REDACTED

Memorandum

TO: NOVA SCOTIA UTILITY AND REVIEW BOARD

FROM: DAVID WHITE

DATE: AUGUST 16, 2017

RE: EVIDENCE RE THE NSPI 2017 LOAD FORECAST (M08087)

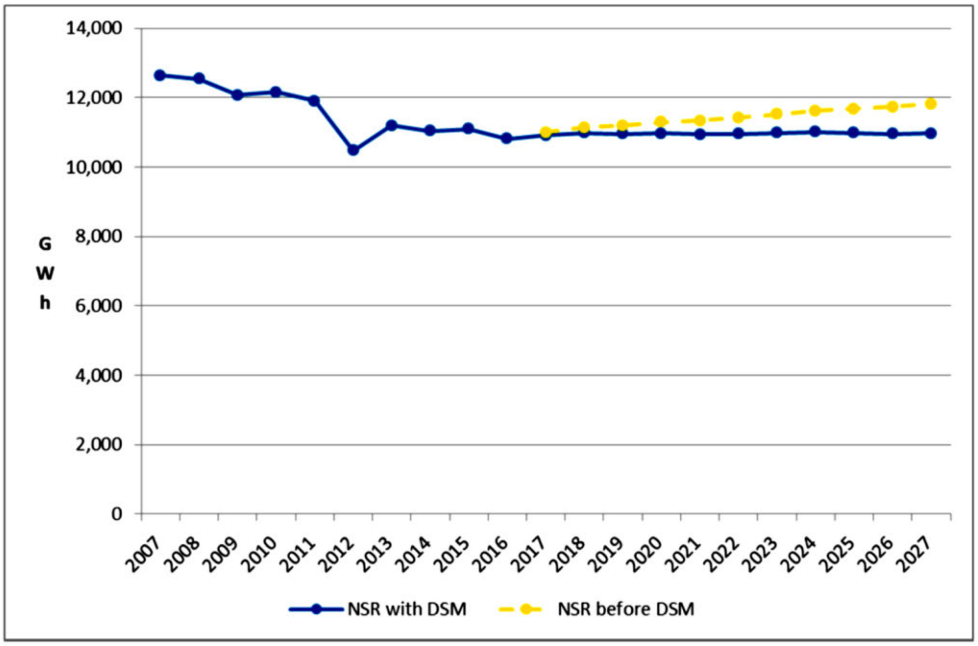
Introduction

In most regards, the Nova Scotia Power Inc. (NSPI) 2017 Load Forecast is very similar to the 2016 filing addressed in our previous comments. In this memorandum, we assess substantive differences to the two forecasts that comprise the load forecast: the energy forecast and the peak forecast.

We note that the energy forecast without demand-side management (DSM) is predicted to increase at an annual rate of 0.82 percent from 2016. With DSM effects, that rate is expected to be only 0.13 percent. We observe that this "with DSM" forecast is a change from the historical trend from 2007 to 2016, which declined at an annual rate of 1.7 percent.[1] We note though that the historical decline was essentially due to the loss of industrial customers.

[1] Calculated from the NSPI response to Synapse IR-1.

Figure 1: Historical and Predicted Net System Requirements (page 6 of the 2017 Load Forecast Report)



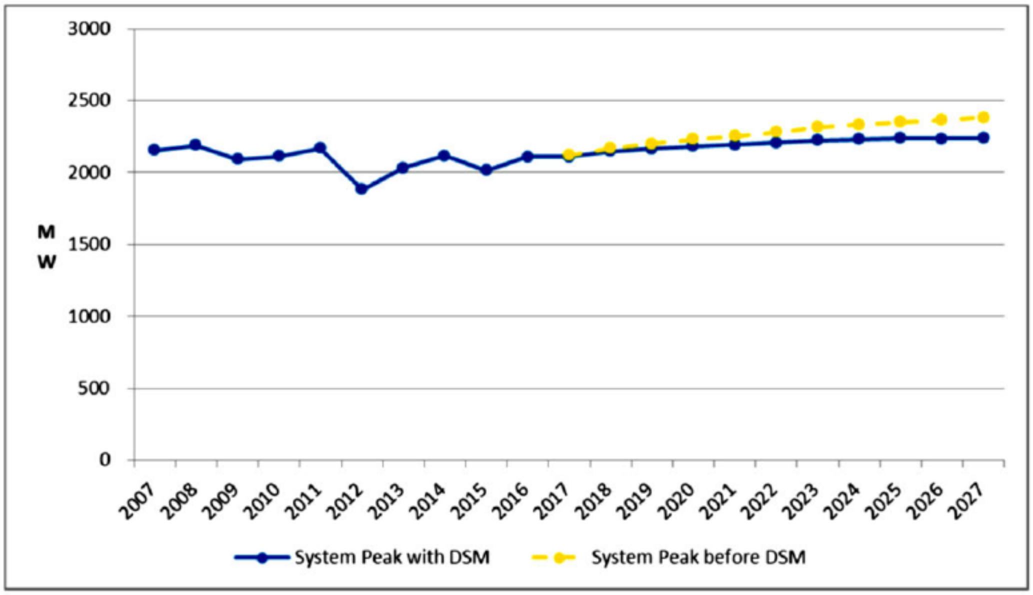
There are several issues raised by this forecast that we discuss further below:

1. Why does the future growth trend differ from the recent historical one?
2. What are the components and drivers for that change?
3. Are the effects of DSM programs properly represented?

The peak forecast, although similarly driven by energy requirements, differs in several ways from the energy forecast. The peak forecast without DSM is predicted to increase at an annual rate of 1.11 percent from 2016. With DSM effects, that rate is expected to be 0.53 percent. The historical trend from 2007 was a decline at an annual rate of 0.23 percent.[2] The same issues apply to the peak forecast as to the energy forecast.

[2] Calculated from the NSPI response to Synapse IR-1.

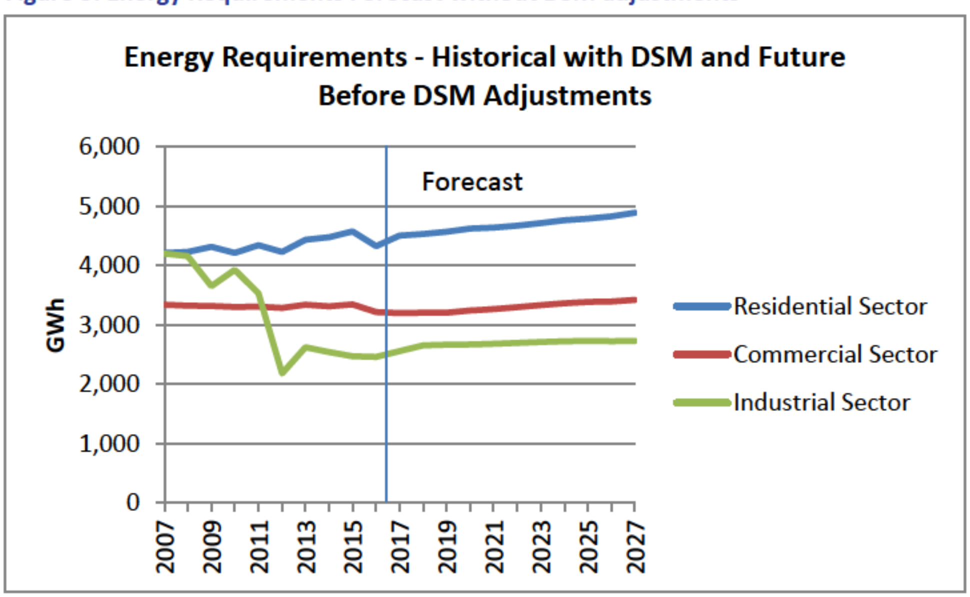
Figure 2: Historical and Predicted Annual System Peak (page 7 of the 2017 Load Forecast Report)



Energy Forecast

NSPI presents the forecast in three sectors: Residential, Commercial, and Industrial. Each sector is forecast separately using end-use and econometric methods. Then NSPI makes further adjustments to reflect the impacts of DSM programs. From an energy perspective, the unadjusted forecast predicts a 10 percent increase in energy use by 2027. Of that increase 54 percent is residential, 26 percent is commercial, and 20 percent is industrial. This is illustrated in the following figure based on Table A2 in the load forecast report. The growth in the residential load is 13 percent, commercial load 6 percent, and industrial load 11 percent.

Figure 3: Energy Requirements Forecast without DSM adjustments



Residential Forecast

The residential forecast is based on a statistically adjusted end-use (SAE) model designed to capture the nature of the sector's uses. The primary change in the residential sector is the increase in the use of electric heat pumps (HPHeat) and a decline in electric resistance heating (EFurn). This change in end-use intensities is illustrated graphically in Figure 8 in the Load Forecast Report. Note that these intensities are averages representing a combination of the device use and the penetration level. They also represent improvements in equipment efficiency as documented in the responses to Synapse IR-5.

