Evidence Regarding Nova Scotia Power's 2024 Load Forecast

Evidence RE: M11689

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1. INTRODUCTION

For many years, Nova Scotia Power, Inc. (NSPI) has filed annual load forecast reports, and Synapse Energy Economics Inc. (Synapse) has reviewed many of these. NSPI's load forecast reports have changed considerably over time. The *2024 Load Forecast Report* [1] (Report) continues the trend of improvement in expository quality by providing additional information. Synapse also notes in particular that the 2024 forecast is generally more conservative than last year's, with projected increases in annual sales and peak load trending back toward the levels of the 2022 forecast. While this year's forecast anticipates a notable bump in both energy and peak in 2024, in subsequent years, the rate of growth moderates considerably, with a compound annual growth rate in the annual sales forecast of 0.2 percent per over the entire forecast, and a compound annual growth rate for peak totaling 1.2 percent. The principle drivers of growth in both energy and peak are the forecast increases in the number of electric vehicles (EVs), in adoption of electric heating end-uses, and in the total number of customers. Nonetheless, NSPI has reduced its projection for EV growth in the province and has also raised its forecast for the Renewables to Retail (RTR) market, which together contribute to reducing the forecast increases in energy and peak relative to last year's load forecast.

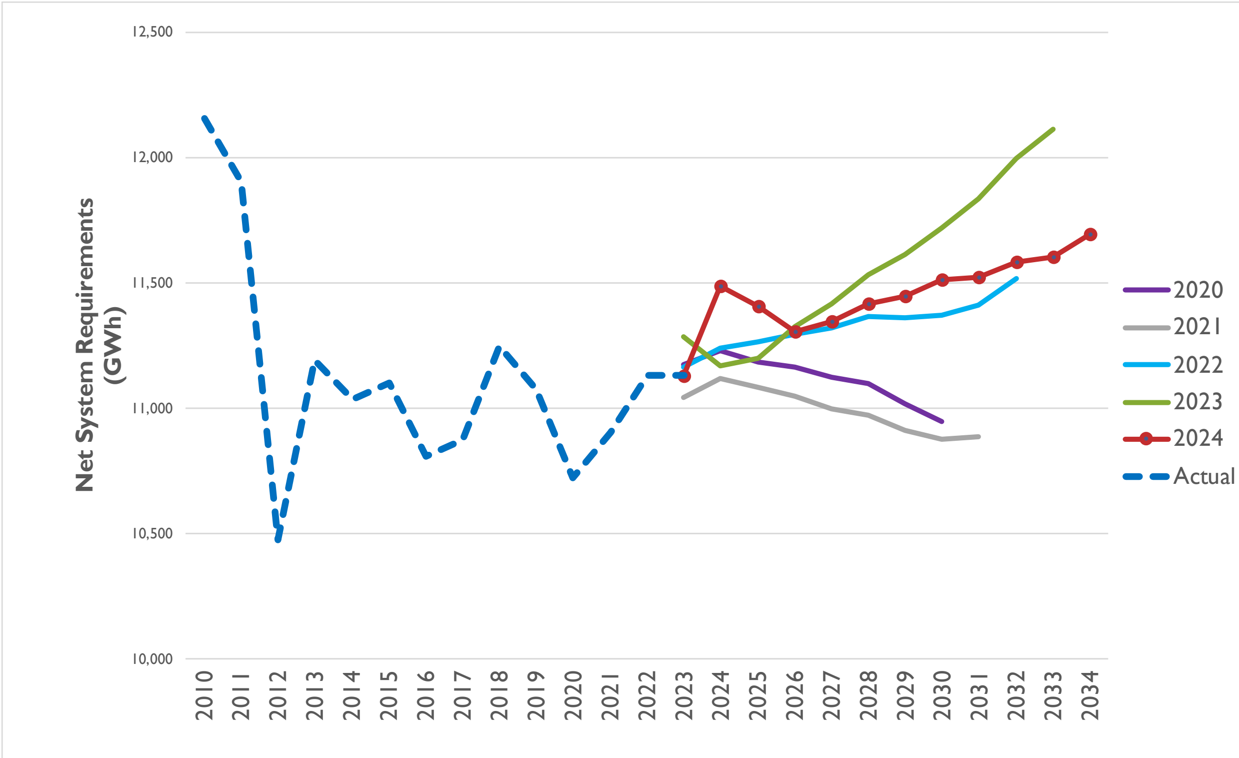
Consistent with previous forecasts, NSPI's 2024 load forecast is composed of three discrete elements. The first is the Statistically Adjusted End-Use (SAE) model forecast based on customer end-uses. The second is the set of demand-side management (DSM) adjustments applied to the SAE forecast values. Third, NSPI applies other factors to reflect customer growth and specific program adjustments. We will discuss all these components in this evidence.

1.1. Forecast Comparisons

First, we look at how this forecast compares with those of recent years. Figure 1 below shows both the actual historical energy requirements and recent forecasts. Energy loads declined substantially between 2010 and 2013 as many industries in the province contracted. Since 2013, actual loads have been relatively flat. While loads were down in 2021 because of the COVID-19 pandemic, they rebounded in 2022. Recent years' forecasts have varied widely. The 2020 and 2021 load forecasts projected modest declines going forward, while the 2022 forecast projected substantial load increases into the future, and the 2023 forecast anticipated even greater future load growth. This year's load forecast reflects changing conditions driven by climate-related reductions in fossil fuels and increased electrification for a number of end-uses, and it anticipates overall more modest growth in load than last year's forecast predictions.

[1] Nova Scotia Power, Inc. *2024 Load Forecast Report*, April 30, 2024 (2024 Load Forecast).

Figure 1. Net system requirements



Source: Synapse from Figure 1 in NSPI's 2024 Load Forecast Report (2024 Load Forecast) and responses to Synapse IR-1

The current forecast predicts a 205 GWh increase in the net system requirement (NSR) from 2024 to 2034, which is equal to 1.8-percent total increase. NSPI lays out the components of this change in Figure 55 of its Report, as shown in Table 1 below. The "Model" growth is primarily a result of electrification of heating loads along with greater cooling usage. Other factors causing increases in load are growth in new customers and electric vehicles (EV). Offsetting these increases are rooftop solar, DSM, and sales through the RTR market. In addition, adjustments made to reflect newly introduced hybrid heating assumptions also reduce the total net system requirement. We discuss several factors in more detail in this evidence.

Table 1. Net system requirement components

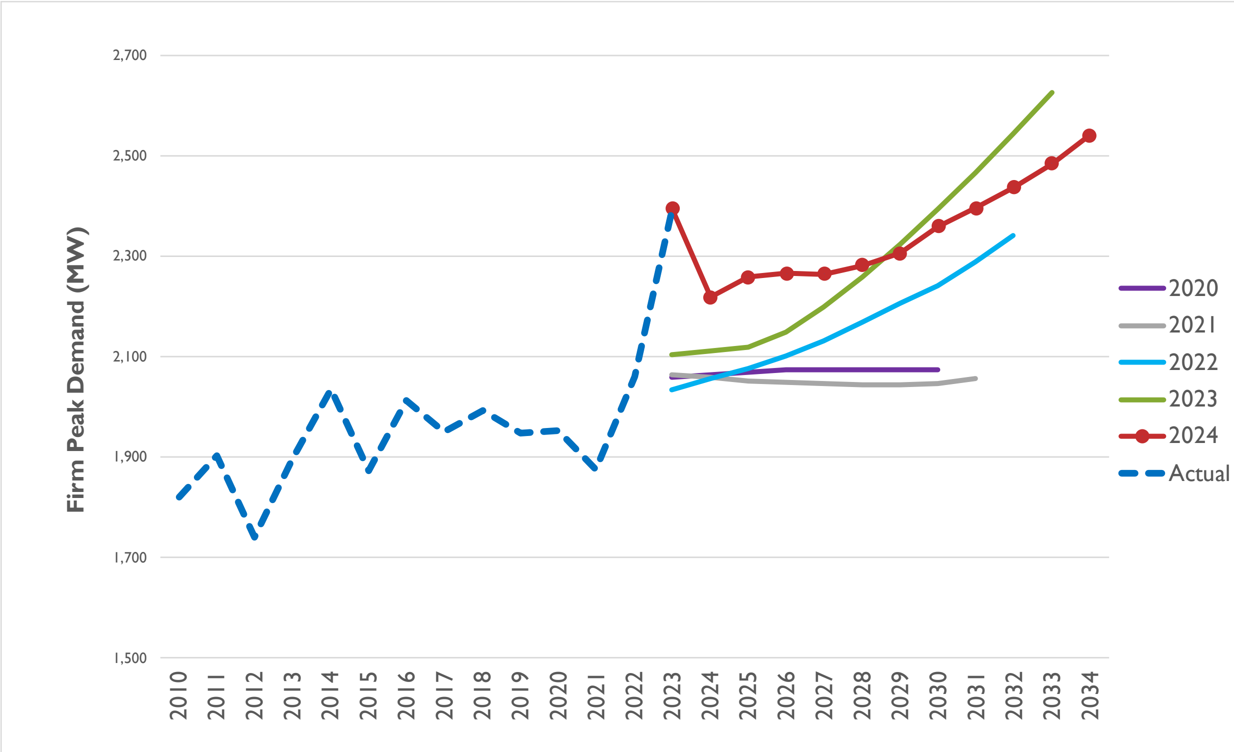
	Res.	Comm.	Ind.	Mun. and Other	Losses	NSR
2024 Forecast (GWh)	**5,180**	**3,118**	**2,267**	**159**	**767**	**11,490**
Model	466	352	41	-82	69	986
New Customers	366	32				398
Solar	-416	-210				-627
EV	312	236				548
Commercial & Industrial Electrification		9	25			34
Large Customer Projects		9	42			50
Hybrid Model Adjustment	-177	-63				-240
RTR	-75	-112	-59	139		-246
DSM	-356	-221	-57	-3	-61	-699
2034 Forecast	**5,298**	**3,151**	**2,258**	**213**	**775**	**11,695**

