

# Nova Scotia Utility and Review Board

IN THE MATTER OF *The Public Utilities Act*, R.S.N.S. 1989, c.380, as amended

## 2024 Load Forecast Report

April 30, 2024

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**Attachments (Electronic Only)**

- Attachment 1: Residential Intensities
- Attachment 2: Commercial Small General Intensities
- Attachment 3: Commercial General Intensities
- Attachment 4: 10-Year Forecast Classes (Partially Confidential)
- Attachment 5: Residential Model Inputs & Outputs
- Attachment 6: Small General Model
- Attachment 7: General Demand Model
- Attachment 8: Small Industrial Model
- Attachment 9: Medium Industrial Model
- Attachment 10: Peak Model Inputs

**Appendices**

- Appendix A: 2024 NS Power Forecast
- Appendix B: Forecast Model Details
- Appendix C: Forecast Comparison (Partially Confidential)
- Appendix D: Forecast Sensitivity (Partially Confidential)
- Appendix E: Stakeholder Presentation

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**1.0 EXECUTIVE SUMMARY**

In accordance with the Nova Scotia Wholesale Electricity and Renewable to Retail Market Rules, Nova Scotia Power Incorporated (NS Power, the Company) is required to provide the Nova Scotia Utility and Review Board (NSUARB, Board) with its 10-year energy and demand forecast by the end of April each year for the 10-year period beginning in the following January (Load Forecast).

The 2024 Load Forecast provides an outlook on the energy and peak demand requirements of in-province customers for the period 2024 to 2034. In addition, it describes the considerations, assumptions, and methodology used in the preparation of the forecast. The Load Forecast provides the basis for the planning and overall operating activities to serve customer load.

The Load Forecast is based on analyses of sales history, weather, end-use saturations and efficiencies, economic indicators, customer surveys, technological and demographic changes in the market, and the availability of other energy sources.

As with any forecast, there is a degree of uncertainty around actual future outcomes. In electricity forecasting, much of this uncertainty is due to the impact of variations in weather, energy efficiency program effectiveness, the health of the economy, government policy, the impact of electrification, changes in large customer loads, the number of electric appliances and end-use equipment installed, and changes in technology.

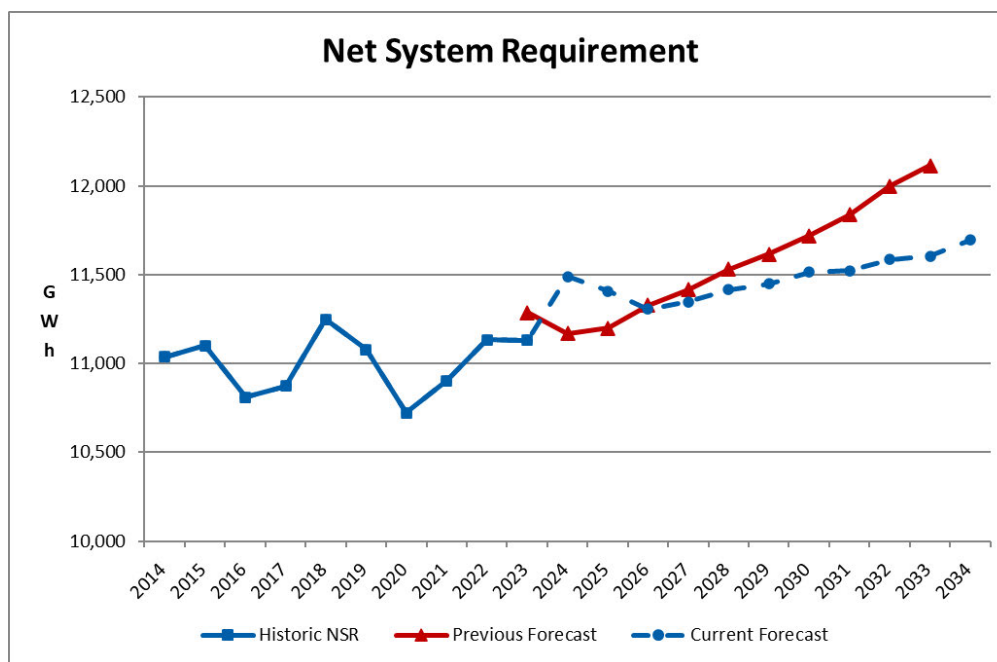
NS Power continues to use and refine Statistically Adjusted End-Use (SAE) models to forecast load for the residential and commercial rate classes. The SAE models explicitly incorporate end-use energy intensity projections into the Load Forecast. End-use energy forecasts derived from the residential and commercial SAE models are then combined with an econometric-based industrial forecast and customer specific forecasts for NS Power's

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large customers to develop an energy forecast for the province, also referred to as the Net System Requirement (NSR).

Compared to the 2023 Load Forecast, the 2024 Load Forecast shows higher growth in the near term due to more new customer additions and higher average use when adjusted for weather in 2023. Mid- to long-term growth is driven by sustained customer growth, Electric Vehicle (EV) sales, though estimated EV sales are lower than in 2023 due to the federal zero-emissions vehicle sales targets applying only at the national level, not the provincial level. Sales through the Renewable to Retail (RTR) market will reduce load in the 2025-2026 timeframe by approximately 250 GWh. In the long term, energy sales will be reduced by Demand Side Management (DSM) initiatives and natural energy efficiency improvements outside structured DSM programs, as well as increased behind-the-meter small scale solar installations. The net result is a forecast average annual increase of 0.2 percent. Annual historic and forecast NSR are shown below in **Figure 1**.

**Figure 1: Historical and Predicted Annual Net System Requirement**



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In addition to annual energy requirements, NS Power forecasts system peak demand. Customer growth, electrification of heating and increased EV sales will increase the peak, while DSM and DR activities will reduce the peak. Compared to 2023, the near-term peak forecast is higher due to increased impact from electric heating loads, while in the long term the peak forecast is reduced due to lower EV sales and adoption of a hybrid heating scenario in alignment with Nova Scotia's Clean Power Plan and NS Power's Evergreen IRP. As a result, the system peak demand is expected to increase at an average of 1.4 percent annually over the forecast period, as shown in **Figure 2**.

**Figure 2: Historical and Predicted Annual System Peak**

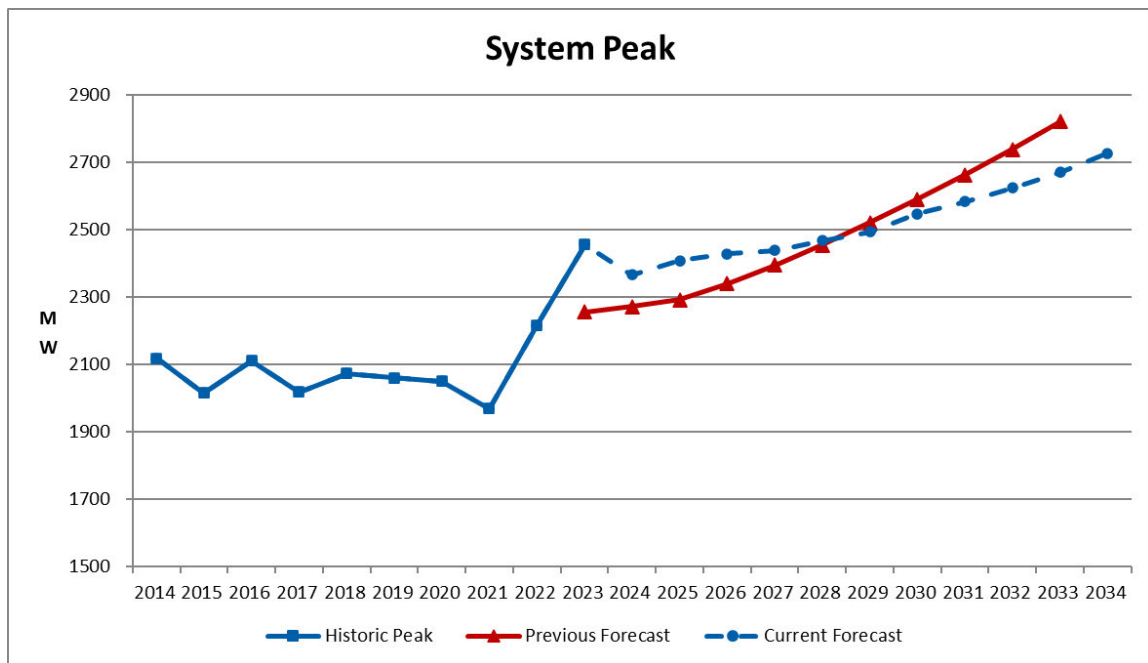


**Figure 3** below shows the changes to system load and system peak over the historic and forecast periods.

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**Figure 3: Historic and Forecast Net System Requirement and System Peak**

| <b>Year</b> | <b>NSR (GWh)</b> | <b>Growth (%)</b> | <b>System Peak (MW)</b> | <b>Growth (%)</b> |
|-------------|------------------|-------------------|-------------------------|-------------------|
| 2014        | 11,037           | -1.4              | 2,118                   | 4.2               |
| 2015        | 11,099           | 0.6               | 2,015                   | -4.9              |
| 2016        | 10,809           | -2.6              | 2,111                   | 4.8               |
| 2017        | 10,873           | 0.6               | 2,018                   | -4.4              |
| 2018        | 11,250           | 3.5               | 2,073                   | 2.7               |
| 2019        | 11,077           | -1.5              | 2,060                   | -0.6              |
| 2020        | 10,723           | -3.2              | 2,050                   | -0.5              |
| 2021        | 10,902           | 1.7               | 1,968                   | -4.0              |
| 2022        | 11,134           | 2.1               | 2,216                   | 12.6              |
| 2023        | 11,131           | 0.0               | 2,455                   | 10.8              |
| 2024F       | 11,490           | 3.2               | 2,365                   | -3.7              |
| 2025F       | 11,409           | -0.7              | 2,408                   | 1.8               |
| 2026F       | 11,306           | -0.9              | 2,428                   | 0.8               |
| 2027F       | 11,347           | 0.4               | 2,437                   | 0.4               |
| 2028F       | 11,416           | 0.6               | 2,466                   | 1.2               |
| 2029F       | 11,448           | 0.3               | 2,493                   | 1.1               |
| 2030F       | 11,514           | 0.6               | 2,547                   | 2.2               |
| 2031F       | 11,523           | 0.1               | 2,583                   | 1.4               |
| 2032F       | 11,585           | 0.5               | 2,623                   | 1.5               |
| 2033F       | 11,605           | 0.2               | 2,670                   | 1.8               |
| 2034F       | 11,695           | 0.8               | 2,727                   | 2.1               |

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2.0 INTRODUCTION

NS Power annually develops a forecast of energy sales and peak demand requirements to assess the effects of end-use and economic factors on the future power system load and load shape. The forecast is a foundational input to the overall planning, budgeting and operating activities of the Company. Produced in the winter of 2023-2024 and using information available at the time, this forecast covers the period of 2024-2034. Unless otherwise noted, reported average annual growth rates are for the 2024-2034 period.

In 2023, the NSUARB initiated a paper hearing process to review the 2023 Load Forecast Report.<sup>1</sup> The Consumer Advocate (CA), the Small Business Advocate (SBA), the Industrial Group (IG), EfficiencyOne (E1), and Eastward Energy (EE) registered and took part as intervenors. In addition, Board Counsel engaged Synapse Energy Economics (Synapse) to review and provide a report on NS Power's 2023 Load Forecast.

Following NS Power's response to Information Requests (IRs), filing of evidence by intervenors and Board Counsel and Reply Evidence by NS Power, the Board issued its Decision respecting NS Power's 2023 Load Forecast. The Board noted that "NS Power has agreed to many of the intervenors' recommendations and acknowledges this commitment towards continuous improvement of the Load Forecast."<sup>2</sup> The Board further stated as follows:

The Board directs NS Power to proceed with implementing the recommendations it has agreed to in the next Load Forecast report, including:

- the IRP, SGNS, AMI, TVP Pilot outcomes;
- reviewing the assumptions applied in the model to reduce carbon emissions; and,
- assessing the historical load of survey sales realization, to compare how the historical load compares with the survey results.

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<sup>1</sup> NSUARB Hearing Order, 2023 Load Forecast Report (M11108), May 2, 2023.

<sup>2</sup> Nova Scotia Power Inc. 2023 Load Forecast Report, UARB Decision, November 7, 2023, page 6 (M11108).

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1 In addition to the above directives, the Board encourages NS Power to  
2 include information on each of the following in future load forecasts:

- 3
- 4 • Evaluate the elasticity used in the SAE model with the elasticity  
5 estimation from the TVP Pilot EM&V in matter M11267 and assess if  
6 the results provide a more robust model.
  - 7 • Evaluate the input variables in the residential model and test, over a  
8 period of time, if alternative inputs make the residential model more  
9 robust, considering the following:  
10
    - 11 ○ Given the continued population growth in Nova Scotia and  
12 ongoing housing shortage, re-evaluate the use of housing  
13 completions for the near-term.
    - 14 ○ Consider incorporating household size and age of household  
15 residents, to determine if a better understanding on demand load  
16 by time of day is achieved.
    - 17 ○ Revisiting the short-term economic inputs provided by the  
18 Conference Board of Canada to ensure the data is close to what  
19 is used in the forecasts of Canada's major Banks.
    - 20 ○ Revisit the model's EV adoption rates to ensure that the model's  
21 inputs are in keeping with the data reported by Statistics Canada  
22 and Nova Scotia Open data.
    - 23 ○ With respect to the status of large infrastructure projects, NS  
24 Power is encouraged to maintain communications with those  
25 customers to ensure system adequacy.

26 //

27  
28 The Board expects NS Power to continue exploring all realistic scenarios  
29 related to commercial hydrogen production and, where there is sufficient  
30 data, incorporate them to the extent possible, in load forecast modelling.

31  
32 The Board notes that there is a significant variance between the 2022  
33 forecast and the actual Net System Requirement of 234 GWh. This variance  
34 has been attributed to the COVID-19 pandemic and heat pump installations,  
35 which are confounding factors during a year of warm weather. The Board  
36 finds that given the size of the unexplained variance, this category needs to  
37 be revisited. NS Power is encouraged to consider the following potential  
38 effects on load:

- 39
- 40 • cooling demand during the summer months;
  - 41 • increased demand from customers upgrading the electrical capacity of  
42 their homes to accommodate heat pumps and large back-up generators;  
43 and,
  - 44 • any other factors that NS Power considers a driver to increased  
45 electricity demand in the residential class.
-

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1 The Board directs NS Power to examine the 2022 unexplained variance and  
2 report on its findings in the 2024 Load Forecast Report.<sup>3</sup>  
3

4 In accordance with the Board's direction, NS Power revised and enhanced the 2024 Load  
5 Forecast in the following manner:  
6

- 7 • The EV forecast has been updated to reflect the fact that the federal zero-emission  
8 vehicle (ZEV) mandate applies only at the national level, not provincial. Please  
9 refer to **Section 4.4**.
- 10 • In line with the Evergreen IRP the hybrid electrification scenario for building heat  
11 is now integrated into the forecast and is discussed in **Section 4.4**.
- 12 • A summary of the Smart Grid and Demand Response projects is provided in  
13 **Sections 4.4 and 10**.
- 14 • A discussion of the economic inputs, including housing completions and median  
15 income, is provided in **Section 4.3**.
- 16 • The potential impact of the proposed hydrogen production facilities is provided as  
17 a scenario in **Appendix D**.
- 18 • An analysis of the residential forecast variance for 2022 and 2023 is provided in  
19 **Section 5.0**.  
20

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<sup>3</sup> Ibid, pages 6-7 (M11108).

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**Summary of Stakeholder Consultations**

On April 11, 2024, NS Power conducted a stakeholder session by videoconference with representatives of the NSUARB, the Consumer Advocate (CA), the Small Business Advocate (SBA), the Industrial Group (IG), EfficiencyOne (E1) and Eastward Energy. The agenda and presentation materials are included in **Appendix E**. The NS Power Load Forecast team discussed the following changes to the 2024 Load Forecast:

- Updated building heating assumptions;
- Updated electric vehicle (EV) forecast;
- E3 hybrid heating scenario;
- Renewable to retail impact on the forecast;
- Updated assumptions around small-scale solar;
- Class level trends;
- Variance of prior forecast to actuals; and
- Discussion of ongoing forecasting work.

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**3.0 FORECASTING APPROACH**

NS Power continues to use a set of SAE models for the Residential<sup>4</sup> and Commercial<sup>5</sup> rate classes, an econometric model for the Small and Medium Industrial classes, and customer surveys and historical data for the Large Industrial<sup>6</sup> customer classes.

The SAE model is a hybrid of the econometric and end-use methodologies, incorporating economic and end-use forecast variables into one model. An end-use model is a bottom-up approach that estimates the energy consumption of a customer group by summing the energy usage of all the appliances and equipment used by those customers. End-use forecasts are driven by trends in appliance usage and efficiency trends for that equipment. An econometric model describes the historical relationship between electricity consumption and independent economic indicators on provincial economic forecasts as a method to forecast future electricity sales.

The SAE model variables explicitly incorporate end-use saturation and efficiency projections, as well as changes in population, economic conditions, price, and weather. End-use efficiency projections include the expected impact of new standards and naturally occurring efficiency gains (efficiency improvements such as improvements in underlying technology that are not explicitly incentivized). In the long term, both economics and structural changes drive energy and demand growth. Structural changes are captured in the residential forecast model through the SAE model specifications. **Figure 4** shows the general forecast approach used in the SAE models.

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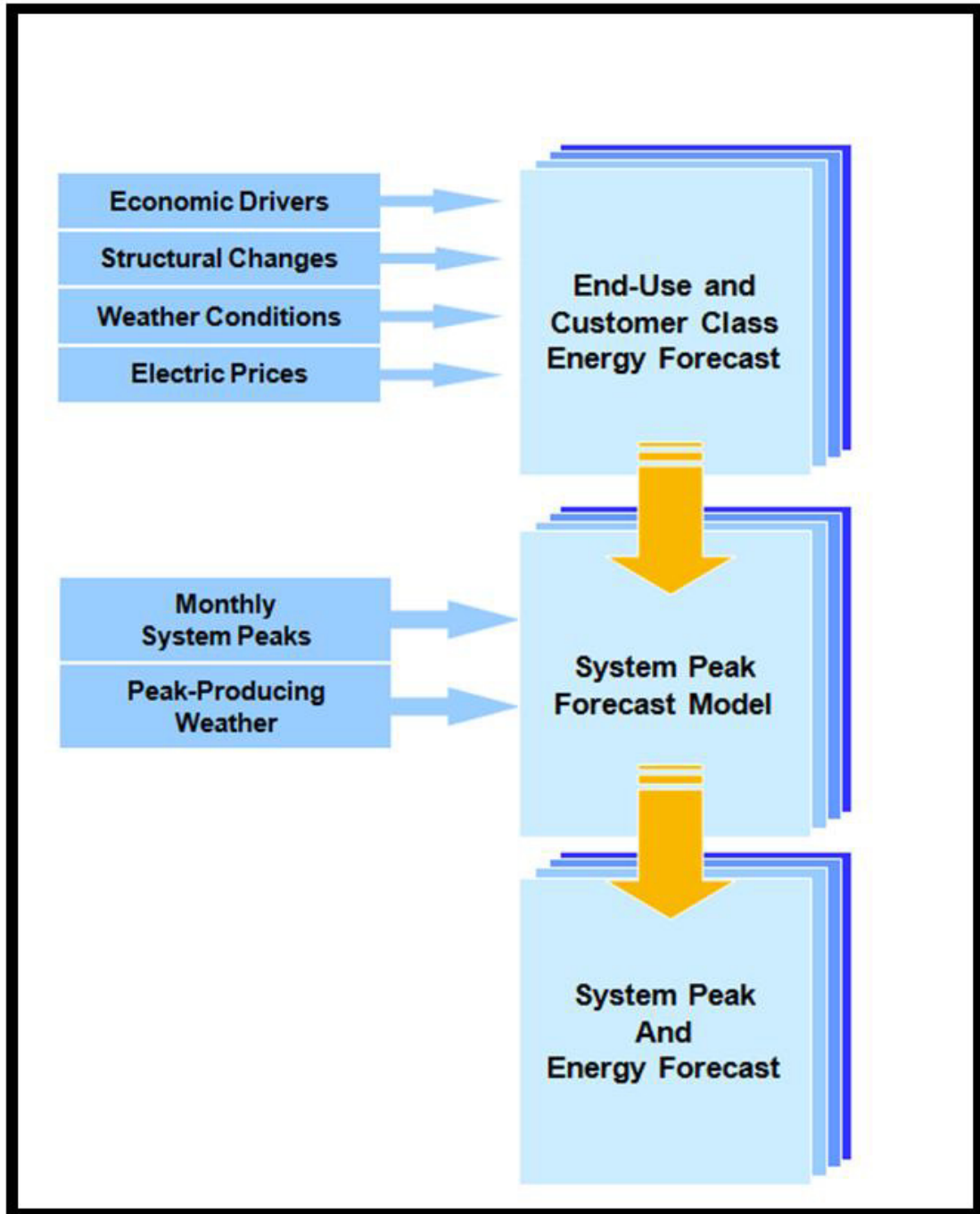
<sup>4</sup> References to the Residential class include Domestic Service and Domestic Service Time-of-Day.

<sup>5</sup> References to the Commercial class include Small General, General and Large General unless specified otherwise.

<sup>6</sup> References to the Industrial class include the Small, Medium and Large Industrial classes unless specified otherwise.

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Figure 4: Forecast Approach



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**4.0 DISCUSSION OF MAJOR INPUTS**

**4.1 Historical Class Sales and Energy Data**

The Load Forecast is developed using NS Power’s “billed” sales rather than “accrued” sales. Billed sales refer to the amount of energy billed to customers in a given period such as a calendar month or year. Accrued sales recognize the amount of energy generated and consumed during that specific time period. Due to the periodic nature and delays inherent in any meter reading and billing process, billed sales vary from accrued sales on a monthly basis but are essentially the same on an annual scale.

Historical monthly billed sales are the primary dependent variables in the linear regression models used in developing the forecast. For the 2024 Load Forecast, the residential and commercial energy forecasts are estimated using monthly billed sales data for the period January 2014 to December 2023. The industrial forecasts use the periods January 2014 to December 2023 (Small Industrial) and January 2006 to December 2023 (Medium Industrial) to improve the model fit.

For the peak demand forecast, historical system monthly energy and monthly demand data is derived from system hourly load data for the period January 2014 to December 2023. Large customer peak demand is forecast separately.

The Renewable to Retail (RtR) electricity market was established in Nova Scotia in 2016 to enable independent licensed retailers to sell renewable energy generated within the province directly to NS Power’s retail customers. The impact of this input is discussed in **Section 4.7.**

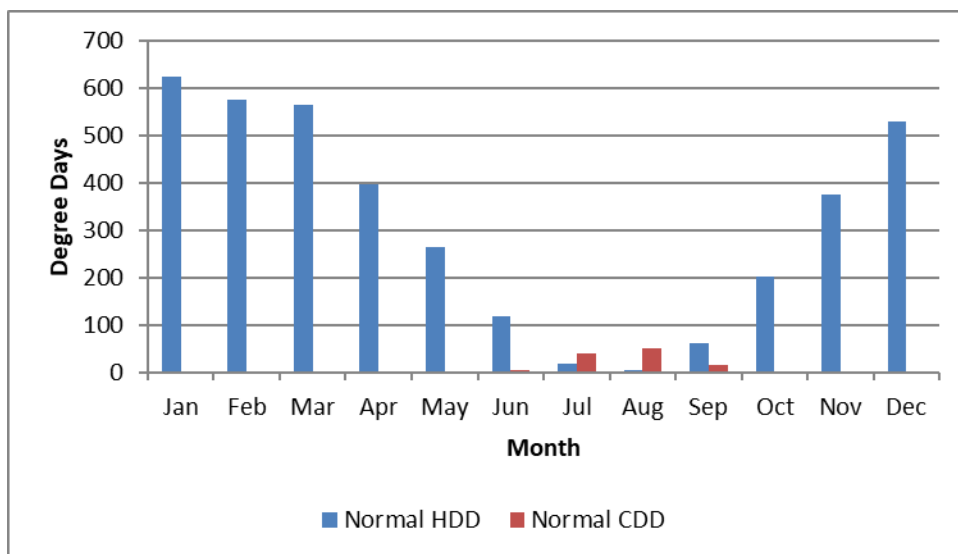
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## 4.2 Weather Data

Weather conditions have the largest single impact on month-to-month variation in electric sales. The impacts of temperature are captured by monthly Heating Degree Day (HDD) and Cooling Degree Day (CDD) variables. HDD are a common measure of heating requirement based on the degree difference between the daily mean temperature and a given reference temperature. The reference temperature of 18 degrees Celsius (°C) is used for these calculations. 18°C is assumed to be a comfortable room temperature below which space heating is generally required and above which space cooling is also required. Monthly HDD and CDD are calculated from Environment Canada hourly temperature information for the Shearwater Airport. Normal monthly HDD and CDD, as shown in **Figure 5** below, are calculated using 10 years of actual weather data covering the period January 2014 to December 2023. The average temperature continues to show a warming trend: the 30-year average annual HDD is 3,864 while the 10-year average is 3,743.

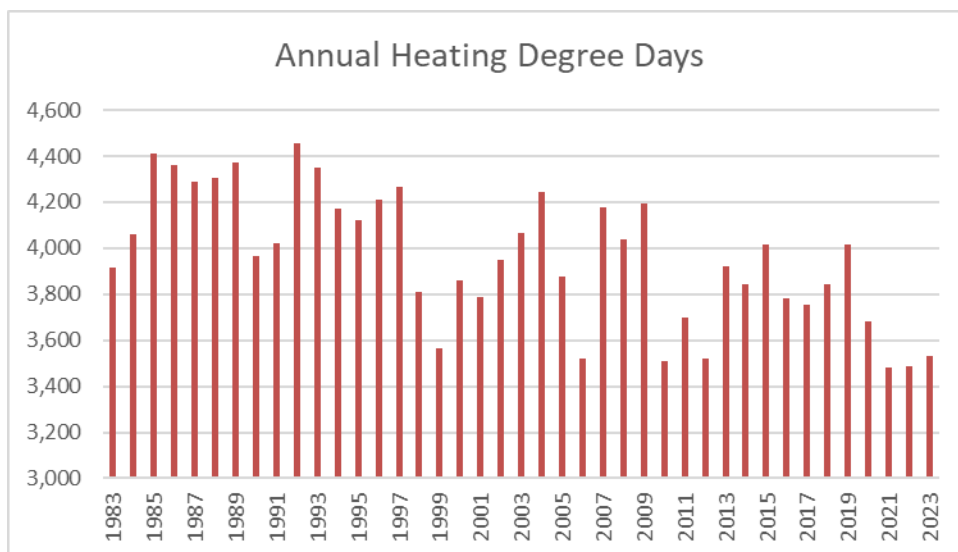
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Figure 5: 10 Year Normal Monthly HDDs and CDDs



The annual number of HDD has been declining as a result of climate trends, as shown in Figure 6.

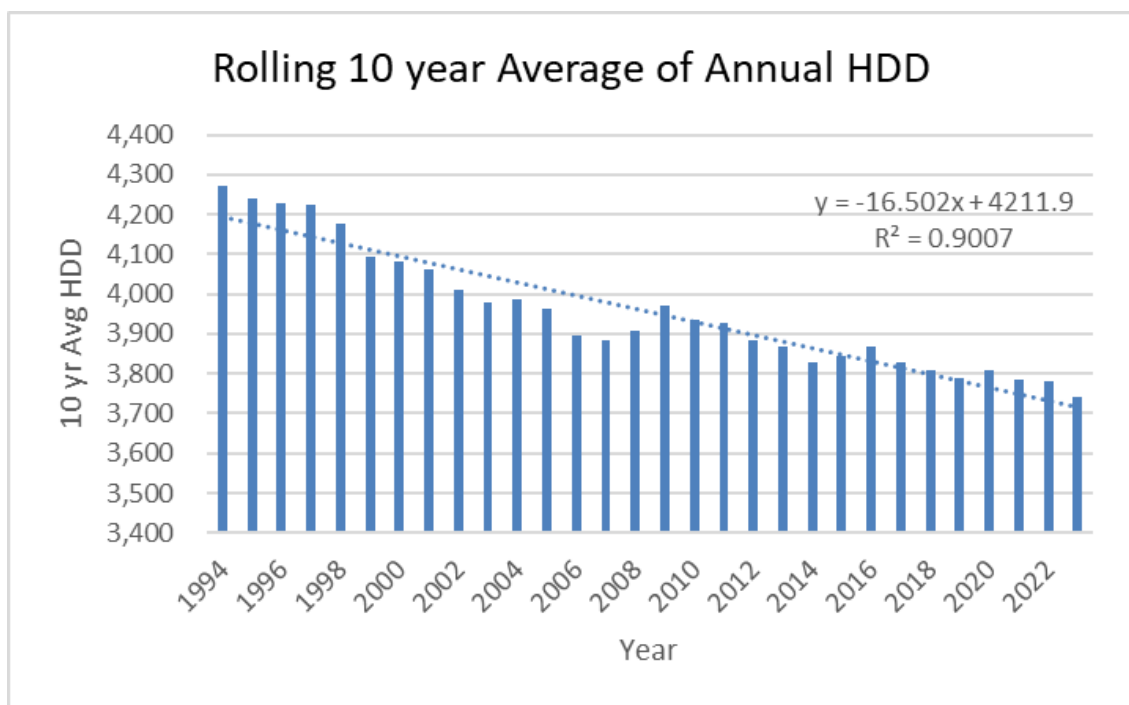
Figure 6: Historic Annual HDD



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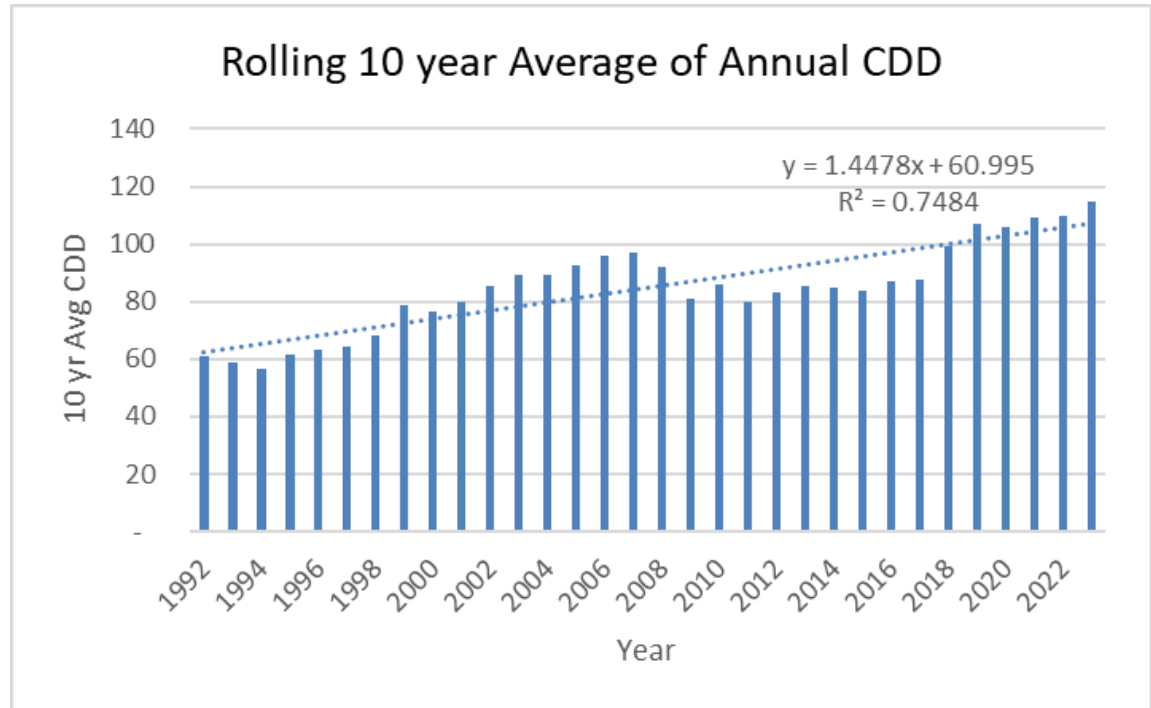
To reflect the general warming trend as seen in the 30-year vs 10-year averages, a trend is applied to the annual HDD and CDD variables. These trends are based on regression analysis of 30 years of historic data using a 10-year moving average (to smooth the series), with HDD decreasing by approximately 17 HDD/year, and CDD increasing by approximately 1.4 CDD/year. See **Figure 7** below for HDD and **Figure 8** below for CDD.

**Figure 7: HDD Trend**



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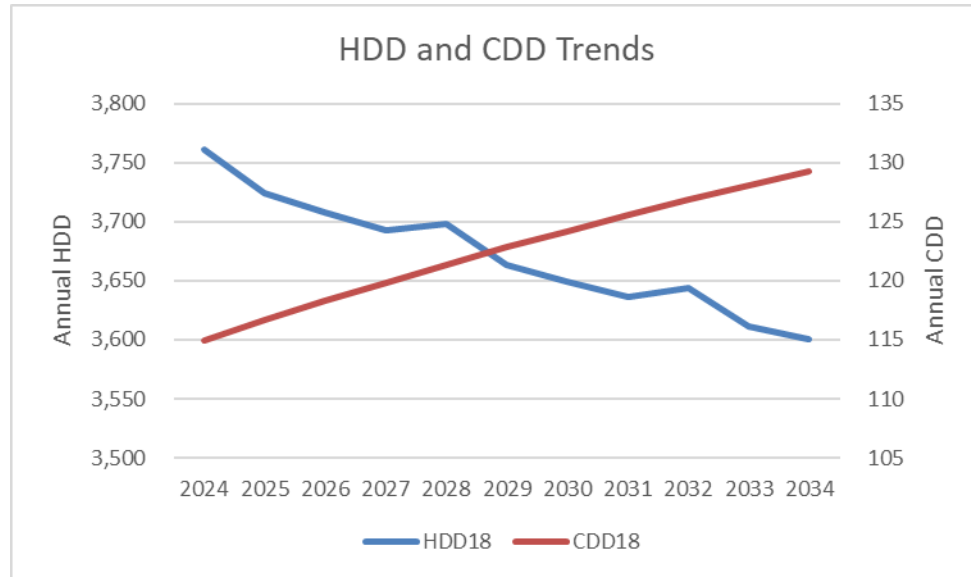
Figure 8: CDD Trend



These trends are reduced over time (approximately 40 years) such that the average annual HDD is not forced to 0 and the average annual CDD does not increase indefinitely. **Figure 9** shows how the HDD and CDD variables evolve over the 10-year forecast period. 2024 represents the 10-year average (and includes the impact of the extra day in February), and by 2034 the annual HDD value is reduced to 3,600 while the CDD value has increased to 129. The implication of this change is a reduced winter heating load and an increased summer cooling load in both the Residential and Commercial classes. The bumps in 2024, 2028 and 2032 are due to leap years which have an extra day in February.

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Figure 9: Annual HDD and CDD Over Time

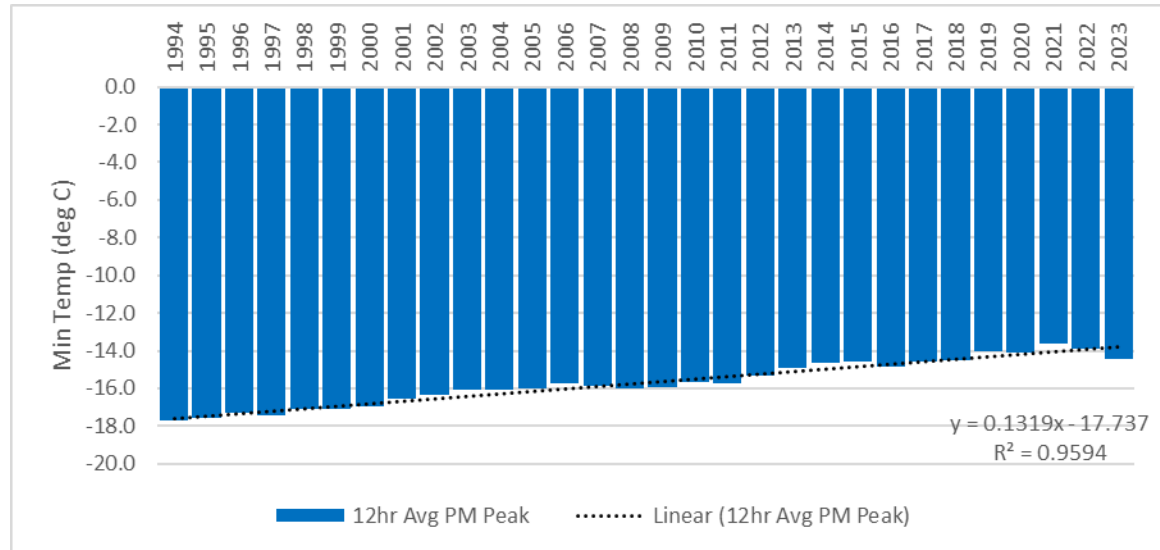


Like the 2023 model, for the 2024 peak model the temperature input uses a 12-hour lagged temperature in combination with an average daily wind speed variable. 10-year averages for both parameters serve as the forecast variables, with an average 12 hour lagged temperature of -14.4°C and an average peak day wind speed of 17.5 km/h. The updated average temperature has decreased from -13.9°C in the 2023 forecast, contributing to an increased peak forecast in 2024.

The other factor included in the peak forecast temperature is a trend similar to the one included in the annual HDD calculations. Looking at a rolling 10-year average of annual 12 hour lagged average minimum temperatures shows that the minimum is increasing at a rate of around 0.13 degrees per year, as shown in **Figure 10**. Like the trend in the HDD series, the peak trend also tapers off over a period of approximately 40 years.

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Figure 10: Rolling 10 Year Average of Annual Evening Min Trend



Several resources were consulted that support these assumptions. The Climate Atlas of Canada<sup>7</sup> provides estimates for annual HDD as well as number of “Winter Days” that are -15° or colder under different climate change scenarios between now and 2050. Annual HDD for Halifax is forecast to decline to a 30 year average of 3597 between 2021 and 2050 under the scenario where greenhouse gas emissions continue at present rates, or to 3636 where emissions slow. The number of “Winter Days” is forecast to decrease from a 30 year average of 13 (between 1976 and 2005) to around 6 under both scenarios. Both trends are in line with the trends being applied to annual HDD and peak temperature increases in the forecast. Research on trends in New England<sup>8</sup> points to general warming patterns both in terms of average temperatures as well as minimum and maximum temperatures.

<sup>7</sup> <https://climateatlas.ca/map/canada>

<sup>8</sup> [Overall Warming with Reduced Seasonality: Temperature Change in New England, USA, 1900-2020](#), Stephen S. Young and Joshua S. Young, 2001

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4.3 Economic Information

Economic and other provincial statistics used in the load forecast are from the Conference Board of Canada's 20-year forecast. This forecast provides a provincial perspective and considers specific Nova Scotia projects and demographics.

In the SAE framework, economic data drives the utilization of the end-use stock over the forecast period. The impact of increased work-from-home activity on the residential class (resulting in increased sales) is handled by a distinct variable rather than relying on the economic variables. New housing completions for both single-family and multi-unit buildings are used in generating residential customer forecasts. Growth of new customers is expected to remain positive but decrease over time, as population growth slows from the expected peak in 2023. As noted in its Decision<sup>9</sup>, the NSUARB directed that:

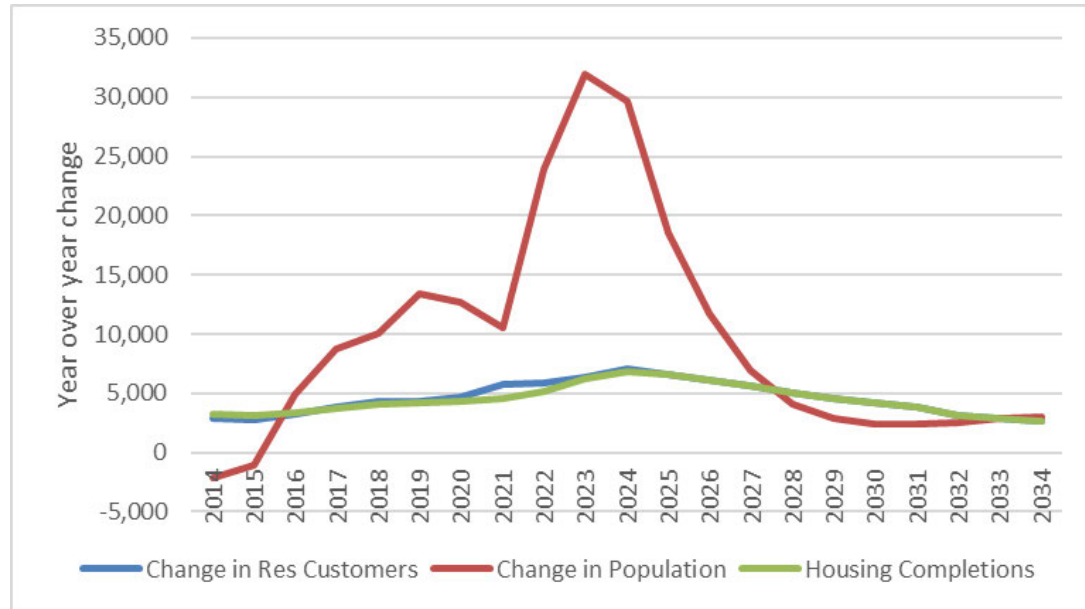
- Given the continued population growth in Nova Scotia and ongoing housing shortage, re-evaluate the use of housing completions for the near-term.
- Consider incorporating household size and age of household residents, to determine if a better understanding on demand load by time of day is achieved.

