

Consumer demand for electrification

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February 27, 2019

Agenda for Today

Technological innovation, market development, and an evolving supply mix are driving a rapid evolution of Ontario's electricity sector. Today we'll explore current and expected challenges and opportunities emerging through this evolution, including:

- Electricity demand forecast dynamics and electrification assumptions
- Case study: electricity growth in the Kingsville-Leamington area
- Evolution of Ontario's electricity market and planning products

ELECTRICITY DEMAND FORECAST DYNAMICS AND ELECTRIFICATION ASSUMPTIONS

Gross demand gives an indication of number of devices that consume electricity

Distributed Generation

Grid Demand

Energy
Efficiency

Codes and
Standards

Net Demand

Commercial
Floor Space

Electric
Vehicles

Transit

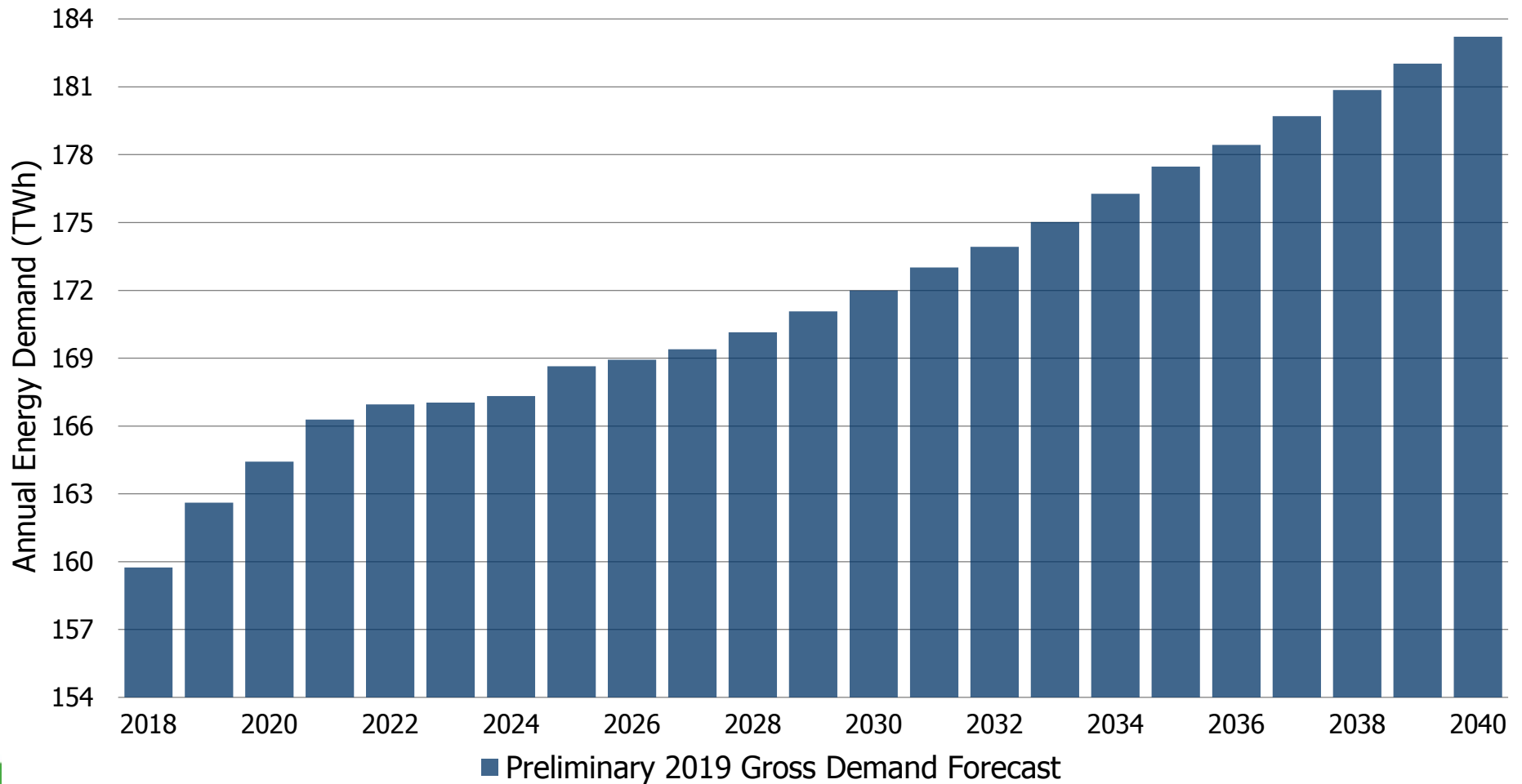
Residential
Households

Industrial
Load

Agriculture

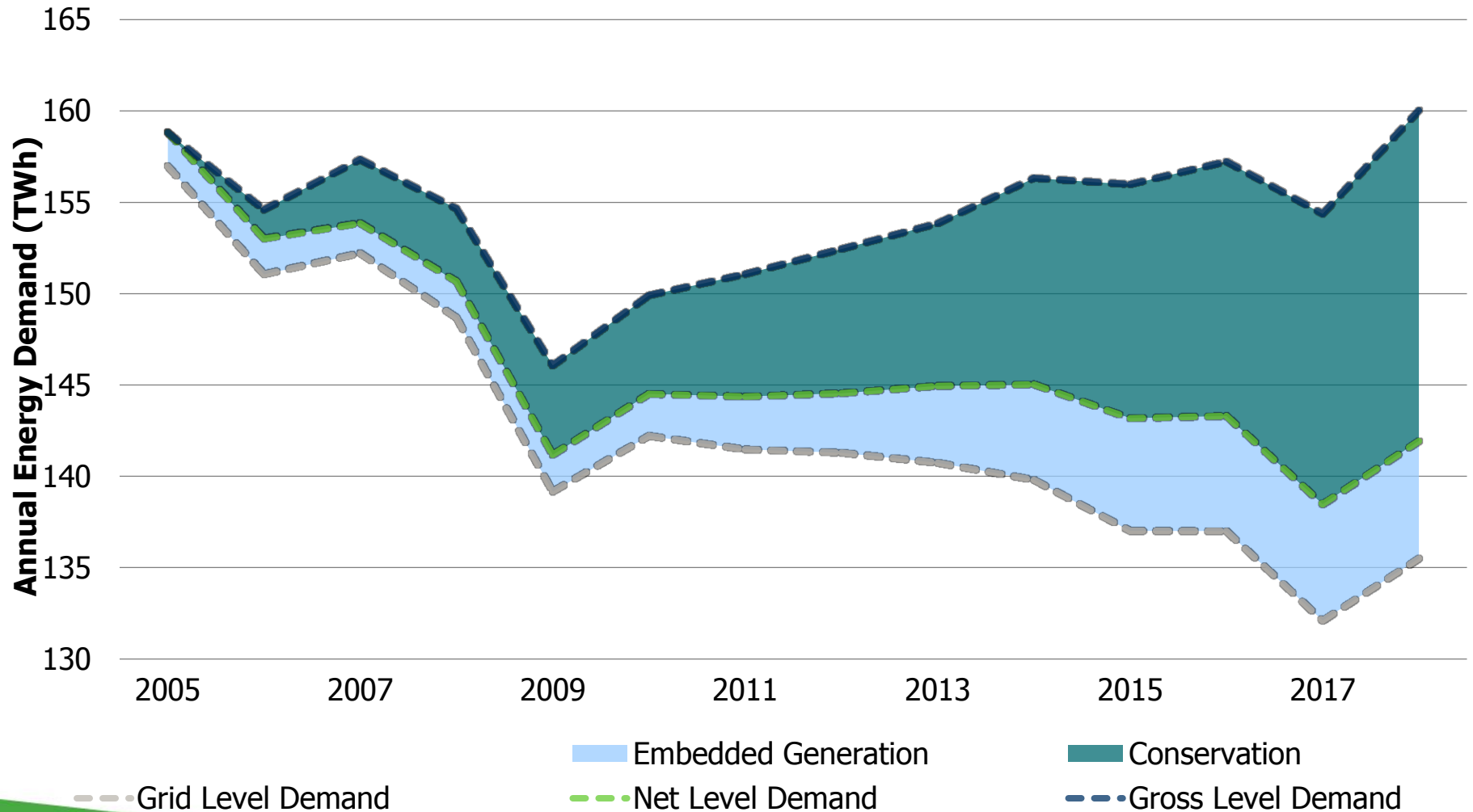
Gross Demand

IESO forecasts growth in gross demand*



*Preliminary results in draft form
Base year: 2017

Net electricity demand declining from impacts of conservation, economic change, distributed generation



Assumptions driving electrical demand are evolving

Sector	2016 Ontario Planning Outlook	2019 preliminary annual planning outlook*	2019 annual planning outlook – preliminary assumptions*		
			Years 1 - 5 (2020 - 2024)	Years 6 - 10 (2025 - 2029)	Years 11 - 21 (2030 - 2040)
1) Commercial floor space	Floor space grows by 736 M sqft, 21.9 % or 1.2 % / yr from 2018 – 2035	Floor space grows by 587 M sqft, 17.7 % or 1.0 % / yr from 2018 – 2035	Floor space grows by 202 M sqft, 6.0 % or 1.2 % / yr	Floor space grows by 150 M sqft, 4.2 % or 0.8 % / yr	Floor space grows by 359 M sqft, 9.7 % or 0.8 % / yr
