
Evidence Regarding Nova Scotia Power's 2023 Load Forecast

Evidence RE: M11108

Prepared for the Nova Scotia Utility and Review Board

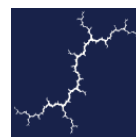
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1. INTRODUCTION

For many years, Nova Scotia Power, Inc. (NSPI) has filed annual load forecast reports, many of which Synapse Energy Economics (Synapse) has been involved in reviewing. NSPI's load forecast reports have changed considerably over time. The *2023 Load Forecast Report*¹ (Report) continues the trend of improvement in expository quality by providing additional information. However, Synapse observes that the 2023 forecast predictions are significantly above those of recent years. This is in large part because of provincial and federal efforts to reduce fossil fuel use with additional electrification.

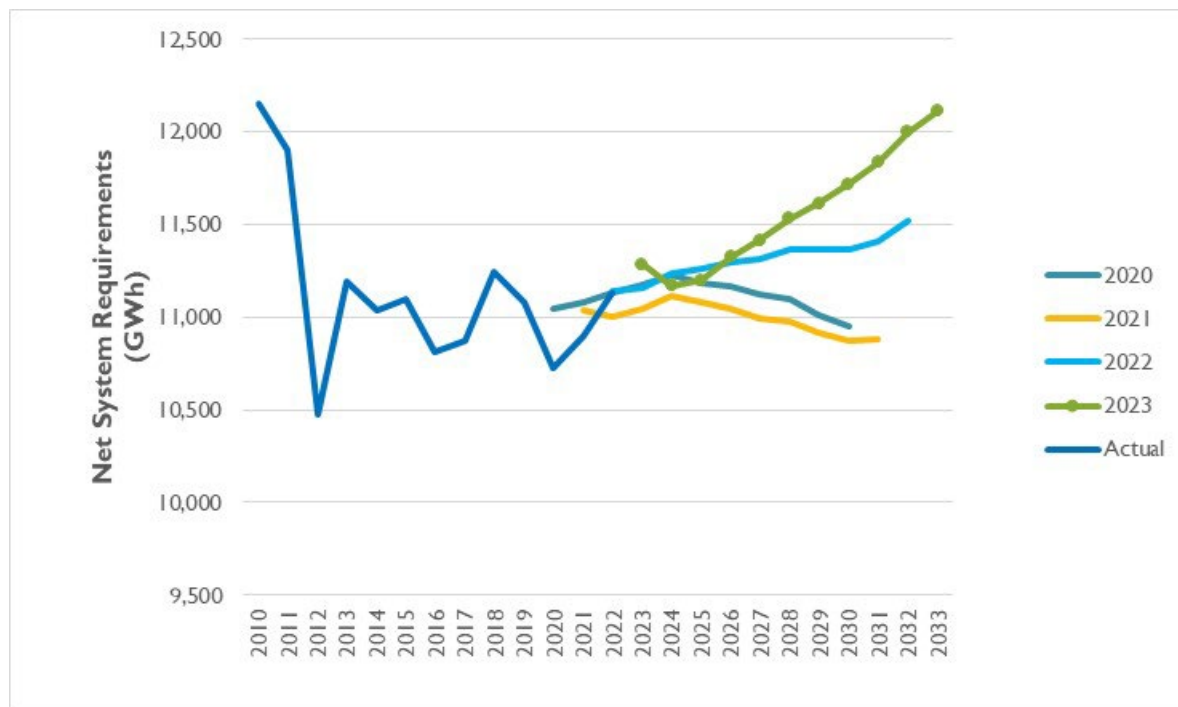
We note that the load forecast consists of three discrete elements. The first is the Statistically Adjusted End-Use (SAE) model forecast based on customer end-uses. The second is the set of demand-side management (DSM) adjustments applied to the SAE forecast values. Third, NSPI applies other factors 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 COVID-19, they rebounded in 2022. Recent year 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 anticipates 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.

¹ Nova Scotia Power, Inc. *2023 Load Forecast Report*, April 28, 2023.

Figure 1. Net system requirements



Source: Synapse from NSPI Figure 1 and responses to Synapse IR-1.

The current forecast represents an 825 GWh increase from 2023 to 2033, which is equal to 7.3 percent growth in total load. NSPI lays out the components of this change in Figure 55 of its Report, as listed in Table 1 below. The “Model” changes represent primarily electrification of heating loads along with greater cooling usage. Other factors causing increases are growth in new customers and electric vehicles (EV). Offsetting these increases are rooftop solar and DSM. We will discuss several of these items in more detail in this report.

Table 1. Net system requirement components

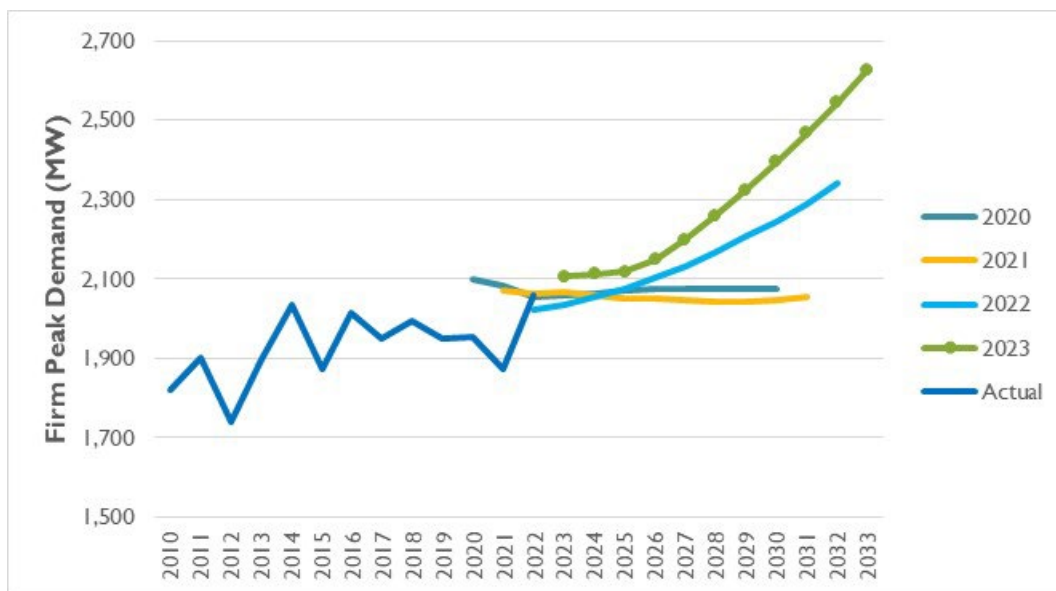
GWh	Res	Comm	Ind	Other	Losses	NSR
2023 Forecast	4,830	3,142	2,436	138	742	11,288
Model	224	121	31	-34	104	446
New Customers	377	31				408
Solar	-446	-61				-507
EV	659	338				997
Commercial & Industrial Electrification		23	35			58
Large Customer Projects		31	95			126
RTR	-14	-64	-38			-117
DSM	-269	-205	-57	-3	-51	-586
2033 Forecast	5,360	3,355	2,501	101	795	12,113

Source: Figure 55 from the NSPI forecast Report.

