

Ontario Planning Outlook: Technical Report

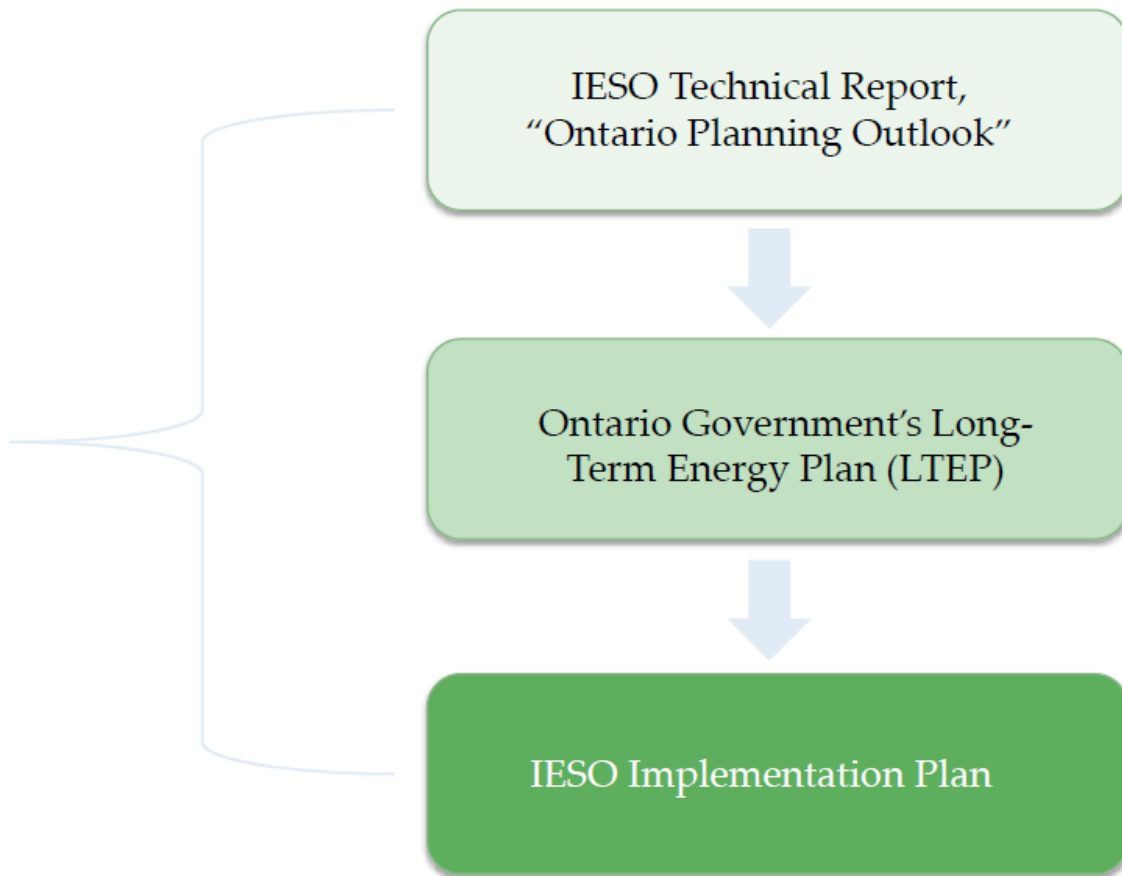
Prepared for discussion with the IESO Stakeholder Advisory Committee

Chuck Farmer, Director, Stakeholder & Public Affairs
October 19, 2016

Planning Context Under Bill 135

Bill 135, the *Energy Statute Law Amendment Act, 2016*

Received Royal Assent on June 09, 2016



What is the Ontario Planning Outlook?

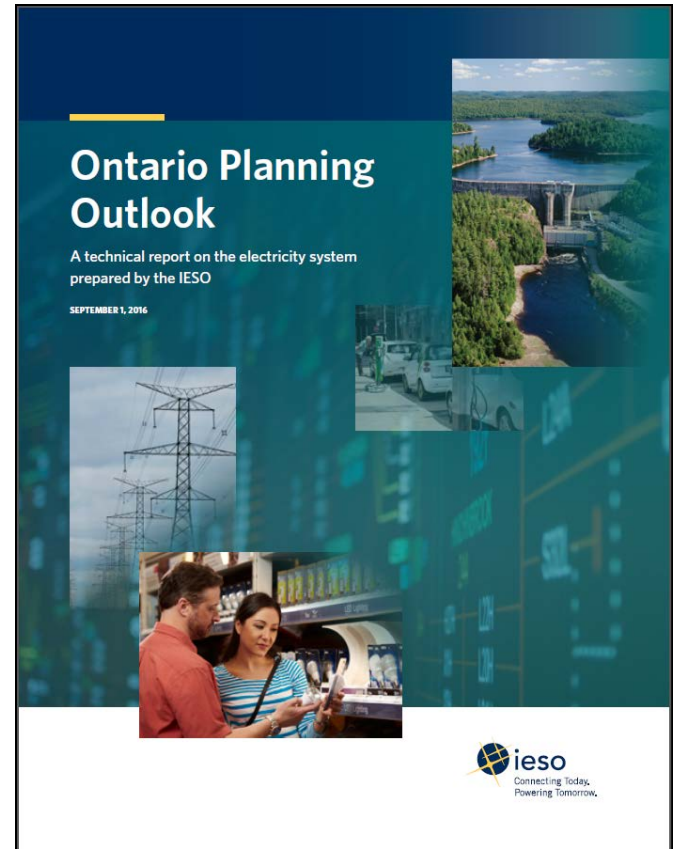
- It is the IESO's report responding to the June 10, 2016 request from the Minister of Energy, pursuant to section 25.29(3) of the Electricity Act, 1998, to have the IESO submit a technical report on the adequacy and reliability of Ontario's electricity resources in support of the development of the Long-Term Energy Plan.
- It was submitted to the Minister and published on September 1, 2016.
- The report provides planning context for policy makers and industry stakeholders and serves as an early input into the government's LTEP consultation process.

