# Memorandum

TO: NOVA SCOTIA UTILITY AND REVIEW BOARD (NSUARB)

FROM: DAVID WHITE, JAMIE HALL

DATE: JULY 21, 2021

RE: EVIDENCE RE THE NSPI 2021 LOAD FORECAST (M10109)

## Introduction

Every year for many years Nova Scotia Power, Inc. (NSPI) has filed a load forecast report.[1] These reports have changed considerably over time. The *2021 Load Forecast Report* represents substantial improvements in an expository sense by providing additional information that was requested last year. Overall, the 2021 forecast values are similar to those of recent years.

We note that the final forecast results consist of two discrete elements. The first being the Statistically Adjusted End-Use (SAE) model forecast. The second being the Demand Side Management (DSM) adjustments in which the DSM program projections are reduced and subtracted from the SAE forecast values to produce the final forecast. We will discuss both of those elements in this testimony.

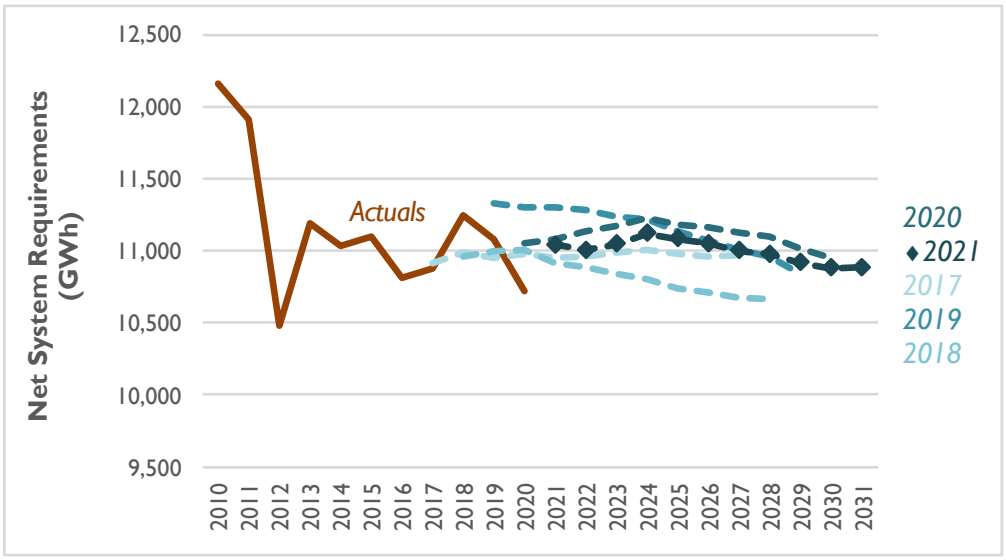
### Forecast Comparisons

First, we look at how this forecast compares with recent ones. Figure 1 below shows both the actual historical energy requirements and recent forecasts, including this one, that include DSM effects. Energy loads have declined substantially since 2010 as industries have closed in the province. Actual loads since 2013 have been relatively flat. Recent forecasts have predicted modest changes in future loads varying from -4.3 percent to +0.5 percent over their respective forecast periods. The current energy forecast has an overall decline of 1.4 percent. The increase up to 2024 appears to be associated with new industrial loads.[2]

[1] Nova Scotia Power, Inc. *2021 Load Forecast Report*, April 30, 2021.

[2] Id, page 7.

**Figure 1: Net system requirements**

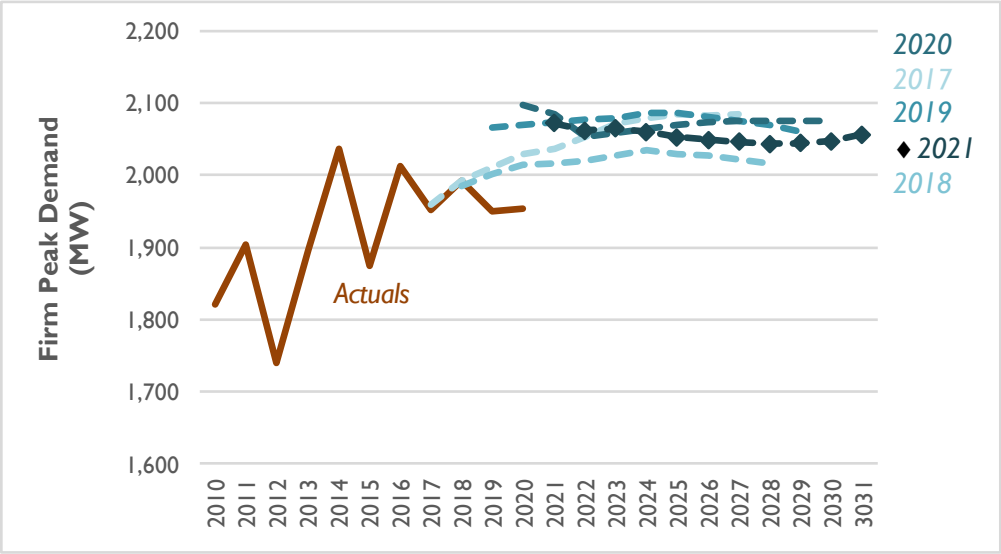



*Source: Synapse from NSPI Figure C1.*

The firm peak demand is shown in Figure 2. The historical trend here shows an increase instead of a decline. There is a drastic increase from the recent historical years (2018–2020) to 2021, the first forecast year, that seems incongruous. We note that the 2020 forecast exhibited a similar phenomenon. In part this appears to be related to weather normalization of the peak load, which we will discuss later.

