Annual Planning Outlook

Demand Forecast Module

December 2021

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Table of Contents

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.

This *Demand Forecast Module* provides greater context of the changes in the demand forecast in the 2021 Annual Planning Outlook (APO) and provides a detailed assessment of updates on a sector level basis.

2. Demand Forecast Summary

The IESO 2021 APO long-term demand forecast covers the period of 2023-2042 and is produced at the net-demand level.

Major updates have been incorporated in the demand forecast since the 2020 APO, which was based primarily on the uncertainty of the recovery from the COVID-19 pandemic and subsequent economic recession. In the 2020 APO, two scenarios were produced that varied based on the recovery rate. Scenario 1 was based on a shallow economic recession in years 2020 and early 2021 and rapid recovery in 2021-2022 with electricity demand recovering to pre-pandemic 2019 levels by year 2023. Scenario 2 was based on a deep and prolonged economic recession remaining to 2022 and prolonged and slow recovery, with electricity demand recovering to pre-pandemic 2019 levels by year 2026. As the 2021 year progressed, pandemic, economic and electricity demand conditions trended toward a recovery comparable to the 2020 APO Scenario 1.

Nearly as soon as the 2020 APO was published, societal focus swiftly shifted from pandemic and economic recovery towards climate change mitigation and decarbonization and electrification as a natural pathway towards achieving these goals. The 2021 APO demand forecast accounts for all known confirmed projects and other changes in electricity demand and policy at the time of finalization, including initial electrification projects, including:

1. the June 29, 2021 Government of Canada policy annoucement on passenger vehicle and truck sales target in 2035, the significant electrification impact in the 2021 APO demand forecast
2. the July 5, 2021 industrial primary steel sub-sector electrification project with significant demand impacts
3. current state of the mineral natural resource market and mining projects, playing a supporting role towards the shift towards electrication
4. current national immigration policy, which impacts residential sector household formation
5. current pandemic impact mitigation policy and working-from-home trends on the commerical sector
6. continued greenhouse sector growth in the West of London area
7. continued development of rail transit electrification projects
8. continued assumed long-term conservation program framework implementation, and
9. current confirmed greenhouse gas emissions pricing impacts on fuel rates

All of these updates since the 2020 APO demand forecast has created a significant long-term upward pressure on electricity demand to levels not seen in recent history.

While demand forecasts are, by definition, inexact, as climate change mitigation, decarbonization and electrification projects, strategy and policy evolve, it will become ever more challenging assessing the scale, location and timing of resulting future changes in demand. These uncertainties are addressed in Chapter 4.

The 2021 APO demand forecast is summarized as having strong growth in the early to mid 2020s as a result of industrial mining sub-sector project implementation, expansion and extensions, strong residential sector household growth and subsequent electricity demand, and a robust commercial sector recovery from the recent economic recession. In the mid 2020s to early 2030s, significant agricultural sector growth, consistent with previous APO demand forecasts, leads to overall system demand growth. In 2029, it is expected significant primary steel electrification will occur causing a distinct step in energy and peak demand. And in early to late 2030s, increases in electric vehicles are expected to significant impact system level demand.

Figure 1: Net Annual Energy Demand

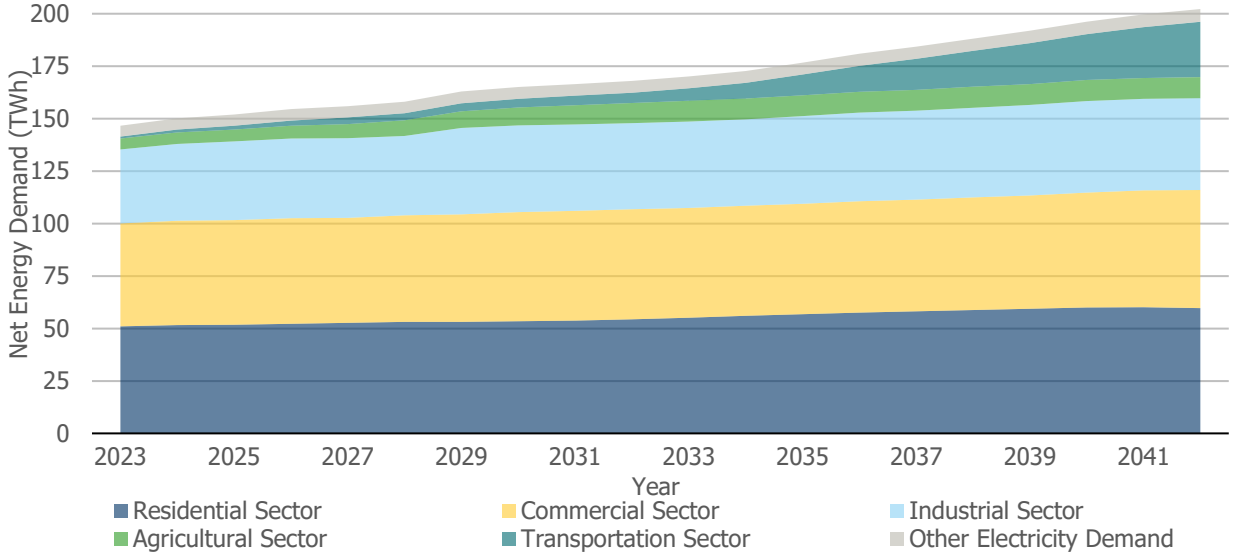
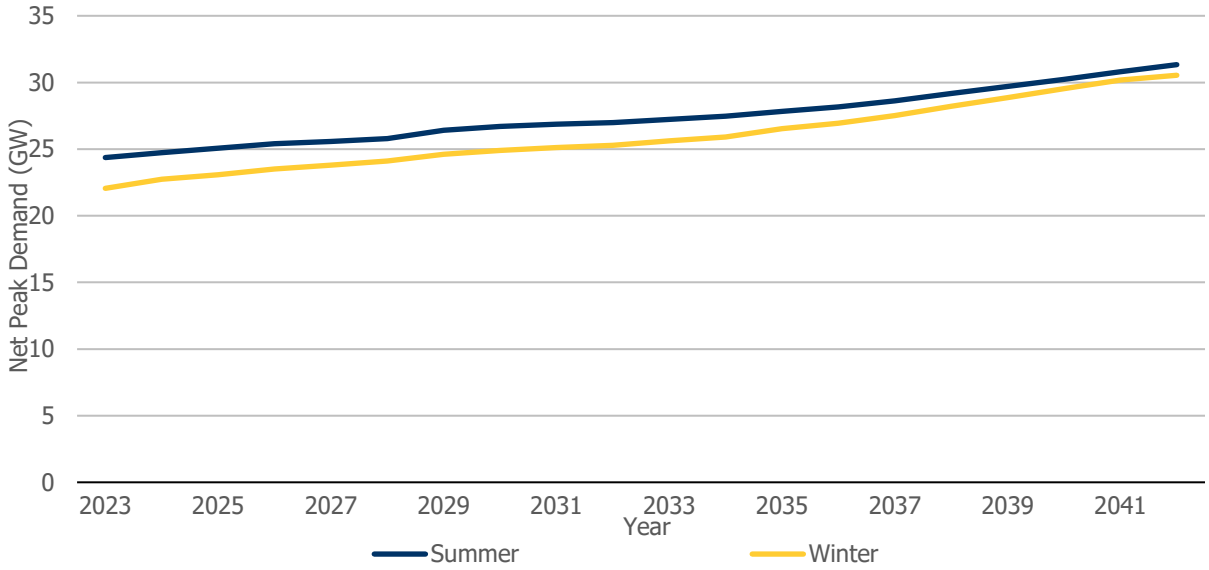


