Annual Planning Outlook

Demand Forecast Module

December 2020

ieso
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Powering Tomorrow.

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1. Introduction

The Independent Electricity System Operator (IESO) conducts long-term power system planning for the province on an annual basis. The demand for electricity establishes the context for integrated planning, as it determines the amount of electricity that must be served. Electricity is used every day by Ontarians to provide a wide range of services. Electricity demand forecasting attempts to anticipate future requirements for the services that electricity provides. Updates to the electricity demand forecast provide context for updated integrated plans, energy-efficiency program planning and supply procurement decisions.

Electricity requirements are affected by many factors, including choice of energy form, technology, equipment purchasing decisions, behaviour, demographics, population, the economy, energy prices, transportation policy and conservation. The IESO monitors and interprets these and other factors on an ongoing basis to develop outlooks against which system planning can take place.

The COVID-19 pandemic and the ensuing public health and policy responses, have had significant effects on Ontarians' behaviour and economic activity. Initially, these effects had a profound impact on electricity consumption patterns. The stay-in-place policies in conjunction with the closure of non-essential businesses caused overall electricity consumption to drop. With more people working from home, residential consumption increased. Commercial loads have dropped but the declines have not offset the increase in residential loads. With the staged re-opening of the economy, commercial and industrial loads have picked back up and consumption patterns are gradually returning to pre-COVID-19 pandemic levels.

To account for the current uncertainty, the 2020 Annual Planning Outlook (APO) will consider two demand forecast scenarios that reflect the potential range of recovery from COVID-19 pandemic impacts on the system: Scenario 1 and Scenario 2. In the near term, demand is expected to be lower than previous forecasts as a result of the COVID-19 pandemic and resulting economic impacts. The pace of economic recovery is the primary factor in forecasting when demand is expected to return to pre-COVID-19 pandemic levels. In the longer term, in both scenarios, electricity demand is expected to exceed pre-COVID-19 pandemic levels.

2. Demand Forecast Summary

The IESO 2020 APO long-term demand forecast covers the period of 2022-2040 and is produced at the net-demand level. For planning purposes, two demand scenarios were developed: Scenario 1 and Scenario 2.

Scenario 1 is based on assumptions of a shallow economic recession in 2020 and early 2021 due to a mild COVID-19 pandemic second wave, coupled with the impacts of a small-scale reimplementation of temporary restrictions and business closures in early 2021 followed by a rapid economic recovery in 2021-2022. Scenario 2 is based on assumptions of a deep economic recession in 2020 to the end of 2021, prolonged and medium to severe COVID-19 pandemic impacts, followed by a slow, multi-year economic recovery starting in 2022. Overall electricity demand is expected to be less than Scenario 1 in the near term and grow at a slower rate than Scenario 1 over the course of the outlook period.

Figure 1: Net Annual Energy Demand (TWh)

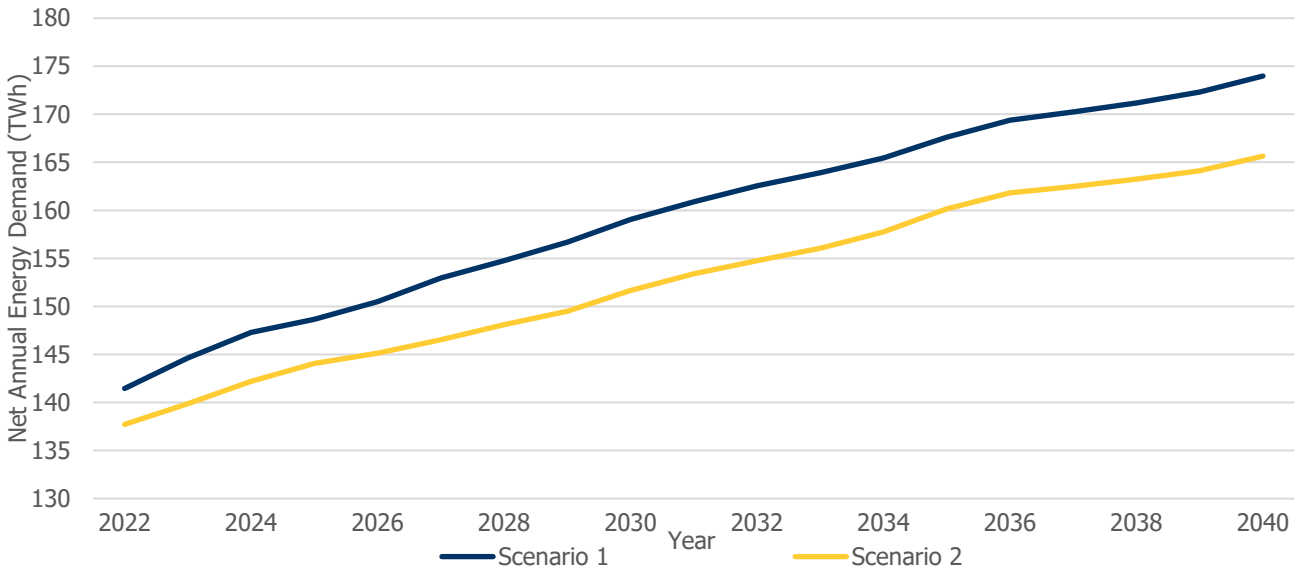


Figure 2: Net Annual Summer Peak Demand (GW)

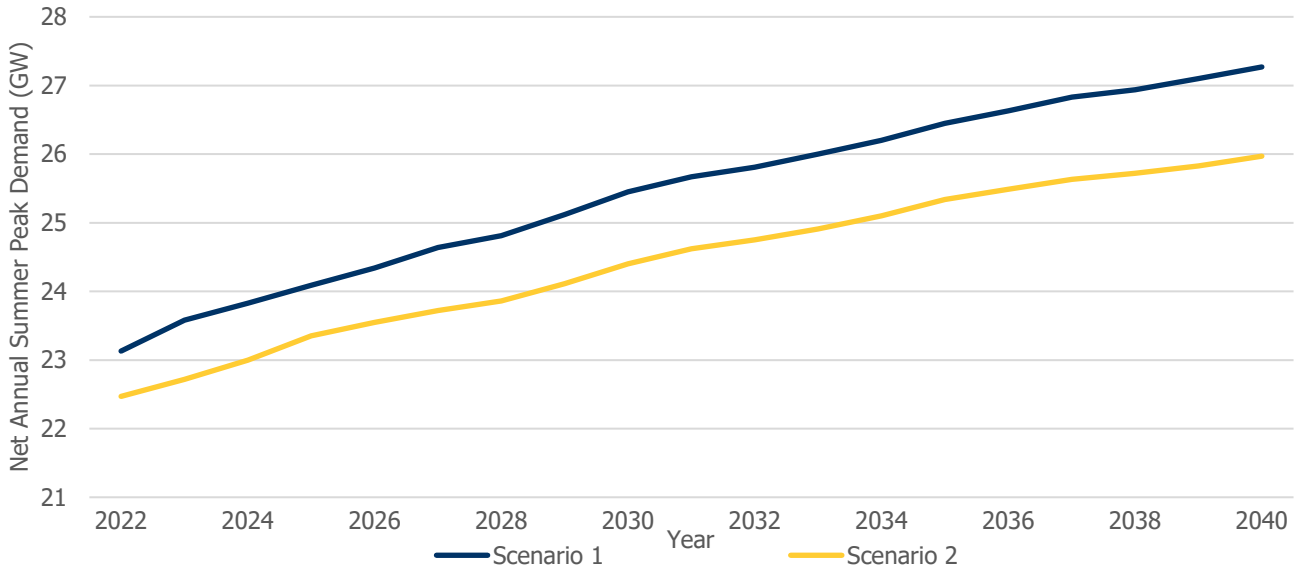
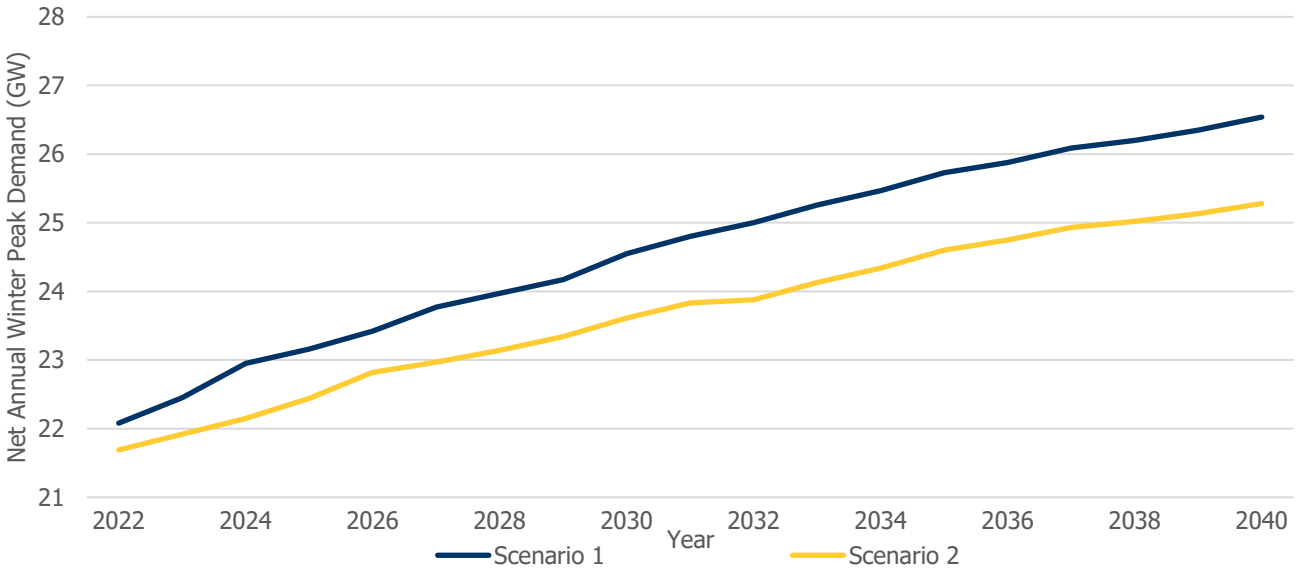