Report structure

Table of Contents

1. Foreword
2. The State of the System: 10-Year Review
3. Electricity System 20-Year Outlook
 - 3.1. Demand Outlook
 - 3.2. Conservation Outlook
 - 3.3. Supply Outlook
 - 3.4. Market and System Operations Outlook
 - 3.5. Transmission and Distribution Outlook
 - 3.6. Emissions Outlook
 - 3.7. Electricity System Cost Outlook
4. Conclusion

Appendices and Modules

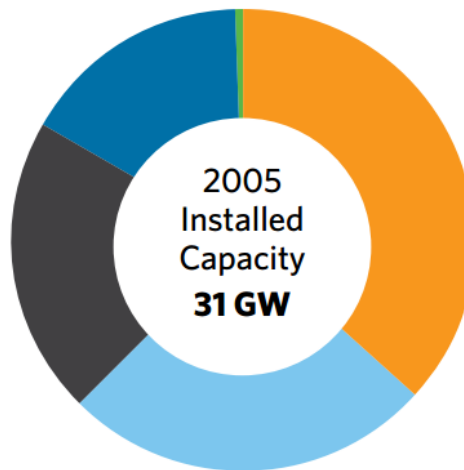


A set of Modules accompany the report, providing further insights and assumptions with respect to the areas described in the report. Modules and data tables can be found on the IESO website:

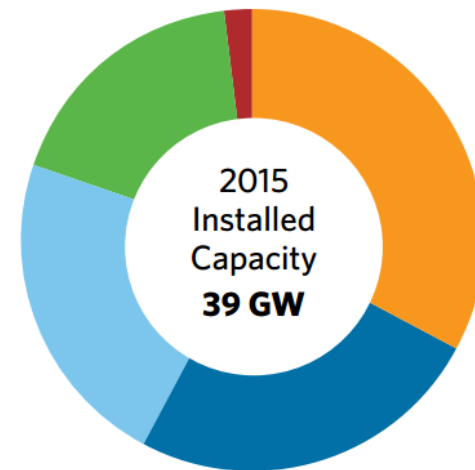
<http://ieso.ca/Pages/Ontario%27s-Power-System/Ontario-Planning-Outlook/default.aspx>

State of the system: 10-year review

- Demand has been on a declining trend driven by increased conservation efforts and changes in Ontario's economy
- Coal-fired generation has been retired and at the same time Ontario saw additions in non-carbon emitting and natural gas-fired generation
- Reliability concerns of a decade ago have been addressed
- Greenhouse gas emissions in Ontario's electricity sector have been reduced by more than 80 percent
- Current and planned investments will meet the province's electricity needs well into the next decade



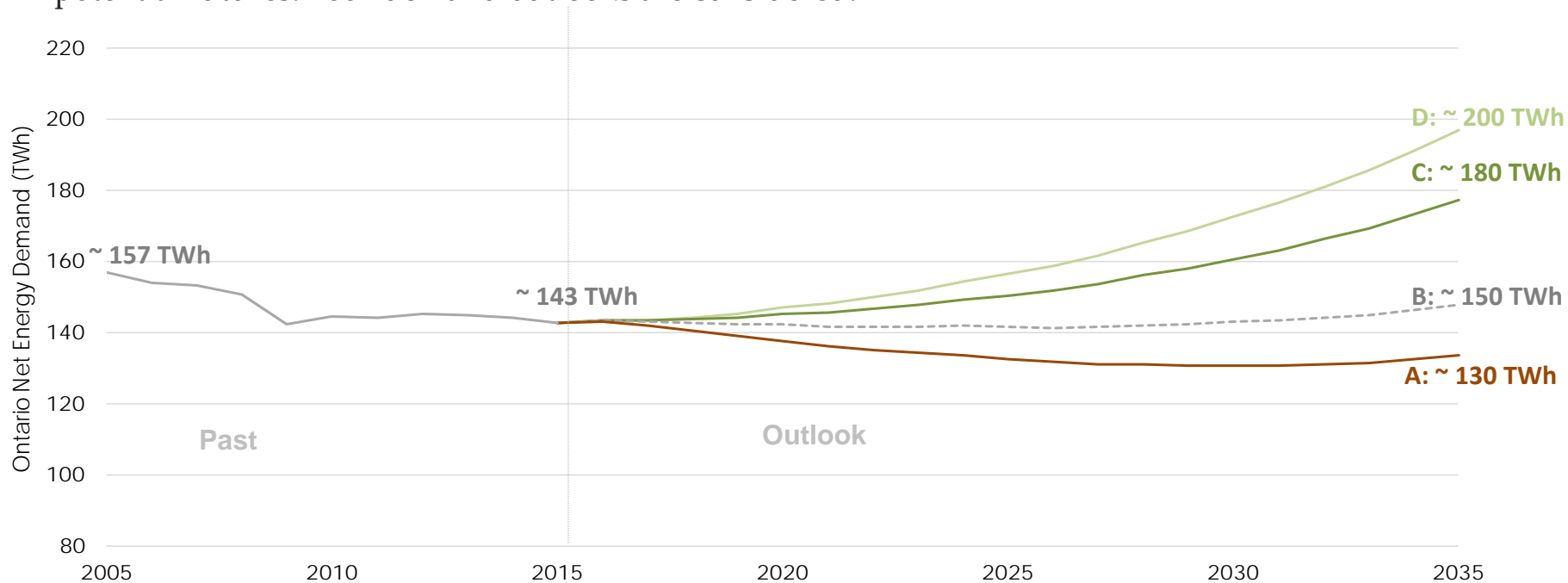
■ Nuclear	37%
■ Water	26%
■ Coal	21%
■ Natural Gas	16%
■ Solar/Wind/Bioenergy	<1%



■ Nuclear	33%
■ Natural Gas	25%
■ Water	22%
■ Solar/Wind/Bioenergy	18%
■ Demand Response	2%
■ Coal	0%

Electricity system 20-year outlook: Four demand outlooks considered

- The demand for electricity is the starting point used in assessing the outlook of the electricity system
- There is uncertainty in any demand forecast. Planning recognizes the uncertainty by addressing a range of potential futures. Four demand outlooks are considered.