Figure 2: Net Annual Seasonal Peak Demand



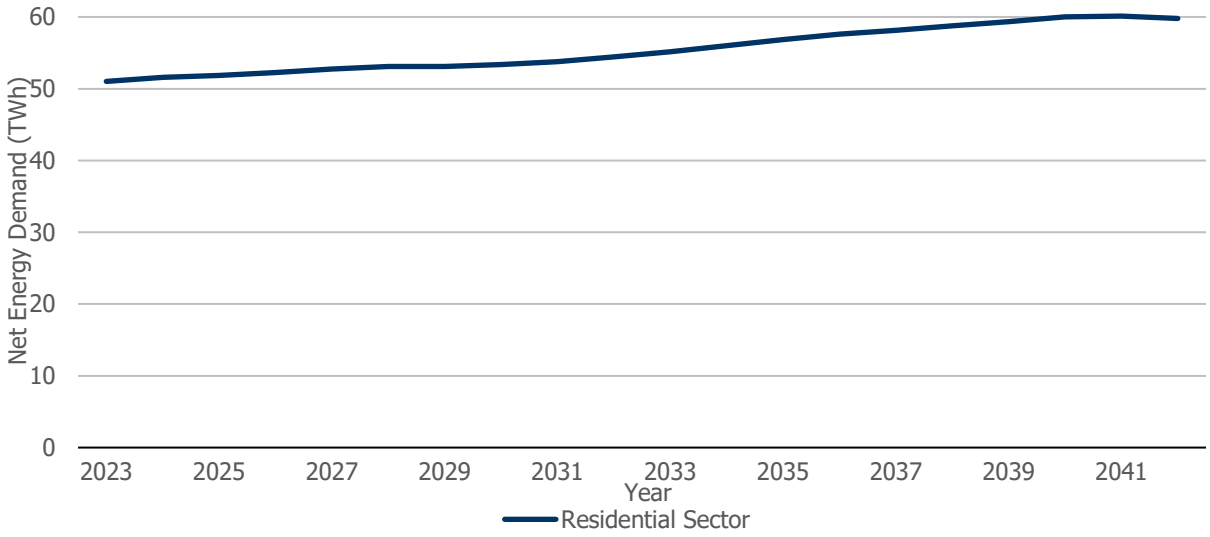
In the 2021 APO demand forecast, net annual energy demand grows from 147 TWh in 2023 to 202 TWh in 2042, a 38 percent increase, net summer peak demand grows from 24.4 GW in 2023 to 31.3 GW in 2042, a 29 percent increase and net winter peak demand grows from 22.1 GW in 2023 to 30.5 GW in 2042, a 38 percent increase as well. The average annual growth rate of energy from 2023 to 2042 is 1.7 per cent per year, summer peak is 1.3 per cent per year and winter peak is 1.7 per cent per year.

3. Demand Forecast Drivers

3.1 Residential Sector

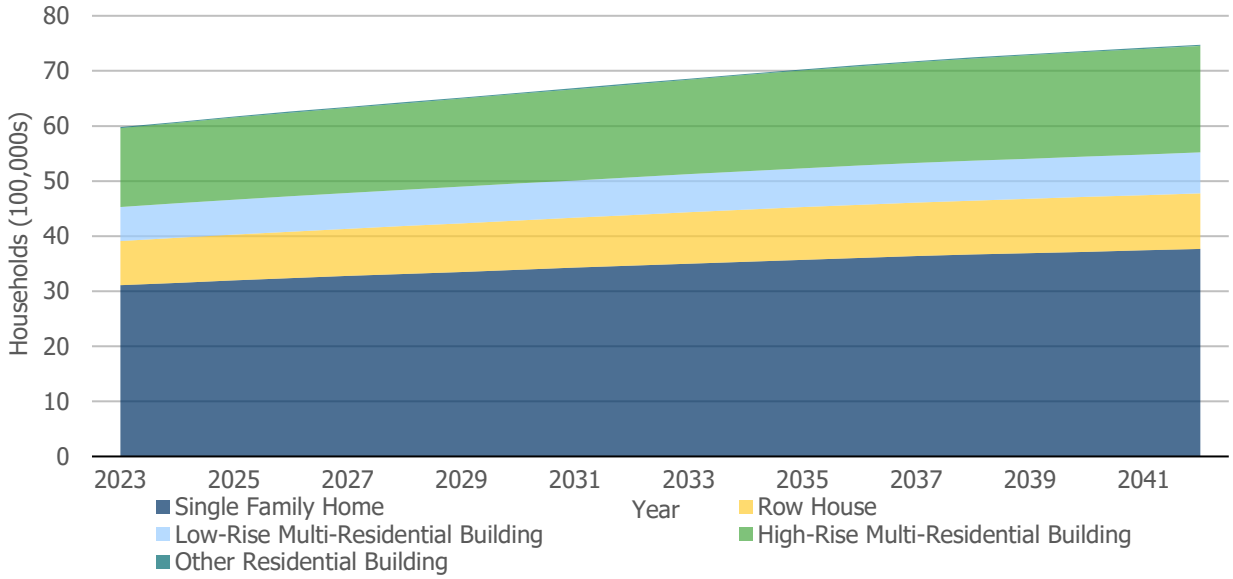
Residential sector electricity demand is expected to grow slowy for the remainder of the 2020s decade then accelerate in the arly 2030s before flattening again in the late 2030s. net annual energy demand grows from 51.0 TWh in 2023 to 59.8 TWh in 2042 or at an average annual growth rate of 0.8 per cent.

Figure 3: Residential Sector - Net Annual Energy Demand



The residential sector's major driver is household count. Household count projections in the early 2020s are lower than previously forecasted in the 2020 APO, partially a result of lower immigration levels achieved due to pandemic impacts. This is expected to change going forward as immigration policy attempts to catch up to previously set targets, household growth is expected to be commensurately robust while slowly flattening through the outlook period. Overall the number of households is expected to increase by an additional 1.5 million over the outlook period.

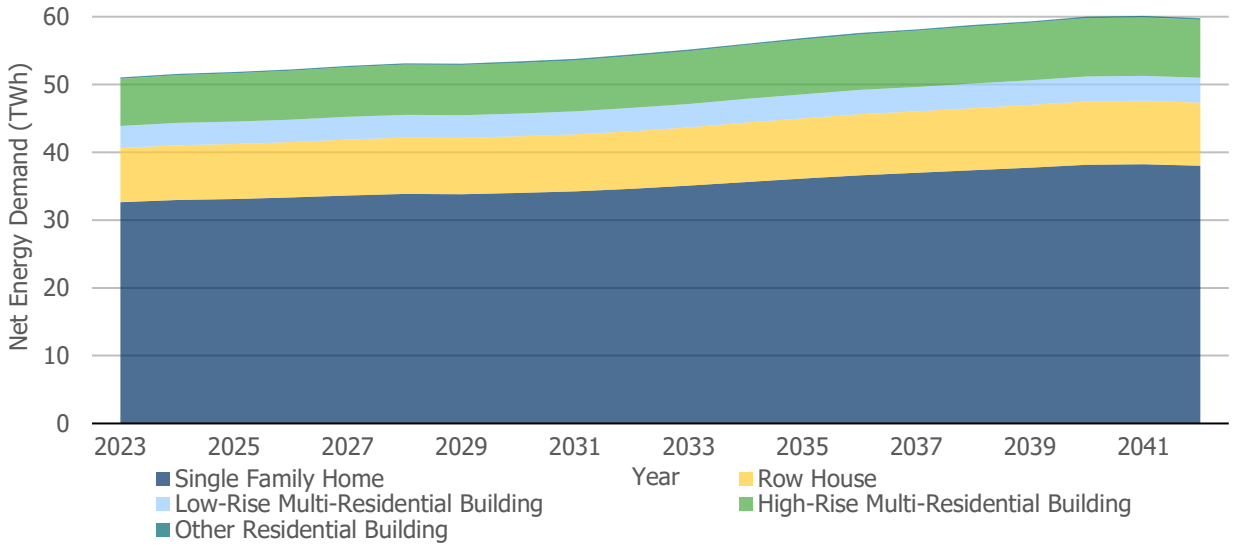
Figure 4: Residential Sector - Building Type - Count



Residential usage patterns also continue to evolve, reflecting the increase in work-from-home and online learning arrangements. Heating, cooling, ventilation, and lighting have all contributed to this increase during the COVID-19 pandemic. The impact of computers, small appliances and other consumer electronics on residential sector electricity demand is expected to grow from 19 per cent in 2023 to 25 per cent in 2042.

