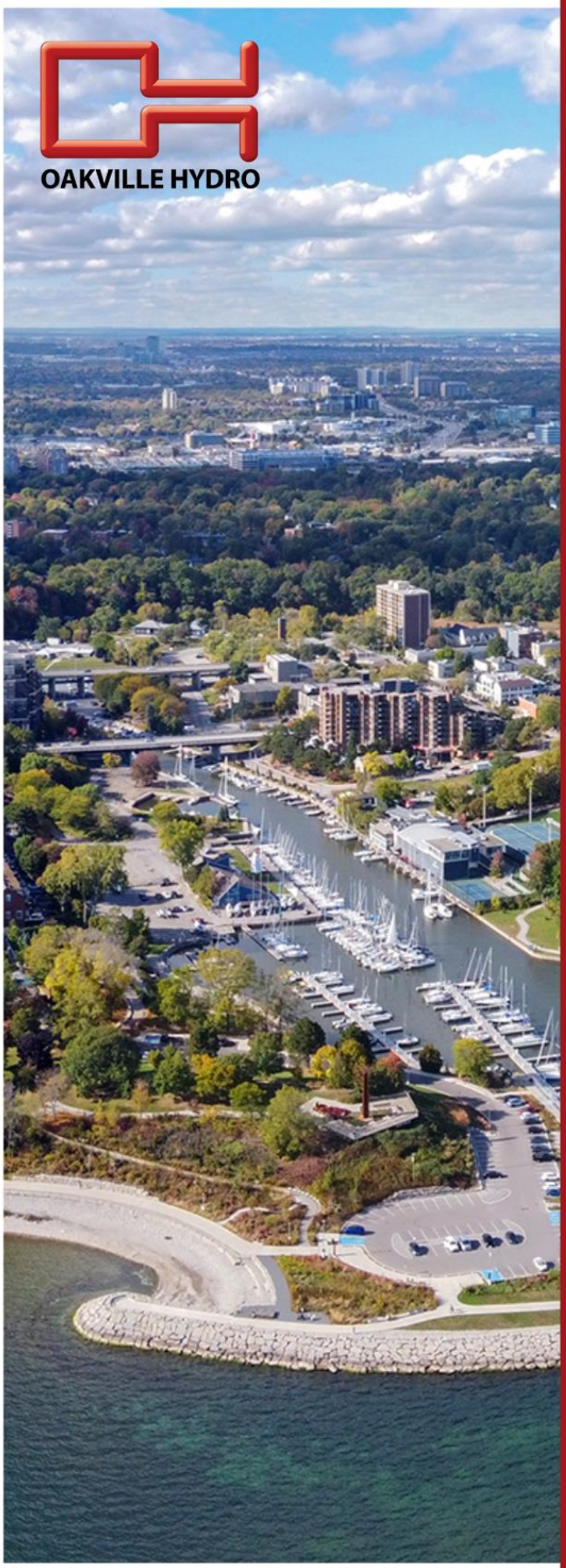


Electrification Readiness

Future-Ready: A Resilient Grid for Oakville's Electrified Tomorrow

November 2024

Contents

Executive Summary

Electrification is set to bring significant and far-reaching impacts to electric utilities. The transition to electric vehicles (EVs), the electrification of buildings, and the proliferation of distributed energy resources (DERs) are driving a fundamental shift in how energy is consumed and managed. This shift will require the grid to accommodate higher levels of demand and increased load variability through strategic upgrades and enhanced operational practices. Furthermore, the integration of DERs, such as rooftop solar and battery storage, will add complexity to grid management, necessitating the adoption of advanced technologies and more dynamic grid operations.

Oakville's community is poised for substantial growth, with projections indicating a doubling of both population and employment by 2051. This growth, coupled with electrification will place significant demands on the electricity grid. Oakville Hydro's (OH) load forecast, which is aligned with key industry reports, anticipates a 48% to 106% increase in peak demand by 2050. The demand forecast highlights the diverse impacts of electrification on the grid and emphasizes the importance of proactive planning and investment to maintain reliability and ensure sufficient capacity.

Thanks to its robust transmission and distribution networks, OH's grid is well-equipped to support the anticipated growth in electricity demand. Uniquely positioned with access to three independent high-voltage transmission networks and five transformer stations supplying 27.6 kV circuits across the Town of Oakville, OH boasts a highly flexible grid. The grid's high density of distribution automation and looped feeders enables it to adapt efficiently to the community's evolving needs.

Figure 1: Transmission Connections - Oakville Hydro

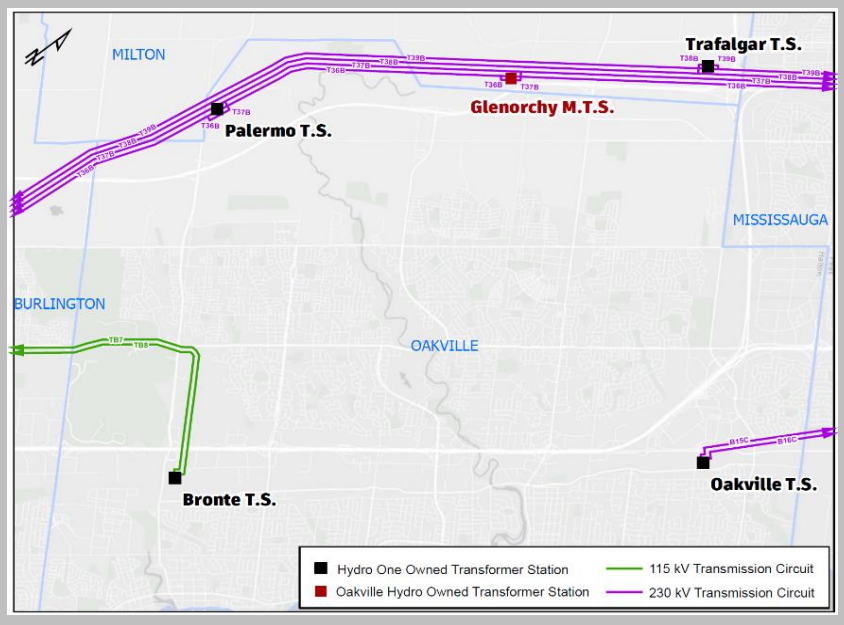


Figure 1 illustrates Oakville's transmission connections and transformer stations, which convert high-voltage transmission lines to distribution voltages suitable for local delivery. The network comprises three independent high-voltage transmission circuits and five transformer stations, including the Glenorchy Municipal Transformer Station (M.T.S.), which is owned and operated by OH.

OH's Electrification Strategy is comprehensive, focusing on system planning, grid operations, design practices, and customer engagement. By updating load forecasting methodologies, modernizing grid operations, and refining design standards to account for electrification and climate change, OH is well-positioned to meet the evolving energy needs of the community. Additionally, the strategy emphasizes empowering customers through education and support, positioning OH as a leader in the transition to a sustainable energy future.

OH's system-wide load forecast provides a detailed analysis of future electricity demand under various growth and electrification scenarios. The forecast reveals that OH may need to make significant infrastructure upgrades as early as the mid-2030s to accommodate peak load increases. These upgrades will be essential to maintain grid reliability and ensure that Oakville can meet the growing electricity needs of its residents and businesses.

Significant capital investments are required to support Oakville's electrification and community growth. OH's capital planning process is prioritized through asset management planning, ensuring that investments in grid infrastructure, smart technologies, and renewable energy integration are timely and effective. OH's investment outlook anticipates a 65%-130% increase in gross annual capital additions by 2050, translating to $1.2 billion to $1.5 billion in total capital expenditures through 2050. These investments will focus on critical areas such as new transformer station construction, substation upgrades, new distribution lines, voltage conversions, climate hardening and emerging technology innovations such as EV charging management.

The transition to an electrified future, while necessary, brings with it the challenge of managing rate impacts. OH is committed to balancing the required investments in grid modernization, network expansion, and enabling technologies with the need to keep electricity affordable for customers. Analysis indicates that, under various electrification and community growth scenarios, electricity rates could increase by 30-60%, leading to an average annual rate growth of 1%-2%, by 2050. However, strategic planning and investment will help mitigate these impacts, ensuring that rate increases remain affordable and aligned with community expectations.

Glossary of Terms

Advanced Distribution Management System (ADMS): A comprehensive software platform that integrates utility systems to automate outage restoration, optimize grid performance, and manage distributed energy resources (DERs).

Climate Resilience: The ability of the electricity grid to withstand and quickly recover from extreme weather events and other climate-related challenges, ensuring continuous and reliable service.

Conservation and Demand Management (CDM): Strategies and programs aimed at reducing electricity consumption and managing demand, often through energy efficiency improvements and peak load reductions.

Distributed Energy Resources (DERs): Small-scale energy resources connected to the distribution system, including solar panels, wind turbines, and battery storage systems, that can generate or store electricity locally.

Distribution System Operator (DSO): A model where the utility manages energy flows within the distribution network, optimizing the integration and operation of DERs, and balancing supply and demand at the local level.

Electric Vehicle (EV): A vehicle that is powered entirely or partially by electricity, using an electric motor and battery instead of, or in addition to, an internal combustion engine. EVs include both Battery Electric Vehicles (BEVs), which run solely on electric power, and Plug-in Hybrid Electric Vehicles (PHEVs), which combine an electric motor with a traditional gasoline engine.

Electrification: The process of replacing technologies that use fossil fuels with those that use electricity, particularly in transportation, building heating and cooling, and industrial processes.

Energy Storage Systems: Technologies that store energy during periods of low demand and release it during peak demand, enhancing grid stability and supporting the integration of renewable energy sources.

Grid Modernization: The process of upgrading the electricity grid with advanced technologies to improve reliability, efficiency, and resilience, enabling the grid to meet future demands and support electrification.

Harmonics: Distortions in the electrical waveform caused by non-linear loads, such as EV chargers and LED lighting, which can affect the efficiency and reliability of electrical systems.

Load Forecast: Projections of future electricity demand based on factors such as community growth, EV adoption, DER integration, and extreme weather impacts, used to guide infrastructure planning and investment.

Non-Wires Solutions (NWS): Alternatives to traditional infrastructure upgrades, such as demand response programs and energy efficiency initiatives, that can help manage load growth and alleviate stress on the grid.

Outage Management System (OMS): A system that uses real-time data to monitor and manage electricity outages, improving the utility's ability to restore service quickly and efficiently.

Peak Demand: The highest level of electricity demand observed over a specific period, which utilities must be prepared to meet to ensure reliable service.

Power Quality: The stability and consistency of voltage and frequency in the electricity supply, which can be affected by factors such as increased demand, DER integration, and the proliferation of EVs.

Renewable Energy Integration: The incorporation of renewable energy sources, such as solar and wind, into the electricity grid, often involving the use of DERs and energy storage systems.

Smart Grid Technologies: Advanced technologies that enhance the electricity grid's ability to monitor, control, and automate operations, improving efficiency, reliability, and resilience.

Supervisory Control and Data Acquisition (SCADA): A system used by utilities to monitor and control grid operations remotely, improving response times to outages and optimizing the performance of the distribution network.

System Average Interruption Duration Index (SAIDI): A reliability metric that measures the total duration of outages experienced by the average customer over a year.

System Average Interruption Frequency Index (SAIFI): A reliability metric that measures the average number of interruptions experienced by each customer over a year.

Transformer Station: A facility where electricity is transformed from high to lower voltage levels for distribution to homes and businesses.

Voltage Fluctuations: Variations in voltage levels that can cause damage to electrical equipment and reduce the efficiency of electrical systems, often exacerbated by increased demand or DER integration.

Zero-Emission Vehicle (ZEV): A vehicle that produces no tailpipe emissions of pollutants or greenhouse gases while in operation. This category includes Battery Electric Vehicles (BEVs), which are powered entirely by electricity, and hydrogen fuel cell vehicles, which generate electricity through a chemical reaction between hydrogen and oxygen, emitting only water vapor as a byproduct.

Introduction

Oakville Hydro (OH) is at the forefront of the energy transition, serving over 77,000 customers in the vibrant and rapidly growing community of Oakville, Ontario. A strong commitment to reliability, safety, and exceptional customer service forms the cornerstone of OH's operations, catering to the energy needs of a predominantly residential customer base. As Oakville continues to expand, so does the demand for innovative, sustainable, and resilient energy solutions.

OH's service territory is robustly supported by a well-structured transmission and distribution network, including six 230 kV and two 115 kV transmission circuits that feed into four Hydro One-owned transformer stations and one OH-owned transformer station. The management of 19 municipal stations ensures seamless electricity delivery across the town, highlighted by a historical system peak of 371 MW. This infrastructure underpins essential services such as the Oakville Hospital, water and wastewater treatment plants, municipal facilities, community centers, and various industrial facilities, underscoring OH's integral role in the community's infrastructure.

As OH navigates the path towards an electrified future, the commitment to sustainability and innovation remains steadfast. OH is actively involved in initiatives aimed at enhancing operational efficiency through the adoption of new technologies and practices. The goals align with broader energy transition objectives, ensuring readiness to meet the increasing demand for electricity in a sustainable and economically viable manner.

Figure 2 : Transformation Stations in Oakville

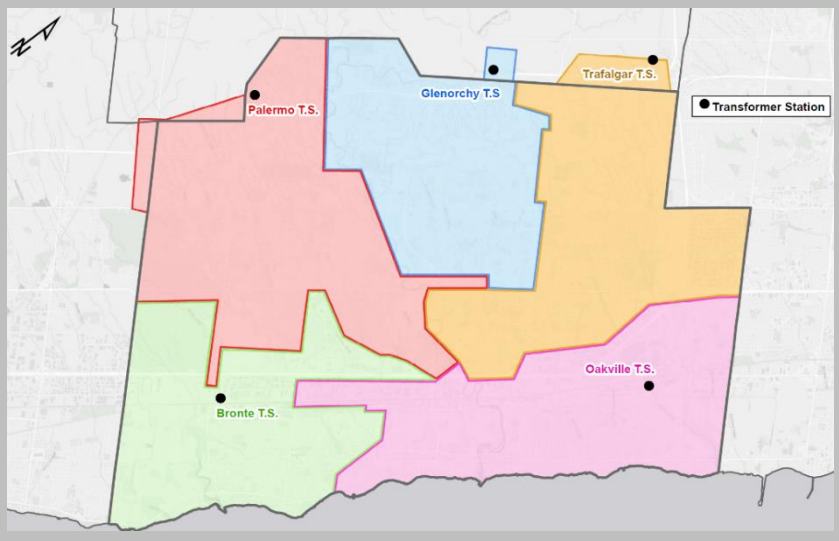


Figure 2 shows the coverage areas of the high voltage transformer stations that supply electricity to Oakville from 230kV and 115kV transmission circuits. Electricity feeders originating from these stations distribute power at 27,600 volts to customers and substations within the designated colored areas.

Through strong partnerships with the Town, other utilities, government agencies, and community organizations, OH continues to foster collaboration and drive progress in sustaining a reliable, affordable, and clean electricity system. Regulatory compliance and proactive customer engagement strategies further reinforce OH's commitment to excellence and community well-being.