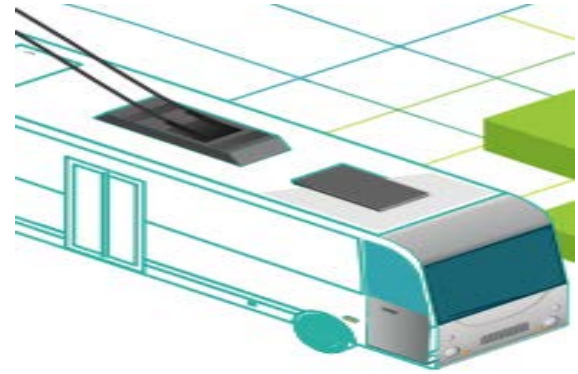
Outlook A (or “low demand outlook”), which explores the implications of lower electricity demand

Outlook B (or “flat demand outlook”), which explores a level of long-term demand that roughly matches the level of demand that exists today

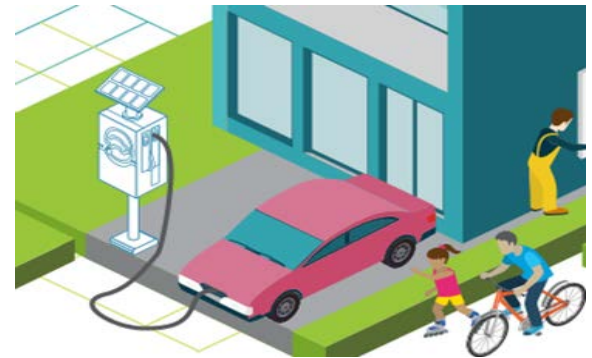
Outlooks C and D (or “higher demand outlooks”), which explore higher levels of demand

Electrification and the Climate Change Action Plan

- Implementation of the province's climate change policies consistent with the Climate Change Action Plan (CCAP) will have an impact on the demand for electricity through greater electrification of the economy
- Electrification potential exists in nearly every part of the energy system
- Early focus of the CCAP is on programs over the next five years
- In the longer term, there is uncertainty with respect to the pace of electrification
- It is anticipated the CCAP will be regularly updated