Housing completion numbers continue to be highly correlated with residential customer count, as seen in **Figure 11**, and continue to be the most appropriate indicator in the near term. NS Power is aware of the ongoing housing shortage in the province and will continue to monitor any government initiatives that address the shortage and increase housing supply.

<sup>9</sup> Nova Scotia Power Inc. 2023 Load Forecast Report, UARB Decision, November 7, 2023, page 6 (M11108).

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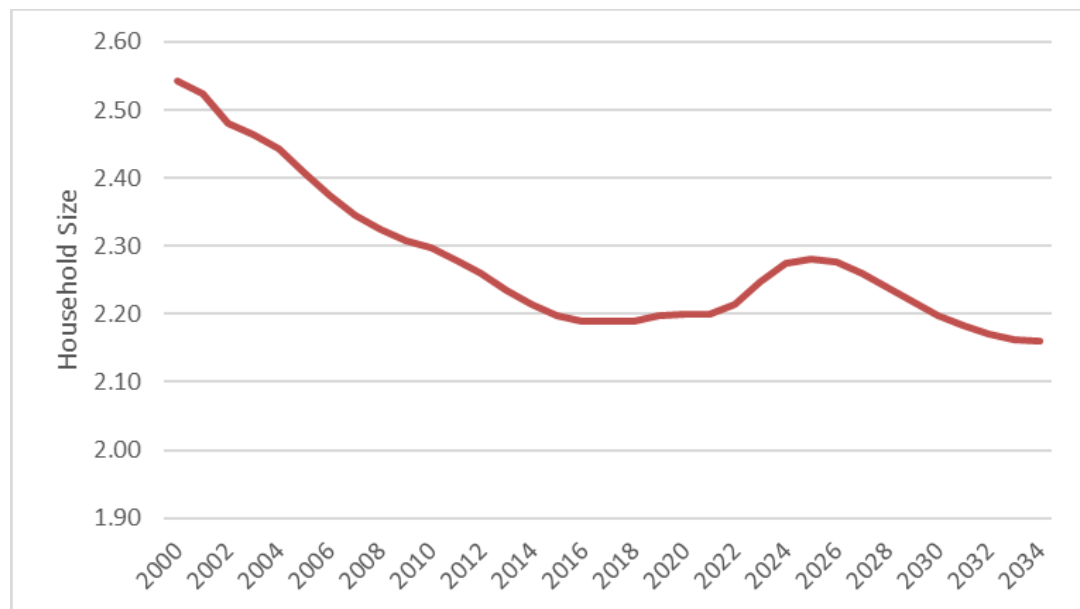
Figure 11: Yearly Change in Customers, Population, and Housing Completions



Regarding household size, population is currently used in combination with customer count to estimate average household size in the SAE model via the Heat Use, Cool Use, and Other Use variables (see **Appendix B**). As this number increases or decreases, the utilization rate of the corresponding usage variable will increase or decrease as well. **Figure 12** shows how the Household Size variable changes over time:

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Figure 12: Household Size



Household Size decreased steadily from 2000 to 2016 as population growth stagnated while new housing continued to increase. From 2016 to 2022 the average household size was steady around 2.2, but between 2022 and 2025 household size increases as population increases, with a decline after 2025 as population growth slows.

In the commercial models, non-manufacturing gross domestic product (GDP) and non-manufacturing employment continue to be used. In the industrial sector, rate classes are forecast using an econometric framework, with manufacturing GDP and manufacturing employment used as the economic drivers. The regression timescale for the medium industrial model remains longer than the other class models (17 years vs 10 years for the residential model) to help improve the relevance of the economic variable in the small industrial model (the model produces a high P-value on the economic variable using a 10-year timeframe) and to help improve the fit in the medium industrial model (adjusted R-squared of 0.281 for 10 years vs 0.684 for 17 years). **Figures 13, 14 and 15** summarize the economic drivers, on an annual basis, used in the 2024 Load Forecast. For financial measures, the variables have been adjusted to constant dollars, eliminating the inflation effects from the series.

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Figure 13: Residential Economic Drivers

| Year  | New Construction<br>(number) | % Change | Household Compensation<br>(mil \$2002) | % Change |
|-------|------------------------------|----------|----------------------------------------|----------|
| 2014  | 3,262                        |          | 17,254                                 |          |
| 2015  | 3,184                        | -2.4     | 17,488                                 | 1.4      |
| 2016  | 3,327                        | 4.5      | 17,118                                 | -2.1     |
| 2017  | 3,698                        | 11.1     | 17,517                                 | 2.3      |
| 2018  | 4,036                        | 9.2      | 18,036                                 | 3.0      |
| 2019  | 4,183                        | 3.6      | 18,061                                 | 0.1      |
| 2020  | 4,365                        | 4.4      | 18,077                                 | 0.1      |
| 2021  | 4,614                        | 5.7      | 18,945                                 | 4.8      |
| 2022  | 5,167                        | 12.0     | 19,148                                 | 1.1      |
| 2023  | 6,206                        | 20.1     | 19,637                                 | 2.6      |
| 2024  | 7,021                        | 13.1     | 20,089                                 | 2.3      |
| 2025  | 6,614                        | -5.8     | 20,562                                 | 2.4      |
| 2026  | 6,169                        | -6.7     | 20,949                                 | 1.9      |
| 2027  | 5,695                        | -7.7     | 21,244                                 | 1.4      |
| 2028  | 5,084                        | -10.7    | 21,522                                 | 1.3      |
| 2029  | 4,591                        | -9.7     | 21,771                                 | 1.2      |
| 2030  | 4,174                        | -9.1     | 22,018                                 | 1.1      |
| 2031  | 3,809                        | -8.7     | 22,267                                 | 1.1      |
| 2032  | 3,158                        | -17.1    | 22,525                                 | 1.2      |
| 2033  | 2,898                        | -8.2     | 22,813                                 | 1.3      |
| 2034  | 2,660                        | -8.2     | 23,124                                 | 1.4      |
| 14-23 |                              | 7.4      |                                        | 1.4      |
| 24-34 |                              | -9.5     |                                        | 1.4      |

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Figure 14: Commercial Economic Drivers

| Year  | Non-Manufacturing GDP<br>(mil \$2012) | % Change | Non-Manufacturing Employment<br>(000) | % Change |
|-------|---------------------------------------|----------|---------------------------------------|----------|
| 2014  | 32,350                                |          | 418                                   |          |
| 2015  | 32,571                                | 0.7      | 416                                   | -0.6     |
| 2016  | 33,027                                | 1.4      | 414                                   | -0.3     |
| 2017  | 33,723                                | 2.1      | 417                                   | 0.6      |
| 2018  | 34,264                                | 1.6      | 419                                   | 0.6      |
| 2019  | 35,352                                | 3.2      | 431                                   | 2.8      |
| 2020  | 34,134                                | -3.4     | 411                                   | -4.8     |
| 2021  | 36,191                                | 6.0      | 435                                   | 6.0      |
| 2022  | 37,231                                | 2.9      | 450                                   | 3.5      |
| 2023  | 37,536                                | 0.8      | 459                                   | 1.9      |
| 2024  | 37,842                                | 0.8      | 460                                   | 0.3      |
| 2025  | 38,734                                | 2.4      | 468                                   | 1.6      |
| 2026  | 39,582                                | 2.2      | 473                                   | 1.1      |
| 2027  | 40,403                                | 2.1      | 479                                   | 1.2      |
| 2028  | 41,220                                | 2.0      | 484                                   | 1.2      |
| 2029  | 41,835                                | 1.5      | 489                                   | 1.0      |
| 2030  | 42,314                                | 1.1      | 493                                   | 0.9      |
| 2031  | 42,851                                | 1.3      | 498                                   | 0.9      |
| 2032  | 43,378                                | 1.2      | 502                                   | 0.9      |
| 2033  | 43,907                                | 1.2      | 507                                   | 1.0      |
| 2034  | 44,418                                | 1.2      | 513                                   | 1.1      |
| 14-23 |                                       | 1.7      |                                       | 1.0      |
| 24-34 |                                       | 1.6      |                                       | 1.1      |

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Figure 15: Industrial Economic Drivers

| Year  | Manufacturing<br>GDP<br>(mil \$2012) | % Change | Manufacturing<br>Employment<br>(000) | % Change |
|-------|--------------------------------------|----------|--------------------------------------|----------|
| 2014  | 2,397                                |          | 30                                   |          |
| 2015  | 2,443                                | 1.9      | 28                                   | -4.5     |
| 2016  | 2,462                                | 0.8      | 29                                   | 2.2      |
| 2017  | 2,490                                | 1.2      | 31                                   | 5.4      |
| 2018  | 2,577                                | 3.5      | 33                                   | 6.8      |
| 2019  | 2,736                                | 6.1      | 34                                   | 2.9      |
| 2020  | 2,600                                | -4.9     | 33                                   | -2.5     |
| 2021  | 2,809                                | 8.0      | 33                                   | 0.8      |
| 2022  | 2,780                                | -1.0     | 35                                   | 4.9      |
| 2023  | 2,761                                | -0.7     | 36                                   | 4.1      |
| 2024  | 2,765                                | 0.1      | 36                                   | -0.1     |
| 2025  | 2,870                                | 3.8      | 36                                   | 0.8      |
| 2026  | 2,970                                | 3.5      | 36                                   | 0.3      |
| 2027  | 3,073                                | 3.5      | 37                                   | 0.3      |
| 2028  | 3,178                                | 3.4      | 37                                   | 0.5      |
| 2029  | 3,285                                | 3.4      | 37                                   | 0.5      |
| 2030  | 3,394                                | 3.3      | 37                                   | 0.7      |
| 2031  | 3,503                                | 3.2      | 37                                   | 0.6      |
| 2032  | 3,609                                | 3.0      | 38                                   | 0.7      |
| 2033  | 3,716                                | 3.0      | 38                                   | 0.8      |
| 2034  | 3,823                                | 2.9      | 38                                   | 0.9      |
| 14-23 |                                      | 1.6      |                                      | 2.2      |
| 24-34 |                                      | 3.3      |                                      | 0.6      |

The major Canadian banks provide short term (1-2 year) forecast for some of the key economic indicators, and these are provided in **Figure 16**. The Conference Board of Canada forecast is in line with the forecasts from the banks.

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Figure 16: Economic Forecast Comparison

|                             | <u>GDP</u> |      | <u>Employment</u> |      | <u>Housing Starts</u> |      |
|-----------------------------|------------|------|-------------------|------|-----------------------|------|
|                             | 2024       | 2025 | 2024              | 2025 | 2024                  | 2025 |
| Conference Board of Canada  | 0.8%       | 2.5% | 0.2%              | 1.6% | 6762                  | 6491 |
| BMO <sup>10</sup>           | 0.9%       | 1.6% | 0.8%              | 1.0% | 10000                 | 8000 |
| RBC <sup>11</sup>           | 1.2%       | 2.3% | 1.2%              | 1.7% | 7600                  | 7000 |
| TD <sup>12</sup>            | 1.0%       | 1.2% | 0.8%              | 0.3% | 6400                  | 5900 |
| National Bank <sup>13</sup> | 0.1%       | 0.9% | 0.8%              | 0.9% | 6000                  | 6200 |

<sup>10</sup> BMO Provincial Economic Outlook, Dec 2023

<sup>11</sup> RBC Provincial Forecast, Dec 2023

<sup>12</sup> TD Provincial Economic Forecast Dec 2023

<sup>13</sup> National Bank of Canada Monthly Economic Monitor, Dec 2023

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4.4 End-Use Intensity Trends

In addition to economic data, the SAE model also uses end-use data, in the form of saturations and efficiencies, from NRCan and the US Energy Information Agency (EIA). NRCan data for the residential sector is specific to Nova Scotia, while NRCan data for the commercial sector is for Atlantic Canada. EIA data is for New England and is calibrated to fit existing Nova Scotia data.

The approach to developing the individual end-use intensities is to start with historical NRCan end-use saturation trends combined with data derived from surveys and use year-over-year changes in saturation projections and end-use efficiency estimates for the New England Census Division. The resulting end-use intensity trend is then compared with end-use energy estimates from NRCan. If necessary, it is then adjusted so that the resulting intensities are consistent with NRCan reported end-use consumption and actual average use derived from NS Power billing data.

In the case of end uses where there is little historical activity or where future behaviour is expected to vary significantly from the existing data set due to targeted programs, these are modeled outside the average use intensities. EVs and rooftop solar photovoltaic (PV) continue to be modeled outside the average use intensities as they have little historic data. This method also allows these items to be tracked more directly to help fine-tune future forecasts. The PV forecast has been updated based on actual installations in 2023. Key end uses are discussed individually below.

As with the 2023 Load Forecast, the forecasts developed by third party consultant E3 for space heating and EV load shapes are used. The space heating forecast uses the uptake required to meet stated emission goals over the next 20 years, without assuming any specific changes to regulations or incentives, though both are possible in the timeframe of the current 10-year load forecast.

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**Heat Pumps**

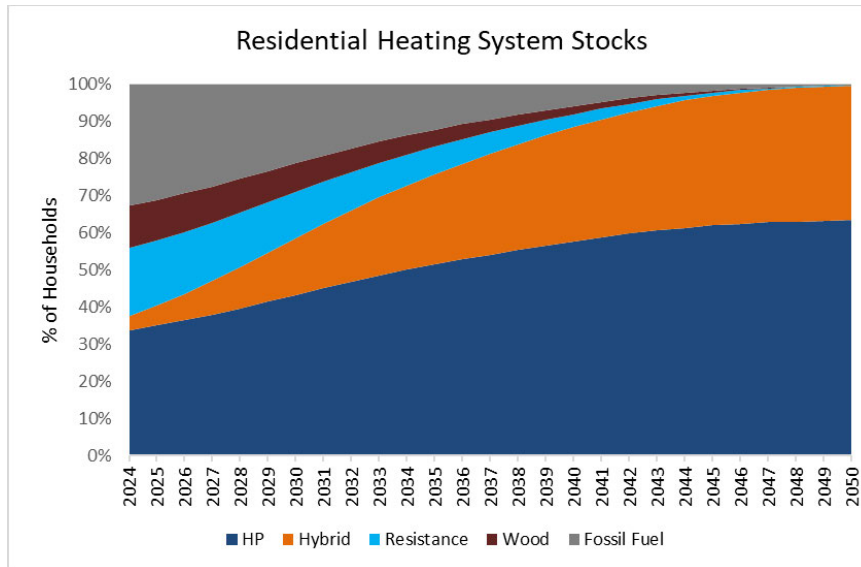
Heat pump usage continues to grow in the province as more customers find heat pumps an efficient way to heat and cool buildings as well as providing environmental and financial benefits. The end-use model uses an estimated saturation of 44 percent of customers supplying their heat via heat pumps in 2024. The estimated number of customers who installed heat pumps in 2023 was almost 20,900, in line with the 2023 forecast. This level of uptake is expected to continue in the near term given the continued availability of grants and financing (\$300/ton for qualifying mini splits, \$500/ton for qualifying ducted systems and up to \$30,000 for oil conversions for low and median income households). The result is continued strong uptake that is expected to continue through the forecast period. As part of the updates for 2024, the E3 scenario used in the forecast has been updated to the hybrid scenario, where a portion of customers adopting heat pumps retain their non-electric backup heating systems to provide heating on the coldest days. This assumption is in line with the Nova Scotia Power Electrification Strategy Report released in late 2023, which states “Winter peak impacts on the electricity system from cold-climate heat pumps can be mitigated by encouraging hybrid (mini-split) systems and best-in-class performing heat pumps.”<sup>14</sup> As stated in response to E1 IR-02 in the 2024 Annual Capital Expenditure proceeding, “The province’s 2030 Clean Power Plan calls for peak management, demand response and efficiency investments to reduce 150 MW of peak and peak growth by 2030. The Hybrid Peak Mitigation electrification scenario, with its modeled peak reduction of 100 MW beyond those achieved via the demand response and efficiency programming incorporated in the Base DSM scenario, is the scenario studied in the Evergreen IRP which most closely matches this objective.”<sup>15</sup> The forecast continues to assume 100 percent heat pump saturation in the residential sector in order to achieve carbon reduction targets of net-zero by 2050 as shown in **Figure 17**.

<sup>14</sup> The Economics of Electrification in Nova Scotia, Energy+Environmental Economics, Oct 2023, page 7

<sup>15</sup> 2024 ACE Plan (M11458), EfficiencyOne IR-02 part (b), February 9, 2024, page 3.

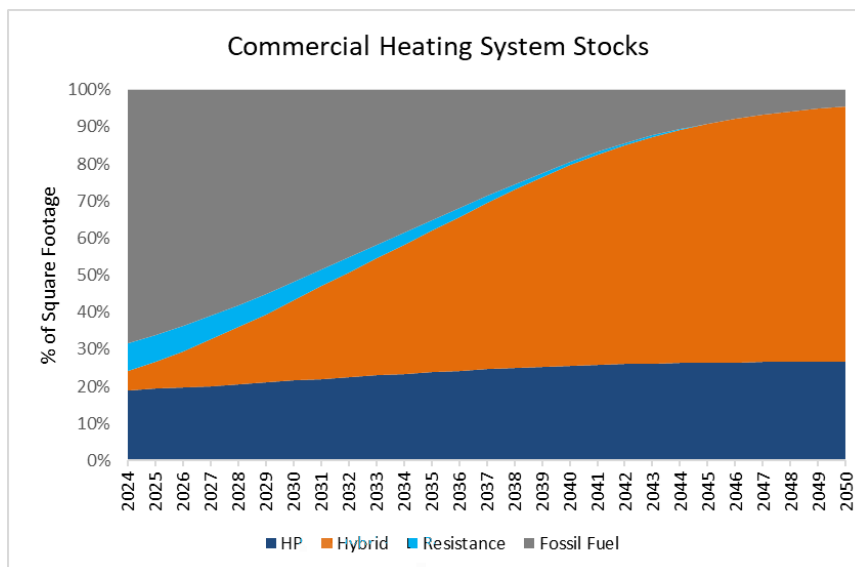
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Figure 17: E3 Residential Space Heating Saturation



On the commercial side, the E3 electric heating stock model has a similar trajectory to that of the residential model (see **Figure 18**) but has a higher adoption of hybrid systems and does not reach 100 percent by 2050 as there will be a portion of the buildings that may not be able to fully convert.

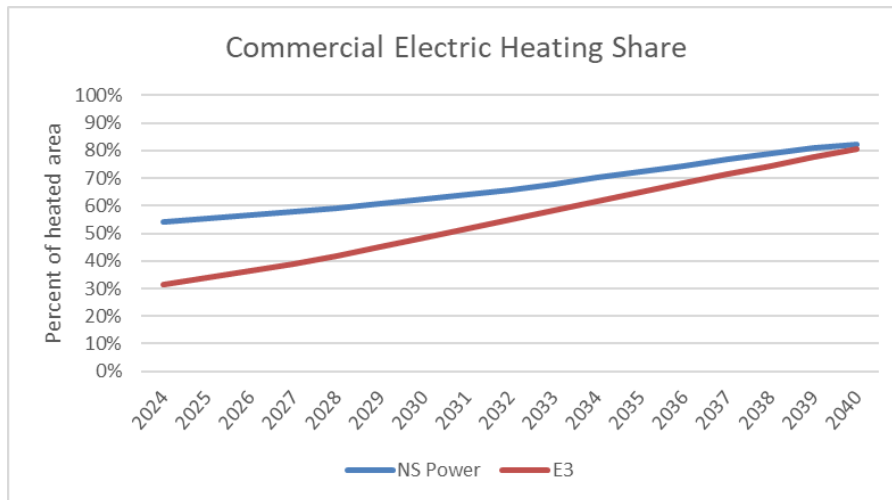
Figure 18: E3 Commercial Space Heating Saturation



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E3 saturation estimates had a lower starting point than the NS Power models, so the NS Power series was adjusted to meet the E3 series by around 2040 as shown in **Figure 19**, resulting in a slightly lower trajectory.

**Figure 19: Commercial Space Heating Saturation Comparison**



For the 2024 forecast, energy and peak values predicted by the SAE models are higher than the E3 hybrid scenario models where some of the heating requirements are handled by the secondary non-electric heat source. **Figure 20** shows the estimated energy and peak impact from the NS Power models compared to the E3 projections, as well as the corresponding adjustments to the energy and peak forecast values. These adjustments are applied to the model to estimate the impact of the hybrid scenario.

**Figure 20: Heat Pump Energy and Peak Comparison**

| Year | NS Power<br>HP Energy<br>(GWh) | E3 HP<br>Energy<br>(GWh) | Change in<br>Energy Forecast<br>(GWh) | NS Power<br>HP Peak<br>(MW) | E3 HP<br>Peak<br>(MW) | Change in Peak<br>Forecast (MW) |
|------|--------------------------------|--------------------------|---------------------------------------|-----------------------------|-----------------------|---------------------------------|
| 2030 | 242                            | 74                       | -154                                  | 110                         | 83                    | -27                             |
| 2035 | 481                            | 205                      | -262                                  | 219                         | 176                   | -43                             |

E3 commercial values adjusted to account for share difference

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**Figure 21** shows the forecast for residential installations and changes to saturation and intensity over the forecast period.

**Figure 21: Heat Pump Forecast**

| Year | Total Cumulative New Installs | % Install Non-Elec. Heat | % Install Elec. Heat | Overall % Sat. for Heating | Overall Heating Intensity (kWh/house) | Overall % Sat. for Cooling | Overall Cooling Intensity (kWh/house) |
|------|-------------------------------|--------------------------|----------------------|----------------------------|---------------------------------------|----------------------------|---------------------------------------|
| 2024 | 21,187                        | 68                       | 32                   | 44                         | 2,066                                 | 55                         | 220                                   |
| 2025 | 42,586                        | 68                       | 32                   | 47                         | 2,271                                 | 59                         | 234                                   |
| 2026 | 63,771                        | 68                       | 32                   | 51                         | 2,454                                 | 63                         | 247                                   |
| 2027 | 84,744                        | 68                       | 32                   | 54                         | 2,636                                 | 67                         | 261                                   |
| 2028 | 104,983                       | 68                       | 32                   | 58                         | 2,814                                 | 71                         | 273                                   |
| 2029 | 124,513                       | 68                       | 32                   | 61                         | 2,973                                 | 75                         | 285                                   |
| 2030 | 143,360                       | 68                       | 32                   | 64                         | 3,128                                 | 78                         | 297                                   |
| 2031 | 161,547                       | 68                       | 32                   | 67                         | 3,277                                 | 81                         | 308                                   |
| 2032 | 178,825                       | 68                       | 32                   | 70                         | 3,422                                 | 85                         | 318                                   |
| 2033 | 195,240                       | 68                       | 32                   | 73                         | 3,554                                 | 88                         | 328                                   |
| 2034 | 210,833                       | 68                       | 32                   | 75                         | 3,680                                 | 90                         | 337                                   |

The overall heating intensity has increased compared to the 2023 forecast as a result of adjustments made in response to the “unallocated” variance in the residential class results (discussed in **Section 9**). The heat pump heating component intensities were adjusted to account for the fact that the large unallocated variance occurred mainly in the winter months and was determined to be primarily weather dependent. The increase in heating intensity is likely due to increased hours of heating resulting from increased work-from-home activity but may also be driven by higher overall equipment intensity (higher temperature setpoints, more heating load served by the heat pumps). Compared to the 2023 intensities, overall heating intensities have increased by approximately 39 percent, as shown in **Figure 22**.

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Figure 22: Heating Intensity Comparison

| Year | 2024 Heating Intensity (kWh/house) | 2023 Heating Intensity (kWh/house) | Change (Percentage) |
|------|------------------------------------|------------------------------------|---------------------|
| 2024 | 2,066                              | 1,511                              | +37                 |
| 2025 | 2,271                              | 1,639                              | +39                 |
| 2026 | 2,454                              | 1,770                              | +39                 |
| 2027 | 2,636                              | 1,899                              | +39                 |
| 2028 | 2,814                              | 2,026                              | +39                 |
| 2029 | 2,973                              | 2,140                              | +39                 |
| 2030 | 3,128                              | 2,250                              | +39                 |
| 2031 | 3,277                              | 2,357                              | +39                 |
| 2032 | 3,422                              | 2,459                              | +39                 |
| 2033 | 3,554                              | 2,552                              | +39                 |
| 2034 | 3,680                              | 2,631                              | +40                 |

### Water Heaters

NS Power anticipates that some customers who convert their oil heating systems to heat pumps will also convert their hot water supply to electric hot water tanks because of the annual operating savings. Growth is expected to remain steady, with saturation increasing to 88 percent by 2034. As part of a joint demand response working group, NS Power and E1 are continuing with a program that involves controlling water heaters directly to achieve benefits to the system (see **Section 10**). **Figure 23** shows the expected changes in saturation and overall intensity over the forecast period. The efficiency improvements of heat pump hot water heaters are still not incorporated into the forecast as uptake is still small (114 in 2021 and 163 in 2022 according the 2022 DSM Programs Evaluation Report filed by EfficiencyOne<sup>16</sup>) despite an available rebate of \$400.

<sup>16</sup> 2022 DSM Programs Evaluation Reports, Residential Efficient Product Rebates Program, EfficiencyOne, Table 20, page 30.

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Figure 23: Water Heater Forecast

| Year | Overall % Saturation | Overall Intensity (kWh/household) |
|------|----------------------|-----------------------------------|
| 2024 | 73                   | 1,633                             |
| 2025 | 76                   | 1,675                             |
| 2026 | 78                   | 1,711                             |
| 2027 | 80                   | 1,745                             |
| 2028 | 82                   | 1,777                             |
| 2029 | 83                   | 1,807                             |
| 2030 | 84                   | 1,822                             |
| 2031 | 85                   | 1,837                             |
| 2032 | 86                   | 1,852                             |
| 2033 | 87                   | 1,867                             |
| 2034 | 88                   | 1,881                             |

### Electric Vehicles (EVs)

The existing federal incentives remain unchanged for 2024 at \$5000 for light duty battery electric vehicles (BEVs) and long range plug-in hybrid electric vehicles (PHEVs), \$2500 for short range PHEVs, and up to \$200,000 for medium and heavy-duty vehicles. The provincial government continues to provide incentives of \$3000 for new BEVs and long range PHEVs, \$2000 for used BEVs and new short range PHEVs, and \$1000 for used short range PHEVs. It is estimated that there were approximately 4100 BEV + PHEVs (together considered as EVs) in the province as of the end of 2023. The EV forecast has been updated for 2024 based on the report entitled “Ensuring ZEV Adoption in Nova Scotia”<sup>17</sup>, with a provincial vehicle sales forecast that aligns with the federal sales targets of 20 percent by 2026, 60 percent by 2030 and 100 percent by 2035<sup>18</sup>, but takes into account the fact that the sales targets are at the national level and sales in Nova Scotia will likely lag larger

<sup>17</sup> [https://ecologyaction.ca/sites/default/files/2023-05/RegionalZEVAdoptionOptions\\_Dunsky\\_March2023.pdf](https://ecologyaction.ca/sites/default/files/2023-05/RegionalZEVAdoptionOptions_Dunsky_March2023.pdf), prepared by Dunksy Energy+Climate Advisors for the Ecology Action Center

<sup>18</sup> <https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/canada-s-zero-emission-vehicle-zev-sales-targets>

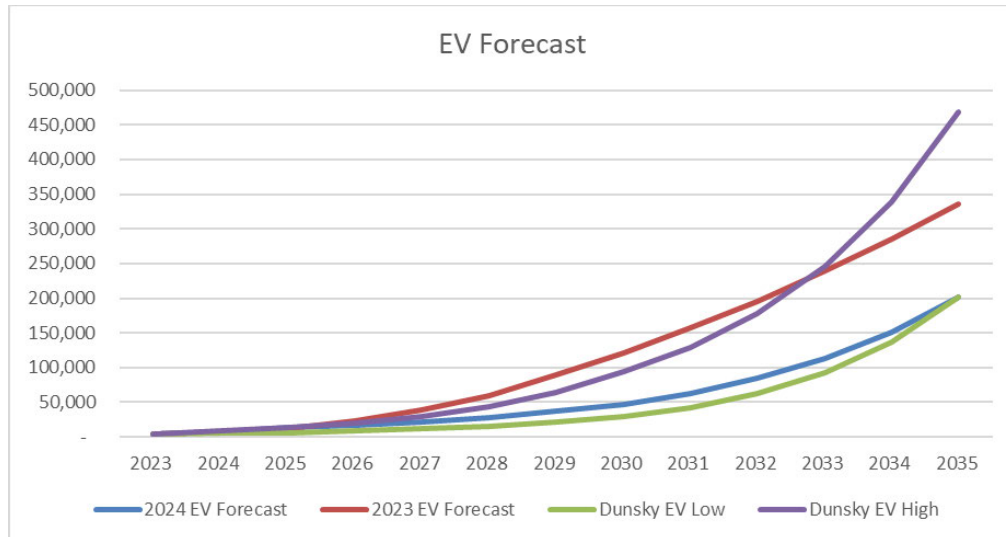
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markets like Ontario, Quebec and British Columbia. According to the report, “Taking together the current state of ZEV adoption in Nova Scotia and the trends observed in the U.S. under rules with little or no regional requirements, it is reasonable to expect that adoption in Nova Scotia will continue to lag behind the national targets for several years, with this gap narrowing as the federal annual sales targets increase to 100% in 2035.”<sup>19</sup> In the report two adoption forecasts are provided, a low scenario where sales in Nova Scotia lag the federal mandates, and a high scenario where sales are distributed evenly across the provinces. The 2024 forecast aligns with the low scenario but is adjusted for recent trends. The low scenario has 6300 EVs on the road by 2025, which would imply sales of around 1100/year from the 2023 starting point of 4100 EVs. Estimated numbers for EVs in Nova Scotia indicate that sales have been roughly doubling for the last several years (500 in 2021, 1000 in 2022, 2200 in 2023), and if the trend were to continue the estimate for 2025 would be closer to 17,000. To account for the higher growth in recent years, the high scenario is used for 2025, 50 percent of the high scenario was used for 2030, and the forecast aligns with the low scenario for 2035. A comparison of the 2024, 2023, Dunskey Low and Dunskey High scenarios is shown the **Figure 24**.

<sup>19</sup> [https://ecologyaction.ca/sites/default/files/2023-05/RegionalZEVAdoptionOptions\\_Dunskey\\_March2023.pdf](https://ecologyaction.ca/sites/default/files/2023-05/RegionalZEVAdoptionOptions_Dunskey_March2023.pdf), prepared by Dunskey Energy+Climate Advisors for the Ecology Action Center, page 16.

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**Figure 24: EV Forecast**



The forecast includes both light-duty vehicles (LDV) as well as medium-duty vehicles (MDV) such as delivery trucks and other medium-duty fleet vehicles, and heavy-duty vehicles (HDV) focusing on buses. The revised EV forecast estimates that Nova Scotia will have over 150,000 EVs on the road by 2034, mostly made up of LDVs compared to a forecast of 285,000 vehicles by 2034 in the 2023 Load Forecast.

The impact of EVs on energy sales and peak demand depends on several factors including the types of vehicles adopted (plug-in hybrid vs battery electric), charging capacity (anywhere from 3 kW<sub>ac</sub> to 20 kW<sub>ac</sub> depending on vehicle limits and home charger type, and much higher for commercial DC Fast Chargers), driving patterns, temperature and access to charging. E3 provided estimates of total load and normalized per-vehicle electric vehicle load shapes over the course of the year based on E3’s EV Load Shaping Tool. E3’s tool simulates driving and charging electric vehicles in Nova Scotia, based on a bottom-up modelling approach that simulates driving and charging of thousands of EV drivers, and produces a load shape that captures the diversity of driving behavior, EV types, and charging access across the Nova Scotia driving population. **Figure 25** shows the EV load and peak demand contribution estimated from the load shapes provided by E3.

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**Figure 25: EV Mileage Assumptions and Load/Peak Modeling Results**

| Vehicle Type | Avg km/year <sup>20</sup> | Avg kWh/year | Avg kW/vehicle on Peak |
|--------------|---------------------------|--------------|------------------------|
| LDV          | 17,427                    | 3,485        | 0.9                    |
| MDV          | 22,779                    | 8,205        | 1.6                    |
| HDV          | 62,888                    | 113,890      | 7.3                    |

The peak impact assumes that 70 percent of charging is managed (including direct control through EV smart charging vehicle-grid-integration controlled by a distributed energy resource management system, and influenced by rates) and 30 percent of charging is unmanaged. The load and peak demand contributions account for a mix of vehicle types and charging infrastructure based on the projected split of EV adoption by vehicle type and charger installation and utilization by EVs. The overall average peak contribution in E3's "blended" managed and unmanaged charging scenario is 0.9 kW/vehicle, compared to an overall peak contribution of 1.6 kW/vehicle in the unmanaged scenario. The management of charging in this scenario was based on minimizing the cost of electricity to charge using residential electric rates like the existing time of use tariffs currently in the pilot stage, coupled with vehicle-grid-integration (EV smart charging) coordinated using technology like a distributed energy resource management system (DERMS) as tested in the Smart Grid Nova Scotia pilot to smooth large spikes in charging that would occur during switches from peak to off-peak rate periods.

**Figure 26** provides the estimated energy and peak impacts that correspond to the number of EVs in the forecast, along with a sensitivity showing potential peak impact without managed charging measures; this sensitivity assumes an average peak demand of 1.6 kW/vehicle based on the E3 unmanaged model.

<sup>20</sup> Based on the *NRCAN 2009 Canadian Vehicle Survey Summary Report*,  
<https://oee.nrcan.gc.ca/publications/statistics/cvs/2009/appendix-1.cfm?graph=11>

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Figure 26: EV Impact to Energy and Peak Forecasts (cumulative)

| Year | New EVs | Load (GWh) | Peak @ 0.9kW/vehicle (MW) | Peak @ 1.6kW/vehicle (MW) |
|------|---------|------------|---------------------------|---------------------------|
| 2024 | 3,387   | 12         | 3                         | 6                         |
| 2025 | 9,491   | 34         | 9                         | 16                        |
| 2026 | 13,466  | 51         | 12                        | 22                        |
| 2027 | 18,587  | 75         | 17                        | 31                        |
| 2028 | 25,167  | 107        | 24                        | 42                        |
| 2029 | 33,586  | 144        | 32                        | 56                        |
| 2030 | 44,365  | 189        | 42                        | 74                        |
| 2031 | 60,545  | 249        | 57                        | 101                       |
| 2032 | 82,105  | 326        | 76                        | 136                       |
| 2033 | 110,852 | 426        | 102                       | 183                       |
| 2034 | 149,197 | 560        | 136                       | 245                       |

Nova Scotia-specific information on the peak and energy impact of EVs was explored through the Smart Grid Nova Scotia (SGNS) Project. A final report was submitted to the UARB in March 2024.<sup>21</sup> Through the project, 100 EV smart chargers were deployed under a ChargePoint pilot program where data collection and control of Electric Vehicle Supply Equipment (EVSE) provided capability for the utility to influence charging times by sending curtailment events. The project also established an EV telemetry pilot with *ev.energy* in which up to 160 drivers enrolled their vehicles and again capability for the utility to influence charging times by sending curtailment events as well as enabled the *ev.energy* smart-charging algorithm to shape charging patterns, influenced by a user-controllable “ready-by” time. Results of these pilots are detailed in the SGNS Final Report.

Appendix C of the Smart Grid Nova Scotia Final Report includes a discussion of electric vehicle charging characteristics in Nova Scotia as observed by the Smart Grid Nova Scotia project.

<sup>21</sup> Smart Grid Nova Scotia (SGNS) Project Final Report (M11621), March 15, 2024.

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1 The maximum contribution to the 17:00 – 19:00 evening peak demand from participants  
2 in the SGNS project was calculated in both the ChargePoint program and the ev.energy  
3 program. In the winter months (December through February), the ChargePoint customers  
4 had an average evening peak contribution of 0.24 kW/vehicle, while the ev.energy  
5 customers had an average evening peak contribution of 0.65 kW/vehicle. Both average  
6 peaks are unmanaged.

7  
8 During the ChargePoint pilot the non-coincident peak occurred on April 6, 2023 for the  
9 15-minute interval ending at 18:30 as vehicles were charging at 15 of 46 available chargers  
10 at a total aggregate power of 107.2 kW. This represented an unmanaged evening peak  
11 impact of 2.33 kW per enrolled vehicle.

12  
13 During the ev.energy pilot the non-coincident peak occurred on June 4, 2023 for the 30-  
14 minute interval ending at 19:00 as 34 of 160 enrolled vehicles were charging at a total  
15 aggregate power of 306.8 kW. This represented an unmanaged evening peak impact of  
16 1.92 kW per enrolled vehicle.

17  
18 Section 4.1.1.4 of SGNS Final Report details the Demand Response observed per Enrolled  
19 EV under the ChargePoint and ev.energy pilots. The response varied between the two  
20 technology providers, but in the first hour the response at system peak time on average was  
21 0.35 kW.

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**Solar Generation (PV)**

Solar generation consists of two main types – distributed small-scale solar (mainly rooftop) that falls under NS Power’s net metering program, and small- to large-scale generation that is fed directly onto the grid via power purchase agreements or direct utility ownership.<sup>22</sup> In the Load Forecast, only the former is considered, as it serves as a reduction in load mainly in the Residential class. The 2023 Load Forecast was for 2,268 new installations, while the actual number was 2,233, for a cumulative total of 8,221 (72 MW) by the end of the year.<sup>23</sup> As of 2023, the average installed capacity is approximately 8.3 kW for residential customers and 28 kW for non-residential, and total annual net metering solar generation is estimated at 78.8 GWh. The average capacity factor is estimated to be 12.5 percent.

The number of solar installations is expected to increase in the coming years as a result of continued initiatives such as Property Assessed Clean Energy Programs (e.g. Solar City in Halifax), and the continuation of the provincial SolarHomes rebate of \$0.30/W of installed capacity and updated legislation that allows for larger commercial installations. The forecast has been updated to reflect these recent trends, with total installed capacity of almost 674 MW by 2034. This assumes that rebates continue to be available in the coming years. The overall impact is shown in **Figure 27**. There is no forecast reduction in NS Power peak demand, as solar generation occurs at times non-coincident with NS Power’s system peak (refer to **Section 10** for further discussion on peak impacts).

<sup>22</sup> The Smart Grid Nova Scotia solar garden in Amherst falls under direct utility ownership.

<sup>23</sup> NS Power, 2023 Net Metering Report, January 31, 2024.

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Figure 27: PV Impact to Energy (cumulative)

| Year | Total New Installs | Load (GWh) | Peak (MW) |
|------|--------------------|------------|-----------|
| 2024 | 3,019              | -33        | 0         |
| 2025 | 6,361              | -70        | 0         |
| 2026 | 10,062             | -111       | 0         |
| 2027 | 14,163             | -158       | 0         |
| 2028 | 18,708             | -209       | 0         |
| 2029 | 23,746             | -267       | 0         |
| 2030 | 29,334             | -331       | 0         |
| 2031 | 35,480             | -410       | 0         |
| 2032 | 42,241             | -490       | 0         |
| 2033 | 49,678             | -577       | 0         |
| 2034 | 56,738             | -660       | 0         |

### New Technologies

The 2024 Load Forecast does not assume a significant amount of distributed solar/battery storage combinations or storage only deployments. The cost of home batteries is still relatively expensive, in the range of \$15,000-\$20,000<sup>24</sup> for a single battery and installation (for 5-7 kW batteries). This is more expensive than the cost of a gas-powered generator, which varies from as little as \$1,000 for a moderately sized stand-alone generator to supply plug loads (also around 5-7 kW), up to \$10,000 or more for an installed whole-home generator. Currently, the only major driver for residential batteries is for back-up power, so gas generators are a more cost-effective solution. The Time Variable Pricing (TVP) rates currently being piloted might start to encourage battery installation either alone or in conjunction with solar panels, but the initial costs associated with batteries are still high. As battery technology improves and costs come down over time, this is likely to change,

<sup>24</sup> <https://www.zdnet.com/home-and-office/energy/best-home-battery/> estimate of \$12000-\$20000 USD installed.

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1 but research in these areas is ongoing and timelines for significant shifts in this technology  
2 are unknown.

3  
4 The use of home battery storage was explored through the SGNS Project and coordinated  
5 through a utility DERMS as a virtual power plant for load shifting, demand response, and  
6 other grid-aware use cases. Performance data on both stand-alone battery backup and  
7 PV/battery combinations is included and presented in Section 4.2 of the Appendix A –  
8 Impact Analysis Report of the Project Final Report.<sup>25</sup> Key results included demonstration  
9 of load following demand response modes in evening peak periods of 1 – 1.5kW over four-  
10 hour events, shifting load to periods of lower marginal cost and emissions, and delivering  
11 avoided capacity, and avoided transmission & distribution benefits. Of note, when  
12 uncontrolled/uncoordinated, home batteries may recharge at full power following an  
13 outage event, exacerbating local cold load pickup events or system peaks following a larger  
14 event. This is discussed in Section 3.4 of the Appendix A – Impact Analysis Report of the  
15 Project Final Report.