Figure 3: Net Annual Winter Peak Demand (GW)



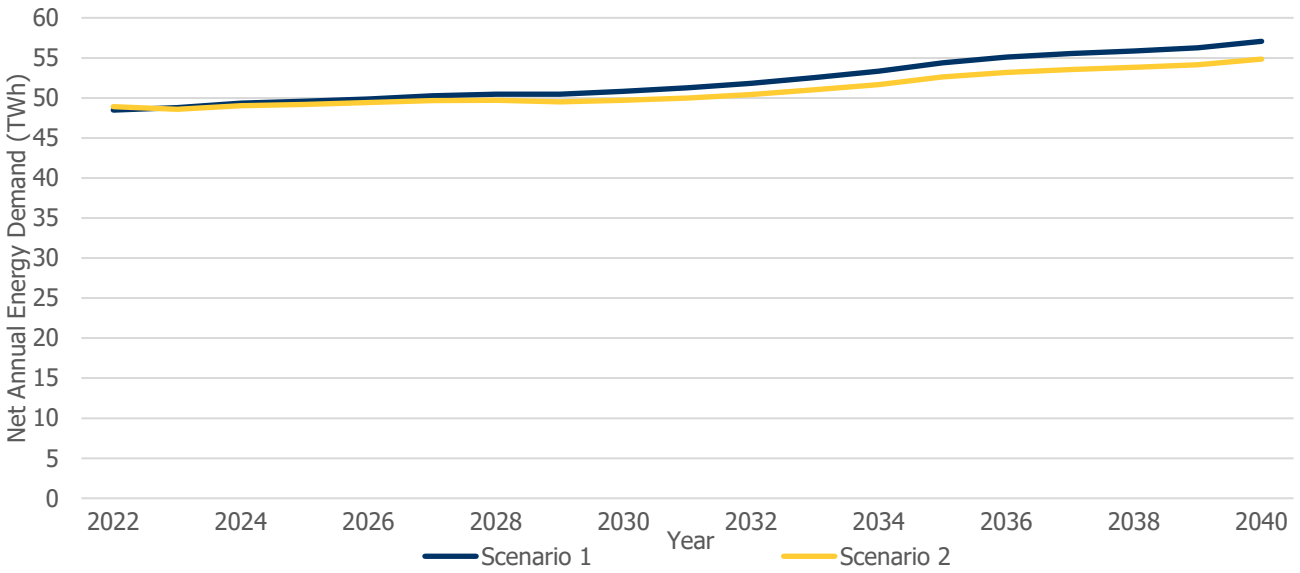
In Scenario 1, the average annual growth rate of energy from 2022 to 2040 is 1.2 per cent per year, summer peak is 0.9 per cent per year and winter peak is 1.1 per cent per year. The average annual growth rate of energy in Scenario 2 is slower than in Scenario 1. It is 1.1, 0.8, and 0.9 per cent per year for energy, summer peak and winter peak respectively.

3. Demand Forecast Drivers

3.1 Residential Sector

Residential demand continues to grow slowly in each scenario. For Scenario 1, the energy grows from 48.5 TWh in 2022 to 57.1 TWh in 2040 or at an average annual growth rate of 0.8 per cent. For Scenario 2, commercial sector energy grows from 48.9 TWh to 54.9 TWh or at an average annual growth rate of 0.6 per cent.

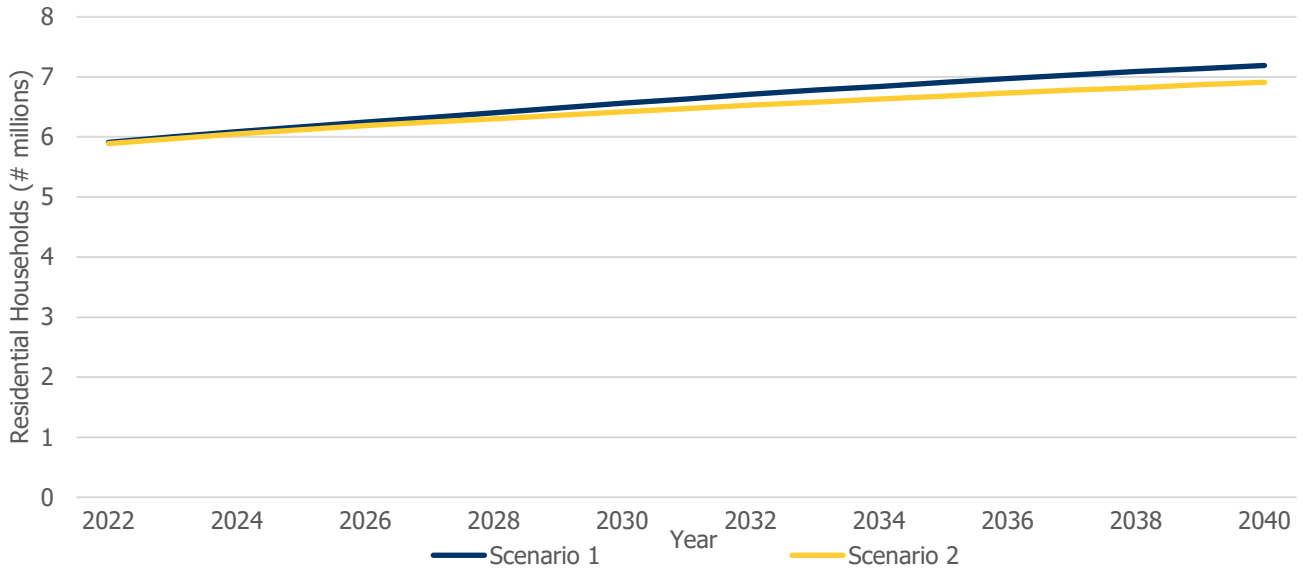
Figure 4: Net Annual Residential Sector Energy Demand (TWh)



The residential sector's major driver is household count. As immigration slows in the near term, the household count growth rate slows as well. In the longer term, household count growth is higher than previously forecasted, with the number of households expected to increase by an additional 1.4 million over the outlook period in Scenario 1.

In Scenario 2, however, a prolonged economic recession leads to a sustained lower household count projection. Many demographic factors are affected by the COVID-19 pandemic, including recovery from lower immigration rates in the near term, emerging suburban and exurban migration, increased household occupancy, and working-from-home. The low-growth scenario provides a reasonable forecast range based on plausible changes in the factors of household count. Household count is expected to increase by 1.1 million until the end of 2040.

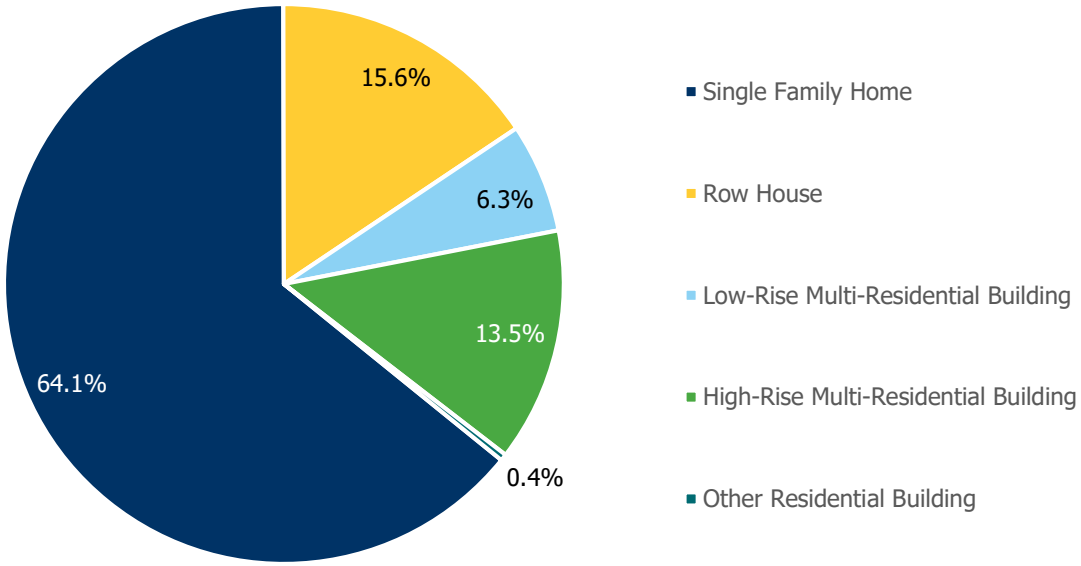
Figure 5: Annual Residential Sector Household Count Projections (# millions)



Residential usage patterns are also evolving, reflecting the increase in online learning and work-from-home arrangements. Heating, cooling, ventilation, and lighting have all contributed to this increase during the COVID-19 pandemic. The impact of small appliances and other consumer electronics on residential sector electricity demand is expected to grow from 17 per cent to 22 per cent in 2040.