The 2021 peak forecast shows a decrease of 0.8 percent over its forecast period (2021–2031), whereas the previous three forecasts showed changes ranging from +1.6 to -1.1 percent. The system peak for 2030 of 2,047 MW is a little below the equivalent 2,076 MW peak of the 2020 forecast. Overall the recent forecasts are much the same.

Figure 2: Firm peak demand




*Source: Synapse from NSPI Figure C3.*

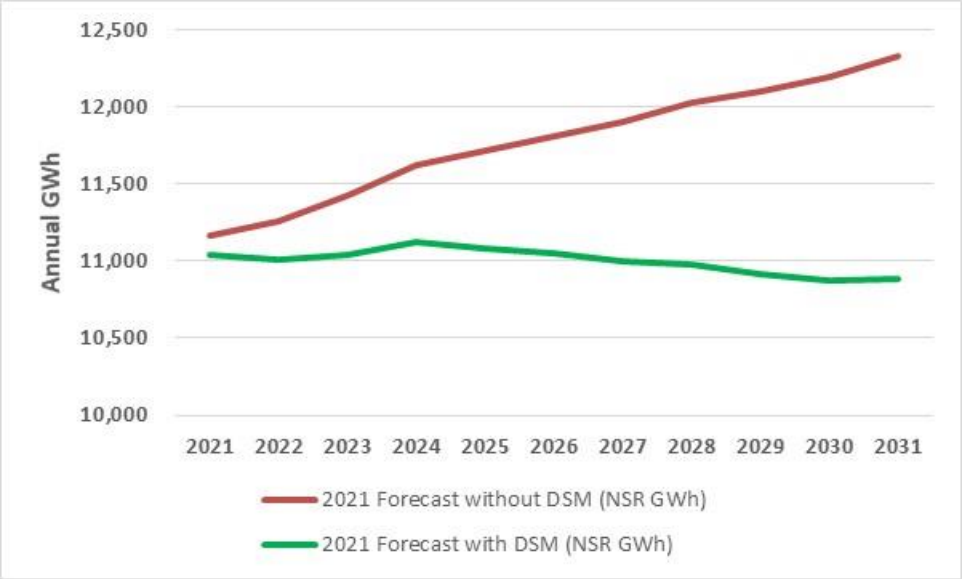
## DSM Overview

In previous forecast reports, NSPI provided energy and peak loads with and without DSM effects in Appendix A. This current report does not provide the loads before the DSM adjustments which makes it much more difficult to track the effects of DSM by sector and by year. However, the company provided the information to us in its response. We understand that this change in the report is based on feedback received on the 2019 load forecast.[3] Note also that Figure 24 of the current report does provide the DSM savings that are used in the forecast.

The following figure compares the total energy forecast (without DSM) for the current report. The overall change of the current forecast is -1.4 percent with DSM. Without DSM the increase would be 10.5 percent. These results are consistent with the previous forecast report. Overall, DSM is playing a major role in producing the flat energy forecast.

[3] Id, page 42.

Figure 3: Energy forecast comparison with and without DSM

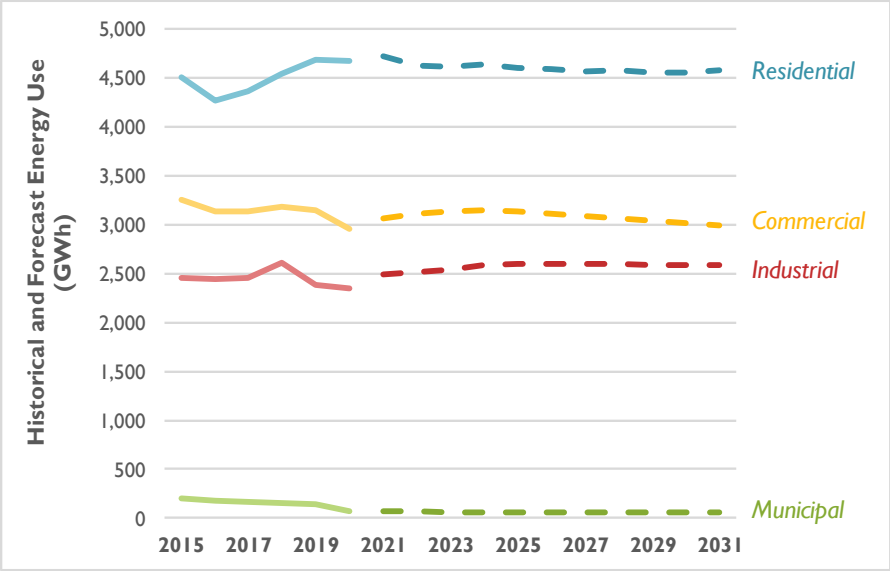



*Source: Synapse from NSPI load forecast filings—using DSM savings from Figure 24.*

## Sector Overview

The following figure shows the historical and forecast energy use by sector. Overall, the residential load (representing around 40 percent of the total load) is flat, the commercial load is slightly declining, and the industrial load is slightly increasing.

Figure 4: Energy historical and forecast by sector



*Source: Synapse from NSPI load forecast filings—based on Table A1 of the load forecast report. Dashed lines represent historical values and solid lines represent forecasted values.*

The following table summarizes the forecast components by sector. The residential sector is the largest one and has a decline after DSM. The industrial sector represents only about one-quarter of the load but has a slightly positive growth rate. Municipal customers are a small declining component of the total. Overall losses can be attributed on a roughly proportional basis to the other loads.