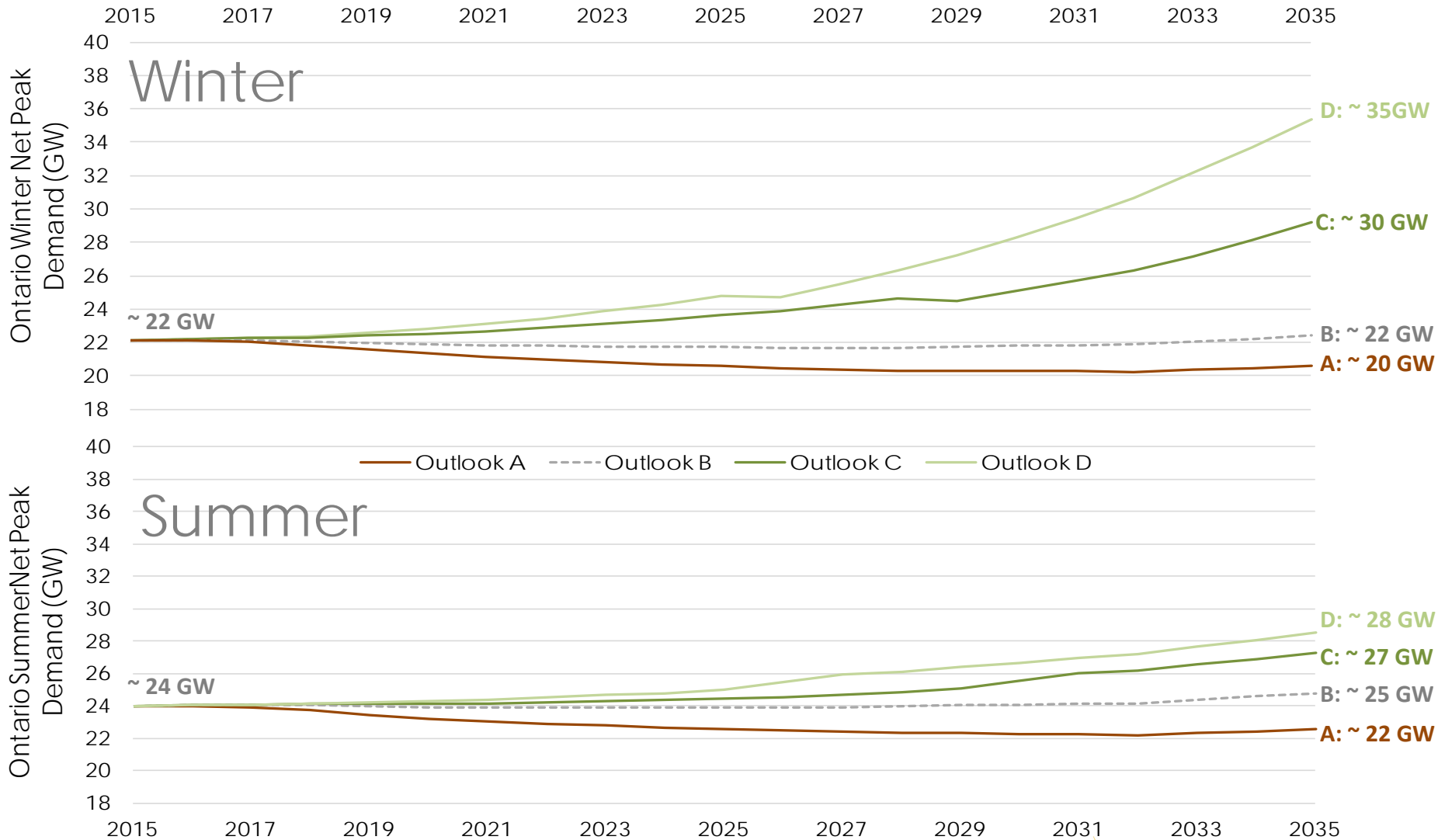
ONTARIO'S FIVE YEAR CLIMATE CHANGE ACTION PLAN 2016 - 2020



Energy demand by sector for each Outlook, with key assumptions for higher electrification under Outlooks C and D

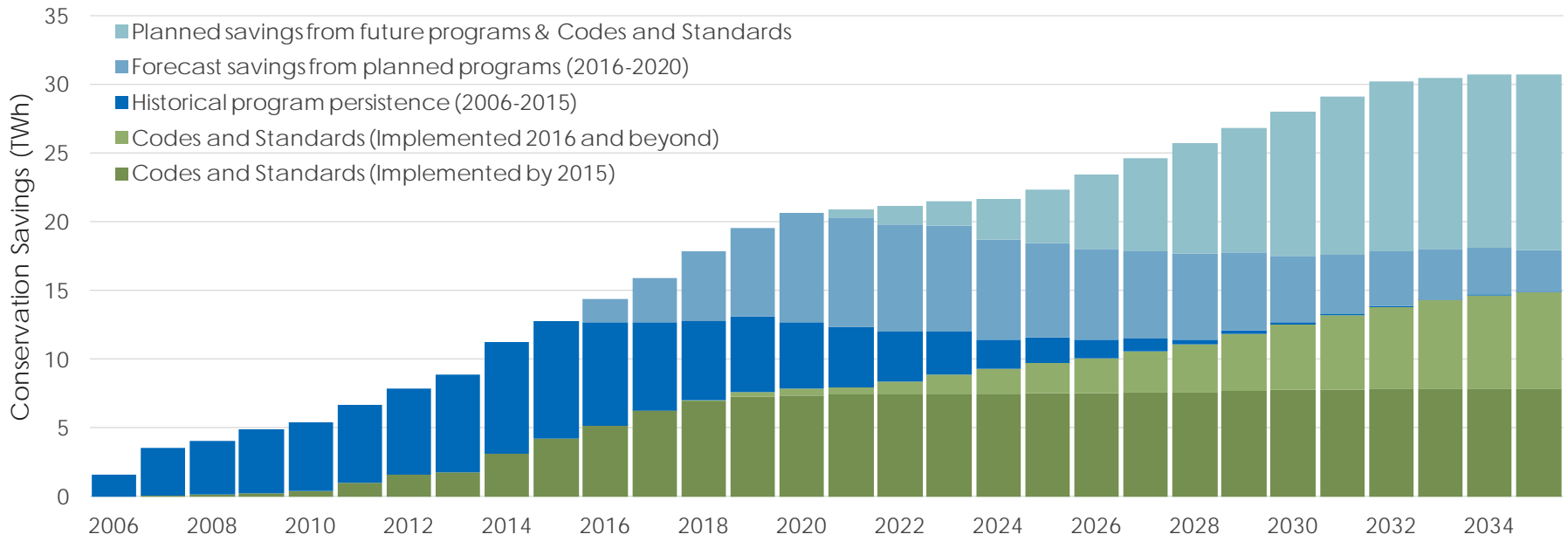
Sector	Outlook A	Outlook B	Outlook C	Outlook D
Residential (52 TWh in 2015)	48 TWh in 2035	51 TWh in 2035	Oil heating switches to heat pumps, electric space and water heating gain 25% of gas market share (58 TWh in 2035)	Oil heating switches to heat pumps, electric space and water heating gain 50% of gas market share (64 TWh in 2035)
Commercial (51 TWh in 2015)	49 TWh in 2035	54 TWh in 2035	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	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	2.4 million 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	Planned projects, 2017-2035 (1 TWh in 2035)	Planned projects, 2017-2035 (1 TWh in 2035)
Other* (5 TWh in 2015)	5 TWh in 2035	5 TWh in 2035	5 TWh in 2035	5 TWh in 2035
Total** (143 TWh in 2015)	133 TWh in 2035	148 TWh in 2035	177 TWh in 2035	197 TWh in 2035

Ontario becomes a strongly winter peaking jurisdiction under higher demand outlooks driven by growth in electric space heating