16  
17 In addition to vehicle-grid-integration (VGI) EV smart charging as discussed above, the  
18 Project demonstrated the use of EV batteries in vehicle-to-grid (V2G) technology to return  
19 power to commercial buildings to lower peak demand, including both the coordination of  
20 demand response but also localized, automated demand charge management. These results  
21 are presented as ‘Proof of Concept’ and discussed in detail in Section 4.1.2 of the Appendix  
22 A - Impact Analysis Report of the Project Final Report. Key outcomes demonstrated the  
23 promise of the technology to shift load from periods of higher marginal cost and emissions  
24 to lower marginal cost and emissions and offer peak demand response, similar to stationary  
25 battery technology, but with the added dimension of vehicle availability (a measure of  
26 whether the vehicle is plugged in and able to charge/discharge).

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<sup>25</sup> Smart Grid Nova Scotia (SGNS) Project Final Report (M11621), March 15, 2024.

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The technology required for V2G is still in development and is not widely available, but a few manufacturers have included the capability in existing vehicles (the Nissan Leaf is one example) or have announced that they will provide V2G capability in the near future. For true V2G capabilities, which would not only allow a vehicle to power a home or building, but also allow energy to be fed onto the grid, there is still development required on the technology as well as the codes and standards to allow that functionality.

Data from the project demonstrates that when coordinated (as with a utility DERMS), energy demand from DERs like EVs and recharging stationary batteries can be smoothed or coordinated to avoid coinciding with system peak or localized system anomalies and constraints while avoiding creating new peak periods or contributing to snapback (as with time varying rates). Energy limited devices like batteries and vehicle-to-grid can also discharge to support the system, further capitalizing on the coordinated opportunity of distributed energy resources. For example, **Figure 28** below shows a range of peak mitigation based on residential customer battery uptake scenarios (by 2034) that assume optimal utility level control. These are illustrative estimates based on the 5 kW batteries utilized in the SGNS project, should those batteries be able to discharge their full capacity to the grid (in practice the available demand reduction would be lower than shown).

**Figure 28: Potential Peak Impacts from Batteries**

| Technology                                    | Residential Share (%) |       |       |       |
|-----------------------------------------------|-----------------------|-------|-------|-------|
|                                               | 50%                   | 25%   | 10%   | 5%    |
| Battery Peak Impact - No Control (MW)         | 0                     | 0     | 0     | 0     |
| Battery Peak Impact - Optimal DR Control (MW) | (1,367)               | (683) | (273) | (137) |

The impacts of technologies related to direct load control (DLC) of heating and hot water loads are discussed in **Section 10**.

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**Intensities**

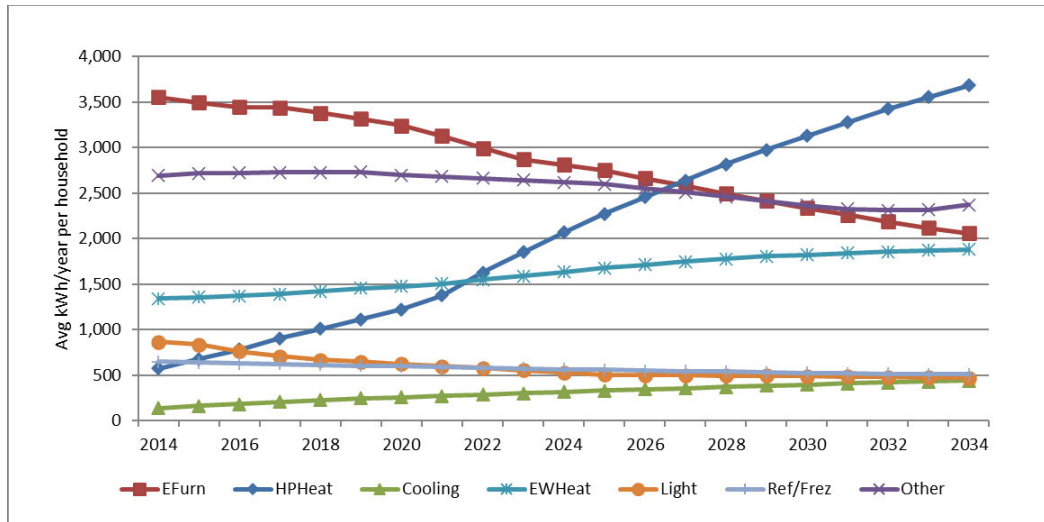
**Figure 29** provides an estimate of the resulting residential end-use intensities. This figure represents the intensities that are inputs to the XHeat, XCool and XOther variables; they are not direct inputs to the forecast. The relative contribution of each will change based on the coefficient applied to the XHeat, XCool and XOther variables.

PV and EV are modeled outside the regression but are estimated in the “Other” category below in order to illustrate their impact relative to other end uses. A summary of the impact of the different variables post-regression is included in **Section 5**, while a complete breakdown of each element before and after the regression is provided in **Appendix B**. The end uses listed include:

- EFurn: electric baseboard and electric forced air furnaces and secondary electric heaters
- HPHeat: heat pump electric heat
- Cooling: room and central air conditioners, as well as heat pump cooling
- EWHeat: electric water heaters
- Lights: indoor lighting
- Ref/Frez: primary and secondary refrigerators and deep freezes
- Other: all other major appliances (stoves, dishwashers, clothes washers and dryers, televisions) as well as smaller appliances such as computers, dehumidifiers, microwaves, etc. This category also includes solar generation (photovoltaic or PV) and EV forecasts.

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**Figure 29: Residential End-Use Intensities**



The intensity trends are similar to those in prior forecasts. The use of heat pumps for space heating is forecast to increase steadily throughout the forecast period including the conversion of both electric baseboard and non-electric homes. Offsetting this increase is a corresponding decrease in electric baseboard heating. Heat pumps also drive an increase in cooling intensity, but not during periods of peak demand. Electric water heating is expected to increase slowly as saturation increases, mainly due to conversions of non-electrically heated households to heat pumps. Lighting and refrigerators/freezers show a slow decline related to natural increases in efficiency. The forecast in the “Other” category is much lower by 2034, due mainly to reduced assumptions around EV sales and increased PV generation. Supporting data for the residential end-use intensities is included in **Attachment 1**.

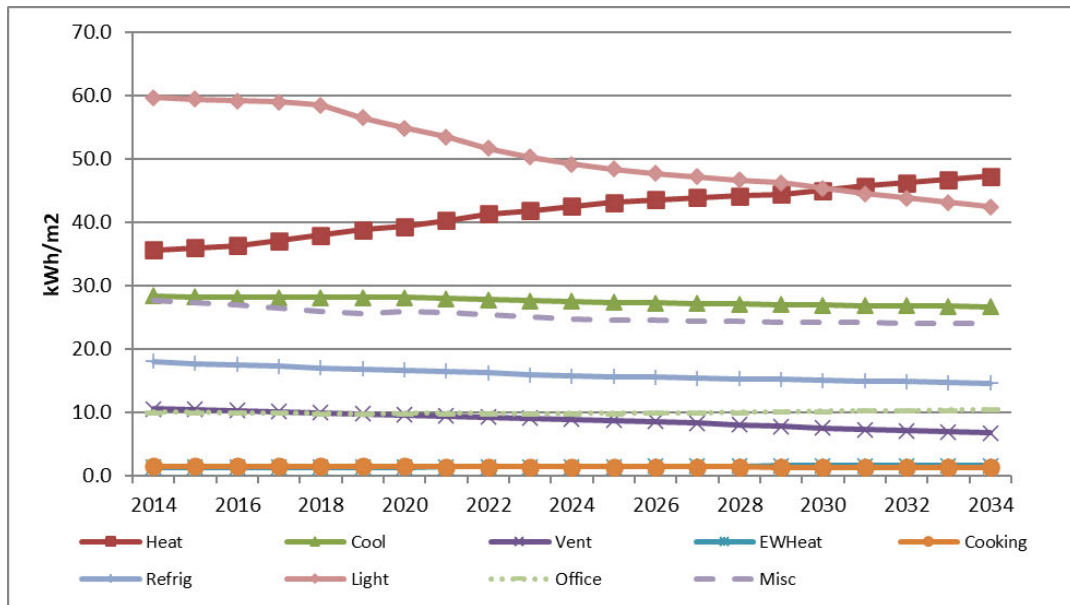
The end-use intensities for the commercial models are done on a per square metre basis, rather than per customer. The forecasts for the end-use intensities are set out in **Figures 30** and **31** below. The end uses listed include:

- Heat: electric heating
- Cool: air conditioning
- Vent: ventilation

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- EWHeat: electric water heaters
- Cooking: electric stoves
- Refrig: refrigerators and freezers
- Light: indoor and outdoor lighting
- Office: computers and printers
- Misc: other loads including motors, servers, escalators, medical equipment, etc.

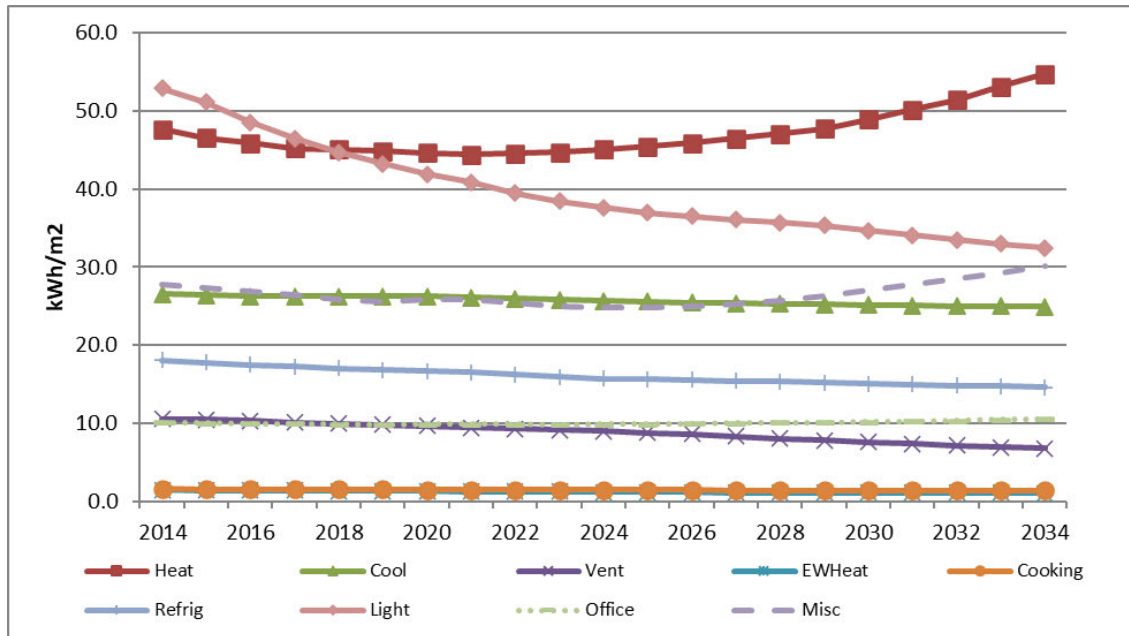
**Figure 30: Historical and Projected Small General Commercial End-Use Intensity (kWh/m<sup>2</sup>)**



Supporting data for Small General commercial end-use intensities is included in **Attachment 2**.

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Figure 31: Historical and Projected General Commercial End-Use Intensity (kWh/m<sup>2</sup>)



Supporting data for General commercial end-use intensities is included in **Attachment 3**.

For the 2024 Load Forecast, data from the EIA 2021 Annual Energy Outlook uses the same baseline data (2015 Residential Energy Consumption Survey and 2012 Commercial Building Energy Consumption Survey) as the 2023 Load Forecast. Small scale solar and EV load has been included in the Miscellaneous category.

### Commercial and Industrial Growth

The commercial and industrial sectors are projected to see targeted growth as a result of the federal and provincial push to net-zero emissions and the resulting electrification programs designed to reduce customers' annual energy usage and lower their carbon emissions. These programs involve converting heating loads to electricity (mainly from oil), accelerating the uptake of electric cooling technologies, and examining opportunities to power industrial processes through electrification. Large Industrial customers are

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evaluated on a case-by-case basis to try to enable the use of electricity while providing benefits to the system (such as through the interruptible rider). Forecasts by class (including new projects in the Large General and Large Industrial classes) are shown in **Figure 32**.

**Figure 32: Commercial and Industrial Electrification Forecasts (cumulative)**

| Year | LrgGen<br>(GWh) | SmInd<br>(GWh) | MedInd<br>(GWh) | LrgInd<br>(GWh) | Coinc.<br>Peak<br>(MW) |
|------|-----------------|----------------|-----------------|-----------------|------------------------|
| 2024 | 2               | 0              | 1               | 3               | 0                      |
| 2025 | 5               | 1              | 4               | 4               | 1                      |
| 2026 | 8               | 1              | 5               | 4               | 2                      |
| 2027 | 11              | 1              | 7               | 5               | 2                      |
| 2028 | 13              | 1              | 8               | 6               | 3                      |
| 2029 | 15              | 2              | 10              | 7               | 4                      |
| 2030 | 16              | 3              | 11              | 8               | 4                      |
| 2031 | 18              | 3              | 13              | 9               | 5                      |
| 2032 | 19              | 4              | 14              | 9               | 5                      |
| 2033 | 20              | 4              | 16              | 10              | 6                      |
| 2034 | 20              | 4              | 16              | 10              | 6                      |

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**4.5 Price Data**

Price data is an input to the SAE forecasts for the residential, small general and general services classes, and the price series is calculated from historical billed sales and billed revenues. Revenue per kWh is first calculated and translated to a real dollar basis; the price variable itself is then derived as a 12-month moving average of the real revenue per kWh series. The 12-month moving average uncouples the current month sales/revenue relationship, smooths out the price series, and provides a reasonable expectation as to how customers respond to price over time.

In the forecast period, the nominal price of electricity for 2024 is based on an average increase of 7.7 percent in the 2024 FAM AA/BA Application, which includes the Base Cost of Fuel Increase approved as part of the 2023-2024 GRA and the BA Rider approved in April of 2024.<sup>26</sup> 2025 is forecast to increase to account for projected increased fuel costs while 2026 is forecast to increase to account for recovery of outstanding fuel costs over a period of 3 years, while the remaining years are forecast to increase at an average of 2 percent per year (with the exception of 2029 where the prior increase for outstanding fuel costs is removed), or around the rate of inflation, which results in a flat profile in real terms.

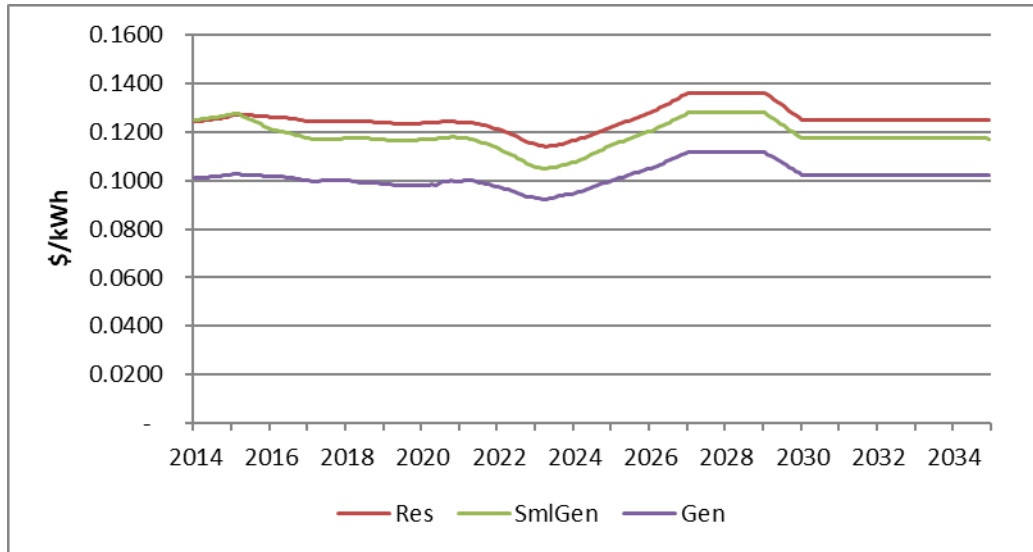
**Figure 33** shows price forecasts by class.

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<sup>26</sup> 2024 FAM AA/BA Application M11393 - January 29, 2024, page 10.

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Figure 33: Historical and projected real electricity prices (real dollars per kWh)



Prices impact the class sales through imposed price elasticities. The SAE models are estimated using a price elasticity of -0.15. Another item raised in the NSUAR decision<sup>27</sup> is to “Evaluate the elasticity used in the SAE model with the elasticity estimation from the TVP Pilot EM&V in matter M11267 and assess if the results provide a more robust model.” The TVP Pilot estimates two elasticities:<sup>28</sup>

- Own/daily price elasticity captures the change in the level of overall consumption due to the changes in the average daily price.
- Substitution price elasticity captures customers’ ability to substitute inexpensive off-peak consumption for more expensive peak consumption.

These elasticity estimations are based on subsets of customers (those enrolled in the TVP pilot) and represent changes in demand relative to hourly or daily pricing changes, and so are not necessarily directly comparable to the longer term time frame of the load forecast or to the population as a whole. The elasticity in the load forecast model represents changes

<sup>27</sup> Nova Scotia Power Inc. 2023 Load Forecast Report, UARB Decision, November 7, 2023, page 6 (M11108).

<sup>28</sup> M09777 Time Varying Pricing Pilot Program Nova Scotia Power Year Two Report, July 28 2023

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in consumption behaviour in response to year-over-year price changes. The estimated elasticities for the two TVP rates are shown in **Figure 34**.

**Figure 34: TVP Price Elasticity Estimates**

| Price Elasticity Metric                    | TOU           | CPP           |
|--------------------------------------------|---------------|---------------|
| Daily Price Elasticity                     | -0.458 ±0.152 | -0.084 ±0.091 |
| Inter-Period Substitution Price Elasticity | -0.186 ±0.006 | -0.161 ±0.007 |

Although the Daily Price Elasticity for the TOU rate is significantly higher than that used in the load forecast, the Inter Period Substitution values are similar. A scenario using the daily price elasticity value of -0.458 in the Residential model is included in **Appendix D (Figure D8)**, and even if the elasticity is tripled the resulting impact to sales in 2034 is only -1%, and the differences in the model statistics are negligible. In the SAE model the price elasticity does impact sales, but it is not a large driver compared to other components of the model such as the intensities or inputs like DSM and EVs. The current value of elasticity is reasonable to capture the impact on sales from changes in price.

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4.6 Demand Side Management

Demand Side Management (DSM) and conservation plans continue to play a role in the use of electricity in Nova Scotia, and the forecast takes the projected energy and demand savings into account. Between 2022 and 2025, DSM amounts are based on E1's proposed supply agreement.<sup>29</sup> Beyond 2025, DSM amounts are based on E1's 2019 Potential Study.<sup>30</sup> base case scenario. These values are all in line with past assumptions about future DSM.

In order to highlight the impact of DSM in the province, the forecast amounts are subtracted from the results of the forecast regression models. As with other jurisdictions and utilities with significant DSM activity, NS Power must address the issue of double counting the impact of DSM savings. The forecast is a regression model based on sales which include past DSM activity, and past DSM also has an influence on other inputs to the load forecast such as price, end-use appliance efficiency and economic variables. Subtracting 100 percent of forecast DSM activities results in a model that understates sales because it has taken DSM into account in both the regression (via the historic data) and in the projected end-use data. The effect of DSM on non-sales related inputs also makes it unrealistic to add historic DSM into past sales to produce a "without DSM" forecast – the impact of DSM would have to also be removed from price, overall appliance efficiency and provincial economics.

To address the issue of double counting, the approach used is the same as that used in prior forecasts: to introduce cumulative historical DSM savings as reported by E1 to the regression model as a load modifying variable and allow the model to determine what level of DSM is already included in other variables. Assuming future DSM activities are similar to historic activities, the coefficient applied to historic DSM will also apply to the forecast DSM. This does not imply that a portion of DSM activities is not taking place or that

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<sup>29</sup> M10473, EfficiencyOne 2023-2025 DSM Resource Plan Filing, March 11, 2022.

<sup>30</sup> M08929, Exhibit N-1, EfficiencyOne, DSM Potential Study, August 14, 2019.

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forecast DSM is overstated; rather, it is a way of accounting for DSM that is captured elsewhere in the forecast. The methodology is not specific to DSM and could be applied to other variables that need to be highlighted in the forecast provided they have similar characteristics (historical trend, potentially included in other inputs, and some information about future impact).

In the Residential model, adding the historic DSM improves the fit of the Residential model (R squared of 0.989 vs 0.988 without the DSM variable, and a mean absolute percent error (MAPE) of 2.18 percent vs 2.30 percent without the variable). By including this variable, the corresponding coefficient, as determined by the regression model, is an indication of the amount of DSM not captured by the other variables. If the coefficient is -1, no DSM is included in other variables, or in practical terms the regression model determined 100 percent of the DSM savings were required to explain the annual change in historical load levels. If the coefficient is 0, 100 percent of the DSM is included in other variables. As can be seen in the Residential model results, the coefficient on the DSM variable is -0.556 (similar to prior values) meaning 44.4 percent of savings are already accounted for in the regression, and 55.6 percent are not captured by other variables, and need to be included in the forecast.

For the Commercial and Industrial classes, a combined model was created to identify the level of DSM already captured by other variables. DSM impacts are not provided for Commercial and Industrial customers by rate class or by month, so by creating a combined model for these classes, the level of uncertainty around allocating historical DSM savings across rate classes and months of the year is reduced. The DSM variable coefficient is similar to prior years: -0.448, meaning future years in the load forecast should be adjusted by 45 percent of the forecast DSM amounts. The adjusted R-squared for the model is 0.821 while the MAPE is 2.75, indicating a good fit overall. **Figure 35** shows the DSM levels (at the generator) incorporated into the forecast.

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Figure 35: Annual Forecast Residential DSM Savings (incremental)

| Year | Forecast Residential DSM savings (GWh) | Forecast Commercial DSM savings (GWh) | Forecast Industrial DSM savings (GWh) | DSM captured by Residential end use forecast (GWh) | DSM captured by Comm/Ind end use forecast (GWh) | DSM Adjustment for Residential with Coefficient (GWh) | DSM Adjustment for Comm/Ind with Coefficient (GWh) |
|------|----------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------------------|-------------------------------------------------|-------------------------------------------------------|----------------------------------------------------|
| 2024 | 60.9                                   | 69.4                                  | 12.3                                  | 27.0                                               | 45.1                                            | 33.9                                                  | 36.6                                               |
| 2025 | 65.6                                   | 71.3                                  | 12.6                                  | 29.1                                               | 46.3                                            | 36.5                                                  | 37.6                                               |
| 2026 | 69.6                                   | 56.7                                  | 10.0                                  | 30.9                                               | 36.8                                            | 38.7                                                  | 29.9                                               |
| 2027 | 71.6                                   | 55.7                                  | 9.8                                   | 31.8                                               | 36.2                                            | 39.8                                                  | 29.4                                               |
| 2028 | 73.0                                   | 62.9                                  | 11.1                                  | 32.4                                               | 40.8                                            | 40.6                                                  | 33.2                                               |
| 2029 | 73.7                                   | 52.2                                  | 9.2                                   | 32.7                                               | 33.9                                            | 41.0                                                  | 27.5                                               |
| 2030 | 73.3                                   | 51.0                                  | 9.0                                   | 32.5                                               | 33.1                                            | 40.8                                                  | 26.9                                               |
| 2031 | 74.1                                   | 48.0                                  | 8.5                                   | 32.9                                               | 31.2                                            | 41.2                                                  | 25.3                                               |
| 2032 | 73.2                                   | 46.8                                  | 8.3                                   | 32.5                                               | 30.4                                            | 40.7                                                  | 24.7                                               |
| 2033 | 71.3                                   | 43.4                                  | 7.7                                   | 31.7                                               | 28.2                                            | 39.6                                                  | 22.9                                               |
| 2034 | 69.1                                   | 44.0                                  | 7.8                                   | 30.7                                               | 28.6                                            | 38.4                                                  | 23.2                                               |

The methodology used to determine the DSM coefficient only works for levels of DSM that have been relatively consistent throughout the historical data set and does not imply that only a portion of future DSM will impact sales. If forecasts for DSM change significantly then this methodology will have to be revisited. One potential approach might be to treat net new incremental levels of DSM (those above the historical norm) as not being embedded in the forecast variables and subtracted at 100 percent for a period of time, but this will have to be evaluated with any proposed change to DSM levels.

A breakdown of the impact of DSM by class is provided in **Section 9**.

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4.7 Renewable to Retail

One application has been submitted by a third party to the NSUARB for approval as a Licensed Retail Supplier (LRS) to provide service under the RTR tariffs starting in 2025.<sup>31</sup> The service is forecast to produce 340 GWh of energy through wind production when fully operational in 2026, and will serve approximately 250 GWh of load with 31 percent serving residential customers, 45 percent serving commercial customers, and 24 percent serving industrial customers. The corresponding energy amounts have been subtracted from the forecast starting in 2025 as outlined in **Figure 36**. Although load will be migrating from the various customer classes to the RTR market, part of the energy required to supply those customers will be provided by NS Power as top-up under the Energy Balancing Service tariff (approximately 140 GWh). The peak forecast remains unchanged as NS Power is required to serve the full peak of these customers if needed.

**Figure 36: RTR Forecast by Class**

| Class             | 2025 Impact (GWh) | 2026+ Impact (GWh) |
|-------------------|-------------------|--------------------|
| Residential       | 18                | 75                 |
| Small General     | 1                 | 7                  |
| General Demand    | 23                | 97                 |
| Large General     | 2                 | 8                  |
| Small Industrial  | 1                 | 4                  |
| Medium Industrial | 10                | 39                 |
| Large Industrial  | 5                 | 16                 |
| <b>Total</b>      | <b>61</b>         | <b>246</b>         |

<sup>31</sup> The effective date for sales from a retail supplier to a retail customer to commence under s.3C(1) of the Electricity Act has not been set. As such, the licence issued by the NSUARB included a condition that no sales can occur before the effective date prescribed by the Governor in Council. In addition, it is a condition of the license issued by the NSUARB that if no electricity is sold to a customer under the authority of the license by December 31, 2024, the Licensed Retail Supplier must apply to the NSUARB to show cause why the licence should not be cancelled at that time (M10293).

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5.0 RESIDENTIAL SECTOR

The Residential sales forecast is generated as the product of a residential average use forecast and a customer count forecast. The residential average use model is specified using a SAE model structure and the customer count forecast is based on forecast housing completions. Full details on the residential SAE model can be found in **Appendix B** and in **Attachment 5**. As outlined in **Section 4.4**, projections for EVs and residential solar are added to the modeled load projection. New customers are also added outside of the model.

On a weather normalized basis, residential sales grew by 1.6 percent between 2022 and 2023 due to continued work-from-home activity, increased number of new customers, and an increased number of heat pumps. **Figure 37** shows a breakdown of the different components for 2021, 2022 and 2023 actuals vs forecast and weather normalized totals, and the 2024 forecast.

**Figure 37: Comparison of Forecast to Actuals**

| Year                   | 2021 | 2022 | 2023 | 2024 |
|------------------------|------|------|------|------|
| Forecast Sales         | 4718 | 4715 | 4830 | 5175 |
| Weather variance       | -141 | -127 | -126 | -    |
| Other variance         | +42  | +263 | +230 | -    |
| Actual Sales           | 4619 | 4851 | 4934 | -    |
| Weather-adjusted sales | 4760 | 4978 | 5060 | 5175 |

As discussed in **Section 4.4**, the “Other variance” amounts for 2022 and 2023 were found to be related to large variances in the winter months and are assumed to be mostly heating related, though they may also include portions that are not weather dependent. As a test of the updates to the residential class, for the last three filings of the Load Forecast Report (LFR), the most recent year (12 months) of their respective actual load was held for testing, and the 10 prior years were used to run the residential SAE model. Then a statistical comparison of the model fit for the 12 most recent months (which also include actual weather) can be made to each LFR (each of which has its own assumptions about

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electrification). The 2024 updates to heating intensity (see **Figure 22**) reduce the variance significantly as shown in **Figure 38**:

**Figure 38: Comparison of Forecast to Actuals – One Year Ahead.**

| Load Forecast Report | Year forecasted | MAD. <sup>32</sup> | MAPE. <sup>33</sup> | Predicted Avg Sales (kWh/cust) | Customer Count | Sales Forecast (GWh) | Actual Sales (GWh) | Variance (GWh) | % Variance |
|----------------------|-----------------|--------------------|---------------------|--------------------------------|----------------|----------------------|--------------------|----------------|------------|
| 2022                 | 2021            | 20.4               | 2.6%                | 9,531                          | 482,771        | 4,601                | 4,661              | 59.5           | 1.3%       |
| 2023                 | 2022            | 48.9               | 6.4%                | 9,641                          | 488,654        | 4,711                | 4,822              | 110.6          | 2.3%       |
| 2024                 | 2023            | 15.4               | 1.8%                | 10,064                         | 495,055        | 4,982                | 4,986              | 3.8            | 0.1%       |

The adjusted heating intensities are expected to result in a smaller unexplained variance in future years.

The COVID-19 variable that was added in 2020 continues to be used. The variable is reduced after July 2022 to reflect the end of specific restrictions. The impact of the variable to the Residential forecast is approximately +100 GWh in 2024 and beyond, and assumes that the increase in recent years which is attributed to more people working from home on a regular basis will continue. As the historic sales data begins to encompass more of the post-COVID years it is expected that this variable will continue to decrease in magnitude in future forecasts.

2023 was higher than forecast despite being a warm year, and 2024 sales are expected to be in line with the 2023 weather normalized results. A decline in 2026 is the result of load migrating to the RTR market, while the long-term change from increasing to flat sales is driven by the lower EV forecast as well as the increased behind the meter solar forecast. As with previous forecasts, new customers and increased electric heating will increase sales, while DSM and naturally occurring efficiency improvements will decrease sales over

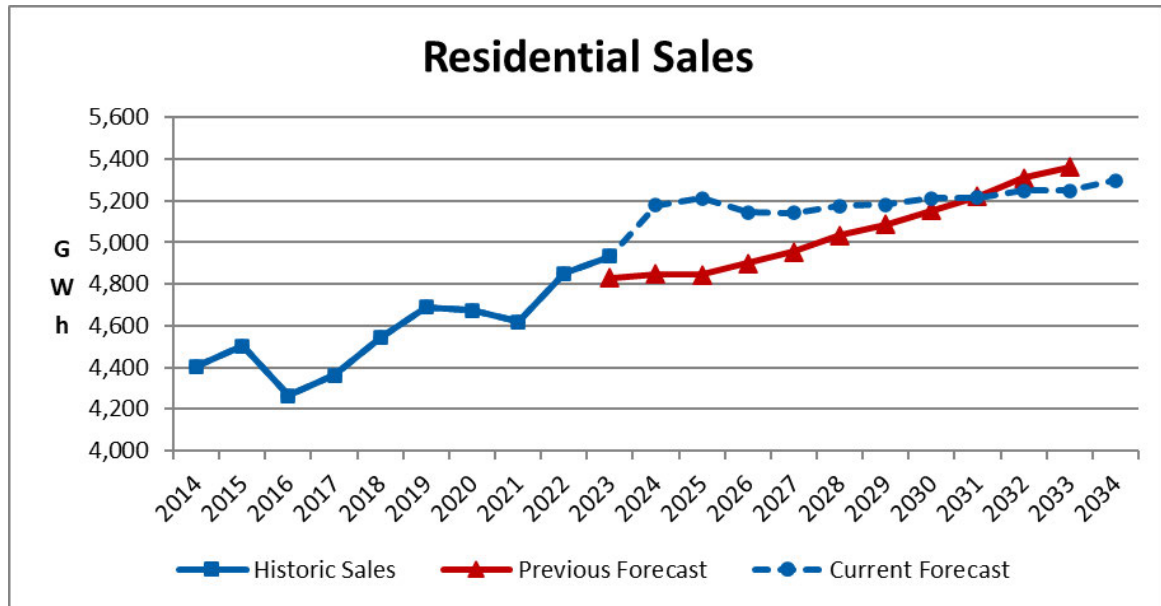
<sup>32</sup> Mean absolute deviation.

<sup>33</sup> Mean absolute percentage error.

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time. Over the 2024-2034 period, forecast sales in this class increase 0.2 percent annually. Historical and forecast annual residential sector loads are shown in **Figure 39**.

**Figure 39: Historical and Forecast Annual Residential Sales**



The forecast for new construction in 2023 was for 6,177 units, while actual customer growth was 6,401. Nova Scotia's population continues to increase (see **Figure 11**) through immigration from abroad and from other provinces. The Conference Board of Canada predicts continued population growth, with almost 87,000 more people in the province by 2034. New housing is expected to be almost 52,000 new units by 2034, with 35,700 new multi-unit residences and 16,200 single family homes. Single-family homes are assumed to use approximately 16,000 kWh per year on average, while multi-unit homes use 4,860 kWh per year on average. In addition to using these averages, a structural index was applied that considers building shell efficiency (BSE from the EIA forecast) as well as projected changes in house size. Building efficiency is expected to improve, although based on calibration done in 2013, improvements are expected to be lower in Nova Scotia than in the EIA forecast for New England. While efficiency is expected to increase, house size

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is also expected to continue increasing, albeit at a slower rate than in previous years. These two factors combined lead to a steady average use per new residential customer. Building shell efficiency, floor area and the resulting structural index are in **Figure 40**. Future surveys will help to identify trends in this area.

**Figure 40: Building Characteristics and Structural Index**

| Year | BSE Heat EIA<br>(New England) | BSE Heat NS | Floor Area (m <sup>2</sup> ) | Structural Index |
|------|-------------------------------|-------------|------------------------------|------------------|
| 2024 | 0.925                         | 0.968       | 152.9                        | 1.000            |
| 2025 | 0.920                         | 0.967       | 153.2                        | 1.001            |
| 2026 | 0.914                         | 0.965       | 153.4                        | 1.001            |
| 2027 | 0.908                         | 0.964       | 153.7                        | 1.001            |
| 2028 | 0.901                         | 0.962       | 153.9                        | 1.000            |
| 2029 | 0.895                         | 0.959       | 154.0                        | 0.999            |
| 2030 | 0.888                         | 0.957       | 154.2                        | 0.997            |
| 2031 | 0.881                         | 0.954       | 154.3                        | 0.995            |
| 2032 | 0.874                         | 0.951       | 154.4                        | 0.992            |
| 2033 | 0.868                         | 0.949       | 154.5                        | 0.991            |
| 2034 | 0.862                         | 0.948       | 154.6                        | 0.990            |

**Figure 41** provides a breakdown of the components of the Residential forecast at the system level. Please refer to **Appendix B** for tables with a detailed breakdown of the changes from 2024 to 2034.

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Figure 41: Residential Sales Components by Year

| Year | Regression Model Output (GWh) | New Cust. (GWh) | Hybrid Adjust. (GWh) | Solar Impact (GWh) | EV Impact (GWh) | RTR Sales (GWh) | DSM Adjust. (GWh) | Total Sales (GWh) | Total Res. DSM <sup>34</sup> (GWh) | DSM captured by end uses <sup>35</sup> (GWh) |
|------|-------------------------------|-----------------|----------------------|--------------------|-----------------|-----------------|-------------------|-------------------|------------------------------------|----------------------------------------------|
| 2024 | 5181                          | 62              | 0                    | -44                | 10              | 0               | -30               | 5180              | -55                                | -24                                          |
| 2025 | 5220                          | 120             | 0                    | -71                | 23              | -18             | -63               | 5211              | -114                               | -51                                          |
| 2026 | 5240                          | 173             | -26                  | -99                | 31              | -75             | -98               | 5146              | -177                               | -79                                          |
| 2027 | 5271                          | 220             | -53                  | -131               | 41              | -75             | -133              | 5140              | -241                               | -108                                         |
| 2028 | 5349                          | 262             | -79                  | -165               | 54              | -75             | -170              | 5176              | -307                               | -137                                         |
| 2029 | 5403                          | 300             | -106                 | -204               | 71              | -75             | -207              | 5183              | -373                               | -166                                         |
| 2030 | 5483                          | 333             | -132                 | -246               | 93              | -75             | -243              | 5213              | -439                               | -196                                         |
| 2031 | 5522                          | 363             | -144                 | -298               | 126             | -75             | -280              | 5215              | -506                               | -226                                         |
| 2032 | 5585                          | 386             | -155                 | -350               | 172             | -75             | -317              | 5248              | -572                               | -255                                         |
| 2033 | 5605                          | 408             | -166                 | -407               | 235             | -75             | -352              | 5249              | -636                               | -284                                         |
| 2034 | 5647                          | 428             | -177                 | -461               | 322             | -75             | -387              | 5298              | -698                               | -311                                         |

Figure 42 provides an approximation of the heat pump heating, heat pump cooling, electric baseboard, and water heater loads at the system level (these are included in the Regression Model Output column). This approximation uses the same methodology as outlined in the response to NSUARB IR-12 (e) from the 2020 Load Forecast, where the end-use intensity is multiplied by the number of existing customers, the appropriate X coefficient from the regression model, and either the HeatUse variable or the CoolUse variable (see **Appendix B** for details of these components). As this assumes that the X variables apply equally to all end uses, which may not be the case, the numbers are illustrative only. These numbers also do not include any DSM amounts that would impact the specific end use.

<sup>34</sup> Total DSM is the amount from Figure 20, adjusted for losses and with approximately 0.4 percent allocated to the Municipal class customers.

<sup>35</sup> These amounts are embedded in the Regression Model Output column through the end use efficiency estimates, i.e. the amount not captured by the DSM coefficient.

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Figure 42: Illustrative Contribution of Specific End Uses

| Year | HP Heat<br>(GWh) | HP Cool<br>(GWh) | Baseboard Heat<br>(GWh) | Water Heat<br>(GWh) |
|------|------------------|------------------|-------------------------|---------------------|
| 2024 | 980              | 136              | 1025                    | 816                 |
| 2025 | 1067             | 146              | 979                     | 831                 |
| 2026 | 1142             | 155              | 922                     | 843                 |
| 2027 | 1214             | 165              | 864                     | 855                 |
| 2028 | 1297             | 176              | 821                     | 873                 |
| 2029 | 1363             | 187              | 773                     | 888                 |
| 2030 | 1442             | 198              | 735                     | 904                 |
| 2031 | 1506             | 207              | 691                     | 912                 |
| 2032 | 1577             | 217              | 653                     | 923                 |
| 2033 | 1626             | 226              | 611                     | 929                 |
| 2034 | 1680             | 235              | 577                     | 937                 |

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**6.0 COMMERCIAL SECTOR**

The Commercial SAE model creates a unique forecast for the Small General and General rate classes. Like the residential model, the commercial SAE models express monthly sales as a function of heating, cooling, and other loads. The Small General forecast is based on a monthly SAE average use model and a separate customer forecast. The General rate class model is estimated on a total monthly sales basis (class level sales vs customer level) where total monthly billed sales is a function of total monthly heating requirements, cooling requirements, and other use. The end-use variables are constructed by interacting annual end-use intensity projections that capture end-use intensity trends, with GDP and employment, real price, monthly HDD and CDD and a variable accounting for the number of days in each month. As discussed in the introduction, employment by sector has been added to the commercial intensity models to calibrate the underlying NRCAN data for the Atlantic provinces to Nova Scotia specifically.

A detailed breakdown of the two commercial SAE models is provided in **Appendix B** and in **Attachments 6** and **7**. Although sales were negatively impacted by the COVID-19 pandemic in 2020 and 2021, commercial sales rebounded in 2022 along with the economy, and grew in 2023 (though less than forecast). **Figure 43** shows the drop in 2020 and 2021 followed by the rebound in 2022.

For 2024, the impact of RTR has increased (-112 GWh compared to -64 GWh in the 2023 forecast), and the EV load has decreased (+244 GWh by 2034 compared to +403 GWh in the 2023 forecast), resulting in lower growth than the previous forecast.