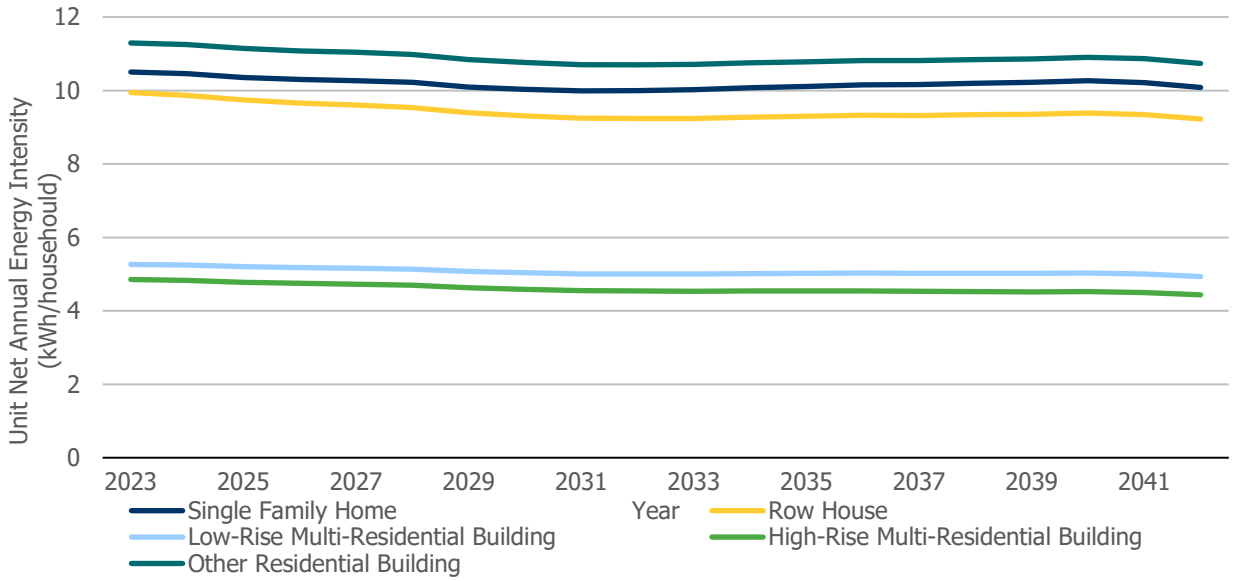
The forecast continues to assume that multi-residential and row housing take a proportionately higher share of new building construction compared with single-family homes, mainly due to housing affordability. This is a change from historical patterns. The chart below summarizes residential energy consumption 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 2023. The relative share of single-family homes is expected to fall sightly to 50 per cent by the end of the outlook period.

Figure 5: Residential Sector - Building Type - Net Annual Energy Demand



The residential sector unit annual net energy intensity is expected to fall over the course of the outlook period with the impacts of conservation programs, codes and standards, and natural efficiency being felt. Residential sector average unit annual net energy intensity decreases from 8,540 kWh per household per year in 2023 to 8,000 kWh per household per year by the end of the outlook period.

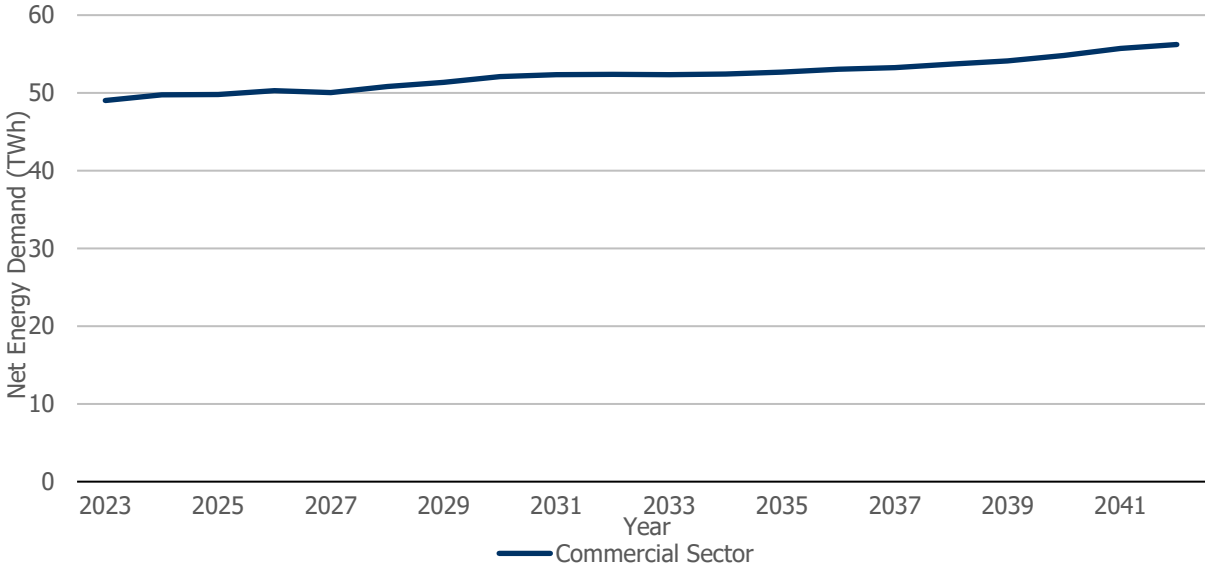
Figure 6: Residential Sector - Building Type - Unit Net Annual Energy Intensity



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 the 2021 APO demand forecast, commercial sector energy grows from 49.0 TWh in 2023 to 56.2 TWh in 2042 or at an average annual growth rate of 0.7 per cent.

Figure 7: Commercial Sector - Net Annual Energy Demand



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

1. A return to the long-term trend of 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, hybrid or permanent work from home practices 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. An accellerated shift in consumer shopping behaviour, as more opportunities for reinforcing and increasing the trend away from in person shopping and 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 commercial warehouse 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

The 2021 APO demand forecast assumes that the average annual growth rate of the total commercial floor space is 0.8 per cent and includes updated assumptions of:

- Earlier and more robust recovery of businesses from the pandemic and resulting economic recession
- Continued 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)
- Accelerated customer preference shifts toward online shopping
- Lower demand for new industrial-type space (including both commerical/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.

