demand outlook B)
    - As about 95% of the identified achievable potential is already included in the planned conservation, there is little room and high cost to achieve additional conservation from the existing loads
  - New space heating, water heating, and some industrial heating loads where natural gas is converted to electricity as a result of electrification
    - A natural gas achievable potential study overseen by the OEB was recently completed on June 30, 2016. Though the study was initiated and completed for natural gas conservation, the IESO has analyzed the data and results to identify measures and potential applicability to the new loads due to electrification, mostly space heating and water heating.
    - Savings can be achieved through non-equipment measures (e.g. weatherization), which can be implemented by codes and standards, gas company programs, and electricity programs
    - Savings can also be achieved through implementing higher efficiency equipment. E.g. when a gas furnace is assumed to be replaced with a air source heat pump, a more efficient option such as a geothermal system may be cost-effective.

Incremental conservation efforts may offset an additional 7% of the new electrification loads in outlooks C and D

- Significant conservation is assumed to occur when loads electrify. For example, heat pump technology rather than electric resistance is assumed when a gas furnace is replaced.
- It is estimated that about 7% of the incremental loads due to electrification can be saved by conservation, about 1.7 TWh in outlook C and 3.1 TWh in outlook D. These savings would be incremental to the planned savings (31 TWh by 2035).
- As stated in the Climate Change Action Plan, the government intends to update the building code and continue to update and enhance product efficiency standards to reduce carbon emissions.
- The incremental savings will be achieved through programs and codes and standards.



- More analysis is required to determine feasibility of additional efficiency options beyond the planned conservation and incremental conservation of electrification loads.

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Data: additional conservation savings by 2035 as a result of electrification

Additional Conservation by 2035 as a Result of Electrification (TWh)

	Outlook C	Outlook D
Residential	0.6	1.1
Commercial	0.5	0.8
Industrial	0.6	1.3
total	1.7	3.1

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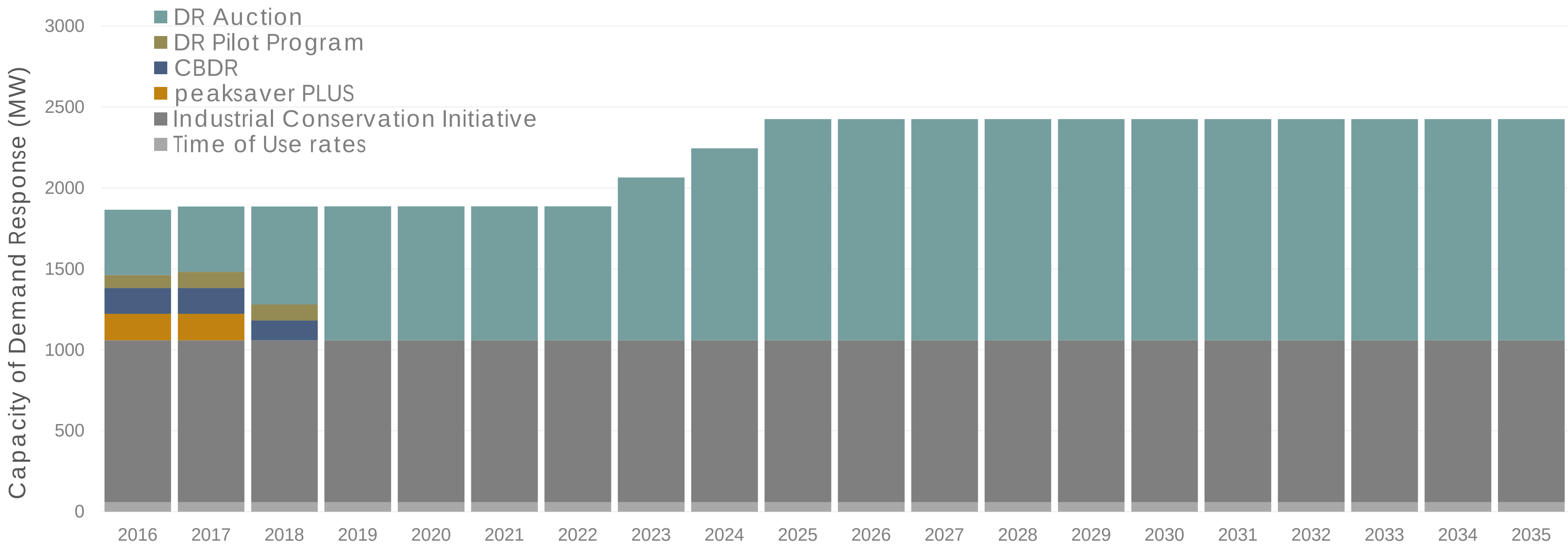
Demand Response