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Figure 43: Commercial Class Sales

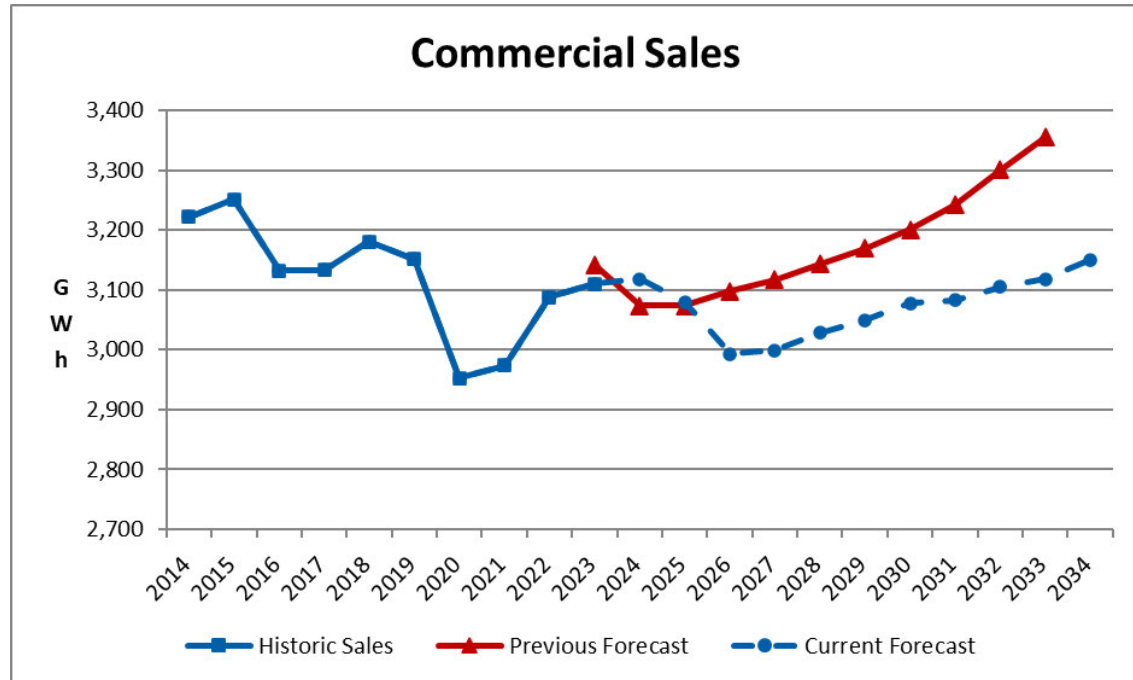
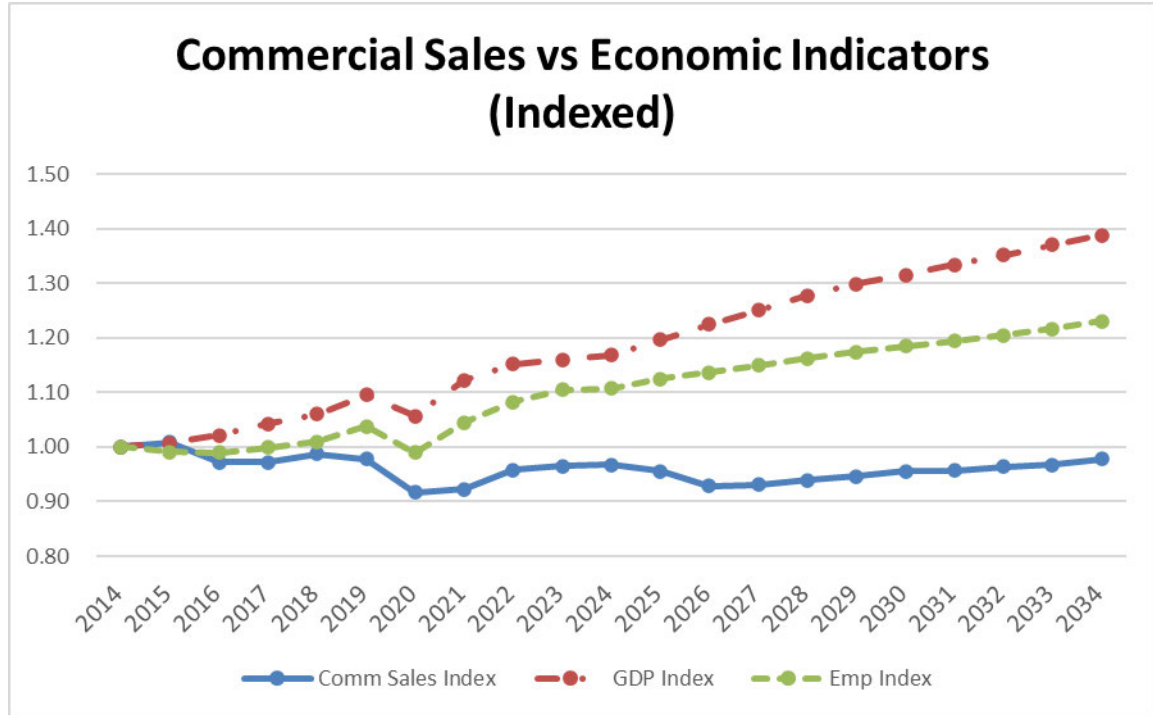


Figure 44 shows a comparison of commercial energy sales to both GDP and employment indicators for Nova Scotia. The sharp drop in 2020 is of a relatively similar magnitude in all three measures. Sales continue to lag the rebound in the economic variables, likely related to reduced opening hours at many retail establishments. A specific COVID variable was added to the General rate class model in 2023 to help account for the likely continued lag in sales in the forecast years (around -57 GWh/year).

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Figure 44 Commercial Sales vs Economic Indicators

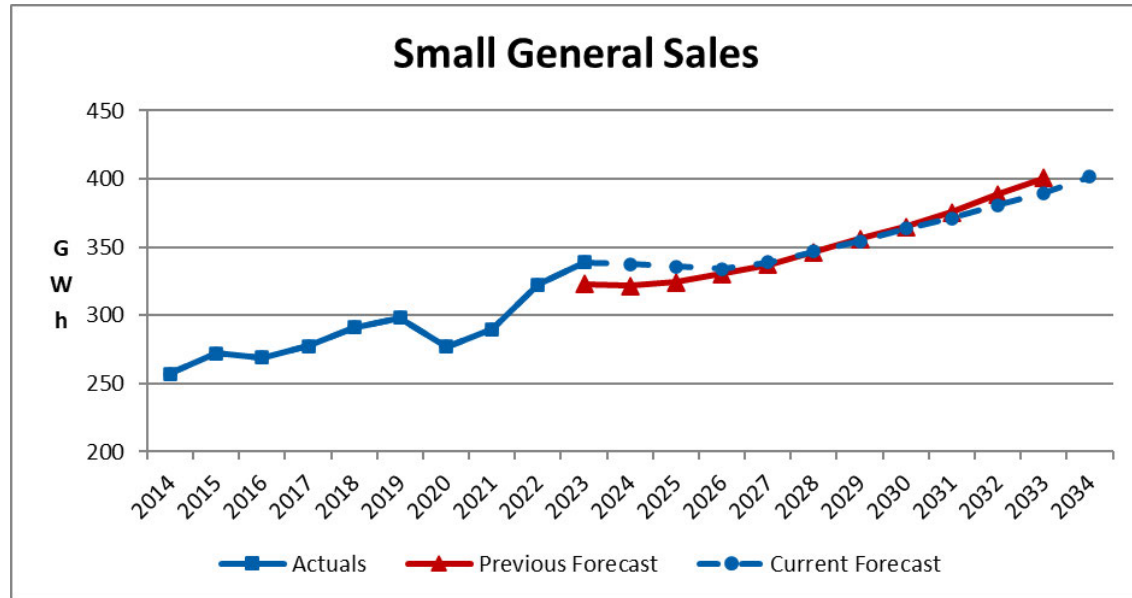


### 6.1 Small General Service

Historical and forecast Small General service loads are shown in **Figure 45**. Small General service load shows an average annual increase of 1.8 percent compared to an increase of 2.2 percent per year in the 2023 Load Forecast. Commercial electrification of heating will be offset by a combination of DSM and decreased intensity forecasts for the ventilation, lighting and miscellaneous end uses. As with the 2023 Load Forecast, the heating penetration from the residential class was used as the end-use intensities are similar.

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Figure 45: Historical and Forecast Annual Small General Sales



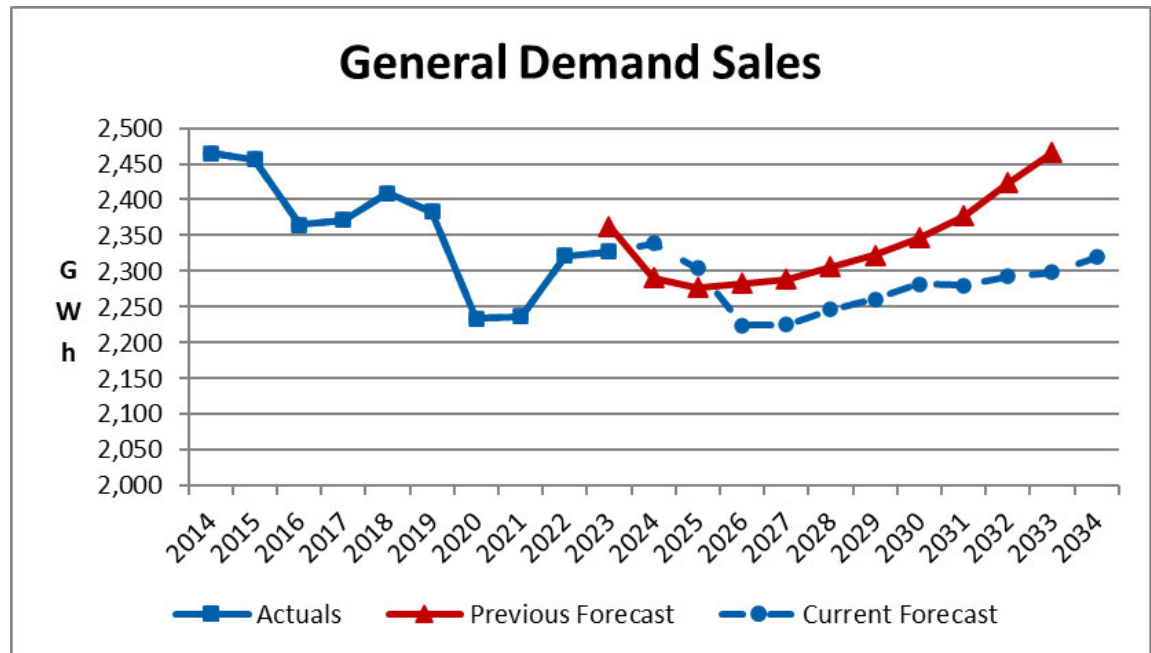
Please refer to **Appendix B** for tables with a detailed breakdown of the changes from 2024 to 2034. Total change between 2024 and 2034 is an increase of 19 percent.

## 6.2 General Service

Historical and forecast General class sales are shown in **Figure 46**. General class load is expected to decrease by 0.1 percent per year during the 10-year forecast period, compared to an increase of 0.4 percent in the 2023 Load Forecast. The primary changes to the forecast include lower EV load as well as the commercial energy impact of the hybrid heating scenario. Increased space heating will continue to be offset by DSM programs as well as increased efficiency of the lighting and miscellaneous end uses. A drop in sales in 2026 is related to sales shifting to the RTR market (-97 GWh per year), and higher solar generation will reduce sales by a further 198 GWh by 2034.

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Figure 46: Historical and Forecast Annual General Demand Sales



Please refer to **Appendix B** for tables with a detailed breakdown of the changes from 2024 to 2034. Total change between 2024 and 2034 is a decrease of 0.8 percent.

### 6.3 Large General Service

The Large General class shows slower growth than the 2023 forecast due to revised estimates of large project completion. The class is forecast using a combination of customer survey and historical sales information. Customers are surveyed annually to determine their electricity requirements over the next three-year period. In addition, NS Power personnel are in regular contact with key customers within this class. Details on planned production levels or equipment changes help inform energy requirement expectations. In the absence of survey or publicly available information, load levels are forecast to be flat before the impact of any DSM activities. As requested in the 2024 Board Decision, **Figure 47** compares the previous two forecasts for large customer growth in the Large General class

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with actual year over year changes, and the resulting 2024 forecast which has been adjusted to account for the over estimation in prior years.

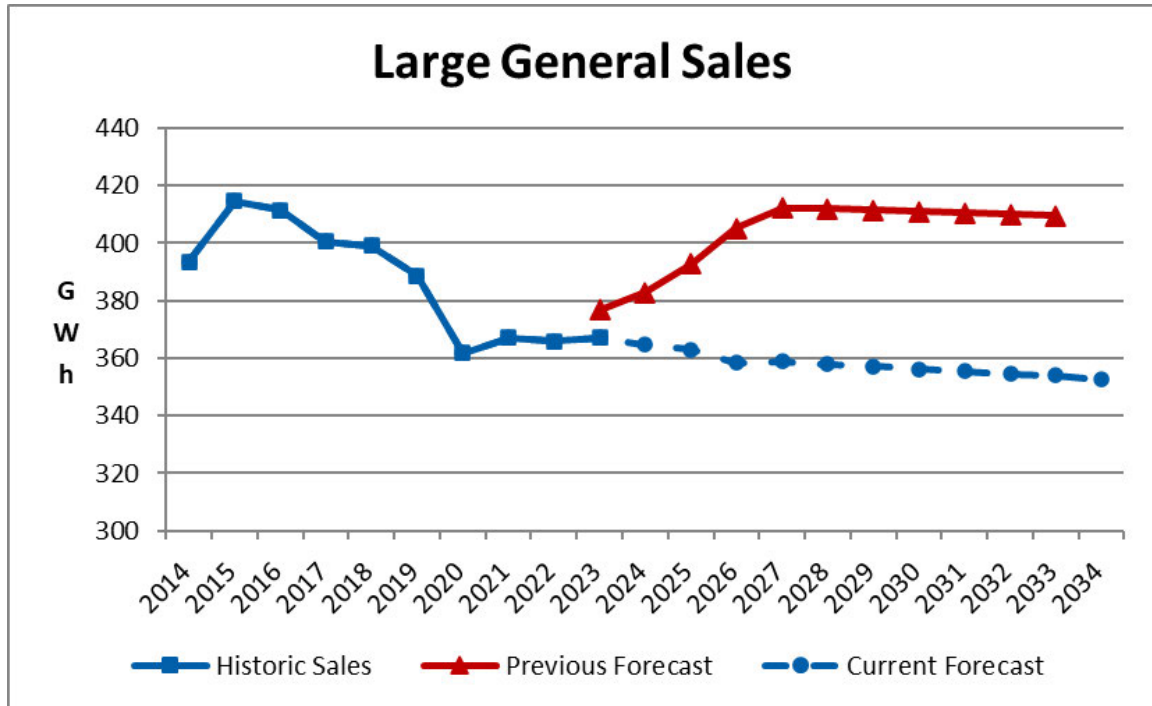
**Figure 47: Large General Annual Growth (GWh)**

| Year                  | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|-----------------------|------|------|------|------|------|------|------|
| 2022 Forecast         | 12   | 29   | 22   | 19   | 0    | 0    | 0    |
| 2023 Forecast         |      | 7    | 10   | 16   | 11   | 6    | 2    |
| Actual year over year | -1   | 1    |      |      |      |      |      |
| 2024 Forecast         |      |      | 2    | 3    | 3    | 3    | 2    |

For the 2024 survey, nine customers indicated no change to consumption, eight indicated an increase and two did not respond. Growth in this class is expected to be driven by institutional facilities, in particular expansions at several hospital sites in the province, though at a slower pace than in the 2023 forecast. The overall forecast has a decrease of approximately 12 GWh by 2034 as shown in **Figure 48**. The decline is due to DSM outweighing projected growth.

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Figure 48: Historical and Forecast Annual Large General Sales



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**7.0 INDUSTRIAL AND MUNICIPAL SECTORS**

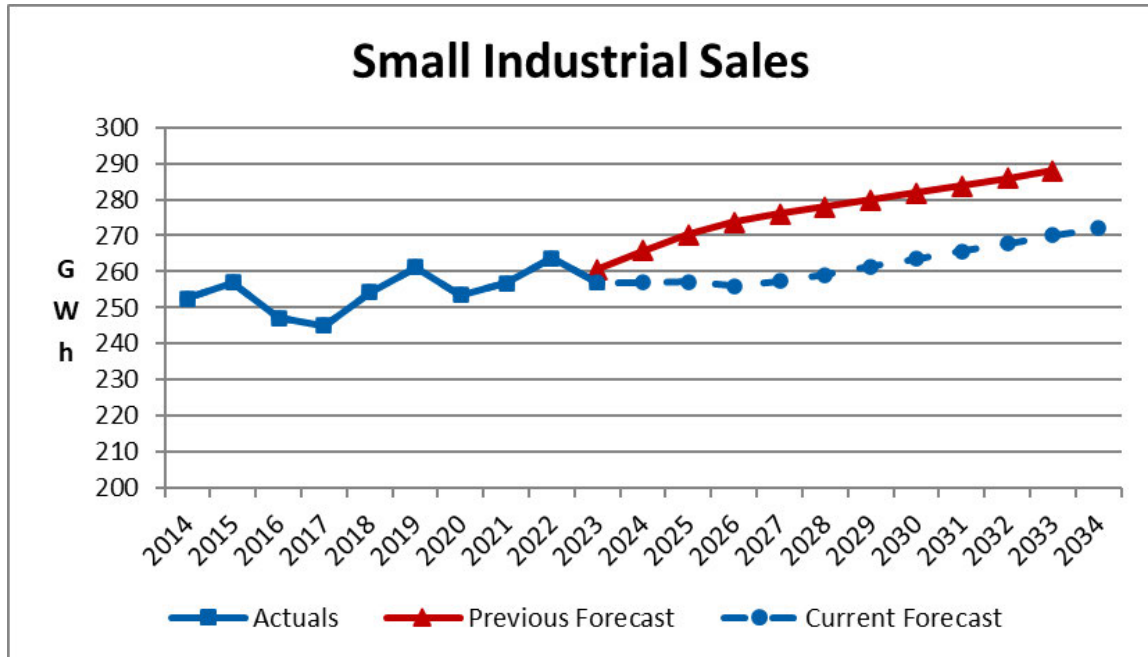
The forecast models for the Small Industrial and Medium Industrial classes are econometric-based models (i.e. dependent on economic variables). Provincial manufacturing GDP is used as the primary economic variable in the Small Industrial forecast and manufacturing employment is used for the Medium Industrial class. The Small and Medium Industrial class models are developed using monthly sales information, as opposed to annual sales, in order to align the timeframes of industrial models with those of the residential and commercial forecast models. This is required in order to implement an end-use-based peak forecast for the commercial and residential sectors. Supporting data is included in **Attachments 8 and 9**.

**7.1 Small Industrial**

**Figure 49** depicts historical and projected sales for the Small Industrial class. Sales in this class have been flat for the last 10 years and are expected to grow at 0.6 percent annually over the forecast period due to underlying economic growth offset by a migration of load to RTR (4 GWh).

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Figure 49: Historical and Forecast Annual Small Industrial Sales

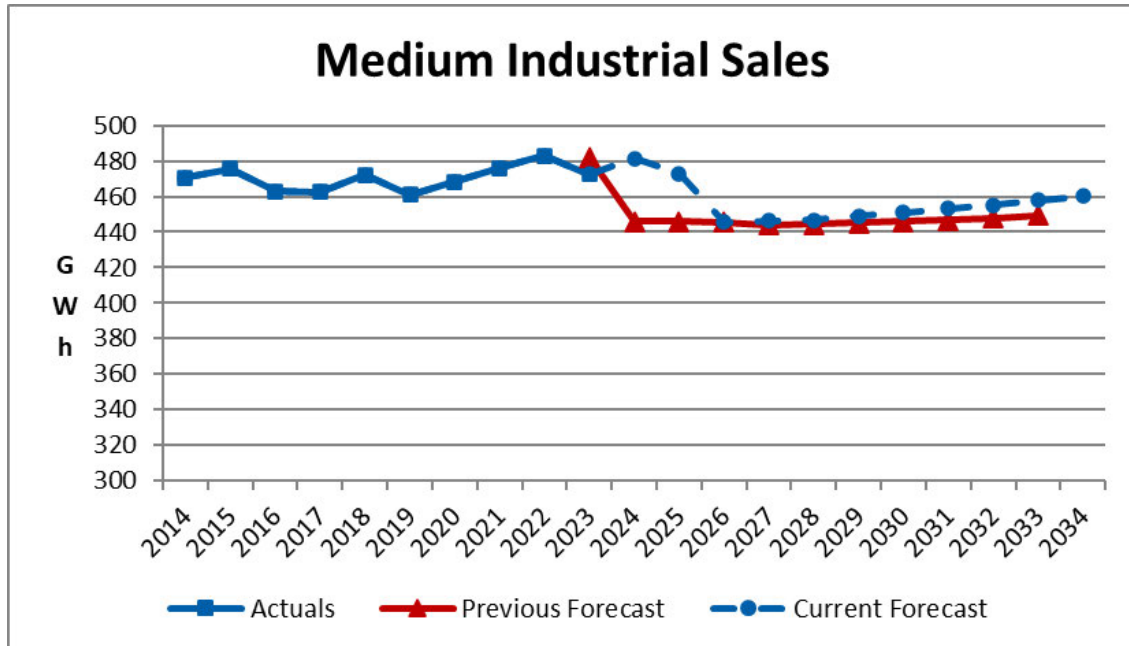


## 7.2 Medium Industrial

Figure 50 depicts historical and projected sales for the Medium Industrial class. Load in this class has been flat since 2014. There was an increase in sales between 2019 and 2022 due to several new facilities ramping up production and minimal impact from the COVID-19 pandemic restrictions. Sales are expected to decline in 2026 as load migrates to the RTR market (39 GWh), resulting in an average decline of 0.4 percent over the forecast period.

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Figure 50: Historical and Forecast Annual Medium Industrial Sales



### 7.3 Other Industrial Rate Classes

Other Industrial rate classes include Large Industrial, Large Industrial Interruptible, Generation Replacement and Load Following, One-Part Real Time Pricing, Shore Power, and the Extra Large Industrial Active Demand Control tariff.

Like the Large General rate class, load for these rate classes is forecast using a combination of customer survey and historical sales information. Customers are surveyed regularly to gather their electricity requirements over the next three-year period. Details on planned production levels or equipment changes help inform expectations on energy sales. In the absence of any survey or general public information, load levels are forecast as being flat. For the 2024 survey, twenty-one said energy consumption would remain the same, eight indicated consumption would increase, and one customer did not respond. One customer makes up over [REDACTED] of sales within this class and is forecast to increase load by [REDACTED] in 2024 compared to 2023 actuals, or a decrease of [REDACTED] compared to the 2023

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forecast. Another Large Industrial customer has temporarily reduced load to the point that they have migrated to the Medium Industrial class, but are expected to ramp up operations in 2026, offsetting load migration to the RTR market (16 GWh).

Although discussions with customers have indicated that several new facilities or expansions are expected in various industries in the coming years, there is uncertainty in the timing and magnitude of these changes. As with the customer growth in the Large General class, **Figure 51** compares the assumptions from previous forecasts to actual year over year changes. Based on the discrepancy between past estimates and actuals, the forecast for 2024 has been adjusted to account for over estimation in previous years.

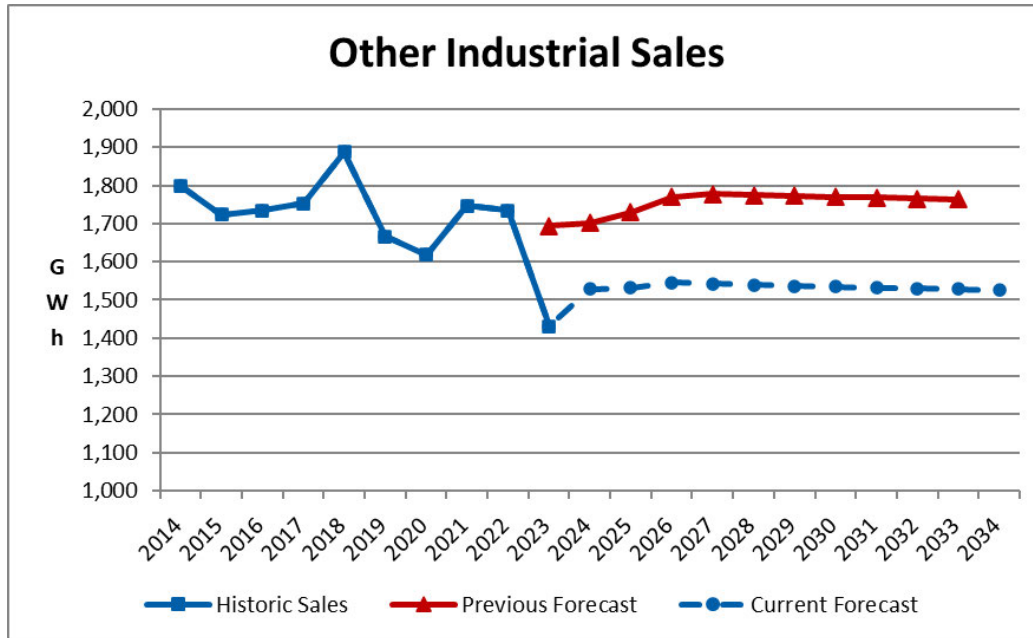
**Figure 51: Large Industrial Annual Growth (GWh)**

| Year                  | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|-----------------------|------|------|------|------|------|------|------|
| 2022 Forecast         | 11   | 13   | 36   | 30   | 1    | 1    | 1    |
| 2023 Forecast         | 0    | 3    | 10   | 49   | 29   | 10   | 1    |
| Actual year over year | -6   | -24  |      |      |      |      |      |
| 2024 Forecast         |      |      | 3    | 1    | 0    | 1    | 1    |

**Figure 52** shows the historic and forecast sales for the Other Industrial sector.

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Figure 52: Historical and Forecast Annual Other Industrial Sales



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1       **7.4   Municipal**

2  
3       The Municipal class comprises municipal electric utilities that purchase wholesale  
4       electricity from NS Power and distribute it within their own service territories. Utility loads  
5       within these municipalities include customers in residential, commercial and industrial  
6       sectors. Energy in this class also includes the losses incurred by the municipal utilities in  
7       meeting their electricity requirements.

8  
9       Since 2007, the municipal electric utilities have been able to source their electricity from  
10      providers other than NS Power through the Open Access Transmission Tariff (OATT).  
11      Four municipal electric utility customers were sourcing approximately half of their energy  
12      requirement from suppliers other than NS Power, and in 2020 increased their energy  
13      purchases to 100 percent from third parties, resulting in a reduction in municipal load of  
14      about 150 GWh from historic levels. These customers have their load served by a  
15      combination of in-province generation and either the bundled municipal rate (2023 and  
16      2024) or imported third-party generation in combination with energy under the Wholesale  
17      Market Backup/Top-Up (BUTU) Tariff in cases where their third-party supply is  
18      unavailable or interrupted. They have applied for third-party supply in 2025 and this is  
19      assumed to be their supply arrangement after 2025.

20  
21      Because NS Power is required to provide back-up capacity, including reserve margin, to  
22      the municipal electric utilities taking third-party supply in the near term and must continue  
23      to plan for serving these customers in the long term, the full amount of the municipal  
24      electric utilities' peak demand is included in the Load Forecast.

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**8.0 SYSTEM LOSSES AND UNBILLED SALES**

The difference between energy generated for use within provincial borders and the total NS Power billed sales comprises transmission and distribution system losses as well as changes to the level of unbilled sales. Energy generated and sold but not yet billed is referred to as “Unbilled” sales. System losses averaged 6.5 percent of NSR over the past five years and are forecast to remain in the 6.0 to 7.0 percent range over the 10-year forecast period.

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9.0 NET SYSTEM REQUIREMENT

The NSR is the energy required to supply the sum of residential, commercial, and industrial electricity sales, plus the associated system losses, within the province of Nova Scotia. Loads served by industrial self-generation, exports, and transmission losses associated with energy exports are not included. **Figure 53** provides a breakdown of the significant variances between forecast and actuals for 2023.

**Figure 53: 2023 Variance to Actual**

|                             | Res   | Comm  | Ind   | Other | Losses | NSR    |
|-----------------------------|-------|-------|-------|-------|--------|--------|
| <b>2023 Forecast</b>        | 4,830 | 3,142 | 2,436 | 138   | 742    | 11,288 |
| Est. Weather Impact         | -126  | -25   |       | -3    | -11    | -164   |
| Large Customer New Projects |       |       | -3    |       |        | -3     |
| Large Customer Actuals      |       |       | -260  |       |        | -260   |
| Unexplained Variance        | 230   | -8    | -12   | 19    | 40     | 270    |
| <b>2023 Actual</b>          | 4,934 | 3,110 | 2,161 | 154   | 772    | 11,131 |

Note that the largest variances are due to weather, the unexplained variance in the residential class (discussed in **Section 5**), and the variance in large customer actuals (REDACTED) of which is related to a single customer). Like 2022, 2023 was a very warm year overall, with 3,530 HDD compared to the 10-year average of 3,743. The estimated weather impact, while sizeable, it is still within the P10/P90 typical uncertainty shown in Appendix D over the years (e.g., the 2024 estimate is +/- 234 GWh). The weather impact captures both the variance in heating load in the winter months and the variance in cooling load during the summer.

From 2024 to 2034, NSR is forecast to increase at an average of 0.2 percent per year, driven mainly by new customers, space heating and EV adoption, with solar, DSM and RTR migration offsetting sales. Annual NSR is shown below in **Figure 54**. Forecast NSR values and the contribution to NSR from the different sectors can be found in **Appendix A**.

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Figure 54: Historical and Forecast Annual NSR

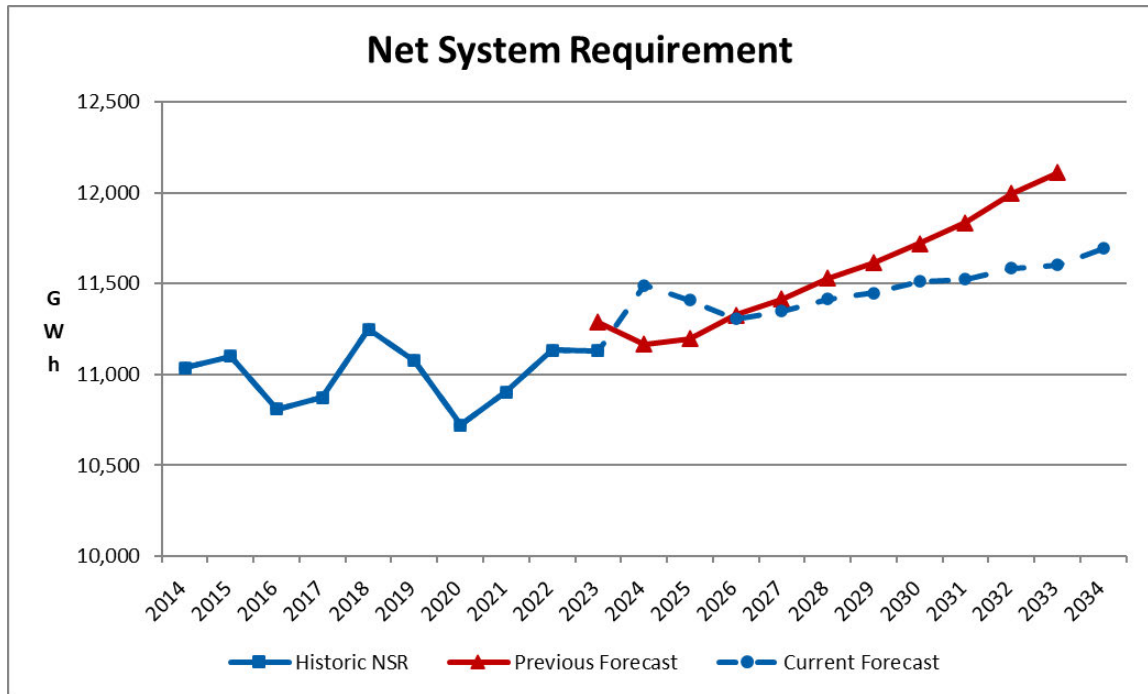


Figure 55 provides a breakdown of the various components of the change in the forecast from 2024 to 2034. Data for all classes is included in Attachment 4.

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Figure 55: Forecast Components

| GWh                               | Res          | Comm         | Ind          | Other      | Losses     | NSR           |
|-----------------------------------|--------------|--------------|--------------|------------|------------|---------------|
| <b>2024 Forecast</b>              | <b>5,180</b> | <b>3,118</b> | <b>2,267</b> | <b>159</b> | <b>767</b> | <b>11,490</b> |
| Model                             | 466          | 352          | 41           | -82        | 69         | 986           |
| New Customers                     | 366          | 32           |              |            |            | 398           |
| Solar                             | -416         | -210         |              |            |            | -627          |
| EV                                | 312          | 236          |              |            |            | 548           |
| C&I Electrification               |              | 9            | 25           |            |            | 34            |
| Large Customer Projects           |              | 9            | 42           |            |            | 50            |
| Hybrid Model Adjustment           | -177         | -63          |              |            |            | -240          |
| RTR                               | -75          | -112         | -59          | 139        |            | -246          |
| DSM                               | -356         | -221         | -57          | -3         | -61        | -699          |
| <b>2034 Forecast</b>              | <b>5,298</b> | <b>3,151</b> | <b>2,258</b> | <b>213</b> | <b>775</b> | <b>11,695</b> |
|                                   |              |              |              |            |            |               |
| Total DSM forecast                | -695         | -558         | -98          | -7         | -124       | -1,483        |
| DSM captured in underlying models | -339         | -337         | -41          | -4         | -63        | -784          |

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10.0 PEAK DEMAND

The total system peak is defined as the highest single hourly average demand experienced in a year. It includes both firm and interruptible loads. Due to the weather-sensitive load component in Nova Scotia, the total system peak occurs in the period from December through February.

Since 2015 NS Power has employed an end-use approach to deriving the peak forecast. The breakdown of energy into heating, cooling, and other load components from the energy SAE forecasts was used as an input into the peak forecast. This allowed for the impact of changing heating and cooling requirements, which drive the peak in most months, to be reflected in the peak forecast (but does not provide details of the specific underlying end uses). Details about the peak forecast model can be found in **Appendix B** and in **Attachment 10**.

For the 2024 Load Forecast, and consistent with the 2023 Load Forecast, peak mitigation for EVs as well as a contribution from forecast demand response (DR) activities are included. For 2024, the impact of the hybrid heating scenario modeled by E3 and used in the current Evergreen IRP models has been added to the peak (refer to **Figure 20**). The peak estimates for EVs are informed by E3's modeling as outlined in **Section 4.4**, with a combination of managed and unmanaged charging. DR savings amounts are based on the demand reduction amounts included in the 2022 Evergreen IRP. The individual programs within the 'Base' program are modeled and include Direct Load Control (DLC), Time Variable Pricing (TVP) and BNI Curtailment. The achievable potential of these programs was used in the Load Forecast. NS Power's IRP Action Plan has targeted 75 MW of capacity for DR deployment by 2025. The estimates in the Load Forecast have been moved back to 2028 to align with the current program development and expected ramp-up for both DLC and CPP. DR forecasts continue to use an effective load carrying capacity (ELCC) of 48 percent to account for the fact that the full nameplate capacity will not be available

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at all times, and this value will be reassessed as more information is gathered through the implementation of DR programs.

Annual DR totals by program are provided in **Figure 56**.

**Figure 56: Demand Response**

| Year | Direct Load Control (MW) | TVP Rate(MW) | Business, Non-Profit & Industrial Curtailment (MW) | Total (MW) | Total with ELCC (MW) |
|------|--------------------------|--------------|----------------------------------------------------|------------|----------------------|
| 2024 | 0                        | 2            | 0                                                  | 2          | 1                    |
| 2025 | 4                        | 4            | 1                                                  | 9          | 4                    |
| 2026 | 12                       | 12           | 2                                                  | 26         | 12                   |
| 2027 | 24                       | 22           | 4                                                  | 50         | 24                   |
| 2028 | 36                       | 32           | 6                                                  | 74         | 36                   |
| 2029 | 39                       | 36           | 7                                                  | 82         | 39                   |
| 2030 | 39                       | 35           | 6                                                  | 81         | 39                   |
| 2031 | 39                       | 35           | 6                                                  | 80         | 39                   |
| 2032 | 39                       | 34           | 6                                                  | 79         | 38                   |
| 2033 | 39                       | 34           | 6                                                  | 79         | 38                   |
| 2034 | 38                       | 33           | 6                                                  | 78         | 37                   |

A pilot project was completed in 2021 and 2022 in conjunction with E1 to investigate direct load control through water heater controls. Through the project 201 water heater controllers were procured and installed in residential homes, and testing was completed to demonstrate the benefit of utility-managed load shift events. Results from the pilot, as presented in E1's 2023 DSM Programs Evaluation Report<sup>36</sup>, indicated that the average available DR capacity per controller during the utility winter peak period is 385 W. Results indicated that capacity tends to be lower during the last hour of a four-hour event. Results also indicated that available DR capacity per controller during mornings and evenings were 430 W and 359 W, respectively.

<sup>36</sup> 2023 DSM Programs Evaluation Reports, March 28 2024, Residential Demand Response Final Report page 8

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NS Power is also working with E1 on a two-phase pilot project to investigate automatic and manual control of various loads for commercial and industrial (C&I) customers. Results from the winter 2022/2023 season, as presented in E1's 2023 DSM Programs Evaluation Report<sup>37</sup>, indicated total available DR capacity at the generator of 2.365 MW for the 9 participating C&I customers. Results also indicated that available capacity tends to vary from event to event and be lower than enrolled capacity, and that available capacity tends to vary depending on time of day, with capacity being higher in mornings than evenings. Customer recruitment was scaled up during 2023 for the 2023/2024 winter season, with the addition of 39 new customers. DR capacity results for the winter 2023/2024 season are still being evaluated.

NS Power is also working with E1 on the Eco Shift pilot which involves directly controlling residential smart thermostats, electric vehicles (EVs), EV chargers, and batteries. The two-year pilot was launched in December 2023 and recruitment of eligible smart thermostats, EVs, and EV chargers was completed. Recruitment of batteries is expected to become available in 2024. DR capacity results for the winter 2023/2024 season are still being evaluated.

As the DR projects in conjunction with E1 continue to progress, data collected will be used to inform forecast assumptions. Learnings from these pilots will be incorporated in future Load Forecasts. The impact of these initiatives, at least within the 10-year timeframe of this forecast, is expected to fall within the sensitivity analysis provided in **Section 11**. Like the interruptible load, DR programs are a resource that can be called upon if required, but they will not inherently reduce demand. In recognition of this, peak reduction from DR is included in the firm peak but is excluded from the system peak.

For the 2024 Load Forecast, as discussed in **Section 4.2**, the assumed peak temperature inputs use a lagging 12-hour average as well as windspeed. The coefficients used for peak

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<sup>37</sup> Ibid, Business, Non-profit, and Institutional Demand Response Final Report, page 22.

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normalization are the same as those used in the 2023 forecast and are described in **Figure 57** below:

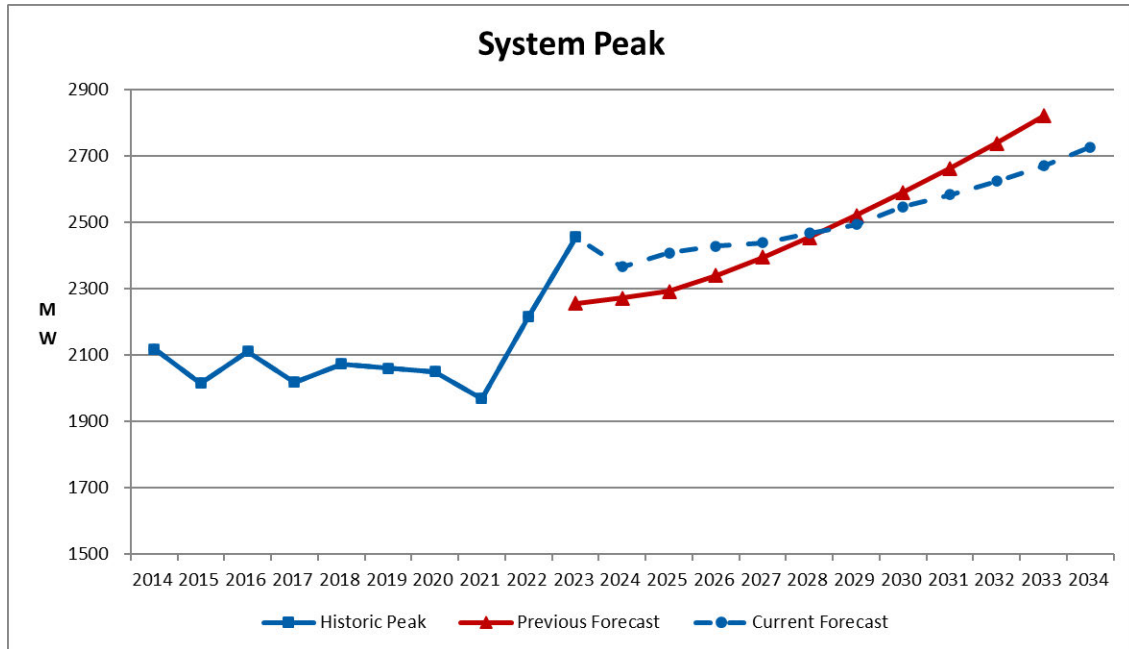
**Figure 57: Peak Regression Coefficients**

| Coefficient | Value | Description                                                                                          |
|-------------|-------|------------------------------------------------------------------------------------------------------|
| Weekdays    | 30.5  | Peaks that occur on weekdays will be 30.5MW higher than those on weekends, all else being equal.     |
| Wind        | 2.7   | Average daily windspeed will add 2.7MW for every 1km/hr. 10 year average is 18.8 km/hr on peak days. |
| 12hrAvgLag  | -28.0 | 12 hour lagging average of temperature, for a drop of 1 degree Celsius the peak will increase 28MW.  |

The peak contribution from large customer classes continues to be calculated from historical coincident load factors for each of the rate classes, and the large customer forecast is added to the accrued class forecast to obtain the total system peak. The forecast system peak for 2024 to 2034 is shown below in **Figure 58**, and is expected to increase by 1.4 percent annually. The peak is higher in the near term due mainly to the increased estimated heating load (refer to **Section 4.4**) as well as the updated 10 year average of the peak temperature from -13.9 to -14.4 degrees Celsius. In the long term the peak forecast has decreased from the 2023 forecast due to less impact from EVs as well as the impact of the hybrid heating scenario.