2) Electric Vehicles (EVs)	Electric vehicles grows by 978 k, or 24 % / yr from 2018 – 2035	Electric vehicles grows by 825 k, or 21 % / yr from 2018 – 2035	Electric vehicles grows by 157 k, 298 % or 31.8 % / yr, to 210 k	Electric vehicles grows by 310 k, 147 % or 19.9 % / yr, to 520 k	Electric vehicles grows by 480 k, 92 % or 6.1 % / yr, To 1 M
3) Residential households	Households grows by 1.0 M, 18 % or 1 % / yr from 2018 – 2035	Households grows by 1.3 M, 24 % or 1.3 % / yr from 2018 – 2035	Households grows by 440 k, 7.8 % or 1.5 % / yr	Households grows by 375 k, 6.2 % or 1.2 % / yr	Households grows by 644 k, 10.0 % or 0.9 % / yr
4) Industrial Load	Flat load from 2018 – 2035	Mining sector continues to grow from 2018 – 2035	Mining sector continues to grow		
5) Transit	GO Rail electrification & LRT projects as planned by 2016 + 548 GWh annual energy demand from 2018 – 2035	GO Rail electrification & 7 LRT projects as planned by 2016 + 1,403GWh annual energy demand from 2018 – 2035	First 6 LRTs in service	GO Rail system electrification as well as 2 LRT phases	No additional projects
6) Agriculture	Flat load 2.2 TWh from 2018 – 2035	Dramatic increase due to greenhouse load in southern Ontario to 4.0 TWh from 2018 – 2035	Dramatic increase due to greenhouse load in southern Ontario + 0.8 TWh to 3.9 TWh in 2024	Flat load 3.9 TWh in 2029	Flat load 4.0 TWh in 2040

*Preliminary assumptions in draft form

Residential, commercial, agricultural, transportation sectors driving growth in preliminary forecast*

Key Driver	Forecast growth from 2019 to 2040 (TWh)
Electric vehicle charging	3.2
Commercial floor space	7.4
Residential dwellings	6.9
Public transit electrification	1.4
Agriculture	0.8

- Structural economic change shifting employment from manufacturing to service sector results in relatively flat industrial growth expectations
- Modest growth expected from mining sector
- Sensitivity analysis on carbon and energy costs does not result in material changes to fuel switching for space heating
- Various loads' peak impacts are different. For example, EV charging demand can be managed to avoid adding burden to the system peak.