The forecast assumes that multi-residential and row housing take a proportionately higher share of new building construction compared with single-family homes, mainly due to housing affordability. This is a change from historical patterns. The chart below summarizes residential energy consumption by dwelling type. The 52 per cent of Ontario households that reside in single-family homes are expected to account for 64 per cent of residential electricity demand in 2022. The relative share of single-family homes is expected to remain similar to current levels (approximately 64 per cent throughout the forecast).

Figure 6: Residential Sector Energy Consumption by Building Type (year 2022, %)



The residential net unit energy intensities for the two scenarios are similar. With the impacts of conservation programs, codes and standards, and natural efficiency, residential net energy unit intensity decreases from 8,100 kWh per household per year in 2022 to 7,800 kWh per household per year by the end of the forecast.

Figure 7: Residential Sector Annual Projections - Scenario 1

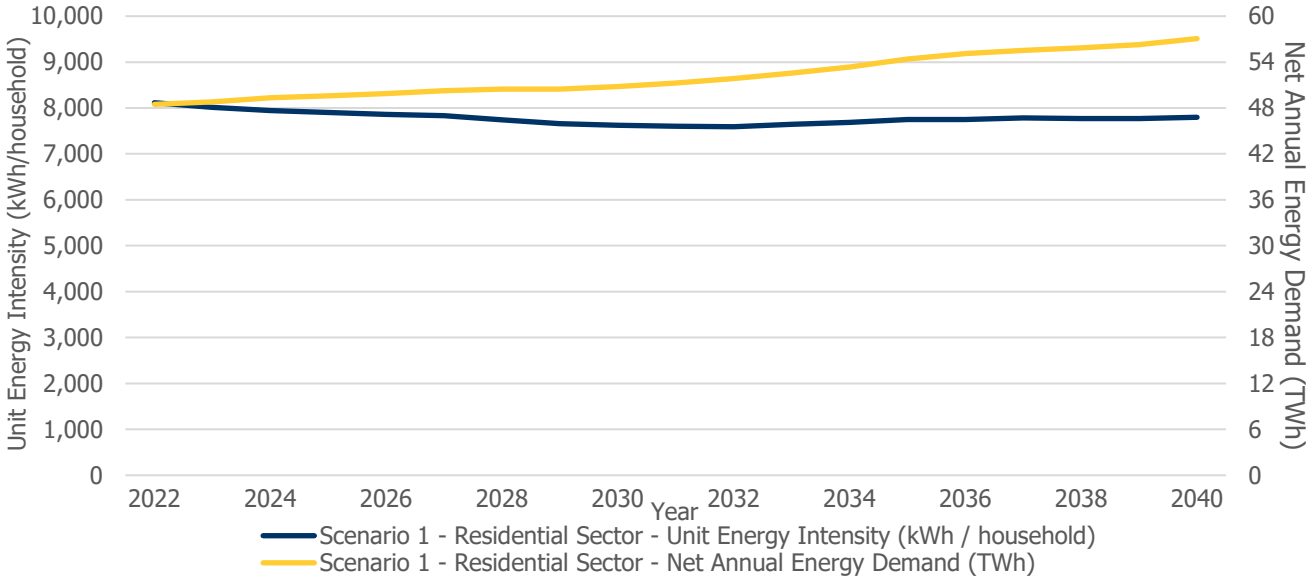
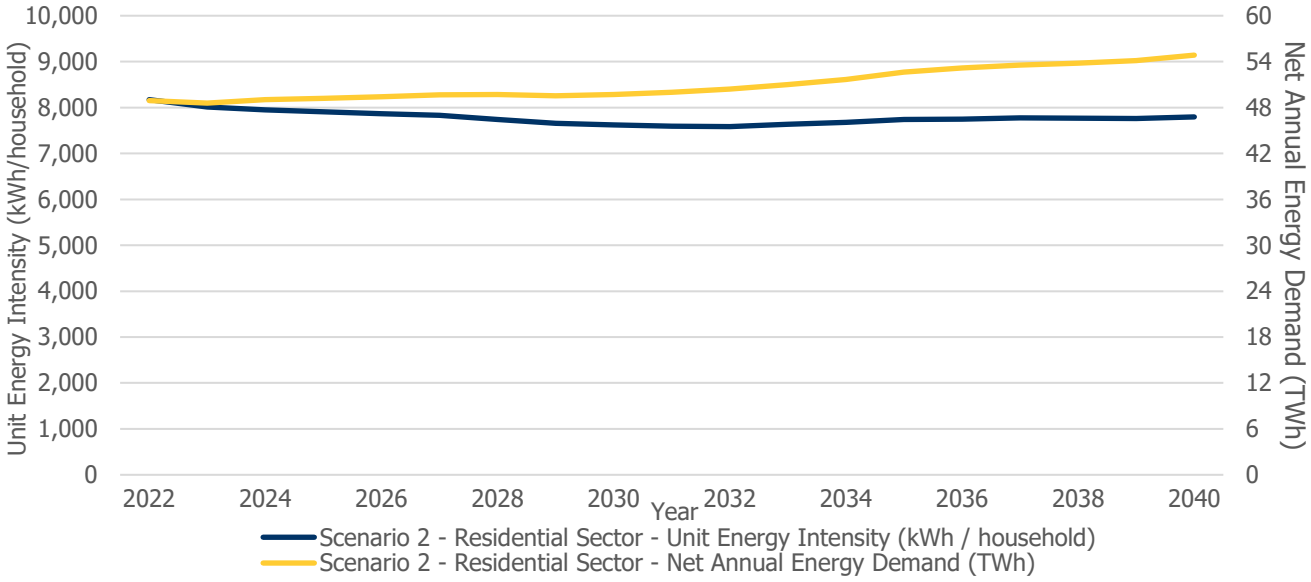


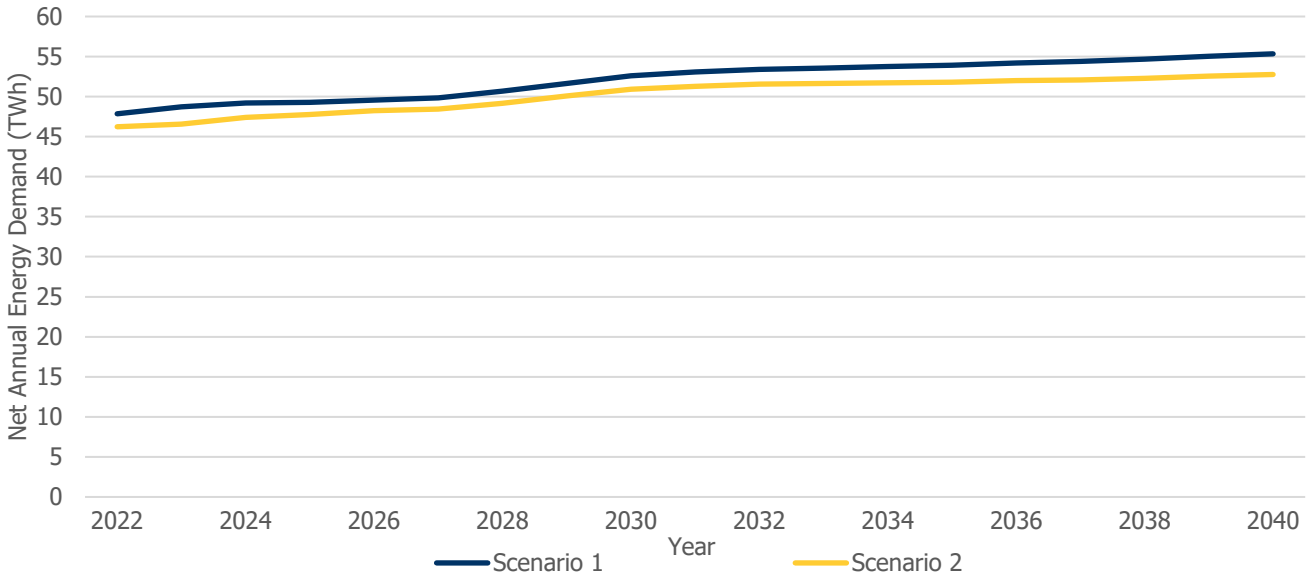
Figure 8: Residential Sector Annual Projections - Scenario 2



3.2 Commercial Sector

While the commercial sector – including sub-sectors, such as recreational facilities, restaurants, retail and office space – has been the most negatively affected by COVID-19 pandemic economic shutdowns, it is also the most likely to rebound over time. In Scenario 1, commercial sector energy grows from 47.9 TWh in 2022 to 55.3 TWh in 2040 or at an average annual growth rate of 0.8 per cent. For Scenario 2, commercial sector energy grows from 46.2 TWh to 52.8 TWh or at an average annual growth rate of 0.8 per cent.

Figure 9: Net Annual Commercial Sector Energy Demand (TWh)



Commercial floor space is the major driver of commercial sector energy demand. Major themes in the commercial energy forecast include:

1. An increasing residential base in downtown Toronto, due to the recent construction boom, increasing demand for institutional services (education and health care), and adding pressure on existing facilities to expand in their current locations
2. A continuing trend toward decreasing square footage per worker achieved through alternative workplace strategies and more efficient building design, particularly evident in major urban markets. As the amount of rentable square feet per employee decreases, it becomes more viable for firms to relocate from suburban locations to more expensive urban areas
3. A shift in consumer shopping behaviour, as more opportunities for reinforcing and increasing the trend toward online retail and e-commerce have a lasting impact. These formats are expected to have a significant effect on future consumer habits. As online retailing is less space intensive, this trend is also expected to significantly reduce the demand for retail space
4. Growth in the industrial real estate market, with increasing demand for large warehousing, logistics and distribution hubs and data centres in the wake of changes to the retail real estate landscape, e-commerce and other technological advances

Scenario 1 assumes that the average annual growth rate of the total commercial floor space is 0.8 per cent. In Scenario 2, this number decreased to 0.7 per cent per year due to foreseeable pandemic-related reasons. These include:

- The permanent closure of some small businesses
- Lower new office space requirements (the consequence of increasing mobility, both in and outside of the workplace resulting in a lower space per employee/desk allocation)
- More rapid shifts to online shopping
- Lower demand for new industrial-type space (including both industrial and warehousing/distribution/logistics uses) as a result of economic shifts affecting the production and distribution of goods

The major commercial/institutional sector segments are shown in the following figures, where the "office" segment represents 35 per cent of total commercial/institutional electricity energy consumption in 2040 followed by "non-food retail" sector at 13 per cent.