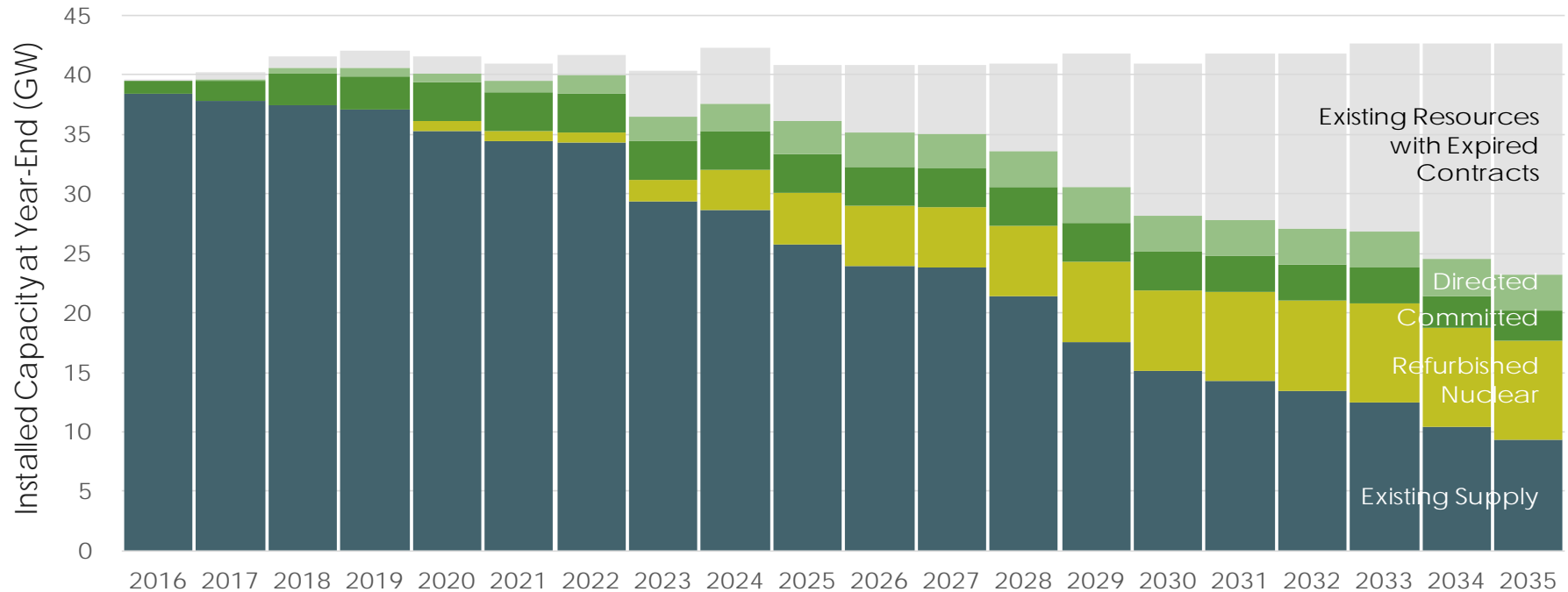
Conservation outlook

- All four outlooks reflect achievement of 2013 LTEP conservation targets and the Conservation First Framework. Achieved through a combination of conservation programs and building codes and equipment standards.
- In the flat demand outlook, conservation effectively offsets all growth due to economic activity
- Opportunities for conservation can vary with reductions or increases in demand. The value of conservation is greater under higher demands, unlocking conservation potential which was otherwise uneconomic and supporting higher investment in more efficient technologies.
- The Achievable Potential Study results identify that the existing conservation targets and planned savings are feasible. The LTEP process and results of the Achievable Potential Study will help inform the review of conservation targets as part of the IESO's mid-term review process