**Table 1: Sector energy forecasts after DSM**

| | | 2021-2031 Change |
|---|---|---|
| Sector | 2020 Fraction | With DSM |
| Residential | 44% | -2.9% |
| Commercial | 28% | -2.6% |
| Industrial | 22% | 3.9% |
| Municipal | 1% | -16.7% |
| Losses | 6% | -4.7% |
| **Total** | **100%** | -1.5% |

*Source: Synapse from NSPI load forecast report.*

In general, the forecast appears reasonable. Nevertheless, there are several aspects identified below in our review that should be investigated further, especially regarding load growth drivers. However, the forecast is consistent with current trends and other forecasts such as those for New England. We also note that, historically, energy and peak loads have declined substantially since 2008. Loads reached a low point in 2012, rose in 2014, and since then have remained fairly level with only modest variations. The current pandemic has produced a reduction in electricity consumption which may have effects on future loads as well.

We will look at specific forecast components to note where there are still 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?

## Recommendations from the Previous Forecast Review

The Synapse Evidence regarding the 2020 forecast and the resulting Board Order list several recommendations for improving the forecast.[4]

[4] Page 20 of the Synapse 2020 Evidence.

For the 2021 forecast we recommend:

- Prior to developing a new forecast have a formal stakeholders' meeting with an agenda and advance materials discussing the issues and any planned forecast changes or enhancements. Discuss specifically the issues raised in the most recent Board order.
- Consider both the near-term and long-term effects of the COVID-19 on future electricity sales, fossil fuel prices, DSM programs, new construction, and retrofits.
- Consider more fully technologies to control peak space heating and water heating loads.
- Include more information and learnings from the Smart Grid Nova Scotia program.
- Consider the possible impact of customer battery storage in conjunction with solar.
- Consider the use of electric vehicle battery storage.

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.

# Energy Forecast

In Table 1, 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.

### Major Inputs

In addition to end-use technology changes and numbers of customers, the forecast is also influenced by several economic and environmental drivers. The economic and employment data is from latest Conference Board of Canada's economic outlook. The residential model uses retail sales (RRTS) and household income (RPDI) variables, weighted at 85/15. In previous years, a 50/50 weighting was used but series diverged in 2020 because of the pandemic; a different weighting had better statistics and was determined to be more appropriate. The two drivers chosen are similar in their trends and the current weighting appears to be appropriate, but the choice of the drivers[5] and their weighting should be reevaluated in future forecasts. New housing completions were used for new customer growth. These choices seem reasonable for this forecast but should be reviewed every year.

The statistical model introduced a binary variable to represent the effects of COVID-19. That variable was given a value of 1.0 for 2020. It was reduced by 25 percent in 2021 and then a further 50 percent in 2022 and beyond. The future values chosen for that variable appear somewhat arbitrary. Although that is understandable at the present time, the COVID-19 variable should be reevaluated going forward.

For the non-residential models, non-manufacturing gross domestic product and non-manufacturing employment continued to be used. In the industrial sector, gross domestic product and manufacturing employment were used. 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 Conference Board forecast is a reasonable choice given the need for general consistency within Canada as a whole. It would be good if there were another widely available forecast that could be used for comparison, but asking NSPI to develop an independent forecast does not seem practicable. We note however the inherent uncertainty of all economic forecasts and also that the future may diverge significantly from the forecast.

In this forecast, more consideration was given 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. These trends are then incorporated 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.

[5] Another possibility to consider is median income. However, all of the likely choices have similar future trends.

## Residential Sector

The residential sector represents about 44 percent of the total load. The residential forecast including DSM effects (as shown in Table 1) decreases by 2.9 percent over the forecast period. Although not specifically stated in the forecast report, our rough calculations indicate that residential energy loads would have increased by about 11 percent without DSM programs.[6]

The continued use of the economic drivers of retail sales and household income with a 50/50 weighting is a reasonable approach.

The residential forecast is based on a statistically adjusted end-use (SAE) model designed to capture the nature of the sector's uses. We are pleased to see that the key future load drivers (heat pumps, water heaters, electric vehicles, and PV generation) are discussed separately and explicitly in the report.

### *Heat pumps*

The heat pump section of the report discusses replacement of both fossil and electric resistance heating by heat pumps in existing buildings (new customers are handled separately).[7] The report indicates that based on a 2019 survey 36 percent of customers use heat pumps for cooling, 33 percent use heat pumps for some heating, and 19 percent identify heat pumps as their primary source of heat. This implies that 3 percent of customers use heat pumps only for cooling, 14 percent for some heating, and 19 percent as the primary heating source. Going forward, about 16,000 heat pump installations are expected per year in the near term. The prediction is that roughly 65 percent of these are for non-electric heating customers and roughly 35 percent for electric heating customers. What needs further clarification is the mode of these new heat pump installations. For example, how many are the sole heating source or whether some existing fossil heating systems remain in place. Replacing fossil heating increases the electrical loads, while replacing resistance heating reduces it.

The report does not specify the net effect of the residential heat pump transition with other effects such as EV and Solar on Figure 28 of the report. Those effects appear to be folded into the regression model values, which show a slight decline. The Residential XHeat table on page 7 of Appendix B appears to indicate that the increase in heat pump consumption is offset by the reduction in resistance heating.

The report states that heating shows a slight decline in its peak contribution over the study period.[8] That does not seem entirely intuitive as conversion from fossil fuels to heat pumps would be expected to increase the peak load. The report states that this will be investigated further as part of the ongoing heat pump monitoring project.

[6] Based on information in the LFR Attachment 04 10 year Forecast Classes response.

[7] Load Forecast Report, pp.32-33.

[8] Id, Figure 50 p. 79.

We ask NSPI to provide additional currently available information and to address this more fully in the next report.