Source: Figure 55 from 2024 Load Forecast

The historical trend for firm peak demand shows a general increase, as shown in Figure 2 below. We plotted the actual rather than the weather-normalized historical peaks to give a sense of the year-to-year variations. The 2024 forecast is initially higher than the 2023 forecast but then grows at a slower rate. The increase over the forecast period for this forecast is 323 MW or 14.6 percent. This increase is mostly driven by the expectation of increased electrification.

The components producing this change are specified in Figure 61 of the Report (reproduced below as Table 2). The modeled values are what come from the SAE modeling and what follows are various adjustments to that to arrive at the firm peak. Note that EVs are the largest addition by an order of magnitude.

Figure 2. Firm peak demand



Source: Synapse from Figure 2 from 2024 Load Forecast and responses to Synapse IR-1

Table 2. Firm peak demand components

	Modeled Peak (MW)	Res. Heat Peak (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	2,219	144	2,365
2034	2,505	13	156	-37	-68	4	115	-145	2,542	147	2,727
2034 (no EV mitigation)	2,505	13	281	-37	-68	4	115	-145	2,670	147	2,851

Source: Figure 61 from 2024 Load Forecast

NSPI provides the percent error and mean absolute percent error for the firm peak forecast in Figure C5 of Appendix C. In aggregate, the average percent error of the forecast is minimal for a small lead time and increases as the lead time increases. Thus, the firm peak has in aggregate been under-forecast and for each year further in the forecast, the degree of under-forecasting is larger. The lowering of the firm peak forecast from 2023 to 2024 may logically follow the reduction in electric vehicle adoption and further pursuit of hybrid heating. However, such a decrease in the forecast may not be warranted if NSPI has consistently under-forecast load. This issue is discussed in more detail in the Section 4 on sensitivities.

1.2. Sector Overview

The following table shows the forecast energy use by sector. Overall, the residential load (representing around 45 percent of the total load in 2024) is growing the most in terms of energy, driven by electric vehicles, new customers, and building electrification. The commercial forecast increases at a more modest level, and the industrial load shows a small decrease.

Table 3. Sector energy requirements (GWh)

	Residential	Commercial	Industrial	Municipal and Other	Losses	Total
2024	5,180	3,118	2,267	159	767	11,490
2034	5,298	3,151	2,258	213	775	11,695
Change	118	33	-9	54	8	205
Percent Change	2%	1%	0%	34%	1%	1.8%

Source: Synapse from Table A1 from 2024 Load Forecast

In general, the forecast seems reasonable given the ongoing changes. In the following sections, we will look at specific forecast components and note where there are questions and possible improvements.

1.3. DSM Overview

DSM plays a substantial role in reducing energy use and to a lesser degree, peak loads. Specific effects appear in Figures 35 and 55 of the Report. Overall, NSPI projects DSM will reduce the 2034 load by 699 GWh, or about 5.6 percent.

Note however that the DSM Program savings are reduced from their nominal levels to reflect the fact that the SAE regression models use historical data that contain the effects of previous DSM programs. Thus, some DSM savings are assumed to be "captured" in the forecasts. To avoid double-counting, an adjustment factor needs to be determined. This is done statistically, and for the residential sector it was determined that 55.6 percent of the DSM program savings are not in the statistical model results. For the C&I sectors, that value is 44.8 percent. Overall, the net additional savings are about half through 2034. This indicates that a little more than half of the DSM program nominal savings are included in the statistical forecast methodology.[2]

If the DSM programs were to increase above historical levels, then an analysis based on the historical data would likely undercount the savings. But as can be seen in the table below, that is not the current case. Overall, DSM is playing a major role in limiting energy growth. However, we note as reasonable NSPI's suggested potential approach to treat any incremental savings above historical norms as *not*

[2] 2024 Load Forecast, Section 4.6.

embedded in forecast variables but instead to subtract these out at 100 percent over the relevant period of time.[3]

Table 4. DSM Program savings versus forecast adjustments

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)	Net DSM Savings (Percent)
2024	60.9	69.4	12.3	27.0	45.1	33.9	36.6	49%
2025	65.6	71.3	12.6	29.1	46.3	36.5	37.6	50%
2026	69.6	56.7	10.0	30.9	36.8	38.7	29.9	50%
2027	71.6	55.7	9.8	31.8	36.2	39.8	29.4	50%
2028	73.0	62.9	11.1	32.4	40.8	40.6	33.2	50%
2029	73.7	52.2	9.2	32.7	33.9	41.0	27.5	51%
2030	73.3	51.0	9.0	32.5	33.1	40.8	26.9	51%
2031	74.1	48.0	8.5	32.9	31.2	41.2	25.3	51%
2032	73.2	46.8	8.3	32.5	30.4	40.7	24.7	51%
2033	71.3	43.4	7.7	31.7	28.2	39.6	22.9	51%
2034	69.1	44.0	7.8	30.7	28.6	38.4	23.2	51%

Source: Synapse from Figure 35 from 2024 Load Forecast

Recommendations and Considerations

We ask that NSPI explore the benefits of increasing DSM levels in the future.

[3] 2024 Load Forecast, page 56.

1.4. Board Directives from Matter

In its Decision concerning NSPI's 2023 forecast, in Matter 11108, dated November 7, 2023, the Board issued several directives to NSPI for its 2024 forecast and also encouraged NSPI to address or otherwise attend to multiple other issue areas in this year's evidence.

First, in this Decision, the Board issued the following directions:

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.*[4]

Next, the Board encouraged NSPI to provide information on the following:

- *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.*
- *Evaluate the input variables in the residential model and test, over a period of time, if alternative inputs make the residential model more robust, considering the following:*
    - *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.*
    - *Revisiting the short-term economic inputs provided by the Conference Board of Canada to ensure the data is close to what is used in the forecasts of Canada's major Banks.*
    - *Revisit the model's EV adoption rates to ensure that the model's inputs are in keeping with the data reported by Statistics Canada and Nova Scotia Open data.*
    - *With respect to the status of large infrastructure projects, NS Power is encouraged to maintain communications with those customers to ensure system adequacy.*

The Board continued by stating its expectation that NSPI would continue to explore all realistic scenarios relating to hydrogen production and incorporate these into the load forecast modeling.

[4] NSUARB Decision in Matter 11108, page 6.

Finally, the Board noted "significant variance" between forecast and actual 2022 Net System Requirement in the 2023 load forecast and thus directed NSPI to examine the unexplained variance and report its findings with its 2024 load forecast. To this end, the Board encouraged NSPI to consider the effects of the following on load:

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

NSPI's responses to these directives are addressed through the sections that follow. Overall, we find that NSPI has been reasonably responsive to the Board's Decision in Matter M11108, with some specific exceptions specifically called out in the following sections.

1.5. Recommendations from the Previous Forecast Review

The Synapse Evidence regarding the 2023 forecast and the resulting Board Order put forward several recommendations for improving the forecast.[5] The Evidence also included questions for NSPI. These recommendations and questions are reproduced in Appendix A to this report.

[5] Synapse 2023 Evidence, pages 28-29.

2. ENERGY FORECAST

In this section, we begin with a review of NSPI's modeling methodology, and then consider in turn the modeling approaches and results for each of the sectors.

2.1. Major Inputs and Regression Models

In addition to changes in end-use technology, the forecast is influenced by economic, demographic, and weather-related factors.

Changes in overall economic health drive the utilization of the end-use stock. NSPI sources economic projections for the province from the latest Conference Board of Canada (CBoC) 20-year forecast. For the residential forecast, specifically utilizes the CBoC's household income forecast. The suitability of CBoC's forecast data in general, and whether any alternative source might be superior, has been a recurring topic of discussion attending the annual load forecast review. To this end, in its Decision on NSPI's 2023 Load Forecast, the Board in directing NSPI to "[e]valuate the input variables in the residential model, and test, over a period of time, if alternative inputs make the residential model more robust," specifically instructed NSPI to consider "[r]evisiting the short-term economic inputs provided by the Conference Board of Canada to ensure the data is close to what is used in the forecasts of Canada's major banks."[6]

NSPI responds to the Board's direction in its 2024 load forecast with a table comparing the CBoC's forecasts for GDP, employment, and housing starts, with the forecasts of several major Canadian banks for 2024-2025.[7] While the CBoC's short-run projections are generally consistent with those of the various bank forecasts provided, there is uncertainty concerning both the alignment of the CBoC's forecast with bank forecasts beyond 2025, to the extent that such forecasts exist, and also, more generally, with the reliability of the CBoC's forecast further into the future. Sensitivity analyses are useful for looking at this issue.