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 firm peak forecasts for 2020 and 2021 showed little change. This forecast and the previous one show significant increases. The increase over the forecast period for this forecast is 521 MW or 25 percent. This increase is mostly driven by the expectation of increased electrification.

The components producing this change are specified in Figure 65 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 followed by commercial and industrial (“C&I”) electrification and then large customers. This will be discussed in more detail in the following sections of this report.

Figure 2. Firm peak demand



Source: Synapse from NSPI Figure 2 and responses to Synapse IR-1

Table 2. Firm peak demand 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)	2,223	12	424	-37	181	119	-121	2,811	156	3,004

Source: Figure 65 of the Load Forecast Report.

1.2. Sector Overview

The following table shows the forecast energy use by sector. Overall, the residential load (representing around 40 percent of the total load) is growing the most, 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 increase.

Table 3. Sector energy requirements (GWh)

	Residential	Commercial	Industrial	Municipal	Losses	Total
2023	4,830	3,142	2,436	138	742	11,288
2033	5,360	3,355	2,501	101	795	12,113
Change	530	213	65	-37	53	825
Percent Change	11.0%	6.8%	2.7%	-26.8%	7.1%	7.3%

Source: Synapse from Table A1 of NSPI forecast Report.

In general, the forecast seems reasonable given the ongoing changes, but there are significant increases in the energy and peak requirements. These increases need to be explored and understood. In recent years energy and peak loads have been relatively flat, but the predicted increases will have numerous implications. The primary driving factors appear to be increased electrification and population and economic growth.

We will look at specific forecast components and note where there are questions and possible improvements. We will look at each sector in sequence and discuss the following issues:

1. What are the components and drivers for the changes?
2. Are the effects of DSM programs properly represented?

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 38 and 55 of the Report. Overall, NSPI projects DSM will reduce the 2033 load by 586 GWh, or about 4.8 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 indicated that 42.5 percent of the DSM program savings are not in the statistical model results. For the

C&I sector, that value is 39.7 percent. Overall, the net additional savings are 41 percent. This indicates that most 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 following table, that is not the current case. Overall, DSM is playing a major role in limiting energy growth.

Recommendations and Considerations

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

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)
2023	69.3	43.7	7.7	39.9	31.0	29.5	20.4	41%
2024	60.9	69.4	12.3	35.0	49.3	25.9	32.4	41%
2025	65.6	71.3	12.6	37.7	50.6	27.9	33.3	41%
2026	69.6	56.7	10.0	40.0	40.2	29.6	26.5	41%
2027	71.6	55.7	9.8	41.2	39.5	30.4	26.0	41%
2028	73.0	62.9	11.1	42.0	44.6	31.0	29.4	41%
2029	73.7	52.2	9.2	42.4	37.0	31.3	24.4	41%
2030	73.3	51.0	9.0	42.1	36.2	31.1	23.8	41%
2031	74.1	48.0	8.5	42.6	34.1	31.5	22.4	41%
2032	73.2	46.8	8.3	42.1	33.2	31.1	21.8	41%
2033	71.3	43.4	7.7	41.0	30.8	30.3	20.3	41%

Source: Synapse from NSPI load forecast filings—using DSM savings from Figure 38.

² See Section 4.6 of the forecast Report.

1.4. Recommendations from the Previous Forecast Review

The Synapse Evidence regarding the 2022 forecast and the resulting Board Order listed several recommendations for improving the forecast.³ These are reproduced in Appendix A to this report. NSPI responses to these are presented in Section 2.0 of the forecast Report.

We support these ongoing efforts and will discuss some of them in the appropriate sections below. We especially note the importance of the heat pump and water heater end uses for the residential sector.

³ Page 23 and 24 of the Synapse 2022 Evidence.



2. ENERGY FORECAST

In Table 3, we saw the sectorial components of the Nova Scotia load. Here, we will review each of them in sequence, going in the same order as in the forecast report.

2.1. Major Inputs and Regression Models

In addition to end-use technology changes and numbers of customers, the forecast is influenced by several economic and environmental drivers. The economic and employment data is from the latest Conference Board of Canada (CBoC) 20-year forecast. This is the only long-term forecast available for the province. Other forecasts for the short term indicate the CBoC values are generally consistent with the various bank forecasts available. However, there is greater uncertainty in any longer-term forecast, and sensitivity analyses are useful for looking at this issue.

The residential model uses household income as the primary economic driver. As suggested last year, median income data was investigated but did not improve the model statistics and also is not currently available. Growth in new customers is highly correlated with housing completions and that was used as well. Note that new customer load is calculated outside of the regression model.⁴ 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 4.7 percent over the forecast period, associated primarily with electrification of heating. New customers increased the total residential load by 7.8 percent.⁵ The choice of drivers is reasonable but should be reviewed regularly. We note that 4.7 percent represents the increase in existing customer load from 2023 to 2033, whereas the 7.8 percent value represents the increase in new customer load as a percentage of the 2023 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.⁶

The residential statistical model includes a binary variable to represent the effects of COVID-19. NSPI gave that variable a value of 1.0 for 2020. It was reduced to 0.5 in October 2020, to 0.43 in January 2022, and then to 0.36 in July 2022 (where it currently stays).⁷ The net effect going forward is nil, but the actual effect may decline in the future. The COVID-19 variable should be reevaluated going forward. Perhaps it should even be removed altogether from future years.

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

⁴ See Residential Load - Post Regression table on page 6 of Appendix B.

⁵ Ibid.

⁶ Ibid.

⁷ Load Forecast Report, Appendix B, p. 3.

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 use of the widely available CBoC forecast is a reasonable choice given the need for general consistency within Canada as a whole. We note however the inherent uncertainty of all economic forecasts and also that the future may diverge significantly from the forecast.