***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.[9] Based on Figure 14, the electric water heater saturation will increase from 68 to 81 percent, which implies that about 40 percent of the current non-electric water heating customers will convert to electric water heaters by 2031. The overall saturation and increase are greater than presented in the 2020 report. This is a fairly substantial increase and should be carefully monitored as this is a large energy and peak load growth driver.

The net effects are not given in the report. However, inspecting the XOTHER table on page 8 in Appendix B seems to indicate a 3.6 percent increase in water heating usage.

We ask NSPI to confirm the net water heating increase. We also recommend further consideration of heat pump-based hot water heating.

NSPI notes that a pilot project is being finalized with E1 to investigate demand response for water heaters.

We ask that NSPI provide updates on the water heating load control project in the 2022 load forecast report, including estimates of the impact of hot water heater device control initiatives on system peak demand.[10]

***Electric vehicles***

Electric vehicles represent another growth area, but with a great deal of uncertainty. This forecast has electric vehicles making up 9 percent of the vehicle stock (~58,000) vehicles by 2031. That would represent an energy load of about 195 GWh and peak load impacts ranging from 39 to 83 MW.[11] That represents a 1.8 percent increase in energy load and a 2 to 4 percent increase in the 2031 peak load.[12]

Time of charging is also an important peak load issue, and programs need to be implemented to reduce on-peak charging as the electric vehicle penetration increases. NSPI notes that its Smart Grid Nova

[9] Id, pp. 33-34

[10] Demand Response is discussed further in section 10,0 of the forecast report and will be commented on later.

[11] Id, Figure 16.

[12] Id, Figure 47.

Scotia (SGNS) Project is testing options for direct utility control of charging, to shift electric vehicle charging to off-peak times.[13]

We ask that preliminary results of the SGNS project be included in the next load forecast report.

***Solar generation***

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 dramatically over the forecast period. Because of the timing of the system peak, NSPI predicts no effect for the future peak load but predicts a net reduction of 183 GWh (2.4 percent) in the combined residential and commercial energy load.[14] This forecast does not consider any significant battery storage that could modify the peak loads. The effects on the load requirements are modest but should be monitored.

***Solar-plus-battery***

The report discusses solar/battery storage combinations but does not expect them to have much effect on future loads.[15] However, some possible impacts based on preliminary results from the SGNS project are presented in Figure 18. 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 plant investments.

***New customers***

The final piece of the residential forecast are the new customers discussed in Section 5.0. This is based on new residential sales which are expected to stay constant at about 4,500 per year. Overall, new customers represent the greatest source of the residential load increase and are expected to add 253 GWh (5.5 percent) to the 2031 residential load.[16]

The heat pump and hot water end-uses are integrated into the intensity calculations and regression model results rather than being treated separately. However, Figure 29 of the report does provide some illustrative contributions. Heat pump heating load increases by 267 GWh while baseboard heating load decreases by 241 GWh. Thus, they are roughly equivalent. However, heat pumps displace some fossil fuel heating and thus there are savings there.

We find the reconciliation of the residential model changes on pages 6-7 of Appendix B to be very helpful in understanding the forecast model behavior. Especially interesting is the 0.3 percent decrease

[13] Id, p. 36

[14] Id, pp. 37-39.

[15] Id, pp. 39-41.

[16] Id, Figure 28.

in the load associated with existing customers but a 4.5 percent increase associated with new customers.

The current SAE model formulations appear reasonable, but the choice of the key drivers should be reevaluated for each forecast.

## Commercial Sector

The commercial sector represents 28 percent of the customer load. The commercial forecast (as shown in Table 1 above) decreases by 2.6 percent over the forecast period. In the 2020 forecast, it decreased by 4.2 percent. In the 2019 forecast, the decrease was 11.9 percent.

The commercial sector actually consists of three subsectors: Small General Service, General Service, and Large General Service. In 2020, the Small General Service group represented 9 percent of the commercial load, the General Service group represented 76 percent, and the Large General Service group represented 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 Appendix B and found them satisfactory. The current report has also provided specifics of the various factors affecting the changes in sales, which we replicate below. The total change between 2021 and 2031 is a decrease of 5 percent. As indicated, the vast majority of this is from DSM programs.

We also raise a point about the appropriateness of the electrification programs. We ask NSPI to provide further information about their relative benefits and costs.

**Table 2: General demand sales drivers from 2021 to 2031**

| Category | 2031 Change |
|---|---|
| Average Model Use Contributions | +0.3% |
| Electrification | +2.6% |
| Solar | -0.7% |
| DSM[17] | -7.2% |
| Total Change | -5.0% |

*Source: Load Forecast Report, Appendix B p. 18.*

We also found the comparisons of the 2031 versus the 2021 regression values for the Small General Service sector on page 13 of Appendix B helpful in understanding the forecast model behavior.

NSPI states that the COVID-19 pandemic had some impact on commercial sales, but they are expected to rebound in 2021 and 2022. [18] This will need to be reevaluated and updated in the next forecast.

[17] 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.

[18] We calculate this to be roughly 200 GWh on 2020 sales, or about 7 percent.

## Industrial Sector

The industrial sector represents 22 percent of the customer load. The industrial forecast (shown in Table 1) increases by 3.9 percent over the forecast period. In the 2020 forecast, this was 5.4 percent. In the 2019 forecast, the increase was 4.5 percent. 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. 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. The Medium sector is expected to grow at 0.2 percent annually driven by economic activity. The Large (also called Other) category represents about 70 percent of the industrial load and has an annual 0.4 percent rate of increase. The change in this category is based on customer surveys and new customer inquiries. Thus, the methodology is different than for the other sectors and should be considered as an informed estimate rather than a calculation.

