

NOVA SCOTIA UTILITY AND REVIEW BOARD

IN THE MATTER OF: **The Public Utilities Act**

- and -

IN THE MATTER OF: **Nova Scotia Power Incorporated ("NS Power")**
10 - Year Energy and Demand Forecast
(2022 Load Forecast Report)

NON-CONFIDENTIAL INFORMATION REQUESTS

To: **Jennifer Ross**
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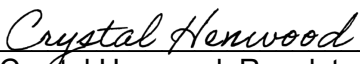
From: **Synapse Energy Economics Inc.**
Board Counsel Consultant

Responses Due: **July 8, 2022**

Copies: 1 electronic copy (PDF searchable)
3 hard copies

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Crystal Henwood, Regulatory Affairs Officer/Clerk

Questions regarding the NSPI “2022 Load Forecast Report” of April 29, 2022

Request IR-1:

Report Tables

- a. Please provide in electronic spreadsheet format all tables and graphs with identification of the data source(s) that appear in the load forecast report and appendices, retaining all formulas and calculations.

Request IR-2:

Historical Sales and Energy Data (Figures 1, 3, 38, and 42-50)

- a. Please provide in electronic spreadsheet format the customer sales data by rate class since 2006, on a monthly basis.
- b. Please provide in electronic spreadsheet format historical usage and customer data for electric space-heat customers since 2006 on a monthly basis.
- c. Please provide in electronic spreadsheet format system hourly load data from January 2006 through December 2021.
- d. Please provide the magnitude of unmetered historical sales by year and by category since 2006.

Request IR-3:

Billed versus Accrued Sales and Regression Period (Section 4.0, p 18)

- a. The report notes that the load forecast uses “billed” sales rather than “accrued” sales. Please identify the quantitative differences between the two for the most recent available year.
- b. The report notes that it uses monthly billed sales data from January 2012 to December 2021 for the residential and commercial energy forecasts, and sales data from January 2010 to December 2020 for Small Industrial, and from January 2006 to December 2021 for Medium Industrial “to improve the fit.” Please quantify the nature of the improved fit.
- c. Please identify the effect if the industrial forecast used the same period as the residential and commercial forecasts (that is, January 2012 to December 2021).

Request IR-4:

Weather Data (Section 4.2, pp 19-29)

- a. Please provide in electronic spreadsheet format the temperature data on a daily basis for January 2006 through December 2021, and the monthly HDD and CDD values used for this forecast identifying the weather station.

- b. Please provide in electronic spreadsheet format the monthly HDD and CDD data for other weather stations in Nova Scotia for the same period.
- c. Please provide the calculations used to construct the data values in Figure 7: HDD Trend from the Historic Annual HDD shown in Figure 6. Please identify the years represented on the x-axis for Figure 7.
- d. Please provide the data and calculations for Figure 8: CDD Trend. Please identify the years represented on the x-axis for Figure 8.
- e. Please provide the data and calculations behind the HDD and CDD forecast in Figure 9.
- f. Please provide the hourly peak loads and temperature data for twenty years as referenced on page 23.
- g. Please identify which years represent the 10-year averages for the bars in Figure 11.
- h. Besides the two climate resources cited on Page 25 were any others investigated? If so, please cite the sources. How do their estimates differ from those presented?
- i. Regarding the weighing of weather station data and the comparisons between the two approaches which is presented as the Mean Absolute Percentage Error (MAPE)? Were other comparison approaches investigated? Why was the MAPE method selected?

Request IR-5:

Economic Information (Section 4.3, pp 29-34)

- a. Please provide in electronic spreadsheet format all economic and provincial statistical data used both in developing the models and the forecasts for the historical analysis and forecast period.
- b. Please describe the construction of the work from home variable.
- c. Please provide the sources and the assumptions behind the new housing completions variables. To what degree do housing completions represent replacement of existing stock?
- d. Regarding Figure 16 and the historical changes. What is the forecast for the population changes during the forecast period?
- e. Please discuss why non-manufacturing gross domestic product and non-manufacturing employment continue to be used for the commercial models. Were other drivers considered? Why were they not chosen?
- f. Please discuss why manufacturing GDP and manufacturing employment were chosen for the industrial models. Were other drivers considered? Why were they not chosen?
- g. What consideration of any was given to labor shortages or increased automation for the industrial sector.