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 basically the same as those used in the previous forecast. NSPI now incorporates these trends into the forecasts. This change represents an acknowledgement of climate reality and is a definite step forward. This data should be analyzed and updated on a regular basis.

NSPI previously investigated the use of more weather station data from other parts of the province. However, this seemed to have a very minimal effect on the forecast results. This was not incorporated in the current forecast.

2.2. Residential Sector

The residential sector represents about 45 percent of the total customer load. The residential forecast, including the load-reducing effects of DSM programs, increases by 11.0 percent over the forecast period, from 2023 to 2033. Without DSM programs, the increase would be 16.6 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 7.8 percent to load between 2023–2033. Meanwhile, incremental EV charging contributes about 13.6 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).⁸

⁸ Load Forecast Report, Appendix B, pp. 1-8.

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 7.4 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 60.1 percent.⁹

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* 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 1.3 percent.¹⁰

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, 44 percent is associated with heating, 3 percent with cooling, and 53 percent with other uses. For existing customers, average heating load increases by 3.3 percent, average cooling load increases by 2.1 percent, and the average load associated with other end uses falls by 0.7 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 renewable to retail (RTR) 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.

⁹ Load Forecast Report, Appendix B, pp. 2, 7.

¹⁰ Load Forecast Report, Appendix B, pp. 2, 8.

Table 5. Residential load: post regression (GWh)

	Existing Customer Average Use from Regression Model (kWh/year)	New Cust. Load	EVs	Solar	RTR	Res DSM Adjustment	Res Sales	Total Res DSM (at the meter)	DSM captured by end uses
2023	9,845	54	7	(39)	0	(27)	4,830	(62)	(36)
2033	10,305	431	666	(485)	(14)	(297)	5,360	(698)	(402)
Change to load	4.7%	7.8%	13.6%	-9.2%	-0.3%	-5.6%	11.0%		

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

Source: NSPI load forecast report Appendix B.

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 4.7% over the forecast period. This increase is largely the result of electrification, as NSPI projects growing adoption of heat pumps for heating and cooling and growing adoption of electric water heating. The increase in existing customer consumption is also driven by a forecast increase in household compensation.¹¹

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.

The heat pump section of the report discusses replacement of both fossil and electric resistance heating by heat pumps in existing buildings. The end-use model uses a heat pump saturation of 40 percent in 2023, which then increases to reach 100 percent in 2050.¹² NSPI also projects that a majority of new construction will feature heat pumps.¹³

NSPI explains that actual installations of heat pumps in 2022 were greater than forecast, which has led NSPI to revise up its heat pump adoption projection in this year's load forecast.¹⁴ In the near term, NSPI

¹¹ Response to Board IR-3(c).

¹² Load Forecast Report, p. 33.

¹³ Response to Synapse IR-7(b).

¹⁴ Response to Board IR-5.

expects about 21,000 heat pump installations per year. The prediction is that roughly 68 percent of these are for non-electric heating customers and roughly 32 percent are for electric heating customers.¹⁵ The scenario that NSPI adopted for the forecast assumes that when a non-electric customer installs a heat pump, the legacy equipment is removed, and that customer then subsists entirely on electricity for heating. For all heat pump installations in existing buildings, NSPI assumes that backup heat is provided by electric resistance heat.¹⁶

The forecast growth in heat pumps explains much of the growth in average electricity consumption for existing customers.¹⁷ Heat pumps drive a 26.8 percent increase in the XHeat load variable and 30.9 percent increase in XCool. Overall, the residential average load increases by 3.3 percent because of heating changes and increases by another 2.1 percent because of cooling. Figure 43 of the Report quantifies this new load in energy unit terms. Heat pump heating load increases by 577 GWh and cooling load increases by 89 GWh for a total of 666 GWh. However, baseboard heat decreases by 447 GWh. Heat pumps displace some fossil fuel heating and thus there are additional unreported savings there.

On a more granular level, the increase in the forecast adoption of heat pumps is the driver of the increase in the XHeat term relative to its value in the 2022 SAE modeling.¹⁸ Whereas the XHeat term was projected to decline by 0.9 percent between 2022–2032 in the 2022 load forecast analysis, the same term is projected to increase by 7.4 percent over the period 2023–2033 in the latest load forecast.¹⁹

Meanwhile, the projected intensity for heat pumps as a component of XCool is lower in the 2023 load forecast than in the 2022 load forecast.²⁰ However, the decline in projected intensity is largely offset by a higher regression coefficient on the XCool term.

There is some uncertainty as to the overall energy and peak effects of increased heat pump usage, as indicated in Figure 23 of NSPI's report. As with the 2022 forecast, NSPI retained third-party consultant E3 to develop estimates of space heating and EV load shapes.²¹ The estimates provided by E3 indicate significantly lower energy effects than those estimates resulting from NSPI's SAE model. This should be

¹⁵ Load Forecast Report, Figure 24, p. 37.

¹⁶ Response to CA IR-2(b).

¹⁷ Response to Board IR-24.

¹⁸ Load Forecast Report, Appendix B, p. 7.

¹⁹ Load Forecast Report, Appendix B, p. 7; 2022 Load Forecast Report, Appendix B, p. 7.

²⁰ Load Forecast Report, Appendix B, p. 7; 2022 Load Forecast Report, Appendix B, p. 7.

²¹ Load Forecast Report, p. 32.

evaluated more closely in future years using AMI data. NSPI indicated that “work is ongoing to further reduce the differences in the models.”²²

Replacing fossil heating increases the electrical loads, while replacing resistance heating reduces it. In the 2022 load forecast, these effects were close to offsetting. In this year’s iteration of the forecast, incremental electricity consumption associated with heat pump adoption more substantially outweighs savings from the retirement of less efficient resistance heating equipment, in part as a result of high assumed resistance heating intensity through the modeled period (i.e., lesser retirement of this equipment and greater utilization of it).

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 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.

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.²³ 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 25 of NSPI’s report, the electric water heater saturation will increase from 71 to 87 percent, which implies that about 55 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.

NSPI’s Report does not provide the net effects. However, inspecting the table on page 8 in Appendix B seems to indicate a 5.0 percent increase in XOther driven by water heating usage between 2023 and 2033. We observe that the projected change in electric water heater intensity through the forecast period in the 2023 load forecast is almost identical to the same from the 2022 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.

²² Load Forecast Report, p. 35.

²³ Load Forecast Report, p. 37.

²⁴ Load Forecast Report, pp. 78-79.