We note too that the survey of the Large General Service customers appears to have achieved a good coverage for this report, with 25 responses to the survey. NSPI also indicates that several expansion projects and new customers are likely to occur in the next several years. That is the primary reason for the overall increase in the energy sales up to 2024.

This forecast assumes the continuation of Port Hawkesbury Paper (PHP) load throughout the forecast period. Major changes in the operation, or even closure, of that plant represent a major uncertainty in the industrial load.

As with the commercial sector, the pandemic has had an impact on the industrial sector in that the 2019 and 2020 loads are a roughly 200 GWh (7.6 percent) below those of 2018. The current forecast predicts a recovery, but the loads are slightly below the previous one.

**Table3: Industrial loads with DSM (GWh)**

| Category | 2021 | Fraction | 2031 | Change | % Change |
|---|---|---|---|---|---|
| Small | 261 | 10% | 276 | 15 | 5.9% |
| Medium | 476 | 19% | 486 | 11 | 2.3% |
| Large | 1,751 | 70% | 1,823 | 72 | 4.1% |
| **Total** | **2,487** | **100%** | **2,585** | **98** | **3.9%** |

*Source: Synapse IR-1 response, Figures 35 - 38 and Table A1 from the forecast report.*

It is not clear in the report how much of the commercial and industrial demand savings presented in Figure 24 are contained in the industrial forecast. We ask NSPI to clarify this.

## Municipal Sector

The municipal sector represents a declining 1 percent of the customer load. Six municipal electric utilities have purchased power from NSPI and include residential, commercial, and industrial users. Four of these utilities have elected to provide 100 percent of their energy from other sources. This is the cause of the drop in municipal sales from 146 GWh in 2019 to 75 GWh in 2020. NSPI continues to provide backup power, so their needs are included in the peak load requirements. The remaining municipal utilities energy needs are expected to be supplied by NSPI throughout the forecast period.

## Energy Forecast and DSM Effects

NSPI makes exogenous adjustments to its SAE model results to reflect the impacts of DSM programs. Previous reports presented the SAE model results before the DSM adjustments.[19] However, this report no longer presents that "before" information. We understand that this information was removed based on feedback to avoid confusion.[20] However, its absence makes it harder to analyze specific DSM impacts.

Future DSM savings used in this forecast are presented in Figure 24 of the report. The forecast total annual DSM savings correspond to about 1.6 percent of the residential plus commercial load. The DSM adjustments to the SAE forecast are about half as much as the full DSM savings. This is because the SAE model already includes the effects of some of those savings in its statistical equations that are based on historical data and trends.

The approach used by NSPI and its consultant (Itron) is to perform a regression analysis of the historical sales data using an EESavings variable for the past reported savings. For the residential sales, the coefficient for that variable was calculated to be -0.587, meaning that 41.3 percent of the DSM savings are already included in the regression. Thus, the SAE residential load forecast adjustment should only be 58.7 percent of the forecast DSM savings.

A similar calculation was carried out for the combined commercial and industrial classes. Although those sectors are very different, this is a reasonable approach given the available data. Compared to the residential calculations, the savings variable coefficient for this regression came out at -0.437. This implies that about 56 percent of the savings are included in the SAE results and only an additional 43.7 percent adjustment should be made.

The adjustments discussed in the forecast report appear reasonable to us.[21] Since these factors are statistically derived, the values could vary by +/- 10 percent, but this should be considered as yet another uncertainty in the forecast.

[19] Tables A2 and A4 in the 2019 report.

[20] 2020 Report, page 42.

[21] Ib, pp. 40-41.

Overall, we feel that this type of approach and the proposed magnitudes of the adjustments are appropriate for this forecast.

However, 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.

## Peak Forecast

As shown in Figures 2 and 3 of the load forecast report, the system peak (including DSM effects) is almost the same in 2031 as in 2021, with an increase of 0.2 percent per year. In the 2019, forecast there was essentially no increase. The 2021 energy forecast by contrast declines at a rate of 0.1 percent over the same period. The difference is related to a shift in the load components, with the greatest one being the relative increases in heating loads that contribute more to the winter peaks.

If one looks at the firm peak historical and forecast values in Figure 46 of the report, one is immediately struck by the apparently anomalous jump of about 150 MW (8 percent) from the historical to the forecast values. But in Figure 46, which shows the firm weather normalized historical peaks, the differences are much less pronounced. This raises the issue of what the design day temperature should be going forward in an era of global warming.

The HDD and CDD values have been adjusted for the energy forecast; perhaps the design day temperature should be as well. This is an issue that has come up in other locations and we recommend that NSPI devote more attention to this matter in future load forecasts.

The firm contribution to peak declines from 2,073 MW in 2021 to 2,057 in 2031, representing net effects of energy efficiency and DSM. Demand response also reduces net system peak over the forecast period from a net zero in 2021 to 32 MW in 2031.

The interruptible load going forward is projected to increase from 111 MW in 2019 to 155 MW in 2021 to 168 MW in 2031, representing primarily large industrial customers. Any variations from that will affect the system peak.

Figure 47 in the report (reproduced below) shows the effects of various components on the future peak load. Note that the reductions from DR and DSM essentially offset the increases from large customers and electrification. An important factor in controlling the peak load are electric vehicle mitigation measures which have yet to be implemented.