Figure 8: Commercial Sector - Business Type - Floorspace

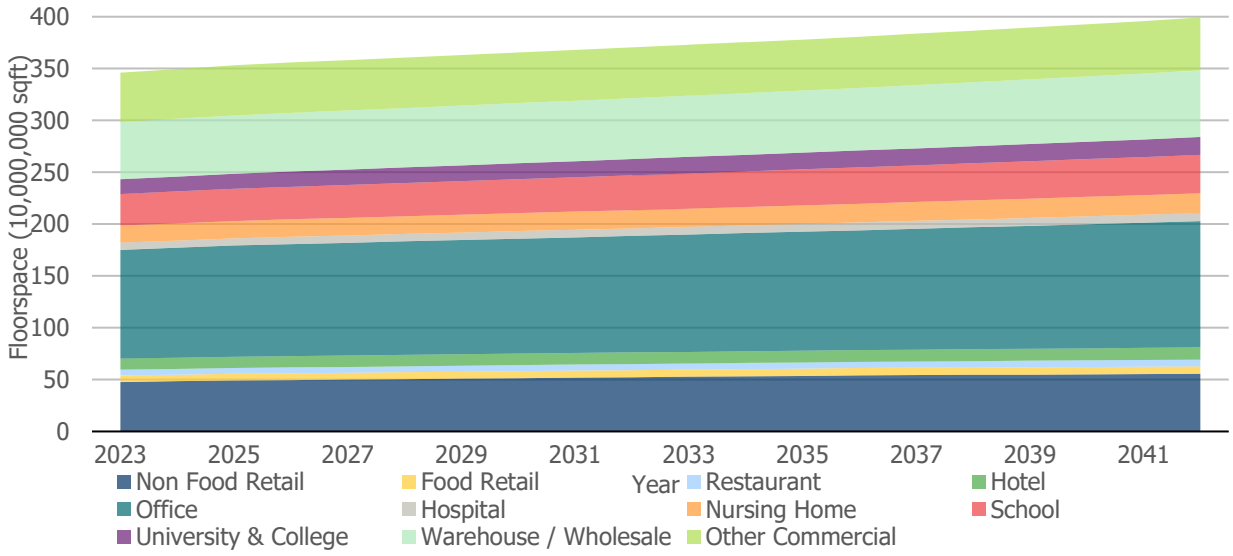


Figure 9: Commercial Sector - Business Type - Net Annual Energy Demand

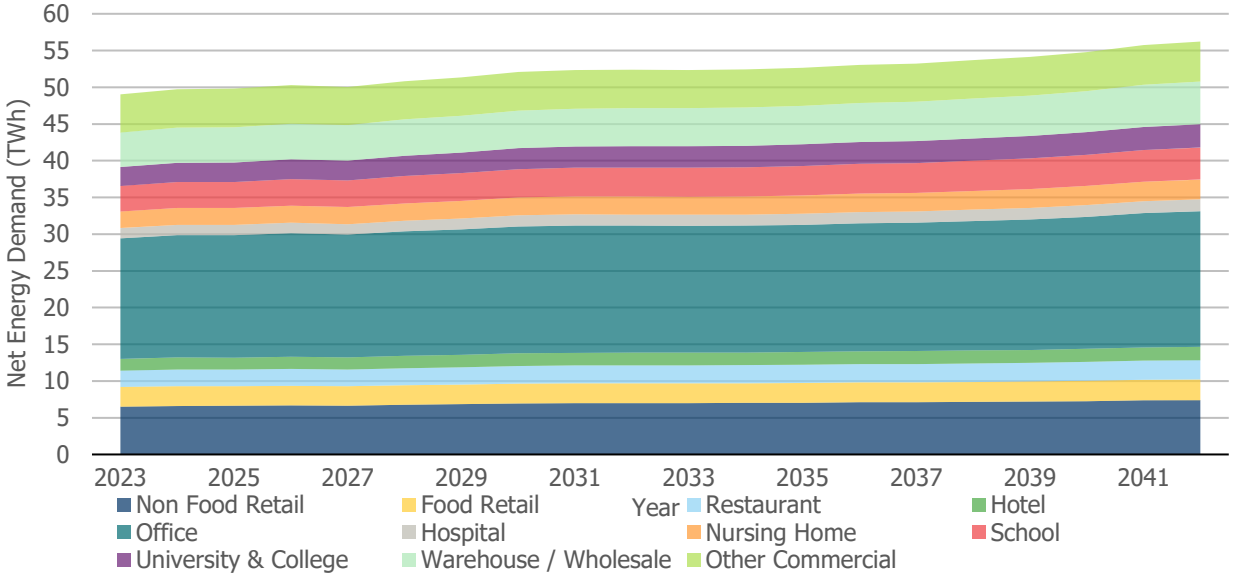
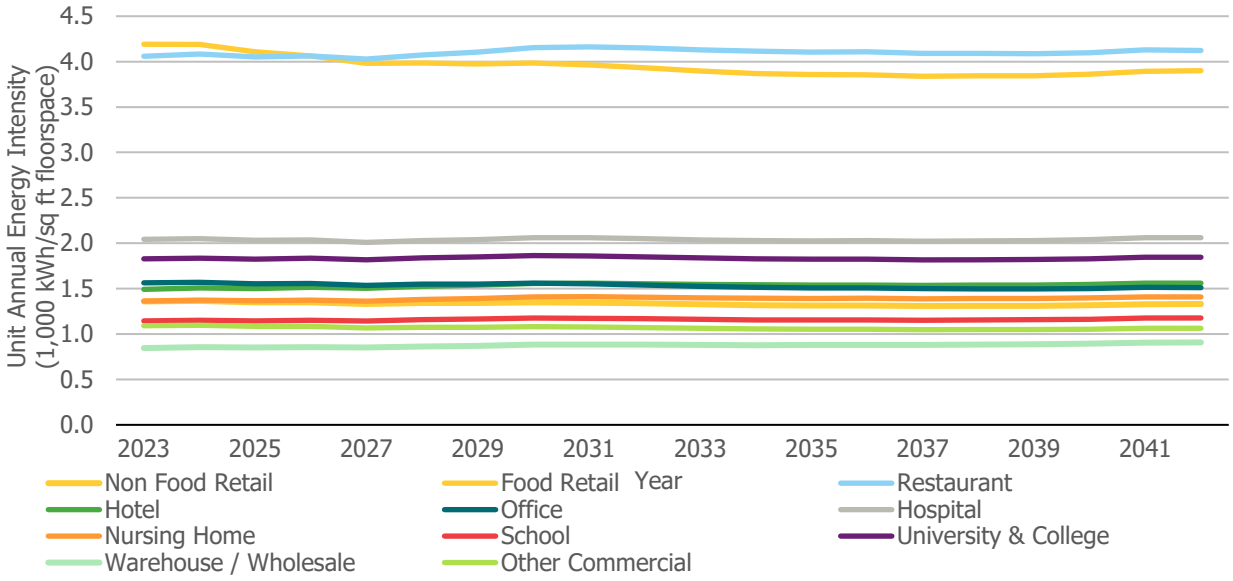


Figure 10: Commercial Sector - Business Type - Unit Net Annual Energy Intensity



3.3 Industrial Sector

Consistent with 2020 APO observations and forecasts the industrial sector has continued to face minimal electricity demand impacts resulting from the COVID-19 pandemic, mitigation measures and subsequent economic recession, and has been surprisingly resilient and stable. Over the course of 2021, societal focus has shifted from pandemic recovery and local supply chain security to climage change mitigation, decarbonization and electrification and the industrial sector as as an opportunity.

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.

In the 2021 APO demand forecast, strong industrial sub-sector growth is seen concentrated in the mining and primary metal sub-sectors and each is supported by policy initiatives.

In the mining sub-sector, concentrated in northern Ontario, electricity demand is expected to grow robustly in the near term supported by favourable resource prices and the implementation of Ontario's Critical Mineral Strategy, which aims to develop sources of minerals that have specific industrial, technological and strategic applications and support dependent Ontario sectors such as information and communcations technology, clean technology, energy, transportation, aerospace and defense, and health and life sciences. Strong electricity demand growth is predicted in the mining sub-sector as new mining operations reach commerical operation, and existing mines complete expansions or extensions in the early to mid 2020s and then slowly decline in the late 2020-mid 2030s as existing mining operations reach their respective end-of-lives.