To estimate growth in new customers, the residential load forecast utilizes projected housing completions, which are correlated to growth in customers. Meanwhile, new customer load is calculated outside of the regression model.[8]

The regression statistics as reported in NSPI's Appendix B are acceptable, although other models with different input variables could have been investigated. In terms of the impacts as reported in NSPI's Appendix B, the change in average energy use for existing customers increased by 9.0 percent over the forecast period, associated primarily with electrification of heating and cooling. New customers

[6] NSUARB Decision in Matter 11108, page 6.

[7] 2024 Load Forecast, Figure 16.

[8] 2024 Load Forecast, Appendix B, page 6.

increased the total residential load by 7.0 percent.[9] The choice of drivers is reasonable but should be reviewed regularly. We note that 9.0 percent represents the increase in existing customer load from 2024 to 2034, whereas the 7.0 percent value represents the increase in new customer load as a percentage of the 2024 residential sales estimate. Both these values are presented in the same row of the "Residential Load – Post Regression" table in NSPI's Appendix B and should be calculated consistently or labeled clearly.[10]

The residential statistical model also includes a quasi-binary variable to represent the effects of continued working from home activity related to the COVID-19 pandemic. NSPI gave that variable an initial value of 1.0 for July 2020 and reduced the *input* to this variable to 0.65 for August 2022 and all subsequent months in the 2024 load forecast.[11] In the 2023 load forecast, the input for this term was set to 1.0 for July 2020, reduced to 0.5 in October 2020, reduced to 0.43 in January 2022, and reduced a final time to 0.36 in July 2022 and for all modeled months hence.[12] In the 2024 forecast, the regression coefficient on this term was 25.611,[13] while in the 2023 load forecast, the regression coefficient on the COVID term in the residential model was 70.957.[14]

NSPI explains that the variable "will continue to decrease in magnitude in future forecasts" as the historical period on which the regression is run is increasingly a post-COVID period.[15] In the 2023 forecast, NSPI forecast an enduring effect on residential load from COVID of about 150 GWh for 2023 and beyond. In the 2024 forecast, NSPI forecast the same effect at about 100 GWh for 2024 and beyond.

The treatment of DSM effects is discussed in a later section of this Evidence.

For the commercial (General Services) models, NSPI continues to use non-manufacturing gross domestic product and non-manufacturing employment. In the industrial sector, NSPI used manufacturing gross domestic product and manufacturing employment. A longer regression timescale was used for the industrial models as that produces better statistics. We consider these to be reasonable choices.

The forecast now gives more consideration to long-term weather trends. NSPI analyzed the trend in heating degree days (HDD) and cooling degree days (CDD) over time, considering the effects of climate change. As one might expect, there has been a decline in HDD and an increase in CDD. The HDD trend used for this forecast was -17 HDD/year. The CDD trend was +1.4 CDD/year. These are the same as those used in the previous forecast. NSPI now incorporates these trends into the forecasts. The 12-hour

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[9] 2024 Load Forecast, Appendix B, page 8.

[10] 2024 Load Forecast, Appendix B, page 8.

[11] 2024 Load Forecast, Appendix B, page 4.

[12] 2023 Load Forecast, Appendix B, page 3.

[13] 2024 Load Forecast, Appendix B, page 5.

[14] Nova Scotia Power, Inc. *2023 Load Forecast Report*, April 28, 2024 (2023 Load Forecast), Appendix B, page 3.

[15] 2024 Load Forecast, page 59.

lagged temperature in the peak model has decreased from -13.9 °C to -14.4 °C, which results in an increased peak forecast. This data should be analyzed and updated on a regular basis.

2.2. Residential Sector

The residential sector currently represents about 44 percent of the total customer load. The residential forecast, including the load-reducing effects of DSM programs, increases by 2.3 percent over the forecast period, from 2024 to 2034. Without DSM programs, the increase would be 9.1 percent.

The two largest contributors to the increase in the residential load forecast over the modeled period are the increase in new customers and the growth in EV load. New customers, estimated based upon projected new housing construction, add about 7.0 percent to load between 2024–2034. Meanwhile, incremental EV charging contributes about 6.0 percent to load. On the other hand, the growth in distributed solar photovoltaic (PV) adoption and incremental DSM offset a portion of overall load growth.

The residential forecast is formulated from a regression-based SAE model, which includes several inputs that are in turn functions of bottom-up analyses of customer load drivers. Included in the SAE model is a term for customer heating (XHeat), a term for customer cooling (XCool), and a term for other end uses (XOther). The SAE model also includes a few other terms: one for historical (embedded) DSM savings, one to capture the impact of increased working from home as a result of COVID, and several binary terms to account for variances in consumption associated with specific months (i.e., time-fixed effects).[16]

We will next discuss the Residential SAE model in some detail to better understand the drivers behind the forecast.

The **XHeat** variable is the product of the HeatUse and HeatIndex terms. *HeatUse* represents (a) heating degree days, (b) household income, (c) household size, and (d) energy price. *HeatIndex* represents (a) heating saturation, (b) equipment efficiency, (c) building shell integrity, and (d) building size. The major change drivers for XHeat are electric (resistance) heat, heat pumps, and, to a lesser extent, secondary heat. The net change over the forecast period is a 12.5 percent increase.

The **XCool** variable is the product of the CoolUse and CoolIndex terms. *CoolUse* represents (a) cooling degree days, (b) household income, (c) household size, and (d) energy price. *CoolIndex* represents (a) cooling saturation, (b) equipment efficiency, (c) building shell integrity, and (d) building size. The major change driver for XCool is heat pump cooling. The net effect is to increase XCool by 57.8 percent.[17]

The **XOther** variable is the product of the OtherUse and OtherIndex terms. *OtherUse* represents (a) seasonal use pattern, (b) household income, (c) household size, and (d) energy price. *OtherIndex*

[16] 2024 Load Forecast, Appendix B, pages 1-8.

[17] 2024 Load Forecast, Appendix B, pages 2, 7.

represents (a) other appliance saturation and (b) efficiency trends. The primary change drivers for XOther are water heating (increased electric heater saturation), reductions in lighting use, and decreased television use. The net effect is to decrease XOther by 2.1 percent.[18]

There are many factors driving the SAE model regressions and it is difficult to untangle all the effects. However, Appendix B of the Report provides a rough summary of the overall effects of the major terms on the average use. For the residential average use, 45 percent is associated with heating, 4 percent with cooling, and 53 percent with other uses. For existing customers, average heating load increases by 5.6 percent, average cooling load increases by 2.2 percent, and the average load associated with other end uses increases by 1.1 percent over the forecast period.

The output of the SAE model is an average consumption value for residential customers. To formulate the overall residential class forecast, NSPI multiplies the average consumption value by the number of existing customers (fixed through the forecast period), then adds new customer load, new EV load, incremental PV generation, and incremental RTR sales before finally accounting for incremental DSM. To represent these various effects, we reproduce below a table from Page 6 of NSPI's Appendix B. The first column shows the SAE regression model results, and the other columns reflect various adjustments to the forecast.

Table 5. Residential load: post regression (GWh)

	Existing Customer Average Use from Regression Model (kWh/year)	New Cust. Load	EVs	Solar	RTR	Hybrid	Res. DSM Adjust.	Res Sales	Total Res. DSM (at meter)	DSM captured by end-uses
2024	10,468	62	10	(44)	0	0	(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%		

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

Source: Appendix B from 2024 Load Forecast

In addition to the outsized contribution of EVs and new customer load to the overall growth in residential consumption, the table above also illustrates that average consumption for existing customers is projected to increase by about 2.3 percent over the forecast period. This increase is largely the result of electrification, as NSPI projects growing adoption of heat pumps for heating and cooling

[18] 2024 Load Forecast, Appendix B, pages 2, 8.

and growing adoption of electric water heating. The increase in existing customer consumption is also driven by a forecast increase in household compensation.[19]

In the sections that follow, we examine in more detail specific contributions to load and provide feedback and recommendations for improvement where warranted.

Heat pumps

NSPI's treatment of heat pumps enters into its residential load forecasting through the XHeat and XCool terms within the SAE model and also through NSPI's separate modeling of new customer load.