**Table 4: Peak contribution components**

| | Modeled Peak (MW) | EV (MW) | DR (MW) | C&I Elect. (MW) | Large Cust. (MW) | DSM (MW) | Firm Peak (MW) | Inter. Cust. (MW) | System Peak (MW) |
|---|---|---|---|---|---|---|---|---|---|
| 2021 | 1,985 | 0 | - | 5 | 103 | -18 | 2075 | 155 | 2,230 |
| 2031 | 2,082 | 46 | -37 | 21 | 108 | -162 | 2057 | 168 | 2,263 |
| 2031 (no EV mitigation) | 2,082 | 89 | -37 | 21 | 108 | -162 | 2100 | 168 | 2,306 |

*Source: Figure 47 of the Load Forecast Report.*

The end-use contributions to the peak shares are shown in Figure 50 for the residential sector and in Figure 51 for the commercial sector. These are very useful for understanding the forecast. NSPI provided the data behind these figures in its response to Synapse IR-28, which revealed some interesting results.

We looked at the peak changes associated with the various end-uses. We believe that these numbers represent mostly the Modeling category above.

We ask NSPI to clarify how the Peak DSM effects are calculated and how they are incorporated in the final forecast.

For the Residential sector, water heat has the second largest increase and basically represents the replacement of fossil water heaters with electric ones. The largest increase is for electric vehicles. Both of those categories have potential for load control measures which should be implemented to manage peak load growth.

**Table 5: Residential peak contributions by end-use category (MW)**

| End Use | 2021 | 2031 | Change | % of Change |
|---|---|---|---|---|
| Heat | 823.2 | 837.1 | 13.9 | 49.8% |
| WaterHt | 130.2 | 168.5 | 38.3 | 19.1% |
| Cooking | 97.1 | 111.4 | 14.2 | 4.7% |
| Misc | 67.7 | 87.3 | 19.6 | 10.5% |
| Lighting | 65.2 | 46.5 | -18.6 | -17.8% |
| TV | 37.7 | 39.9 | 2.2 | -1.4% |
| Dryer | 66.6 | 77.0 | 10.4 | 3.7% |
| Refrig | 24.8 | 25.0 | 0.2 | -1.1% |
| Freezer | 13.5 | 13.9 | 0.4 | -0.4% |
| Dish | 2.5 | 2.8 | 0.3 | 0.1% |
| Washer | 3.3 | 3.9 | 0.6 | 0.2% |
| EV | 0.3 | 39.4 | 39.1 | 32.6% |
| **Total** | 1,332 | 1,453 | 121 | 100% |

*Source: Synapse from NSPI load forecast responses.*

For the Commercial sector, the Heat end-use showed the greatest increase, likely representing the replacement of fossil fuels with electric heat pumps. The Miscellaneous category shows the second greatest increase but is offset by reductions in lighting.

Table 6: Commercial peak contributions by end-use category (MW)

| End Use | 2020 | 2030 | Change | % of Change |
|---|---|---|---|---|
| Heat | 153.7 | 192.2 | 38.5 | 119.9% |
| Misc | 100.8 | 120.2 | 19.5 | 60.7% |
| Light | 159.5 | 137.9 | -21.6 | -67.1% |
| Vent | 30.2 | 26.4 | -3.8 | -11.9% |
| Refrig | 49.8 | 50.5 | 0.7 | 2.1% |
| Office | 24.8 | 23.7 | -1.0 | -3.3% |
| EWHeat | 5.1 | 4.8 | -0.3 | -1.0% |
| Cooking | 9.8 | 10.0 | 0.2 | 0.6% |
| **Total** | **534** | **566** | **32.1** | **100.0%** |

*Source: Synapse from NSPI load forecast responses.*

Overall, the peak forecast seems plausible, although it starts above recent historical levels. There should be more discussion of the underlying factors causing peak growth (and decline).

We acknowledge NSPI's exploration of peak load mitigation possibilities. We also note that further refinements of the peak forecast methodology to use class-specific information are underway. We look forward to seeing future refinements of the peak model in future reports.

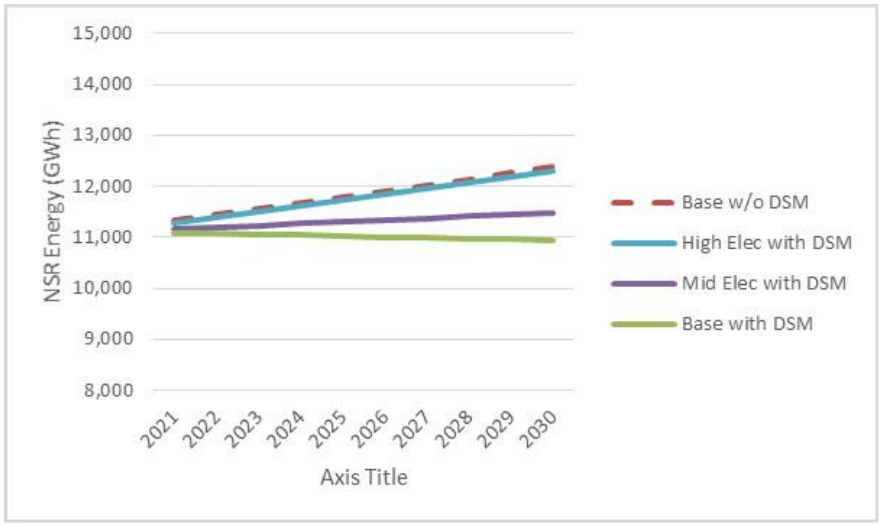
## Sensitivity Analysis

The forecast report (in Section 10 and Appendix D) presents sensitivity analyses that help understand potential future load variations. The peak load analysis includes (1) peak period temperature, (2) monthly HDD and (3) economic drivers. The analysis shows a 50 percent certainty band of roughly 150 MW, or about ±3.2 percent of the peak load. The 90 percent certainty band is a little over 400 MW, or about ±8.5 percent of the peak load. Historically, from 2004 to 2020 the average peak has been 2,091 MW with a standard deviation of 79 MW (±3.8 percent) which is roughly consistent with the sensitivity analysis.