While Synapse recommended in its 2022 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 so limited. However, NSPI bases this conclusion on just two years of data—for 2020 and 2021—during which time uptake of heat pump hot water heaters doubled. Uptake may have further increased since then.²⁵

Recommendations and Considerations

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.

Electric vehicles

NSPI forecasts new EV load separately from its SAE modeling, as noted previously. EVs represent another load growth area, but one with a great deal of uncertainty. This forecast predicts that there will be 237,016 EVs in Nova Scotia by 2033.²⁶ That would represent a total energy load of 1,003 GWh with peak load impacts ranging from 209 to 374 MW.²⁷ The residential sector load impact in 2033 is estimated at 666 GWh.²⁸

The projection of overall EV energy consumption and peak load contribution in this load forecast is from the projection of the same in last year's forecast. For 2032, this year's forecast predicts 194,001 total EVs (across all sectors), representing an 824 GWh load contribution and peak impacts between 172 and 307 MW.²⁹ This is a substantial increase from the previous load forecast's projection of 96,612 vehicles for 2032, with associated respective energy and peak load impacts of 510 GWh and 89 to 131 MW.³⁰

By 2033, this year's load forecast projects that EVs will represent 8.3 percent of the energy sales and 8.0 to 14.2 percent of the peak load across all sectors.³¹ For the residential class alone, NSPI forecasts EVs will account for about 12.4 percent of energy sales in 2033³² and for 7.5 percent of residential peak load in 2032.³³

²⁵ Load Forecast Report, pp. 37-38.

²⁶ Load Forecast Report, Figure 30.

²⁷ Load Forecast Report, Figure 30.

²⁸ Load Forecast Report, Figure 30, Figure 42.

²⁹ Load Forecast Report, Figure 30, Figure 30.

³⁰ 2022 Load Forecast Report, Figure 28.

³¹ Load Forecast Report, Figure 30, Figure 3, Figure 65.

³² Load Forecast Report, Figure 42.

³³ Load Forecast Report, Figure 68.

These predictions are based on meeting stated public goals and may not actually be achieved. The underlying goals are very ambitious, and when translated into NSPI's projection would entail, for example, a greater than 50 percent year-on-year rate of increase in the total stock of EVs for every year from 2023 through 2029.³⁴ We also understand that there currently are some supply chain problems. NSPI should carefully monitor EV adoption trends and revise its forecast accordingly as required for accuracy.

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 notes that its SGNS project is testing options for direct utility control of charging, to shift EV charging to off-peak times.³⁵ The forecast currently assumes 70 percent managed charging.³⁶

Recommendations and Considerations

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.

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 a larger utility-scale. The load forecast considers the customer-level impacts. Currently the number of installations is small but is projected to increase more than 20-fold over the forecast period. This is a notable increase from the previous forecast, which predicted a 10-fold increase from 2022 to 2032. Because of the timing of the system peak, NSPI predicts no effect on the winter peak load but predicts a “nominal” peak reduction benefit of 10 percent for June and September and 15 percent for July and August. NSPI indicates that it is still collecting data on these impacts through the SGNS program.³⁷ NSPI further forecasts a net reduction of 531 GWh (6.1 percent) in the combined residential and commercial energy load.³⁸

Recommendations and Considerations

³⁴ Load Forecast Report, Figure 30.

³⁵ Load Forecast Report, pp. 40, 46.

³⁶ Load Forecast Report, p. 40.

³⁷ Response to Synapse IR-10(b).

³⁸ Load Forecast Report, pp. 44-45.

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

Solar-plus-battery

The report discusses solar/battery storage combinations but does not expect them to have much effect on future loads.³⁹ However, NSPI presents some possible impacts based on preliminary results from the SGNS project in Figure 32 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

We ask that updated results of the SGNS project regarding battery storage be included in the next load forecast report. We again request that NSPI investigate more fully 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.

NSPI projects new customers based upon forecast new home construction. The projection for new customer load has increased substantially in this year's load forecast relative to the previous year's forecast. New customers are expected to add 431 GWh (8.0 percent) to the residential load by 2033.⁴⁰

Synapse has previously noted concerns about the strength of the relationship between new housing and customer growth. 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.⁴¹ NSPI does affirmatively state its view that forecast housing completions remain the best proxy for new customer growth,⁴² and it further indicates that the increase in housing completions assumed in this year's load forecast relative to last year's is the product of heightened immigration to the province that is expected to continue.⁴³

³⁹ Load Forecast Report, pp. 45-46.

⁴⁰ Load Forecast Report, Figure 42.

⁴¹ Response to Synapse IR-5(c).

⁴² Response to Board IR-3.

⁴³ Response to Synapse IR-5(d).

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. 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.

Other

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.⁴⁴ While NSPI claims to have complied with this directive, it has not made 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."⁴⁵ Still, NSPI's assumed input of 0.36 for this variable remains unsupported and arbitrary. We note that inputting a non-integer value for a binary variable is not conventional, especially where the coefficient on this variable has been estimated anew in this year's model run.

Moreover, as a result of NSPI's re-estimation of the coefficient on the COVID-19 variable for the 2023 forecast, projected residential energy usage as a result of COVID-19 work-from-home impacts actually *increased* from the 2022 and 2023 load forecasts, rising from an estimated 208 kWh per residential customer for 2022 in the 2022 load forecast to 308 kWh per residential customer in the 2023 load forecast. Whereas NSPI projected the value of this variable to decline over time in last year's load forecast report, in this year's report, NSPI is projecting that COVID-19 work-from-home impacts will remain constant through 2023.

In its 2022 Decision, the Board suggested that NSPI consider incorporating household size and age of household residents to possibly improve understanding of demand on load by time of day.⁴⁶ NSPI uses household size in its residential model calculations and has stated that it will investigate household size and demographics for a future forecast.^{47, 48}

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 further its technical modeling approach and the functional form, since inputting a non-integer value for a binary variable, especially

⁴⁴ Board Decision in Matter M10569, p. 5.

⁴⁵ Response to Synapse IR-18(d).

⁴⁶ Load Forecast Report, p. 11.

⁴⁷ Response to CA IR-10.

⁴⁸ Response to Synapse IR-46.

where the coefficient has been estimated anew this year, is not conventional. We also reiterate the Board’s 2022 suggestion to consider the impacts of household demographics on residential load.

2.3. Commercial Sector

The commercial sector represents 30 percent of the customer load. The commercial forecast (as shown in Table 3 of this evidence) increases by 6.8 percent over the forecast period. In the 2022 forecast, it decreased by 0.58 percent.