*Preliminary assumptions in draft form

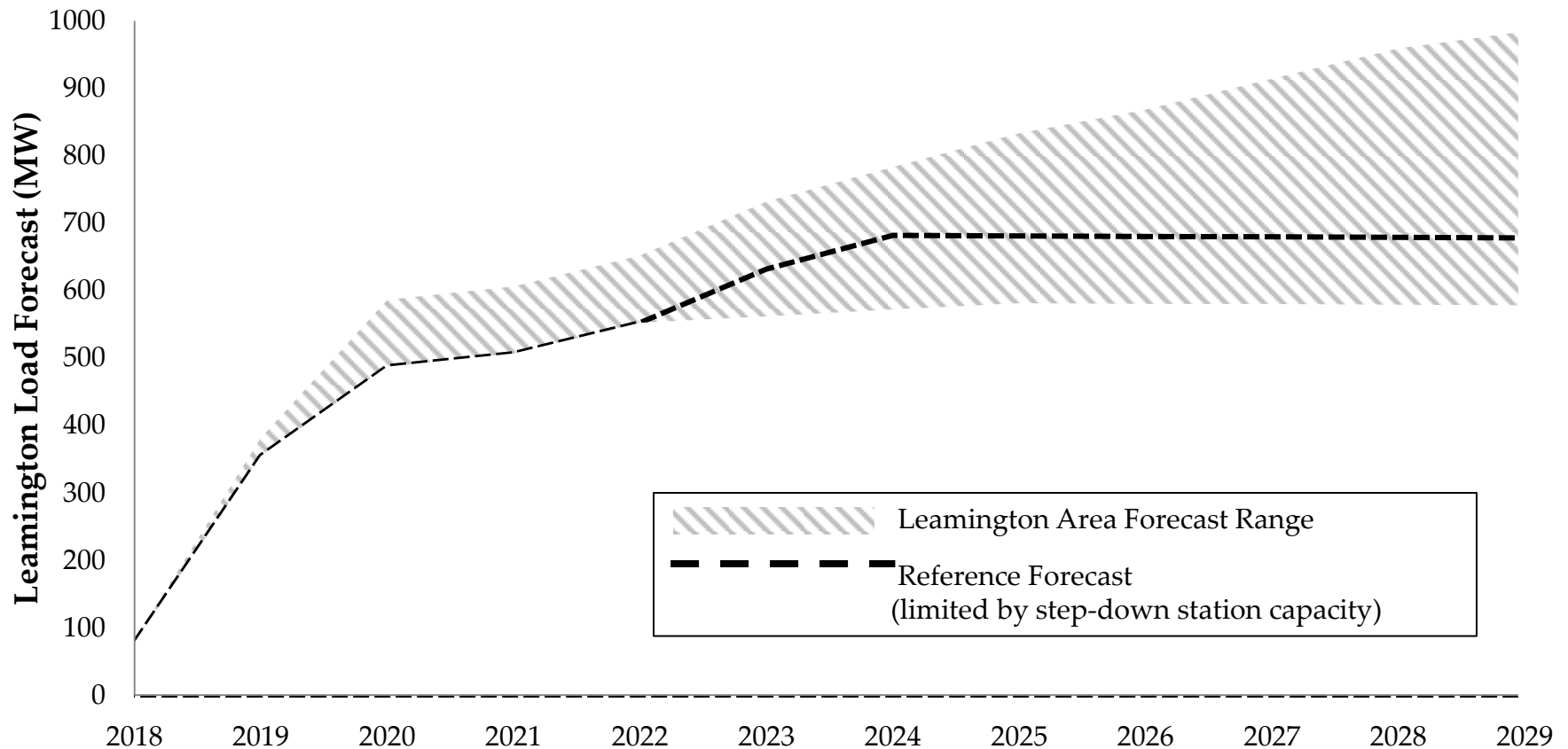
Case study: Examples of Artificial Growth Lighting in Greenhouses



Case study: Agricultural growth in the Kingsville-Leamington Area

- Due to forecasted load growth exceeding what had been predicted in the previous regional planning cycle, a Needs Assessment was conducted by Hydro One and published in Q4 2017
 - Over 500MW of forecast load expected for the Kingsville-Leamington area versus 170 MW that was forecast in the last cycle
- The majority of the load growth is due to significant greenhouse expansion in the Kingsville-Leamington area
- An Integrated Regional Resource Plan is recommended due to:
 - Potential for non-wires solutions to address the identified needs
 - Opportunities to maximize use of end-of-life assets
 - Potential reliability impact of local generation reaching contract expiry
 - Identify the required mid to long-term plans to meet the growing need