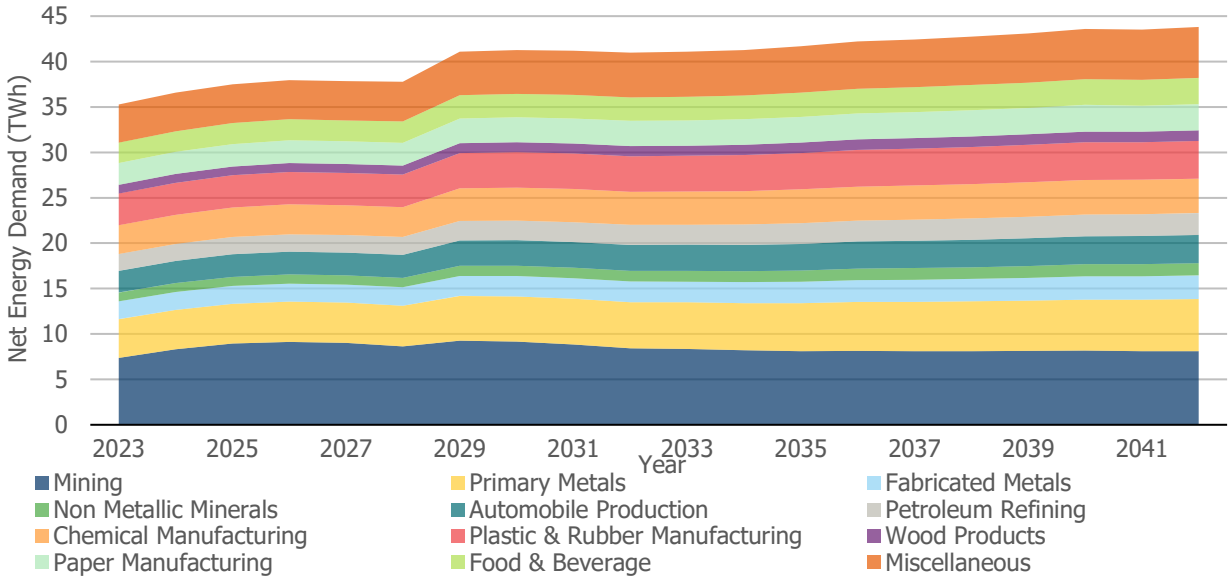
In the primary metals sub-sector, decarbonization and electrification is underway in the form of the provincial steel production sub-sector planned implementation of electric arc furnaces as annouced in mid-2021. The 2021 APO demand forecast has specifically accounted for the July 5, 2021 annoucement of Algoma Steel's project as supported by the Government of Canada support. This particular industrial project is expected to materialize in 2029 with a signficiant and distinct increase in demand. Subsequent to the completeion of the 2021 APO demand forecast, ArcelorMittal Dofasco annouced on July 30, 2021, plans to implement an electric arc furance, that is supported by policy initiatives as well. Although not incorporated in the 2021 APO demand forecast, it has been recognized in the 2021 APO uncertainties assessment and will be accounted for in future APOs.

Another industrial sector development in late 2021, subsequent to the completion of the 2021 APO demand forecast was the restarting of General Motors Oshawa assembly plant that was shuttered in 2019 and had a significant impact on electriicty demand. This and any future changes in the automobile production sub-sector, including potential electric vehicle battery cell production as contemplated in the 2021 APO uncertainties assessment, will be closely monitored and be accounted for in future APOs.

Apart from the aforementioned mining, primary metal and automobile production industrial sub-sectors, all other industrial sub-sectors are expected to see slow growth through the outlook period that is consistent with 2020 APO forecasts.

The demand forecast see industrial energy growing from 35.3 TWh in 2023 to 43.8 TWh in 2042, an average annual growth rate of 1.2 per cent.

Figure 11: Industrial Sector - Sub-Sector - Net Annual Energy Demand

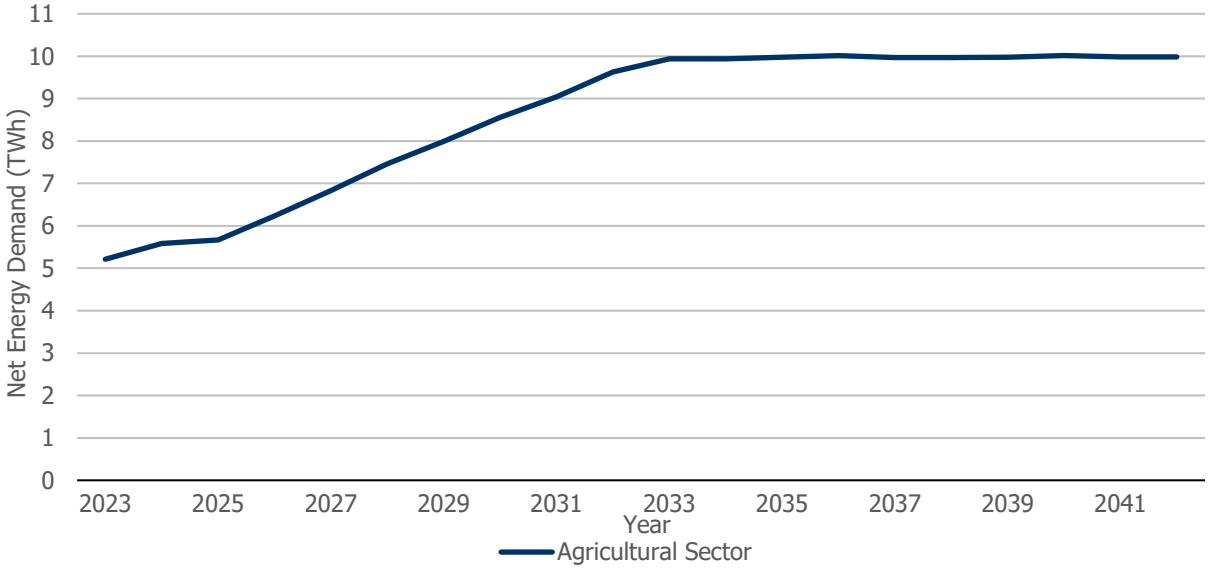


3.4 Agricultural Sector

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 detailed in the IESO's Need for Bulk System Reinforcements West of London bulk power system planning report.. Overall, sector electricity demand growth increases energy and peak demand primarily in the winter season. Overall, the agriculture sector energy grows from 5.2 TWh in 2023 to 10.0 TWh in 2042.

Figure 12: Agricultural Sector - Net Annual Energy Demand



3.5 Transportation Sector

3.5.1 Electric Vehicles

The electric vehicle (EV) market has been fast growing and there are increasingly more EVs on Ontario roads every year. By the end of 2020, there were approximately 51,000 EVs registered in Ontario. Their electricity charging demand is estimated as nearly 200 GWh in 2020, which represents 0.15% of total electricity consumption in the province. With more EVs replacing internal combustion engine vehicles, it is projected that EV charging demand will increase significantly. EV charging demand is estimated and updated regularly with the latest available information.

EVs are a unique electricity end use with its own characteristics. Many factors can affect EV charging demand. As a result, the EV forecast has a higher uncertainty than many other end uses in residential and commercial sectors. For the demand forecast in this APO, the IESO's analysis focuses on three key factors that largely determine electricity charging demand. They are the number of EVs, average driving distance, and fuel efficiency.

On June 29 2021, Government of Canadian advanced its target of 100% of car and passenger truck sales to be zero emissions by 2035 in Canada. The 2021 APO demand forecast considers an adoption path to achieve this targetwith a moderate adoption rate for the remainder of the 2020s and then a steep ramp up after 2030. The projected number of EVs in Ontario will reach 500,000 by 2030 and 6,600,000 by 2042.