The commercial sector consists of three subsectors: Small General Service, General Service, and Large General Service. The Small General Service group represents 10 percent of the commercial load, the General Service group 75 percent, and the Large General Service group 15 percent.

Our comments focus on the General Service (also called Medium) group which represents 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 2022 and 2032 is an increase of 4.4 percent. The increases in the regression model results are driven by the XHeat component and represent primarily electrification of heating loads. A new addition this year is a significant electrical vehicle component representing daytime on-site charging. The reductions from DSM programs offset a good portion of the increases.

Table 6. General service sales drivers from 2023 to 2033

Category	2033 Change
Medium Gen Sales 2023	2,378 GWh
Regression model	+ 4.3 %
Renewable to Retail	- 2.7 %
Electric Vehicles	+ 11.4 %
Solar	- 1.9 %
DSM ⁴⁹	- 6.8 %
Total Change	+ 4.4 %

Source: Load Forecast Report, Appendix B p. 19.

The Small General Service average loads show greater proportional increases. The average use per customer from the regression analysis has an increase of 3.9 percent. But there is a projected 10 percent increase in the number of customers which boosts the model load by 48 GWh (or 14.8 percent). Note also the big increase associated with commercial EV usage.

⁴⁹ 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 2023 to 2033

Category	2033 Change
Small Gen Sales 2023	323 GWh
Regression model + new customers	+ 14.8 %
Renewable to Retail	NA
Electric Vehicles	+ 20.8 %
Solar	- 4.7 %
DSM ⁵⁰	- 7.0 %
Total Change	+ 24.0 %

Source: Load Forecast Report, Appendix B p. 13.

The EV commercial load increase is “mostly related to a shift of part of the EV loads from the residential class to the commercial class ...”⁵¹

NSPI states that the COVID-19 pandemic had a long impact on commercial sales. The ongoing impact is projected to be -13 GWh in 2023 and future years.⁵²

Large Gen loads are expected to increase by 26 GWh in 2033 from electrification.⁵³ Sales are also expected to increase by about 35 GWh with the expansion of institutional facilities. NSPI provided no solar or DSM projections.

*Two hospitals, one in Halifax and one in Cape Breton, account for an estimated 20 GWh of growth, while government buildings account for an estimated 6 GWh, universities account for an estimated 5 GWh, and other customers account for 3 GWh.*⁵⁴

To summarize, the increase in the Commercial load appears to be related to these factors:

- Shifting of some EV charging from residential locations to commercial sites
- Increased electrification of commercial space heating
- Increases in the number of customers

The offsetting load reduction factors are the following:

- DSM programs
- On-site solar
- Renewable to retail supply increases

⁵⁰ 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.

⁵¹ Response to Synapse IR-20.

⁵² Ibid.

⁵³ Forecast Report Figure 36.

⁵⁴ Response to Synapse IR-23.

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

Recommendations and Considerations

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?

Might there be overall benefits from expanding DSM programs in this sector?

What is the potential for expanding on-site solar as much of the commercial load coincides with solar generation?

What is the potential for expanding the RTR program?

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?

2.4. Industrial Sector

The industrial sector represents 23 percent of the customer load. The industrial forecast increases by 2.7 percent over the forecast period. In the 2022 forecast, this was 2.4 percent. In the 2021 forecast, the increase was 3.9 percent. Most of the change is associated with current and potential new large customers which is lumpy by nature and thus subject to a fair amount of uncertainty.

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 1.0 percent annually, driven by economic growth. The Medium sector is expected to decline by 0.7 percent annually as load migrates to RTR providers. The Large (also called Other) category represents about 70 percent of the industrial load and has a 0.3 percent annual rate of increase.

The change in the Large category is based on customer surveys and new customer inquiries. Figure 51 of the Report projects for new Large industrial projects to add 95 GWh by 2027. Since this is more than the sector projected increase of 65 GWh, some load reduction through DSM or other measures is likely happening.

The forecast projects increased electrification of the industrial sector with a total load increase of 40 GWh by 2033.⁵⁵ 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 38 GWh.⁵⁶

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

Table 8. Industrial loads with DSM (GWh)

Category	2023	Fraction	2033	Change	% Change
Small	261	11%	288	27	10.5%
Medium	482	20%	449	(33)	-6.8%
Large	1,694	70%	1,764	70	4.2%
Total	2,436	100%	2,641	65	2.7%

Source: Synapse IR-1 response, Figures 49-52 and Table A1 from the forecast report.

⁵⁵ Forecast Report Figure 36.

⁵⁶ Forecast Report 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 36 of the Report.⁵⁷ The impacts start off strong, reaching 43 GWh by 2026. However, they then increase at just a few GWh per year reaching 66 GWh in 2033. It would seem likely that electrification would continue to grow at a more regular rate.

Recommendations and Considerations

We ask NSPI to further investigate the commercial and industrial electrification prospects after 2026.

2.6. The Municipal Sector

The municipal sector represents a minimal 138 GWh of the customer load in 2023 which is expected to decline to 100 GWh in 2024 and remain at that level going forward. NSPI continues to provide backup power, so those utilities' needs are included in the peak load requirements. One might think that the municipal sector load would then increase similarly to the NSPI residential sector on the order of 10 percent.

2.7. Energy Forecast and DSM Effects

Future DSM savings used in this forecast are presented in Figure 38 of the Report. The DSM savings are fairly modest. For example, the residential 2023 savings of 69.3 GWh represents about 1.4 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 decreasing. This year it was -0.425, in 2022 this was -0.512, and in 2021 it was -0.587. This implies that the SAE model is embedding greater DSM savings than before, so the adjustments are less. The net effect of DSM savings is -269 GWh in 2033 for the residential sector.

⁵⁷ Electrification for the other commercial subsectors are included in the modeling for those subsectors.

For the commercial/industrial adjustments, the factor is -0.397. This is a little more than the -0.38 used last year, but less than the -0.437 used in 2021. The net load impacts of DSM in 2033 are -205 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.⁵⁸ Since these factors are statistically derived, the values could vary by +/- 20 percent; this should be considered as yet another uncertainty in the forecast. 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.

⁵⁸ Id, pp. 54-56.

3. PEAK FORECAST

As shown in Figures 2 and 3 of the load forecast Report, the system peak (including DSM effects) increases substantially in this forecast. For a direct comparison, the 2032 firm demand in this forecast is 202 MW (11 percent) greater than that of the previous forecast. The 2033 system peak after adjustments in demand is 565 MW greater than the 2023 peak.