This Electrification Readiness report provides a comprehensive overview of OH's current capabilities, opportunities, and plans in navigating the evolving energy landscape. OH is committed to staying at the leading edge of the electrification movement by delivering innovative, reliable, and sustainable energy solutions to the community. Embracing the future, the focus on strategic investments, technological advancements, and community engagement will guide OH in meeting the dynamic needs of Oakville, ensuring a reliable, resilient, and flexible electricity grid.

Policy Landscape

Federal Policies and Regulations

Government policies and regulatory frameworks are critical in driving the electrification transition. Key policies include incentives for electric vehicle (EV) adoption, subsidies for energy-efficient appliances, and regulations to reduce carbon emissions. OH's initiatives align with these policies to promote sustainable growth.

Federal energy policy could impact Ontario's long-term energy landscape, specifically with respect to the Clean Electricity Regulation (CER) and Investment Tax Credits (ITCs). Figure 3 provides an overview of major federal policies and regulations that impact the transition to electrified and sustainable energy solutions in Canada, highlighting objectives and their broader impact on industry, infrastructure, and consumer practices.

Figure 3: Overview of Major Federal Policy and Regulations

	Objective	Impact
Canadian Net-Zero Emissions Accountability Act (2021) and Clean Electricity Regulations (CER)	Achieve net-zero greenhouse gas (GHG) emissions economy-wide by 2050, and a net-zero pan-Canadian electricity system by 2035	Drives investments in clean energy technologies and infrastructure, including electrification initiatives across various sectors
Clean Fuel Standard (CFS)	Reduce the carbon intensity of fuels used in Canada.	Encourages the use of electricity as a cleaner alternative to traditional fuels, promoting the shift to electric vehicles (EVs) and electrified industrial processes.
Zero-Emission Vehicle (ZEV) Mandates	Increase the adoption of electric vehicles.	Provinces are required to set targets for ZEV sales, accelerating the transition to electric mobility and necessitating investments in charging infrastructure.
Green Infrastructure Fund	Support green infrastructure projects, including those that enhance electrification.	Provides financial support for projects like smart grids and electric public transportation, fostering a more robust electric energy sector.
Carbon Pricing	Reduce GHG emissions through carbon pricing mechanisms.	Makes fossil fuels more expensive, thereby incentivizing the adoption of electric alternatives in transportation, industry, and residential sectors.

Electrification and the Energy Transition

Electrification is fundamentally transforming the energy sector, creating profound implications for electricity demand, customer interaction, grid infrastructure, and energy management. OH is proactively plans and prioritizes investment to accommodate this shift, with a strategic focus on enhancing grid capacity, integrating renewable energy sources, and ensuring resilience against climate impacts.

This section explores the multifaceted aspects of the energy transition, emphasizing the integration of renewable energy sources, advancements in energy storage, and the pivotal role of smart grid technologies. Decarbonization efforts are accelerating the shift from fossil fuels to electricity across various sectors, including transportation, building heating, and industrial processes, with a strong focus on sustainability.

In Ontario, the IESO published two key documents outlining the increasing demand on the provincial electricity grid: the 2024 Annual Planning Outlook (APO) and the Pathways to Decarbonization (P2D) report. Both reports forecast electricity needs through 2050, offering varying levels of electrification scenarios. Provincial electricity demand growth is primarily driven by electrification in mining, steel production, EV battery materials processing and cell manufacturing, and naturally a growing proliferation of electric transportation across all vehicle classes.

Throughout this report, OH will present quantitative metrics from these industry reports alongside comparative results from OH's long-term load forecast, specific to the Oakville community. The following table provides a comparative analysis between the IESO reports and OH's load forecast.

Figure 4: Comparative Analysis of Electricity Demand Forecasts

Metric	Timeframe	Average Annual Peak Demand Growth Rate	Overall Increase in Peak Demand	Key Drivers
IESO Annual Planning Outlook (APO)	2025-2050	1.7- 2.0%	50% - 60% increase 23 (2025) GW to 37 GW (2050)	Industrial mining, residential growth, commercial recovery, agricultural growth, electric vehicles, data centre growth
IESO Pathways to Decarbonization (P2D)	2023-2050	1.5-3.8%	54% - 160% increase 20 GW (2023) to 60 GW (2050)	Aggressive electrification of transportation, heating, and industrial processes
OH Load Forecast	2025-2050	1.4-2.7%	48% - 106% 360 MW (2023) to 740 MW (2050)	Electrification of transportation, community growth, DER integration

As shown in the comparative analysis, electricity demand projections in Ontario vary, with OH's forecast positioned between the two IESO scenarios. This variability underscores the dynamic nature of electrification and its potential impacts on the electricity grid, emphasizing the need for adaptable planning at both the provincial and local levels.

OH System Wide Load Forecast

As Oakville continues to experience rapid growth and increasing electrification, understanding the future electricity demands on the grid is crucial for effective planning and investment. OH's system wide load forecast provides a comprehensive analysis of anticipated electricity demand scenarios, driven by factors such as community growth, EV adoption, DERs and the electrification of buildings and water heating. This section outlines the methodology used to project future peak demand and the subsequent impacts on grid capacity. By analyzing demand scenarios, OH is able to ensure that the grid remains resilient, reliable and capable of meeting the evolving needs of the community. The insights gained from this forecast will guide strategic investments and operational adjustments necessary to support Oakville's sustainable growth.

Methodology

The load forecasting methodology for OH involves a comprehensive approach that includes historical data analysis, current usage patterns, and future trends. This methodology is critical for anticipating system-wide requirements over a long-term horizon, ensuring OH remains prepared for the evolving electricity demands.

The system wide load forecast represents future peak demand scenarios for low, medium and high community growth and electrification scenarios. The peak demand scenarios are compared against total existing feeder and station capacity

Existing station capacity: The aggregate of total available demand capacity at existing transformer stations, i.e. stations may have additional capacity for additional feeder connections.

Existing feeder capacity: The aggregate of total demand capacity available on existing distribution feeders.

Low, medium, and high electricity demand forecast scenarios are built up of the following electricity demand contributors,

- → Community growth
- → EV charging
- → DER generation
- → Electrification of building and water heating
- → Extreme weather
- → Conservation and demand management

The load forecast scenarios assume OH remains summer peaking throughout the forecast period.

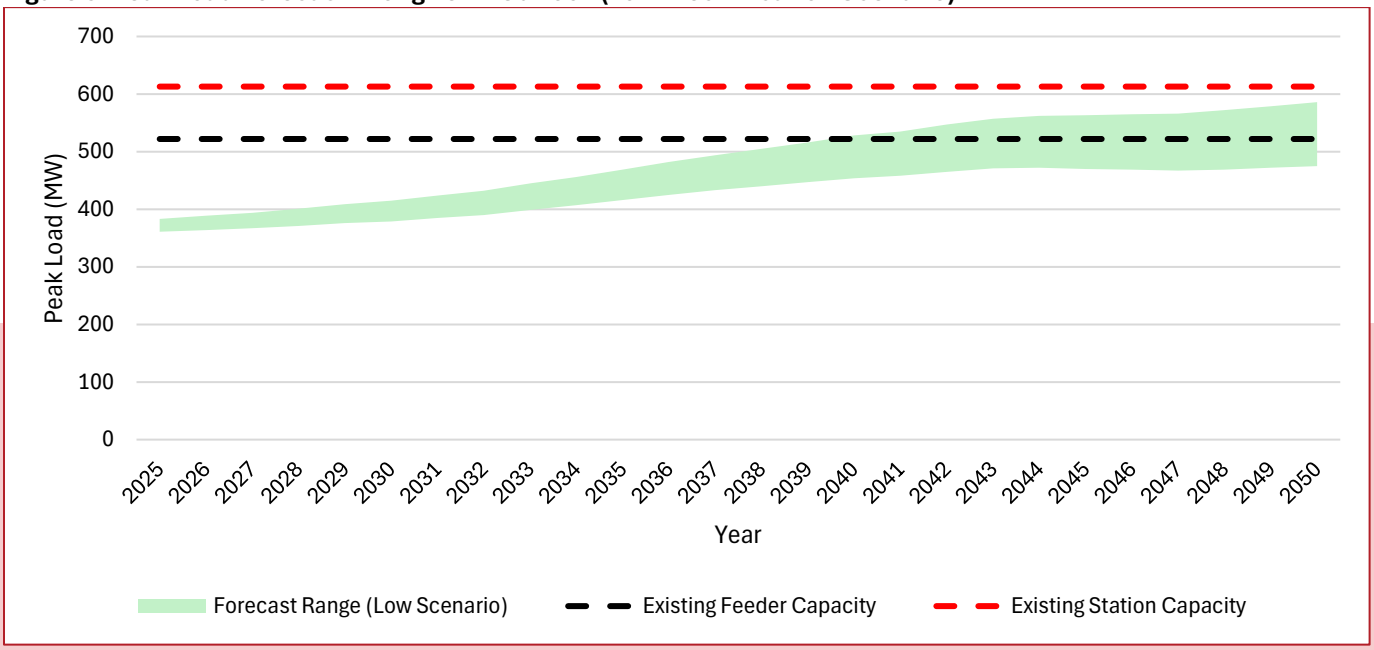
Results and Analysis

As OH plans for the future, understanding the long-term electricity demand outlook is crucial for ensuring the reliability and resilience of the grid. The following analysis presents three distinct scenarios—low, medium, and high electrification and growth—projecting peak load increases through 2050. These scenarios explore different assumptions about community growth, EV adoption, building electrification, and other key factors that will influence demand. By examining these scenarios, OH evaluates infrastructure investments needed to meet the evolving needs of the community while maintaining system reliability. Each scenario provides insights into when existing feeder and station capacities may be exceeded, highlighting the importance of proactive planning and strategic upgrades to support Oakville's energy future.

Low electrification and growth scenario:

- → Load forecast: the peak load is projected to grow 48% from 359 MW in 2023 to 530 MW by 2050, an average annual demand increase of 1.4%
- → Key contributors: growth in this scenario is driven by more conservative assumptions regarding community growth, EV adoption, and other factors
- → Observations: Under this scenario, **both feeder and station capacities are expected to remain within their limits up to 2050.** However, there may still be a need for minor upgrades or optimizations to maintain reliability as the system nears its capacity towards the end of the forecast period

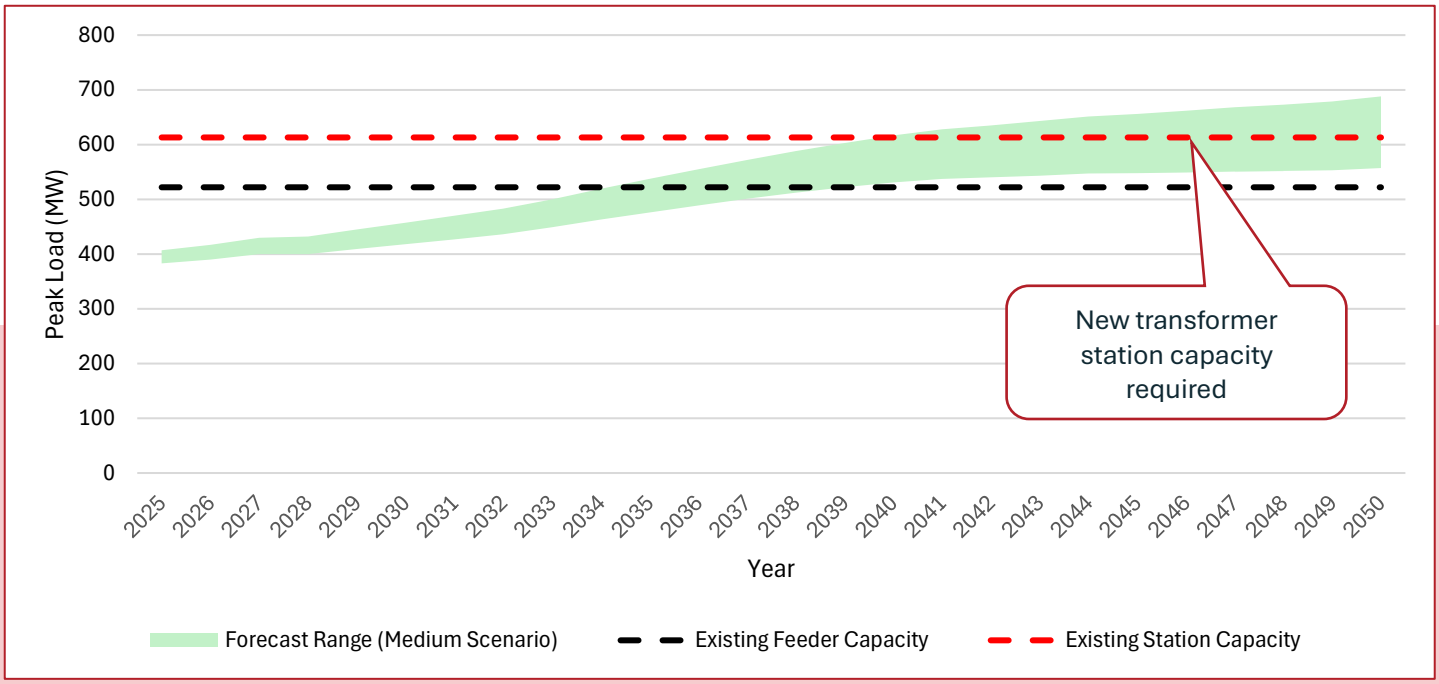
Figure 5: Peak Load Forecast - Long-Term Outlook (Low Electrification Scenario)



Medium electrification and growth scenario:

- → Load Forecast: The peak load is projected to grow 73% from 359 MW in 2023 to 622 MW by 2050, an average annual demand increase of 2.1%
- → Key Contributors: The primary drivers of this increase include community growth and EV charging, though at a moderate pace compared to the high impact scenario
- → Observations: **Feeder capacity may be exceeded by the late 2030s, with station capacity approaching its limits by late 2040s**. This scenario indicates the need for targeted infrastructure investments, particularly in the 2030s, to ensure the grid can handle increasing demand without compromising reliability