Ontario is aiming to use demand response to meet 10% of peak demand by 2025

- Demand Response (DR) includes actions taken by customers to reduce their demand in response to contractual or market signals and in response to targeted rate structures such as Time of Use rates and the Industrial Conservation Initiative
- As indicated in the LTEP 2013, Ontario aims to use demand response to meet 10% of peak demand by 2025, equivalent to approximately 2.4 GW under demand outlook B forecast.
  - Current level of DR capacity is maintained and will ramp up to meet target in 2025



PeaksaverPLUS as a conservation program will discontinue after 2017. It is assumed that its capacity will move to DR Auction.

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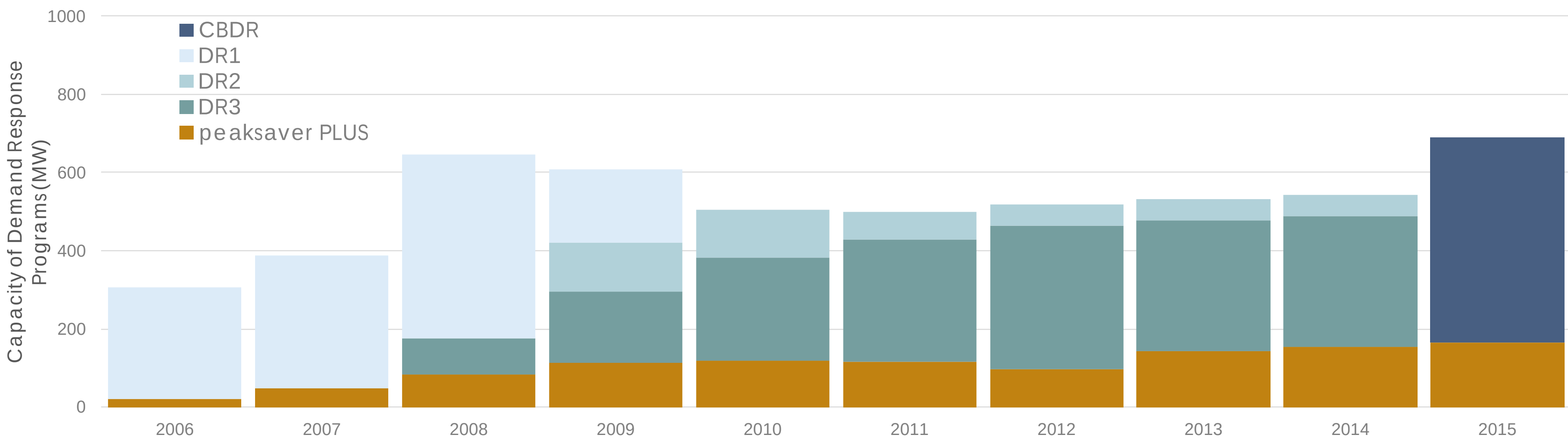
Data: planned demand response capacity 2016 - 2035

Planned Demand Response (2016-2035, MW)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Time of Use rates	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Industrial Conservation Initiative	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
peaksaver PLUS	164	164																		
CBDR	159	159	122																	
DR pilot program	80	100	100																	
DR auction	404	404	605	827	827	827	827	1006	1186	1366	1366	1366	1366	1366	1366	1366	1366	1366	1366	1366
Total	1865	1885	1885	1886	1886	1886	1886	2065	2245	2425	2425	2425	2425	2425	2425	2425	2425	2425	2425	2425

Contractual and Market-Based Demand Response

- Demand response programs introduced prior to 2015 included DR1, DR2, and DR3 for business customers and peaksaver PLUS for residential customers
- Beginning in 2015, the DR1, DR2 and DR3 programs were transitioned to the Capacity-Based Demand Response (CBDR) program
- The first capacity-based demand response auction conducted in December 2015 is contributing 391.5 MW for the 2016 summer season and 403.7MW for the 2016-2017 winter season



Data: historical demand response programs

Capacity of DR Programs (MW)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
peaksaver PLUS	20	48	84	112	117	115	96	143	152	164
DR3	0	0	91	182	264	315	367	335	335	
DR2	0	0	0	128	122	69	56	55	55	
DR1	285	340	471	188	0	0	0	0	0	
CBDR										526
Total	305	388	646	609	504	498	519	533	542	690