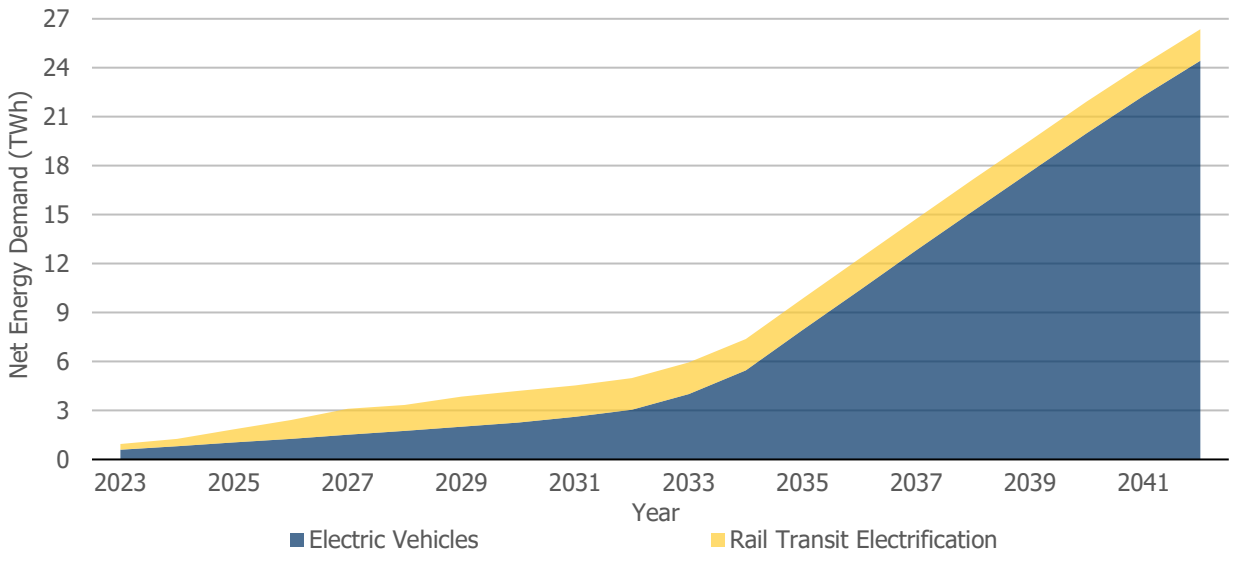
It is projected that light duty EVs (LDEVs), for both personal use and for commercial fleet purposes, represent the majority of EVs over the outlook period. Most transit buses will be electrified (e-buses) over the next two decades as supported by government iniatives and announced by various municipal or regional transit agencies. LDEVs and e-buses are the two main categories that EV charging demands are analyzed. Electricity demand of other electric mobility modes, though small, is also estimated. A total EV charging demand is forecasted to grow from 0.6 TWh in 2023 to 24.4 TWh in 2042.

Real-world charging data from the Charge the North project was used to develop the charging profile and EV hourly demand forecast. By the end of the planning horizon of the 2021 APO, EV system peak demand impact is estimated at about 1,200 MW.

3.5.2 Rail Transit

Broad rail transit electrification is underway in Ontario with projects at various stages, including nine light rail transit projects, three subway projects, and the Metrolinx GO Transit rail system electrification. Most projects are at early planning stage, in procurement process, or under construction. Their electricity demands are estimated with limited information. It is projected that electricity demand to power rail transit will reach nearly 2 TWh by 2030 through 2042. The demand forecast will be updated with new information when it becomes available.

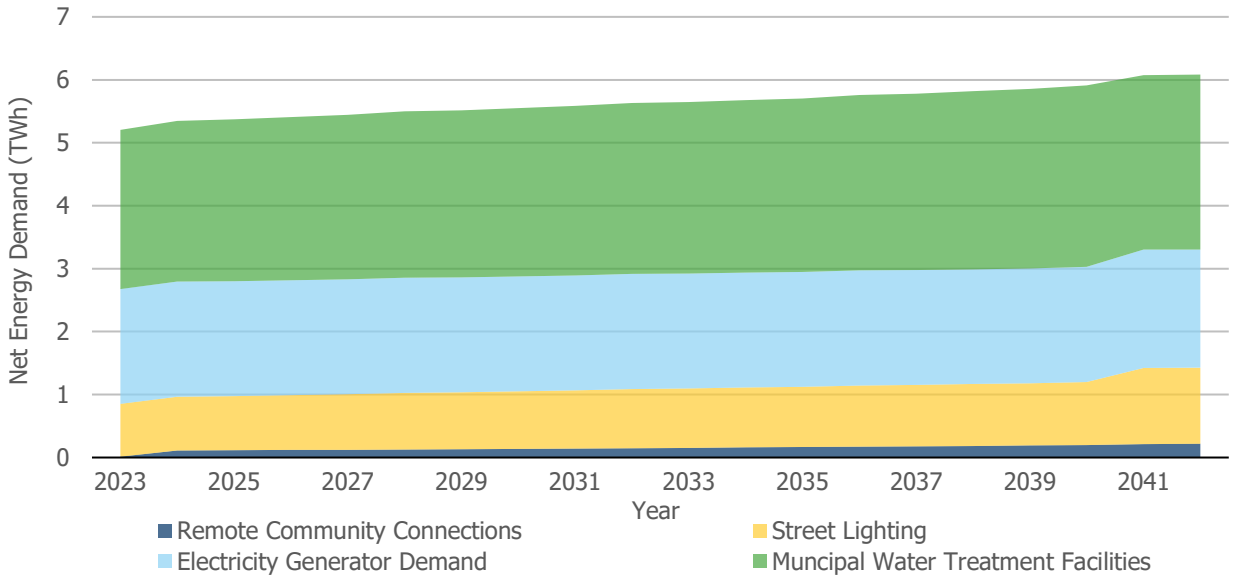
Figure 13: Transporation Sector - Mode - Net Annual Energy Demand



3.6 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 2023. 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 2042. Collectively these four "other" load categories are expected to grow minimally, but consistently, over the course of the outlook to 6.1 TWh in 2042, an annual increase of 0.9 TWh or 0.8 per cent per year.

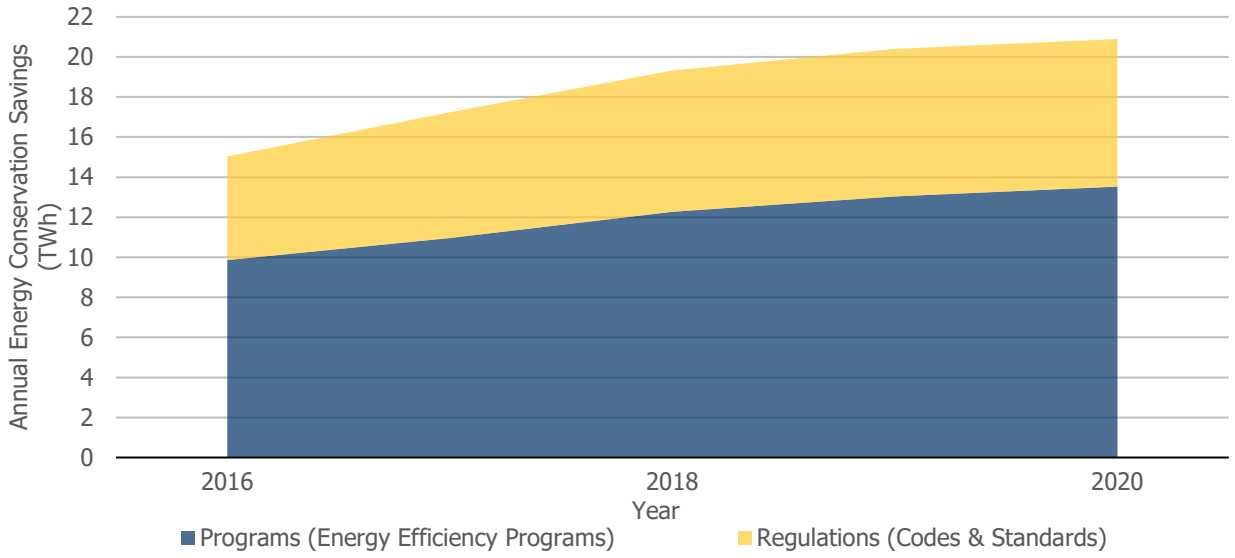
Figure 14: Other Electricity Demand - Segment - Net Annual Energy Demand



3.7 Conservation

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 two main categories, conservation programs, and building codes and equipment standards regulations. It is estimated that the programs implemented between 2006 and 2020 has contributed approximately 13.5 TWh electricity savings in 2020. Regulations of building codes and equipment standards regulations have delivered approximately 7.4 TWh electricity savings in 2020.