- h. What would be the effects on the industrial forecast if 10 years were used for the regression?
- i. Please provide the inflation adjustments used to convert to constant dollars.
- j. Regarding economic forecasts, identify the scenario/case used for this analysis and the reasons for choosing it.
- k. Please indicate any other economic forecasts that are available and indicate why they were not chosen. For example, the use of major bank forecasts for the near term.

Request IR-6:

Residential End-Use Intensity Trends (Section 4.4, pp 35-53)

- a. Please provide in electronic spreadsheet format the end-use data in the form of saturations and efficiencies from NRCan and U.S. EIA used for the residential and commercial models.
- b. Please identify specifically which of that data was used in the SAE modeling and any adjustments, transformations, etc. that were made in that process.
- c. Please identify the adjustments that were made “so that the resulting intensities are consistent with NRCan-reported end-use sales and actual average use derived from NS Power billing data.” [page 35, lines 13-15]
- d. Please provide specific information about how the results of the 2019 end use survey of residential customers were used to make any of the above adjustments.

Request IR-7:

Residential and Commercial Heating and Heat Pumps (Section 4.4, pp 35-36)

- a. Please provide for all the forecast years:
 - 1. Total number of residential customers,
 - 2. Number of customers using primarily electric resistance heating,
 - 3. Number of customers using supplemental resistance heating,
 - 4. Number of customers using heat pumps for primary heating,
 - 5. Number of customers using heat pumps for supplemental heating,
 - 6. Number of customers using heat pumps for cooling,
 - 7. Number of customers using oil for heating,
 - 8. Number of customers using natural gas or propane for primary heating,
 - 9. Number of customers using other energy sources for primary heating.
- b. Please indicate the number of new customers from 2022 through 2032 and the breakout of their space heating technology.

- c. Please provide supporting evidence for the 35 percent saturation of customers providing their heat via heat pumps in 2022 (p.36).
- d. Please provide the data sources and the E3 estimates regarding the commercial heat pump saturation forecast.
- e. Please quantify, with underlying calculations, the differences between E3 and the current forecast in regards to peak load impacts as presented in Figure 23.
- f. Please provide more specifics about the work that is underway to collect more detailed data for the residential heat pump forecast as presented in Figure 24.

Request IR-8:

Residential Water Heaters (WH) (Section 4.4, p 41)

- a. Are more efficient hot water end-use devices considered in this analysis?
- b. What are the existing or proposed standards for improving hot water efficiency in the province?
- c. Does NSPI or E1 have a plan for promoting HP rather than resistance-based water heaters?
- d. How would the water heating load change if half of the new water heaters were HP based?
- e. Please provide an update of the joint pilot on controlling water heaters directly and looking at potential benefits to the system.
- f. It appears that the Intensity in Figure 25 represents an average that is increasing because the saturation is increasing. Please confirm if this is the driver. Please provide the intensity per electric water heating household for each year in the table.

Request IR-9:

Residential Electric Vehicles (EV) (Section 4.4, pp 41-45)

- a. How do the daily load shapes for various types of electric vehicles correspond to NS's system load patterns? How does the peak demand pattern for electric vehicles correspond to NS's summer and winter peak demands?
- b. Please provide more details about E3's EV Load Shaping Tool and how it was used to produce the results for this forecast. Specifically, the calculations behind the values in Figure 27.
- c. Please provide more specifics about the time of use tariffs currently in the pilot stage.
- d. Please provide preliminary results from the SGNS project that are available, especially EV charging patterns.
- e. Please provide the inputs and the calculations behind the results in Figure 28.

Request IR-10:

Solar Generation (PV) (Section 4.4, pp 45-47)

- a. Please provide supporting data for the average capacity and capacity factor for the PV installations used in the forecast.
- b. Have you calculated the impacts of PV on summer peaks over the forecast period? If so, please provide those results.
- c. Please provide the source data and calculations for the values in Figure 29.

Request IR-11:

New Technologies (Section 4.4, pp 47-49)

- a. Please provide sources for the current costs of home batteries.
- b. Were projected cost declines of home batteries considered in the study? If so, please provide the assumed cost declines.
- c. Please provide further information about the SGNS project including any available reports.
- d. Please provide the assumptions and calculations behind the values in Figure 30.