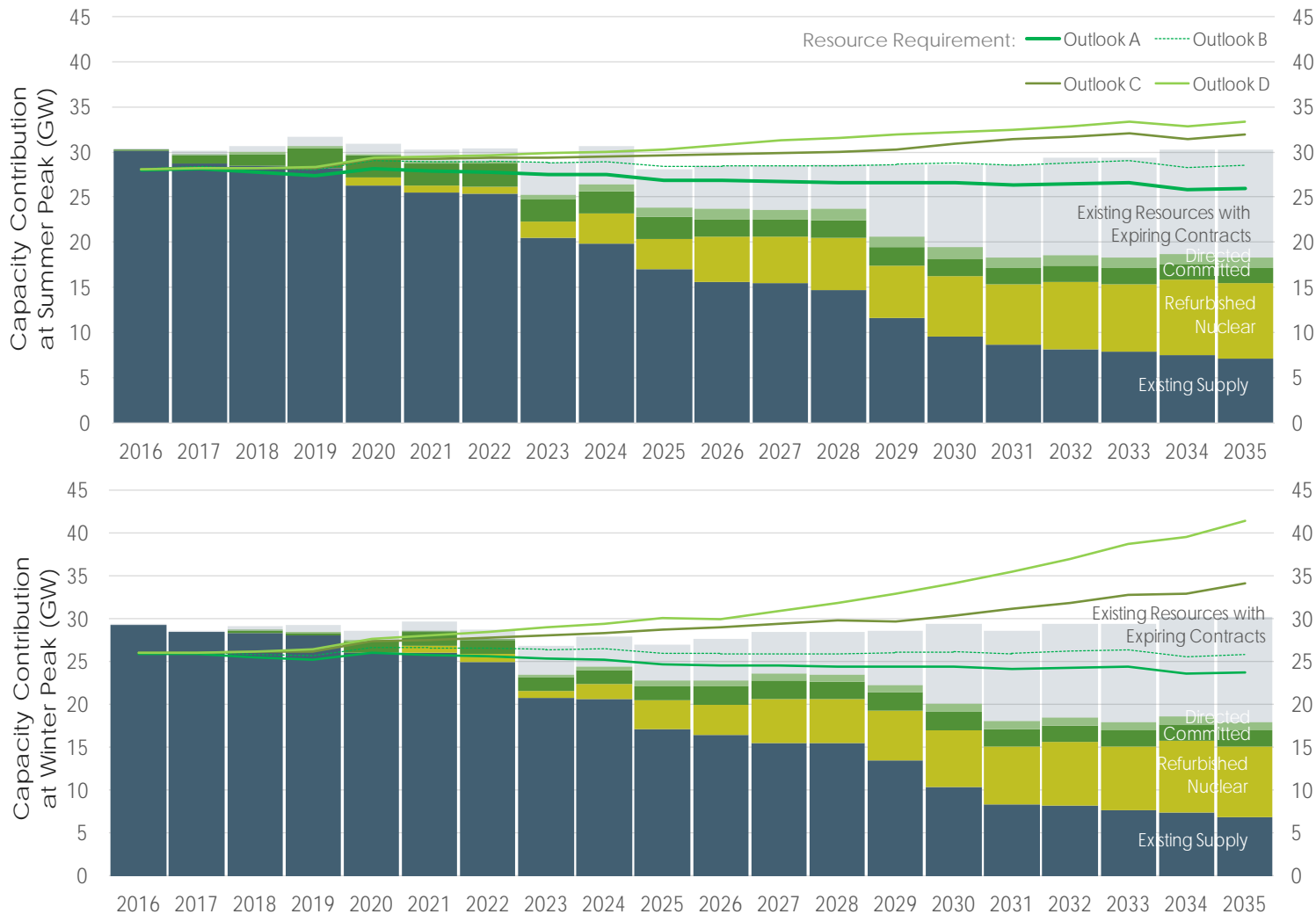
Outlook for installed supply capacity

- If all existing resources continue to operate after contract expiry and if planned resources come into service as scheduled, Ontario would have a total installed capacity of ~43 GW by 2035
- In contrast, if all existing resources are removed from service after contract expiry, Ontario would have a total installed capacity of ~25 GW by 2035
- Potential implementation delays, including with the nuclear refurbishment program, and the effect of aging on the performance of the generation fleet could affect the availability of supply over the planning outlook



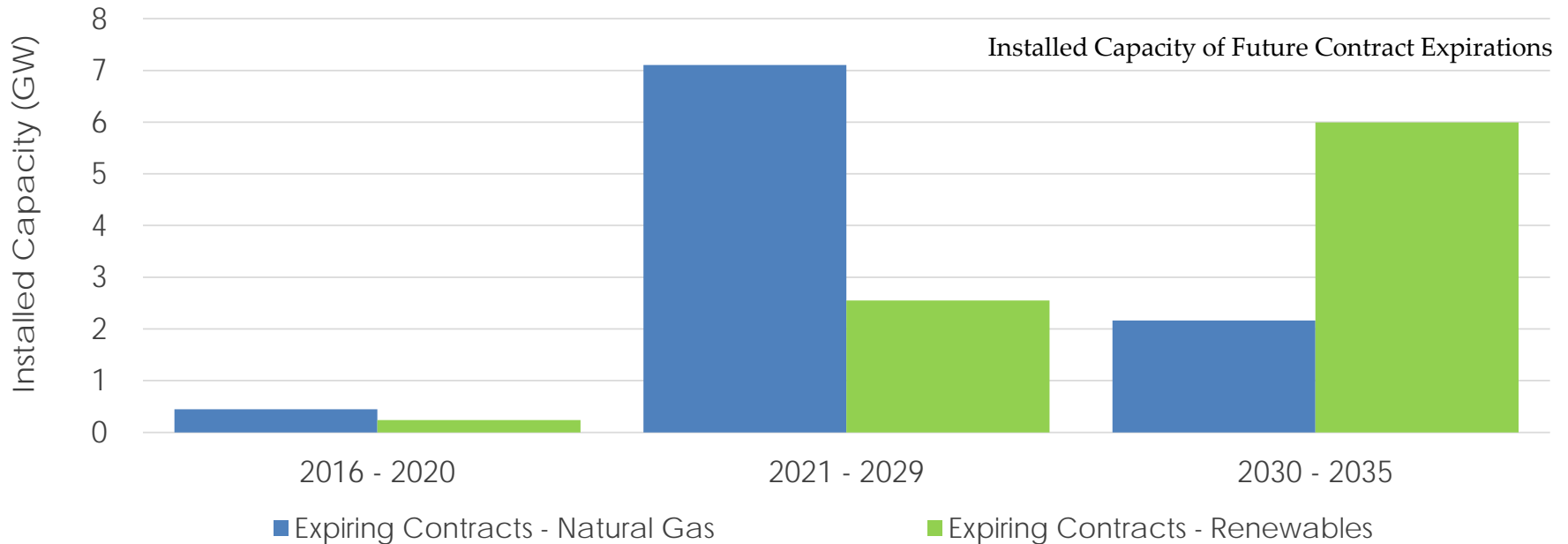
Resource adequacy outlook

- Ontario's existing, committed and directed resources would be sufficient, at the provincial level, to meet the flat demand outlook
- There is enough flexibility to address a lower growth in demand or to adapt to new opportunities or priorities
- Additional resources would be required to meet any increased growth in demand



Supply outlook under the low demand outlook

- Ontario could adapt to low demand outlooks by not recontracting with generation facilities when contracts expire
- Ontario also has the option of exercising nuclear refurbishment off-ramps in response to sustained, very low demand expectations resulting from structural or disruptive technological change
- These provide the ability to align future investments with the province's evolving needs, opportunities and priorities
 - Also provide opportunities to diversify resource commitments including through the use of mechanisms such as capacity auctions



Supply outlook under the higher demand outlooks

- Ontario is expected to have sufficient resources to meet demand generally over the next decade across all outlooks. Higher demand could create a need for additional resources in the longer-term.
- A number of choices exist across the sector – being driven by technological advancements, evolutions in policy and market design and increasing customer engagement
- No single resource option can meet all customer needs at all times
- Maintaining a diverse resource mix can provide the different services necessary to support reliable and efficient operations

	Capacity	Energy	Operating Reserve	Load Following	Frequency Regulation	Capacity Factor	Contribution to Winter Peak	Contribution to Summer Peak	LUEC (\$/MWh)
Conservation	Yes	Yes	No	No	No	Depends on Measure	Depends on Measure	Depends on Measure	\$30-50
Demand Response	Yes	No	Yes	Yes	Limited	N/A	60%	85%	N/A
Solar PV	Limited	Yes	No	Limited	No	15%	5%	30%	\$140-290
Wind	Limited	Yes	No	Limited	No	30%	30%	10%	\$65-210
Bioenergy	Yes	Yes	Yes	Limited	No	40-80%	90%	90%	\$160-260
Storage	Yes	No	Yes	Yes	Yes	Depends on technology/application	Depends on technology/application	Depends on technology/application	Depends on technology/application
Waterpower	Yes	Yes	Yes	Yes	Yes	30-70%	75%	71%	\$120-240
Nuclear	Yes	Yes	No	Limited	No	85-95%	90-95%	95-99%	\$120-290
Natural Gas	Yes	Yes	Yes	Yes	Yes	up to 65%	95%	89%	\$80-310