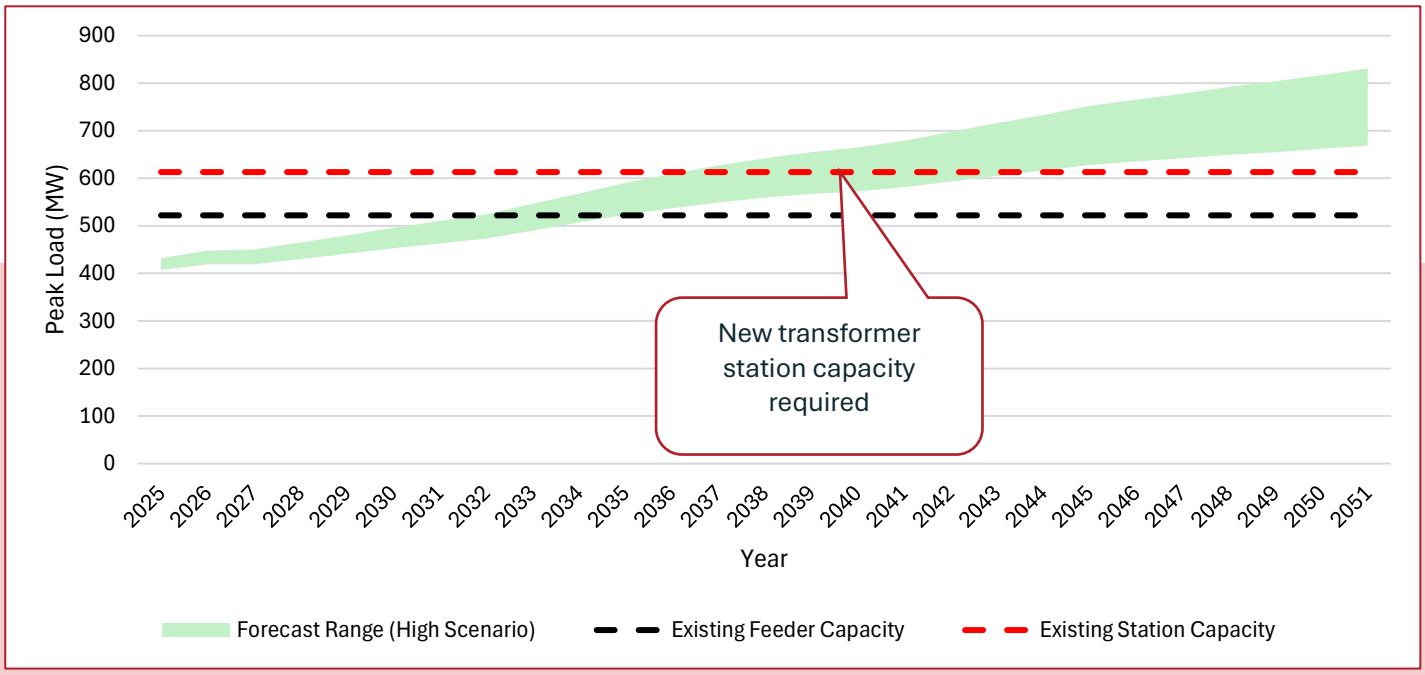
Figure 6: Peak Load Forecast - Long-Term Outlook (Medium Electrification Scenario)



High Impact Scenario:

- → Total Load Forecast: the peak load is projected to increase 106% from 359 MW in 2023 to 740 MW by 2050, an average annual demand increase of 2.7%
- → Key contributors: significant contributions to this increase come from community growth, EV charging, and extreme weather impacts, with building electrification also playing a role
- → Observations: the forecast indicates **that by the mid-2030s the existing feeder capacity will be surpassed and station capacity will be at risk of being exceeded by 2040**. This suggests that substantial upgrades will be necessary before 2040s to accommodate this growth, particularly in feeder infrastructure and station capacity enhancements

Figure 7: Peak Load Forecast - Long-Term Outlook (High Electrification Scenario)



The results of this analysis underscore the importance of forward-looking planning and investment in OH's infrastructure. Each electrification and growth scenario presents unique challenges and opportunities, with the high impact scenario highlighting the most pressing need for capacity upgrades as early as the mid-2030s. Even under the low and medium scenarios, careful monitoring and timely enhancements will be essential to ensure that the grid can meet increasing demand without compromising reliability. As Oakville continues to grow and embrace electrification, strategic investments in feeder and station capacity, along with the integration of smart technologies, will be critical to maintaining a resilient and reliable electricity supply for the community. OH's proactive approach in addressing these future challenges will be key to supporting sustainable development and meeting the evolving needs of its customers.

Regional Planning

The regional planning process for electricity bulk system needs in Ontario involves several key steps and elements to ensure a reliable power supply across 21 planning regions.

- → Coordination: aligning local, regional, and provincial electricity needs, considering factors like community energy plans and new bulk transmission lines
- → Engagement: public participation, involving local distributors, Indigenous communities, municipalities, individuals, and businesses
- → Integration: planners develop recommendations by assessing conservation, demand management, generation, transmission, and innovative solutions.

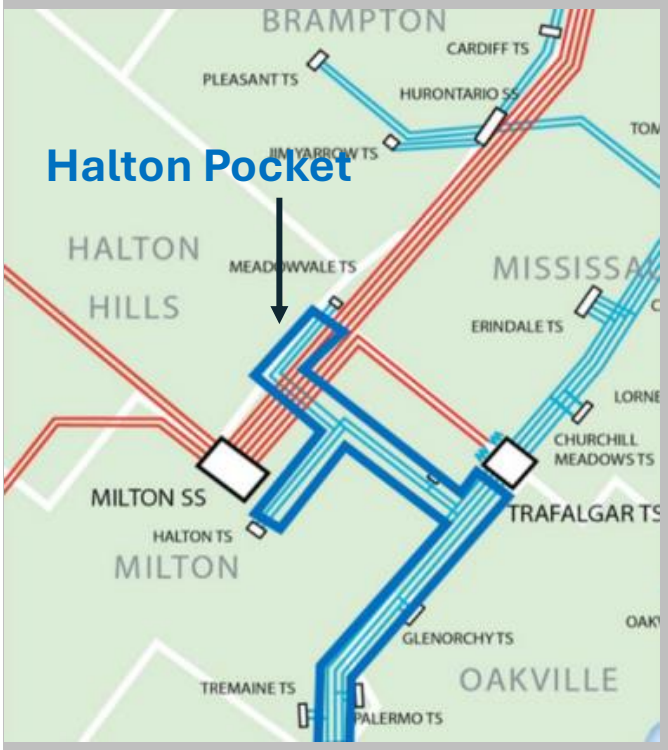
Regional plans are created with a 20-year outlook and are evaluated every five years, at minimum, to adapt to changing needs and circumstances.

OH operates within two Regional Planning zones: Burlington-Nanticoke and GTA West. OH actively participates in the development of regional plans and contribute to technical working groups. The load forecast results are used as inputs for determining the future demand needs of the Oakville community, which in turn drive provincial planning initiatives.

There are currently two constraints identified as part of regional planning that impact OH:

- → The load at Bronte Transformer Station (TS) surpassing 135 MW, and the loss of one of the 115 kV transmission circuits supplying the station would result in overloading of the remaining circuit. To address this constraint, load shifting measures have been implemented and the needs of the local area continue to be monitored.
- → Halton Pocket Supply Capacity Need – the load growth on the transmission lines contained within the Halton Pocket are expected to surpass supply capacity by 2031. This constraint continues to be monitored by the working group and the need will be revisited in the next cycle of regional planning.

Figure 8: Overview of the Halton Pocket



Source: IESO GTA West IRRP Report, July 2021

Figure 8 provides an overview of the transmission lines within the Halton Pocket (outlined in blue), a network that serves a region experiencing substantial growth.

Next Steps

Building on this load forecast, the immediate next step is to increase the magnification to analyse at a more granular level to highlight by ward, by postal code, what infrastructure investments are needed and incorporate those findings into OH's investment plans.

- → Station and feeder level forecasting: the next phase of load forecasting will focus on station and feeder levels, breaking down the system-wide projections into more localized forecasts. This detailed approach will allocate projected demand increases to specific geographical locations, considering land-use patterns, planned developments, and demographic shifts within Oakville. By understanding the demand at a more granular level, OH can plan for efficient infrastructure upgrades and expansions.

- → Allocation of demand based on land-use: accurately allocating demand to specific areas based on land-use is a key component of the station and feeder level forecast. This process will involve analyzing current and future land-use plans, such as residential, commercial, and industrial developments, to predict where significant demand increases are likely to occur. A targeted approach will ensure that resources are directed to the areas of greatest need, supporting sustainable growth while minimizing unnecessary expenditures.

- → Identifying local constraints: a critical part of the advanced forecasting process is the identification of local constraints that may impact the ability to meet future demand. Constraints could include physical limitations of existing infrastructure, regulatory challenges, or environmental considerations. Identifying these constraints allows for the development of strategic solutions, whether through infrastructure upgrades, operational changes, or other means, to ensure continued reliability and service quality.

- → Evaluating non-wires solutions (NWS): in addition to traditional infrastructure investments, OH will explore non-wires solutions (NWS) as alternatives to mitigate identified constraints. NWS, such as demand response programs, energy efficiency initiatives, and DERs, can provide cost-effective and flexible options to manage load growth and alleviate stress on the grid. Evaluating these solutions will be an integral part of the planning process, ensuring that OH can deliver reliable service while optimizing capital expenditures.

By taking these next steps, OH will be well-positioned to address the challenges of future demand growth in a strategic and sustainable manner. Advanced level of load forecasting will provide the insights necessary to ensure that infrastructure investments are aligned with the specific needs of the community, supporting the continued delivery of reliable, high-quality electricity service.

Drivers of Electrification

Electrification is driven by several key factors, including EV charging, the electrification of building heating and cooling systems, the decarbonization of tools and equipment, and the digitization and automation of manufacturing. Each of these drivers presents unique challenges and opportunities for OH.

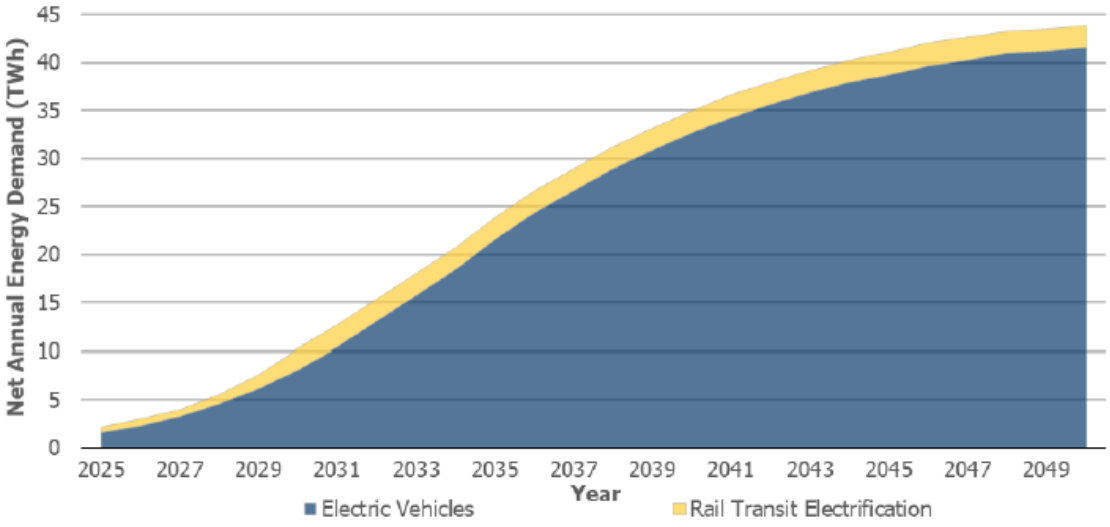
EV Charging

In December 2023, the Government of Canada introduced regulations mandating that manufacturers and importers meet annual sales targets for zero emission vehicles (ZEVs). Starting with the 2026 model year, at least 20 percent of new light-duty vehicles sold must be ZEVs. This requirement will increase annually, reaching at least 60 percent by 2030 and 100 percent by 2035.

Policy measures, improved technology, matured production, and consumer preference continue to contribute to the shift from internal combustion engine vehicles to electric vehicles. The Ontario government's policies promote EV adoption and the expansion of charging infrastructure. The private sector's investment in charging stations and EV-related services has further facilitated this growth. Recently, the OEB introduced the Electric Vehicle Charging Connection Procedures, which aim to standardize and streamline the process for connecting electric vehicle supply equipment across Ontario. The OEB has also proposed an alternative rate design for electricity delivery rates for distribution-connected commercial EV fleets and public fast charging stations, which could generate bill savings of 8% to 42% for eligible participants. The new rates are expected to come into effect January 2026.

EV adoption is one of the fastest-growing segments for energy consumption, with the IESO APO forecasting EV charging energy needs to rise from 1.6 TWh in 2025 to 42 TWh in 2050. This is an increase of 40 TWh, 2500%, or an average annual growth rate of 15%. This growth is supported by federal mandates requiring increasing percentages of new vehicles to be zero-emission.

Figure 9: Transportation Sector - Net Annual Energy



Source: IESO 2024 Annual Planning Outlook

Projections indicate a substantial increase in the number of light-duty electric vehicles on Ontario's roads. By 2025, it is expected that nearly 400,000 EVs will be registered across the province. This figure is anticipated to skyrocket to approximately 11.5 million by 2050, reflecting a dramatic shift in consumer preferences, advancements in EV technology, and supportive government policies aimed at promoting cleaner transportation options.

The Oakville community is actively embracing EVs, with over 6,000 registered as of the first quarter of 2024. This significant milestone reflects the community's strong commitment to sustainable transportation. The average annual growth rate of 42% in EV registrations since 2021 highlights the rapid adoption driven by increased environmental awareness, more affordable and advanced EV models, and the expansion of charging infrastructure. In OH's load forecast, EV charging is projected to become the second largest contributor, accounting for 15%-30% of electricity demand growth in Oakville by 2050, factoring in charging diversity.

Figure 10: Electric Vehicles (EVs) in Oakville

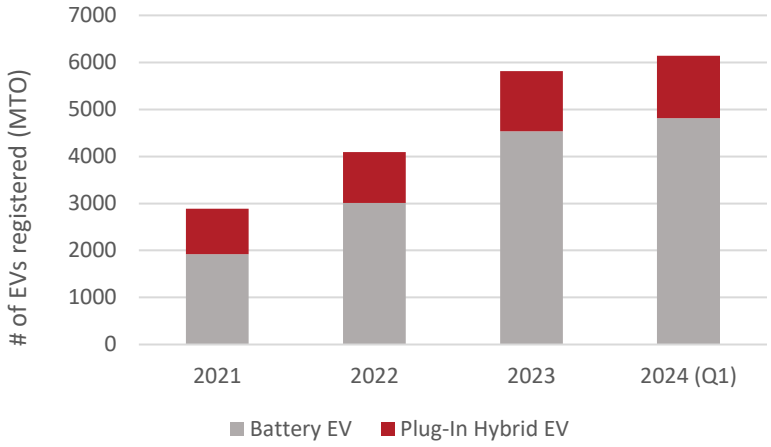
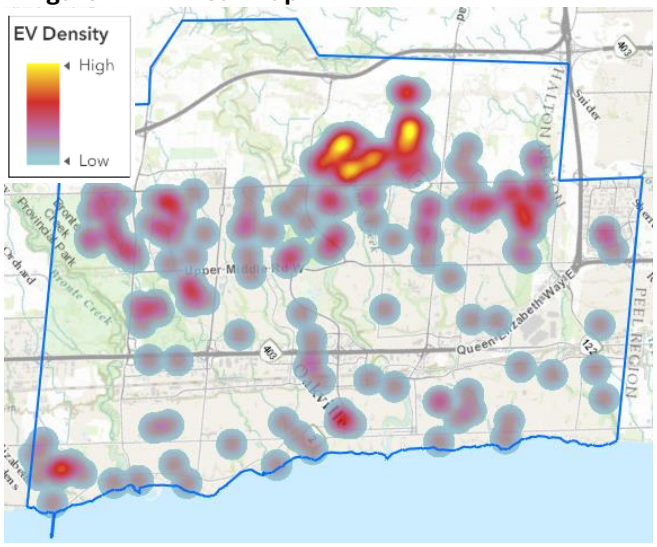


Figure 11: EV Heat Map



Ontario Local Distribution Companies (LDCs) can access Ministry of Transportation (MTO) EV registration data by postal code, allowing utilities to spatially represent EV growth within the distribution system. As illustrated in the following heat map, EVs are sporadically located throughout Oakville, with noticeable densification in new developments in North Oakville. This data is utilized to support asset management planning and optimize grid operations to ensure the grid is equipped to support the ongoing adoption of EVs.