Electricity demand forecast for Kingsville-Leamington Area



Case study: Agricultural growth in the Kingsville-Leamington Area

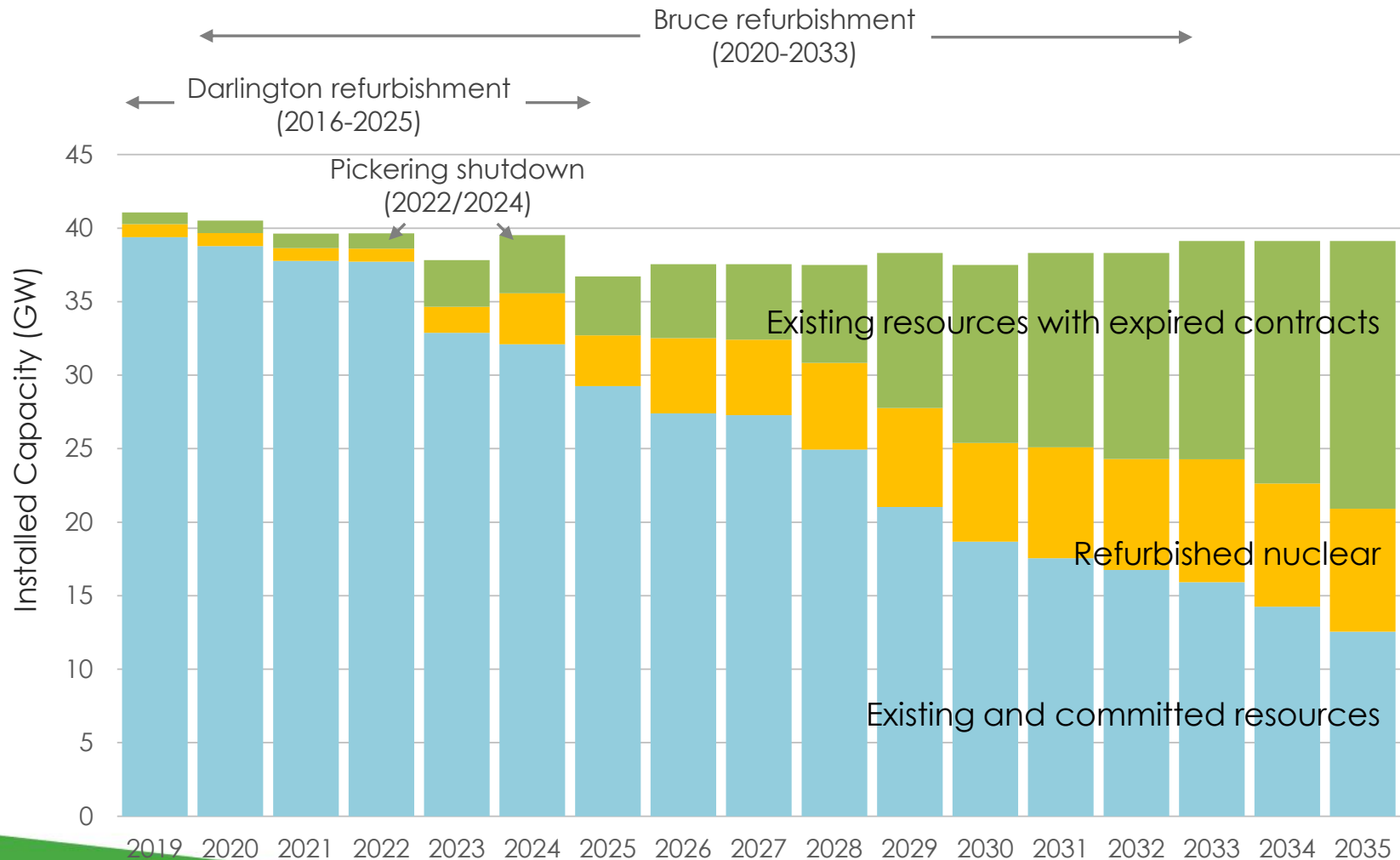
- Majority of load growth is due to a demand to utilize growth lights to extend and increase the yield of vegetables and cannabis
 - Rough breakdown of load in the agriculture load expected in the area will be vegetable greenhouses (70%) and cannabis greenhouses (30%)
- The Kingsville-Leamington Area will become winter peaking by 2019 due to growth in demand for vegetable and cannabis production
 - Artificial lighting is used to supplement/act as natural sunlight
 - Typical lighting energy intensity for fruits/vegetables with industry standard technology (High Pressure Sodium lighting) is $1\text{kW}/10\text{m}^2$ or $\sim 0.4\text{MW}/\text{acre}$ whereas total non-lighting load is $\sim 0.005\text{--}0.015\text{MW}/\text{acre}$
 - Cannabis total energy intensity can be greater than $0.8\text{MW}/\text{acre}$ due to higher requirements for HVAC load in addition to lighting loads