LUEC: Levelized Unit Electricity Cost (a measure of the cost of a unit of energy)

Distributed energy resources (DER): Key considerations

- Evolutions in technology and policy are expanding opportunities for customer engagement and participation
- Distributed energy resources (DERs) are contributing to a system more characterized by two-way flows, rather than only one-way delivery from large central stations
- A number of communities are now developing community energy plans and DER is becoming a key component of those plans
- Higher growth outlooks provide greater opportunities for harnessing DER and reducing the need for new grid-connected resources



- Pilot programs, and lessons learned from other jurisdictions, can help Ontario better understand available or emerging options and identify barriers that might hinder their success.
- Addressing barriers to the adoption of distributed energy resources, such as cost allocation and integration issues, could help to better realize their potential benefits

Market and system operations outlook

- As the sector continues to evolve and innovate, so does the electricity market
 - The IESO has successfully integrated over 6,000 MW of wind and solar PV into Ontario's electricity system
 - Renewable Integration Initiative (RII) introduced centralized forecasting of variable generation and the capability to dispatch variable generators
- Looking ahead, the complexity of the power system will continue to grow
 - Investments to be made in people and processes to ensure efficient and reliable operations against the backdrop of increased renewable generation, distributed energy resources, changing customer demand patterns, and nuclear outages
 - Newer technologies such as storage are being explored with the expectation that they can provide valuable operability characteristics
 - Expanded markets would allow for more dynamic real-time coordination between system needs and available resources
 - Greater coordination between the grid operator and embedded resources, directly or through LDCs, could also enhance reliability and efficiency



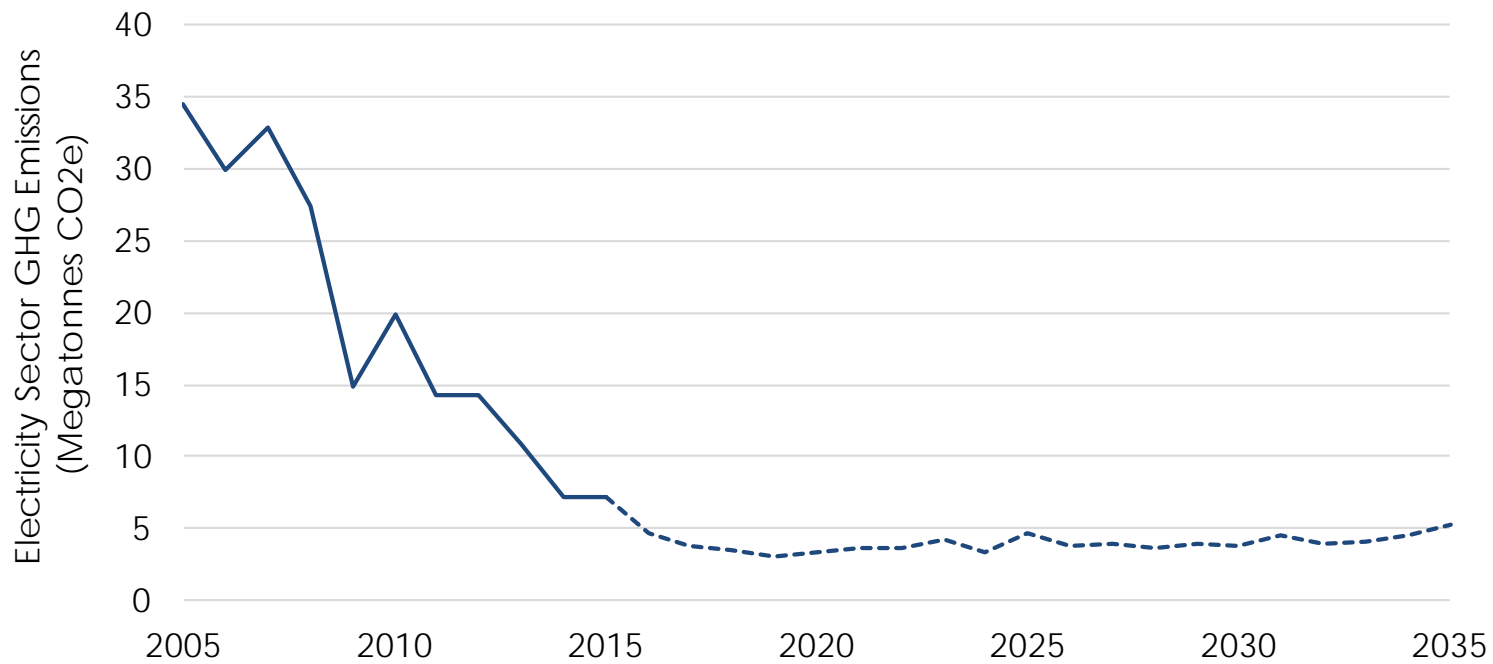
Transmission and distribution outlook

- Beyond current projects, no significant new transmission investments would be required in the flat electricity demand outlook served by existing and currently planned resources.
- However the amount of remaining transmission availability is limited - in higher demand outlooks, long lead-time investments in transmission will be required to accommodate new resources.
- In the near term, while the system could manage some overall increases in demand, LDCs and regional transmission may be more significantly impacted as local peak demands grow
 - Strategies and options to address local issues could be addressed in regional planning processes, working together with transmitters and LDCs
- The need to replace aging assets over coming years will also present opportunities to “right-size” investments in line with evolving circumstances