In addition to light-duty vehicles, medium and heavy-duty vehicles combined account for nearly 3 percent of the total vehicles in Ontario. Despite significant technological advancements in recent years, further efforts are needed to support the commercialization and adoption of zero-emission vehicles in these segments. Various organizations hold differing opinions on the optimal fuel types for powering medium and heavy-duty vehicles. However, it is generally agreed that the electrification of these vehicles with battery power will progress more slowly than that of light-duty vehicles.

The electrification of Oakville's municipal transit system is expected to introduce a significant load to the OH grid in the coming years, with current estimates projecting a 16 MW peak demand. OH is fully prepared to support this increased demand by integrating on-site energy storage and on-site generation into the electrical grid. This strategic approach ensures a reliable and efficient power supply for the electrified transit system, highlighting OH's capability and commitment to facilitating a smooth transition to sustainable public transportation.

Building Electrification

The electrification of building heating, cooling and hot water systems is a significant driver of electricity demand. Transitioning from fossil fuel-based systems to electric heat pumps and other energy-efficient technologies is encouraged through incentives and regulations aimed at reducing greenhouse gas emissions. In Ontario, building codes and retrofit programs are supporting the adoption of these technologies in residential, commercial, and industrial buildings.

The impact of building electrification on the electricity grid will be driven by policy, economic, and sustainability factors. Building electrification is expected to significantly contribute to winter peaking grids in Ontario. The 2024 IESO Annual Planning Outlook forecast anticipates a winter peak around 2045, whereas the IESO Pathways to Decarbonization forecast predicts a more aggressive transition to winter peaks by 2029. According to OH's current system load forecast, the trend indicates a continuation of summer peaks within the forecast horizon.

Within OH's load forecast, electrification of water heating is a contributor to peak demand, as customers replace traditional gas systems with electrified alternatives. OH forecasts that electric hot water heating will contribute 7%-10% of electricity demand growth in Oakville by 2050.

Distributed Energy Resources (DERs)

Integrating DERs such as solar panels, wind turbines, and battery storage systems enhances grid resilience, supports renewable energy adoption, and provides customers with more energy choices.

DERs refers to energy resources that are directly connected to the electricity distribution system, or indirectly connected behind a customer's meter. Behind the meter refers to connections on the customer premises. DERs generate electricity, store energy or control load. DERs can be both larger, grid scale resources, or smaller customer scale resources.

Figure 12: Types of DER

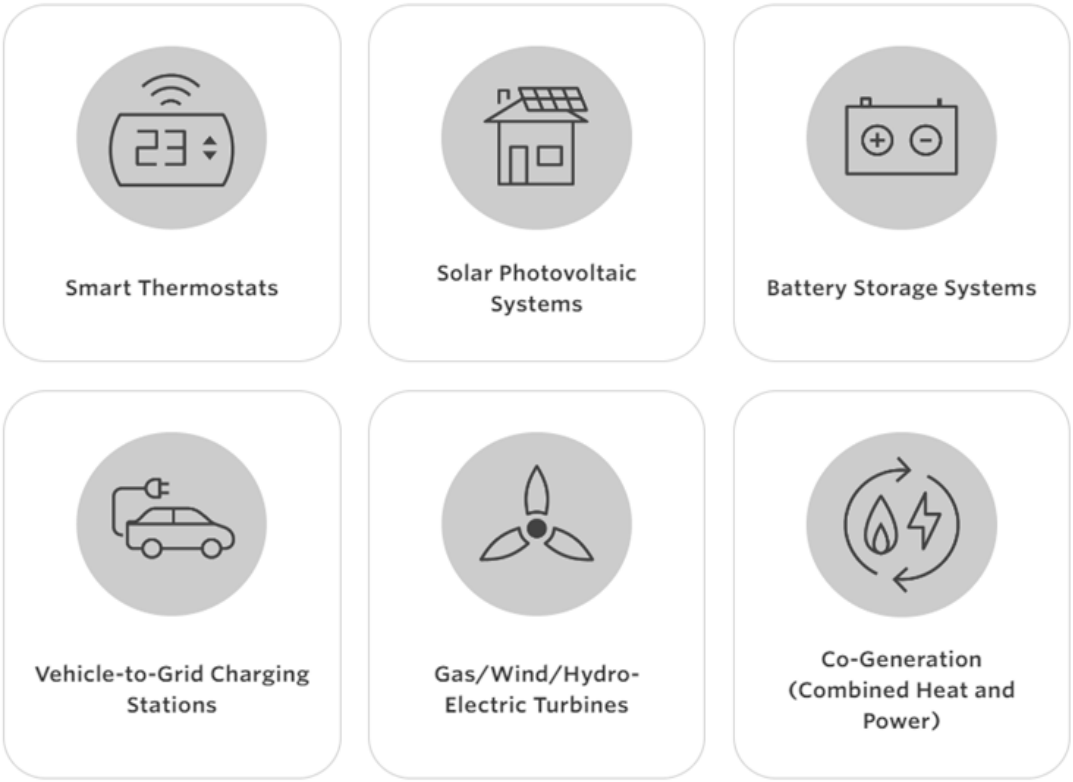
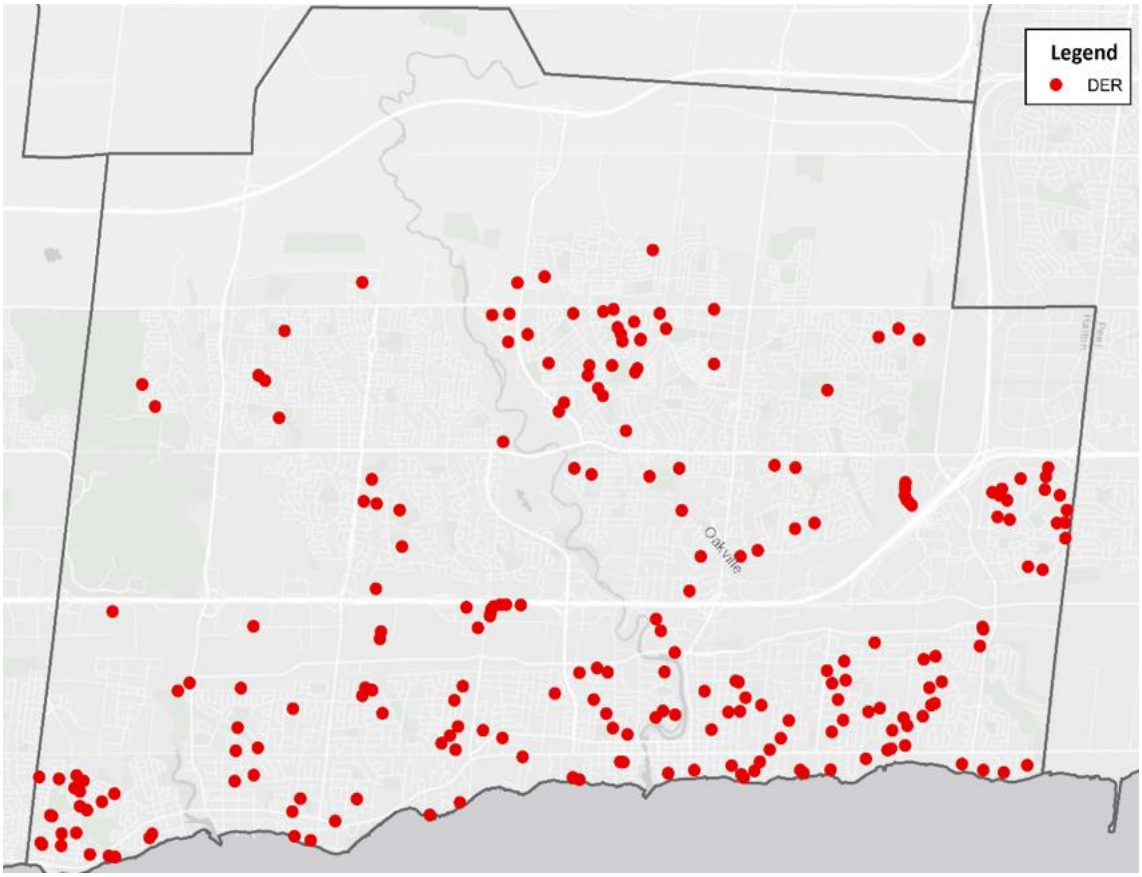


Figure 13: DER- Locations in Oakville



Ontario has over 10,000 MW of deployed DER capacity. Locally, Oakville boasts approximately 4 MW of installed DER capacity, representing just over 1% of the Town's electricity peak. Customers are increasingly turning to DERs to manage energy costs and engage in sustainability initiatives. There are over 200 individual generators in Oakville, predominantly consisting of residential solar rooftops, with the map below spatially illustrating DERs throughout Oakville.

OH's load forecast scenarios estimate DERs to generate 5%-14% of system peak by 2050. This would increase DER generation 500% to 2,500%, which is the equivalent of adding 2,500 to 10,600 residential solar arrays (10kW) within the Town.

Decarbonization of Tools and Equipment

There is an ongoing shift towards electrification in various sectors, including construction, manufacturing, and agriculture. Electrifying tools and equipment not only reduce carbon emissions but also enhances operational efficiency and safety.

Industrial electrification, including the adoption of electric arc furnaces in steel production and new electric vehicle battery factories, is set to drive substantial electricity demand growth in the province's industrial sector, with IESO predicting net annual energy demand increasing by over 50 % by 2050.

OH collaborates closely with commercial and industrial customers to identify opportunities for decarbonizing tools and equipment. Some examples of projects where OH has supported these customer initiatives include:

- → Installation of air source heat pumps and geo-exchange systems
- → Upgrades to injection molding machines
- → Installation of EV charging stations for fleet and customer use
- → Implementation of battery energy storage for peak reduction
- → Upgrades to industrial chillers
- → Replacement of glycol boilers with electric boilers
- → Upgrades to air compressors

Heat pumps installed at Oakville Place

Digitization and Automation of Manufacturing

The manufacturing sector is undergoing a digital transformation, where automation, robotics, and data-driven processes are becoming the norm. This shift towards Industry 4.0, characterized by smart factories and advanced manufacturing technologies, is heavily reliant on a stable and substantial electricity supply. Automation and digitization require a continuous power supply for robotics, computer systems, and data management tools, significantly increasing electricity consumption in this sector.

Given the current scale of OH's industrial and manufacturing sector, the direct impact of decarbonization of tools and equipment, and digitization and automation on overall electricity demand may not be as significant as in regions with a larger industrial base. However, as manufacturing processes continue to evolve and embrace new technologies, OH continues to monitor this evolution to ensure the grid can support these advancements effectively.

OH Electrification Strategy

OH's Electrification Strategy presents a thorough and forward-thinking plan to integrate electrification into all facets of OH's operations. This strategy is designed to address the evolving energy landscape, marked by increased adoption of EVs, electrification of building heating, and DERs. By updating system planning, modernizing grid operations, refining design practices, and strengthening customer engagement, OH aims to enhance and optimize the grid to ensure it remains resilient, efficient, and sustainable in meeting the future demands of the Oakville community. OH's approach not only focuses on technical upgrades and infrastructure improvements but also emphasizes the importance of empowering customers with the knowledge and tools they need for their electrification journey. This comprehensive strategy ensures that OH remains a leader in the transition to a clean energy future, fostering sustainable growth and development within the community.

System Planning

Objective: To adapt to evolving energy demands through accurate load forecasting that includes EV adoption, electric space and water heating, DERs, and most recent community growth projections

Actions:

- → Updating long term load forecasting to include grid impacts of electrification and community growth
- → Identifying feeder level constraints and evaluating alternatives to upgrading poles and wires infrastructure, known as non-wires alternatives
- → Developing tailored plans for constrained areas, ex. non-wires alternatives, battery energy storage

Impact: These measures aim to enhance the resilience and efficiency of the local energy system, ensuring it can meet future demands and support community-wide electrification efforts.

Grid Operations

Objective: To modernize grid operations to support increased electrification and improve data collection and analysis capabilities.

Actions:

- → Enhancing system modelling capabilities to optimize system automation
- → Developing and implementing a smart meter replacement plan to enhance data collection and functionality
- → Planning for utility transformation to a distribution system operator model, where utilities manage energy flows to optimize electricity market performance

Impact: These initiatives are intended to optimize grid performance, meet the increasing demands of electrification, and deliver high-quality service to customers through enhanced operational insights.

Design Practices

Objective: To review and update design standards and practices in light of electrification and climate change.

Actions:

- → Finalizing secondary equipment and design standards to ensure readiness for electrification
- → Evaluating the long-term impacts of electrification and climate change on design practices

Impact: The focus is on ensuring that infrastructure design aligns with electrification goals and is resilient to the impacts of climate change, ultimately supporting sustainable community development.

Customer

Objective: To engage and support customers through their electrification journey, making the utility an information hub for electrification.

Actions:

- → Planning for a growing community
- → Leveraging online platforms to provide tools and information on electrification, creating an electrification information hub
- → Continue to evaluate opportunities for partnerships and engage stakeholders
- → Establishing the utility as an electrification information hub
- → enhancing customer service representative training on electrification topics.

Impact: These efforts aim to empower customers with the knowledge and resources needed for electrification, promoting sustainable energy use within the community.

Customer Growth – Ontario and Oakville

Ontario's population is projected to grow significantly, with an expected increase of nearly 15%, or two million people, by the end of this decade. This surge in population necessitates the construction of 1.5 million new homes to accommodate the influx (Source: Powering Ontario's Growth). Such growth not only underscores the province's attractiveness as a place to live but also highlights the critical need for reliable and sufficient electricity to support this expanding populace. As more households are established, there will be a corresponding rise in electricity consumption to meet the demands for heating, cooling, and powering an increasing number of electric vehicles, emphasizing the urgency for infrastructure development and energy planning.