The largest sensitivities are associated with DSM and a possible change in industrial load. We note that historically the load decreased dramatically with the closure of some industries. We are not sure how much uncertainty there really is with DSM. The province is committed to a substantial level of DSM going forward so that is unlikely to decrease. However, there is the possibility of increased DSM as represented by the mid DSM case with an additional 290 GWh of savings (a 20 percent increase) above the base case. Another significant uncertainty is the electric vehicle load growth and how it is managed.

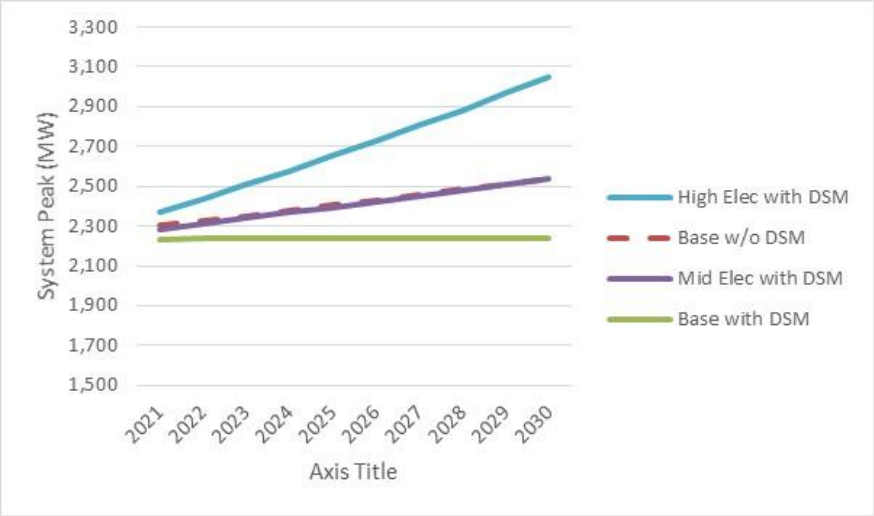
Another view of the uncertainty is represented by the scenarios considered in the 2020 IRP. The following figures show the 2020 energy and peak forecasts, with and without DSM, as well as the IRP Mid and High electrification scenarios. There are two key points to make here. The first is that the effect of DSM is to produce a fairly flat energy and peak trajectories for the Base forecast. The second is that, with increased electrification, the energy and peak loads increase substantially. For the High Electrification case, energy loads increase by 9 percent and peak loads by 29 percent over the 2021–2030 period. This represents a considerable uncertainty regarding future loads based on policy decisions.

**Figure 5: 2020 energy forecasts with and without DSM, and with electrification**




*Source: Synapse from NSPI load forecast filings—based on Figure 41 of the 2020 load forecast report. Values interpolated between 2021 and 2030.*

**Figure 6: 2020 peak forecasts with and without DSM, and with electrification**




*Source: Synapse from NSPI load forecast filings—based on Figure 41 of the 2020 load forecast report.*

## NSPI Response to Previous Synapse Recommendations

Our report from last year included several recommendations and NSPI has moved to address most of them. For the record, we have attached NSPI's replies to Synapse IR-41 and acknowledge its responsiveness. While there are still some issues to consider, this forecast represents a further improvement over the previous one.

In our 2020 report we made some recommendations that were included in the Board decision.

> General Modeling Improvements – The Board decision of October 2020 makes reference to several stakeholder recommendations on page 5:
>
> - Harmonizing efforts with EOne.
> - Prior to developing a new forecast, have a formal stakeholder meeting with an agenda and advance materials discussing the issues and any planned forecast changes or enhancements. Discuss specifically the issues raised in the most recent Board Order.
> - Consider both the near-term and long-term effects of COVID-19 on future electricity sales, fossil fuel prices, DSM programs, new construction, and retrofits.
> - Provide a more detailed explanation of the end-use contributions to the increases in peak load.
> - Incorporate Class level date from AMI once available.
> - Incorporate savings related to time varying rates in future forecasts.
> - Incorporate additional sources for electric vehicle forecasts for 2021 to improve the breadth of information relied upon.
> - Track and forecast expectations surrounding business electrification efforts.

We found NSPI to be responsive to these recommendations and are attaching the NSPI responses to Synapse IR-41, IR-42, and IR-43 to this report.

## Questions

We ask further clarification on the following matters as discussed above in our review:

- We ask NSPI to confirm the net water heating increase. We also recommend further consideration of heat pump-based hot water heating. (p.8)
- We ask that NSPI provide updates on the water heating load control project in the 2022 load forecast report, including estimates of the impact of hot water heater device control initiatives on system peak demand. (p.9)
- We ask NSPI to provide further information about the appropriateness of the electrification programs by providing information on their relative benefits and costs. (p.11)

- We ask NSPI to clarify how much of the commercial and industrial demand savings presented in Figure 24 of the report are contained in the industrial forecast. (p.12)
- We ask NSPI to provide more information about how the peak DSM effects are calculated and how they are incorporated in the final forecast. (p.16)