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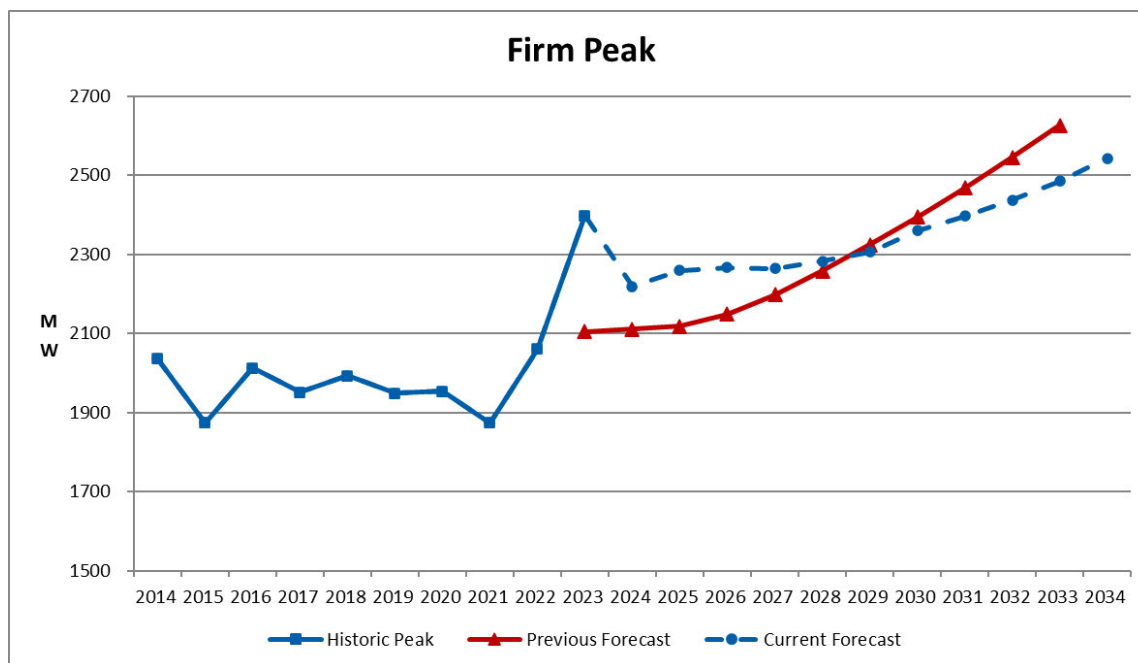
Figure 58: Historical and Forecast System Peak (no DR)



As indicated in **Figure 59**, the firm peak (system peak less interruptible and DR) is expected to increase by 1.4 percent annually.

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Figure 59: Historical and Forecast Firm Peak (including DR)



Forecast peak values, firm peak and interruptible peak information can be found in **Appendix A**.

Normalizing the firm peak for temperature, wind and weekday/weekend (and for lighting load in 2019 and 2023), the historic trend shows a better fit with the forecast peaks as shown in **Figure 60**.

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Figure 60: Weather-Normalized Firm Peak (including DR)

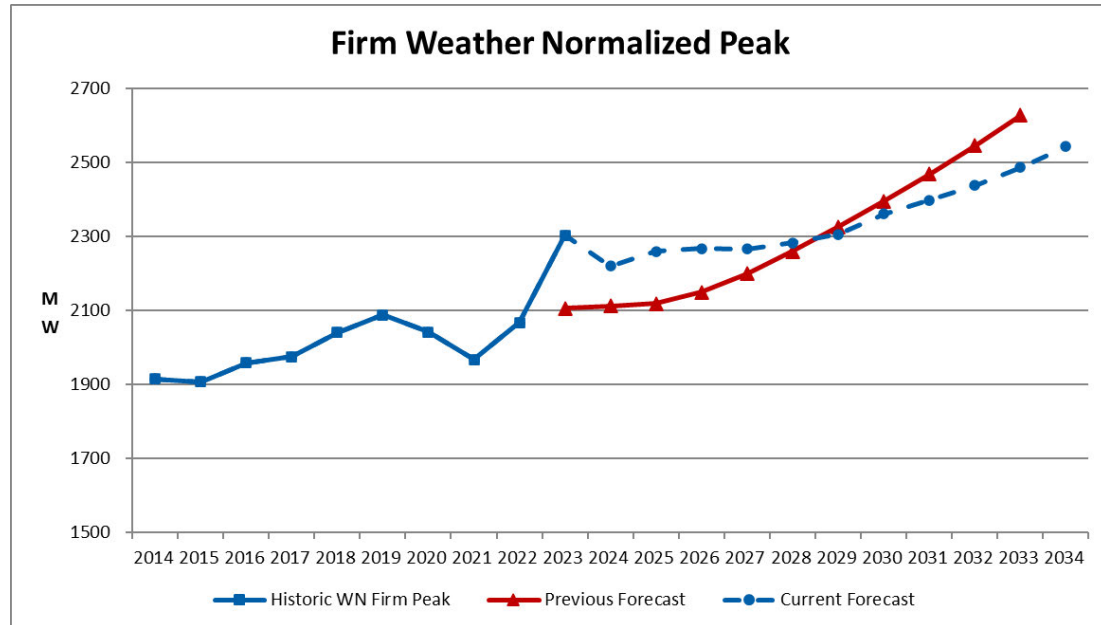


Figure 61 below shows the breakdown of the peak forecast by the various components.

Figure 61: Peak Contribution Components (MW)

|                         | Modeled Peak (MW) | Res Heat (MW) | EV (MW) | DR (MW) | Hybrid (MW) | C&I Elect. (MW) | Large Cust. (MW) | DSM (MW) | Firm Peak (MW) | Inter. Cust. (MW) | System Peak (MW) |
|-------------------------|-------------------|---------------|---------|---------|-------------|-----------------|------------------|----------|----------------|-------------------|------------------|
| 2024                    | 2,125             | 2             | 6       | -1      | -           | 0               | 104              | -16      | 2219           | 144               | 2,365            |
| 2034                    | 2,505             | 13            | 156     | -37     | -68         | 4               | 115              | -145     | 2542           | 147               | 2,727            |
| 2034 (no EV mitigation) | 2,505             | 13            | 281     | -37     | -68         | 4               | 115              | -145     | 2670           | 147               | 2,851            |

Modeled peak is the end-use forecast portion that represents the peak contribution of the Residential, Small and General Demand, Small and Medium Industrial classes, as well as losses. The contributions of the various growth programs discussed in the End-Use Intensity section are then added (including their associated losses), as well as large customer and interruptible customer contributions, and finally DSM. As discussed in

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**Section 4.4**, the EV contribution to peak is expected to be partially mitigated via utility managed charging. The firm peak without EV peak mitigation (assuming 1.6 kW/ vehicle without mitigation) would grow at 1.9 percent per year, and the overall impact in 2034 would be to add approximately 128 MW to the peak compared to the base assumptions. The space heating contribution to peak based on E3's hybrid modeling (as discussed in **Section 4.4**) is also included, and is estimated to reduce peak by around 68 MW in 2034.

**Analysis of 2023 Actual Peak**

The 2023 system peak occurred at noon on Saturday, February 4 and was the highest peak recorded to date. It was the coldest day in almost 20 years with a 12-hour lagging average temperature of -22.8°C and a daily average windspeed of 28.4 km/h. Large customer interruptions were called at the time of peak, reducing their contribution to system peak. The recorded peak was 2,455 MW with a firm peak of 2,398 MW, while the normalized firm peak is estimated to be 2,302 MW. **Figure 62** provides a breakdown of actual system peak compared to the forecast for 2022.

**Figure 62: Forecast Peak Variance vs Actuals**

|                                | MW           |
|--------------------------------|--------------|
| <b>2023 Forecast Peak</b>      | <b>2,256</b> |
| Interruptible                  | -88          |
| Weather (-22.8°C 12hr lag avg) | +250         |
| Wind (28.4 km/h daily avg)     | +26          |
| Weekend                        | -30          |
| Lighting (estimated)           | -150         |
| Unexplained                    | +191         |
| <b>2023 Feb Peak</b>           | <b>2,455</b> |

The nature of this peak is one that falls outside the abilities of a regression model to accurately predict, even when adjusting for weather, day of week and time of day (lighting). All those predictors are based on average, or close to average values, as the majority of the

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historic data on which these are modeled would be close to average, which is why the “Unexplained” portion is so large compared to a peak set under more typical conditions. This peak would be best evaluated by comparison to a low probability “tail” estimate, such as a P90, as that would cover the more extreme possibilities as far as weather is concerned. As shown in **Section 11**, the P90 value for 2024 is 2,580 MW, which would encompass the 2023 peak.

The increase to heating intensity in the 2024 forecast corrects for the unexplained variance on the energy side (refer to **Figure 38**), but it also impacts the forecast peak loads, and helps address the unexplained variance in the 2023 peak. Similar to the analysis of residential energy actuals versus forecast, as a test, the modeled peak<sup>38</sup> can be run, holding off the last 12 months of actuals of each of the last 3 LFRs. The end-use assumptions vary between forecasts, and **Figure 63** below shows that with the updated assumptions for 2024, and once accounting for weather, the uncertainty for 2023 is reduced and in line with previous years, even when in 2023 the peak experienced a rare mid-day occurrence.

**Figure 63: Comparison of Peak Forecast to Actuals – One Year Ahead.**

| Load Forecast Report | Year forecasted | MAD  | MAPE | Predicted Peak <sup>39</sup> (MW) | Peak Actual (MW) | Difference (MW) | % Difference |
|----------------------|-----------------|------|------|-----------------------------------|------------------|-----------------|--------------|
| 2022                 | 2021            | 35.2 | 2.6% | 1,718.2                           | 1,783.5          | -65.3           | -3.7%        |
| 2023                 | 2022            | 55.2 | 4.3% | 1,986.7                           | 1,967.6          | 19.1            | 1.0%         |
| 2024                 | 2023            | 52.0 | 3.6% | 2,266.5                           | 2,302.1          | -35.6           | -1.5%        |

<sup>38</sup> Modeled peak does not include all components, it is based on a regression of the system load less large customers.

<sup>39</sup> The 2023 Predicted accrued Peak was adjusted by subtracting about 150 MW of lighting that would be included in a normalized peak.

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**Solar Impact to Peak**

One question raised in the 2023 forecast proceeding was for quantitative information on the impact of solar production on peak demand. Hourly data from six community solar farms of varying size (10 kW to 67 kW) was compared to system hourly data to determine the coincidence factor (percentage of nameplate capacity at system peak time) on a monthly basis. As previously assumed, the coincidence factor in the winter months was 0 as the system peaks occurred in the evening. In the summer months, the coincidence factor was higher than previously assumed, varying from 21 percent in June to 39 percent in September. The factors by month are provided in **Figure 64**. As these are impacted by both weather patterns affecting solar production (cloud cover) as well as the timing of the system peak, both of which can vary independently from year to year, the coincident factors will have to be monitored and updated in future forecasts. Since the annual system peak forecast is assumed to occur on a cold January evening after sunset, the coincidence factor impacting the maximum demand is unlikely to change in the near term.

**Figure 64: Peak Contribution Components (MW)**

|           | Previous Coincident Factor Estimate (percent) | Updated Coincidence Factor (percent) |
|-----------|-----------------------------------------------|--------------------------------------|
| January   | 0                                             | 0                                    |
| February  | 0                                             | 0                                    |
| March     | 0                                             | 1                                    |
| April     | 0                                             | 1                                    |
| May       | 0                                             | 10                                   |
| June      | 10                                            | 21                                   |
| July      | 15                                            | 35                                   |
| August    | 15                                            | 33                                   |
| September | 10                                            | 39                                   |
| October   | 0                                             | 5                                    |
| November  | 0                                             | 0                                    |
| December  | 0                                             | 0                                    |

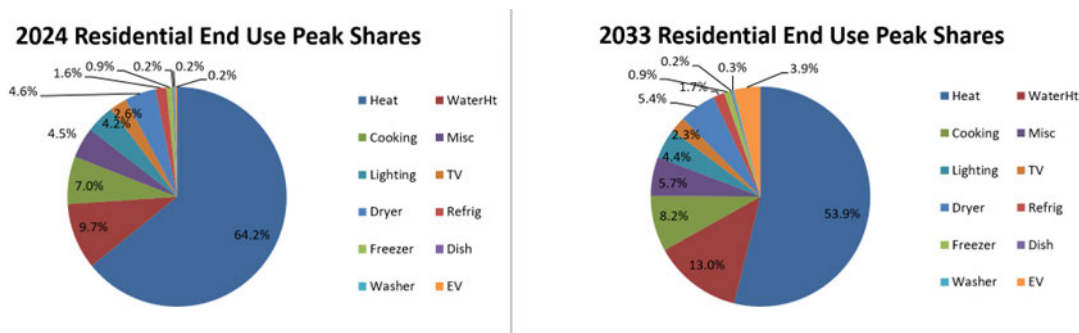
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End Use Peak Estimates

While the Load Forecast is a good statistical fit for the historical data, it presents challenges when trying to assess the contribution of individual end uses to peak by class. The overall peak forecast looks at the heating, cooling, and other variables across the Residential and Commercial classes. To illustrate the impact of the individual end uses on the peak for the individual classes, the coincident peak contribution of each class (Residential, Commercial and Industrial) is derived from load research data and fit to the energy amounts from the end-use models. The individual end-use shapes are then fit to the end-use intensity energy amounts from the end-use models.

Figure 65 below shows illustrative breakdowns of contribution to peak by Residential end use.

Figure 65: Residential End-Use Peak Shares

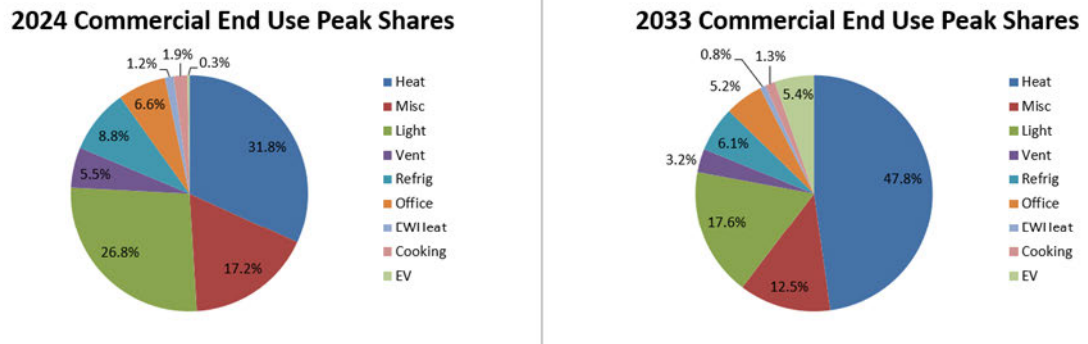


Over the forecast period the peak contribution of most end uses stays stable, with the EV contribution increasing from 0.2 percent in 2024 to 3.9 percent of the total by 2033. This scenario also shows an overall decrease in the relative contribution to peak from electric heating sources that fall from 64.2 percent to 53.9 percent.

Figure 66 shows the breakdown in the contribution to peak by Commercial end use.

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Figure 66: Commercial End-Use Peak Shares



The trend in the Commercial classes shows that the heating component of the peak is expected to increase significantly over the forecast period, driven by the increased space heating electrification and commercial EVs. All other categories decreased through the forecast period.

### Current Class Coincident Peak Demand Research

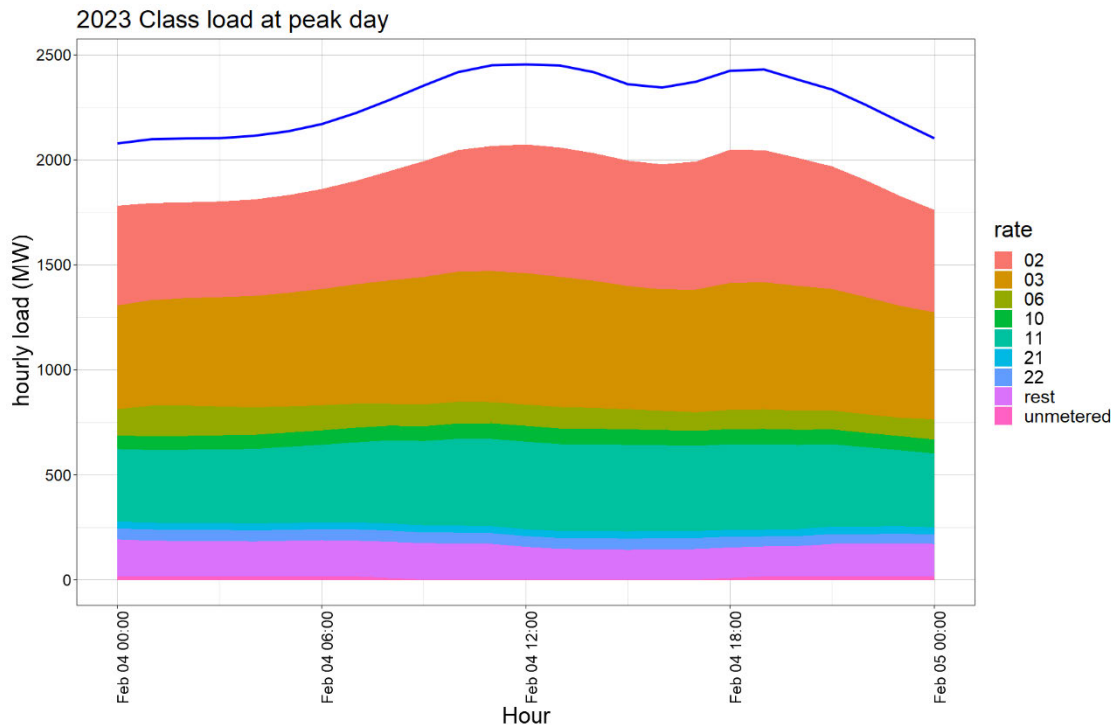
NS Power has been exploring ways of using interval data to understand peak at the class level from a bottom-up perspective, as discussed in prior Load Forecast reports. NS Power currently forecasts system peak at the aggregate level, as it is the most complete and granular information available (provided by the generation stations). Once peak information is obtained, the system peak is disaggregated into rate class contributions based on historic load factors, losses, and load research data. This year marks the first year in which the available AMI information has been incorporated into analyses instead of the older method which used the Load Research Sample (LRS).

**Figures 67 and 68** show the 2023 combined AMI for each customer class. The “rest” category is the sum of all the fully sampled (100 percent) classes, including Large Industrial customers. Rates 2 and 3 are Residential (non-all-electric and all-electric) classes and Rate 11 is the General Demand class. To create these figures, the sum of all the available AMI

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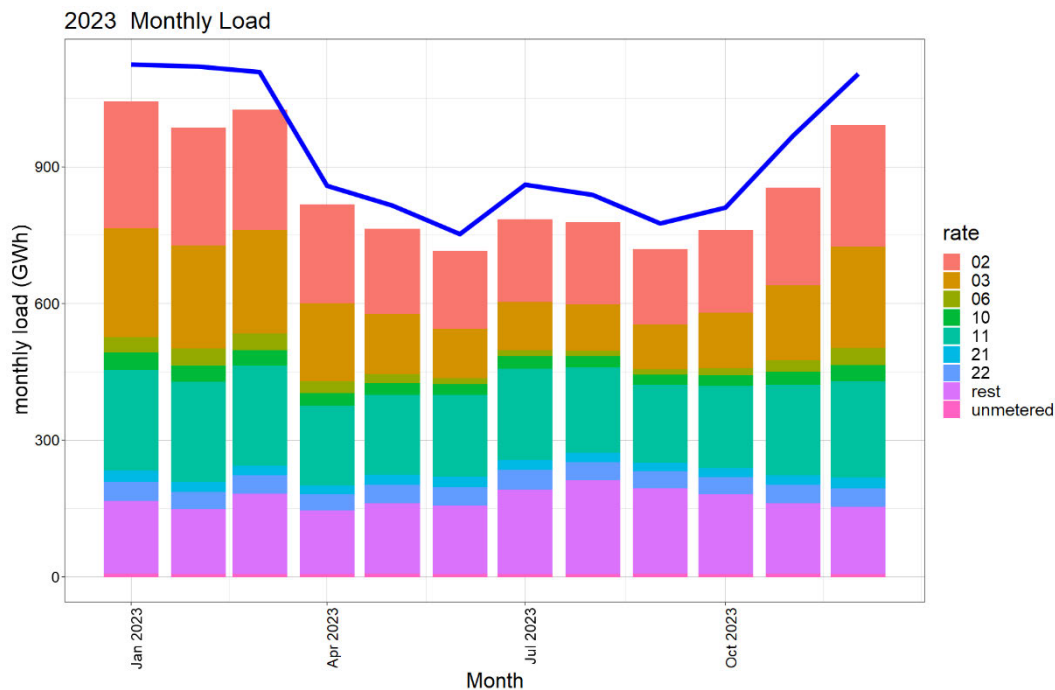
meters, per hour, per class, is later adjusted so the monthly totals correspond to revenue class sales information. Figure 69 shows how having an improved hourly resolution due to AMI makes the sum of all customer classes follow generation with greater accuracy and smoothness (the gap is system energy losses). In contrast, in previous years, similar plots would exhibit sharp edges that reflect the statistical uncertainty of the LRS information, increasingly degrading year after year.

**Figure 67: 2023 AMI class load shapes vs System Generation, 2023 Annual Peak**



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Figure 68: 2023 Monthly Load Research Data vs System Generation



Class coincident peak demand forecast using LRS and the AMI future

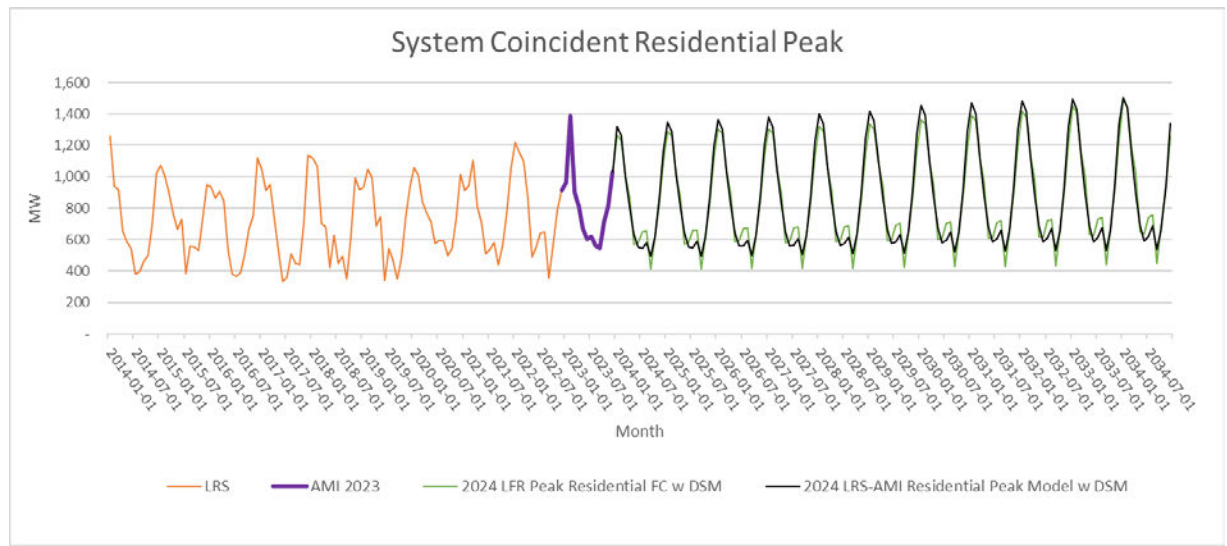
The 2024 class contribution to peak analysis is still focused on the residential class as it is less noisy and more weather dependent than any other class, which aligns well with the Peak SAE model, which is mostly dependent on peak weather. However, this year marks the first year where an entire residential hourly data series has been calculated solely relying on AMI.

This model does not need all 8760 hours available each year, only residential loads at the hour of system peak in each month of the historical series. In addition, only peak weather, relevant residential end uses and economics are needed in the right-hand side of the SAE Peak Demand equation (see **Appendix B**). **Figure 69** shows historical information, the

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current residential system coincident demand forecast (top-down model), and the resulting forecast informed by the LRS-AMI historical series (bottom-up).

**Figure 69: Monthly historical Residential LRS load at peak and forecasts**



Both the current residential peak demand forecast (green line) and the LRS peak experimental model (black line) are designed to produce a January peak forecast for a system design temperature of -14.4°C (the remaining months follow normal peak weather distributions) following the same conventions as the current system peak forecast, including the wind speed adjustment.

Differences between the forecast green (top-down) and black lines (bottom-up) highlight the different approaches and cover a range from near zero MW in the early years to 100 MW. The top-down class peak estimates rely on load factors that are updated once a year for the relevant system peak month. There is no growth model for load factors; therefore, residential trends are derived from system trends. For the current report, and as both methods show similar forecasting results (given how close they are in the early forecast years), the top-down approach continues to be used, as the top-down approach starts at

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1 system peak (the sum of all customer classes) and then AMI informed load factors are used  
2 to disaggregate it into all the classes. In the future, when a bottom-up forecast is used for  
3 all classes, the sum of all will be unlikely to match the system peak due to statistical  
4 modeling errors and therefore an extra step for adjustments will need to be made.

5  
6 Other than speeding up the process of data acquisition and improving precision, AMI may  
7 also be used for county/regional forecasts, which may shed light on how sales and peak  
8 evolve throughout the province and help with distribution and transmission planning.  
9 Electrification may have different impacts in different areas of the province, depending on  
10 local adoption trends, with regional sales trends reflecting this diversity. And in terms of  
11 peak demand, whose magnitude may also differ across regions, may also show that the  
12 time of peak is shifting depending on geography.

13  
14 The class load shapes obtained through AMI will also be used to test end-use sensitivities.  
15 For example, the Residential peak model shown above, can be used to test how changing  
16 end-use stock and efficiencies affect the magnitude of the residential peak. So far, the  
17 historical end-use series is comprised of information provided by NRCAN, NS Power  
18 surveys, and analyst adjustments (for example, to align trends with E3 scenarios); however,  
19 ongoing work with end-use disaggregation may be used to update/validate end-use  
20 assumptions (depending on accuracy per appliance type) and then used to evaluate the  
21 impact to the Residential peak.

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11.0 SENSITIVITY ANALYSIS

The sales and peak forecasts are fundamentally uncertain and depend on many variables, including economics, weather, adoption of distributed generation, electricity rates and DSM. Although each of these variables is forecast discretely, the uncertainty in these data sets will impact the load forecast to varying degrees. Load can also be affected by extraordinary events such as economic events, strikes, trade disputes, natural disasters, pandemics, and volatility in commodities.

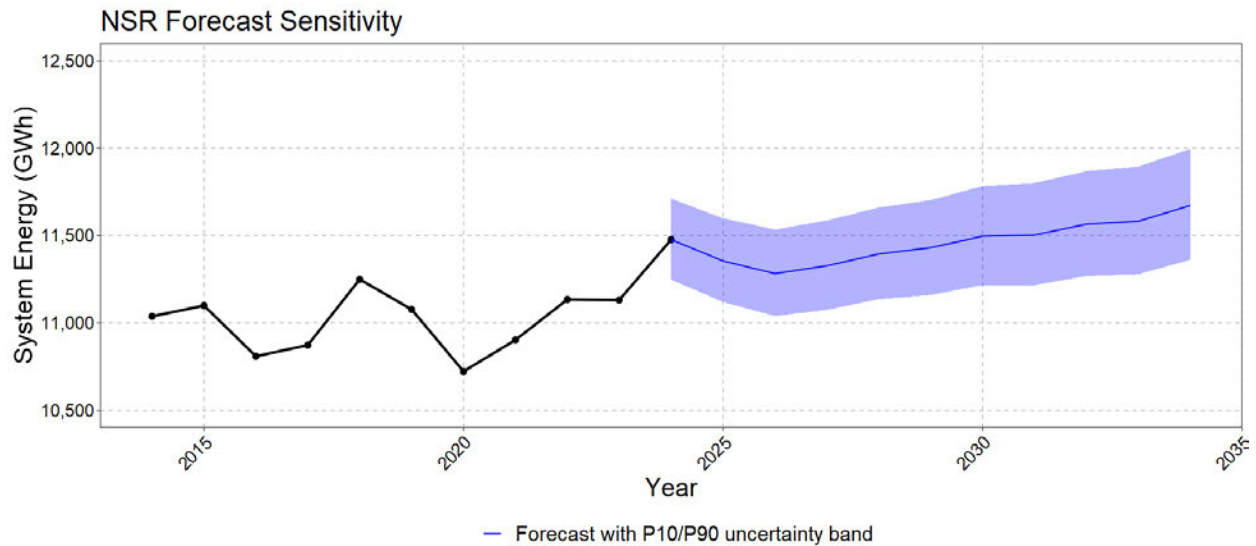
In 2017, based on recommendations from Synapse on the 2016 Load Forecast, NS Power developed a P10/P90 probability analysis using the Monte Carlo simulation approach. This was to create a high and low range for the forecast that encompasses possible (not extreme) scenarios. A full description of the sensitivity methodology is contained in Appendix D.

The probable distribution of future load is estimated by sampling 10,000 random trial values of the economics and weather each year, using their respective historical distributions.

**Figure 70** shows the sensitivity bands, which are represented by the shaded regions. These represent a range from the low 10<sup>th</sup> percentile to the high 90<sup>th</sup> percentiles (there is a 10/90 percent probability that the forecast will be below/above these shaded areas). These P10/P90 bands cover a range of approximately 468-646 GWh during the 10-year period, which is explained mainly by the impact of weather variation (HDD) and economic impact in the long term. The black line and points represent actual system totals.

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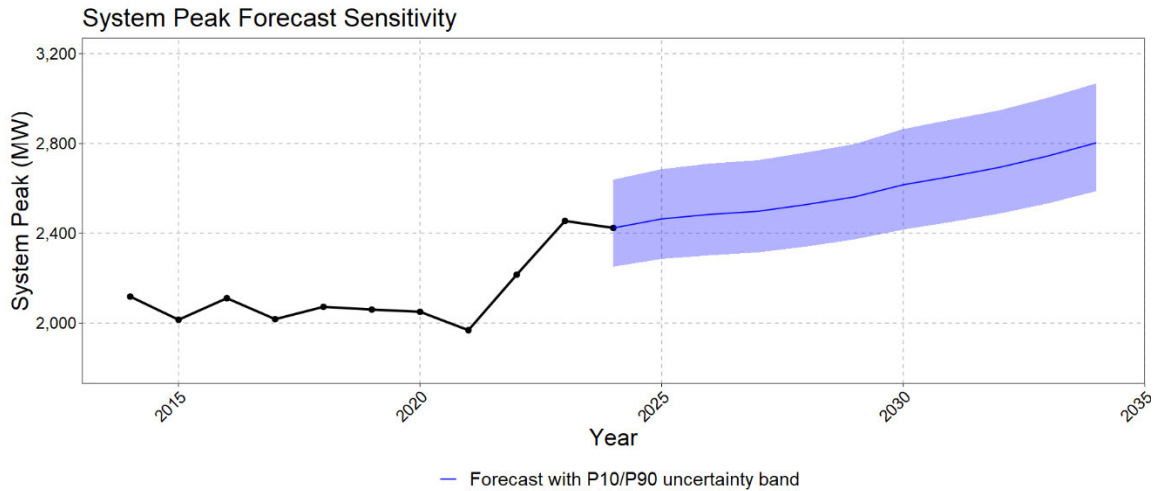
**Figure 70: System Energy Sensitivity**



Similarly, a P10/P90 scenario was created for peak demand using a random sampling of weather and economic drivers. The width of the P10/P90 envelope is approximately 430-530 MW, reflecting the greater overall variation in the peak. **Figure 71** shows the peak forecast, which includes the latest adjustments (wind and 12-hour temperature averages) to the peak end-use model.

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**Figure 71: System Peak Sensitivity**



This analysis provides a potential range of outcomes for the 2024 Load Forecast. Energy is most sensitive to economics over the long term, while peak is most sensitive to temperature. In addition, peak is more variable overall. The impacts of other inputs that cannot easily be represented by probabilistic analysis are provided in **Figure D8** in **Appendix D**.

### Evergreen IRP Comparison

**Figure 72** below compares the 2023 Load Forecast, the 2024 Load Forecast, and the Company's Evergreen IRP cases with Base DSM. The Evergreen IRP analysis incorporated the 2022 Load Forecast as its central planning case, which had a much lower estimate for load served through the RTR market (29 GWh compared to 246 GWh in the present forecast), as well as lower initial peak expectations. There are no specific assumptions around incentives that might impact EV and heat pump uptake; the values represent a slow ramp-up of uptake of these technologies that would allow interim sales targets as well as the target of net zero emissions by 2050 to be achieved. There will be more policy and regulation changes related to decarbonization targets in the course of the

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10-year timeframe of this forecast, but the scenario developed represents the likely trajectories of these technologies.

**Figure 72: 2022 Evergreen IRP Scenarios Comparison**

| Item                                              | 2024 NSR<br>Energy<br>(GWh) | 2024 Firm<br>Peak<br>(MW) | 2034 NSR<br>Energy<br>(GWh) | 2034 Firm<br>Peak<br>(MW) |
|---------------------------------------------------|-----------------------------|---------------------------|-----------------------------|---------------------------|
| 2023 Load Forecast                                | 11,168                      | 2,111                     | 12,272                      | 2,710                     |
| 2024 Load Forecast                                | 11,490                      | 2,219                     | 11,695                      | 2,542                     |
| Evergreen IRP E1 – Current Policy<br>and Trends   | 11,236                      | 2,055                     | 11,710                      | 2,454                     |
| Evergreen IRP E2 – Hybrid Peak<br>Mitigation      | 11,236                      | 2,055                     | 11,605                      | 2,336                     |
| Evergreen IRP E3 – Accelerated<br>Electrification | 11,236                      | 2,142                     | 12,573                      | 2,881                     |

**Appendix A – Forecast Values**  
**2024 NS Power Load Forecast**

**1.1 Table A1: Energy Requirement – 2024 NS Power Forecast Energy Forecast**

| <b>Year</b> | <b>Residential<br/>Sector</b> | <b>Growth</b> | <b>Commercial<br/>Sector</b> | <b>Growth</b> | <b>Industrial<br/>Sector</b> | <b>Growth</b> | <b>Municipal<br/>and Other</b> | <b>Growth</b> | <b>Losses</b> | <b>Total<br/>Energy</b> | <b>Growth</b> |
|-------------|-------------------------------|---------------|------------------------------|---------------|------------------------------|---------------|--------------------------------|---------------|---------------|-------------------------|---------------|
|             | <b>GWh</b>                    | <b>%</b>      | <b>GWh</b>                   | <b>%</b>      | <b>GWh</b>                   | <b>%</b>      | <b>GWh</b>                     | <b>%</b>      | <b>GWh</b>    | <b>GWh</b>              | <b>%</b>      |
| 2014        | 4,404                         | 1.0           | 3,222                        | -0.7          | 2,522                        | -3.1          | 198                            | -1.4          | 691           | 11,037                  | -1.4          |
| 2015        | 4,504                         | 2.3           | 3,251                        | 0.9           | 2,456                        | -2.6          | 197                            | -0.2          | 691           | 11,099                  | 0.6           |
| 2016        | 4,264                         | -5.3          | 3,133                        | -3.7          | 2,444                        | -0.5          | 179                            | -9.2          | 789           | 10,809                  | -2.6          |
| 2017        | 4,363                         | 2.3           | 3,133                        | 0.0           | 2,461                        | 0.7           | 163                            | -9.0          | 753           | 10,873                  | 0.6           |
| 2018        | 4,542                         | 4.1           | 3,181                        | 1.5           | 2,614                        | 6.2           | 154                            | -5.7          | 758           | 11,250                  | 3.5           |
| 2019        | 4,688                         | 3.2           | 3,151                        | -0.9          | 2,388                        | -8.7          | 146                            | -4.7          | 704           | 11,077                  | -1.5          |
| 2020        | 4,675                         | -0.3          | 2,957                        | -6.2          | 2,343                        | -1.9          | 68                             | -53.6         | 688           | 10,731                  | -3.1          |
| 2021        | 4,619                         | -1.2%         | 2,973                        | 0.7%          | 2,480                        | 6.0%          | 72                             | 5.6%          | 757           | 10,902                  | 1.7%          |
| 2022        | 4,851                         | 5.0%          | 3,088                        | 3.9%          | 2,480                        | 0.0%          | 69                             | -3.5%         | 645           | 11,134                  | 2.1%          |
| 2023        | 4,934                         | 1.7%          | 3,110                        | 0.7%          | 2,161                        | -12.9%        | 154                            | 122.5%        | 772           | 11,131                  | 0.0%          |
| 2024        | 5,180                         | 5.0%          | 3,118                        | 0.3%          | 2,267                        | 4.9%          | 159                            | 3.3%          | 767           | 11,490                  | 3.2%          |
| 2025        | 5,211                         | 0.6%          | 3,080                        | -1.2%         | 2,263                        | -0.2%         | 93                             | -41.8%        | 763           | 11,409                  | -0.7%         |
| 2026        | 5,146                         | -1.3%         | 2,993                        | -2.8%         | 2,247                        | -0.7%         | 171                            | 84.8%         | 750           | 11,306                  | -0.9%         |
| 2027        | 5,140                         | -0.1%         | 3,000                        | 0.2%          | 2,246                        | 0.0%          | 211                            | 23.5%         | 751           | 11,347                  | 0.4%          |
| 2028        | 5,176                         | 0.7%          | 3,028                        | 0.9%          | 2,245                        | 0.0%          | 212                            | 0.2%          | 755           | 11,416                  | 0.6%          |
| 2029        | 5,183                         | 0.1%          | 3,049                        | 0.7%          | 2,247                        | 0.1%          | 212                            | 0.1%          | 757           | 11,448                  | 0.3%          |
| 2030        | 5,213                         | 0.6%          | 3,078                        | 0.9%          | 2,249                        | 0.1%          | 212                            | 0.2%          | 762           | 11,514                  | 0.6%          |
| 2031        | 5,215                         | 0.0%          | 3,083                        | 0.2%          | 2,251                        | 0.1%          | 212                            | 0.1%          | 762           | 11,523                  | 0.1%          |
| 2032        | 5,248                         | 0.6%          | 3,105                        | 0.7%          | 2,253                        | 0.1%          | 213                            | 0.2%          | 767           | 11,585                  | 0.5%          |
| 2033        | 5,249                         | 0.0%          | 3,119                        | 0.4%          | 2,256                        | 0.1%          | 213                            | 0.0%          | 768           | 11,605                  | 0.2%          |
| 2034        | 5,298                         | 0.9%          | 3,151                        | 1.0%          | 2,258                        | 0.1%          | 213                            | 0.1%          | 775           | 11,695                  | 0.8%          |

**Table A2: Coincident Peak Demand - 2024 NS Power Forecast Peak Forecast**

| <b>Year</b> | <b>Interruptible<br/>Contribution to<br/>Peak<br/><br/>(MW)</b> | <b>Demand<br/>Response<br/>(reduction in<br/>Firm Peak only,<br/>MW)</b> | <b>Firm<br/>Contribution<br/>to Peak<br/><br/>(MW)</b> | <b>Net System<br/>Peak<br/><br/>(MW)</b> | <b>Growth<br/><br/>(%)</b> | <b>Temp at<br/>Peak<br/><br/>(deg C)</b> | <b>12hr Lag<br/>Temp<br/><br/>(deg C)</b> | <b>Notes</b>                                    |
|-------------|-----------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------|----------------------------|------------------------------------------|-------------------------------------------|-------------------------------------------------|
| 2014        | 83                                                              | -                                                                        | 2,036                                                  | 2,118                                    | 4.2                        | -19                                      | -18                                       | January 2 weekday evening                       |
| 2015        | 141                                                             | -                                                                        | 1,874                                                  | 2,015                                    | -4.9                       | -12                                      | -12                                       | January 6 weekday evening                       |
| 2016        | 98                                                              | -                                                                        | 2,013                                                  | 2,111                                    | 4.8                        | -14                                      | -15                                       | December 16 weekday evening                     |
| 2017        | 67                                                              | -                                                                        | 1,951                                                  | 2,018                                    | -4.4                       | -13                                      | -13                                       | December 28 weekday evening (between holidays)  |
| 2018        | 80                                                              | -                                                                        | 1,993                                                  | 2,073                                    | 2.7                        | -12                                      | -13                                       | January 7 weekend evening                       |
| 2019        | 111                                                             | -                                                                        | 1,949                                                  | 2,060                                    | -0.6                       | -15                                      | -14                                       | February 27 weekday morning (min lighting load) |
| 2020        | 96                                                              | -                                                                        | 1,954                                                  | 2,050                                    | -0.5                       | -13                                      | -10                                       | January 17 weekday evening                      |
| 2021        | 94                                                              | -                                                                        | 1,875                                                  | 1,968                                    | -4.0                       | -10                                      | -10                                       | March 2 weekday evening                         |
| 2022        | 155                                                             | -                                                                        | 2,061                                                  | 2,216                                    | 12.6                       | -15                                      | -14                                       | January 11 weekday evening                      |
| 2023        | 58                                                              | -                                                                        | 2,397                                                  | 2,455                                    | 10.8                       | -22                                      | -23                                       | February 4 weekend noon                         |
| 2024        | 144                                                             | 1                                                                        | 2,219                                                  | 2,365                                    | -3.7                       |                                          | -14                                       | Forecast                                        |
| 2025        | 144                                                             | 4                                                                        | 2,259                                                  | 2,408                                    | 1.8                        |                                          | -14                                       | Forecast                                        |
| 2026        | 149                                                             | 12                                                                       | 2,267                                                  | 2,428                                    | 0.8                        |                                          | -14                                       | Forecast                                        |
| 2027        | 148                                                             | 24                                                                       | 2,265                                                  | 2,437                                    | 0.4                        |                                          | -14                                       | Forecast                                        |
| 2028        | 148                                                             | 36                                                                       | 2,283                                                  | 2,466                                    | 1.2                        |                                          | -14                                       | Forecast                                        |
| 2029        | 148                                                             | 39                                                                       | 2,306                                                  | 2,493                                    | 1.1                        |                                          | -14                                       | Forecast                                        |
| 2030        | 148                                                             | 39                                                                       | 2,360                                                  | 2,547                                    | 2.2                        |                                          | -14                                       | Forecast                                        |
| 2031        | 147                                                             | 39                                                                       | 2,397                                                  | 2,583                                    | 1.4                        |                                          | -14                                       | Forecast                                        |
| 2032        | 147                                                             | 38                                                                       | 2,438                                                  | 2,623                                    | 1.5                        |                                          | -14                                       | Forecast                                        |
| 2033        | 147                                                             | 38                                                                       | 2,485                                                  | 2,670                                    | 1.8                        |                                          | -13                                       | Forecast                                        |
| 2034        | 147                                                             | 38                                                                       | 2,542                                                  | 2,727                                    | 2.1                        |                                          | -13                                       | Forecast                                        |

**Appendix B – Forecast Model Details**  
**2024 NS Power Load Forecast**

### Residential Model Detail

The residential average use SAE model is defined as a function of the three primary end uses – cooling ( $XCool$ ), heating ( $XHeat$ ) and other use ( $XOther$ ):

$$ResAvgUse_m = b_1 \times XHeat_m + b_2 \times XCool_m + b_3 \times XOther_m + b_4 \times AvgEESavings_m + b_5 \times CovidVariable_m + \sum Binaries + ARMA$$

The end-use variables incorporate both a variable that captures short-term utilization (Use) and a variable that captures changes in end-use efficiency and saturation trends (Index). The heating variable is calculated as:

$$XHeat = HeatUse \times HeatIndex$$

HeatUse is defined as:

$$HeatUse_{y,m} = \left( \frac{HDD_{y,m}}{HDD_{15}} \right) \times \left( \frac{HHSIZE_{y,m}}{HHSIZE_{15}} \right)^{HHSIZEElas} \times \left( \frac{ResEcon_{y,m}}{ResEcon_{15}} \right)^{HHIncElas} \times \left( \frac{Price_{y,m}}{Price_{15}} \right)^{PriceElas}$$

Where  $HDD_{y,m}$  is the Heating Degree Day for a given month  $m$  of the year  $y$ ,  $HHSIZE$  is the average household size,  $ResEcon$  is Employment Compensation divided by House Hold population,  $Price$  is the price of electricity for the specific customer class. Each variable uses its own elasticity, and the base line year is 2015.