The tables below show both the peak load contributions in this forecast and the previous one. The modeled peak in 2033 is 2,233 MW, which is 240 MW higher than the 2032 peak in the prior forecast. The adjustments are similar to those used in the 2022 forecast. Figure 65 in the Report (reproduced below) shows the effects of various components on the future peak load. 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 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 of the 2023 Load Forecast Report.

Table 10. 2022 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)
2022	1,920	7	3	0	10	99	-18	2,021	144	2,165
2032	1,993	120	103	-37	193	112	-141	2,342	152	2,532
2032 (no EV mitigation)	1,993	120	152	-37	193	112	-141	2,392	152	2,581

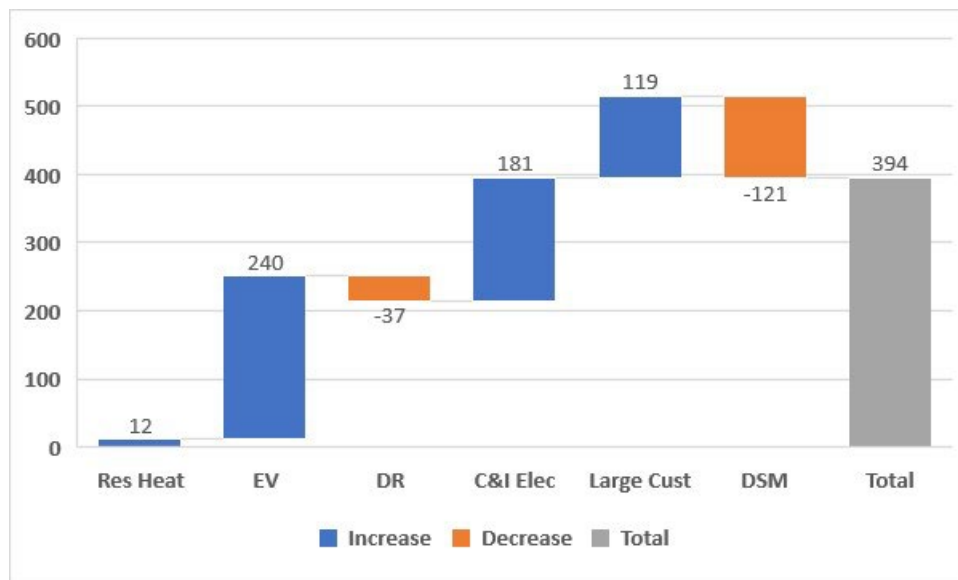
Source: Figure 58 of the 2022 Load Forecast Report.

Recommendations and Considerations

We ask NSPI to explain why the future System Peak values do not equal the Firm Peak less the interruptible customers.

To show the peak contributions more visually, we have created the following waterfall graph showing both the increases and decreases. The net effect of these adjustments is to increase the modeled peak by 394 MW.

Figure 3. Peak contribution adjustments to 2033 (with EV mitigation)



Source: Figure 65 of the Load Forecast Report.

Note that the largest contributor to the peak growth is EVs. Without mitigation this would be nearly twice as great. C&I 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 146 MW to 152 MW. Increasing this further would help moderate the peak.

We note that a peak increase of 565 MW by 2033 means an increase in capacity requirements of 678 MW (using a 20 percent planning reserve margin). This represents a significant increase and investment cost. Those impacts are reflected in the NSPI current 10-year system plan.⁵⁹

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. We would like to see a more complete evaluation of the options to control this growth in the next forecast. While Synapse requested the same detail in last

⁵⁹ "2023 10-Year System Outlook NS Power," June 30, 2023.

year's Evidence, NSPI replied in its Report this year that it was still collecting information on the peak contribution of EVs as part of the SGNS project.⁶⁰

We note that the load forecast Report's Figure 56 shows that demand response is not increased after 2027, although we also understand that NSPI is developing larger demand response programs as part of the IRP Action Plan.

In its response to EOne IR-2, NSPI stated that a mix of heat pumps were modeled with different efficiencies at low temperatures. Considering the peak load impacts of these differences, it would be good to consider the impacts associated with greater use of "best in class" equipment.

Recommendations and Considerations

We ask NSPI to further investigate the performance of heat pumps during peak load conditions.

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. PEAK DEMAND RESEARCH

The exploration of using interval data to understand peak at the class level should better inform future forecasts. The comparisons provided in Figure 73 of the forecast Report show modest differences for the residential coincident peak. This appears to be a useful path to explore to improve peak forecast accuracy.

⁶⁰ Forecast Report, pg. 40.

We appreciate ongoing efforts with the use of AMI and LRS (Licensed retail Supplier) data and await the results in future forecasts.

5. SENSITIVITY ANALYSIS

The forecast Report (in Section 10 and Appendix D) presents sensitivity analyses that help to understand potential future load variations:

- The energy load sensitivity considered weather and economic impact variations. In part they are chosen because they are easy to model and have a long history of reliable information. Inputs for DSM and end uses are being considered for the future.⁶¹

Detailed results are found in Appendix D and generally appear plausible, with temperature being the greatest near-term uncertainty and the economic uncertainty dominating by 2032.

- The peak load sensitivity also used a set of weather and economic drivers. As expected, the peak is most sensitive to the peak temperature and has a greater relative range than energy. However, the temperature at peak and the monthly HDD series are probably highly correlated. The economic and wind at peak components have very minimal impacts.
- Figure D8 shows additional potential impacts. Especially interesting is the E3 Hybrid Scenario that maintains non-electric backups for peak load times.

In general, the sensitivity analyses appear reasonable and provide some insight into the forecast uncertainty. However, we note that all of the sensitivities are basically statistical. It might be informative to also do some *what-if* analyses. This could look at policy options such as, for example, proactive utilization of TOU/CPP to attack peak increases.

Recommendations and Considerations

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.

⁶¹ Response to Synapse IR-32.

6. NSPI RESPONSE TO PREVIOUS SYNAPSE RECOMMENDATIONS

Our evidence from last year included several recommendations and NSPI has moved to address most of them. For the record, we have attached our recommendations and NSPI's replies in attachments to this report.

Most of the issues are addressed in NSPI's current Report although one has been deferred and another is ongoing (See Appendix B). We wish to acknowledge NSPI's responsiveness. While there are still some issues to consider, this forecast represents a further improvement over the previous one.