Infrastructure development required for transformational industry shifts

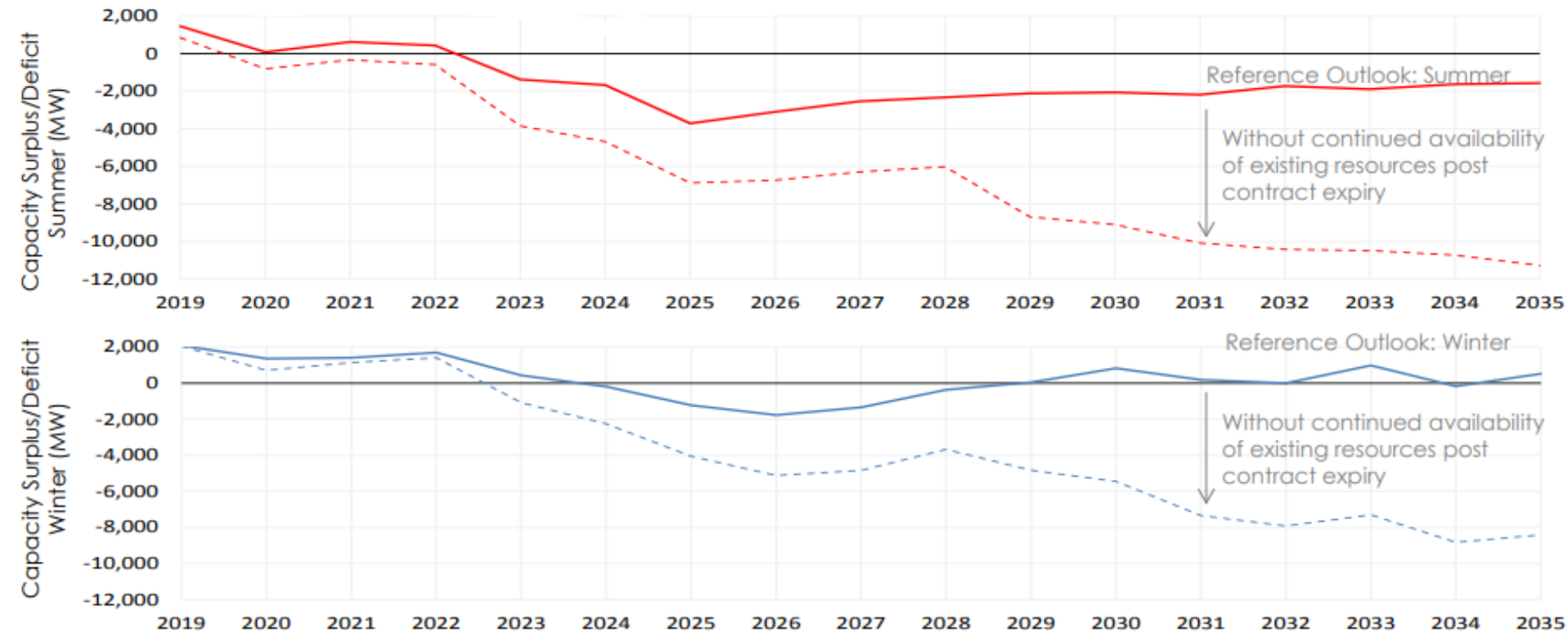
- When customer demand for electricity surpasses the power system's ability to reliably deliver, infrastructure investments are required
- For the electrical demand from greenhouses to materialise, the scope of infrastructure development extends far beyond the electricity sector and includes access to water and natural gas, adequate sanitation lines/sewer system, availability of labour, adequate roads, etc.
- Demand forecasting based on best knowledge at the time, there's potential for growth in other sectors (cloud computing, bitcoin mining) to grow at faster paces than infrastructure planning cycles

CHALLENGES AND OPPORTUNITIES IN AN EVOLVING SECTOR

Ontario's evolving electricity supply



Requirement for *capacity* expected to emerge in 2023



Capacity Surplus (+)/Deficit (-) (MW)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Summer Adequacy: Reference Outlook	1,454	81	622	433	-1,377	-1,673	-3,711	-3,099	-2,536	-2,330	-2,118	-2,065	-2,192	-1,729	-1,895	-1,625	-1,566
Summer Adequacy: Reference Outlook Without Existing Res.	847	-811	-335	-583	-3,844	-4,686	-6,878	-6,736	-6,292	-6,018	-8,689	-9,096	-10,077	-10,418	-10,475	-10,724	-11,273
Winter Adequacy: Reference Outlook	2,091	1,364	1,408	1,698	435	-192	-1,229	-1,770	-1,343	-366	47	825	184	-2	983	-176	523
Winter Adequacy: Reference Outlook Without Existing Res.	2,060	710	1,143	1,410	-1,085	-2,263	-4,063	-5,124	-4,838	-3,675	-4,833	-5,451	-7,344	-7,921	-7,306	-8,834	-8,419

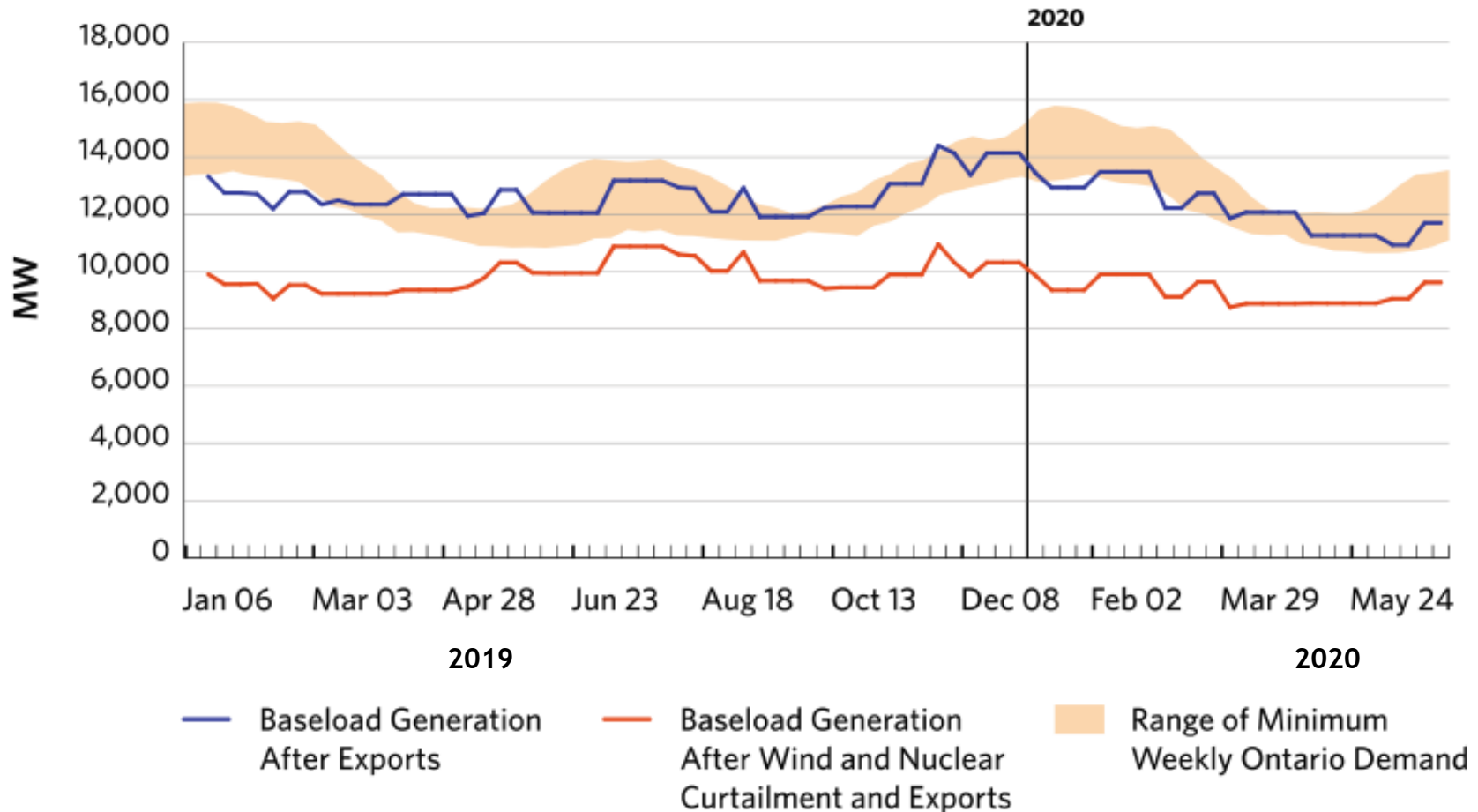
An Incremental Capacity Auction (ICA) will enable Ontario to cost-effectively meet future capacity needs