HeatIndex is defined as:

$$HeatIndex = f(\text{Heating Saturation, Efficiency, Shell Integrity, Square Footage})$$

The cooling variable is defined as:

$$XCool = CoolUse \times CoolIndex$$

CoolUse is defined as:

$$CoolUse_{y,m} = \left( \frac{CDD_{y,m}}{CDD_{15}} \right) \times \left( \frac{HHSIZE_{y,m}}{HHSIZE_{15}} \right)^{HHSIZEElas} \times \left( \frac{ResEcon_{y,m}}{ResEcon_{15}} \right)^{HHIncElas} \times \left( \frac{Price_{y,m}}{Price_{15}} \right)^{PriceElas}$$

Where  $CDD_{y,m}$  is the Cooling Degree Day for a given month  $m$  of the year  $y$ ,  $HHSIZE$  is the average household size,  $ResEcon$  is Employment Compensation divided by House Hold population,  $Price$  is the price of electricity for the specific customer class. Each variable uses its own elasticity, and the base line year is 2015.

CoolIndex is defined as:

$$CoolIndex = f(\text{Cooling Saturation, Efficiency, Shell Integrity, Square Footage})$$

$XOther$  captures non-weather sensitive end uses:

$$XOther = OtherUse \times OtherIndex$$

OtherUse is calculated as

$$OtherUse_{y,m} = \left( \frac{CDays_{y,m}}{30.44} \right) \times \left( \frac{HHSIZE_{y,m}}{HHSIZE_{15}} \right)^{HHSIZEElas} \times \left( \frac{ResEcon_{y,m}}{ResEcon_{15}} \right)^{HHIncElas} \times \left( \frac{Price_{y,m}}{Price_{15}} \right)^{PriceElas}$$

Where  $CDays_{y,m}$  is the number of days for a given month  $m$  of the year  $y$ ,  $HHSIZE$  is the average household size,  $ResEcon$  is Employment Compensation divided by House Hold population,  $Price$  is the price of electricity for the specific customer class. Each accompanied by its own elasticities. Base line year is 2015.

OtherIndex is defined as:

$$OtherIndex_{y,m} = \sum_{Type} EI_{15}^{Type} \times \frac{\left( \frac{Sat_y^{Type}}{Eff_y^{Type}} \right)}{\left( \frac{Sat_{15}^{Type}}{Eff_{15}^{Type}} \right)} \times MoMult_m^{Type}$$

Where  $Type$  is an end-use,  $Sat_y^{Type}$  is the saturation (shares) of an end-use of given  $Type$  for a particular year  $y$ ,  $Eff_y^{Type}$  is the efficiency of an end-use of given  $Type$  for a particular year  $y$ , and  $El_{15}^{Type}$  is a reference year (2015) calibration weight per end-use  $Type$ . The factors:

$$El_{15}^{Type} \times \frac{\left( Sat_y^{Type} / Eff_y^{Type} \right)}{\left( Sat_{15}^{Type} / Eff_{15}^{Type} \right)}$$

are the annual intensities in the Intensities tab in Attachment 1 - Residential Intensities of the Load Forecast Report for each relevant end-use and converted to monthly values using the  $MoMult_m^{Type}$  factor.

Where

$OtherUse = f(\text{Seasonal Use Pattern, Household Income, Household Size, and Price})$

$OtherIndex = g(\text{Other Appliance Saturation and Efficiency Trends})$

The  $AvgEESavings$  term captures E1's DSM past reported savings for the residential class. The associated regression coefficient,  $b_4$ , assesses the portion of embedded DSM activity that is already included in the billed sales information. The negative sign of  $b_4$  indicates that DSM activity reduces load.

The COVID variable is a binary that starts in July 2020 and attempts to mirror the impacts of COVID on load. It starts with a value of 1, is reduced to 0.65 in August 2022. As discussed in **Section 5**, this variable was used to explain the increase in residential load from people working from home during the pandemic and stays in the forecast at a reduced level to recognize permanent changes related to working patterns.

Binary shift variables are added to the model for the months of January, August, September, and October to improve model fit and particular monthly trends, while binaries for April and May of 2015 and October 2022 to compensate for anomalies in the billing data during this period related to delayed meter reads. An additional binary was added for February 2018 to correct for high

residual values. After running the linear regression with the main variables, the residuals show a slight autocorrelation, which happens when a model does not take into account relatively small drivers that should explain the dependent variable (in this case, sales). To help eliminate this autocorrelation, a moving average, MA, of period 1, MA(1) was added, which estimates the autocorrelation with its the predecessor.

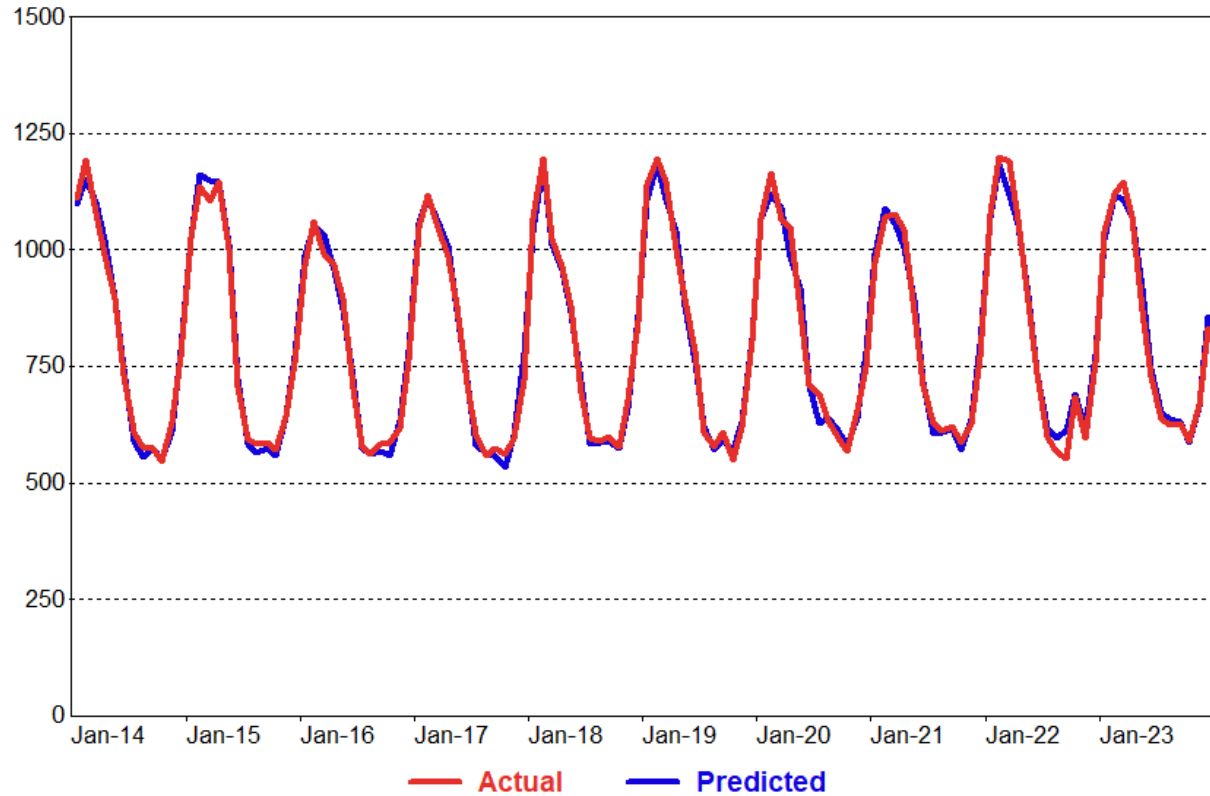
| <b>Variable</b>             | <b>Coefficient</b> | <b>StdErr</b> | <b>T-Stat</b> | <b>P-Value</b> |
|-----------------------------|--------------------|---------------|---------------|----------------|
| MStructRes.WtXHeat          | 0.923              | 0.024         | 38.044        | 0.00%          |
| MStructRes.WtXCool          | 1.094              | 0.259         | 4.222         | 0.01%          |
| MStructRes.WtXOther         | 1.03               | 0.039         | 26.32         | 0.00%          |
| MSales.AvgEESavingsProfiled | -0.556             | 0.199         | -2.793        | 0.62%          |
| MBin.Jan                    | 77.035             | 7.386         | 10.429        | 0.00%          |
| MBin.Aug                    | 53.829             | 13.937        | 3.862         | 0.02%          |
| MBin.Sep                    | 77.941             | 18.424        | 4.23          | 0.01%          |
| MBin.Oct                    | 45.054             | 11.565        | 3.896         | 0.02%          |
| MBin.Apr15                  | 85.798             | 24.931        | 3.441         | 0.08%          |
| MBin.May15                  | 89.61              | 24.68         | 3.631         | 0.04%          |
| MBin.Feb18                  | 62.30              | 21.74         | 2.866         | 0.50%          |
| MBin.CovidVariable          | 25.611             | 9.099         | 2.815         | 0.58%          |
| MBin.Oct22                  | 140.062            | 22.657        | 6.182         | 0.00%          |
| MA(1)                       | 0.506              | 0.094         | 5.412         | 0.00%          |

### **Residential Model Statistics**

| <b>Model Statistics</b>   |              |
|---------------------------|--------------|
| Iterations                | 21           |
| Adjusted Observations     | 120          |
| Deg. of Freedom for Error | 106          |
| R-Squared                 | 0.989        |
| Adjusted R-Squared        | 0.987        |
| AIC                       | 6.481        |
| BIC                       | 6.806        |
| F-Statistic               | #NA          |
| Prob (F-Statistic)        | #NA          |
| Log-Likelihood            | -545.11      |
| Model Sum of Squares      | 5,407,511.96 |
| Sum of Squared Errors     | 61,990.34    |
| Mean Squared Error        | 584.81       |

| <b>Model Statistics</b>  |        |
|--------------------------|--------|
| Std. Error of Regression | 24.18  |
| Mean Abs. Dev. (MAD)     | 17.4   |
| Mean Abs. % Err. (MAPE)  | 2.18%  |
| Durbin-Watson Statistic  | 2.069  |
| Durbin-H Statistic       | #NA    |
| Ljung-Box Statistic      | 21.71  |
| Prob (Ljung-Box)         | 0.5968 |
| Skewness                 | 0.264  |
| Kurtosis                 | 3.786  |
| Jarque-Bera              | 4.49   |
| Prob (Jarque-Bera)       | 0.1059 |

### Residential SAE Model Fit



### Residential Model 2024-2034 Reconciliation

The following tables provide details reflecting the changes between 2024 and 2034 forecast years. Some of the numbers have small discrepancies compared to those used in the final annual figures as there is a conversion between monthly data at the model level to annual data at the system level.

### Residential Load – Post Regression (GWh)

|                | Existing Customer Average Use from Regression Model (kWh/year) | New Cust. Load | EVs  | Solar | RTR   | Hybrid | Res DSM Adjust ment | Res Sales |  | Total Res DSM (at the meter) | DSM captured by end uses |
|----------------|----------------------------------------------------------------|----------------|------|-------|-------|--------|---------------------|-----------|--|------------------------------|--------------------------|
| 2024           | 10,468                                                         | 62             | 10   | (44)  | -     | -      | (30)                | 5,180     |  | (55)                         | (24)                     |
| 2034           | 11,411                                                         | 428            | 322  | (461) | (75)  | (177)  | (388)               | 5,298     |  | (698)                        | (310)                    |
| Change to load | 9.0%                                                           | 7.0%           | 6.0% | -8.0% | -1.4% | -3.4%  | -6.9%               | 2.3%      |  |                              |                          |

Res Sales = Existing Customer + New Customer + EV + Solar + RTR + Hybrid + DSM

Existing customer load is calculated as Res Average Use (10,468 kWh/customer in 2024, 11,411 kWh/customer in 2034) x number of customers as of 2024 (495,055). The tables below show the appliance information incorporated in the end-use input tables.

### Residential Average Use –Regression

|                | XHeat | XCool | XOther | AvgEE Savings | Binaries | ARMA | COVID Variable | Res Average Use |
|----------------|-------|-------|--------|---------------|----------|------|----------------|-----------------|
| 2024           | 4,712 | 392   | 5,560  | (637)         | 254      | (13) | 200            | 10,468          |
| 2034           | 5,300 | 619   | 5,675  | (637)         | 254      | -    | 200            | 11,411          |
| Change to load | 5.6%  | 2.2%  | 1.1%   | 0.0%          | 0.0%     | 0.1% | 0.0%           | 9.0%            |

Res Avg Use = XHeat + XCool + XOther + AvgEESavings + Binaries + ARMA + COVID Var

### Residential Input Variables – XHeat

|                | Intensities |         |                |              | Econ + Struct    | Regression |             |
|----------------|-------------|---------|----------------|--------------|------------------|------------|-------------|
|                | Efurn       | HP Heat | Secondary Heat | Furnace Fans | HeatUse Variable | Coeff      | Total XHeat |
| 2024           | 2,160       | 2,066   | 583            | 70           | 1.05             | 0.923      | 4,712       |
| 2034           | 1,263       | 3,680   | 734            | 61           | 1.00             | 0.923      | 5,300       |
| Change to load | -19.0%      | 34.2%   | 3.2%           | -0.2%        | -4.4%            | 0.0%       | 12.5%       |

$$XHeat = (Efurn + HP\ Heat + Secondary\ Heat + Furnace\ Fans) \times HeatUseVariable \times Coeff$$

Note that because these factors are multiplicative, the growth rate for the intensities is multiplied by the coefficients to calculate the overall impact. For example, the contribution of Efurn is calculated as  $[(Efurn_{2034} - Efurn_{2024}) \times HeatUse \times Coeff] / WtXHeat_{2024}$

### Residential Input Variables – XCool

|                | Intensities |         |         | Econ + Struct    | Regression  |             |
|----------------|-------------|---------|---------|------------------|-------------|-------------|
|                | Central AC  | HP Cool | Room AC | CoolUse Variable | Coefficient | Total Xcool |
| 2024           | 29          | 220     | 65      | 1.1              | 1.094       | 392         |
| 2034           | 35          | 337     | 68      | 1.3              | 1.094       | 619         |
| Change to load | 1.4%        | 29.9%   | 0.9%    | 12.4%            | 0.0%        | 57.8%       |

$$XCool = (Central\ AC + HP\ Cool + Room\ AC) \times CoolUseVariable \times Coeff$$

**Residential Input Variables – XOther**

|                   | Intensities   |      |         |              |       |       |       | Econ +<br>Struct    | Reg   |                 |
|-------------------|---------------|------|---------|--------------|-------|-------|-------|---------------------|-------|-----------------|
|                   | Water<br>Heat | Cook | Ref/Frz | Wash/<br>Dry | TV    | Light | Misc  | Other<br>Use<br>Var | Coeff | Total<br>Xother |
| 2024              | 1,633         | 474  | 564     | 718          | 412   | 528   | 1,173 | 0.98                | 1.030 | 5,560           |
| 2034              | 1,881         | 473  | 506     | 727          | 304   | 467   | 1,273 | 0.98                | 1.030 | 5,675           |
| Change<br>to load | 4.5%          | 0.0% | -1.0%   | 0.2%         | -1.9% | -1.1% | 1.8%  | -0.3%               | 0.0%  | 2.1%            |

$X_{Other} = (Water\ Heat + Cook + Ref/Frz + Wash/Dry + TV + Light + Misc) \times OtherUseVariable \times Coeff$

## Commercial Model Detail

### Small General Service

Small General Service is projected using an SAE average use model and a sales forecast is generated as the product of the average use and customer forecast.

Like the residential model, monthly Small General Service average use is defined as a function of monthly heating requirements ( $XHeat$ ), cooling requirements ( $XCool$ ), and other use ( $XOther$ ). The end-use variables are constructed by interacting annual end-use intensity projections (EI) that capture end-use intensity trends, with  $GDP$  and employment ( $SmlGenVar_m$ ), real price ( $Price_m$ ), monthly  $HDD$  and  $CDD$  and a variable accounting for the number of days in a given month:

$$XHeat_m = EI_{heat} \times Price_m^{-1.5} \times SmlGenVar_m \times HDD_m$$

$$XCool_m = EI_{cool} \times Price_m^{-1.5} \times SmlGenVar_m \times CDD_m$$

$$XOther_m = EI_{other} \times Price_m^{-1.5} \times SmlGenVar_m \times Days_m$$

The coefficients on price are imposed short-term price elasticities.

Several binary shift variables are added to the model to:

- (1) Improve model fit using monthly binaries for March and December.
- (2) Account for billing issues related to the pandemic in May and June 2020.
- (3) Account for billing issues related to the hurricane Fiona in Oct 2022 and hurricane Lee in Sep 2023.
- (4) Account for shifts in usage starting in 2022 (post COVID)

As in the residential model, analysis of the initial regression results indicated that the model would be improved by adding an ARMA process. A seasonal moving average of period 1, SMA(1) was used.

The monthly forecast average use sales model is then estimated as:

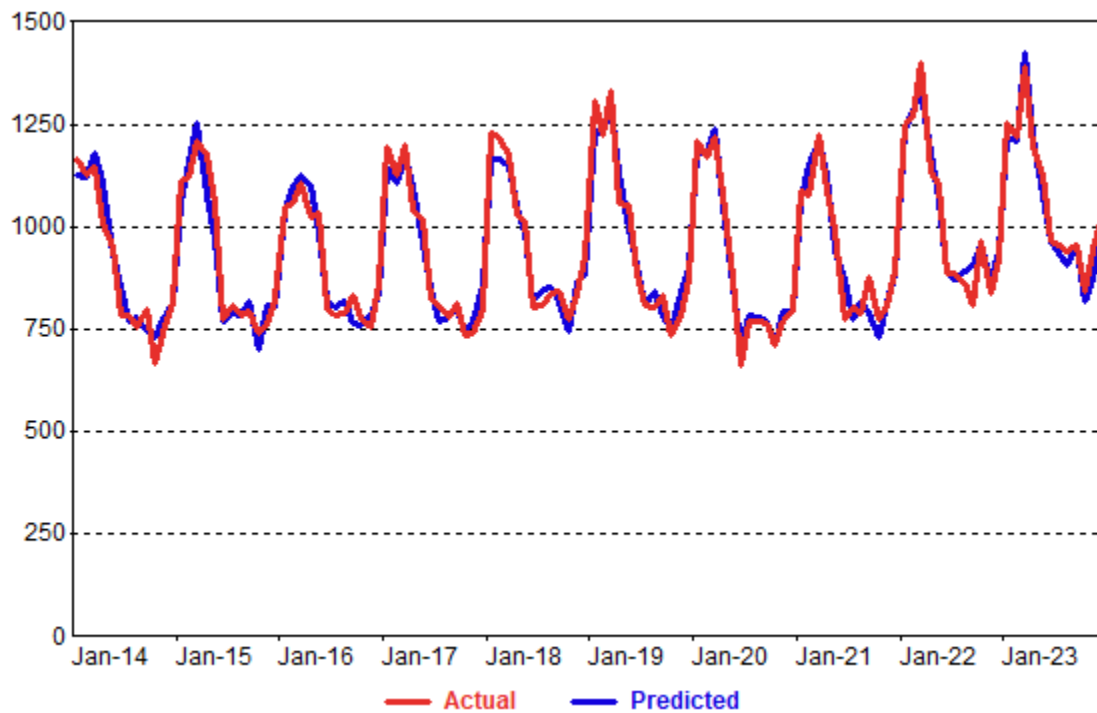
$$SmlGen\_AvgUse_m = b1 \times XHeat_m + b2 \times XCool_m + b3 \times XOther_m + \sum Binaries + ARMA$$

| <b>Variable</b>        | <b>Coefficient</b> | <b>StdErr</b> | <b>T-Stat</b> | <b>P-Value</b> |
|------------------------|--------------------|---------------|---------------|----------------|
| MStructSmlGen.WtXHeat  | 0.856              | 0.037         | 23.347        | 0.00%          |
| MStructSmlGen.WtXCool  | 0.330              | 0.042         | 7.797         | 0.00%          |
| MStructSmlGen.WtXOther | 0.727              | 0.021         | 34.013        | 0.00%          |
| MBin.Mar               | 100.094            | 21.293        | 4.701         | 0.00%          |
| MBin.Dec               | -114.494           | 20.103        | -5.695        | 0.00%          |
| MBin.May20             | -138.367           | 38.301        | -3.613        | 0.05%          |
| MBin.Jun20             | -143.536           | 37.948        | -3.782        | 0.03%          |
| MBin.Oct22             | 132.146            | 39.609        | 3.336         | 0.12%          |
| MBin.Sep23             | 156.046            | 45.461        | 3.432         | 0.09%          |
| MBin.Yr22Plus          | 43.240             | 12.364        | 3.497         | 0.07%          |
| SMA(1)                 | 0.452              | 0.096         | 4.688         | 0.00%          |

### Small General Model Statistics

| Model Statistics          |              |
|---------------------------|--------------|
| Iterations                | 12           |
| Adjusted Observations     | 120          |
| Deg. of Freedom for Error | 109          |
| R-Squared                 | 0.950        |
| Adjusted R-Squared        | 0.945        |
| AIC                       | 7.580        |
| BIC                       | 7.835        |
| F-Statistic               | #NA          |
| Prob (F-Statistic)        | #NA          |
| Log-Likelihood            | -614.07      |
| Model Sum of Squares      | 3,720,817.94 |
| Sum of Squared Errors     | 195,658.57   |
| Mean Squared Error        | 1,795.03     |
| Std. Error of Regression  | 42.37        |
| Mean Abs. Dev. (MAD)      | 32.50        |
| Mean Abs. % Err. (MAPE)   | 3.47%        |
| Durbin-Watson Statistic   | 2.289        |
| Durbin-H Statistic        | #NA          |
| Ljung-Box Statistic       | 70.24        |
| Prob (Ljung-Box)          | 0.0000       |
| Skewness                  | -0.093       |
| Kurtosis                  | 2.846        |
| Jarque-Bera               | 0.293        |
| Prob (Jarque-Bera)        | 0.8638       |

### Small General Model Fit



### Small General 2024-2034 Reconciliation

The Small General Demand customer forecast model is constructed like the residential model (including heat pump programs inside the SAE model). Adjustments done outside the regression include estimates for other commercial and industrial growth programs, PV, EV, RTR and DSM.

Historically the XHeat, XCool and XOther variables are constructed with a flat scaling factor to keep regression coefficients close to 1, which allows for easier comparison.

**Small General Load – Post Regression (GWh)**

|        | Load from Regression Model | EV    | Solar | RTR   | SG DSM adjustment | Small Gen Sales (with DSM) |  | Total SG DSM (at the meter) | DSM captured by end uses |
|--------|----------------------------|-------|-------|-------|-------------------|----------------------------|--|-----------------------------|--------------------------|
| 2024   | 340                        | 1     | (1)   | -     | (3)               | 338                        |  | (7)                         | (4)                      |
| 2034   | 409                        | 49    | (22)  | (7)   | (28)              | 402                        |  | (62)                        | (34)                     |
| Change | 20.2%                      | 13.9% | -6.2% | -2.0% | -7.2%             | 18.9%                      |  |                             |                          |

Small General Sales = Avg Use Existing x customer count + EV Load + Solar Load + RTR + DSM

The load from the regression model is calculated as Small Gen Average Use (12,763 kWh/customer in 2024, 13,895 kWh/customer in 2034) x number of customers (26,675 in 2024, increasing to 29,466 in 2034).

**Small General Average Use –Regression**

|        | XHeat | XCool | XOther | Binaries | ARMA  | Avg Sales (kWh) |
|--------|-------|-------|--------|----------|-------|-----------------|
| 2024   | 4,323 | 586   | 7,266  | 504      | 83    | 12,763          |
| 2034   | 5,182 | 729   | 7,479  | 504      | -     | 13,895          |
| Change | 6.7%  | 1.1%  | 1.7%   | 0.0%     | -0.7% | 8.9%            |

Small General Avg Use = XHeat + XCool + XOther + Binaries + ARMA

**Small General Input Variables – XHeat**

|        | Intensities | Econ + Struct    | Regression |                |                   |
|--------|-------------|------------------|------------|----------------|-------------------|
|        | Heating     | HeatUse Variable | Coeff      | Scaling Factor | Total XHeat (kWh) |
| 2024   | 56,808      | 1.27             | 0.856      | 0.070          | 4,323             |
| 2034   | 63,121      | 1.37             | 0.856      | 0.070          | 5,182             |
| Change | 12.0%       | 7.9%             | 0.0%       | 0.0%           | 19.9%             |

XHeat = Heating x HeatUseVariable x Coeff x Scaling Factor

Note that because these factors are multiplicative, the growth rate for the intensities are multiplied by the coefficients to calculate the overall impact. For example, the contribution of Heating is calculated as  $[(\text{Heat}_{2034} - \text{Heat}_{2024}) \times \text{HeatUse} \times \text{Coeff} \times \text{Scaling}] / \text{WtXHeat}_{2024}$

**Small General Input Variables – XCool**

|        | Intensities | Econ + Struct    | Regression  |                |                   |
|--------|-------------|------------------|-------------|----------------|-------------------|
|        | Cooling     | CoolUse Variable | Coefficient | Scaling Factor | Total XCool (kWh) |
| 2024   | 36,759      | 1.38             | 0.330       | 0.035          | 586               |
| 2034   | 35,682      | 1.77             | 0.330       | 0.035          | 729               |
| Change | -3.8%       | 28.3%            | 0.0%        | 0.0%           | 24.5%             |

XCool = Cooling x CoolUseVariable x Coeff x Scaling Factor

**Small General Input Variables – XOther**

|        | Intensities |            |       |        |        |        |        | Econ + Struct | Reg   |                |                    |
|--------|-------------|------------|-------|--------|--------|--------|--------|---------------|-------|----------------|--------------------|
|        | Vent        | Water Heat | Cook  | Refrig | Light  | Office | Misc   | OtherUse Var  | Coeff | Scaling Factor | Total XOther (kWh) |
| 2024   | 11,963      | 1,963      | 1,918 | 21,022 | 57,077 | 13,164 | 33,072 | 14.26         | 0.727 | 0.005          | 7,266              |
| 2034   | 9,018       | 2,179      | 1,808 | 19,510 | 49,206 | 14,038 | 32,034 | 16.10         | 0.727 | 0.005          | 7,479              |
| Change | -2.4%       | 0.2%       | -0.1% | -1.2%  | -6.3%  | 0.7%   | -0.8%  | 12.9%         | 0.0%  | 0.0%           | 2.9%               |

XOther = (Ventilation+ Water Heat + Cook + Refrigeration + Light + Office + Misc) x OtherUseVariable  
x Coeff x Scaling Factor

## General Service

The General Service rate class model is estimated on a total monthly sales basis where total monthly billed sales is a function of total monthly heating requirements ( $XHeat$ ), cooling requirements ( $XCool$ ), and other use ( $XOther$ ). The end-use variables are constructed by interacting annual end-use intensity projections (EI) that capture end-use intensity trends, with GDP and employment ( $GenVar_m$ ), real price ( $Price_m$ ), monthly HDD and CDD and a variable accounting for the number of days in a given month:

$$XHeat_m = EI_{heat} \times Price_m^{-1.5} \times GenVar_m \times HDD_m$$

$$XCool_m = EI_{cool} \times Price_m^{-1.5} \times GenVar_m \times CDD_m$$

$$XOther_m = EI_{other} \times Price_m^{-1.5} \times GenVar_m \times Days_m$$

The coefficients on price are imposed short-term price elasticities.

Several binary shift variables are added to the model to:

- (1) Improve model fit using monthly binaries for Feb 2018 and May 2023.
- (2) Account for billing issues related to the pandemic in May and June 2020.
- (3) Account for billing issues related to the hurricane Fiona in Sep and Oct 2022.
- (4) Account for shifts in usage resulting from COVID

As in the residential model, analysis of the initial regression results indicated that the model would be improved by adding an ARMA process. A seasonal moving average of period 1, SMA(1) was used.

A monthly forecast sales model is then estimated as:

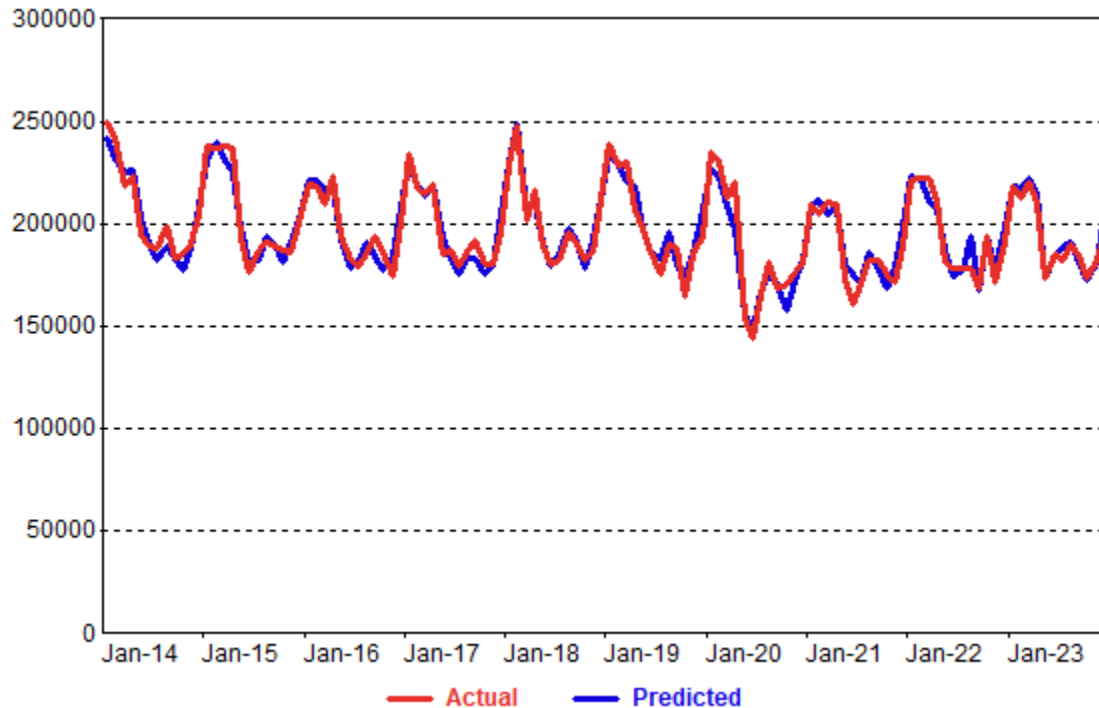
$$GenService_m = b1 \times XHeat_m + b2 \times XCool_m + b3 \times XOther_m + \sum Binaries + ARMA$$

| <b>Variable</b>     | <b>Coefficient</b> | <b>StdErr</b> | <b>T-Stat</b> | <b>P-Value</b> |
|---------------------|--------------------|---------------|---------------|----------------|
| MStructGen.WtXHeat  | 0.743              | 0.031         | 23.702        | 0.00%          |
| MStructGen.WtXCool  | 0.698              | 0.063         | 11.070        | 0.00%          |
| MStructGen.WtXOther | 1.080              | 0.019         | 57.501        | 0.00%          |
| MBin.Feb18          | 29075.854          | 6191.198      | 4.696         | 0.00%          |
| MBin.May20          | -28685.822         | 6257.015      | -4.585        | 0.00%          |
| MBin.Jun20          | -22946.520         | 6252.155      | -3.670        | 0.04%          |
| MBin.Oct22          | 21179.524          | 6220.695      | 3.405         | 0.09%          |
| MBin.Sep22          | -20217.714         | 6281.321      | -3.219        | 0.17%          |
| MBin.COVID2020Plus  | -7274.523          | 1645.480      | -4.421        | 0.00%          |
| MBin.May23          | -16930.880         | 6502.626      | -2.604        | 1.05%          |
| SMA(1)              | 0.295              | 0.095         | 3.098         | 0.25%          |

### General Service Model Statistics

| Model Statistics          |                   |
|---------------------------|-------------------|
| Iterations                | 12                |
| Adjusted Observations     | 120               |
| Deg. of Freedom for Error | 109               |
| R-Squared                 | 0.920             |
| Adjusted R-Squared        | 0.912             |
| AIC                       | 17.628            |
| BIC                       | 17.883            |
| F-Statistic               | #NA               |
| Prob (F-Statistic)        | #NA               |
| Log-Likelihood            | -1,216.92         |
| Model Sum of Squares      | 51,702,353,576.70 |
| Sum of Squared Errors     | 4,519,631,715.13  |
| Mean Squared Error        | 41,464,511.15     |
| Std. Error of Regression  | 6,439.29          |
| Mean Abs. Dev. (MAD)      | 4,799.02          |
| Mean Abs. % Err. (MAPE)   | 2.46%             |
| Durbin-Watson Statistic   | 1.950             |
| Durbin-H Statistic        | #NA               |
| Ljung-Box Statistic       | 32.13             |
| Prob (Ljung-Box)          | 0.1239            |
| Skewness                  | 0.202             |
| Kurtosis                  | 3.516             |
| Jarque-Bera               | 2.147             |
| Prob (Jarque-Bera)        | 0.3419            |

### General Service Model Fit



### General Demand 2024-2034 Reconciliation

The general demand class, which makes up the largest portion of the commercial sector, is forecast as gross total sales rather than average use as is the case in the small general and residential classes.

Like the small general model, a flat scaling factor is used to adjust some of the end-use regression coefficients close to 1, making their interpretation a bit easier. Outside of the SAE regression model, adjustments include EV load, PV, RTR, Hybrid and DSM.