Figure 10: Net Commercial Sector Energy Consumption by Sub-Sector - Scenario 1 (year 2040, %)

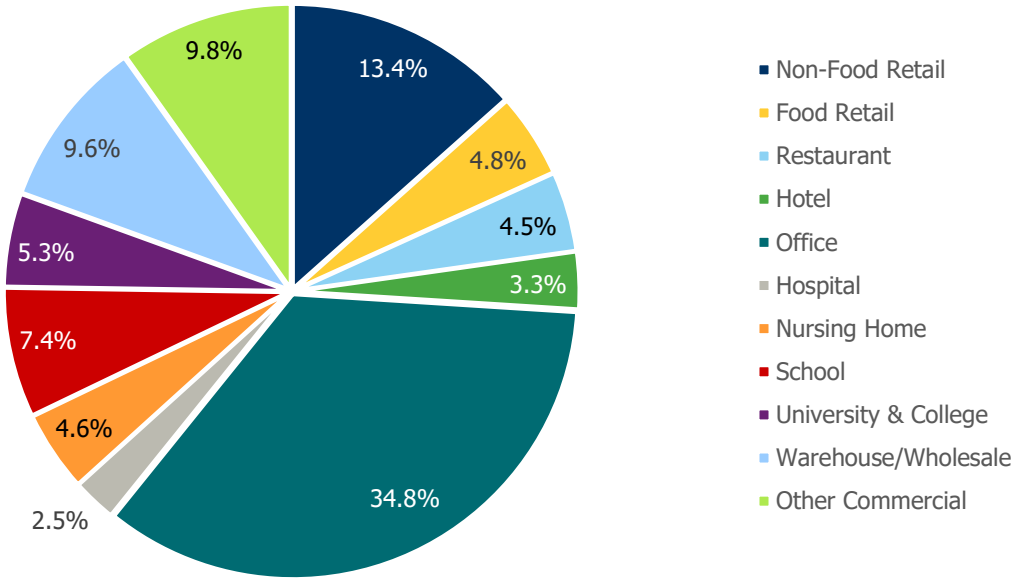
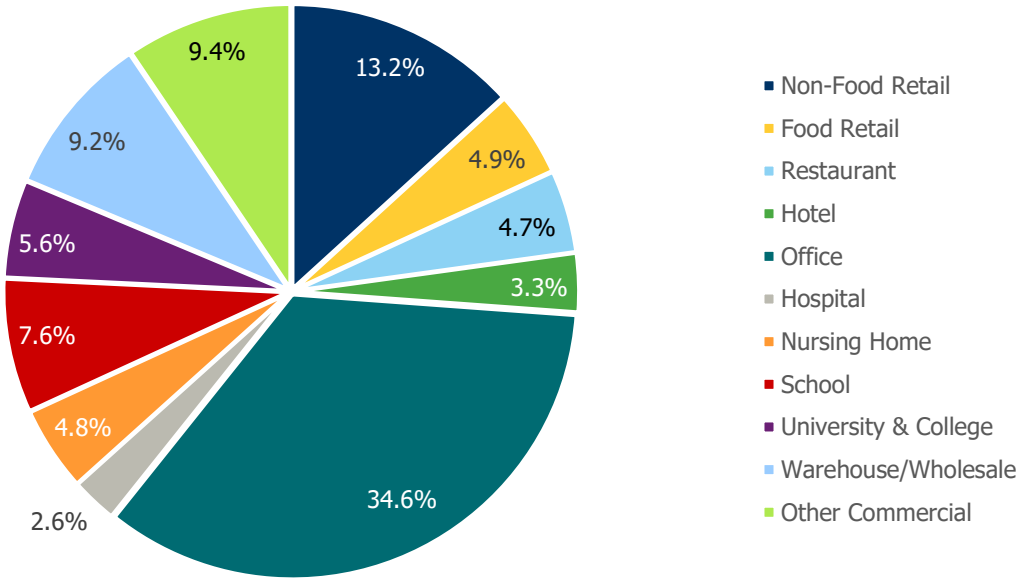


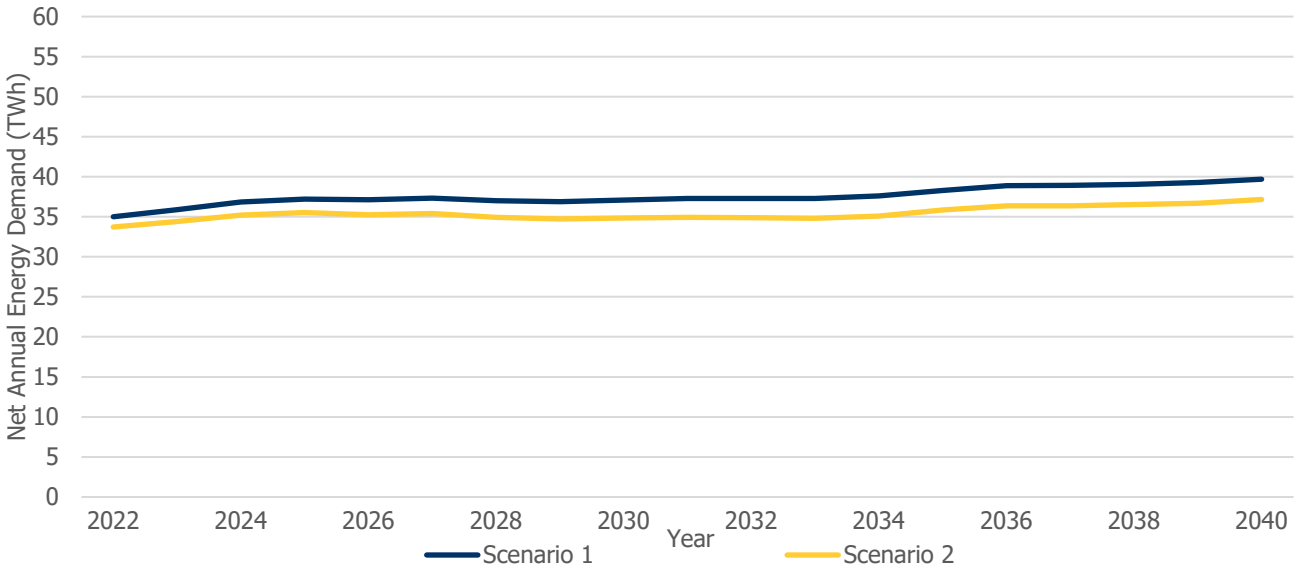
Figure 11: Net Commercial Sector Energy Consumption by Sub-Sector - Scenario 2 (year 2040, %)



3.3 Industrial Sector

To date, the industrial sector has faced minimal impacts resulting from the COVID-19 pandemic, and has been surprisingly resilient and stable. Industrial loads have picked back up and electricity consumption patterns are gradually returning to pre-COVID-19 pandemic levels. For Scenario 1, industrial energy grows from 35.0 TWh in 2022 to 39.7 TWh in 2040 or at an average annual growth rate of 1.0 per cent. For Scenario 2, commercial sector energy grows from 33.7 TWh to 37.2 TWh or at an average annual growth rate of 0.8 per cent.

Figure 12: Net Annual Industrial Energy Demand (TWh)



Pulp and paper, mining (including smelting), primary metals, auto manufacturing and chemicals are the five largest industrial sector electricity consumers in Ontario. In 2005, they together accounted for 62 per cent of Ontario's total industrial electricity consumption. Since then, more than 300,000 Ontario manufacturing jobs have been lost. World economic conditions, particularly those in the United States of America and China, coupled with varying exchange rates and costs, have resulted in a reduction in Ontario exports. Industry has responded to the reduced demand for goods with plant closures and production cut backs.

Industrial sector composition varies by zone. Mining and pulp and paper are concentrated in northern Ontario. Primary metal industries, such as iron and steel, are concentrated in the Southwest (Hamilton, Cambridge, and Nanticoke) and Northeast (Sault Ste. Marie). The auto sector is clustered in the West (Essex, Woodstock, London, Windsor and Ingersoll), Toronto (Oshawa, Brampton, Alliston and Aurora) and Southwest (Cambridge) zones. Chemical and petroleum refining industries are clustered in the West (Sarnia-Lambton) and Southwest (Nanticoke) zones.

The mining industry is forecast to show healthy growth in the near term for both scenarios, before returning to normal growth. Growth opportunities include the northwestern Ontario area – known as the "Ring of Fire" – which have been found to contain high-quality rare earth metal ores, including chromite (which is used in the production of stainless steel).

The industrial sector is expected to grow slightly in the next 18 years in Scenario 1 given the current economic situation. The growth for Scenario 2 is milder than Scenario 1 mainly due to weaker economic conditions.