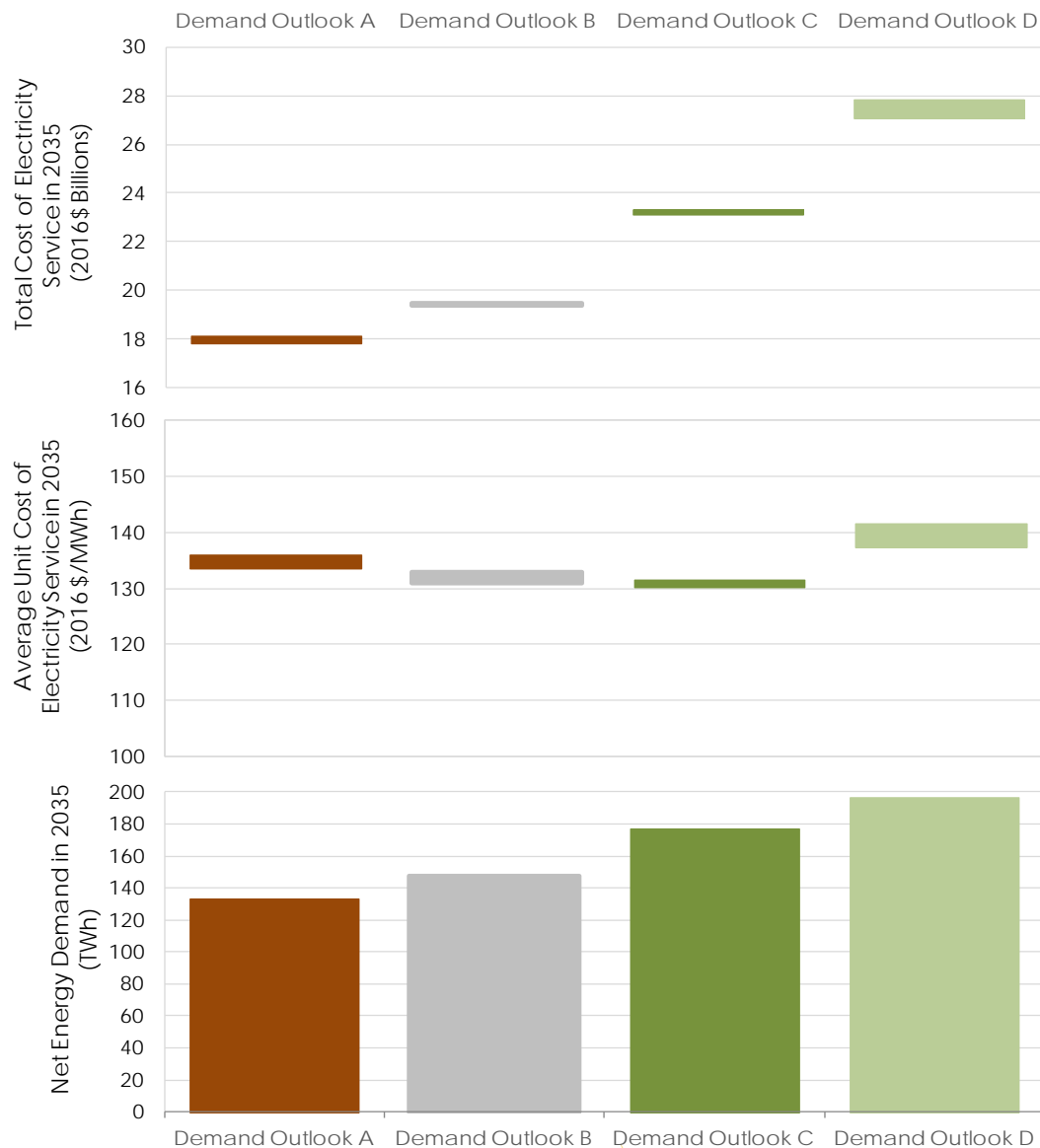
Emissions outlook

- Emissions are expected to continue to decline over the next five years
- When Cap and Trade takes effect in 2017, emissions will be lower than what they otherwise would have been
- In the flat demand outlook, emissions rise slightly following Pickering retirement but remain well below historical levels and relatively flat through to 2035
- Consideration of how to address the higher demand outlooks was based on keeping GHG emissions in the electricity sector within the range of the flat demand outlook



Electricity system cost outlook

- Function of demand growth, cost of operating existing system, and the investments in new resources required to meet potential needs
- In the flat demand outlook, total cost averages ~\$21B/year over the next decade and is estimated to decrease to about \$19B by 2035 (2016\$)
- In higher demand outlooks, investments in new resources (conservation, generation, and transmission) would be required to meet the increase in demand and to reduce increases in emissions
 - Annual cost of electricity service would rise by \$4B to \$9B by 2035 (2016\$)
 - This would be associated with an increase in energy consumption in the province
 - As a result, the average unit cost of electricity service would be within the range of the flat demand outlook



Conclusion

- Actions taken over the past ten years have left Ontario well positioned to meet future provincial needs. However, Ontario's electricity sector will face significant change over the next twenty years.
- Looking ahead, the IESO has considered a range of potential long-term electricity demands and options for addressing them. Evolutions in policy, technology, and markets along with rising customer engagement are happening across the sector. These are adding both capacity and diversity to the suite of available options.
- Ontario has flexibility to adapt to the evolving sector. Positioning Ontario to take advantage of future opportunities and mitigate future risks will require ongoing efforts. Considerations in this regard include maintaining situational awareness, assessing opportunities and risks in an integrated way, and resolving barriers.
- Ontario has access to options for meeting electrification-driven demand growth in ways that result in significant economy-wide carbon emission reductions. In addressing the associated planning issues, the IESO is committed to supporting the Ministry's consultations as the new LTEP is developed.