### General Demand Load – Post Regression (GWh)

|        | Load Regression Model | RTR   | EV   | Solar | Hybrid | GD DSM Adjustment | Gen Sales (with DSM) | Total GD DSM (at the meter) | DSM captured by end uses |
|--------|-----------------------|-------|------|-------|--------|-------------------|----------------------|-----------------------------|--------------------------|
| 2024   | 2,365                 | -     | 6    | (9)   | -      | (23)              | 2,339                | (51)                        | (28)                     |
| 2034   | 2,680                 | (97)  | 195  | (198) | (63)   | (196)             | 2,320                | (437)                       | (241)                    |
| Change | 13.3%                 | -4.1% | 8.0% | -8.0% | -2.7%  | -7.3%             | -0.8%                |                             |                          |

Gen Sales = Sales + RTR + EV Load + Solar Load + Hybrid + DSM

### General Demand Sales –Regression

|        | XHeat   | XCool   | XOther    | Binaries | ARMA    | Sales (GWh) |
|--------|---------|---------|-----------|----------|---------|-------------|
| 2024   | 543,197 | 117,739 | 1,767,734 | (56,741) | (6,996) | 2,364,934   |
| 2034   | 730,139 | 148,836 | 1,857,456 | (56,741) | -       | 2,679,691   |
| Change | 7.9%    | 1.3%    | 3.8%      | 0.0%     | 0.3%    | 13.3%       |

Sales = XHeat + XCool + XOther + Binaries + ARMA

### General Demand Input Variables – WtXHeat

|        | Intensities | Econ + Struct    | Regression |             |
|--------|-------------|------------------|------------|-------------|
|        | Heating     | HeatUse Variable | Coeff      | Total XHeat |
| 2024   | 556,051     | 1.31             | 0.743      | 543,197     |
| 2034   | 676,075     | 1.45             | 0.743      | 730,139     |
| Change | 23.9%       | 10.6%            | 0.0%       | 34.4%       |

XHeat = Heating x HeatUseVariable x Coeff

Note that because these factors are multiplicative, the growth rate for the intensities are multiplied by the coefficients to calculate the overall impact. For example, the contribution of Heating is calculated as  $[(\text{Heat}_{2034} - \text{Heat}_{2024}) \times \text{HeatUse} \times \text{Coeff}] / \text{WtXHeat}_{2024}$

### General Demand Input Variables – XCool

|        | Intensities | Econ + Struct    | Regression  |                |             |
|--------|-------------|------------------|-------------|----------------|-------------|
|        | Cooling     | CoolUse Variable | Coefficient | Scaling Factor | Total Xcool |
| 2024   | 317,164     | 1.44             | 0.698       | 0.370          | 117,739     |
| 2034   | 307,871     | 1.87             | 0.698       | 0.370          | 148,836     |
| Change | -3.8%       | 30.2%            | 0.0%        | 0.0%           | 26.4%       |

$X_{Cool} = \text{Cooling} \times \text{CoolUseVariable} \times \text{Coeff} \times \text{Scaling Factor}$

### General Demand Input Variables – XOther

|        | Intensities |            |        |         |         |         |         | Econ + Struct | Reg   |                |              |
|--------|-------------|------------|--------|---------|---------|---------|---------|---------------|-------|----------------|--------------|
|        | Vent        | Water Heat | Cook   | Refrig  | Light   | Office  | Misc    | Other Use Var | Coeff | Scaling Factor | Total Xother |
| 2024   | 110,549     | 14,613     | 17,719 | 194,259 | 464,452 | 121,648 | 305,610 | 14.80         | 1.080 | 0.090          | 1,767,734    |
| 2034   | 83,335      | 12,980     | 16,711 | 180,289 | 400,402 | 129,720 | 296,021 | 17.07         | 1.080 | 0.090          | 1,857,456    |
| Change | -2.6%       | -0.2%      | -0.1%  | -1.3%   | -6.0%   | 0.8%    | -0.9%   | 15.3%         | 0.0%  | 0.0%           | 5.1%         |

$X_{Other} = (\text{Ventilation} + \text{Water Heat} + \text{Cooking} + \text{Refrigeration} + \text{Lighting} + \text{Office} + \text{Miscellaneous}) \times$

$\text{OtherUseVariable} \times \text{Coeff} \times \text{Scaling Factor}$

## Industrial Econometric Model Details

### Small Industrial model

$$SmlInd\_Sales_m = MBin.Jan_m + MBin.Feb_m + MBin.Mar_m + MBin.Apr_m + MBin.May_m + MBin.Jun_m + MBin.Jul_m + MBin.Aug_m + MBin.Sep_m + MBin.Oct_m + MBin.Nov_m + MBin.Dec_m + MBin.Oct22 + b1 \times MEcon.ManGDP$$

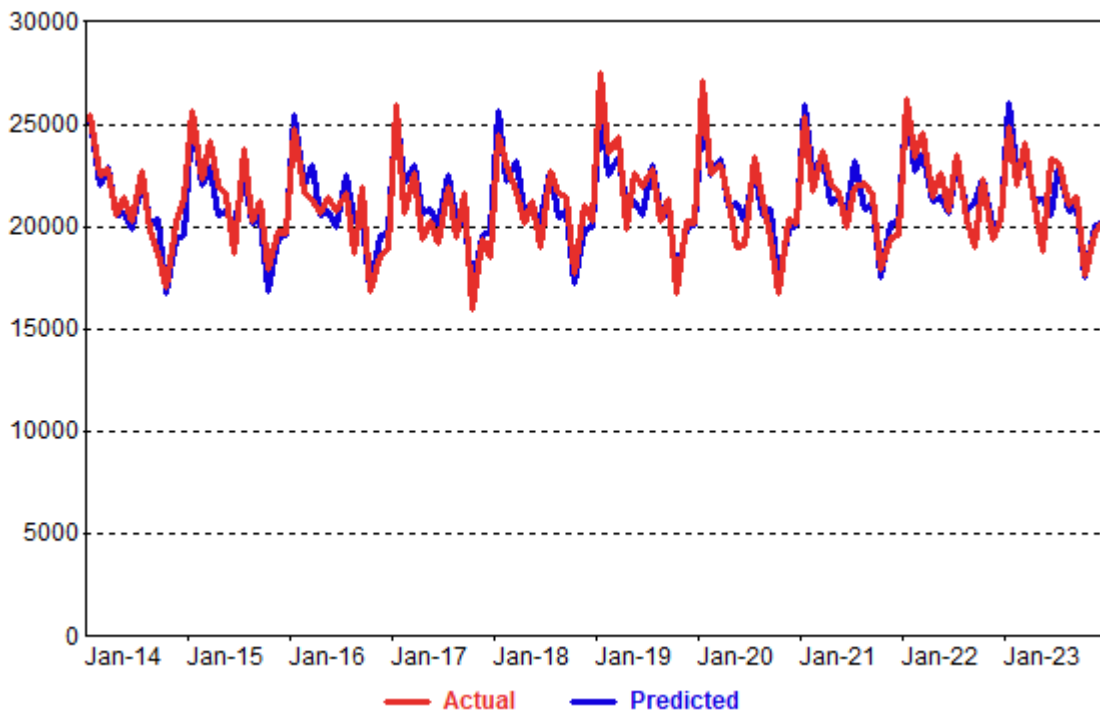
A binary variable was added for October 2022 to account for billing delays after hurricane Fiona.

| Variable     | Coefficient | StdErr   | T-Stat | P-Value |
|--------------|-------------|----------|--------|---------|
| MBin.Jan     | 20630.178   | 1697.352 | 12.154 | 0.00%   |
| MBin.Feb     | 17243.849   | 1698.709 | 10.151 | 0.00%   |
| MBin.Mar     | 18141.898   | 1700.067 | 10.671 | 0.00%   |
| MBin.Apr     | 15765.299   | 1701.424 | 9.266  | 0.00%   |
| MBin.May     | 15948.477   | 1702.782 | 9.366  | 0.00%   |
| MBin.Jun     | 15159.793   | 1704.140 | 8.896  | 0.00%   |
| MBin.Jul     | 17633.568   | 1705.498 | 10.339 | 0.00%   |
| MBin.Aug     | 15368.278   | 1707.436 | 9.001  | 0.00%   |
| MBin.Sep     | 15647.243   | 1709.374 | 9.154  | 0.00%   |
| MBin.Oct     | 12045.995   | 1703.137 | 7.073  | 0.00%   |
| MBin.Nov     | 14667.587   | 1713.250 | 8.561  | 0.00%   |
| MBin.Dec     | 14772.927   | 1715.188 | 8.613  | 0.00%   |
| MBin.Oct22   | 4821.506    | 1039.802 | 4.637  | 0.00%   |
| MEcon.ManGDP | 1.961       | 0.644    | 3.046  | 0.29%   |

### Small Industrial Model Statistics

| Model Statistics          |                |
|---------------------------|----------------|
| Iterations                | 1              |
| Adjusted Observations     | 120            |
| Deg. of Freedom for Error | 106            |
| R-Squared                 | 0.829          |
| Adjusted R-Squared        | 0.808          |
| AIC                       | 13.885         |
| BIC                       | 14.210         |
| F-Statistic               | #NA            |
| Prob (F-Statistic)        | #NA            |
| Log-Likelihood            | -989.38        |
| Model Sum of Squares      | 493,542,174.76 |
| Sum of Squared Errors     | 101,882,733.93 |
| Mean Squared Error        | 961,157.87     |
| Std. Error of Regression  | 980.39         |
| Mean Abs. Dev. (MAD)      | 734.82         |
| Mean Abs. % Err. (MAPE)   | 3.51%          |
| Durbin-Watson Statistic   | 1.883          |
| Durbin-H Statistic        | #NA            |
| Ljung-Box Statistic       | 26.54          |
| Prob (Ljung-Box)          | 0.3262         |
| Skewness                  | -0.167         |
| Kurtosis                  | 3.003          |
| Jarque-Bera               | 0.559          |
| Prob (Jarque-Bera)        | 0.7561         |

### Small Industrial Model Fit



### Medium Industrial Model

$$MedInd\_Sales_m = MBin.Jan_m + MBin.Feb_m + MBin.Mar_m + MBin.Apr_m + MBin.May_m + MBin.Jun_m + MBin.Jul_m + MBin.Aug_m + MBin.Sep_m + MBin.Oct_m + MBin.Nov_m + MBin.Dec_m + MBin.Aft16 + b1 \times MEcon.ManEmp$$

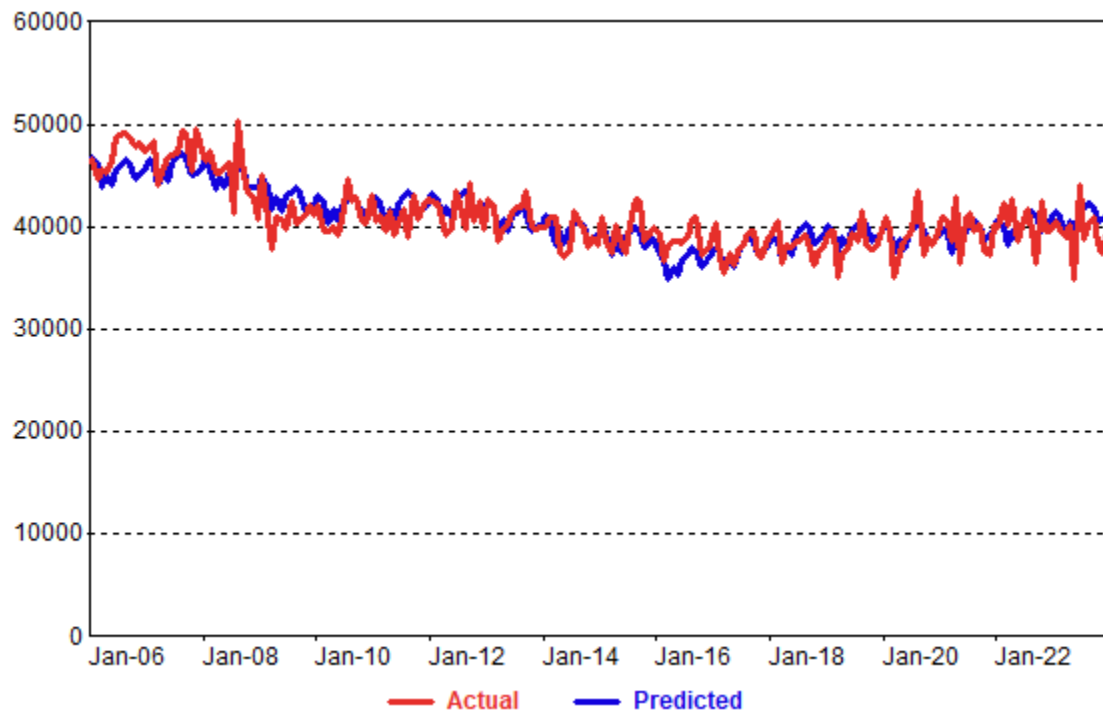
A binary variable for 2016 and subsequent years was added for improved model fit as the historic sales trend transitioned from declining to flat. As discussed in Section 4.0, a historic period of 2006–2023 was used to improve model fit.

| Variable     | Coefficient | StdErr   | T-Stat | P-Value |
|--------------|-------------|----------|--------|---------|
| MBin.Jan     | 21608.674   | 1496.470 | 14.440 | 0.00%   |
| MBin.Feb     | 20881.656   | 1495.637 | 13.962 | 0.00%   |
| MBin.Mar     | 18974.978   | 1494.804 | 12.694 | 0.00%   |
| MBin.Apr     | 20276.370   | 1493.971 | 13.572 | 0.00%   |
| MBin.May     | 19261.195   | 1493.138 | 12.900 | 0.00%   |
| MBin.Jun     | 20947.563   | 1492.305 | 14.037 | 0.00%   |
| MBin.Jul     | 21334.835   | 1491.472 | 14.305 | 0.00%   |
| MBin.Aug     | 21932.918   | 1491.008 | 14.710 | 0.00%   |
| MBin.Sep     | 21468.132   | 1490.543 | 14.403 | 0.00%   |
| MBin.Oct     | 19865.894   | 1490.079 | 13.332 | 0.00%   |
| MBin.Nov     | 20256.638   | 1489.615 | 13.599 | 0.00%   |
| MBin.Dec     | 20550.323   | 1489.151 | 13.800 | 0.00%   |
| MBin.Aft16   | -2479.954   | 258.015  | -9.612 | 0.00%   |
| MEcon.ManEmp | 635.323     | 41.557   | 15.288 | 0.00%   |

### Medium Industrial Model Statistics

| Model Statistics          |                  |
|---------------------------|------------------|
| Iterations                | 1                |
| Adjusted Observations     | 216              |
| Deg. of Freedom for Error | 202              |
| R-Squared                 | 0.703            |
| Adjusted R-Squared        | 0.684            |
| AIC                       | 15.079           |
| BIC                       | 15.298           |
| F-Statistic               | #NA              |
| Prob (F-Statistic)        | #NA              |
| Log-Likelihood            | -1,921.03        |
| Model Sum of Squares      | 1,591,772,636.22 |
| Sum of Squared Errors     | 671,308,642.90   |
| Mean Squared Error        | 3,323,310.11     |
| Std. Error of Regression  | 1,822.99         |
| Mean Abs. Dev. (MAD)      | 1,369.04         |
| Mean Abs. % Err. (MAPE)   | 3.35%            |
| Durbin-Watson Statistic   | 1.412            |
| Durbin-H Statistic        | #NA              |
| Ljung-Box Statistic       | 217.83           |
| Prob (Ljung-Box)          | 0.0000           |
| Skewness                  | -0.070           |
| Kurtosis                  | 3.069            |
| Jarque-Bera               | 0.222            |
| Prob (Jarque-Bera)        | 0.8950           |

### Medium Industrial Model Fit



### Combined Model for Commercial and Industrial DSM Coefficient

$$NonResSales_m = b1 \times NonResEESavingsProfiled_m + b2 \times GenWtXHeat_m + b3 \times GenWtXCool_m + b3 \times GenWtXOther_m + b4 \times NonResCustomers_m + MBin.Feb18_m + MBin.Oct22$$

Weighted X variables from the General Service model were used to represent the underlying end uses in conjunction with the non-residential portion of historical DSM savings, as well as the number of non-residential customers to help explain underlying sales trends over time. Binary variables were added for February 2018 and October 2022 for problems with the billing.

| Variable                 | Coefficient | StdErr    | T-Stat | P-Value |
|--------------------------|-------------|-----------|--------|---------|
| MSales.EESavingsProfiled | -0.448      | 0.108     | -4.147 | 0.01%   |
| MStructGen.WtXCool       | 0.544       | 0.055     | 9.958  | 0.00%   |
| MStructGen.WtXHeat       | 0.878       | 0.041     | 21.349 | 0.00%   |
| MStructGen.WtXOther      | 0.935       | 0.345     | 2.708  | 0.80%   |
| MSales.NonResCusts       | 3.815       | 1.339     | 2.850  | 0.53%   |
| MBin.Feb18               | 35403.115   | 11151.649 | 3.175  | 0.20%   |
| MBin.Oct22               | 38376.536   | 11218.875 | 3.421  | 0.09%   |

The coefficient on the EESavings variable represents the amount of DSM needed to explain historical sales trends beyond the changes in the underlying end-uses.

### Combined Model Statistics

| Model Statistics          |                   |
|---------------------------|-------------------|
| Iterations                | 1                 |
| Adjusted Observations     | 108               |
| Deg. of Freedom for Error | 101               |
| R-Squared                 | 0.831             |
| Adjusted R-Squared        | 0.821             |
| AIC                       | 18.657            |
| BIC                       | 18.831            |
| F-Statistic               | #NA               |
| Prob (F-Statistic)        | #NA               |
| Log-Likelihood            | -1,153.74         |
| Model Sum of Squares      | 59,109,328,237.04 |
| Sum of Squared Errors     | 12,019,848,479.24 |
| Mean Squared Error        | 119,008,400.78    |
| Std. Error of Regression  | 10,909.10         |
| Mean Abs. Dev. (MAD)      | 8,600.90          |
| Mean Abs. % Err. (MAPE)   | 2.75%             |
| Durbin-Watson Statistic   | 1.855             |
| Durbin-H Statistic        | #NA               |
| Ljung-Box Statistic       | 47.39             |
| Prob (Ljung-Box)          | 0.0030            |
| Skewness                  | 0.061             |
| Kurtosis                  | 2.571             |
| Jarque-Bera               | 0.894             |
| Prob (Jarque-Bera)        | 0.6397            |

### Peak Forecast (Accrued Classes)

The long-term system peak forecast for the accrued classes is derived through a monthly peak linear regression model that relates monthly peak demand (excluding large customer contribution) to heating, cooling, and base load requirements, as well as average daily wind:

$$Peak_m = b1 \times HeatVar_m + b2 \times CoolVar_m + b3 \times BaseVar_m + b5 \times PkWindVar_m + \sum Binarie$$

The model variables ( $HeatVar_m$ ,  $CoolVar_m$ , and  $BaseVar_m$ ) incorporate changes in heating, cooling, and base-use energy requirements (which are derived from the class sales forecast models) as well as peak-day weather conditions.

The composition of the models allows historical and forecast heating and cooling load requirement to be estimated. The model coefficients for the heating ( $XHeat$ ) and cooling variables ( $XCool$ ) combined with heating and cooling variable for calendar-month normal weather conditions produce an estimate of the monthly heating and cooling load requirements.

Heating requirements are calculated as:

$$HeatLoad_m = B_1 \times ResXHeat_m + C_1 \times SmlGSXHeat_m + D_1 \times GSXHeat_m$$

Where  $B_1$ ,  $C_1$ , and  $D_1$  are the coefficients on  $XHeat$  in the Residential, Small General Service, and General Service sales forecast models.

Cooling requirements are estimated in a similar manner. Cooling requirements are calculated as:

$$CoolLoad_m = B_2 \times ResXCool_m + C_2 \times SmlGSXCool_m + D_2 \times GSCool_m$$

Where  $B_2$ ,  $C_2$ , and  $D_2$  are the coefficients on  $XCool$  in the residential, Small General Service, and General Service sales forecast models.

In constructing the monthly peak model variables, the heating and cooling load requirements are normalized for the number of days and hours in the month by expressing heating and cooling load requirements on an average MW load basis:

$$HeatAvgMW_m = HeatLoad_m / Days_m / 24$$

$$CoolAvgMW_m = CoolLoad_m / Days_m / 24$$

The impact of peak-day weather conditions are then captured by interacting peak-day HDD and CDD with average monthly heating and cooling load requirements. *HeatAvgMW* and *CoolAvgMW* are interacted with peak-day *HDD* and *CDD* indexes, which allows the impact of peak-day *HDD* and *CDD* to change over the estimation period as the underlying heating and cooling load requirements change.

The peak model heating and cooling variables are calculated as:

$$HeatVar_m = HeatAvgMW_m \times PkHDDIdx_m$$

$$CoolVar_m = CoolAvgMW_m \times PkCDDIdx_m$$

The peak model base load variable (*BaseVar<sub>m</sub>*) is constructed to capture the impact of loads that are not weather sensitive on peak, including residential, commercial, other end-use components along with industrial and unmetered sales. Base load requirements are calculated as:

$$BaseVar_m = \sum C_{m \times mBin} \times OtherLoad_m$$

Where the *C<sub>m</sub>* coefficients are regression coefficients associated with the portions of *OtherLoad<sub>m</sub>*, corresponding to a specific month of the year. In this way *BaseVar<sub>m</sub>* measures the strength of the non-weather sensitive load drivers in each month of the year. *OtherLoad<sub>m</sub>* is comprised of:

$$OtherLoad_m = ResOther_m + SmlGSOther_m + GSOther_m + SmIndSales_m + MedIndSales_m + UnMSales_m$$

Where *ResOther<sub>m</sub>*, *SmlOther<sub>m</sub>* and *GSOther<sub>m</sub>* are the non-weather dependent portion of the sales model (including embedded DSM). For example, the energy sales model can be written as:

$$ResSales = b1 \times ResXHeat + b2 \times ResXCool + ResOther$$

Where *b1* and *b2* are regression coefficients found after running the sales model. *ResOther* can be written as:

$$ResOther_m = ResSales_m - b1 \times ResXHeat_m - b2 \times ResXCool_m$$

In this way,  $ResOther_m$  (and  $SmlOther_m$  and  $GSOther_m$ ) carries the non-weather dependent variables, including past energy-related DSM activity into the peak model, whose impact was assessed through specific coefficients in the energy sales model.

The  $OtherLoad_m$  requirements are normalized for the number of days and hours in the month by expressing the load requirements on an average MW load basis:

$$OtherAvgMW_m = OtherLoad_m / Days_m / 24$$

The  $PkWindVar_m$  is the average daily windspeed on monthly peak days. Binaries are included for June 2020 to account for a high residual and for October 2022 to account for the impact of billing delays related to hurricane Fiona in the energy models.

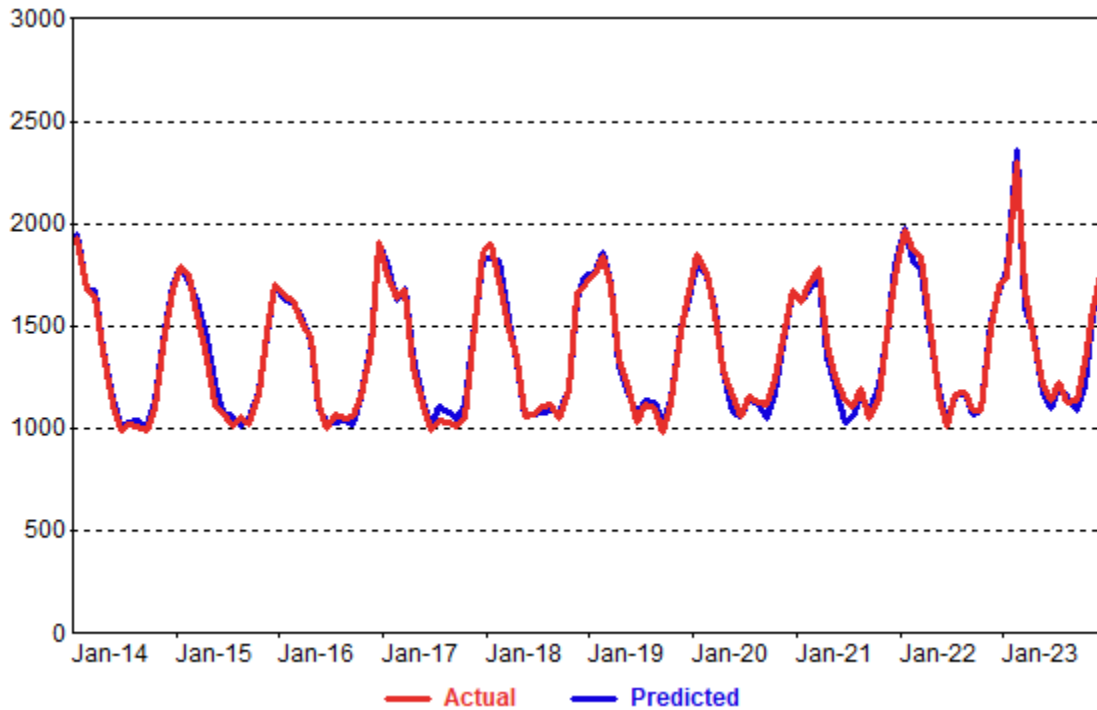
| Variable           | Coefficient | StdErr | T-Stat | P-Value |
|--------------------|-------------|--------|--------|---------|
| mVarsNew.Heat_Var  | 1.541       | 0.080  | 19.375 | 0.00%   |
| mVarsNew.Cool_Var  | 1.346       | 0.206  | 6.536  | 0.00%   |
| mVarsNew.Jan_Other | 1.078       | 0.085  | 12.734 | 0.00%   |
| mVarsNew.Feb_Other | 1.007       | 0.096  | 10.524 | 0.00%   |
| mVarsNew.Mar_Other | 1.198       | 0.078  | 15.281 | 0.00%   |
| mVarsNew.Apr_Other | 1.450       | 0.048  | 29.951 | 0.00%   |
| mVarsNew.May_Other | 1.517       | 0.034  | 44.820 | 0.00%   |
| mVarsNew.Jun_Other | 1.604       | 0.030  | 52.878 | 0.00%   |
| mVarsNew.Jul_Other | 1.630       | 0.043  | 37.588 | 0.00%   |
| mVarsNew.Aug_Other | 1.463       | 0.052  | 27.947 | 0.00%   |
| mVarsNew.Sep_Other | 1.499       | 0.029  | 51.536 | 0.00%   |
| mVarsNew.Oct_Other | 1.565       | 0.031  | 50.455 | 0.00%   |
| mVarsNew.Nov_Other | 1.646       | 0.048  | 34.516 | 0.00%   |
| mVarsNew.Dec_Other | 1.478       | 0.074  | 19.926 | 0.00%   |
| mPkDayWthr.PkWind  | 4.941       | 0.692  | 7.139  | 0.00%   |
| mBin.Oct22         | -235.749    | 45.420 | -5.190 | 0.00%   |
| mBin.Jun20         | 184.032     | 43.195 | 4.260  | 0.00%   |

### Peak Model Statistics

| Model Statistics          |                |
|---------------------------|----------------|
| Iterations                | 1              |
| Adjusted Observations     | 120            |
| Deg. of Freedom for Error | 103            |
| R-Squared                 | 0.984          |
| Adjusted R-Squared        | 0.982          |
| AIC                       | 7.573345       |
| BIC                       | 7.968239       |
| F-Statistic               | #NA            |
| Prob (F-Statistic)        | #NA            |
| Log-Likelihood            | -607.67331     |
| Model Sum of Squares      | 11,093,127.532 |
| Sum of Squared Errors     | 175,870.484    |
| Mean Squared Error        | 1,707.48043    |
| Std. Error of Regression  | 41.32167       |
| Mean Abs. Dev. (MAD)      | 29.99085       |
| Mean Abs. % Err. (MAPE)   | 2.31%          |
| Durbin-Watson Statistic   | 1.402          |
| Durbin-H Statistic        | #NA            |
| Ljung-Box Statistic       | 36.80          |
| Prob (Ljung-Box)          | 0.0458         |
| Skewness                  | 0.116          |
| Kurtosis                  | 3.239          |
| Jarque-Bera               | 0.553          |
| Prob (Jarque-Bera)        | 0.7584         |

### Peak Model Fit

As seen in the figure below (and in the model statistics above), this approach produces a good fit with historical data. Although it was not possible to produce a peak model with an explicit peak DSM variable (like the Residential model) as the associated parameters are insignificant, the indirect effects of energy related DSM in the historical data from the end use model are carried over into the peak model. Assuming there is a relationship between the DSM applied to peak savings and DSM applied to energy savings, this will result in a similar amount of DSM embedded in the peak forecast, either through the embedded portion of energy sales DSM that is present on the *OtherLoad<sub>m</sub>* or embedded on the accrued demand information measured at the system level.



## **Appendix C**

### **Forecast Comparison and Accuracy**

**Figure C1: Total Nova Scotia Energy Requirement (NSR)**

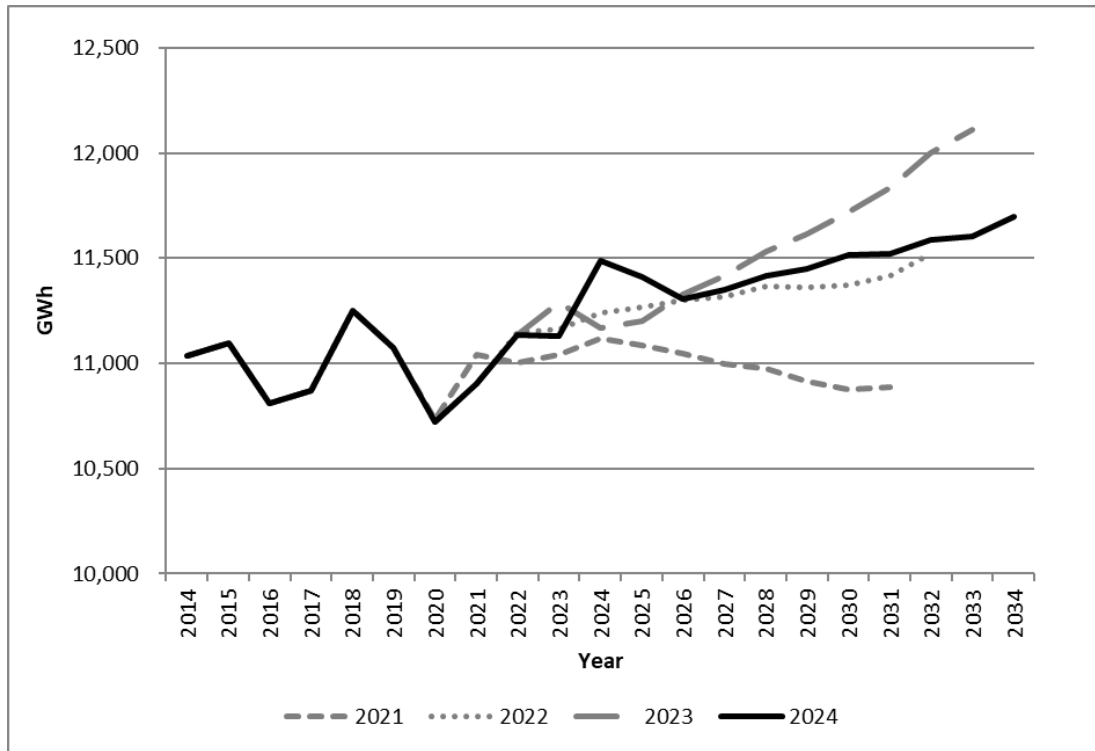


**Figure C2: System Peak Demand**

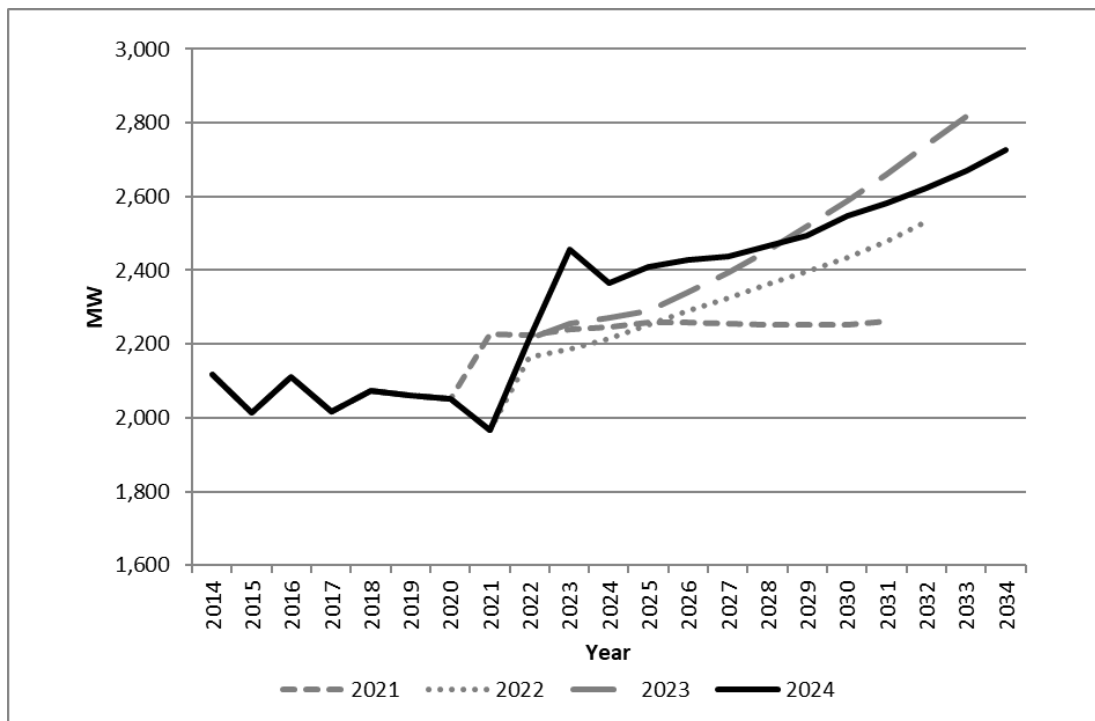


**Figure C3: Firm Peak Demand**

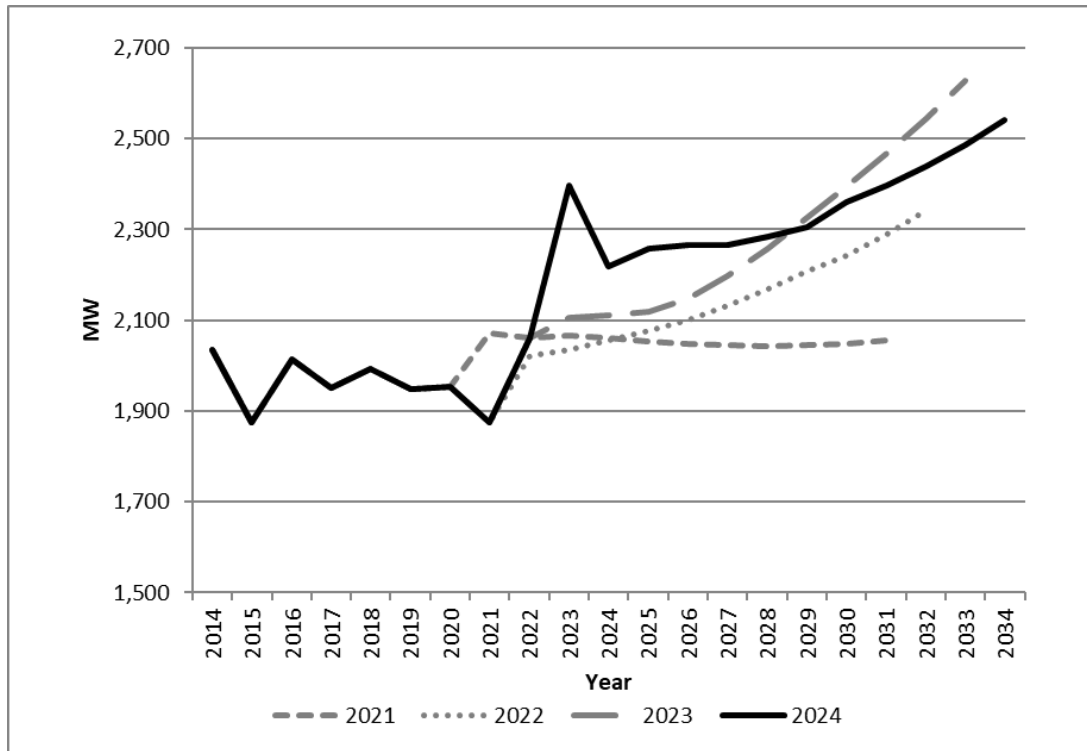


**Figure C4** below provides an overview of the energy forecast accuracy. For these calculations, the load of the major pulp and paper mills is removed from the net system requirement as these contribute a significant amount of unforeseeable variance to the results. The rows show each years' 10-year forecast series with the forecast mill load removed. The row labeled "Actuals less mills" is the actual NSR with mill load removed. Each forecast year is compared to the corresponding actual value, and a 10-year average is calculated based on number of years out in the forecast series. So, a lead time of 1 would correspond to the average error of all the forecast first year estimates versus the corresponding actual value. The statistics show that on a 5-year basis the error (mean absolute percent error, or MAPE) averages just over 2 percent. Beyond 5 years the accuracy diminishes. **Figure C5** provides the same analysis for the firm peak load (the mills are not considered part of the firm load). As the peak is much more sensitive to weather, the error is larger, but averages just over 5 percent in the first 5-year period, with accuracy diminishing in later years. **Figure C6** provides the system peak accuracy, with an average of just under 5 percent in the first 5-year period.

[illegible]

| NSR less mills            |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |
|---------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Forecast                  | Forecast<br>for: | Forecast<br>for: | Forecast<br>for: | Forecast<br>for: | Forecast<br>for: | Forecast<br>for: | Forecast<br>for: | Forecast<br>for: | Forecast<br>for: | Forecast<br>for: |
| <u>Statistics</u>         |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |
| Lead Time (Years):        | 1                | 2                | 3                | 4                | 5                | 6                | 7                | 8                | 9                | 10               |
| No. Observations:         | 10               | 9                | 8                | 7                | 6                | 5                | 4                | 3                | 2                | 1                |
| Average percent<br>Error: | -0.2%            | -0.3%            | -0.5%            | -1.3%            | -2.1%            | -1.9%            | -1.8%            | -4.0%            | -5.0%            | -9.8%            |
| MAPE:                     | 2.1%             | 2.1%             | 1.1%             | 2.4%             | 3.3%             | 3.0%             | 2.5%             | 4.0%             | 5.0%             | 9.8%             |

[illegible]

| Firm Peak              |               |               |               |               |               |               |               |               |               |               |
|------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Forecast               | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: |
| Statistics             |               |               |               |               |               |               |               |               |               |               |
| Lead Time (Years):     | 1             | 2             | 3             | 4             | 5             | 6             | 7             | 8             | 9             | 10            |
| No. Observations:      | 10            | 9             | 8             | 7             | 6             | 5             | 4             | 3             | 2             | 1             |
| Average percent Error: | 0.0%          | 0.1%          | -1.0%         | -1.4%         | -2.6%         | -3.5%         | -6.0%         | -9.4%         | -13.8%        | -19.8%        |
| MAPE:                  | 5.2%          | 4.8%          | 5.0%          | 5.1%          | 5.6%          | 3.5%          | 6.7%          | 11.5%         | 13.8%         | 19.8%         |

[illegible]

| System Peak            |               |               |               |               |               |               |               |               |               |               |
|------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Forecast               | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: | Forecast for: |
| Statistics             |               |               |               |               |               |               |               |               |               |               |
| Lead Time (Years):     | 1             | 2             | 3             | 4             | 5             | 6             | 7             | 8             | 9             | 10            |
| No. Observations:      | 10            | 9             | 8             | 7             | 6             | 5             | 4             | 3             | 2             | 1             |
| Average percent Error: | 2.3%          | 2.5%          | 1.6%          | 1.2%          | -0.4%         | -1.6%         | -5.5%         | -9.6%         | -14.7%        | -21.4%        |
| MAPE:                  | 5.7%          | 5.0%          | 4.8%          | 4.8%          | 4.1%          | 2.6%          | 7.4%          | 9.6%          | 14.7%         | 21.4%         |

## **Appendix D**

### **Forecast Sensitivity Analysis**

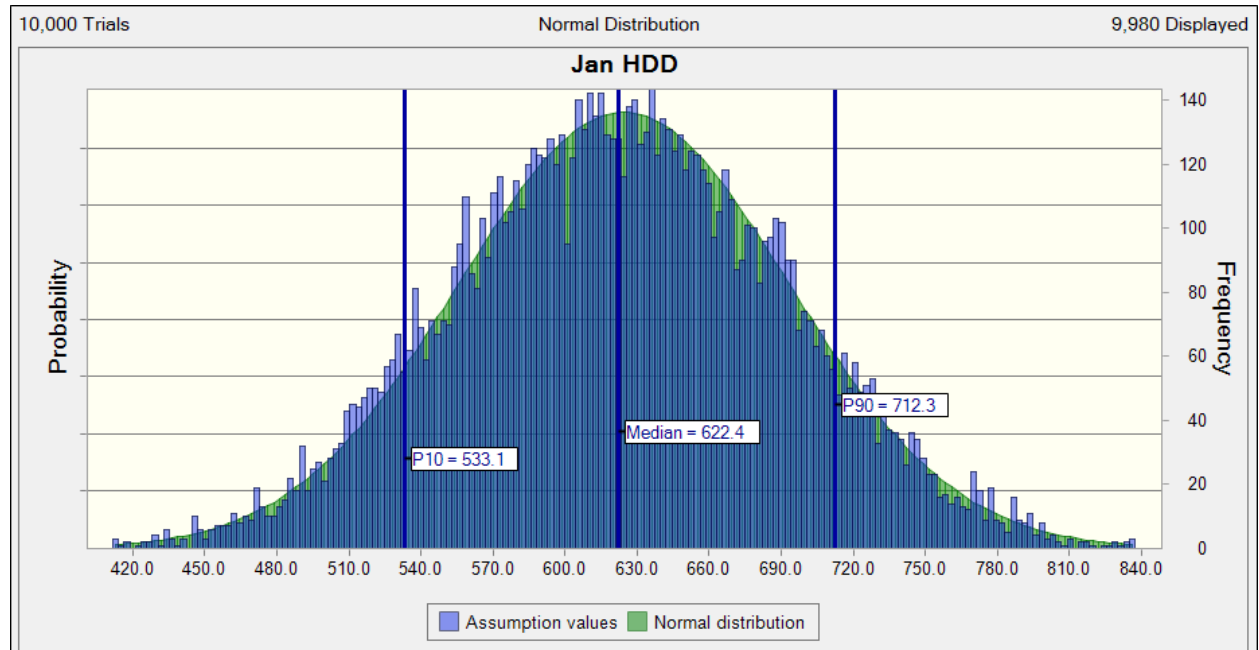
## **Sensitivity Analysis**

The P10/P90 sensitivity analysis used Monte Carlo simulation for the economic and weather variables.

The algorithm uses the following sequence

1. Once the deterministic SAE class regression models are completed, the regression coefficients are exported into the Monte Carlo tool, called Oracle Crystal Ball (MS Excel add-on).
2. The Monte Carlo process assumes that the regression coefficients are held constant throughout the simulation, the historical variation of the inputs (predictors, independent variables) will affect the forecast prediction, in a probabilistic way. In other words, the simulations help to understand how the underlying SAE forecast responds to changes to the inputs based on historical variation.
3. For 2024 the historical variation of monthly and peak day weather (20 years of hourly temperatures expressed in HDDs and CDDs) and economic drivers (20 years of annual data, as obtained from Conference Board of Canada Economic models) was used.
4. The variation of the weather and economic drivers is treated as Normal distributions (see **Figure D1**).

**Figure D1: Distribution of January HDD**



5. Oracle's Crystal Ball runs about 10,000 trials, taking a random set of numbers from the relevant variables for each trial. For example, the random HDD variable for January (above), would have a Normal distributed weight, meaning that after 10,000 trials, a histogram of the variable will have an average and standard deviation that coincides with the distribution of the last 20 years.
6. Incorporating variability in the individual end uses is still in progress, as it is difficult to produce a distribution for historical end use data. EIA and NRCAN have revised their historical data sets in recent years, making historical variation studies challenging. However, as noted in previous sections, heat pumps are included in the input SAE models, and therefore their contributions to load will have an impact in the simulations as well.
7. At the end of the Monte Carlo run, 10,000 output forecast points are produced, each year represented by 10,000 possible outputs, with Normal distributed averages and standard deviations, which are the result of the different combination of the random variable trials.

These distributions are shown in **Figure D2** for energy and **Figure D3** for peak (both before the impact of DSM). 10<sup>th</sup> (10%) and 90<sup>th</sup> (90%) percentiles can easily be obtained from Normal distributions and so they are highlighted in D2.