Figure 13: Annual Industrial Sector Energy Consumption by Major Sub-Sector - Scenario 1 (TWh)

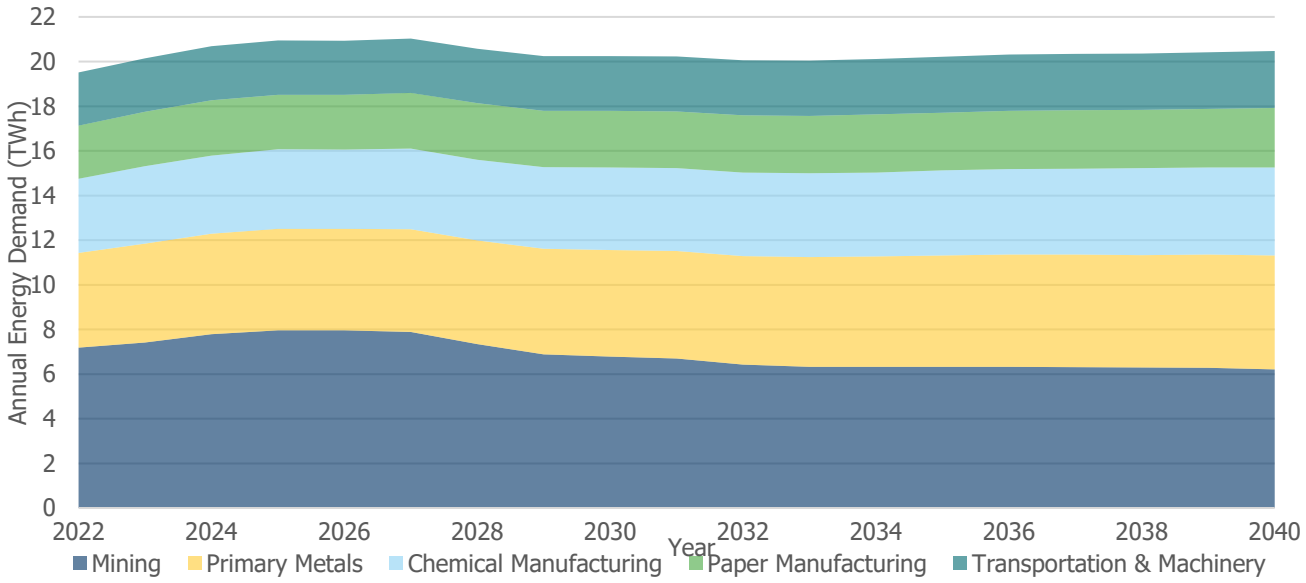
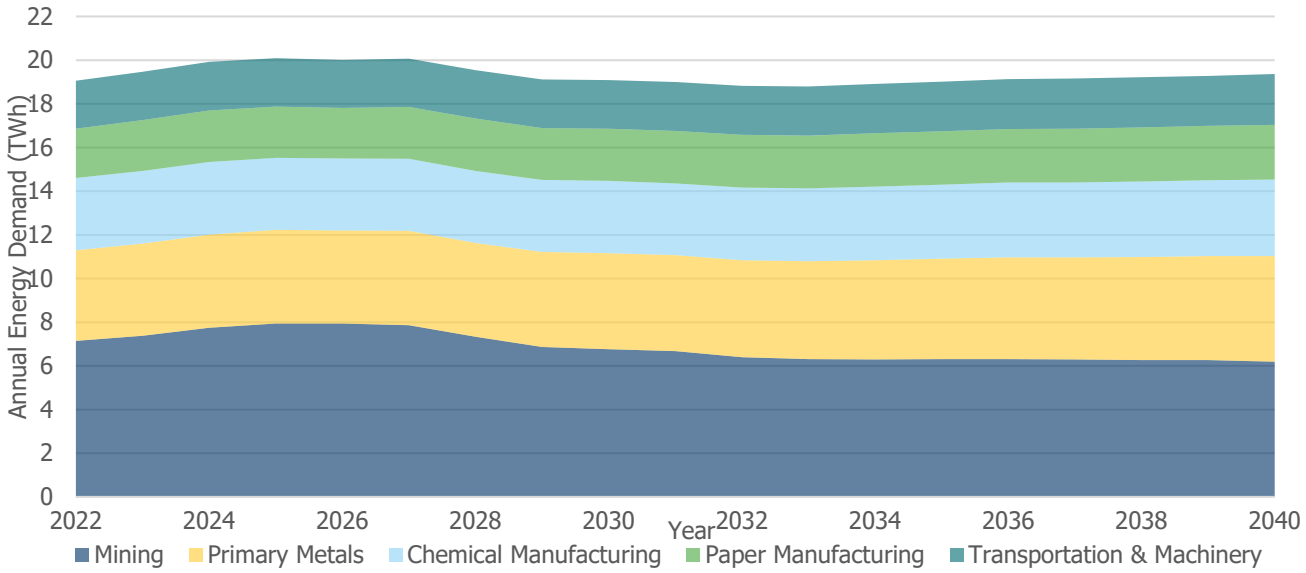


Figure 14: Net Annual Industrial Sector Energy Consumption by Major Sub-Sector - Scenario 2 (TWh)



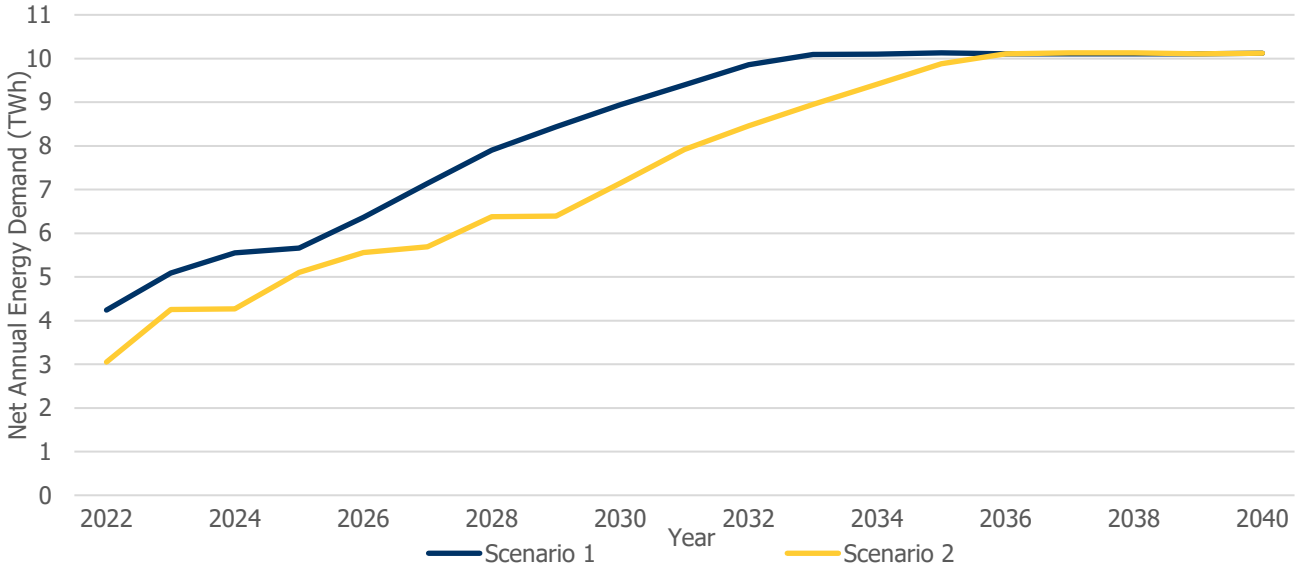
3.4 Agricultural Sector

Demand for electricity from Ontario's agricultural sector continues to grow, driven primarily by greenhouse expansion, as well as the proliferation of lighting in greenhouses in the West Zone. Grow lights enhance production and crop yields of various fruits, vegetables, flowers and cannabis.

This additional demand growth is emerging primarily in three pockets of the West of London area: Kingsville-Leamington, Dresden and Lambton-Sarnia. Overall, sector electricity demand growth increases energy and peak demand primarily in the winter season. The average annual growth rate projected is 6.5 per cent for Scenario 1. Tighter immigration policy and foreign work permit restrictions could result in delays in construction of connection infrastructure. However, by the end of the forecast the magnitude of the connection will not be impacted by the delays.

In Scenario 1, agriculture sector energy grows from 4.2 TWh in 2022 to 10.1 TWh in 2040. In Scenario 2, total agriculture sector energy also reaches 10.1 TWh by 2040.