Request IR-12:

End-Use Intensities (Section 4.4, pp. 49-52)

- a. Please provide the underlying calculations for the residential changes in baseboard heating, heat pump heating, cooling and electric water heating in Figure 31. E.g. changes in customer fractions and base use levels for each category.
- b. Please provide the underlying calculations for the small commercial changes in lighting, heating, and miscellaneous uses in Figure 32.
- c. Please provide the underlying calculations for the general commercial changes in lighting, heating, and miscellaneous uses in Figure 33.
- d. Please explain why the commercial heating intensity increases rather than declining as it has historically in Figure 33.

Request IR-13:

Commercial and Industrial Growth (Section 4.4, pp 52-53)

- a. Please provide the detailed calculations behind the values presented in Figure 34.
- b. For the small and medium commercial customers, identify the components of the demand growth in Figure 34. How much is associated with heat pumps for heating, cooling?
- c. How much of the growth represents increases in number or size of customers? How many new customers are included in the forecasts each year?

Request IR-14:

Price Data (Section 4.5, pp 54-55)

- a. Please provide the Fuel Stability Price Compliance document that is the basis for the prices in Figure 35.
- b. Please provide the data and calculations used to produce the electricity prices shown in Figure 35.
- c. The report states: "The SAE models are estimated using a -0.15 price elasticity." Please provide supporting data for the use of this elasticity.
- d. Have any estimates of price elasticity been calculated specifically for Nova Scotia/Canada or for winter peaking systems?

Request IR-15:

Demand Side Management (Section 4.6, pp 56-58)

- a. Please provide the source data for the DSM values used in this forecast.
- b. Please provide the DSM values used in the latest IRP.
- c. Please provide the DSM levels as presented in the latest E1 potential study.
- d. Please provide the inputs and calculations used to create Figure 36.

Request IR-16:

Demand Side Management Adjustment (Section 4.6, pp 57-58)

- a. Please provide the details of the data and statistical analysis that was used to develop the coefficient for the DSM variable in the Residential SAE Model.
- b. Please provide the details of the data and statistical analysis that were used to develop the coefficient for the DSM variable for the Commercial and Industrial forecast.
- c. Please provide the statistical measures associated with those coefficients.
- d. Please provide the historical and forecasted annual values of DSM that are used for this forecast for each sector.

Request IR-17:

Residential Sector (Section 5)

- a. Please provide the annual adjustments made to the SAE model for (1) EVs, (2) residential solar and (3) new customers.
- b. Please provide the inputs and calculations used to produce those adjustments.
- c. Please provide the source data and calculations behind the results in Figure 37.

- d. Please explain in more detail the reasoning behind the continued work-from-home impacts at 2023 levels.
- e. The report cites increased electric heating load as one of the recent growth factors. Please quantify how much is associated with existing homes converting to electric heat and the form of that heat (e.g. resistance or heat pumps), and how much is associated with new homes and the heating technologies used. Please indicate how this relates to the results from the end use survey of building efficiency and house size.
- f. Please provide the inputs and calculations used to create Figure 37.
- g. Are there any proposed regulations under consideration for improved building shell efficiency? If so, please discuss and indicate how they might affect the values in Figures 38 and 40.
- h. Please provide the inputs and calculations used to create Figure 38.
- i. Please provide the inputs and calculations used to create Figure 39.
- j. Please provide the inputs and calculations used to create Figure 40.
- k. Please provide the inputs and calculations used to create Figure 41.
- l. Please explain the factors behind the increase in water heat load. What efficiency improvements, if any, are included?

Request IR-18:

Commercial Sector (Section 6.0).

- a. Please explain and quantify the impacts of COVID on the 2021 loads.
- b. Please explain and quantify the ongoing effects of COVID in the commercial forecast.
- c. Please explain why the current forecast (Figure 42) remains fairly level through 2032 whereas the previous one showed a decline.

Request IR-19:

Small General Service (Section 6.1).

- d. Please explain and quantify the specific reasons for the differences from the 2021 forecast.
- e. Please identify and quantify in detail the specific components in the forecast model that are causing the increase to about 2025 and the leveling thereafter as shown in Figure 44.

Request IR-20:

General Service (Section 6.2).