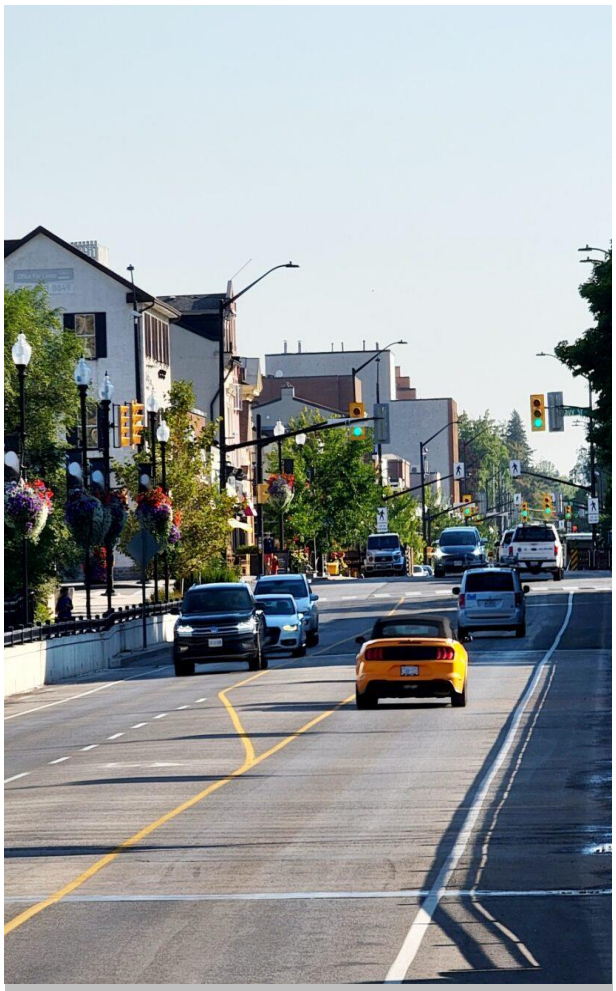
Oakville's community growth and correlating electrification initiatives will be impactful on the provincial and local grids. This section of the report highlights Oakville's population and demographic trends, projected growth rates, and the implications the local electricity grid. Strategic investments in grid infrastructure are necessary to support this growth and ensure reliable service.

Oakville Community Growth

Oakville is poised for remarkable growth in the coming decades, as highlighted in the Halton Region Joint Best Planning Estimates Update Report. This substantial expansion is set to transform the community, doubling the population and significantly increasing housing and employment opportunities. When reviewing population projections for the Halton region, the Ministry of Finance forecast is approximately 15-20% lower compared to the Best Planning Estimates forecast.

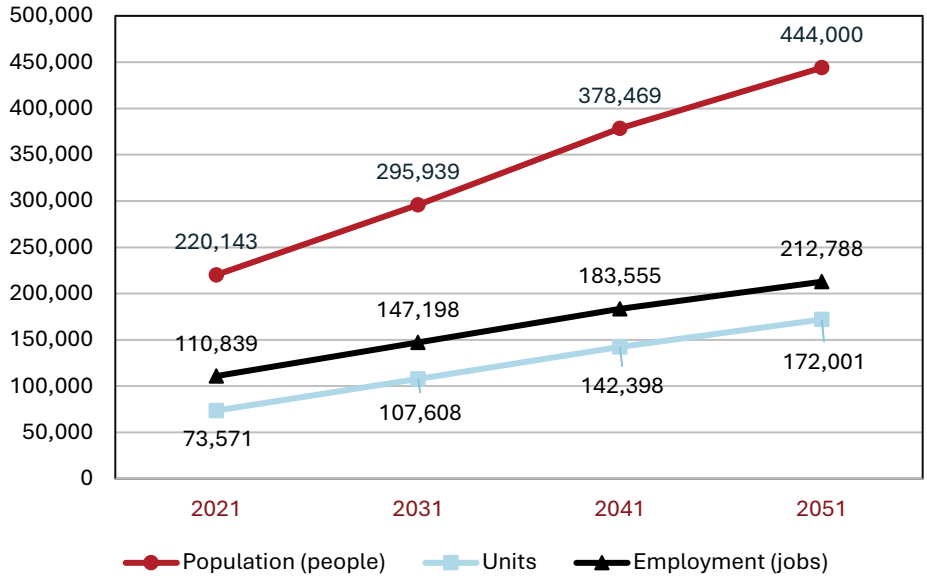
Key Oakville projections include the following increases through 2051,

- → Population increases from 220,000 to 444,000
- → Average annual population growth rate of 2.3%
- → Increase in housing units from 73,500 to 172,000
- → Employment growth from 110,000 to 213,000 jobs
- → 72% of population growth in Strategic Growth Areas
- → Community growth is the largest demand contributor in OH's load forecast, accounting for 57%-70% of electricity demand growth by 2050



Oakville's population is projected to grow significantly, with an expected doubling of population by 2050

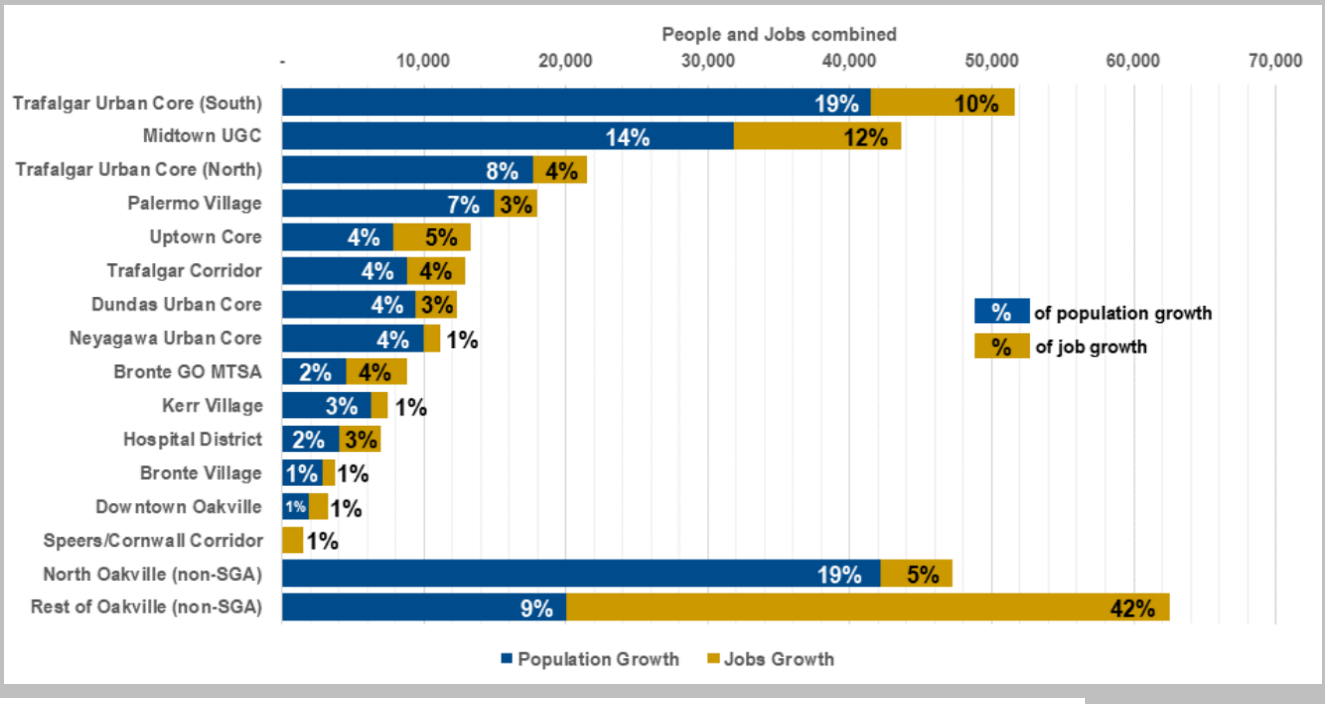
Figure 14: Oakville Population and Employment Forecast



Source: Update Report – Halton Region, Joint Best Planning Estimates, August 15, 2023

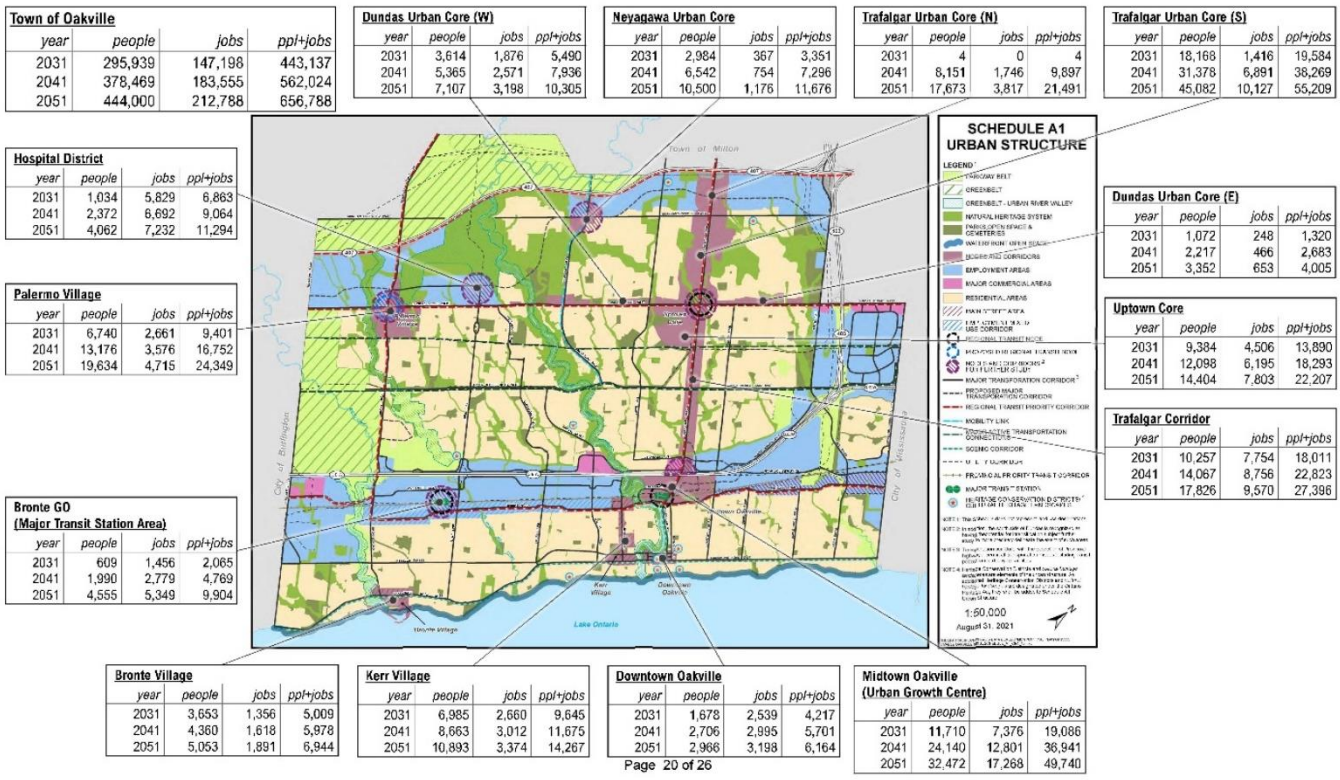
Areas for significant population increases include Strategic Growth Areas (SGAs), such as Midtown Oakville, Bronte Major Transit Station Area, Uptown Core, and various Urban Cores which are expected to accommodate a significant portion of the population increase. The distribution of employment growth is concentrated in both SGAs and existing employment corridors such as the QEW West Employment area and North Oakville Employment zones.

Figure 15: Oakville Growth Distribution Summary by Strategic Growth Area, 2021 To 2051



Source: Update Report – Halton Region, Joint Best Planning Estimates, August 15, 2023

Figure 16: Town of Oakville Strategic Growth Areas



Town of Oakville

year	people	jobs	ppl+jobs
2031	295,939	147,198	443,137
2041	378,469	183,555	562,024
2051	444,000	212,788	656,788

Dundas Urban Core (W)

year	people	jobs	ppl+jobs
2031	3,614	1,876	5,490
2041	5,365	2,571	7,936
2051	7,107	3,198	10,305

Neyagawa Urban Core

year	people	jobs	ppl+jobs
2031	2,984	367	3,351
2041	6,542	754	7,296
2051	10,500	1,176	11,676

Trafalgar Urban Core (N)

year	people	jobs	ppl+jobs
2031	4	0	4
2041	8,151	1,746	9,897
2051	17,673	3,817	21,491

Trafalgar Urban Core (S)

year	people	jobs	ppl+jobs
2031	18,168	1,416	19,584
2041	31,378	6,891	38,269
2051	45,082	10,127	55,209

Hospital District

year	people	jobs	ppl+jobs
2031	1,034	5,829	6,863
2041	2,372	6,692	9,064
2051	4,062	7,232	11,294

Palermo Village

year	people	jobs	ppl+jobs
2031	6,740	2,661	9,401
2041	13,176	3,576	16,752
2051	19,634	4,715	24,349

Bronte GO (Major Transit Station Area)

year	people	jobs	ppl+jobs
2031	609	1,456	2,065
2041	1,990	2,779	4,769
2051	4,555	5,349	9,904

SCHEDULE A1
URBAN STRUCTURE

Dundas Urban Core (E)

year	people	jobs	ppl+jobs
2031	1,072	248	1,320
2041	2,217	466	2,683
2051	3,352	653	4,005

Uptown Core

year	people	jobs	ppl+jobs
2031	9,384	4,506	13,890
2041	12,098	6,195	18,293
2051	14,404	7,803	22,207

Trafalgar Corridor

year	people	jobs	ppl+jobs
2031	10,257	7,754	18,011
2041	14,067	8,756	22,823
2051	17,826	9,570	27,396

Bronte Village

year	people	jobs	ppl+jobs
2031	3,653	1,356	5,009
2041	4,360	1,618	5,978
2051	5,053	1,891	6,944

Kerr Village

year	people	jobs	ppl+jobs
2031	6,985	2,660	9,645
2041	8,663	3,012	11,675
2051	10,893	3,374	14,267

Downtown Oakville

year	people	jobs	ppl+jobs
2031	1,678	2,539	4,217
2041	2,706	2,995	5,701
2051	2,966	3,198	6,164

Midtown Oakville (Urban Growth Centre)

year	people	jobs	ppl+jobs
2031	11,710	7,376	19,086
2041	24,140	12,801	36,941
2051	32,472	17,268	49,740

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Source: Update Report – Halton Region, Joint Best Planning Estimates, August 15, 2023

Impact on Local Electricity Distribution Grid

The substantial increase in both population and employment will place additional demand on Oakville's electricity distribution grid. The anticipated growth, particularly in the SGAs, will necessitate significant enhancements and expansions of the existing grid infrastructure to accommodate the increased electricity consumption. Key impacts include:

Increased Load: The doubling of the population and employment will significantly increase the electricity load. Increased load requires careful planning to ensure that the grid can handle peak demand times, especially in densely populated areas such as Midtown.

Infrastructure Upgrades: There will be a need for reinforcing and upgrading existing infrastructure as well as building new feeders and other major asset investments to ensure reliable power supply. Infrastructure upgrades are particularly important in the SGAs, where high-density development will occur.

Smart Grid Technologies: To efficiently manage the increased demand and ensure stability, integrating smart grid technologies will be crucial. These technologies can help in load management, outage detection and distribution automation.

Renewable Energy Integration: With the emphasis sustainability, integrating renewable energy sources such as solar and wind into the grid will be essential. This integration also includes the installation of energy storage systems to manage intermittent energy supply.