Figure 15: Net Annual Agricultural Sector Energy Demand (TWh)



3.5 Electric Vehicles

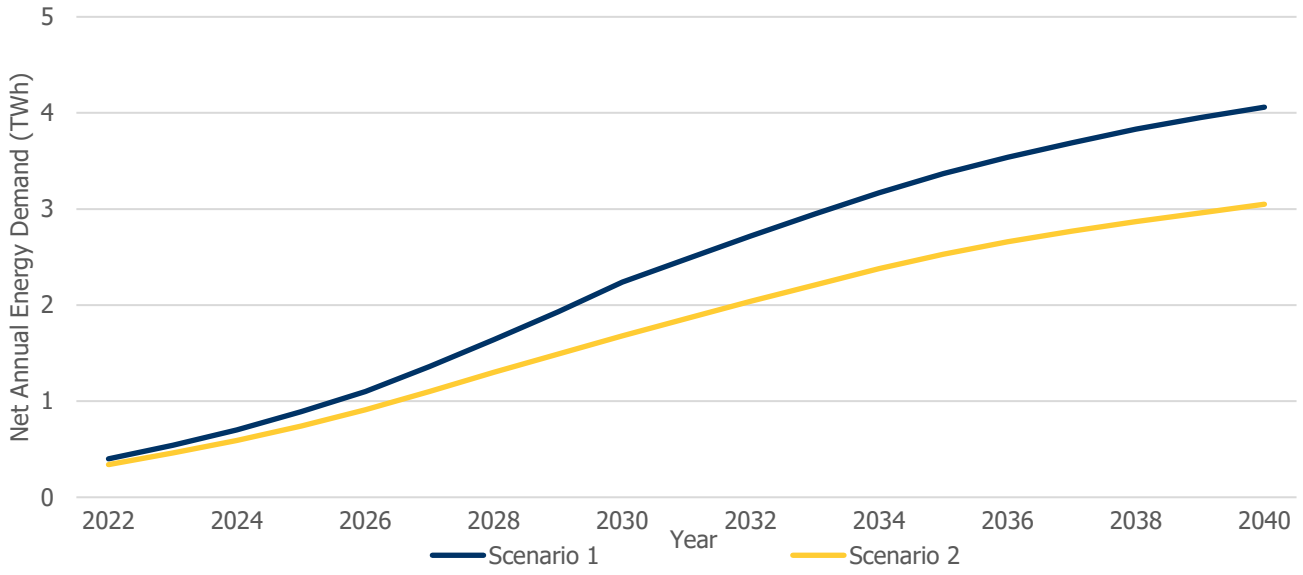
The number of electric vehicles (EVs) – and their associated electricity charging requirements – are currently relatively small, but have been increasing significantly. Many factors affect EV adoption and a wide range of EV adoption forecasts are available. The Canadian government has set a long-term target to sell 100 per cent zero-emission vehicles by 2040, with interim sales goals of 10 per cent by 2025 and 30 per cent by 2030.

The EV charging demand is determined by two key factors: the number of EVs; and average driving distance. Both have been dramatically impacted by the pandemic in 2020. EV sales dropped and people drive less as a result of social distancing practices, temporary business closures, travel restrictions and the increase in work-from-home arrangements.

The state of economic recovery has a compound effect on EV charging demand. Two scenarios of EV charging demand forecast were developed, informed by the fast and slow recovery of the two demand forecast scenarios. Given high uncertainty during the pandemic, the overall charging demand of the 2019 APO EV forecast, which projected the number of EVs in Ontario to reach approximately 0.7 million by 2030 and 1.2 million by 2040, is used as the reference and adjusted for this 2020 APO. In Scenario 1, EV charging demand rebounds fast, reaching the level of the 2019 APO in 2030. Charging electricity demand will grow from 0.4 TWh in 2022 to 4.1 TWh in 2040. In Scenario 2, EV charging demand rebounds slower, reaching 75 per cent of the Scenario 1 level in the medium and long term. Charging electricity demand will grow from 0.3 TWh in 2022 to 3.1 TWh in 2040.

The charging demand estimate accounts for all types of EVs, including personal and commercial EVs, as well as e-trucks and e-buses. Real-world charging data from the *Charge the North* project was used to develop the charging profile and EV hourly demand forecast.

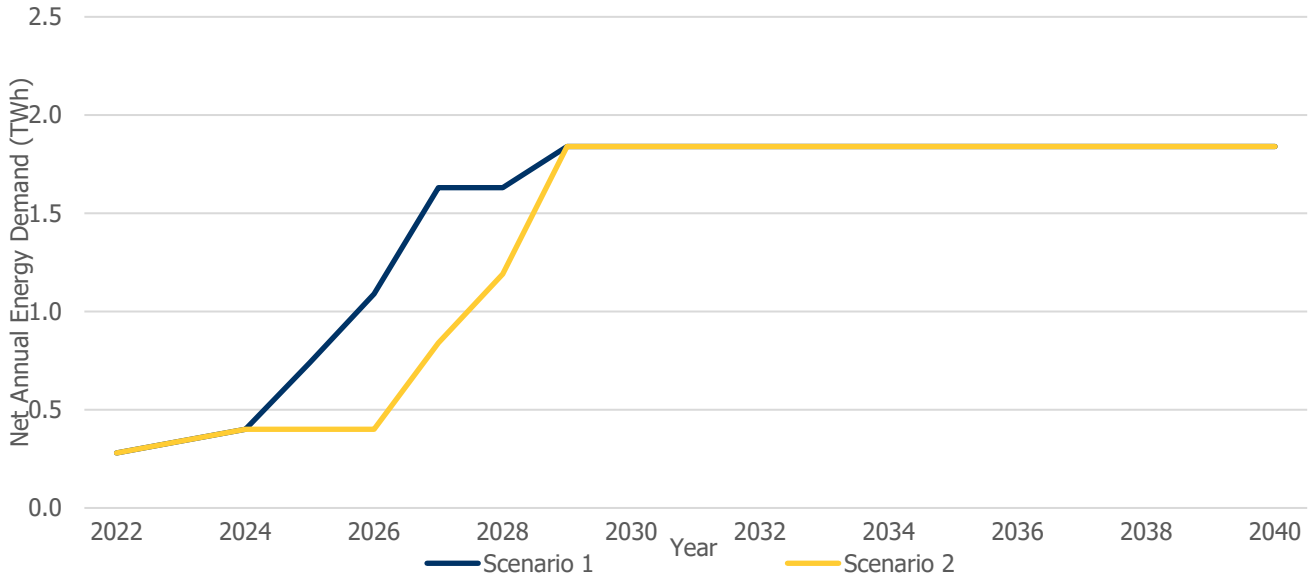
Figure 16: Net Annual Electric Vehicle Charging Energy Demand (TWh)



3.6 Rail Transit Electrification

Broad rail transit electrification is underway in Ontario with projects at various stages, including eight light rail transit projects, three subway projects, and GO rail system electrification. Forecasted electricity demand is based on the most recent available information and will be updated when more information becomes available. Two scenarios were developed with the GO rail electrification implementation timeline as the only variance. In both scenarios, electricity demand will grow from 0.3 TWh in 2022 to 1.8 TWh in 2040.

Figure 17: Net Annual Rail Transit Electrification Energy Demand (TWh)

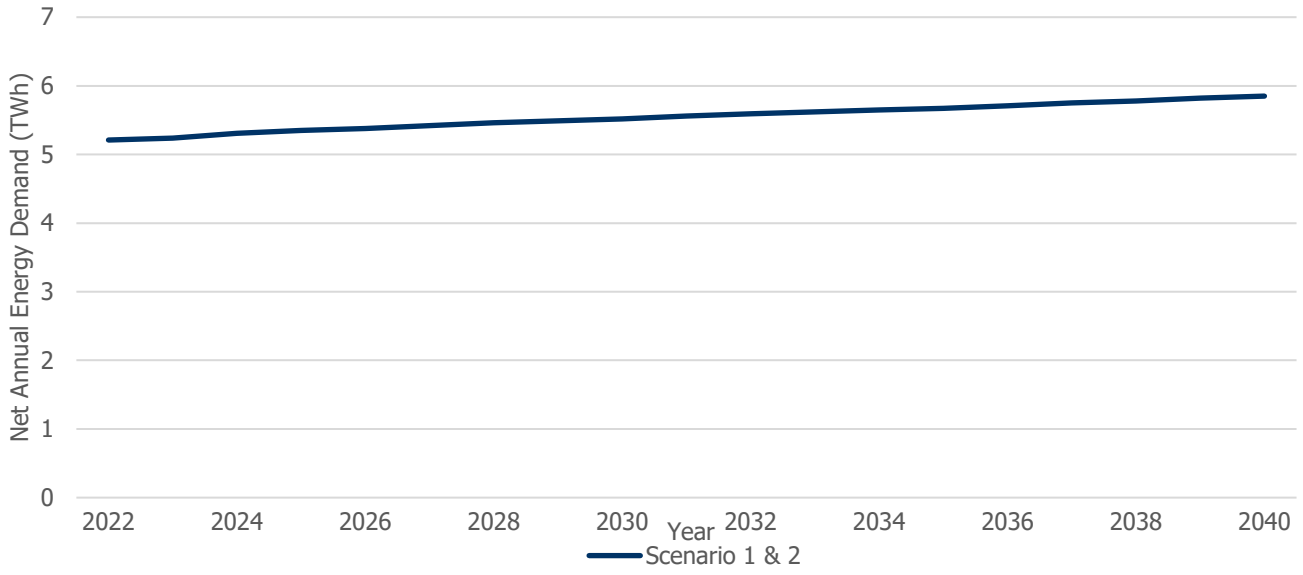


3.7 Other Electricity Demand

This demand forecast accounts for all electricity energy and peak demand in the province, which is generally categorized and evaluated according to established market sectors. Certain loads do not fall under any one sector and are classified as "other." These include: 1) remote communities; 2) electricity generators; 3) street lighting; and 4) municipal water treatment. The demand forecast projects these four segments to consume 5.2 TWh in 2022. A number of small remote communities in northern Ontario are not currently connected to the provincial electricity grid, but will be within the next few years. Connecting these communities is expected to add approximately 0.01 TWh of annual energy demand by 2040. Collectively these four "other" load categories are expected to grow minimally, but consistently, over the course of the outlook to 5.9 TWh in 2040, an annual increase of 34 GWh or 0.7 per cent per year.

Other electricity demand projections are equivalent between the two scenarios.