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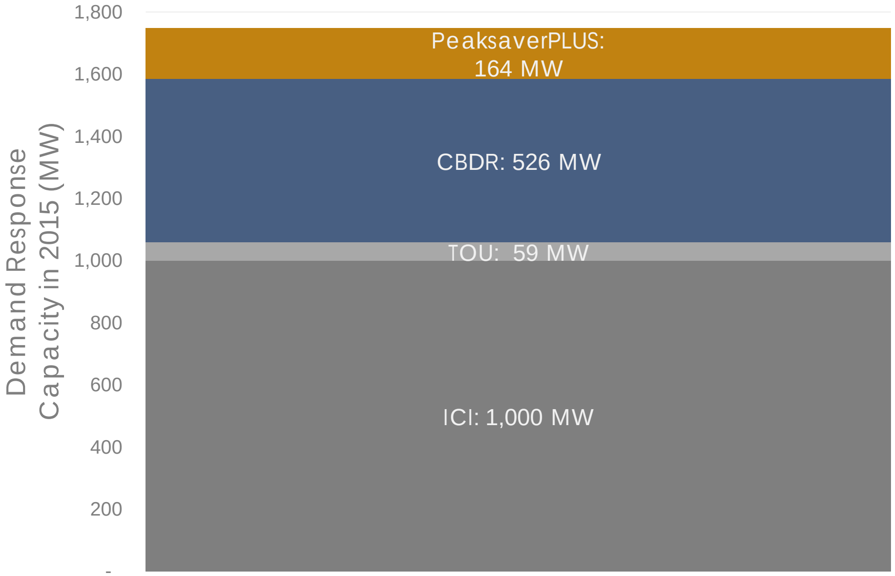
Demand response is also achieved through targeted rate structures for residential and small commercial customers and pricing incentives for large directly connected customers

- Time of Use (TOU) has existed in Ontario since approximately 2005 for low volume electricity consumers with smart meters
  - It provides an incentive for consumers to shift electricity use away from higher demand periods to lower demand periods
- Another pricing incentive program designed to reduce demand at peak times is the Industrial Conservation Initiative (ICI)
  - Certain large customers with demand greater than 3 MW (Class A customers) are eligible to participate
  - Global Adjustment amounts for participating Class A customers are adjusted to reflect their contribution to overall system demand during the top five peak hours of a year



ICI Program: http://www.ieso.ca/Pages/Participate/Settlements/Global-Adjustment-for-Class-A.aspx

- Demand response resources together amounted to approximately 1.8 GW in 2015

Data: demand response capacity in 2015

Demand Response Capacity in 2015

	MW
TOU	59
ICI	1000
Peaksaver PLUS	164
CBDR	526
Total	1749

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Demand response resources in Ontario help manage peak demand

- The IESO continues to develop its understanding of the capability of DR to deliver services to the electricity system.
- Moving forward, the IESO will continue to conduct DR auctions to acquire DR capacity from market participants that are able to provide this capacity through the energy market in exchange for an availability payment.
  - The first DR auction was held in 2015
  - About 400 MW was procured through a competitive auction process
  - The average clearing price for availability payments was about $91/kW-year.
- In the long term, additional DR beyond the planned 2.4 GW may contribute to meet higher demand such as those in outlooks C and D.
- In addition to meeting capacity requirements, there is potential for DR to meet needs driven by operability or regional supply.
  - A DR pilot program currently underway is aimed at better understanding the capabilities of DR to provide the operability services now provided by generators and other suppliers, including five minute load following, hourly load following, and unit commitment.
  - The DR pilot is intended to gather learning on how DR resources can participate within IESO markets and while helping to identify barriers to its participation within the wholesale market.

Further information

- Conservation First Framework (2015 – 2020)

  http://www.powerauthority.on.ca/opa-conservation/conservation-first-framework-2015-2020

- Achievable potential study reports

  http://www.ieso.ca/Pages/Participate/Stakeholder-Engagement/Working-Groups/2016-Achievable-Potential-Study-LDC-Working-Group.aspx

  http://www.ontarioenergyboard.ca/oeb/_Documents/EB-2015-0117/ICF_Report_Gas_Conservation_Potential_Study.pdf

- Conservation evaluation reports

  http://www.powerauthority.on.ca/opa-conservation/conservation-information-hub/evaluation-measurement-verification/reports

- Conservation cost effectiveness and avoided cost

  http://www.powerauthority.on.ca/sites/default/files/conservation/CDM-Cost-Effectiveness-Guide-Draft-v2.pdf

- Demand response auction

  http://www.ieso.ca/Pages/Participate/Demand-Response-Auction/default.aspx