7. 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 (page 5).
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 12).
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 13).
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 14).
5. NSPI should include in its next load forecast more refined and empirically validated assumptions for any peak reduction benefit from solar generation (page 15).
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 15).
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 15)
8. Might there be overall benefits from expanding DSM programs in this sector? (page 16)
9. What is the potential for expanding on-site solar as much of the commercial load coincides with solar generation? (page 16)
10. What is the potential for expanding the RTR program? (page 19)
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 21)

12. We ask NSPI to explore the likelihood and impacts of greater industrial electrification levels (page 21).
13. We ask NSPI to explore the potential for greater industrial savings (page 22).
14. We ask NSPI to explore the impacts of real time rates (page 23).
15. We ask NSPI to explore the impacts of increases in industrial RTR (page 24).
16. We ask NSPI to further investigate the commercial and industrial electrification prospects after 2026 (page 25).
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 25).
18. We ask NSPI to explain why the future System Peak values do not equal the Firm Peak less the interruptible customers (page 25)
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 26).
20. We ask NSPI to further investigate the performance of heat pumps during peak load conditions (page 25).
21. We ask NSPI to further explore and evaluate the impacts of thermal storage, heat pump water heaters, and induction cooking technologies (page 25).
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 25).
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 26).

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 better explains the underlying factors driving the forecast.



Appendix A. ATTACHMENT 1 – SYNAPSE QUESTIONS AND RECOMMENDATIONS FROM THE 2022 EVIDENCE

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

- We ask NSPI to more fully investigate the peak load effects of heat pumps in future forecasts (p.11).
- We recommend consideration of heat pump-based hot water heating (p.11).
- We ask that NSPI provide updates on the water heating load control project in the next load forecast report, including estimates of the impact of hot water heater device control initiatives on system peak demand (p. 11).
- We ask that more complete results of the SGNS project regarding electric vehicle impacts be included in the next load forecast report. We also ask that NSPI investigate more fully the use of electric vehicle batteries, especially for peak management. (p.12).
- We ask that more complete results of the SGNS project regarding battery storage be included in the next load forecast report (p.12).
- We also raise a point about the appropriateness of the commercial electrification programs. We ask NSPI to provide further information about their relative benefits and costs (p.14).
- It is not clear in the report how much of the commercial and industrial demand savings presented in Figure 36 are contained in the industrial forecast. We ask NSPI to clarify the DSM effects for each sector (p.15).
- We'd like further explanation from NSPI about why the commercial and industrial adjustment varies so much from what was used last year (p.16).
- Electric vehicles are a substantial contributor to peak growth. We would like to see a more complete evaluation of the options to control this growth in the next forecast (p.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 (p.19).

- Please include explicitly the effects of the additional DR measures, including those after 2026, that are included in the IRP Action Plan in the next forecast (p.19).
- We ask NSPI to quantify how electric thermal storage could moderate the peak load (p.20).
- Water heating has potential for load control measures which NSPI should fully investigate to manage peak load growth (p.20).
- Induction cooking is a new technology that should be evaluated for its effects on energy and peak loads (p.20).
- We ask NSPI to evaluate commercial heat use more fully as to what is driving it and how the peak impacts could be moderated (p.20).
- We ask that NSPI review its peak forecasting methodology in light of these discrepancies and evaluate what factors (e.g., DSM, heat pumps, weather) account for the gap (p.20).
- We ask that NSPI provide a 2032 peak sensitivity analysis similar to what was done for energy in Appendix D (p.21).
- We ask that NSPI provide more information about the assumptions and the calculations behind the values in Figure D8 (p.21).
- 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 (p.21).

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

Appendix B. ATTACHMENT 2 – NSPI RESPONSES TO SYNAPSE IR-45 AND IR-46

Request IR-45:

General Forecast Report Improvements – The Board Decision of October 31, 2022 notes that NS Power agreed to the following changes in the 2023 forecast report (p 4):

In its Reply, NS Power addressed the concerns raised by the intervenors. NS Power agreed to include analysis of the impact of multi-hour temperature averages and windspeed on the peak in the next forecast. As well, it agreed to investigate multi-station weather for peak load forecasting and to review the methods for integrating weather data with stakeholders before filing the next forecast. NS Power will incorporate water heating load control and provide a peak sensitivity analysis in the 2023 report that is similar to the sensitivity analysis in Appendix D.

NS Power intends to refine the impact of electrification through examining existing measures and trends to achieve government electrification goals. It will investigate and include commercial and industrial electrification impacts after 2027. NS Power will evaluate the findings from the recent Itron Report on the impact of heat pumps. Information from the SGNS project and water heating load control will be incorporated in the next report. EV adoption rates will be updated in the forecast and more details on the EV high and low cases will be provided. NS Power will review how an ELCC adjustment could be applied to EV load shapes.

Changes to the DR estimates in the IRP Action Plan will be incorporated into the forecast. NS Power will consider hybrid scenarios where customers keep their existing non-electric heating as backup, through the 2022 IRP Evergreen process, as well as a scenario analysis for ETS to moderate peak load. It will monitor growth in heating load for commercial customers and work with EOne on possible firm peak mitigation strategies.

NS Power confirmed that the model used a COP of 2.3 at -15oC for new heat pumps. It clarified that an analysis removing lock-out temperature is in the IRP Action Plan. NS Power will continue consulting with EOne and other stakeholders on DR implementation. NS Power confirmed that about 15 percent of the commercial and industrial DSM effects are allocated to the industrial class and 85 percent are allocated to the commercial class. It also confirmed that the DSM coefficients vary each year and the change to the commercial and industrial adjustment is the result of underlying end-use data, particularly the commercial lighting efficiency and intensity.



NS Power's reply submission did not agree with a few of the intervenors' requests. NS Power does not consider the line loss determination model as a tool for load planning and said a report on this topic is not required. NS Power considers an ELCC factor is not needed for the Large Industrial Interruptible Rider (LIIR) because these customers do not contribute to peak demand needs; however, it will consider applying an ELCC adjustment to EV load shapes. A request for the information on the benefits and costs of commercial electrification programs was denied as NS Power has not performed such an analysis.

(a) Please indicate how this report incorporates each of these agreed changes.

Response IR-45:

Please refer to the following table:

Recommendations Agreed To	Status	Notes
Include analysis of the impact of multi-hour temperature averages and windspeed on the peak in the next forecast.	Included	Please refer to Section 4.2 at page 21.
Investigate multi-station weather for peak load forecasting and to review the methods for integrating weather data with stakeholders before filing the next forecast.	Included	Please refer to Section 4.2 at page 24.
Incorporate water heating load control and provide a peak sensitivity analysis in the 2023 report that is similar to the sensitivity analysis in Appendix D.	Included	Please refer to Section 10 at page 78.