Figure 18: Net Annual Other Electricity Demand Energy Demand (TWh)



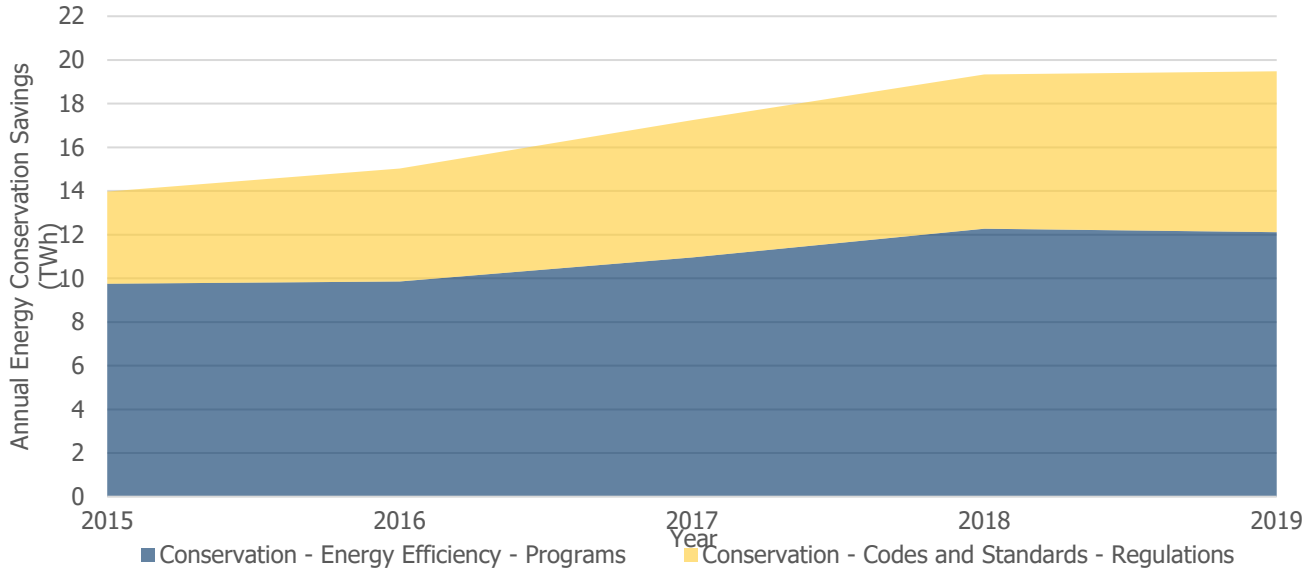
3.8 Conservation

3.8.1 Energy-Efficiency Programs

3.8.1.1 Historical Frameworks

Conservation has made a significant contribution to electricity service in Ontario and has been integral to maintaining a reliable and sustainable electricity system. The resulting electricity savings can be attributed to energy-efficiency programs and improved building codes and equipment standards. The savings, which vary from measure to measure, usually persist a number of years after energy-efficiency measures are implemented. The programs funded by the Ontario Power Authority(OPA)/IESO between 2006 and 2019 contributed to approximately 12.1 TWh electricity savings in 2019. For the same time period, regulations of building codes and equipment standards delivered approximately 7.4 TWh electricity savings in 2019.

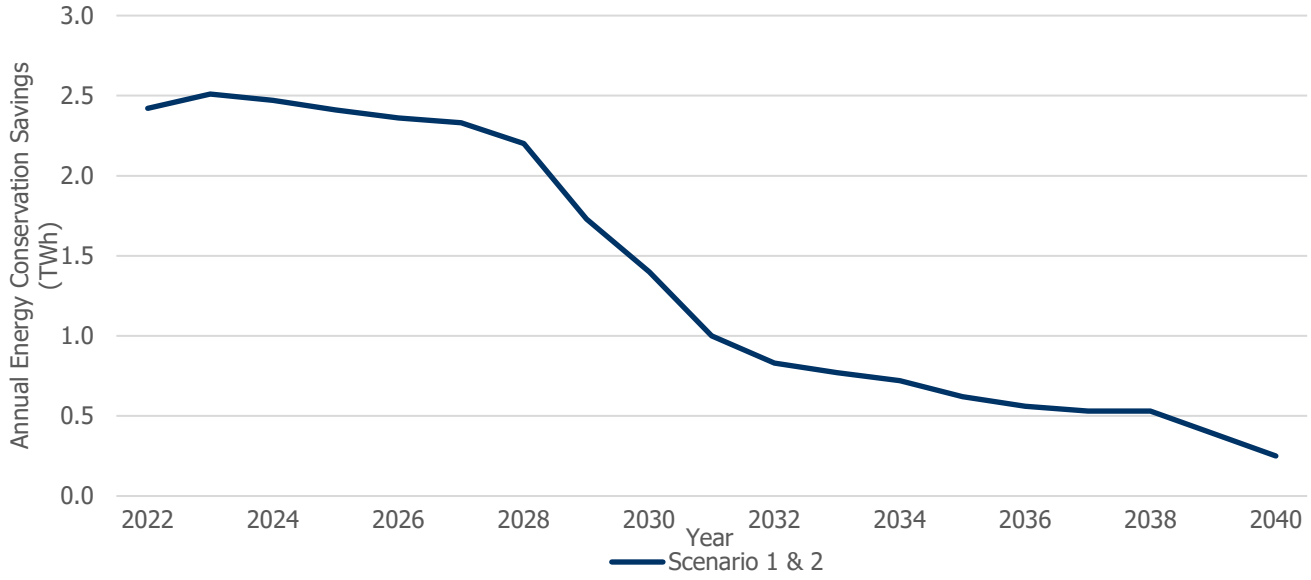
Figure 19: Conservation - Historical Results - Annual Energy Conservation Savings (TWh)



3.8.1.2 Current Frameworks

The 2015-2020 Conservation First Framework (CFF) was discontinued in March 2019 and replaced with an Interim Framework. Projects already in the pipe are expected to be compliant with the CFF Wind Down Guideline dated March 21, 2019. The Interim Framework offers energy-efficiency incentives and rebates to electricity customers through a suite of Save on Energy programs from April 2019 to December 2020. The Program Plan was published in June 2019. Given the current market conditions and the nature of some projects, some savings from the CFF Wind Down and the Interim Frameworks are forecast to materialize after 2020. In a recent update, the frameworks are expected to achieve an annual electricity savings of 2.5 TWh in 2023.

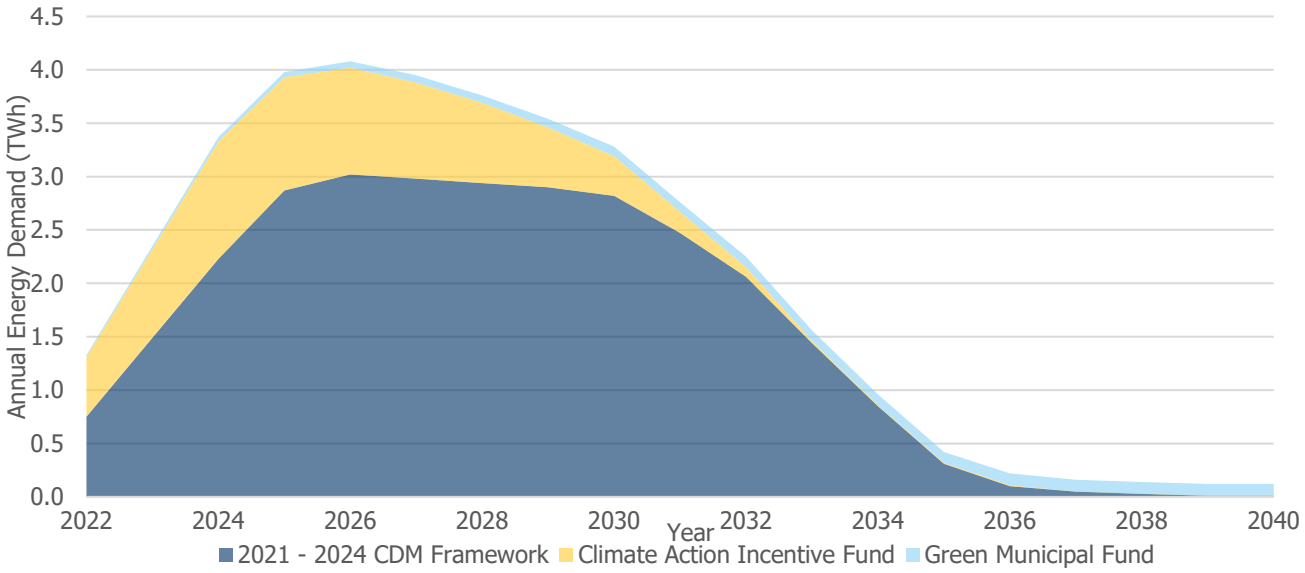
Figure 20: Conservation - Energy Efficiency - Programs - Current Frameworks - Annual Energy Conservation Savings (TWh)



3.8.1.3 Near Term Frameworks

In addition to the existing energy efficiency frameworks, several conservation initiatives have been committed for upcoming years. The first is the 2021-2024 Conservation and Demand Management Framework as directed by the Minister of Energy, Northern Development and Mines on September 30, 2020. Programs will be centrally delivered by the IESO, starting in January 2021, and target commercial, industrial, institutional, on-reserve First Nations, and income-eligible electricity consumers. The annual savings are forecasted to reach 3 TWh in 2026. Second, the Climate Action Incentive Fund run by federal agencies is expected to result in over 1.1 TWh electricity savings in Ontario by 2024. Finally, projects supported through the Green Municipal Fund (GMF), which is managed by the Federation of Canadian Municipalities, are expected to result in electricity savings of about 0.006 TWh each year in Ontario. Collectively, the near-term programs are forecasted to save 4 TWh each year when measures are fully implemented. The saving projection will be updated in future planning products when more program details become available.