**Figure D2: Distribution of Energy (Before DSM)**

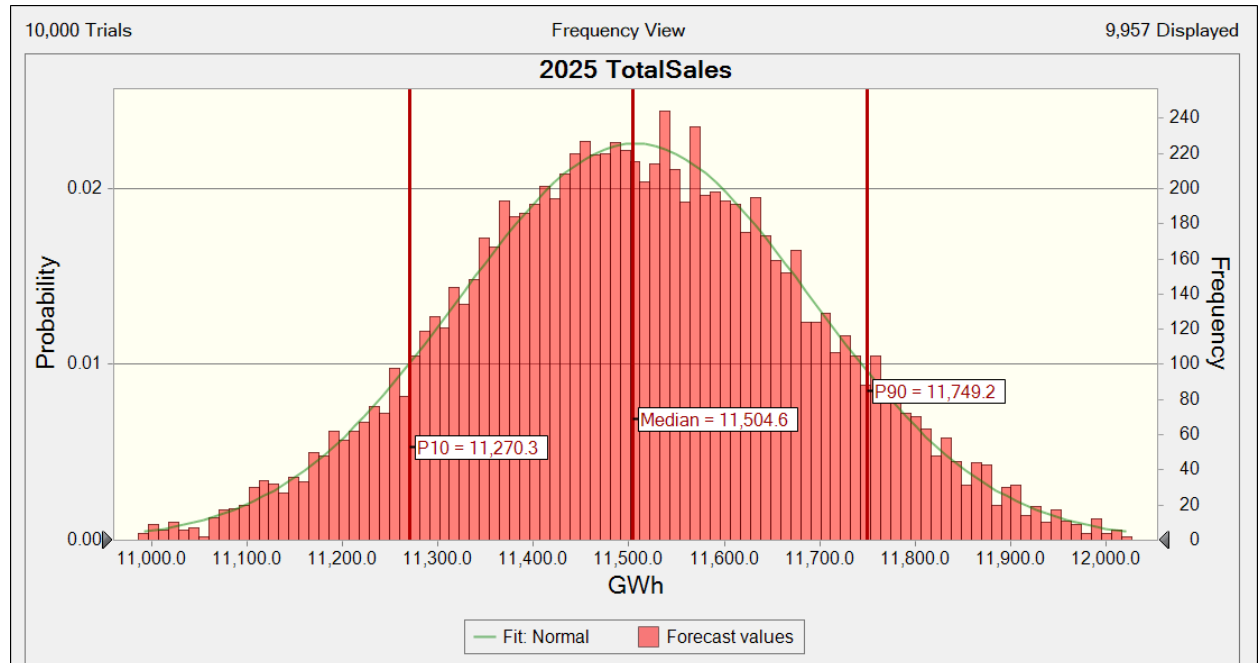
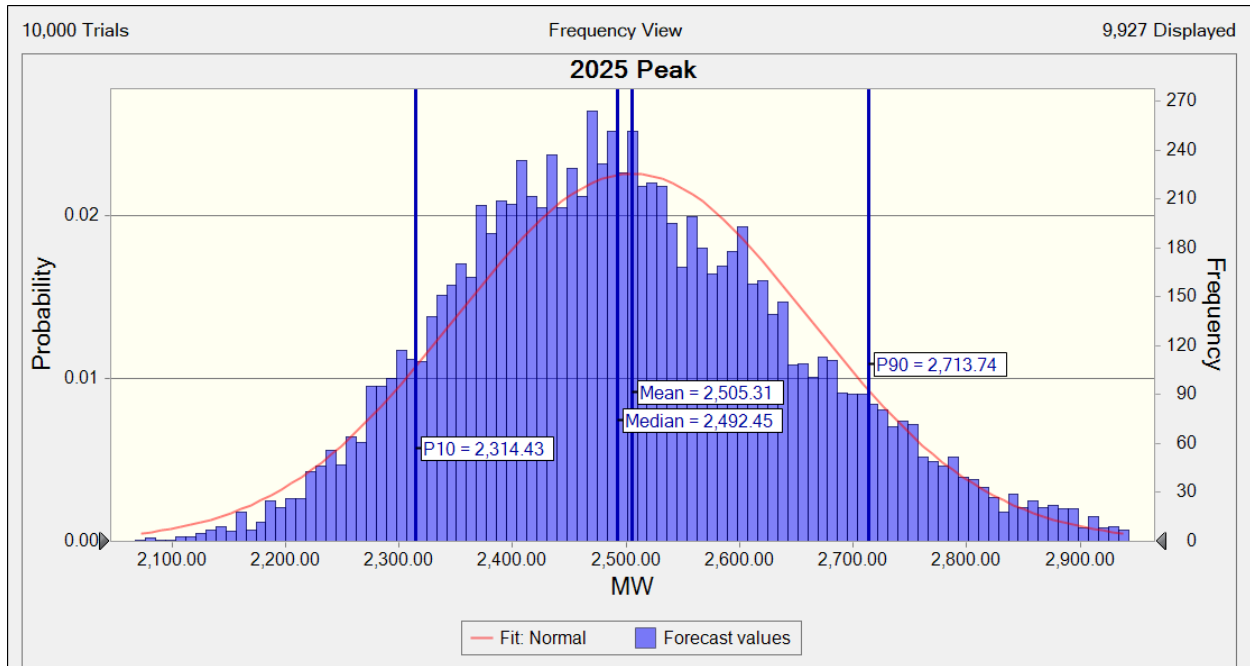
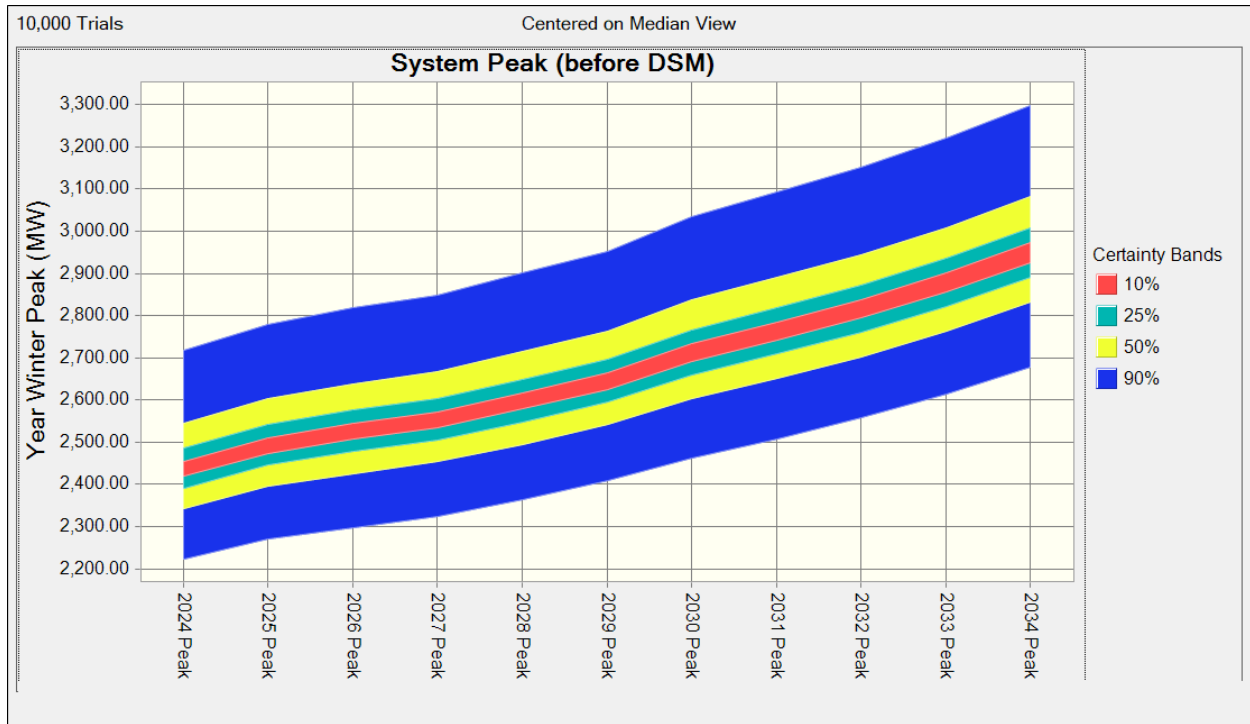


**Figure D3: Distribution of Peak (Residential, Commercial and Small and Medium Industrial)**



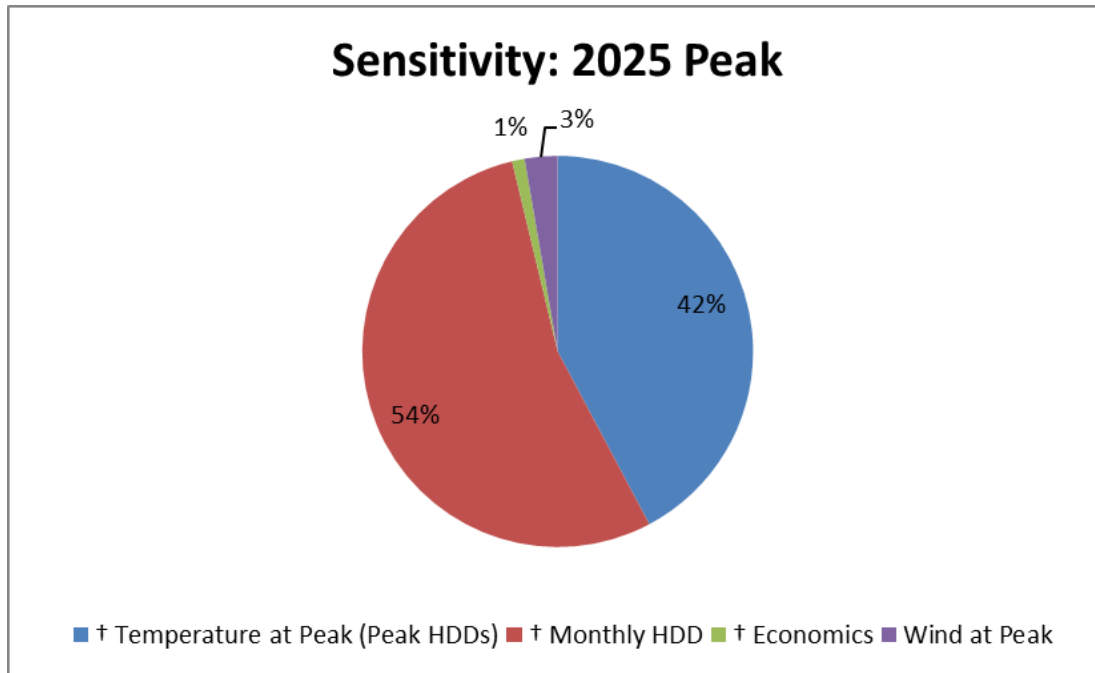
8. From these annual forecast distributions, the various probabilistic forecasts can be obtained as well as sensitivity diagrams that show the relative impact of the variables in each year. In **Figure D4** the probabilities of system peak forecasts (before DSM) around the median are shown. The area contained between blue borders represents a range of peaks that has a 90% chance of occurring; the yellow area highlights a 50% chance, and so on.

**Figure D4: Peak Forecast (Residential, Commercial and Small and Medium Industrial)**



The asymmetry in this figure, seen as the off-centre median, is explained by the bias introduced by plotting the maximum monthly Peak of a given year. Every month has a normal distributed daily Peak HDD, however by using the MAX function a skewed quasi-normal distribution is created when it selects the maximum Peak HDD from the 12 available months. Peak Demand and its associated SAE model are mostly sensitive to the Peak HDD temperature, however, as shown in **Figure D5**, the Monthly HDD has surpassed Peak HDD importance (which now is based in a 12-hour average) in 2025 as year-long residential heating had an impact on sales, and therefore, that impact (sensitive to monthly variations) was translated into Peak Demand.

Figure D5: Relative Sensitivity of Peak



In terms of the sensitivity of the energy sales forecast to the various input variables, **Figures D6 and D7** show that in the near term, weather represents the strongest sensitivity, while in the long term, economics becomes dominant. This is mainly due to the compounding effect of economics over time, as opposed to weather which will only impact a particular year. By 2034 the cumulative impact of the economic variables makes economics rival weather in forecast sensitivity. The monthly (rather than cumulative) nature of HDD means it has much less relative impact in the long term.

Figure D6: Sensitivity of Energy Forecast (2025)

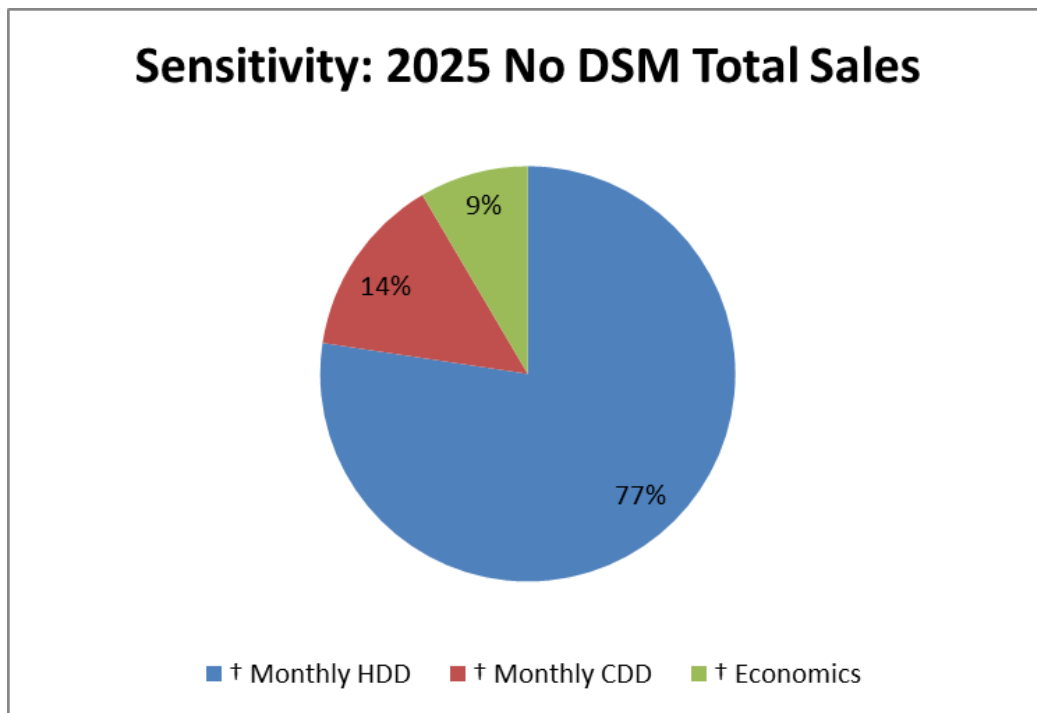
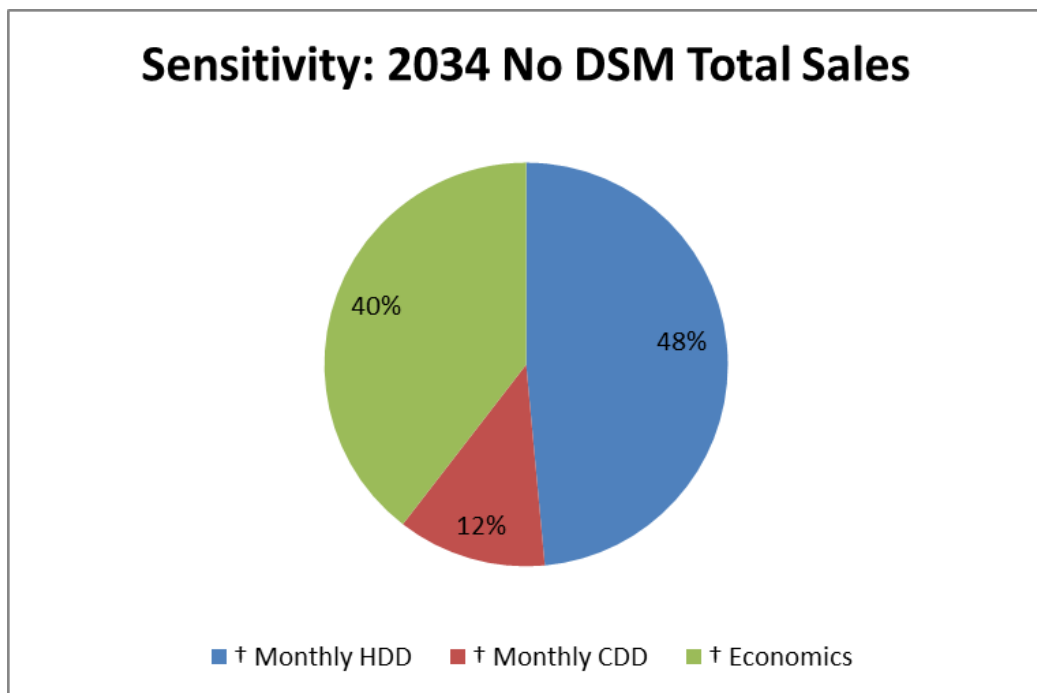


Figure D7: Sensitivity of Energy Forecast (2034)

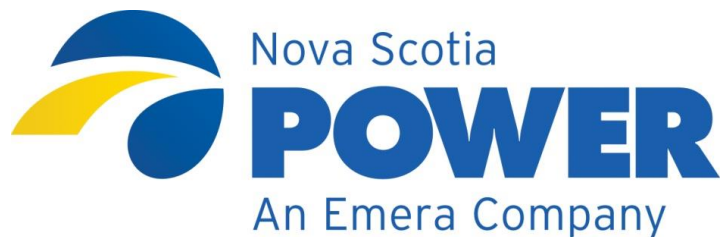


In terms of relative magnitude of the sensitivities, on the energy side DSM, [REDACTED] and EVs are the main drivers, while on the peak side DSM, EVs, hybrid heating peak mitigation and weather/economics are all similar. **Figure D8** shows the relative impact of these items.

**Figure D8: Relative Impact of Inputs**

| Item                                                   | 2024 Energy (GWh) | 2024 Peak (MW) | 2034 Energy (GWh) | 2034 Peak (MW) |
|--------------------------------------------------------|-------------------|----------------|-------------------|----------------|
| Included in Forecast                                   |                   |                |                   |                |
| DSM (base case)                                        | -143              | -26            | -1483             | -266           |
| Solar PV                                               | -55               | 0              | -681              | 0              |
|                                                        |                   |                |                   |                |
| EV (current forecast)                                  | 18                | 6              | 566               | 156            |
| Other Possible Scenarios                               |                   |                |                   |                |
| EV (current forecast, no peak mitigation)              | 18                | 10             | 566               | 281            |
| 2 Hydrogen Production Facilities (firm supply portion) | 0                 | 0              | 824               | 130            |
| Battery (5% share by 2033)                             | 0                 | 0              | 0                 | -135           |
| Weather/Economics P10/P90                              | +/-234            | +/-215         | +/-323            | +/-265         |
| Price Elasticity of -0.458                             | 32                | 0              | -57               | 0              |

At this time, any potential impacts of the proposed hydrogen facilities on the NS Power's Net System Requirement and System Peak are still being evaluated. NS Power understands that two proposed projects have indicated a potential combined firm demand of 130 MW, which is reflected in **Figure D8**. In this sensitivity, the energy required by the facilities is assumed to be mostly self-supplied, with some top up supply from NS Power. The development of this new sector will continue to be monitored in future Load Forecast Reports.



APRIL 11, 2024

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## 2024 10yr Preliminary Forecast



## Purpose

- As in previous years, this presentation on the preliminary 10-year load forecast provides an opportunity to discuss improvements and updates to the forecast and allow stakeholders to ask questions. This allows for feedback to be integrated in the final report and to ensure any outstanding issues are addressed.

# Agenda

- Summary of Changes from 2023 Forecast
- Preliminary Results by Class
- Ongoing Work

# Timeline

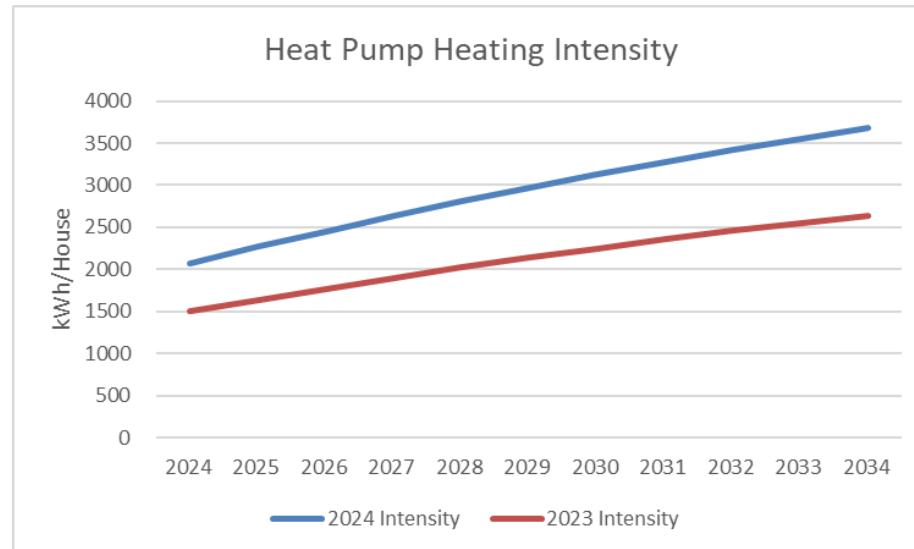
- November 2023: NSUARB Load Forecast Decision released
- December 2023 – March 2024: Forecast preparation
- April 2024: Stakeholder meeting to discuss updates and preliminary results
- April 30, 2024: 2024 Load Forecast Report submitted to the NSUARB

# Changes from 2023

| Input                      | Data Source                                                                                                                                                                                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Heating intensity          | Residential heating intensity updated to reflect 2022 and 2023 actual results.                                                                                                                |
| EVs                        | Vehicle sales updated to reflect the fact that government mandates (20% zero emissions vehicle sales by 2026, 60% by 2030, 100% by 2035) are at the national level, not the provincial level. |
| Electrification of heating | E3 forecast for electrification of residential and commercial heating based on “Hybrid” scenario.                                                                                             |
| RTR in the forecast        | RTR load expected in 2025 (61 GWh) and 2026 (246 GWh).                                                                                                                                        |
| Increased solar generation | Behind the meter solar generation expected to increase compared to the 2023 forecast driven by commercial class.                                                                              |

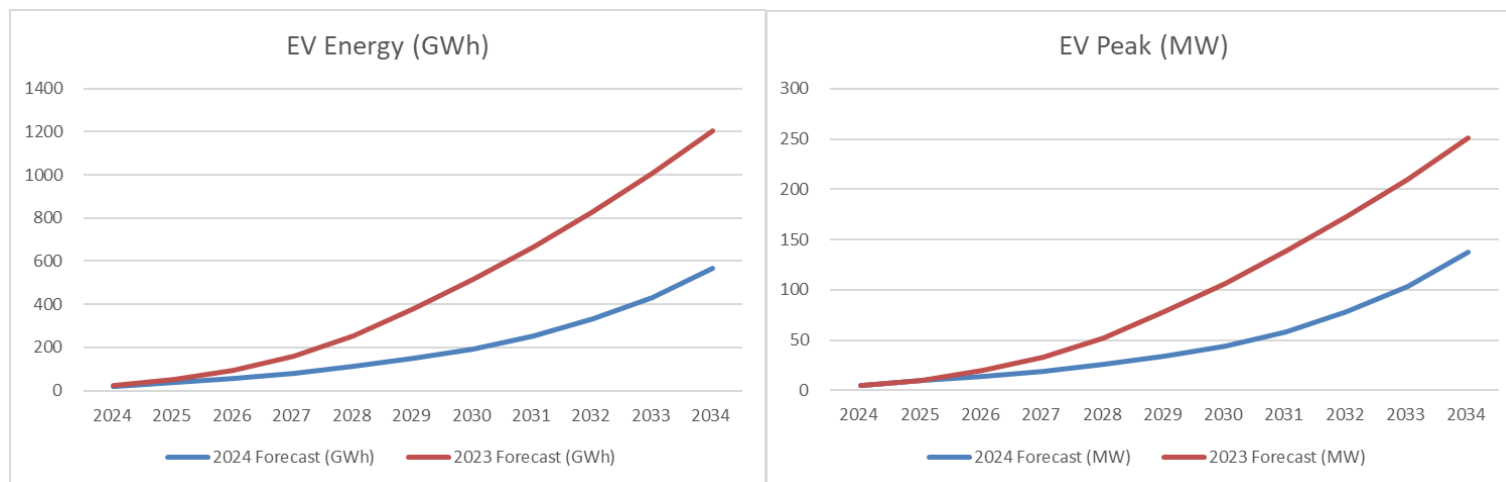
# Heating Intensity

- Both 2022 and 2023 had significant unexplained variances in the Residential class when the impact of weather is included.
- Variances were greatest in winter months, indicating that missing load is likely heating related.
- Heating intensity of heat pumps was increased to account for the missing heating load in the forecast.



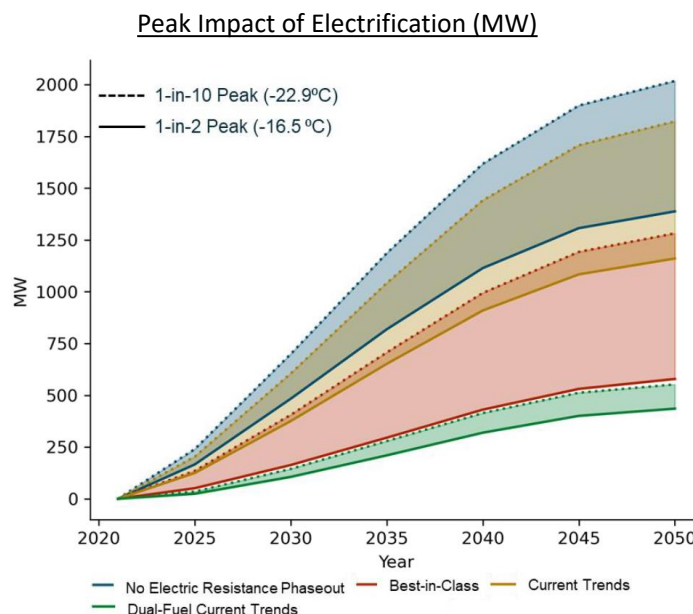
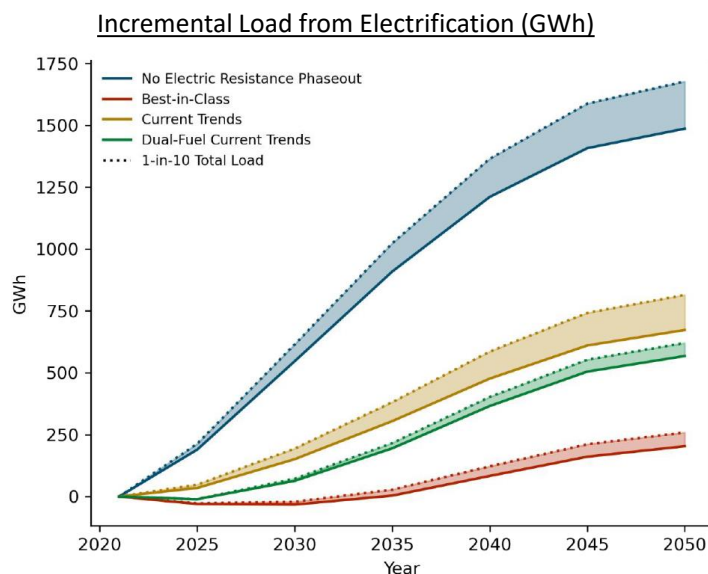
# EVs

- 2024 forecast has been updated to account for the fact that the federal government's zero emissions vehicle (ZEV) sales targets of 60% by 2030 and 100% by 2035 apply at the national level and NS sales will lag.
- EV load shapes are used for energy and peak (managed and unmanaged peak impact).
- 2023 forecast had 1202 GWh (282K vehicles, including medium and heavy-duty) by 2034, while the 2024 forecast has 566 GWh (149K vehicles).
- The peak forecast has decreased from 251 MW to 137 MW in 2034.



# Electrification of Heating

- Using E3 “Hybrid” scenario, aligned with IRP Evergreen.
- The hybrid scenario (dual fuel) has the potential reduction in peak impact by using existing non-electric backup heat to serve peak loads.
- The graphs below show the incremental change in energy consumption and impact on overall peak load.



# Renewable to Retail

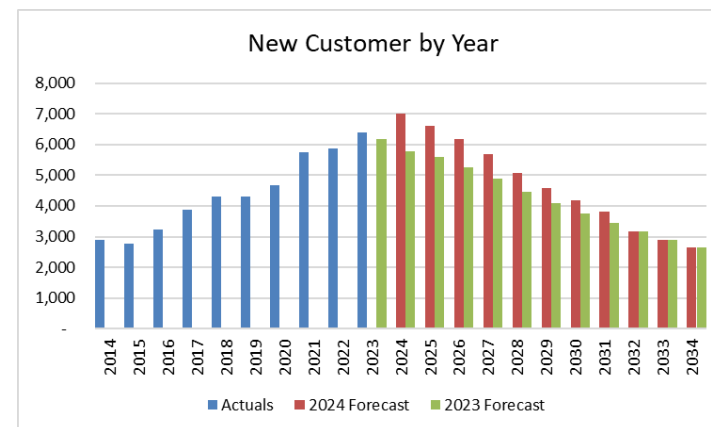
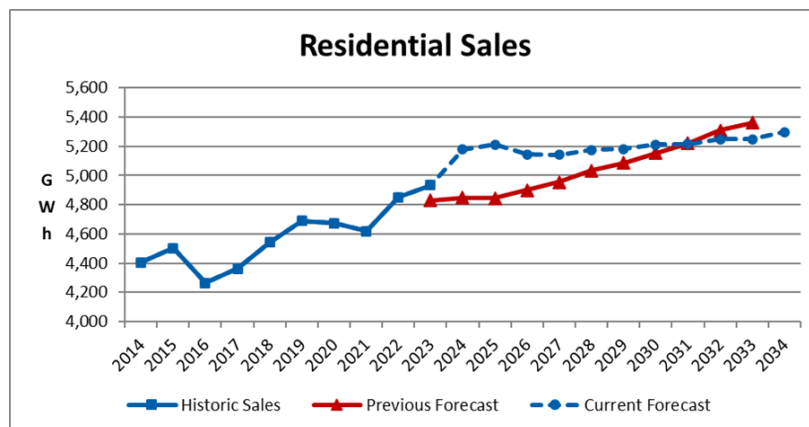
- RTR participation is expected to start in late 2025 (340 GWh of wind production), with a total reduction of 246 GWh compared to an estimated reduction of 116 GWh in the 2023 forecast.
- Customer sales are expected to be as follows and are removed from the forecast:

| Class                   | 2025 Impact<br>(GWh) | 2026+ Impact<br>(GWh) |
|-------------------------|----------------------|-----------------------|
| Residential             | 18                   | 75                    |
| Small General           | 1                    | 7                     |
| General Demand          | 23                   | 97                    |
| Large General           | 2                    | 8                     |
| Small Industrial        | 1                    | 4                     |
| Medium Industrial       | 10                   | 39                    |
| <u>Large Industrial</u> | <u>5</u>             | <u>16</u>             |
| <b>Total</b>            | <b>61</b>            | <b>246</b>            |

# Small Scale Solar

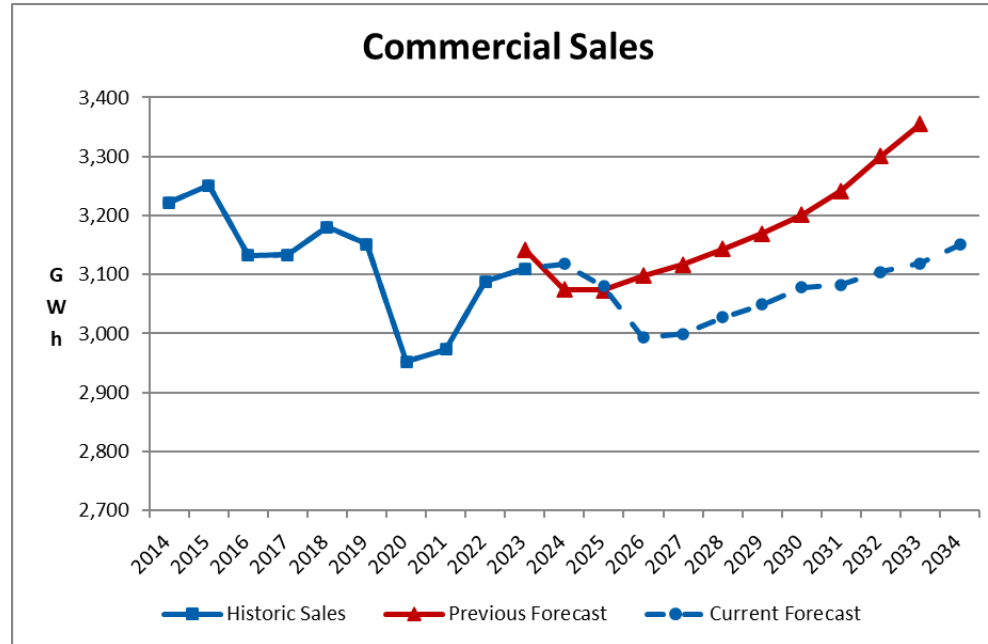
- Small scale solar uptake continues to be strong: as of 2023 approximately 71.7 MW of solar generation has been installed (19.8 MW in 2023).
  - Rebates are still available for residential solar projects (\$0.30/watt from the provincial programs).
  - Changes to net metering legislation will likely result in more interest from commercial customers.
  - Given the continued strong uptake and changes to legislation, the long-term forecast has been adjusted to reflect increased solar penetration in the next 10 years – installed capacity of 674MW by 2034 (compared to 609MW in the 2023 forecast).

# Forecast Comparison - Residential



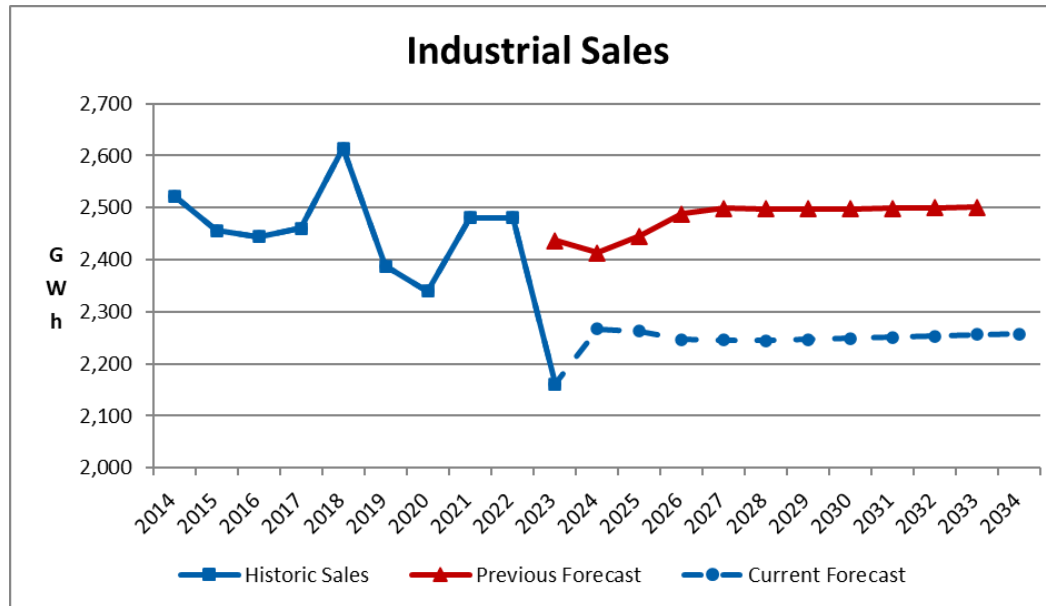
Weather in 2023 was warmer than normal, with an impact of -126 GWh on load. Sales are expected to be driven higher by electric heating and new customers and partly offset by continued DSM, with a reduction in 2025/2026 related to RTR. Forecast new customer growth is higher than the 2023 forecast, with 6K more customers by 2034.

# Forecast Comparison - Commercial



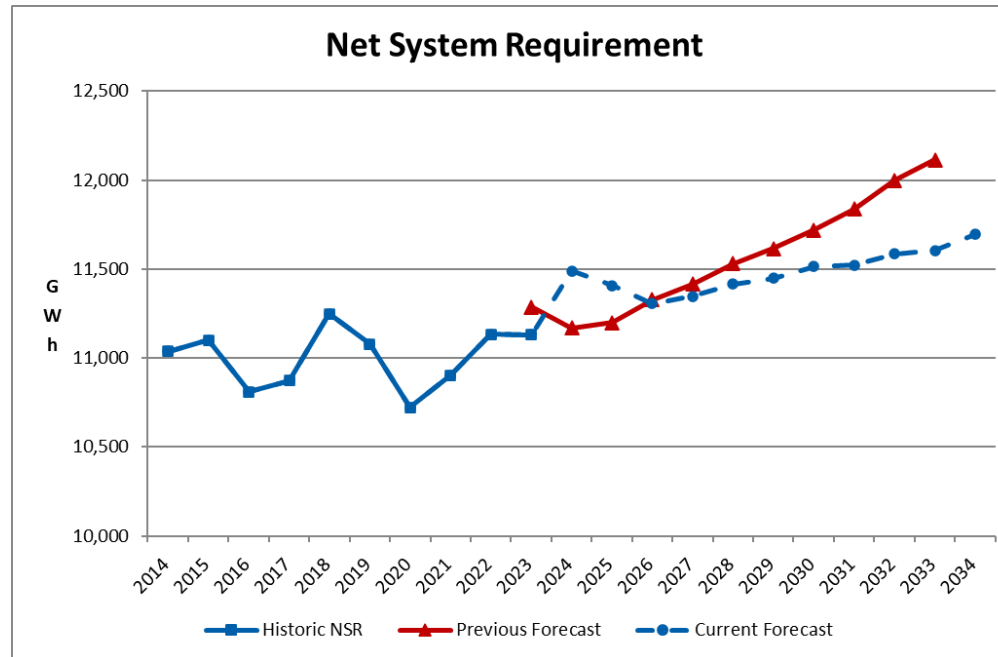
The significant changes to the forecast for 2024 are a larger drop in load between 2025 and 2026 due to the introduction of RTR, with lower growth from EVs.

# Forecast Comparison - Industrial



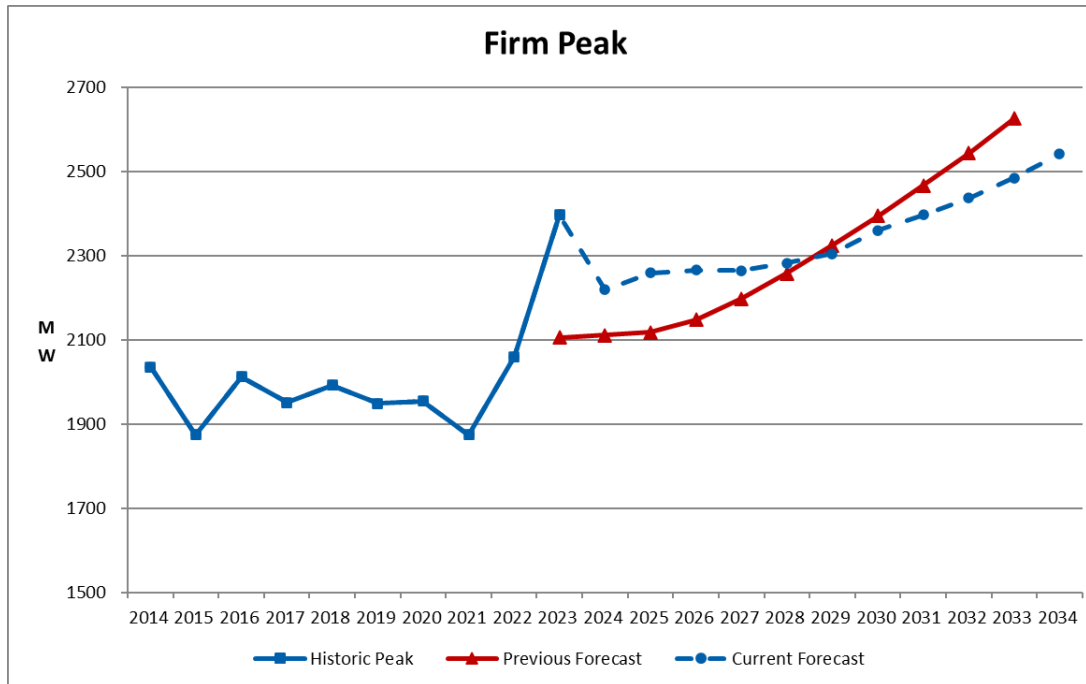
The Industrial class shows a drop compared to the 2022 forecast, mainly driven by a lower forecast for a large customer and lower growth assumptions for large customers.

# Forecast Comparison – Energy



2024 forecast shows higher growth than 2023 in the near term, driven mainly by a combination of increased heating intensities in the Residential class as well as a higher forecast for new residential customers. The decrease in 2025 and 2026 is a result of sales shifting to RTR.

# Forecast Comparison – Peak



The peak forecast is higher than the 2023 forecast in the near term as a result of higher heating intensity and higher forecast for new customers, but is lower than the 2023 forecast in the long term as a result of the revised EV forecast and the integration of the E3 hybrid scenario.

# 2023 Forecast to Actuals

Below is an estimate of the major variances between the 2023 forecast and 2023 actuals for both energy and peak.

| Item                     | GWh    |
|--------------------------|--------|
| 2023 Forecast NSR        | 11,288 |
| • Weather impact         | -164   |
| • Residential pickup     | 230    |
| • Large customer actuals | -263   |
| • Other variance         | 40     |
| 2023 Actual NSR          | 11,131 |

| Item                       | MW   |
|----------------------------|------|
| 2023 Forecast Peak         | 2256 |
| • Interruptibles           | -88  |
| • Weather (-22.8 12hr avg) | 250  |
| • Wind (avg 28.4 vs 18.8)  | 26   |
| • Weekend                  | -30  |
| • Lighting (estimated)     | -150 |
| • Other variance           | 191  |
| 2023 Actual Peak           | 2455 |

## Other items addressed

- Update on potential impact of pilot projects
- Update on impact of solar generation to peak
- Relative impact of hydrogen production added in sensitivities
- Update on AMI integration
- Review of assumptions around large customer growth
- Review of economic inputs and household size
- Review of price elasticity estimate

## Ongoing work for future reports

- Integrating AMI data into the sales and peak forecast
- Impact of electrification/emissions targets
- Continuing evaluation of the impact of new technologies (time variable pricing, direct load control, etc.)

**2024 Load Forecast Report Attachments  
1-10 have been filed electronically.  
Attachment 4 is confidential.**