NSPI takes slightly different approaches to estimate consumption from electric heating for residential and commercial customers. For residential customers, NSPI's end-use load forecast explicitly models a growing level of heat pump saturation over time. NSPI's end-use model starts with the current heat pump saturation of 44 percent in 2024 (a increase of 4 percentage points relative to the 2023 level[20]) and assumes that the saturation increases to 64 percent by 2034.[21] Cumulative new heat pumps are assumed to be approximately 21,200 units in 2024 and increase to 210,800 units by 2034. NSPI assumes that 68 percent of these are for non-electric heating customers and roughly 32 percent are for electric heating customers. In comparison, the total number of heat pumps installed in 2023 were approximately 20,900 heat pumps.[22]

For commercial customers, NSPI models electric heating as the only category in its forecast and does not break down electric heating by specific heating technology.[23] NSPI's model starts with the current penetration rate of 55 percent for electric heating and assumes that the saturation rate increases to approximately 70 percent by 2035.[24]

As with the 2023 load forecast, NSPI's 2024 forecast relies on the forecasts developed by third party consultant E3 for space heating. E3's load forecast now assumes a hybrid heating scenario where a growing share of customers installing heat pumps rely on their non-electric backup heating systems to provide heating during the coldest days. NSPI's heat pump load forecast model does not explicitly estimate loads for hybrid heating systems. In order to incorporate such impacts, NSPI adjusted its heat pump load forecast outputs by comparing the energy and peak load outputs between NSPI's model and E3's model, which is shown in Figure 20 of NSPI's load forecast report. The total adjustment is -68 MW for 2034 from the hybrid heating scenario as shown in Figure 61 of the load forecast report. However, it

[19] Response to Board IR-3(c).

[20] 2023 Load Forecast, page 33.

[21] 2024 Load Forecast, page 31; 2024 LFR Attachment 01, "Shares" tab.

[22] 2024 Load Forecast, page 31.

[23] Response to Synapse IR-7(g)(i).

[24] 2023 Load Forecast, page 33.

is unclear how exactly NSPI estimated this value, and we cannot observe any connection between the savings value and any value presented in Figure 20.

The forecast growth in heat pumps explains much of the growth in average electricity consumption for existing customers.[17] The average residential electricity usage is predicted to increase by 9 percent from 10,468 kWh in 2024 to 11,411 kWh in 2034. The XHeat load is responsible for 5.6 percent load increases (or more than 60 of the total increases) and the Xcool load variable is responsible for 2.2 percent load increases (or about 24 percent of the total increases).[25] NSPI presents the changes in energy intensities for XHeat and XCool by component (e.g., HP Heat, Secondary Heat, Furnace Fans) on page 9 in Appendix B of the load forecast report. Nearly all these increases in heating and cooling are driven by heat pumps. Heat pumps drive a 34.2 percent increase in the XHeat load intensities and 29.9 percent increase in XCool load intensities.[26]

Figure 42 of the Report quantifies these new residential loads in energy unit terms. Heat pump heating load increases by 700 GWh and cooling load increases by 99 GWh for a total of 799 GWh by 2034, which represents 5 percent of the total sales[27] However, baseboard heat decreases by 448 GWh. Heat pumps displace some fossil fuel heating and thus there are additional unreported savings there.

It is important to note in particular two potential issues with the accuracy of NSPI's model in estimating energy and peak load impacts from heat pumps:

- Heating intensities have increased by approximately 39 percent compared to the 2023 heating intensities as shown in Figure 22 of the load forecast report. NSPI states that this increases is "a result of adjustments made in response to the "unallocated" variance in the residential class results" which is discussed in Section 9 of the load forecast report.[28] NSPI further states that this 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)."[29] NSPI made the determination to allocate the "unallocated" variance to space heating because it found most of the monthly variances were found in winter months.

- As mentioned above, NSPI made adjustments to its peak load impacts by comparing E3's energy and peak load calculations for heat pumps with NSPI's own calculations, which is presented in Figure 20 of the report. This reveals a significant difference in energy usage

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[25] 2024 Load Forecast, Appendix B, page 8.
[26] 2024 Load Forecast, Appendix B, page 9.
[27] 2024 Load Forecast, Figure 41, Figure 41, 42.
[28] 2024 Load Forecast, page 34.
[29] 2024 Load Forecast, page 34.

estimates between the two methods: for 2030 NSPI estimates 242 GWh from heat pumps, which is more than three times larger than E3 estimates of 74 GWh. E3's estimates assume a hybrid heating scenario and a slightly lower heat pump saturation rate. However, these do not justify the difference in heat pump energy outputs from the two models.

As with our previous report on the 2023 load forecast report, detailed evaluation of energy and peak load usage from heat pumps is warranted, especially with the use of AMI data, which is mentioned in Appendix E of the 2024 Load Forecast report.

Recommendations and Considerations

We ask NSPI to continue to investigate the energy and peak load effects of heat pumps in future forecasts, especially given the variance between NSPI's analysis and E3's for both whole home heat pumps and hybrid heat pumps and the increasing availability of AMI data that is expected in the future. NSPI should seek to validate any assumptions about the extent to which heat pumps displace legacy fossil-based heating equipment, and NSPI should also seek to validate any other assumptions about customer usage of secondary heating equipment. Finally, NSPI should model hybrid electric heating within its model instead of making a simplified adjustment based on E3's hybrid scenario.

Water heaters

For water heaters, the forecast predicts that a portion of the customers who convert fossil heating systems to heat pumps will also convert to electric water heaters.[30] This effect is captured through the XOther term; adoption of electric water heaters is also captured in the separate new customer load estimate. Based on Figure 23 of NSPI's report, the electric water heater saturation will increase from 73 to 88 percent, while non-electric water heating saturation will shrink from 27 percent to 12 percent. This implies that about 56 percent of the current non-electric water heating customers will convert to electric water heaters by 2033. This is a fairly substantial increase and should be carefully monitored as this is a significant energy and peak load growth driver.

The load forecast does not provide the net effects. However, inspecting the table on page 8 in Appendix B seems to indicate a 4.5 percent increase in XOther driven by water heating usage between 2024 and 2034. We observe that the projected change in electric water heater intensity through the forecast period in the 2024 load forecast is similar to the same from the 2023 load forecast.

NSPI notes in the report that it is continuing work with E1 on demand response projects, and that its pilot project with E1 investigating demand response for water heaters has concluded.[24] NSPI indicates that the data collected from these pilots will be used to inform future load forecasts. While Synapse

[30] 2024 Load Forecast, page 35.

recommended in its 2022 Evidence and its 2023 Evidence that NSPI consider heat pump hot water heaters, NSPI in this year's load forecast does not include heat pump hot water heaters in its evaluation, because adoption of this technology is still small. Despite the current low level of heat pump water heater installations in the province, it is important to start incorporating and modeling heat pump water heaters as a separate end-use technology for two reasons: (a) as stated above, NSPI is projecting a significant increase in electric water heaters in the coming decade; (b) heat pump water heaters can save considerable amounts of energy and reduce peak loads. E1's most recent program evaluation study shows that heat pump water heaters saved the largest amount of electricity (922 kWh energy savings and 149 kW peak savings) on an individual measure basis within the Instant Savings program, while the total amount of energy savings from this measure within the program are still small due to a low uptake of the measure.[31]

Recommendations and Considerations

We recommend that NSPI model heat pump water heaters as a separate end-use technology in the next load forecast.

Electric vehicles

NSPI forecasts new EV load separately from its SAE modeling. EVs represent another load growth area, similar to the expected load growth from heat pumps.

This forecast predicts that there will be "over 150,000" EVs in Nova Scotia by 2034, including 149,197 cumulative new EVs sold through the forecast timeframe.[32] NSPI projects that the new EVs expected to be sold over the forecast period, between 2024 and 2034, will produce a total energy load of 560 GWh with peak load impacts of 136 MW for a base case and 245 MW for a sensitivity case.[33] These impacts represent 5 percent of the energy sales and 6 to 10 percent of the peak load across all sectors.[34] The base case assumes an "blended" managed and unmanaged charging scenario and the sensitivity case assumes no EV managed charging. The residential sector load impact in 2034 is estimated at 322 GWh.[35] NSPI forecasts EVs will account for about 6 percent of residential energy sales in 2034[32] and for 3.9 percent of residential peak load in 2033 (impact for 2034 not provided).[36]

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[31] E1. 2024. 2023 DSM Programs Evaluation, page 34
[32] 2024 Load Forecast, page 38
[33] 2024 Load Forecast, Figure 26.
[34] 2024 Load Forecast, Figure 61.
[35] 2024 Load Forecast, Figure 41.
[36] 2024 Load Forecast, Figure 65.

To estimate the impact of the blended charging profiles, NSPI assumes that 70 percent of the EVs will be on managed charging programs or time varying rates and the rest of the EVs will be unmanaged.[37] However, NPSI does not explain how it developed this assumption.

For 2033, this year's forecast predicts 110,852 total EVs (across all sectors), representing an 426 GWh load contribution and peak impacts between 102 and 183 MW.[38] This is a substantial decrease from the previous load forecast's projection of 194,001 vehicles for 2033, with associated respective energy and peak load impacts of 824 GWh and 172 to 307 MW.[30]

The EV projections in this year's load forecast are based on a new scenario assumption that is significantly different from the previous year's. The previous forecast assumes that the province meets the aggressive EV targets set by the federal government. NSPI developed its new EV adoption rates based on a recent report entitled "Ensuring ZEV Adoption in Nova Scotia" prepared by Dunsky Energy+Climate Advisors ("Dunsky") and made some minor adjustments. The Dunsky report provides EV forecasts for a low scenario, where sales in Nova Scotia lag the federal EV mandates, and a high scenario where EV sales in the country are distributed evenly across the provinces.