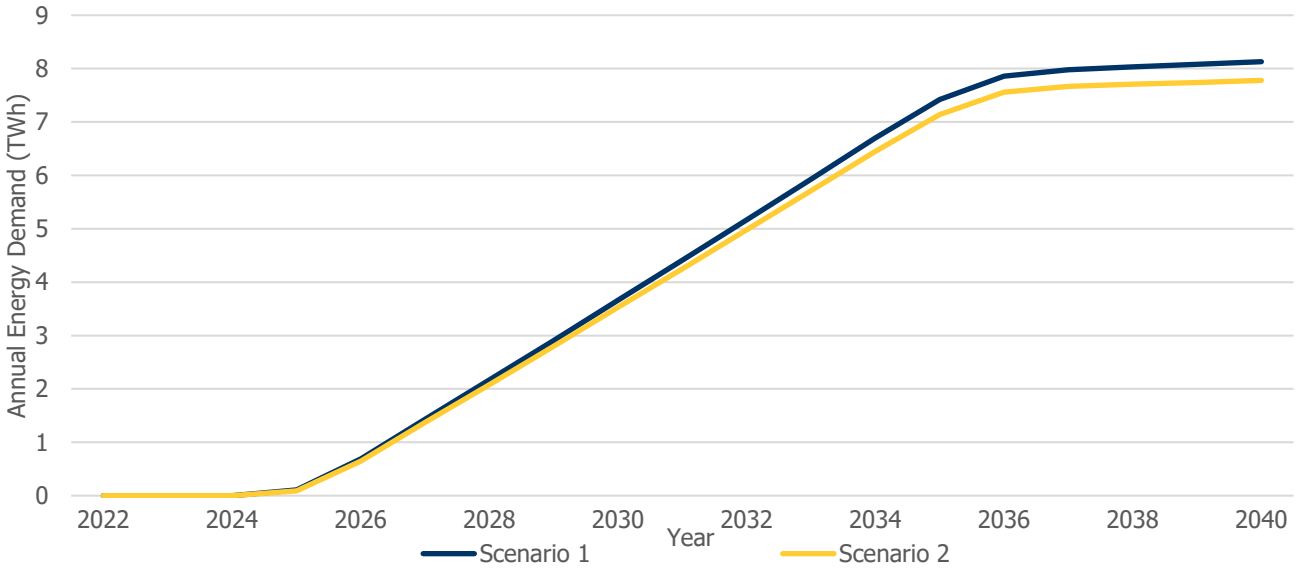
Figure 21: Conservation - Energy Efficiency - Programs - Near Term Framework - Annual Energy Conservation Savings (TWh)



3.8.1.4 Long Term Framework

For long term demand forecast and power system planning, continued investment in energy efficiency is assumed beyond the committed initiatives. The same savings level of 2021-2024 Framework is assumed for the entire planning horizon. For both scenarios, an annual new saving is estimated at 0.46 per cent of gross demand. In 2040, long term savings will reach 8.1 TWh in Scenario 1 and 7.8 TWh in Scenario 2.

Figure 22: Conservation - Energy Efficiency - Programs - Long Term Framework - Annual Energy Conservation Savings (TWh)



3.8.2 Codes and Standards Regulations

Building code and equipment standards regulations are effective energy-efficiency tools, as they have no ratepayer cost, and have broad market coverage. The IESO estimates savings attributable to codes and standards by comparing the demand forecast at the gross level to the demand forecast adjusted for the impacts of regulations. Codes and standards savings projections use consistent residential and commercial assumptions of respective scenarios. Most savings will come from the residential and commercial sectors.

With more people working from home, residential consumption is expected to increase, along with savings from codes and standards compared to the 2019 APO. Since commercial loads have dropped the most and still struggle to recover, codes and standards savings from the commercial sector are estimated to decrease relative to the 2019 APO.

Figure 23: Conservation - Codes and Standards - Regulations - Annual Energy Conservation Savings - Scenario 1 (TWh)

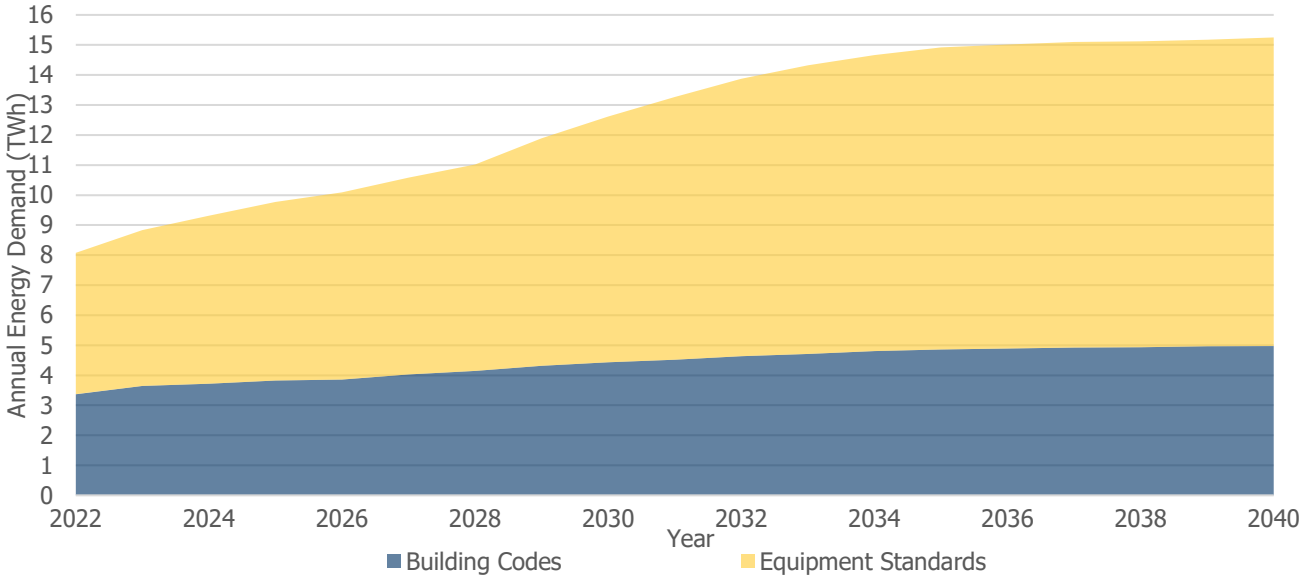
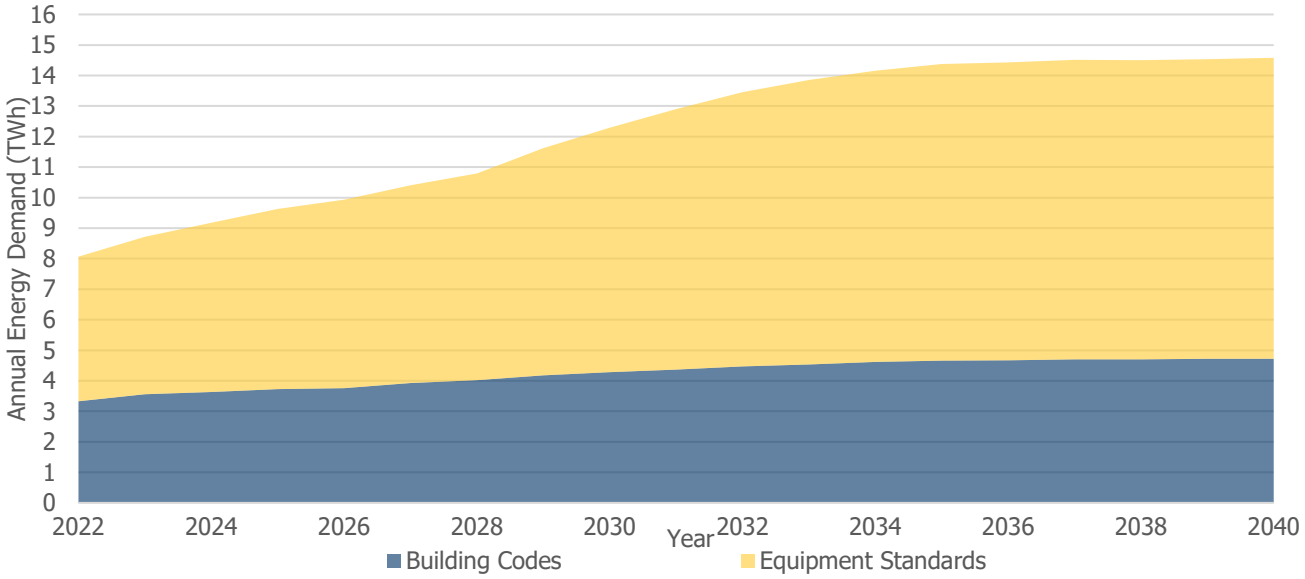


Figure 24: Conservation - Codes and Standards - Regulations - Annual Energy Conservation Savings - Scenario 2 (TWh)



4. Demand Forecast Uncertainties

With the pressure of the COVID-19 pandemic, it is becoming more difficult to make accurate long-term demand forecasts. The total system demand forecast is uncertain as a result of uncertainties in individual substation forecasts, which collectively constitute total system demand.

Over the course of the outlook period, electricity demand is influenced by a number of dependencies, including: the state of the economy, public health and policy responses related to the COVID-19 pandemic and the status of vaccine rollouts, demographic changes, government policy, emerging technology, end-use trends, fuel prices, and other considerations. Within the outlook period, the forecast accuracy level of confidence is highest in the near term (years 1-5), decreasing in time with a relatively lesser degree of confidence in the long term (year 6 and beyond). The IESO continues to monitor and interpret electricity demand drivers and other factors to continuously improve demand forecasts. These factors will help inform updates to electricity demand and will be incorporated into future APOs.

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