- Market Renewal is about improving the way electricity is priced, scheduled and procured in order to meet Ontario's current and future energy needs reliably, transparently, efficiently and at lowest cost
- The Market Renewal Program includes four initiatives that will enable the province to more efficiently meet demand over the near and longer terms and including the ICA
- The ICA will improve the way Ontario acquires resources to meet longer-term supply needs
- A transitional capacity procurement mechanism is being developed to meet capacity requirements in years prior to the first ICA commitment period

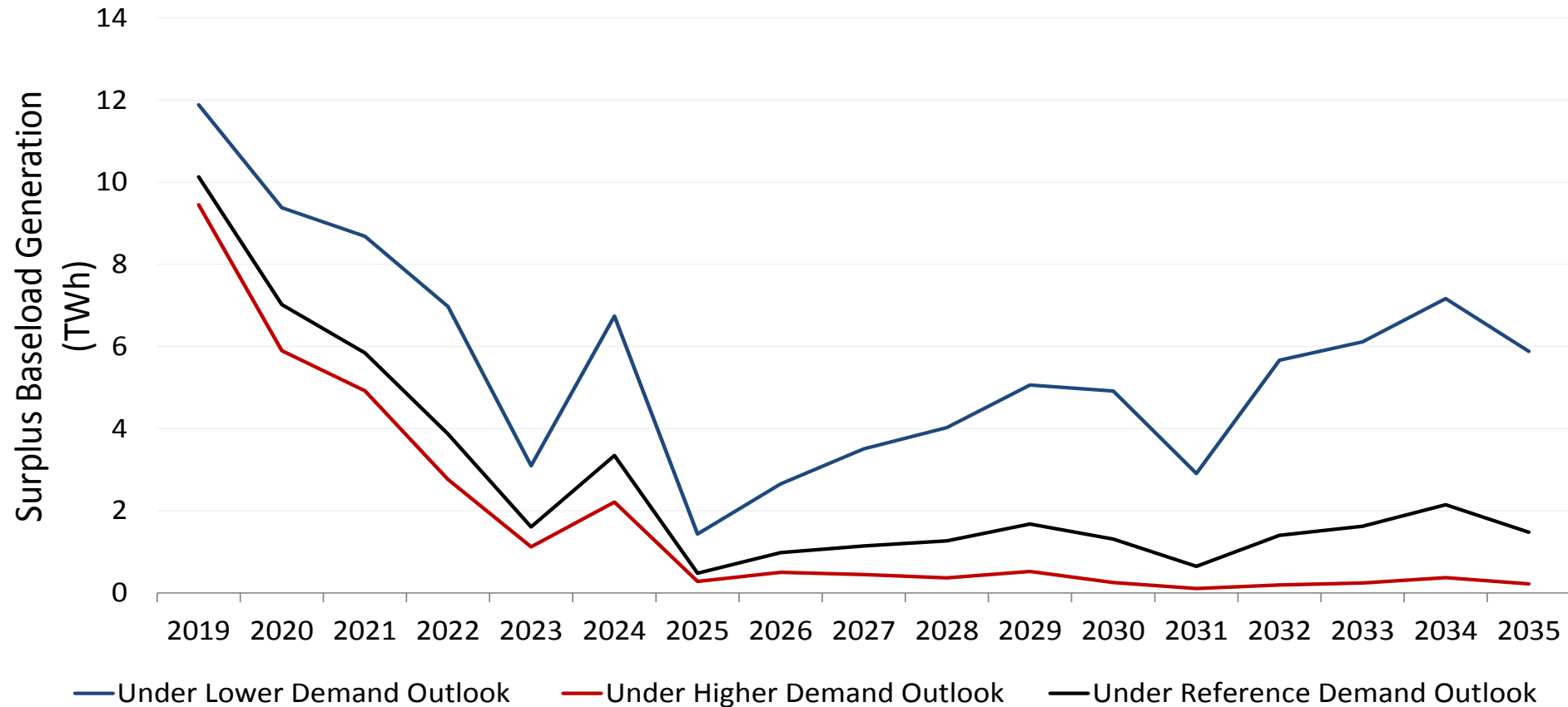
Energy adequate even when capacity requirement emerges