NSPI's 2024 EV forecast assumes that cumulative EVs on the road will exactly match the cumulative EVs in the low scenario in 2035. However, NSPI found that "growth in EV adoption in recent years has exceeded that of the low scenario."[39] Thus, NSPI assumed that total EVs in the near term closely match Dunsky's high scenario and half of the high case target for 2030.[40] Nova Scotia's EV adoption has been lagging behind leading provinces (e.g., British Columbia, Quebec).[41] Thus, it is reasonable not to use the high scenario in the long term. However, it is not clear whether assuming the low case adoption for 2035 is a reasonable approach because NSPI projects that the near-term EV stocks are much higher than the estimates in the low scenario (e.g., more than twice than the low scenario for 2025).[42]

Time of charging is also an important peak load issue, and both rate designs and other programmatic interventions will be needed to reduce on-peak charging as the EV penetration increases. NSPI provides a summary of its Smart Grid Nova Scotia (SGNS) project which examines the peak and energy impact of EVs including managed charging impacts.[43] However, NSPI states that the results were not used to develop peak load impacts of EVs for its load forecast because "[t]he findings from a small pilot group of

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[37] 2024 Load Forecast, page 39.

[38] 2024 Load Forecast, Figure 26

[39] NSPI's response to Synapse IR-9 (c).

[40] 2024 Load Forecast, page 37.

[41] Saxifrage, Barry. 2024. "How your province rates in the global electric car race." *Canada's National Observer*. April 8. Available at: https://www.nationalobserver.com/2024/04/08/analysis/province-rates-global-electric-car-emissions-gas.

[42] NSPI's response to Synapse IR-9 (b), Attachment 1. Sales Comparison tab.

[43] 2024 Load Forecast, pages 40-41.

early adopters in Nova Scotia and demonstrative of the potential of specific use cases for managed charging.

Recommendations and Considerations

NSPI should carefully monitor EV adoption and update its forecast as needed. As part of this update, NSPI should examine the reasonableness of the Dunsky's low scenario for Nova Scotia. NSPI should also continue to examine load impacts from EVs including peak load impacts from EV managed charging and a reasonable share of EVs that can be under managed charging programs and reflect the results of the analysis in the next load forecast. Further, NSPI should develop and implement rate designs and other programmatic options to reduce on-peak EV charging as penetration increases. These load management strategies should be reflected in the next load forecast with greater detail, with all assumptions supported empirically to the maximum extent possible.

Solar generation

As noted previously, NSPI forecasts new PV generation separately from its SAE modeling. Solar generation can either be small-scale at the customer level, or larger utility-scale. The load forecast considers the customer-level impacts of distributed small-scale solar participating in net metering. While the number of total installations remains small in Nova Scotia, it is projected to increase by a factor of more than 18 over the forecast period. This is relatively consistent with the 2023 forecast and represents only a modest reduction in the projected growth trajectory. Because of the timing of the system peak, NSPI continues to predict no effect on the winter peak load.

In response to a request for more substantiation of NSPI's assumptions concerning the availability of solar generation at peak time, NSPI evaluated solar generation data from six community solar farms to determine monthly coincidence factors. Through this exercise, NSPI reports that it has confirmed its assumption of no solar contribution at the time of the overall system peak (which occurs during winter evenings). Meanwhile, NSPI reports that its analysis showed that it underestimated distributed solar generation during non-winter monthly peaks – which are relative, rather than absolute system peaks. As such, NSPI has updated its coincidence factors for March through October.[44] NSPI further forecasts a net reduction of 681 GWh (4.7 percent) in the combined residential and commercial energy load.[45]

Recommendations and Considerations

NSPI should continue to monitor the coincidence of solar generation with month system peaks and make updates to coincidence factors as warranted.

[44] 2024 Load Forecast, page 90.

[45] 2024 Load Forecast, Appendix D, page 9.

Solar-plus-battery

The report discusses solar/battery storage combinations but does not expect them to have much effect on future loads. This approach is consistent with last year's forecast. However, NSPI presents some possible impacts based on preliminary results from the SGNS project in Figure 28 of its Report. With a high penetration of battery systems, the peak impacts could be substantial and are worth exploring, especially if they can reduce the need for new peaking resource investments.

Recommendations and Considerations

NSPI should continue to investigate and report on opportunities for incentivizing cost-effective deployment of battery storage, including through rate design. NSPI should also continue to investigate the use of EV batteries, especially for peak management.

New customers

The final piece of the residential forecast is the contribution of new customers to load, which is discussed in Section 5.0 of NSPI's report. As noted previously, NSPI forecasts new customer contribution to residential load separately from its SAE modeling.

To estimate growth in new customers, the residential load forecast utilizes projected housing completions, which are correlated to growth in customers. New customers are expected to add about 428 GWh (7.0 percent) to the residential load by 2034, a modest decrease in the growth rate relative to last year's forecast.[46] New customer load is calculated outside of the regression model.[47]

Synapse has expressed concerns about the strength of the relationship between new housing and customer growth in the past and continues to consider this issue unresolved. While NSPI was specifically asked about these issues in interrogatories, in Synapse's view, NSPI's responses do not satisfactorily address concerns about this correlation. This includes, for example, concerns that new housing might partially displace existing housing rather than being entirely incremental. NSPI does affirmatively state its view that forecast housing completions remain the best proxy for new customer growth.

It its Decision on NSPI's 2023 load forecast, the Board issued two directives relevant to NSPI's utilization of demographic data in its load forecast model, instructing NSPI to "re-evaluate the use of housing completions for the near-term," and to "[c]onsider incorporating household size and age of household residents, to determine if a better understanding on demand load by time of day is achieved."[48] In response, NSPI asserts that housing completions remain highly correlated with residential customer counts and remains the most appropriate proxy for customer count growth. NSPI indicates that it is aware of the ongoing housing shortage in the province and states that it will continue to monitor

[46] 2023 Load Forecast, Appendix B, page 6 and 2024 Load Forecast, Appendix B, page 8.

[47] 2024 Load Forecast, page 58.

[48] NSUARB Decision in Matter 11108, page 6.

government policies for any effects on increasing the housing supply. NSPI does not appear to directly respond to the second directive, on considering household size and resident age, though NSPI does explain that population and customer counts are together considered to derive average household size for the SAE model.

While NSPI's reliance on household completions is acceptable for purposes of forecasting future customer growth, the ongoing housing shortage may be a confounding factor attenuating the correlation between housing starts and customer growth – as the relationship between housing completions and customer growth changes over time. NSPI should more clearly address the potential shortcomings of its reliance on housing completions and more diligently consider alternatives to forecasting customer growth.

Recommendations and Considerations

NSPI should validate the use of new home construction as a proxy for customer growth, addressing concerns about potential shortcomings of this proxy variable.

Other

The value of price elasticity has little influence on the current forecast, as demonstrated in Appendix D, Figure D8 and discussed in Section 4.5. However, this is due to the nearly completely flat real projected electricity price, as shown in Figure 33. Should the situation change where the projected real electricity price does change dramatically, the estimate of elasticity will be more impactful. For this reason, NSPI, one of its consultants, or Itron should conduct a literature review and provide updated studies providing a more recent estimate of price elasticity. This estimate should then be contextualized to Nova Scotia.

In its Evidence from 2022, Synapse noted concern with NSPI's approach to estimating COVID-19 work-from-home impacts. Subsequently, in its decision on the 2022 load forecast, the Board directed NSPI to re-evaluate this COVID-19 variable.[49] While NSPI claimed to have complied with this directive, it did not make any changes to its modeling approach for COVID-19 impacts on the residential class, indicating rather that "at this point, the long-term impacts of changes to working habits is still unknown."[50]

In the Board's Decision on the 2023 load forecast, the Board acknowledged that the variance between 2022 forecast and actual Net System Requirement had been attributed in part to "the COVID-19 pandemic," which appears to be an acknowledgement that NSPI may not be properly modeling work-from-home effects.[51] In this evidence, Synapse again requests that NSPI provide more empirical justification for both its approach to modeling ongoing COVID consumption changes and the modeling results obtained as a result of this approach. Specifically, NSPI should explain why it has forecast a

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[49] Board Decision in Matter M10569, page 5.

[50] Response to Synapse IR-18(d).

[51] NSUARB Decision in Matter 11108, page 7.

one-third reduction in the enduring effect of COVID on residential sales relative to the 2023 load forecast (approximately 100 GWh per-year for the residential class going forward forecast this year rather than approximately 150 GWh per-year going forward forecast last year). NSPI should also support the differing estimates of *historical* COVID-related work-form-home sales produced by its recent load forecasts – explaining why, for example, the 2022, 2023, and 2024 load forecasts may have presented different estimates of COVID-relative work-from-home activity for the historical years of 2020, 2021, and 2022.