Recommendations Agreed To	Status	Notes
Refine the impact of electrification through examining existing measures and trends to achieve government electrification goals.	Included	Please refer to the updated EV sales targets provided in Section 4.4 at page 38.
Investigate and include commercial and industrial electrification impacts after 2027.	Included	Please refer to Section 4.4 at page 50.
Evaluate the findings from the recent Itron Report on the impact of heat pumps.	Included	Please refer to Section 4.4 at page 36.
Information from the SGNS project and water heating load control will be incorporated in the next report.	Included	Please refer to Section 10 at page 78.
EV adoption rates will be updated in the forecast and more details on the EV high and low cases will be provided.	Included	Please refer to Section 4.4 at page 40.
Review how an ELCC adjustment could be applied to EV load shapes.	Deferred	Will be evaluated in a future capacity value study.
Changes to the DR estimates in the IRP Action Plan will be incorporated into the forecast.	Included	Please refer to Section 10 at page 77.

Recommendations Agreed To	Status	Notes
Consider hybrid scenarios where customers keep their existing non-electric heating as backup, through the 2022 IRP Evergreen process, as well as a scenario analysis for ETS to moderate peak load.	Included	The impact of a hybrid scenario is included in Appendix D page 8. NS Power incorporated three scenarios using a Hybrid Peak forecast in the evergreen IRP Final Modeling Results Release dated May 29, 2023; these scenarios are noted as using electrification forecast “E2”.
It will monitor growth in heating load for commercial customers and work with EOne on possible firm peak mitigation strategies.	Work ongoing	Please refer to Section 10 at page 79.

Request IR-46:

General Forecast Report Improvements – The Board Decision of October 31, 2022 Includes the following findings (pp 5-6):

The Board notes that NS Power has agreed to many of the intervenors' recommendations and acknowledges this commitment as a positive step toward continuous improvement of the Load Forecast. The Board directs NS Power to proceed with implementing the recommendations it has agreed to in the next Load Forecast report, including providing greater details and investigation of the impact to energy and peak from electrification as well as from new technologies, especially findings from pilot projects. Further, NS Power is directed to continue evaluating and implementing improvements to the calculation of weather-normalized values for energy and peak as recommended by intervenors.

The Board directs NS Power to evaluate the model's economic inputs, including the COVID-19 variable and the assumptions and calculations used to assess the impact of DSM, Solar PV, EVs, battery storage, and weather.

The Board acknowledges the intervenors' participation in examining changes to the Load Forecast. The Board directs NS Power to continue to actively engage with intervenors as well as other stakeholders and their consultants well in advance of filing its 2023 Load Forecast Report. As many of the recommendations made by intervenors are important to discuss in the initial stakeholder meeting, it is prudent that NS Power share how potential impacts were evaluated and what was incorporated into the forecast early in the process.

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

- **Examine the elasticity used in the SAE model to exclude elasticities calculated from non-winter peaking utilities or to apply elasticities from Canadian studies of Canadian electric utilities;**
- **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 in the province, re-evaluate the use of housing completions for the near-term;
- Given the current inflationary environment, evaluate the use of Median Household Income in place of Total Household Income, as it is biased by outliers. Should the Conference Board of Canada be unable to provide the Median, NS Power could use data published by Statistics Canada and apply the Conference Board of Canada's annual growth rate to estimate the long-term Median Household Income;
- Consider incorporating household size and age of household residents, to determine if a better understanding of demand on load by time of day is achieved.

(a) Please indicate how this report incorporates each of these directives.

Response IR-46:

Please refer to the table below.

Category	UARB Comments	Status	Notes
NSUARB Direction	The Board directs NS Power to proceed with implementing the recommendations it has agreed to in the next Load Forecast report, including providing greater details and investigation of the impact to energy and peak from electrification as well as from new technologies, especially findings from pilot projects.	Please refer to NSUARB IR-45.	Please refer to NSUARB IR-45.
	NS Power is directed to continue evaluating and implementing improvements to the calculation of weather-normalized values for energy and peak as recommended by intervenors.	Included	Weather normalized values are used for energy and peak throughout the 2023 Load Forecast report.
	The Board directs NS Power to evaluate the model's economic inputs, including the COVID-19 variable and the assumptions and calculations used to	Included	This is updated annually and found throughout the 2023 Load Forecast report.

Category	UARB Comments	Status	Notes
	assess the impact of DSM, Solar PV, EVs, battery storage, and weather.		
Conference on the future of the electricity system in advance of the release of the 2023 Load Forecast Report.	The Board directs NS Power to continue to actively engage with intervenors as well as other stakeholders and their consultants well in advance of filing its 2023 Load Forecast Report.	Completed.	NS Power held a stakeholder conference on March 31, well in advance of the submission of the 2023 Load Forecast Report.
Please refer to NSUARB IR-10	Examine the elasticity used in the SAE model to exclude elasticities calculated from non-winter peaking utilities or to apply elasticities from Canadian studies of Canadian electric utilities.		Please refer to NSUARB IR-10
	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 in the province, re-evaluate the use of housing completions for the near term;			
Given the current inflationary environment, evaluate the use of Median Household Income in place of Total Household Income, as it is biased by outliers. Should the Conference Board of Canada be unable to provide the Median Household Income, NS Power could use data published by Statistics Canada and apply the Conference Board of Canada's annual growth rate to estimate the long-term Median Household Income;			
	• Housing completions are still the best measure; please refer to Section 4.3 at page 28 and NSUARB IR-03		
	• Housing Completions – Re-evaluation considered. • Median Household Income – Included.		
	• Median Household Income is discussed in section 4.3 at page 27 • Household size and demographics will be investigated for a future forecast.		
Household metrics – Not included			
Revisit the short-term economic inputs provided by the Conference Board of Canada		Included.	These metrics are updated annually and included in the forecast.

Category	UARB Comments	Status	Notes
	Canada to ensure data are close to those used in the forecasts of Canada's major Banks.		the 2023 Load Forecast report.
	Revisit the model's EV adoption rates and examine EV rebates to ensure that the model is using data that is in line with the data reported by Statistics Canada and Nova Scotia Open data.	Please refer to NSUARB IR-07	Please refer to NSUARB IR-07
	With respect to the unresolved status of large infrastructure projects, NS Power is encouraged to maintain communications with those customers to ensure system adequacy.	Ongoing.	NS Power is in contact with those customers on a regular basis.