Electrification: The transition towards electrification of various sectors, including transportation, heating and industrial processes, will have a profound impact on the local electricity distribution grid.

As Oakville continues its trajectory of substantial growth, the implications for the local electricity distribution grid are considerable. The anticipated surge in population and employment underscores the need for strategic infrastructure investments and the integration of advanced technologies to support increased demand. OH is committed to proactively addressing these challenges by upgrading and expanding the grid, incorporating smart technologies and facilitating renewable energy integration. These efforts are crucial to ensuring that Oakville's electricity distribution system remains reliable, resilient and capable of meeting the evolving needs of a rapidly growing community.

Climate Resilience

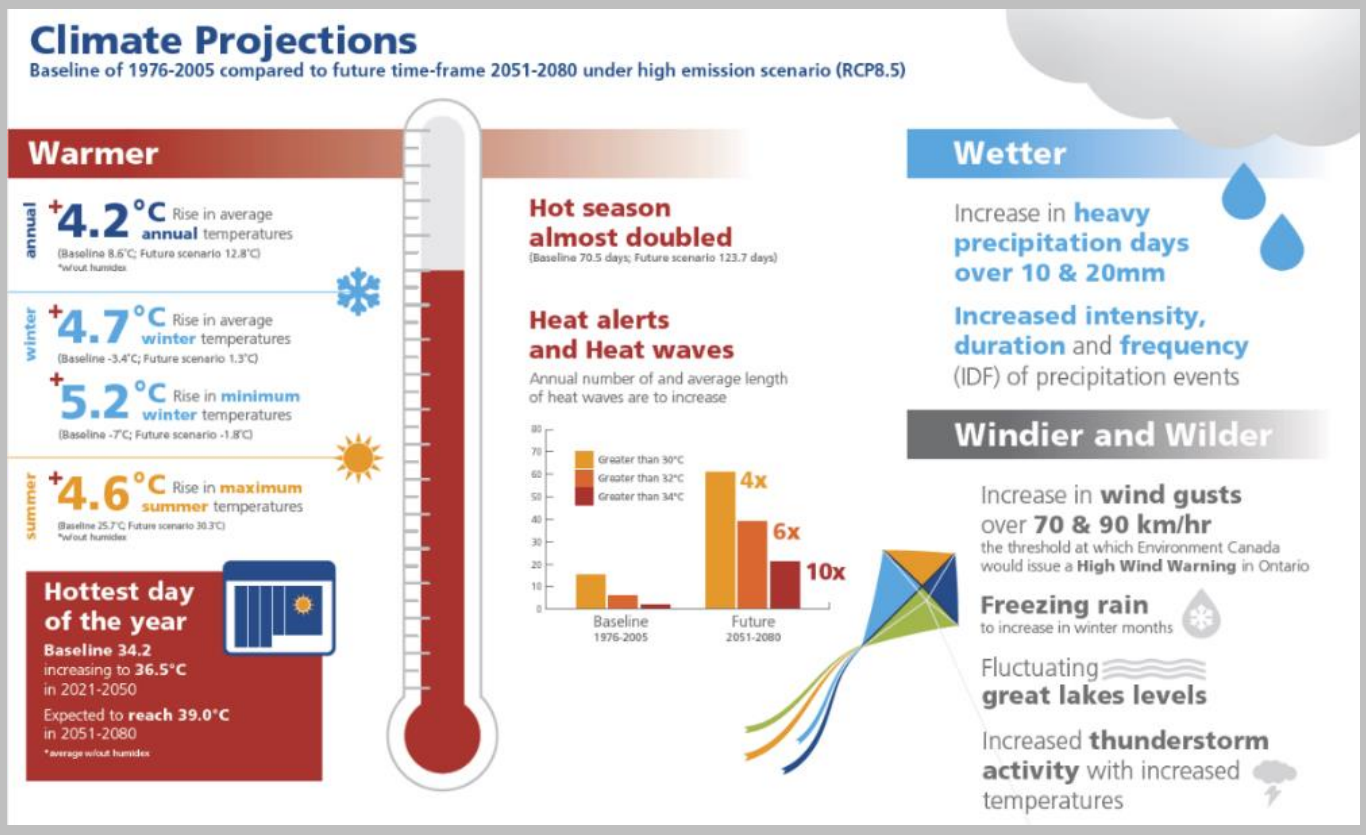
Building climate resilience into electricity grid infrastructure is essential to handle the impacts of extreme weather events. Building climate resilience involves upgrading the grid, integrating DERs, and adopting smart grid technologies to enhance OH's ability to respond to and recover from climate-related disruptions. OH is committed to enhancing the climate resilience of its infrastructure, ensuring a reliable electricity supply amid increasing electrification. In OH 's load forecast, extreme weather is projected to account for 4%-9% of electricity demand growth in Oakville by 2050.

The Town of Oakville's Climate Emergency Declaration Progress Report (June 2021) highlights climatic changes that pose risk to the community, including,

- Elevated projections for hottest day of the year
- Extended hot season
- Increasing heat alerts and heat waves
- Increase in heavy precipitation days
- Increase in high-speed wind gusts
- Increasing freezing rain

These climatic changes underscore the need for a resilient energy infrastructure capable of withstanding and quickly recovering from extreme weather events

Figure 17: Climatic Changes that Pose the Greatest Risk to the Community and Corporation of Oakville



Source: Climate Projections Report – Town of Oakville

Design Standards

In 2022, the Canadian Standards Association (CSA) updated its electricity distribution standards to address the increasing risks posed by climate change. These updates enhance the resilience of both overhead and underground systems against extreme weather events, and other climate-related challenges. OH has adopted or exceeds all CSA climate change enhancements.

OH's enhancements to design standards to strengthen climate resilience include,

- → Smart grid technologies & system automation: implementing technologies that enable real-time monitoring and automated rapid response to disruptions
- → Flood risk resilience: enhancing resiliency against flood risk by prioritizing padmount over submersible equipment applications
- → Overhead design modelling: utilizing more detailed weather load cases for overhead design through non-linear structural analysis
- → Underground distribution standards: for greenfield projects, OH utilizes underground distribution standards with padmount equipment
- → Vegetation Management: maintaining designated clearances around energized power lines, structures, and equipment is crucial for system reliability. OH's rotational vegetation management program enhances safety, reduces power outages, and improves overall power quality.

Underground vs. Overhead Infrastructure

The choice between underground and overhead lines is carefully evaluated, taking into account factors such as affordability, reliability, resilience, and customer preferences. While underground lines can be more resilient to weather-related disruptions, they are also more expensive to install and maintain. In the event of storm damage, repairing underground infrastructure can be more costly and more time-consuming compared to overhead emergency restorations. Overhead lines, while generally less expensive to install, can be more vulnerable to weather-related outages. In a recent survey regarding OH investments, customers ranked burying overhead lines in the lower 50% of priority planning items.

For greenfield development, OH utilizes underground distribution standards with padmount equipment to increase resiliency for the local area to weather-related disruptions. For areas with existing overhead infrastructure, the electricity rate impacts of undergrounding would be significant and redirect investments away from priority system needs. Estimates vary by project, however, costs to relocate express feeder systems underground can range between $10,000 to $15,000 per metre, 6 to 8 times more costly than rebuilding with overhead assets.

Responsiveness

Ensuring rapid response capabilities to minimize disruptions during adverse weather conditions involves enhancing operational readiness and coordination with emergency services. OH is investing in advanced monitoring and control systems to detect and address issues swiftly, minimizing downtime and ensuring a stable electricity supply. In 2023, over 940,000 outage minutes were avoided due to OH's advanced levels of automation and system control. OH has deployed fault location, isolation, service restoration (FLISR) automation across the 27.6kV network, enabling automated restoration plans to be developed immediately following an outage event.

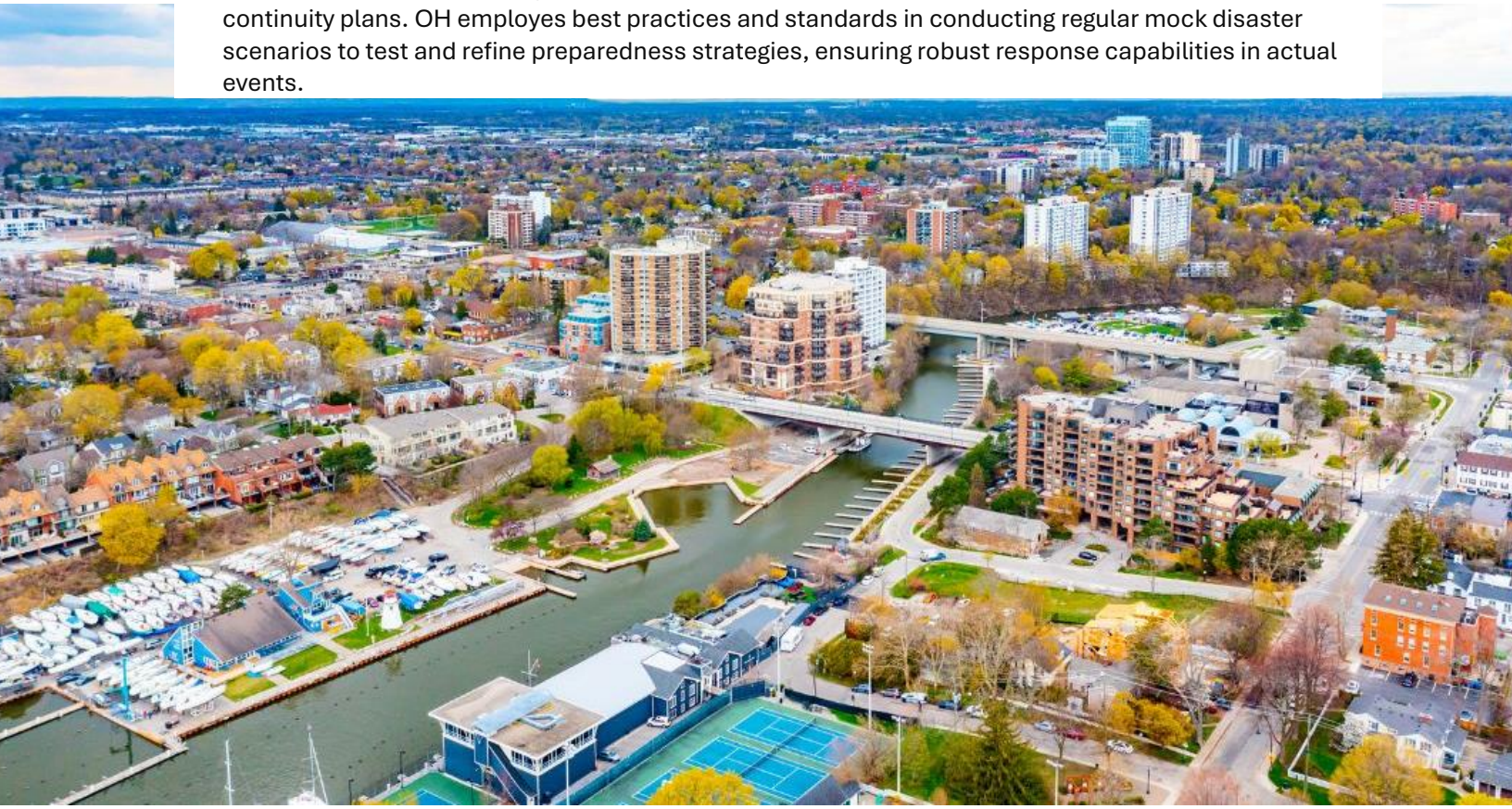
OH is dedicated to increasing its responsiveness to climate events through several key programs:

- → Storm preparedness and response: OH takes a proactive stance by deploying a dedicated storm response team to initiate preparations when impactful weather events are forecasted. This preparation ensures swift and efficient response to minimize service disruptions.
- → Mutual aid groups: OH is an active participant in provincial and Canadian mutual aid groups. Maintaining mutual aid group memberships ensures that, in the event of infrastructure damage exceeding local capabilities, resources and support can be swiftly mobilized from external sources to aid in restoration efforts.

- Outage management system: utilizing supervisory control and data acquisition (SCADA) and advanced metering infrastructure (AMI), OH monitors and controls energy flows throughout the electrical network.

- Smart grid technologies & system automation: implementing advanced technologies, OH enables real-time monitoring and automated rapid responses to service disruptions.

- Business continuity planning: OH is committed to the continuous improvement of its business continuity plans. OH employes best practices and standards in conducting regular mock disaster scenarios to test and refine preparedness strategies, ensuring robust response capabilities in actual events.



Customer

Outage Communications

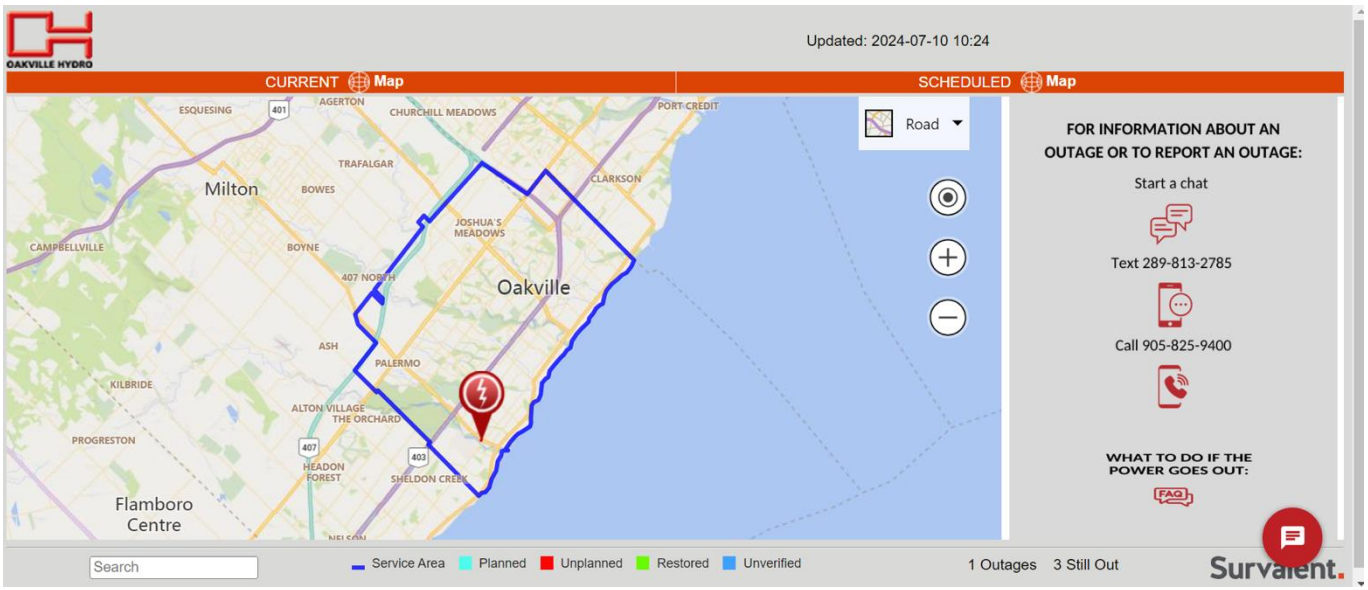
OH prioritizes not only the swift restoration of power during outages but also effective communication, ensuring that customers are well-informed about efforts to address service interruptions and are provided with timely updates on restoration progress.