It would appear that NSPI's chosen approach to modeling enduring COVID-19 effects is not the only econometric strategy, and that alternative approaches might better capture seasonally differentiated COVID-related activity (e.g., increased heat pump utilization in the winter due to working from home) and/or allow NSPI to avoid reducing the value of the inputs to the COVID-19 variable over time in an exogenously determined, but apparently unsupported, fashion. The implication of NSPI's chosen approach in this year's load forecast to reduce the input to the COVID-19 variable from 1.0 to 0.65 is that enduring COVID-related impacts from August 2022 and onward are 65 percent lower than those same effects from July 2020 through July 2022. However, this assumption appears to lack empirical support.

Moreover, given that the load forecast attempts to explain variance between forecast and actual sales using both the COVID-19 and the heating variables, NSPI should elucidate the relationship between these items in the model and clarify how NSPI is able to determine that the appropriate share of unexplained variance is accounted for by each term in the model.

Lastly, NSPI should consider opportunities to enhance the precision and granularity of its load forecast through consideration of household size and household resident age, as the Board has repeatedly raised in its Decisions on NSPI's load forecasts.

Recommendations and Considerations

We ask that NSPI reassess its modeling approach for COVID-19 impacts on the residential class. NSPI should continue to collect data on work-for-home behavior, and it should make modifications to its modeling approach as warranted. We also reiterate the Board's 2023 suggestion to consider the impacts of household demographics on residential load.

2.3. Commercial Sector

The commercial sector represents approximately 28 percent of the customer load. The commercial forecast (as shown in The following table shows the forecast energy use by sector. Overall, the residential load (representing around 45 percent of the total load in 2024) is growing the most in terms of energy, driven by electric vehicles, new customers, and building electrification. The commercial forecast increases at a more modest level, and the industrial load shows a small decrease.

Table 3 of this evidence) increases by 1.1 percent over the forecast period. By contrast, in the 2023 forecast, it increased by 6.8 percent.

The commercial sector consists of three subsectors: Small General Service, General Service, and Large General Service. Our comments focus on the General Service (also called Medium) group, since this cohort represents approximately three-quarters of the commercial load. We reviewed the statistical models in NSPI's Appendix B and found them satisfactory. NSPI's Report has also provided specifics of the various factors affecting the changes in sales, which we replicate below. The total change between 2024 and 2034 is a decrease of 0.8 percent – a notable change from the projected *increase* of about 4.4 percent between 2023 and 2033 in last year's load forecast. The reduction in forecast future load relative to the 2023 load forecast is attributed mainly to the energy impact of the hybrid heating scenario, to commercial sales shifting to the RTR market, and to a reduction in projected EV sales.[52] The 2024 load forecast also projects a significantly greater reduction in load due to growth in distributed solar.

Table 6. General service sales drivers from 2024 to 2034

Category	2034 Change
Medium Gen Sales 2024	2,365 GWh
Regression model	+ 13.3 %
Renewable to Retail	- 4.1 %
Electric Vehicles	+ 8.0 %
Solar	- 8.0 %
DSM[53]	- 7.3 %
Total Change	**-0.8 %**

Source: Appendix B, page 21 from 2024 Load Forecast

The Small General Service average loads show greater proportional increases. The average use per customer from the regression analysis has an increase of 8.9 percent, and there is a projected 10.5 percent increase in the number of customers.

[52] Response to Synapse IR-22.

[53] Note that the reported DSM impacts are in addition to DSM effects embedded in the SAE model itself. Therefore, the actual savings from DSM programs are significantly greater.

Table 7. Small general service sales drivers from 2024 to 2034

Category	2034 Change
Small Gen Sales 2024	340 GWh
Regression model + new customers	+ 20.2 %
Renewable to Retail	-2.0%
Electric Vehicles	+ 13.9 %
Solar	- 6.2 %
DSM[54]	- 7.2 %
Total Change	**+ 18.9 %**

Source: Appendix B, page 15 from 2024 Load Forecast

NSPI states that the COVID-19 pandemic had a long impact on commercial sales. The ongoing impact is projected to be -57 GWh in 2023 and future years.[55]

Large General Service loads are expected to decrease overall, in contrast to the growth that was anticipated in the 2023 load forecast. NSPI has revised its estimates of project completion dates, resulting in a reduction in forecast growth which is more than offset by projected DSM increases.[56] NSPI anticipates a net reduction for Large General Service loads of 12 GWh by 2034. NSPI provided no specific solar or DSM projections.

Overall, the forecast appears reasonable given the inherent uncertainties, but it does raise the following issues for consideration:

Recommendations and Considerations

Given that significant changes to the load forecast relative to the previous year's forecast owing to revisions to assumptions about EV and solar penetration and the impacts of the RTR and hybrid heating, NSPI should address the range of possibilities (sensitivities) in these domains to produce a more robust forecast.

We further ask that NSPI explore the potential impacts of solar and DSM on the Large General Service forecast.

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54 Note that the reported DSM impacts are in addition to DSM effects embedded in the SAE model itself. Therefore, the actual savings from DSM programs are significantly greater.

55 Ibid.

56 2024 Load Forecast, page 69.

2.4. Industrial Sector

The industrial sector represents about 22 percent of the customer load. The industrial forecast remains effectively level over the period 2024-2034, with a projected decrease of less than 1 percent in aggregate. This projection may be contrasted with the 2023 load forecast, which foresaw an *increase* of nearly 3 percent over its ten-year horizon.

The industrial forecast is based on statistical models and customer surveys, i.e., no end-use modeling. There are three subsectors to the industrial customers: (1) Small, (2) Medium, and (3) Other (primarily large). The Small sector is expected to grow at 0.6 percent annually, driven by economic growth with incremental sales through the RTR market partially offsetting this load increase. The Medium sector is expected to decline by 0.4 percent annually as load migrates to RTR providers. The Large (also called Other) category represents approximately two-thirds of the industrial load, with load projected to remain essential flat.

The forecast projects increased electrification of the industrial sector with a total load increase of 30 GWh by 2034, which is a modest reduction compared with last year's forecast.[57] This is a very small fraction of the total industrial load but the potential could be greater as some industries shift further away from fossil fuels.

This forecast assumes the continuation of current major customers throughout the forecast period. Significant changes in those operations represent an uncertainty in the industrial forecast.

DSM savings are forecast at 57 GWh and RTR resources as 59 GWh.[58] While the projected DSM savings have remained level, the forecast for RTR load reduction has increased by more than 50 percent.

As with the commercial sector, the pandemic had an impact on the industrial sector in previous years, but no effects are expected going forward.

[57] Load Forecast, Figure 32.

[58] Load Forecast, Figure 55.

Overall, the industrial forecast appears reasonable given the inherent uncertainties, but it does raise the following issues for consideration:

Recommendations and Considerations

We ask NSPI to explore the likelihood and impacts of greater industrial electrification levels.

We ask NSPI to explore the potential for greater industrial savings.

We ask NSPI to explore the impacts of real time rates.

We ask NSPI to explore the impacts of increases in industrial RTR.

2.5. Commercial and Industrial Electrification

The forecasts of large C&I electrification are presented in Figure 32 of the Report.[59] The forecast rates of growth in electrification appear to be more level than the same rates from the previous year's forecast. This projection appears to better comport with expectations for future growth in electrification.

2.6. The Municipal Sector

The municipal sector represents a minimal 159 GWh of the customer load in 2024 which is expected to decline to 72 GWh in 2025 and remain at that level going forward. This reduction in load is the result of participating customers applications for BUTU to offtake supply from third parties.[60]

2.7. Energy Forecast and DSM Effects

Future DSM savings used in this forecast are presented in Figure 35 of the Report. The DSM savings are fairly modest. For example, the residential 2024 savings of 60.9 GWh represents about 1.2 percent of the residential load. The DSM adjustments to the SAE model results are about half the size of the nominal savings as some savings that are driven by historical data are embedded in the model results.

The residential statistical model includes the variable *AvgEESavings* to capture past reported savings. This is used to adjust the future DSM savings included in the forecast. The coefficient has been changing slightly over time but staying within a +/- 20 percent range. This year the coefficient is -0.556. The past coefficients were -0.425 in 2023, -0.512 in 2022, and 0.587 in 2021. This means that the SAE model is currently embedding less DSM savings than before except in 2021. The net effect of DSM savings is -356 GWh in 2034 for the residential sector.[61]

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[59] Impacts of electrification for the other commercial subsectors is included in the modeling for those subsectors.

[60] Response to Synapse IR-29.

[61] 2024 Load Forecast, Figure 55.

For the commercial/industrial adjustments, the factor is -0.448.This is a little more than the -0.397 last year and the -0.38 in 2022, but close to the -0.437 used in 2021. The net load impacts of DSM in 2034 are -221 GWh for the commercial sector and -57 GWh for the industrial sector.

The adjustment coefficients do vary from year to year, so the forecasted impacts have some degree of uncertainty.