- a. Please explain and quantify the specific reasons for the differences from the 2021 forecast.

- 1 b. Please quantify separately the effects of space heating and increased efficiency to the
2 General class sales forecast.

3
4 **Request IR-21:**

5 Large General Service (Section 6.3).

- 6 a. Please explain and quantify the specific reasons for the differences from the 2021
7 forecast.
8 b. The report indicates that about half of the increase is associated with hospital
9 redevelopment projects. Please quantify that amount. Also please identify and quantify
10 the other sources of the increase.

11
12 **Request IR-22:**

13 Small Industrial (Section 7.1).

- 14 a. Please explain and quantify the specific reasons for the differences from the 2021
15 forecast.
16 b. Please explain why the sales forecast increases to about 2026 and remains level
17 thereafter.

18
19 **Request IR-23:**

20 Medium Industrial (Section 7.2).

- 21 a. Please explain and quantify the specific reasons for the differences from the 2021
22 forecast.
23 b. Please explain and quantify the factors behind the 0.1 percent growth rate.

24
25 **Request IR-24:**

26 Other Industrial (Section 7.3).

- 27 a. Please explain and quantify the specific reasons for the differences from the 2021
28 forecast.
29 b. Of the twenty-three responses that were received from the annual survey (1) what fraction
30 of the sector load does that represent?
31 c. What is the aggregate percentage load change from the responses?
32 d. Based on past experience how reliable are the new project values given in Figure 49?

33
34 **Request IR-25:**

35 Municipal (Section 7.4).

- 36 a. Please provide the total municipal loads in GWh and MW over the forecast period.

- b. What changes if any are anticipated with the municipal supply in the forecast period.

Request IR-26:

System Losses and Unbilled Sales (Section 8).

- a. Please provide the system losses and unbilled sales for each year of the last five years.
- b. Please identify and discuss the reasons for any significant changes either in the historical or forecast values of the system losses or unbilled sales.
- c. How are unmetered sales represented in the forecast?

Request IR-27:

Net System Requirement (Section 9).

- a. Please provide the source data and the calculations used to produce the values in Figure 51.
- b. Please provide the source data and the calculations used to produce the values in Figures 52 and 53.
- c. Please provide the separate contribution of each load component element (residential, small general service, general service, large general service, small industrial, medium industrial, large industrial, municipal, losses, own use,) to the total NSR as shown in Figure 52 following the format as used in Table A1.
- d. Please provide the inputs and calculations used to create Figure 53.

Request IR-28:

Peak Demand (Section 10, pp 80-88)

- a. Please provide details about the Demand Response (DR) resources modeled in this analysis. What sectors are represented and what are the potentials in each sector?
- b. Please provide the basis for the ELCC of 48 percent that is used in the forecast.
- c. Please provide the calculations and assumptions used to produce the DR savings in Figure 54.
- d. Please explain why the demand response decline after 2027.
- e. What period was used to calibrate the peak model? Please provide in electronic format the data used for that calibration.
- f. Please provide the sources and the derivations of the values in Figure 58. Please also provide the values for the intervening years between 2021 and 2032.
- g. Please provide further information about the Unexplained values in Figure 59.

- 1 h. Please provide the data and calculations behind the peak share values in Figures 61 and
2 62 including the actual load values as well as the percentages. Please provide the same
3 data and calculations for 2032.
4

5 **Request IR-29:**

6 Peak Demand (Section 10 Coincident Peak Demand Research, pp 88-94)

- 7 a. Please provide more details about the use of interval data to understand peak loads at the
8 class level.
9 b. Please indicate specifically how many more years of data collection will be needed before
10 the results can be applied to the forecast.
11 c. What are the current levels of AMI coverage for the customer classes?
12 d. Please specify by name the rate classes shown in Figures 63 and 64.
13 e. What were the loss levels (absolute and percentage) on the 2021 peak day by hour as
14 shown in Figure 63?
15 f. What are the monthly loss levels as shown in Figure 64?
16 g. Please quantify and explain the differences in Figure 65 between the Residential
17 coincidental peak load with and without DSM?
18 h. Please relate this to the DSM values in Figure 36 and the demand response values in
19 Figure 54.
20 i. What is the schedule for using the smart meter data in future forecasts to test the accuracy
21 of the model?
22

23 **Request IR-30:**

24 Sensitivity Analysis (Section 11 and Appendix D)

- 25 a. Please provide in electronic format the data and calculations used to create Figures 66,
26 and 67.
27 b. Please explain the reasons that these specific weather and economic variables were
28 selected for the sensitivity analysis.
29 c. Please provide the actual statistical distributions used for those variables and the how they
30 were determined.
31 d. What other variables were considered but not chosen? Please discuss and explain.
32

33 **Request IR-31:**

34 Sensitivity Analysis (Section 11, 2020 IRP Comparison, pp 97-98)

- 35 a. Please confirm that the reference to Figure 69 should be to Figure 68.