- Even when there is a requirement for capacity, we anticipate no additional energy production requirement
- Gas-fired generation picks up the slack when demand exceeds production from lower marginal cost resources such as renewable and nuclear generation
- When Pickering Nuclear Generating Station retires, gas-fired energy production is expected to increase

Surplus baseload generation (SBG) occurs when production exceeds demand



SBG is managed through market mechanisms and expected to decline



The capacity requirement/energy surplus dynamic creates challenges and opportunities

Programs, such as the Industrial Electricity Incentive sought to encourage consumption on off-peak hours

Given the growing role storage is poised to play in maintaining system reliability and enabling customer resiliency, IESO recently completed Removing Obstacles for Storage Resources in Ontario¹

Ontario's storage portfolio includes flow and solid state batteries, compressed air, flywheel, and hydrogen power-to-gas

Past

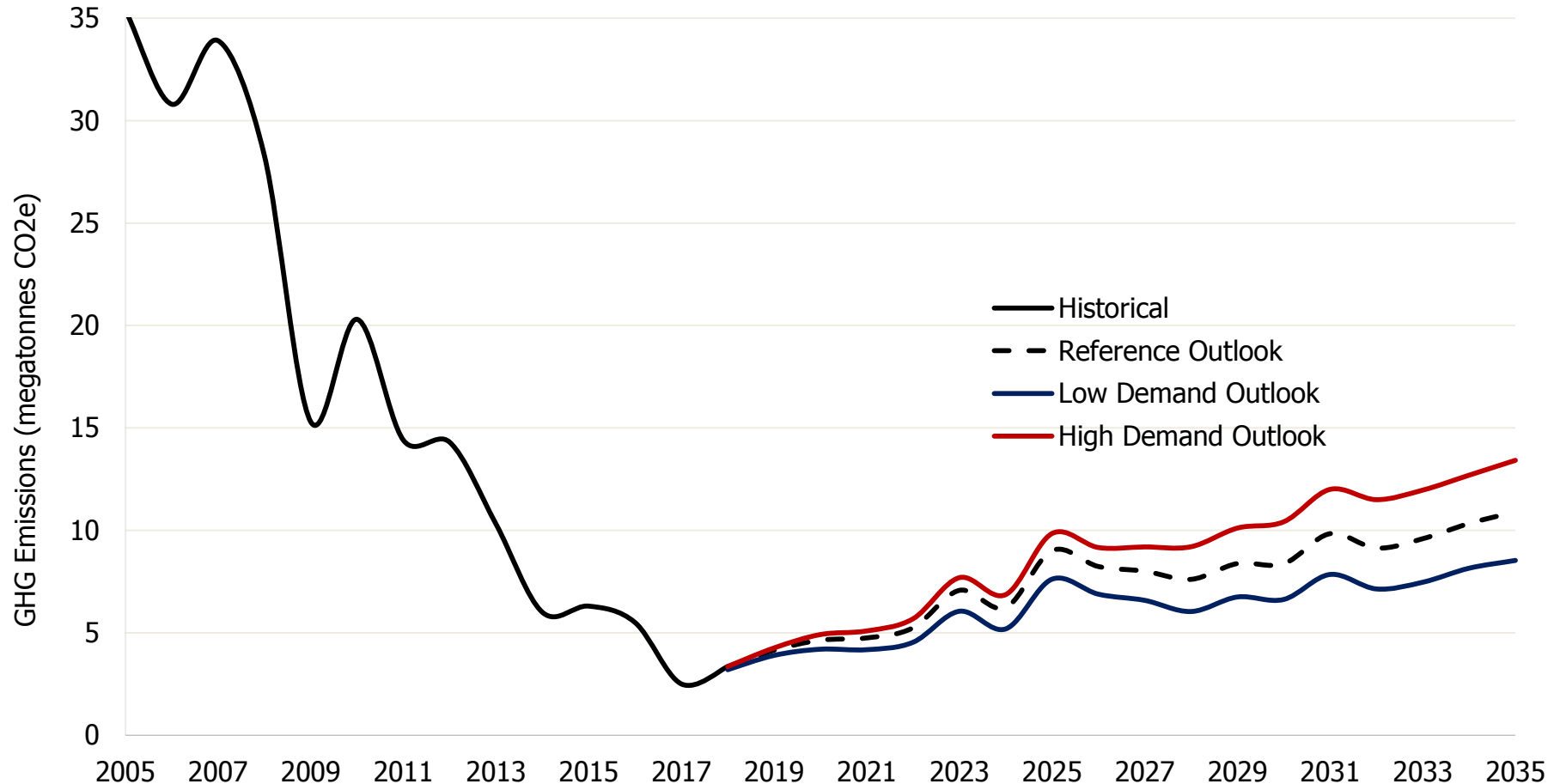
Present

Future

The Industrial Conservation Initiative (ICI) program enables industrials to reduce their electricity costs by reducing demand on the five highest peak days of the year

Electric vehicles and storage offer opportunities to better balance the dynamics between capacity needs and energy surpluses, but requires regulatory, market, and infrastructure evolution

Emissions from Ontario's electricity sector expected to increase from today and remain far below historic levels



EVOLUTION OF MARKETS AND PLANNING PRODUCTS

Planning products evolving to provide more transparent information to support market development