The following table shows those average intensities and their changes in detail. Note that the average intensity for electric furnaces goes down while that for HP heating goes up, for a net average space heating increase of 200 kWh/HH (household). Electric water heating goes up slightly, representing displacement of oil. But the key thing to note here is that the average increase in end-use intensities over the forecast period is only 1 percent, whereas the forecasted growth in the residential load over the same period is 13 percent. The reasons for this discrepancy are unclear and may be related to increases in the housing stock.

Table 1: Residential End-Use Intensities, Average (kWh/HH)

End Use	2016	2027	Change	% Change
EFurn	3,364	2,575	-789	-23%
HPHeat	970	1,959	989	102%
EWHeat	1,625	1,679	53	3%
Light	899	601	-298	-33%
Cooling	139	217	79	57%
Other	2,634	2,803	168	6%
Ref/Frez	721	602	-119	-16%
Total	**10,353**	**10,436**	**84**	**1%**

Note: Extracted from Figure 8 of the Load Forecast Report, Synapse IR-1.

The reasons for the differences between the end-use intensity changes and the forecast can be found in the confidential response to Synapse IR-9. In the *Residential* tab of that response, the customer count is projected to increase by [redacted] percent over the forecast period. That by itself without heat pumps produces a [redacted] percent load growth; when heat pumps are included that increases to [redacted] percent. This is still below the observed residential forecast increase of 13 percent. The reason for this difference is unclear and we ask the company to provide an explanation.

Another issue worth investigating is the projected increase in the number of customers. The provincial forecast data provided in response to Synapse IR-3 predicts a 3.5 percent increase in population over the same period. For comparison, the population change from 2007 to 2016 was only 1.4 percent. The population forecast used, while reasonable, may overstate the actual growth that will occur. A related factor is the decrease in household size that could drive an increase in the number of customers. Overall, all that appears reasonable. But we suggest that smaller household sizes might also impact residential energy intensities. It would be reasonable to think that a smaller household would reduce the electricity use, even in the same residence. Furthermore, if these new households move into newer and smaller units, the electricity use would be expected to decrease even more. We ask the company to explain if these countervailing effects are represented in the residential end-use intensity modeling.

In response to Synapse IR-9, the company indicated that new single-family houses are expected to add 16,000 kWh/year and multi-unit housing adds 4,000 kWh/year. The company provides no supporting information for those values and gives no indication how that might change over time. These are key drivers for the residential forecast and should be better documented.

Another piece of the residential forecast is the statistical model described in Appendix B of the Load Forecast report. Attachment 2 in response to Synapse IR-09 provides the model data and results. These results do not precisely match those of Table 1 above. That is, Attachment 2 shows a 2016 value of 9,383 kWh and the 2027 value is slightly lower at 9,357 kWh. We ask the company for an explanation of this difference.

Commercial Forecast

The commercial forecast is also based on a statistically adjusted end-use (SAE) model that captures the nature of the sector's uses. Except for miscellaneous uses, these intensities decrease as shown in the following table based on Figure 9 of the load forecast report. The overall decrease in average intensity is 8 percent.

Table 2: Commercial End-Use Intensities - Average(kWh/m^2)

End Use	2016	2027	Change	% Change
Heat	26	19	-7	-27%
Cool	17	16	-1	-4%
Vent	13	12	-1	-8%
EWHeat	1	1	0	-15%
Cooking	1	1	0	-12%
Refrig	15	12	-3	-21%
Lighting	26	22	-4	-14%
Office	3	1	-1	-52%
Misc	36	43	7	19%
Total	**137**	**127**	**-10**	**-8%**

Note: Extracted from Figure 9 of the Load Forecast Report, Synapse IR-1.

The overall net growth in the commercial energy forecast of 6 percent (see Figure 3 above) must represent other effects beyond energy end-use intensification, which is seen to be declining overall. Those other effects must account for both the 6 percent overall forecasted growth, plus the estimate of an 8 percent average decline in energy end-use intensity. Thus, the 6 percent net load growth seems a little high given the projected GDP growth of 1.15 percent and employment growth of 0.1 percent for the forecast period. While commercial floorspace is projected to increase by 9.7 percent over the forecast period[3]—a number that also seems high—that increase does not make up the total difference. This apparent discrepancy needs further explanation.

The commercial forecast actually consists of two subsectors “Small General Service” and “General Service” using models documented in Appendix B of the Load Forecast report. The details of those forecasts were provided in response to Synapse IR-10 as Attachments 1 & 2. Summing the sector model outputs provided in that material produces a 2016 load of 2,376 GWh and a 2027 load of 2,449 GWh which is less than that in Table A2 of the Load Forecast report. But a more important concern is that the overall growth from 2016 to 2027 is only 3.1 percent which is only roughly half of the 6 percent reported commercial load growth. This difference needs an explanation.