When outages occur, OH's dedicated team works diligently to restore power as quickly and safely as possible. Recognizing that communication during these times is equally important, OH has implemented several initiatives aimed at keeping customers informed and supported throughout the outage restoration process.

Outage Map and Real-Time Updates

Customers can access the Outage Map, which provides real-time updates on service interruptions. This interactive tool allows customers to view the status of outages, estimated restoration times, and the areas affected. The Outage Map is accessible through the website and mobile app, ensuring customers have easy access to the latest information at their fingertips.

Figure 18: Oakville Hydro Outage Map



Outage Alerts Program

In 2024, OH deployed a new program that allows customers to subscribe to receive outage alerts via email or text message. By subscribing to this service, customers will receive immediate notifications when their service experiences an outage. Additionally, they will be alerted once power has been restored. This program is designed to provide peace of mind and keep customers informed about the status of their electricity service in real-time.

Enhanced Customer Support

During outages, OH's customer support team is available to answer questions and assist. A strong commitment to maintaining open lines of communication ensures that customers feel supported. Representatives are trained to provide accurate information and updates, helping to alleviate concerns and provide clarity on restoration efforts.

Proactive Communication Initiatives

In addition to real-time updates, OH is enhancing proactive communication strategies, including regular updates on the website, social media channels, and direct communication through email newsletters. These efforts aim to educate customers about outage preparedness, safety tips, and the steps being taken to improve climate resilience and response capabilities.

Social Media Engagement

OH actively utilizes social media platforms to communicate with customers when outages occur. Through platforms like X, Facebook, and LinkedIn, OH provides timely updates on outage status, restoration progress, and safety information. Social media allows OH to reach a broad audience quickly, ensuring that customers receive essential information as soon as possible.

In summary, OH's comprehensive approach to customer communication and support during outages underscores a strong commitment to climate resilience. By leveraging advanced tools like the Outage Map, deploying an outage alerts program, enhancing customer support, engaging on social media, and improving proactive communication efforts, OH strives to keep customers informed, safe, and supported during service interruptions.

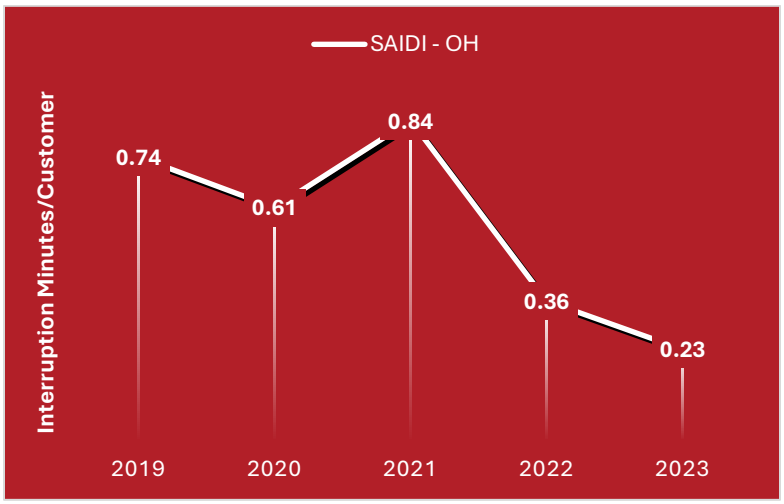
Reliability

OH recognizes that reliability is a top priority for customers, especially as the demands of electrification continue to evolve. Strategic investments in smart grid technologies, advanced asset management practices, and proactive maintenance programs have played a crucial role in achieving exceptional reliability metrics. These efforts underscore a commitment to providing consistent, dependable service, positioning OH as an industry leader in grid reliability and customer satisfaction.

Electric utilities assess system reliability using two key indices that provide important insights into the consistency and stability of electricity service,

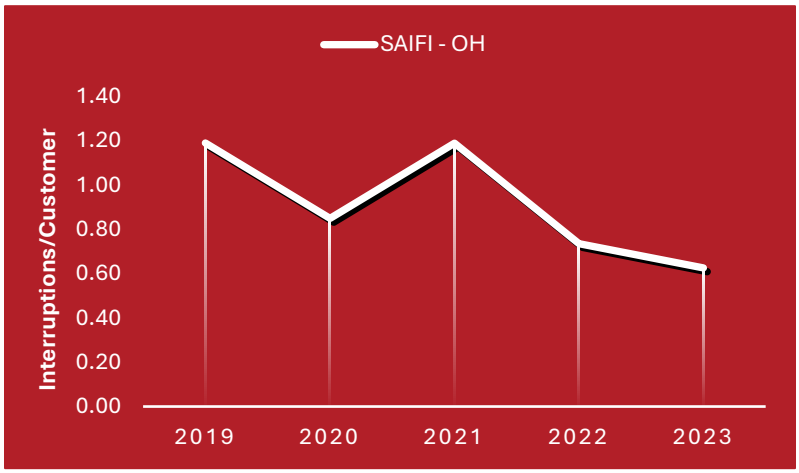
→ The System Average Interruption Duration Index (SAIDI) represents how long the average customer experiences an outage. Lower SAIDI, outage minutes, equates to improved electric reliability. OH's 5-year SAIDI results indicate a downward (positive) trend.

Figure 19: System Average Interruption Duration Index (SAIDI)



→ The System Average Interruption Frequency Index (SAIFI) is the average number of sustained interruptions per customer during the year. Lower SAIFI, outage frequency, equates to improved electric reliability. OH's 5-year SAIDI results indicate a downward (positive) trend.

Figure 20: System Average Interruption Frequency Index (SAIFI)



When assessing reliability to comparator groups, OH's reliability results are excellent when compared to Halton LDCs and GridSmartCity utilities. Lower values represent better performance.

Figure 21: OH SAIDI vs Comparator Group (2023)

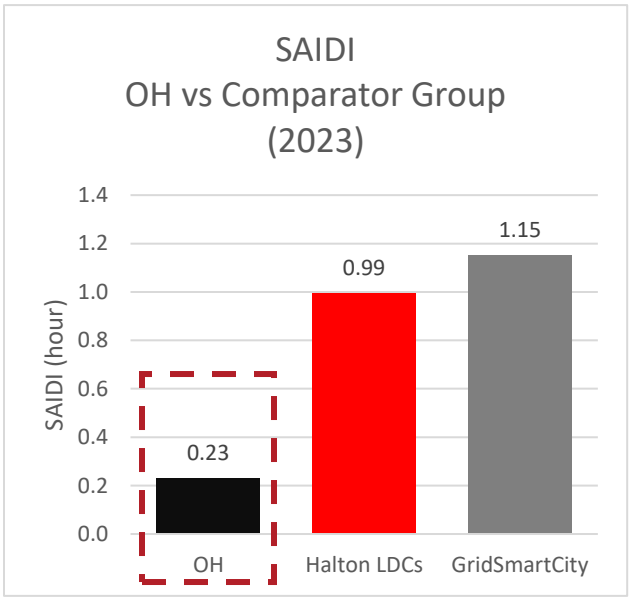
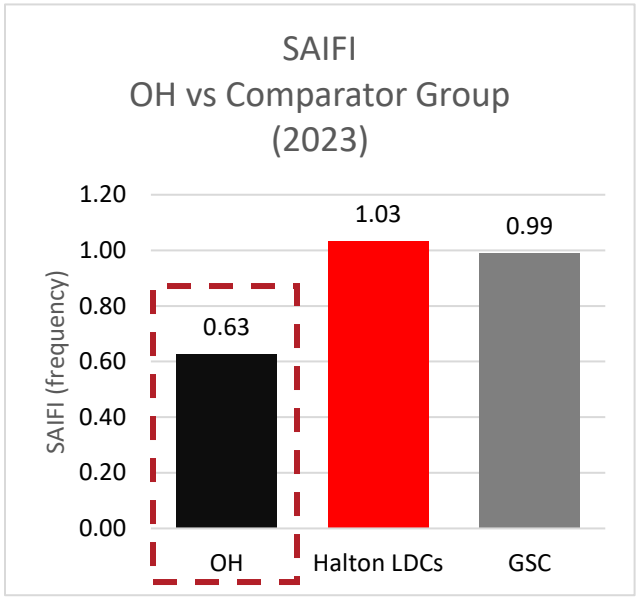


Figure 22: OH SAIFI vs Comparator Group (2023)



Affordability

Community growth and electrification initiatives will necessitate investments in the distribution grid, smart technologies, systems, personnel, and supporting infrastructure. OH is committed to ensuring that grid evolution due to energy transformation occurs in a cost-effective manner, with affordability being a key factor in the decision-making process.

As the transition to increased electricity demand and the necessary infrastructure investments are made to ensure the grid remains reliable and capable of meeting future demands, electricity rates are anticipated to rise. Investments will be implemented strategically to manage costs effectively and support sustainable growth. Oakville Hydro forecasts the following impact on rates (monthly service charge):

- → 30-60% increase in rates by 2050 (excluding inflation)
- → 1-2% average annual growth in rates by 2050 (excluding inflation)
- → High community growth and electrification scenarios result in lower increase in rates

Key Strategies for Maintaining Affordability

Optimizing Capital Investments

OH's Distribution System Plan (DSP) outlines a strategic approach to capital investments that prioritizes the renewal of deteriorating assets, meeting service obligations, customer preferences, and technological innovation. By carefully planning and prioritizing investments, OH aims to extend the life of existing assets and minimize the need for costly replacements. Projects are justified based on risk mitigation, leading to a portfolio that maximizes value and is informed by risk assessments.

Enhancing Operational Efficiency

OH has implemented numerous efficiency improvements, such as fee for service, proactive maintenance and replacement programs, that reduce reactive maintenance costs and improve service reliability. These initiatives help avoid sudden rate spikes and distribute costs more evenly over time. **The fee for service model delivers operational efficiencies through the provision of professional back-office services.** The integration of Geographic Information Systems (GIS) and the asset management planning system, Engin, improves asset management and operational efficiency, enhancing decision-making and cost control.

Leveraging Technology and Innovation

Investments in grid modernization, including SCADA-controlled switches, line monitoring, and Fault Location Isolation Sectionalization Restoration (FLISR) systems, enhance the reliability and efficiency of the distribution system. These technologies help reduce outage times and operational costs, leading to improved service for customers.

The deployment of automated switching capabilities and the enhancement of the Outage Management System (OMS) improve response times and reduce the impact of outages, further contributing to cost savings and reliability enhancements.

Adapting to Climate Change

Proactive measures to adapt to climate change, such as storm hardening techniques and the relocation of vulnerable equipment, help mitigate the financial risks associated with extreme weather events. These investments protect the infrastructure and reduce long-term costs.

Public and Worker Safety

Investments that enhance public and worker safety are prioritized, ensuring that the distribution system is not only reliable but also safe. This focus helps prevent costly incidents and maintains OH's reputation within the community.

Customer Engagement and Preferences

OH actively engages with its customers to understand their preferences and incorporates their feedback into planning processes. Customers have consistently ranked the delivery of electricity at a reasonable price as their top priority, followed by maintaining reliability. These preferences are integral to shaping OH's investment and operational strategies

Conservation

The current IESO Conservation and Demand Management Framework (2021-2024) emphasizes centralized program delivery. LDCs contribute to this model by supporting program rollouts and facilitating customer engagement. OH's Key Account program works with large customers to select centralized programs that may work for them, and support customers in submissions of CDM plans.

Affordability Programs

OH offers programs and incentives to help customers manage their energy usage and costs. These programs are designed to promote energy efficiency and conservation, reducing overall consumption and lowering bills. Current programs include,

- Electricity price plans – time-of-use (TOU), Ultra-Low Overnight (ULO) and tiered prices
- Industrial Conservation Initiative (ICI)

- Low-Income Energy Assistance Program (LEAP)
- Ontario Electricity Support Program (OESP)

Customer Priorities (Survey Results)

OH values customer feedback and conducts annual customer satisfaction surveys to understand and prioritize customer preferences and expectations. Insights gained from these surveys play a crucial role in shaping asset management and investment strategies. In a recent survey, customers identified the following top ten priorities:

1. Investing in the Electricity Grid
2. Reducing Response Times to Outages
3. Weather Resilience and Infrastructure
4. Preventing Data Breaches and Cybersecurity
5. Supporting Increased Electrification
6. Education and Customer Communication
7. Vegetation Management
8. Environmental Impact
9. Safety and Expertise
10. Digital and Communication Enhancements

OH integrates this valuable feedback into its asset management and investment prioritization planning. By aligning strategies with customer priorities, investments are optimized to deliver maximum value, enhance reliability and resiliency, and support the sustainable growth of the community.

Evolving Needs

Customer needs are continually evolving, driven by changes in technology, societal trends, and individual expectations. To effectively serve the community, OH monitors these shifts and proactively adapts.

Increasing Demand for Electrification

As more customers adopt electric vehicles (EVs) and incorporate renewable energy solutions such as solar panels, the demand for electricity is expected to rise significantly. OH invests in infrastructure upgrades and expands system capacity to accommodate the growing load.

Advanced Energy Management

Customers are becoming more energy-conscious and are seeking advanced tools to manage their consumption. There is a rising demand for smart home technologies, real-time energy monitoring, and usage analytics. OH is investing in smart meter technology and customer-facing platforms that provide detailed energy insights and support efficient energy use, such as Green Button.

Reliability and Resilience

With the increasing frequency of extreme weather events and the critical role of electricity in daily life, customers expect a reliable and resilient power supply. OH is focused on enhancing grid reliability through proactive maintenance, weather resilience initiatives, and automated systems to minimize outages and ensure quick restoration of services.

Personalized Customer Service

Customers expect personalized and responsive service that meets their unique needs. OH is enhancing its customer service capabilities through digital channels, personalized communication, and streamlined processes that improve customer satisfaction and engagement.

Sustainability

Sustainability is a growing customer priority, and OH is committed to a more sustainable future. As part of this commitment, OH continues to hold the “Sustainable Electricity Leader” designation awarded by Electricity Canada. The Sustainable Electricity Leader designation, launched by Electricity Canada, recognizes electricity companies in Canada that demonstrate a strong commitment to sustainability.

Sustainable Electricity Program

Trends

To effectively plan, OH monitors and analyzes trends that impact the energy sector and the customer base. Understanding these trends allows OH to anticipate changes, adapt strategies, and ensure the continued ability to meet customer needs.

Technological Advancements

Rapid advancements in technology are transforming the energy landscape. Innovations in grid management, renewable energy integration, and energy storage are creating new opportunities for efficiency and sustainability. OH continues to invest in technology and automation to enhance electrical service and enhance the customer experience.

Electrification of Transportation

The shift towards electric vehicles is gaining momentum, driven by environmental concerns and advancements in EV technology. This trend is increasing electricity demand and necessitating investments in charging infrastructure and grid capacity. OH is proactively planning for this shift to support widespread EV adoption in the community.