- **Reliability Outlook:** Quarterly report with 18 month horizon, extends out 60 months biannually to guide maintenance decisions
 - Assesses potential adverse conditions that might be avoided through adjustment or coordination of outage plans
- **Planning Outlook:** Annual report to provide timely and transparent information to guide investment decisions and market development
 - The 2019 annual planning outlook will inform capacity requirements in interim capacity acquisition and will be released in Fall 2019
 - Timing of future outlooks will coincide with the ICA
- **Bulk Planning Process:** Effort to formalize the integrated power system planning process to evolve and respond to changes in electricity planning and market evolution including implementation of the ICA

Stakeholder engagement is essential to the development of the annual planning outlook

January

- Public stakeholder engagement of Preliminary 2019 Long-Term Demand Forecast (January 31)

February

- Feedback period from stakeholder engagement of at least 10 business days
- Incorporate stakeholder feedback in the 2019 Long-Term Demand Forecast for Resource Adequacy Assessment (end of February 2019)

Q2 2019

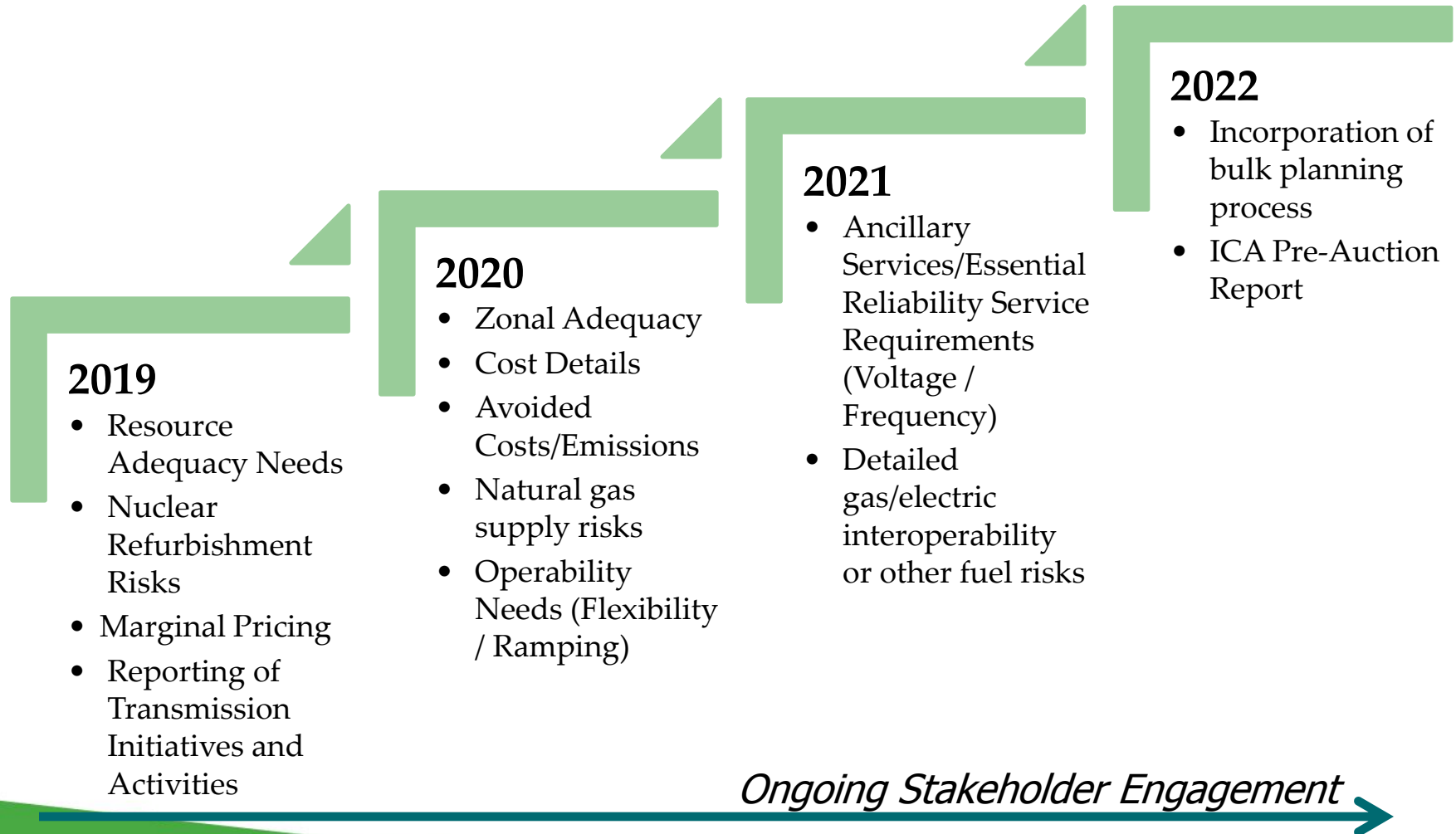
- Public stakeholder engagement regarding methodology to the 2019 annual planning outlook to provide an understanding of our existing approach and methodology
- Inform stakeholders of key changes in approach and methodology, and identify areas where additional stakeholder education is required

Q3-Q4 2019

- Publication of 2019 annual planning outlook
- Technical Planning Conference

Ongoing Stakeholder Engagement →

IESO is working with stakeholders to identify insights and analysis needed to foster market development*



*Illustrative schedule for discussion purposes

To participate in our engagements or find more information...

Planning Outlooks

<http://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/Planning-Outlook>

Bulk System Planning

<http://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Formalizing-the-Integrated-Bulk-System-Planning-Process>

Market Renewal

<http://www.ieso.ca/en/Sector-Participants/Market-Renewal/Overview-of-Market-Renewal>

Innovation Roadmap

<http://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/Innovation-Roadmap>