The adjustments discussed in the forecast report appear reasonable to us.[62] Since these factors are statistically derived, however, there is necessarily some associated uncertainty. Overall, we feel that this type of approach and the proposed magnitudes of the adjustments are appropriate for this forecast.

Recommendations and Considerations

If DSM program savings are increased above historical levels, then the adjustment factors probably should be adjusted upward to reflect greater levels of incremental savings.

[62] Id, pages 54-56.

3. PEAK FORECAST

As shown in Figures 2 and 3 of the load forecast Report, the system peak (including DSM effects) increases moderately in this forecast. However, the projected increase is overall lower than that of the 2023 forecast. Whereas the 2023 forecast projected a system peak of 2820 MW for 2023, this year's load forecast predicts a system peak of 2365 MW for 2024, which is 3.7 percent lower. Overall, the 2024 load forecast projects an increase in the system peak of 362 MW or about 15 percent over the period 2024-2034.

The tables below show both the peak load contributions in this forecast and the previous one. The adjustments are similar to those used in the 2023 forecast. Basically, the peak is first modeled statistically using historical data and economic and demographic projections to produce a Modeled Peak, and then NSPI applies various adjustments to arrive at the System Peak.

Table 8. 2024 Peak contribution components

	Modeled Peak (MW)	Res Heat Peak (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	2,219	144	2,365
2034	2,505	13	156	-37	-68	4	115	-145	2,542	147	2,727
2034 (no EV mitigation)	2,505	13	281	-37	-68	4	115	-145	2,670	147	2,851

Source: Figure 61 from 2024 Load Forecast

Table 9. 2023 Peak contribution components

	Modeled Peak (MW)	Res Heat Peak (MW)	EV (MW)	DR (MW)	C&I Elect. (MW)	Large Cust. (MW)	DSM (MW)	Firm Peak (MW)	Inter. Cust. (MW)	System Peak (MW)
2023	2,011	2	3	-4	2	107	-14	2,105	146	2,255
2033	2,233	12	240	-37	181	119	-121	2,627	156	2,820
2033 (no EV mitigation)	2,233	12	424	-37	181	119	-121	2,811	156	3,004

Source: Figure 65 from 2023 Load Forecast

Note that the largest contributor to the peak growth is EVs. Without mitigation this would be nearly twice as great. Residential heating electrification comes second. We suggest that time-of-use programs might be used to mitigate these impacts.

The interruptible load representing primarily large industrial customers is projected to increase modestly from 144 MW to 147 MW. Increasing this further would help moderate the peak.

We note that a peak increase of 362 MW by 2034 means an increase in capacity requirements of about 434 MW (using a 20 percent planning reserve margin). This represents a significant increase and investment cost.

Recommendations and Considerations

We ask NSPI to investigate what can be done with time-of-use rates and other measures to mitigate the peak load increases for all these components, especially for the C&I sectors.

EVs are a substantial contributor to peak growth, though diminished in expected peak contribution relative to last year's load forecast projections. We would like to see a more complete evaluation of the options to control this growth in the next forecast. As we discussed in Section 2.2 above, NSPI conducted an analysis of the impact of EV managed charging through the SGNS project but did not use the results for its load forecast as NSPI considered the sample size is too small. As we mentioned above in Section 2.2, we encourage NSPI continue to examine load impacts from EVs and reflect the results of future analyses into its load forecast.

To develop its peak impact forecast from demand response, NSPI used the demand response target included in its IRP Action Plan (i.e., a target of 75 MW by 2025), pushed back the implementation timeframe by a few years by reflecting the current program implementation schedule, and then derated the total peak load reduction by applying an effective load carrying capacity (ELCC) of 48 percent.[63] The resulting maximum peak reduction is only 39 MW in 2029. NSPI does not project any increase in demand response after 2029 although it projects considerable load increase from space and water heating through 2034, which provides a greater level of winter peak load reduction potential through demand response. We found several issues with this forecast as follows:

- NSPI derived the ELCC factor of 48 percent from a 2019 study by E3 titled "Planning Reserve Margin and Capacity Value Study." This study provided average ELCC factors for three types of DR programs (e.g., one group with 20 calls/year and 12 hours/call, the second group with 10 calls/year and 4 hours/call). These types were not created for the existing or proposed DR

[63] 2024 Load Forecast, pages 81-82.

programs by NSPI. Further, NSPI did not conduct any detailed analysis of appropriate ELCC values for the proposed DR programs.[64]

- NSPI's approach to apply an ELCC value specific to demand response does not consider any interactive effects with other resources in terms of its peak load impacts. A portfolio wide ELCC of various resources can be greater than a simple sum of ELCC values from individual resources, especially when generation or load profiles different from each other. NSPI should evaluate an ELCC for demand response by conducting a portfolio-level ELCC for various resources including solar PV, wind, battery storage and demand response. In fact, a 2020 report by E3 discusses the benefits and importance of analyzing portfolio-wide ELCC values.[65] Further, in its recent Decision regarding Evergreen IRP Updated Action Plan and Roadmap – 2023 (M11307), the Board, stated that the battery energy storage ELCC profile "needs to be carefully re-examined in conduction with an updated portfolio ELCC analysis, which considers the interactive effect of all four clean resources (i.e., wind, solar PV, battery energy storage, and demand response or peak load mitigation during winter peak periods)." This means that an ELCC for demand response also needs to be derived based on a portfolio level ELCC analysis.
- The current peak load forecasts are significantly greater than NSPI's past forecasts due to electrification (except the last year's forecast). This increase in peak loads due to electrification should be accompanied by the inclusion in modeling of demand response resources likely to arise due to the additional level of electrification that was not assumed when the original demand response target was established.[66] As noted in Synapse' August 2023 comments regarding the Evergreen IRP Update (M11307), "[i]t is analytically inconsistent to minimize the development and modeled representation of future demand response alternatives that are reasonably, if not likely, to emerge in Nova Scotia, while more directly addressing estimated electrification increases."

Recommendations and Considerations

NSPI should conduct an analysis of portfolio ELCC and develop an ELCC value for demand response based on a portfolio ELCC. Further, NSPI should analyze a greater level of demand response programs, that are consistent with a greater level of peak loads due to electrification.

[64] NSPI response to Synapse IR-32 (b).

[65] E3. 2020. Capacity and Reliability Planning in the Era of Decarbonization – Practical Application of Effective Load Carrying in Resource Adequacy. Available at: https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf.

[66] Synapse made a similar comment on demand response in its August 2023 comments regarding the Evergreen IRP Update (M11307).

Previously we asked for more information about thermal storage, heat pump water heaters, and induction cooking potential. There is very little about that in NSPI's Report.

Recommendations and Considerations

We ask NSPI to further explore and evaluate the impacts of thermal storage, heat pump water heaters, and induction cooking technologies.

For the commercial sector, the heating and EV end uses contribute significantly to peak growth.

Recommendations and Considerations

We ask NSPI to quantify specifically the electrification and EV impacts for the commercial sector and to consider how this can be moderated.

Overall, the peak forecast seems plausible, although there are many uncertainties, and some aspects need refinement. There should be more discussion of the underlying factors causing peak growth and what can be done to mitigate it.

4. Sensitivity Analysis

The forecast Report (in Section 11 and Appendix D) presents sensitivity analyses that help to understand potential future load variations.

Detailed results are found in Appendix D and like last year, they appear to be plausible. The potential scenarios discussed in Figure D8 demonstrate dramatically different paths forward. For example, the addition of two Hydrogen Production Facilities has an equal in magnitude but opposite sign on peak load as a 5 percent battery share by 2033. Thus, ensuring that the most likely scenario is included in the base case is more crucial than ever. For example, if the Battery scenario is established to be the most plausible scenario, then nearly the entire effects of EV on 2034 Peak are eliminated by this inclusion.

The peak load sensitivity also used a set of weather and economic drivers. Notably, the peak is more sensitive to monthly HDD than Peak HDD, as shown in Figure D5.

The Weather/Economics P10/P90 scenario demonstrates the largest near-term uncertainty. The potential addition of two Hydrogen Production facilities would have the largest long-term effect on energy and peak demand of the studied scenarios.

We note that NSPI's load forecast only includes a single reference scenario for all the key resources and end-uses (e.g., heat pumps, EVs, DSM and demand response). It is critical to evaluate a range of possible futures, and in fact, NSPI's IRP proceedings test various load scenarios including a few DSM scenarios and electrification scenarios. For the major resources and end uses that pose uncertainties about their future adoption rates, in particular heat pumps, EVs, DSM, and demand response, we highly recommend that NSPI develop a few different scenarios (e.g., low case and high case) in addition to the reference case. For example, NSPI assumed a hybrid scenario for heat pumps, citing that it aligns with Nova Scotia's Clean Power Plan and NSPI's Evergreen IRP. However, this scenario may not be materialized in the future, while the province currently desires it to happen. As another example, NSPI's Evergreen IRP modeled the impacts of another scenario called the Modified Mid scenario, which projects to double DSM investments by 2030. This scenario is an ideal scenario to test one end of possible DSM scenarios on load forecasts. In sum, it is crucial to evaluate and test different possibilities for load forecasts for NSPI and this exercise should be first conducted within this load forecast proceeding, instead of the IRP proceeding.