Figure 15: Conservation - Historical Results - Annual Energy Conservation Savings

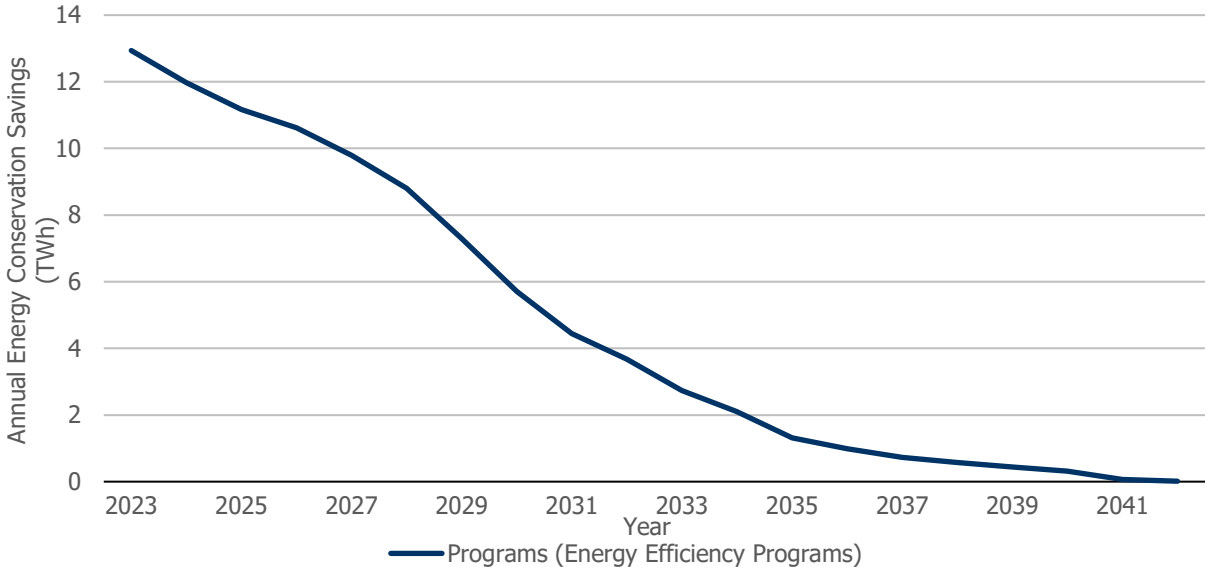


3.7.1 Programs

3.7.1.1 Historical Frameworks

Conservation savings resulted from programs typically persist a number of years after energy efficiency measures are implemented. Historical programs from 2006 to 2020 continue to contribute to electricity savings. Included in *historical frameworks* are the 2019-2020 Conservation Frist Framework Wind Down and the 2019-2020 Interim Framework. Program project completion deadlines in these frameworks have been extended given the current market conditions. It is expected that about 0.6 TWh annual energy savings will materialize from 2021 to 2022. From 2023 annual energy savings achieved from historical frameworks decay as energy efficiency measures that achieve such energy savings reach their end-of-life.

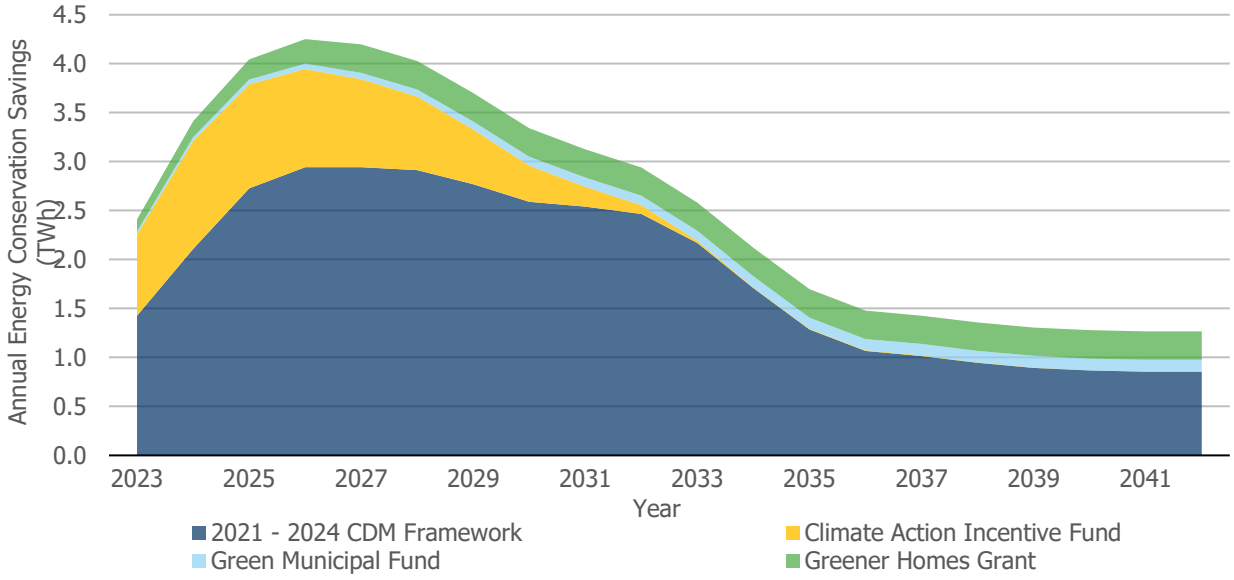
Figure 16: Conservation - Programs - Historical Frameworks - Annual Energy Conservation Savings



3.7.1.2 Current Frameworks

The current conservation program framework consists firstly of the 2021-2024 Conservation and Demand Management Framework as directed by then Minister of Energy, Northern Development and Mines on September 30, 2020. Programs in this framework have been delivered centrally by the IESO under the Save on Energy brand since January 2021 and target commercial, industrial, institutional, on-reserve First Nations, and income-eligible electricity consumers. The annual energy savings are forecasted to reach 3 TWh in 2026. Secondly is the Climate Action Incentive Fund run by federal agencies is expected to result in over 1.1 TWh electricity savings in Ontario by 2024. Thirdly, projects supported through the Green Municipal Fund, which is managed by the Federation of Canadian Municipalities, are expected to result in electricity savings of about 0.01 TWh each year in Ontario. Finally, the Greener Homes Grants announced in 2021 by the Government of Canadian will lead to an estimated 0.3 TWh electricity savings in Ontario. Collectively, the near-term programs are forecasted to save more than 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.