- b. For overall consistency with the forecast period please provide values for 2032 in Figure 68.

Request IR-32:

Appendix A: Forecast

- a. Please provide in electronic format the specific calculations used to create the values in Tables A1, and A2.
- b. Please explain the historical changes in the Interruptible Contribution to Peak values and the future year values used in the forecast.

Request IR-33:

Appendix B: Residential Model (pp 1-7)

- a. Please provide in electronic spreadsheet format the data and the statistical model parameters and the full data and results used to produce the residential model coefficients and statistics tables.
- b. Please provide in electronic format the detailed end-use intensity data and its derivation.
- c. Please provide in electronic spreadsheet format the source and calculations of the values in the tables on pages 5, 6 and 7.
- d. Please provide the data and calculations associated with electric space heat and electric hot water usage.
- e. For the XHeat variable please provide the underlying factors (penetration, usage, etc.) driving the increase of % for HP Heat.
- f. For the XCool variable please provide the underlying factors (penetration, usage, etc.) driving the increase of % for HP Cool.
- g. Has NSPI collaborated with E1 in developing common assumptions for the end-use components? If so, please describe the results of that collaboration.

Request IR-34:

Appendix B: Small General Service Model (pp 8-13)

- a. Please provide in electronic spreadsheet format the data and the statistical model parameters and the full results used to produce the commercial model coefficients and statistics tables.
- b. Please provide in electronic spreadsheet format the calculation of the XHeat, XCool and XOther variables.

- c. Please provide in electronic spreadsheet format the calculations used to produce the commercial sales forecast.
- d. For the XHeat variable please provide the underlying factors (penetration, usage, etc.) driving the increase of 19.1% for Heating Intensity.
- e. Please provide in electronic spreadsheet format the source and calculations of the values in the tables on pages 12-13.

Request IR-35:

Appendix B: General Service Model (pp 14-18)

- a. Please provide in electronic spreadsheet format the data and the statistical model parameters and the full results used to produce the commercial model coefficients and statistics tables.
- b. Please provide in electronic spreadsheet format the detailed end-use intensity data and cite its derivation.
- c. Please provide in electronic spreadsheet format the calculation of the XHeat, XCool and XOther variables.
- d. For the XCool variable please provide the underlying factors (penetration, usage, etc.) driving the increase of 20.4% for the CoolUse Variable.
- e. Please provide in electronic spreadsheet format the source and calculations of the values in the tables on pages 17-18.

Request IR-36:

Appendix B: Small Industrial Model (pp 19-21)

- a. Please provide in electronic spreadsheet format the data and the statistical model parameters and the full results used to produce the model coefficients and statistics tables.
- b. Please explain why “ManGDP” was chosen as the long-term driver for this forecast, whether any other variables were considered, and why they were rejected.

Request IR-37:

Appendix B: Medium Industrial Model (pp 22-24)

- a. Please provide in electronic spreadsheet format the data and the statistical model parameters and the full results used to produce the model coefficients and statistics tables.
- b. Please explain why Manufacturing Employment was chosen as the long-term driver for this forecast, whether any other variables were considered, and why they were rejected.

Request IR-38:

Appendix B: Combined Model for Commercial and Industrial DSM Coefficient (pp 25-26)

- a. Please provide in electronic spreadsheet format the data and the statistical model parameters and the full results used to produce the model coefficients and statistics tables.
- b. Please describe the method and data used to weigh the X variable.
- c. Please explain why the X variables from the General Service model were used to represent both commercial and industrial customers?
- d. Were other alternatives considered? If so, please indicate why this approach was preferred.