We also note specifically that firm peak has in aggregate been under-forecast and for each year further in the forecast, the degree of under-forecasting is larger. The lowering of the firm peak forecast from 2023 to 2024 may logically follow the reduction in electric vehicle adoption and further pursuit of hybrid heating. However, such a decrease in the forecast may not be warranted if NSPI has consistently under-forecast load. In addition to sensitivities to address uncertainty in specific end-use scenarios, NSPI should also evaluate the possibility of a higher than forecast peak in light of the systematic under-forecasting of peak that is noted above.

Recommendations and Considerations

For the major resources and end uses that pose uncertainties about their future adoption rates, in particular heat pumps, EVs, DSM, and demand response, we highly recommend that NSPI develop a few different scenarios (e.g., low case and high case) in addition to the reference case.

NSPI should also evaluate the possibility of a higher than forecast peak in light of the systematic under-forecasting of peak that is noted above.

Finally, we recommend that there be future sensitivity analyses based upon thoughtful/critical examination of realistic but aggressive proactive actions to mitigate projected peak increases using newly available technology.

5. QUESTIONS AND RECOMMENDATIONS

In this Evidence we ask for further clarifications and make several recommendations:

1. We ask that NSPI explore the benefits of increasing DSM levels in the future.
2. We ask NSPI to continue to investigate the energy and peak load effects of heat pumps in future forecasts, especially given the variance between NSPI's analysis and E3's for both whole home heat pumps and hybrid heat pumps and the increasing availability of AMI data that is expected in the future. NSPI should seek to validate any assumptions about the extent to which heat pumps displace legacy fossil-based heating equipment, and NSPI should also seek to validate any other assumptions about customer usage of secondary heating equipment. Finally, NSPI should model hybrid electric heating within its model instead of making a simplified adjustment based on E3's hybrid scenario.
3. We recommend that NSPI model heat pump water heaters as a separate end-use technology in the next load forecast.
4. NSPI should carefully monitor EV adoption and update its forecast as needed. As part of this update, NSPI should examine the reasonableness of the Dunsky's low scenario for Nova Scotia. NSPI should also continue to examine load impacts from EVs including peak load impacts from EV managed charging and a reasonable share of EVs that can be under managed charging programs and reflect the results of the analysis in the next load forecast. Further, NSPI should develop and implement rate designs and other programmatic options to reduce on-peak EV charging as penetration increases. These load management strategies should be reflected in the next load forecast with greater detail, with all assumptions supported empirically to the maximum extent possible.
5. NSPI should continue to monitor the coincidence of solar generation with month system peaks and make updates to coincidence factors as warranted.
6. NSPI should continue to investigate and report on opportunities for incentivizing cost-effective deployment of battery storage, including through rate design. NSPI should also continue to investigate the use of EV batteries, especially for peak management.
7. NSPI should validate the use of new home construction as a proxy for customer growth, addressing concerns about potential shortcomings of this proxy variable.
8. We ask that NSPI reassess its modeling approach for COVID-19 impacts on the residential class. NSPI should continue to collect data on work-for-home behavior, and it should make modifications to its modeling approach as warranted. We also reiterate the Board's 2023 suggestion to consider the impacts of household demographics on residential load.
9. Given that significant changes to the load forecast relative to the previous year's forecast owing to revisions to assumptions about EV and solar penetration and the impacts of the RTR and hybrid heating, NSPI should address the range of possibilities (sensitivities) in these domains to produce a more robust forecast.

10. We further ask that NSPI explore the potential impacts of solar and DSM on the Large General Service forecast.

11. We ask NSPI to explore the likelihood and impacts of greater industrial electrification levels.

12. We ask NSPI to explore the potential for greater industrial savings.

13. We ask NSPI to explore the impacts of real time rates.

14. We ask NSPI to explore the impacts of increases in industrial RTR.

15. If DSM program savings are increased above historical levels, then the adjustment factors probably should be adjusted upward to reflect greater levels of incremental savings.

16. We ask NSPI to investigate what can be done with time-of-use rates and other measures to mitigate the peak load increases for all these components, especially for the C&I sectors.

17. NSPI should conduct an analysis of portfolio ELCC and develop an ELCC value for demand response based on a portfolio ELCC. Further, NSPI should analyze a greater level of demand response programs, that are consistent with a greater level of peak loads due to electrification.

18. We ask NSPI to further explore and evaluate the impacts of thermal storage, heat pump water heaters, and induction cooking technologies.

19. We ask NSPI to quantify specifically the electrification and EV impacts for the commercial sector and to consider how this can be moderated.

20. For the major resources and end uses that pose uncertainties about their future adoption rates, in particular heat pumps, EVs, DSM, and demand response, we highly recommend that NSPI develop a few different scenarios (e.g., low case and high case) in addition to the reference case.

21. NSPI should also evaluate the possibility of a higher than forecast peak in light of the systematic under-forecasting of peak that is noted above.

22. Finally, we recommend that there be future sensitivity analyses based upon thoughtful/critical examination of realistic but aggressive proactive actions to mitigate projected peak increases using newly available technology.

We support NSPI's ongoing efforts to improve the transparency and accuracy of the load forecast. There is still more to do; but overall, NSPI's Report is very well done and satisfactorily explains the underlying factors driving the forecast.

Appendix A. Questions and Recommendations from 2023 Evidence of Synapse Energy Economics

1. We ask that NSPI explore the benefits of increasing DSM levels in the future (page 6).

2. We ask NSPI to continue to investigate the energy and peak load effects of heat pumps in future forecasts, especially given the variance between NSPI's analysis and E3's and the increasing availability of AMI data that is expected in the future. NSPI should specifically monitor trends in heat pump adoption given that this year's forecast was modified upward. Finally, NSPI should seek to validate any assumptions about the extent to which heat pumps displace legacy fossil-based heating equipment, especially in light of the sensitivities that NSPI included testing this issue, and NSPI should also seek to validate any other assumptions about customer usage of secondary heating equipment (page **Error! Bookmark not defined.**).

3. In the next load forecast report, we recommend that NSPI leverage the data from its water heater demand response pilot in formulating its residential peak forecast. We further recommend consideration of heat pump-based hot water heating in the next forecast (page 16).

4. NSPI should carefully monitor EV adoption and update its forecast as needed. NSPI should also continue to develop and implement rate designs and other programmatic options to reduce on-peak EV charging as penetration increases. These load management strategies should be reflected in the next load forecast with greater detail, with all assumptions supported empirically to the maximum extent possible (page **Error! Bookmark not defined.**).

5. NSPI should include in its next load forecast more refined and empirically validated assumptions for any peak reduction benefit from solar generation (page 18).

6. NSPI should validate the use of new home construction as a proxy for customer growth, addressing concerns about potential shortcomings of this proxy variable. Given that NSPI has increased its forecast for new customer growth, it should carefully monitor trends and make any needed modifications in the next load forecast (page 18).

7. What are the net effects of shifting EV loads to the commercial sector? Does this perhaps change the system peak load patterns? And how might time-of-use rates apply? (page 19)

8. Might there be overall benefits from expanding DSM programs in this sector? (page 20)

9. What is the potential for expanding on-site solar as much of the commercial load coincides with solar generation? (page 21)

10. What is the potential for expanding the RTR program? (page 23)

11. We ask what is happening with the large general service customers? Are they implementing DSM measures to reduce load? Adding solar generation? Entering into RTR contracts? Might all this reduce their loads to some degree? (page 25)

12. We ask NSPI to explore the likelihood and impacts of greater industrial electrification levels (page **Error! Bookmark not defined.**).
13. We ask NSPI to explore the potential for greater industrial savings (page 26).
14. We ask NSPI to explore the impacts of real time rates (page **Error! Bookmark not defined.**).
15. We ask NSPI to explore the impacts of increases in industrial RTR (page 28).
16. We ask NSPI to further investigate the commercial and industrial electrification prospects after 2026 (page **Error! Bookmark not defined.**).
17. If DSM program savings are increased above historical levels, then the adjustment factors probably should be adjusted upward to reflect greater levels of incremental savings (page 30).
18. We ask NSPI to explain why the future System Peak values do not equal the Firm Peak less the interruptible customers (page 30)
19. We ask NSPI to investigate what can be done with time-of-use rates and other measures to mitigate the peak load increases for all these components, especially for the commercial and industrial sectors (page 31).
20. We ask NSPI to further investigate the performance of heat pumps during peak load conditions (page **Error! Bookmark not defined.**).
21. We ask NSPI to further explore and evaluate the impacts of thermal storage, heat pump water heaters, and induction cooking technologies (page 30).
22. We ask NSPI to quantify specifically the electrification and EV impacts for the commercial sector and to consider how this can be moderated (page 30).
23. We recommend that there be future sensitivity analyses based upon thoughtful/critical examination of realistic but aggressive proactive actions to mitigate projected peak increases using newly available technology (page 31).