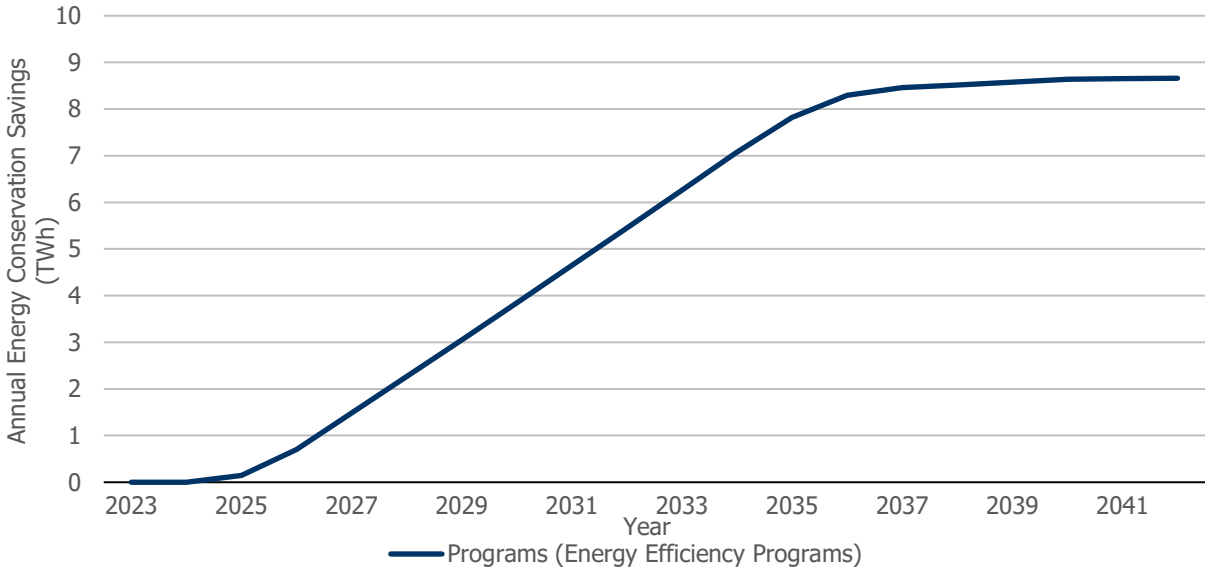
Figure 17: Conservation - Programs - Current Frameworks - Annual Energy Conservation Savings



3.7.1.3 Long Term Framework

In addition to the programs are already in the market, it is anticipated that conservation program frameworks will continue in the post 2021-2024 CDM program framework era. For long term demand forecasting and power system planning, an annual incremental savings rate consistent with the current levels of the 2021-2024 CDM Framework is assumed for the remainder of the outlook period. The long term program frameworks are expected to achieve 8.7 TWh in annual energy savings in by 2042.

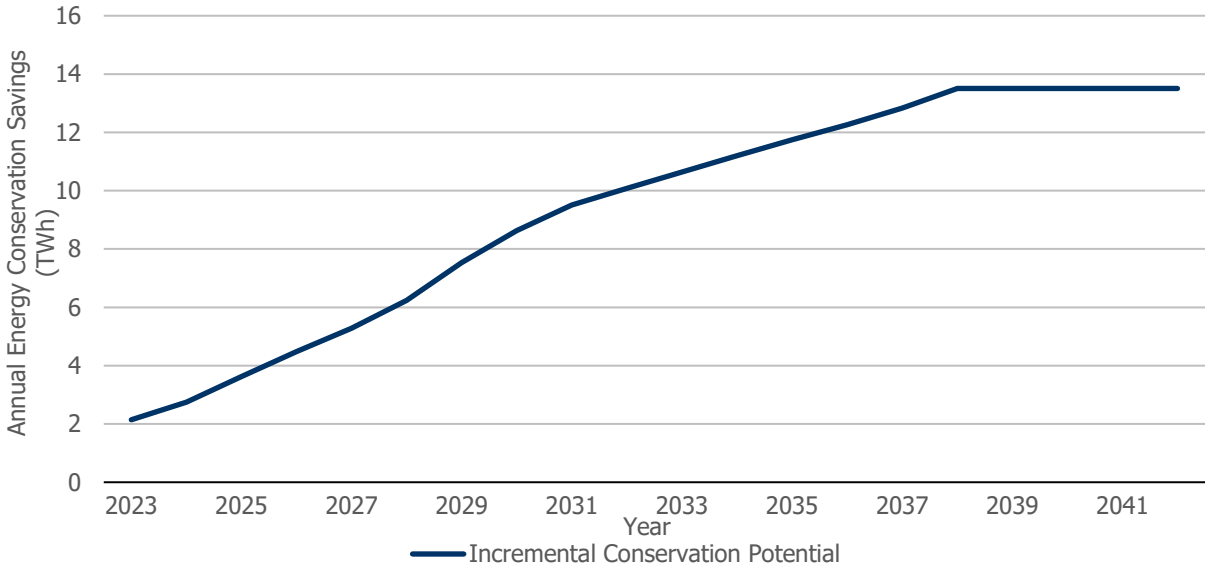
Figure 18: Conservation - Programs - Long Term Frameworks - Annual Energy Conservation Savings



3.7.1.4 Incremental Conservation Potential

Separately from the annual energy conservation savings considered in the reference demand forecast, there is considerable potentials to achieve incremetnal savings as identified and quantified in the IESO and Ontario Energy Board Electricity and Natural Gas Conservation Achievable Potential Study completed in 2019 and is estimated to be 13.5 TWh in annual energy conservation savings by 2038 through 2042.

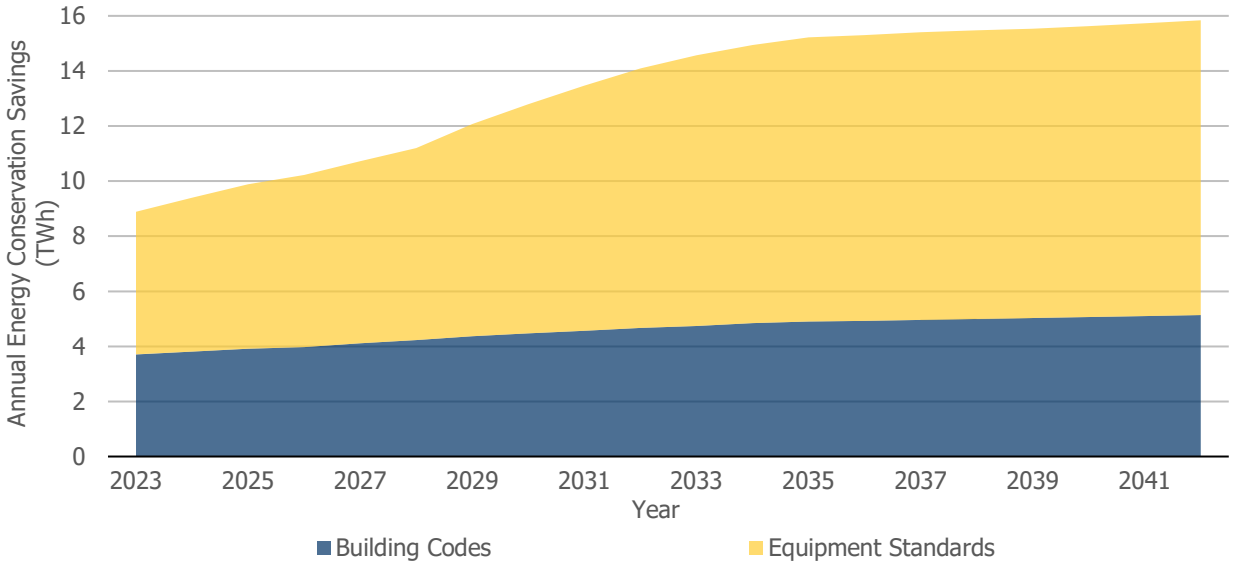
Figure 19: Conservation - Programs - Incremental Conservation Potential - Annual Energy Conservation Savings



3.7.2 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. Most savings will come from the residential and commercial sectors. It is estimated that savings from codes and standards will grow from 8.9 TWh in 2023 to 15.8 TWh in 2042.

Figure 20: Conservation - Regulations - Annual Energy Conservation Savings



4. Demand Forecast Uncertainties

With the constantly evolving state of the COVID-19 pandemic, recovery from economic recession and the drive torwards climate change mitigation, decarbonization and electrifiction, 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 sector level 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, electrfication project development, 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).

To help identify some uncertainties and to gain an initial understanding of the potential impact to resource adequacy, certain assumptions of the demand forecast have been assessed, revised and aggregated into a high demand scenario to identify how system level demand could change should the revised assumptions materialize. This scenario reflects assumptions that are not considered mostly likely to occur, but do have a reasonable potential to occur and is comprehensively discussed in Chapter 8 of the 2021 APO.

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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