Request IR-39:

Appendix B: Peak Forecast (pp 27-31)

- a. Please provide in electronic spreadsheet format the data and the statistical model parameters and the full results used to produce the model coefficients and statistics tables.
- b. Please provide the customer load values used to construct the aggregate HeatVar, CoolVar, and BaseVar values both for the model development and the forecast as represented in the equation on line 5 of page 29.
- c. Please provide the details of the large customer class's energy and coincident load factors. Please provide also the historical coincident peak load factors associated with this load.

Request IR-40:

Appendix C: Forecast Comparison and Accuracy

- a. Is the data in this appendix weather normalized? If so, please provide the raw data and the normalization factors used.

Request IR-41:

Appendix D: Forecast Sensitivity Analysis

- a. Please provide the model outputs in electronic form.
- b. Please provide the full set of Oracle input data in electronic format so that it can be replicated.
- c. Please provide the historical data and forecasts used to develop the probability distributions for each variable used in the Monte Carlo analysis.
- d. Please provide the source data and calculations for Figure D8.

1 **Request IR-42:**

2 Nova Scotia Power Electrification Support Overview by E3

- 3 a. Please provide the full report produced by E3 on this issue.
- 4 b. Please provide any supplemental materials produced by E3 in developing these results.

5

6 **Request IR-43:**

7 General Modeling Improvements – The Board Decision of October 27, 2021 makes several

8 recommendations (p 5-6):

- 9 i) *The intervenors recommended that NS Power re-evaluate the use of a low design temperate*
- 10 *(sic) in future forecasts, to which NS Power agreed. The Board, therefore, directs NS Power to*
- 11 *evaluate peak causing conditions and a peak forecast based on historic peak temperatures*
- 12 *(such as a 1-in-2) in its future load forecasts, as well as add trends in peak weather in the*
- 13 *2022 Load Forecast Report.*
- 14 ii) *NS Power agreed with the CA's recommendation on weather normalizing and presenting a*
- 15 *more accurate approach to estimating the impact of incremental cold on loads. Therefore,*
- 16 *the Board directs NS Power to evaluate improvements to the weather normalization*
- 17 *estimate and examine the impact of incremental cold on loads in the temperate ranges*
- 18 *where peak loads occur. These updates to the forecast are to be provided in future load*
- 19 *forecast reports, preferably in the 2022 Report, but if not possible then in the 2023 Report.*
- 20 iii) *The SBA suggested that NS Power include forecast accuracy for the system peak in addition*
- 21 *to the energy and firm peak presented in the Load Forecast Report. NS Power is directed to*
- 22 *incorporate this into future load forecast reports.*
- 23 iv) *The CA stated that it is more common to use load-weighted averages of temperatures from*
- 24 *multiple weather stations in a load forecast, and cited NS Power's planning reserve margin*
- 25 *study that used weather station data from three different areas of the province. NS Power*
- 26 *agreed to add more weather station data to future load forecasts, but stated that Halifax is*
- 27 *the major load centre of the province, followed by Sydney and the remainder of the load is*
- 28 *dispersed throughout the more rural areas of the province. NS Power suggested that*
- 29 *increasing the data may increase the complexity of the model without improving accuracy.*
- 30 *However, given the ranges in weather event occurrences throughout the province, the Board*
- 31 *directs NS Power to incorporate more weather station data into future load forecasts using a*
- 32 *load weighted approach.*
- 33 v) *NS Power's rebuttal was agreeable with many of the recommendations by intervenors.*
- 34 *However, in response to intervenors' request for more information on the Smart Grid Nova*

1 *Scotia and Water Heating Demand Response projects, NS Power stated that the results are*
2 *preliminary, although they also stated that the results are incorporated into the load*
3 *forecast when possible.*

4 vi) *The Company also indicated that it provides semi-annual reporting to the Board and*
5 *stakeholders on the Smart Grid and the Demand Response projects, therefore, further*
6 *reporting is not necessary. However, the Board directs NS Power to report the results from*
7 *the Smart Grid and Water Heating Demand Response projects, as it relates to the impacts*
8 *that these pilot projects have on load, in the 2022 Load Forecast.*

- 9
- 10 a. Please indicate how this forecast responds, or does not respond, to each of these
- 11 recommendations.
- 12 b. Please indicate how future reports will incorporate these recommendations.
- 13