Decentralization and DERs

The traditional centralized energy model is evolving towards a more decentralized system with the rise of DERs such as rooftop solar panels, wind turbines, and energy storage systems. This trend is reshaping the grid and requires new approaches to integration, management, and regulatory frameworks. OH is developing strategies to incorporate DERs effectively into the distribution network and transition to a distribution system operator (DSO) model.

Growth of Data Centers

The proliferation of data centers, fueled by the exponential growth of cloud computing, big data, and the Internet of Things (IoT), represents a driver of increased electricity demand. Data centers are notoriously energy-intensive, requiring significant and constant power supplies to maintain their operations, cooling systems, and redundancy capabilities. Data centers not only demand high levels of reliable electricity but also require robust backup systems and uninterruptible power supplies. The establishment of new data centers within the jurisdiction, could have a profound impact on the local grid.

Despite the increasing demand for data center capacity across the province, OH has not yet been approached by any data center operators seeking to establish facilities within its service area. This contrasts with other utilities in Ontario that have seen significant interest from this sector. The substantial power requirements of data centers, which often necessitate a consistent and large-scale electricity supply, may exceed the capacity of distribution-level services. As a result, these facilities typically require transmission-connected services to meet their demands reliably.

Regulatory and Policy Changes

The energy sector experiences continuous regulatory and policy changes aimed at promoting sustainability, grid modernization, and consumer protection. OH actively monitors these developments to ensure compliance and capitalize on opportunities to improve services and infrastructure.

Consumer Expectations

Customer expectations are evolving towards greater transparency, engagement, and convenience. There is a growing demand for digital solutions, real-time information and proactive communication. OH is enhancing customer engagement strategies to meet these expectations and deliver exceptional service.

Power Quality Impacts of Electrification

Electrification brings numerous benefits; however, it also presents challenges related to power quality that must be addressed to ensure the reliability and efficiency of the electricity grid. Power quality impacts of electrification primarily stem from increased demand, the integration of renewable energy sources, and the proliferation of electric vehicles (EVs). This section outlines the key power quality issues associated with electrification.

Increased Demand and Load Variability

The transition to electric heating, cooling, and transportation significantly increases electricity demand. Higher load, particularly during peak times, can cause:

- → Voltage fluctuations: increased demand can lead to variations in voltage levels, potentially causing damage to sensitive equipment and reducing the efficiency of electrical appliances
- → Increased losses in the distribution network: higher current flows can increase resistive losses, reducing overall efficiency and increasing operational costs

Integration of Renewable Energy Sources

The increased penetration of DERs introduces variability and intermittency in power generation. These fluctuations can cause:

- → Voltage sags and swells: variations in generation can lead to temporary drops or increases in voltage levels, affecting the performance of electrical devices
- → Harmonic distortions: non-linear loads associated with renewable energy systems can introduce harmonics, leading to interference with other electrical equipment and potential damage over time

Electric Vehicle Charging

The widespread adoption of EVs introduces new power quality challenges, particularly related to charging infrastructure. Rapid and high-power charging can lead to:

- → Localized voltage drops: high demand from EV chargers can cause significant drops in voltage, impacting nearby customers and equipment
- → Harmonic distortions: EV chargers can introduce harmonic currents into the grid, affecting power quality and potentially causing overheating of equipment
- → Increased thermal stress on transformers: frequent and high-power charging can lead to higher temperatures in transformers, reducing their lifespan and reliability

Harmonics and Power Factor Issues

Non-linear loads, such as EV chargers, LED lighting, and variable-speed drives, can introduce harmonics into the power system, leading to:

- → Overheating of equipment: harmonic currents can cause excessive heating in transformers, motors, and other equipment, leading to premature failures
- → Mis-operation of protective devices: harmonics can interfere with the operation of relays and circuit breakers, compromising the protection system
- → Reduced efficiency: harmonics can increase losses in the system, reducing overall efficiency and increasing operational costs.

Power Quality Monitoring and Management Challenges

Maintaining high power quality standards in an electrified grid requires continuous monitoring and management. Challenges include:

- → Real-time data acquisition: ensuring real-time data collection and analysis to promptly identify and address power quality issues
- → Customer awareness and engagement: educating customers about the impacts of their energy usage on power quality and promoting practices that mitigate these impacts

As OH progresses towards a more electrified future, addressing these power quality challenges is crucial to maintaining a reliable and efficient electricity supply. The current state of electrification has not introduced these power quality challenges on the grid, however, OH is enhancing awareness and monitoring. Understanding these impacts is the first step in developing effective strategies to mitigate them and ensure the stability and resilience of the grid.

Investment Outlook

OH's investment outlook focuses on initiatives to support capital planning, grid modernization, network expansion and enabling technology.

Capital Planning

Capital planning at OH is an integral process that ensures alignment with strategy, business planning, asset management program, customer needs, and regulatory compliance. Electrification and energy transformation scenarios impact capital planning, necessitating strategic investments to meet increased demand, integrate new technologies, and ensure grid reliability and resilience.

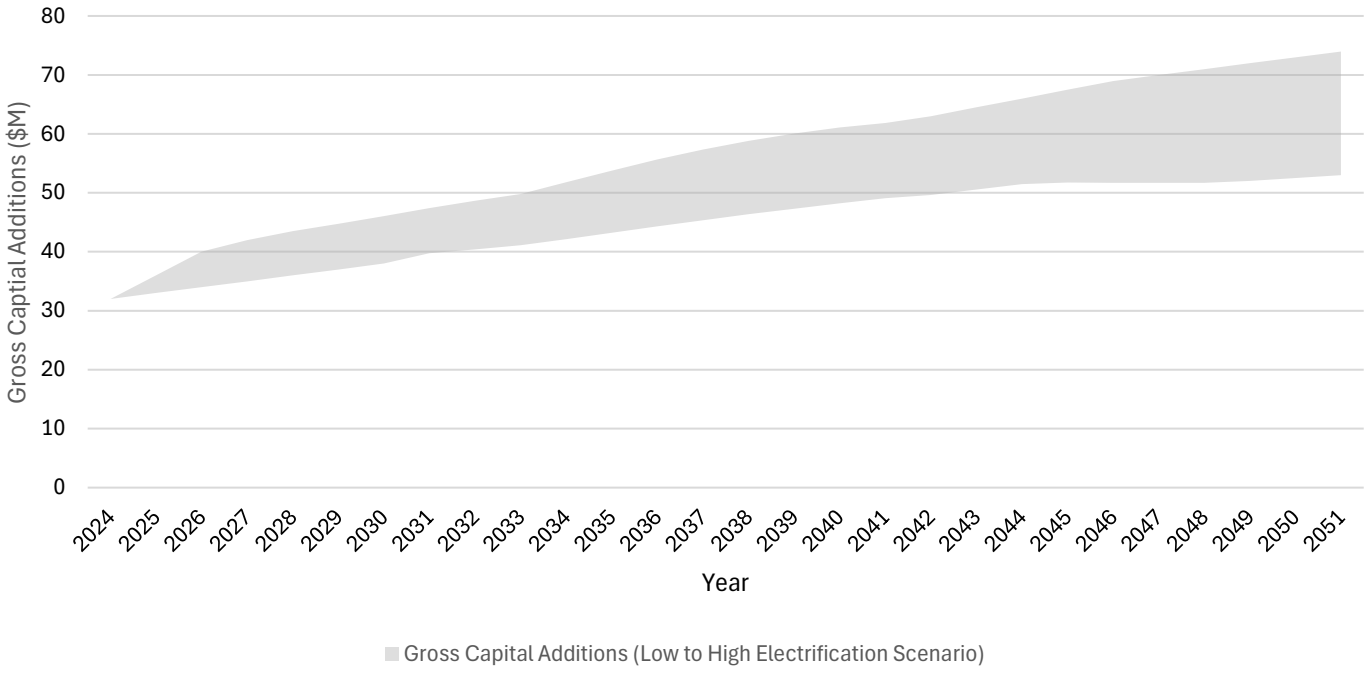
Investment Needs

The Electricity Distributors Association's (EDA) "Solving Grid-Lock" vision paper projects that Local Distribution Companies (LDCs) will experience a significant increase in annual spending on gross capital additions, ranging from a 45% increase in a moderate electrification scenario to a 130% increase under a net-zero scenario by 2050. In total, expenditures in distribution systems across the province are estimated to be between $103 to $120 billion between 2024 and 2050.

The vision paper also highlights the relationship between demand and capital investments, estimating that each megawatt (MW) of non-coincident demand within LDC service areas requires annual capital additions of roughly $0.1 million. Applied to Oakville Hydro's load forecast scenarios through 2050, this methodology suggests:

- → Gross capital additions are expected to increase by 65% to 130%
- → An average annual increase ranging between 1.4% and 2.3%
- → $1.2 billion to $1.5 billion of total capital additions through 2050

Figure 23: OH Gross Annual Capital Additions



Forecasted capital additions include traditional investments in system growth, customer service enhancements, asset renewal projects, automation and technology enhancements and general plant investments, plus impacts of accelerated customer growth and electrification. Based on the electrification scenario, these incremental investments may include,

- New transformer station construction
- Substation upgrades
- Voltage conversions
- New and upgraded distribution lines
- Grid modernization
- Energy storage systems
- Conservation programs
- EV charging infrastructure
- Load management solutions
- New technology innovations

These projections underscore the significant financial investments needed to support Oakville Hydro's journey towards increased electrification.

Resourcing

As OH navigates energy transformation, the skills and capabilities of the workforce will be paramount in ensuring the successful implementation of electrification strategies. The evolving energy landscape demands a workforce equipped with advanced technical knowledge, adaptability, and a commitment to excellence.

Current Workforce Skills and Capabilities

OH's workforce has a strong foundation of skills and capabilities that have enabled the delivery of reliable and efficient electricity services. The current workforce possesses expertise in:

- → Electrical engineering: critical for designing, maintaining, and optimizing the distribution network
- → Project management: essential for overseeing infrastructure projects and ensuring they are completed on time and within budget
- → Customer service: key to maintaining high levels of customer satisfaction and effectively managing customer inquiries and concerns
- → Regulatory compliance: ensuring adherence to industry standards and regulations, which is crucial for operational legitimacy and safety
- → Operational technology: managing and operating the technology that supports the grid, including SCADA/OMS systems and advanced metering infrastructure
- → Cybersecurity: with the rise of digital infrastructure, protecting systems from cyber threats is paramount

The skills and capabilities of the workforce are paramount in ensuring the successful implementation of electrification strategies.

Emerging Workforce Skills and Capabilities

The transition to a more electrified and technologically advanced grid necessitates the development of new skills within the workforce.

- Digital proficiency: as more advanced digital technologies are integrated into operations, proficiency in software and data analytics becomes increasingly important
- DER management: understanding and managing DERs, including solar panels, battery storage, and electric vehicles will be critical as these resources become more prevalent
- Advanced data analytics: utilizing data analytics to optimize grid performance, predict maintenance needs, and improve customer service
- Climate resilience planning: developing strategies and skills to enhance the grid's resilience against extreme weather events and climate change impacts
- DSO (Distribution System Operator) functions: new roles related to managing the increasingly complex grid dynamics, including:
    - DER forecasting: skills in predicting and planning for the integration of DERs into the grid
    - DER Operation and Dispatch: capabilities to operate and dispatch DERs efficiently, ensuring they are effectively integrated and utilized
    - Local markets management: managing local energy markets to balance supply and demand within the distribution network
    - T-D (Transmission-Distribution) coordination: enhancing coordination between Hydro One, IESO and OH systems to ensure seamless operation and reliability

Focusing on developing emerging skills and capabilities will ensure that OH's workforce is well-prepared to meet the challenges of the energy transition and continue delivering exceptional service to customers.

Supply Chain

The supply chain is a critical component of OH's ability to deliver reliable and efficient electricity services, particularly during the transition to a more electrified and technologically advanced grid. Ensuring the availability of necessary materials, equipment, and technologies is essential for the successful implementation of electrification strategies.

Current State of Supply Chain

OH's supply chain is robust, supporting ongoing operations and infrastructure projects. Relationships have been established with a network of reliable suppliers, ensuring timely delivery of essential components such as transformers, switchgear, cables, and advanced metering infrastructure. Procurement processes are designed to maintain high standards of quality, value and compliance with industry regulations.

Challenges in the Supply Chain

The evolving energy landscape presents several challenges for the supply chain:

- Increased demand for materials: as electrification efforts accelerate, the demand for electrical components and advanced technologies is rising, potentially leading to supply shortages and increased lead times, often forcing planning horizons to expand
- Global supply chain disruptions: factors such as geopolitical instability, natural disasters, and pandemics can disrupt global supply chains, affecting the availability and cost of critical materials
- Technological advancements: the rapid pace of technological change necessitates continuous adaptation of the supply chain to source and integrate the latest innovations
- Sustainability requirements: OH’s commitment to sustainability requires a continuous review of the impact of its supply chain

Supply Chain Initiatives

To address these challenges and enhance supply chain resilience, OH is implementing several strategic initiatives:

- → Supplier diversification: expanding the supplier base to include a broader range of vendors
- → Collaborative partnerships: strengthening partnerships with key suppliers and industry stakeholders, such as GridSmartCity, to enhance collaboration, purchasing power, innovation, and supply chain transparency
- → Risk management: identification of potential supply chain risks and implement proactive measures to mitigate their impact
- → Critical equipment planning: developing longer term planning and procurement requirements for critical and long lead time equipment

By focusing on these areas, OH aims to build a more resilient and efficient supply chain capable of supporting objectives and ensuring the successful transition to a sustainable and electrified future.

Key Takeaways and path Forward

As OH looks to the future, several key takeaways guide the approach to ensuring the community is well-prepared for the challenges and opportunities presented by electrification and growth.

Key Takeaways:

- → Significant investments: substantial investments in infrastructure, safety, technology, and people will be necessary to support the growing demands of an electrified community. These investments are critical to maintaining the reliability and resilience of the grid.
- → Advanced load forecasting: advanced forecasts will ensure that the grid is well-prepared to meet future demand as the community continues to grow and embrace electrification
- → Continuous monitoring and updates: ongoing monitoring of peak demand and regular updates to load forecasts are essential to adapting to changes in energy consumption patterns and staying ahead of potential challenges
- → Preparation for an electrified future: OH is focused on preparing for an electrified future by enhancing infrastructure, adopting smart technologies, improving customer engagement, and integrating renewable energy sources

Path forward

Moving forward, OH will continue to focus on investments and initiatives that are aligned with the long-term needs of the community. These investments include advancing grid modernization efforts, expanding network capacity and deploying enabling technologies that will support a more efficient, resilient and sustainable energy system.

OH maintains a proactive approach to risk management, ensuring that infrastructure investments are not only necessary but also timely and cost-effective. Collaboration with regional planners, stakeholders, and the community will be key to aligning efforts with broader energy goals and ensuring that strategies are responsive to both local and provincial needs.

OH is well-positioned to lead the community into an electrified future. By staying focused on strategic priorities, continuously adapting to changing conditions, and making smart investments, OH will ensure that the community's energy needs are met with reliability, sustainability and customer satisfaction at the forefront.

Connecting Communities Through Sustainable Solutions

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