## Recommendations

- Prior to developing a new forecast, have a formal stakeholders' meeting with an agenda and advance materials discussing the issues and any planned forecast changes or enhancements. Discuss specifically the issues raised in the most recent Board order.
- Explore more fully technologies to control peak space heating and water heating loads.
- Explore whether battery storage and solar/battery storage combinations could modify the peak loads. (p.9)
- We ask that NSPI provide updates on the water heating load control project in the 2022 load forecast report, including estimates of the impact of hot water heater device control initiatives on system peak demand. (p.9)
- We ask that preliminary results of the SGNS project be included in the next load forecast report. (p.9) We ask that the next load forecast include more information and learnings from the Smart Grid Nova Scotia program.
- We ask that COVID-19 pandemic impacts on commercial sales be reevaluated and updated in the next forecast. (p.11)
- We ask NSPI to monitor DSM program savings and, if they increase above historical levels, then we ask NSPI to consider adjusting upwards the adjustment factors it makes to its SAE model to reflect greater levels of future savings. (p.14)
- We ask NSPI to consider the issue of what the design day temperature should be going forward in an era of global warming. This is an issue that has come up in other locations and we recommend that NSPI devote more attention to this matter in future load forecasts. (p.15)

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.

**Attachment 1 – NSPI Response to Synapse IR-41**

**Request IR-41:**

**General Modeling Improvements – The Board decision of October 2020 makes reference to several stakeholder recommendations (p 5):**

- **Harmonizing efforts with EOne.**
- **Prior to developing a new forecast, have a formal stakeholder meeting with an agenda and advance materials discussing the issues and any planned forecast changes or enhancements. Discuss specifically the issues raised in the most recent Board Order.**
- **Consider both the near-term and long-term effects of COVID-19 on future electricity sales, fossil fuel prices, DSM programs, new construction, and retrofits.**
- **Provide a more detailed explanation of the end-use contributions to the increases in peak load.**
- **Incorporate Class level date from AMI once available.**
- **Incorporate savings related to time varying rates in future forecasts.**
- **Incorporate additional sources for electric vehicle forecasts for 2021 to improve the breadth of information relied upon.**
- **Track and forecast expectations surrounding business electrification efforts.**

**(a) Please indicate how this forecast responds, or does not respond, to each of these recommendations.**

**(b) Please indicate how future reports will incorporate these recommendations.**

Response IR-41:

(a) Please refer to footnotes 3 to 10 inclusive on pages 10-11 of the Report for where each of these recommendations is addressed in the Report.

(b) Efforts to improve the forecast are continuous; as new information becomes available it is evaluated for the potential to improve the forecast.

NS Power continues to work with stakeholders and to hold stakeholder meetings and will continue to report on them in future reports.

The impact of COVID-19 on the Load Forecast will continue to be monitored and addressed as appropriate in future reports.

With respect to incorporating data arising from AMI meters or time-varying rates, NS Power will include the data as it becomes available.

The sources for EV information used in the 2021 report will continue to be used in future reports and updated as appropriate.

NS Power continues to monitor and track its business electrification efforts, and future reports will reflect this.

**Attachment 2 – NSPI Response to Synapse IR-42**

**Request IR-42:**

**General Modeling Recommendations – The Board decision of October 2020 makes several requests to NSPI (p 5):**

- **More fully consider technologies to control peak space heating and water heating loads.**
- **Include more information and learnings from the Smart Grid Nova Scotia Program.**
- **Consider the possible impact of customer battery storage in conjunction with solar and the use of electric vehicle battery storage.**
- **Provide a more detailed explanation of the end-use contributions to the increases in peak load.**

**(a) Please indicate how this forecast responds, or does not respond, to each of these requests.**

**(b) Please indicate how future reports will incorporate these requests.**

Response IR-42:

(a) Please refer to footnotes 11 to 14 inclusive on pages 11-12 of the Report for where each of these items addressed in the Report.

(b) NS Power is continuing to track the items requested by the NSUARB in the October 2020 directive, and will report on each item in future forecast reports as appropriate and as information becomes available (i.e. emerging technologies, Smart Grid Nova Scotia learnings, and impact of distributed energy resources).

**Attachment 3 – NSPI Response to Synapse IR-43**

**Request IR-43:**

**General Modeling Improvements – The Board decision of October 2020 notes some instances where NS Power did note fully respond to information requests (pp 5-6):**

- **Detail associated with the gross and net effects of heat pumps, water heaters and DSM on the forecast. It appears these elements are significant to the forecast yet are no longer provided in a transparent manner.**
- **Provide before-DSM tables as done in previous reports to enable better tracking of the DSM adjustments. Including these before DSM tables would make comparison between forecasts easier and provide more quantitative details about the DSM effects.**
- **Sensitivity of the load and peak to the one-year peak spike that has been forecast but not realized in each of the past three years.**
- **Provide the comparable 2020 data for the above in addition to 2021 to assist with analyzing impacts.**

**(a) Please indicate how this forecast responds, or does not respond, to each of these directions.**

**(b) Please indicate how future reports will incorporate these directions.**

Response IR-43:

(a) Please refer to footnotes 15 to 18 inclusive on page 12 of the Report for where each of these directions is addressed in the Report.

(b) With heat pumps and water heaters included in the underlying SAE model rather than as adjustments outside the model, the overall regression model is better able to capture historic trends, but at the expense of being able to provide the direct impact of these items.

NS Power has provided estimates of the impact of these items in Figures 13, 14 and 29 and will continue to do so.

As noted in the Load Forecast Report and as discussed with stakeholders, it is not possible to remove the effect of DSM from the forecast. The load and forecast reflect existing and previous effects of DSM (both programmed and naturally-occurring), so it is no longer possible to determine what a "no-DSM" load would look like. The Load Forecast reports will continue to address the impact of DSM as applicable.

NS Power will continue to address the other items referred to in future Load Forecast reports as appropriate and as the information is available.