Industrial Forecast

The industrial forecast is also based on statistical models for the Small and Medium subsectors. Large customers are forecast based on a combination of customer survey and historical sales information. Also included are municipal sales based on contracted levels. Altogether, the industrial sales are dominated by the Large users, who accounted for 64 percent of the load in 2016. The overall industrial load growth over the forecast period is 11 percent. This is much higher than the GDP increase of 1.15 percent and the manufacturing employment increase of 1.29 percent (Figure 7 of the Load Forecast report). This growth is primarily because of the Large customer group, for which little information is available. Most of the increase appears to take place in 2017 and 2018. It would be worthwhile asking the company for a more complete explanation of this growth.

DSM Forecast and Adjustment

After the basic sector forecasts are developed as described above, NSPI makes adjustments for the effect of DSM programs. The starting point is the DSM targets as approved by NSUARB. However, those savings are adjusted to reflect the fact that some DSM savings are included in the historical data that is used to develop the forecast. Thus in essence the forecast as developed already includes some DSM effects. (We note that ISO New England takes a different approach in calculating what the historical loads would have been without DSM to produce a No-DSM forecast.) Determining how to adjust the DSM savings is a complicated statistical effort. NSPI calculated the adjustment factor to be 60.6 percent for residential, and 47.6 percent for commercial and industrial going forward (page 25 and 26 of the Load Forecast report). Synapse IR-08 asked for more information about this calculation—shown in the following table—which appears to reference the source of the adjustment factor.

[3] Figure 6 Load Forecast report.

Table 3: DSM Model Statistics

Variable	Coefficient	StdErr	T-Stat	P-Value
Residential Model [4]				
MSales.AvgEESavings	-0.606	0.122	-4.979	0.00%
Commercial and Industrial Combined Model [5]				
MSales.EESavings	-0.476	0.376	-1.265	20.87%

While we believe that the DSM effect may be roughly of the order seen in this modeling, the statistics for the commercial and industrial sectors are not strong; they have a standard error nearly as large as the coefficient and the t-stat is relatively low. Thus, it is possible that the adjustment applied under-represents the effects of future DSM activities in the commercial and industrial sectors. This flaw would be magnified if DSM levels were to increase in the future.

With the DSM adjustments, the residential load growth changes from 13 to 5 percent, the commercial load growth from 6 to -3 percent, and the industrial from 11 to 8 percent. The overall energy growth changes from 9 to 1 percent.[6]

Peak Forecast and DSM Adjustment

The system peak actually decreased by 2 percent from 2007 to 2016, however it is expected to increase by 13 percent over the forecast period (Figure 19 data provided in response to Synapse IR-1). However the Firm Peak (Figure 20) after interruptible loads increased by 13 percent over the historical period. The difference is due to the interruptible loads associated with industrial users, which were 380 MW in 2007 but only 98 MW in 2016. The unadjusted increase in the firm peak over the forecast period is 11 percent. With the DSM adjustment that becomes 4 percent, which is more than the adjusted energy growth of 1 percent.

The separate peak model is described in Section 10 and Appendix B of the Load Forecast report. The classes are accrued for the peak forecast, e.g. the heating load model variable is composed of residential and commercial customers. Because of this aggregation, the peak load modeling is making limited use of the end-use information contained in the energy forecasting models. Thus, its results should not be viewed as robust.

The expected DSM peak savings are then used to adjust the forecast. No separate calculation has been made to determine the historical DSM effects embedded in the statistical model, but a 50 percent

[4] Load Forecast report page 52.

[5] Page 6 of 9 in response to Synapse IR-8.

[6] Calculated from Tables A1 & A2 in the Load Forecast report.

adjustment is made (Response (m) to Synapse IR-15) which appears to be based on that used for the energy forecast.

Overall the peak load forecast is not as sophisticated as the energy forecast and the greater peak load growth that it predicts should be investigated more closely.

Summary

- Energy forecast differs from historical trend but for generally plausible reasons. Some drivers have greater uncertainty. Heating load growth, especially with new technology and improvements, is less certain.
- DSM effects are based on business-as-usual energy efficiency programs. Adjustment for embedded effects is generally plausible but statistically weak.
- The peak load forecast captures overall historical relationships but does not sufficiently account for changing circumstances such as seen with new technologies. The DSM adjustment factor based on energy data may not be applicable for peak loads.
- The load forecast represents a business-as-usual approach with no representation of any new load control efforts such as demand response, time-of-use pricing, advanced metering, and energy storage.