Nova Scotia Utility and Review Board

IN THE MATTER OF *The Public Utilities Act -*

-and-

IN THE MATTER OF

NOVA SCOTIA POWER'S 2022 LOAD FORECAST REPORT

(M10569)

EFFICIENCYONE

EVIDENCE

FILED

July 29, 2022

TABLE OF CONTENTS

LIST OF TABLES

1. BACKGROUND

On April 29, 2022, Nova Scotia Power Incorporated ("NS Power") submitted its 2022 Load Forecast Report to the Nova Scotia Utility and Review Board ("NSUARB") in both redacted and confidential forms.

On June 16, 2022, as a registered intervenor in this proceeding, EfficiencyOne ("E1") submitted Information Requests ("IRs") to NS Power. Responses to those IRs were received on July 8, 2022. E1 has had an opportunity to review NS Power's 2022 Load Forecast Report and Responses to IRs on this Matter and submits the following evidence for the NSUARB's consideration.

2. INTRODUCTION AND OBJECTIVES OF COMMENT

NS Power's Load Forecast Report provides a 10-year forecast of energy and peak demand requirements of in-province customers for the period of 2022-2032. Required annually under the Nova Scotia Wholesale Electricity and Renewable to Retail Market Rules, the Load Forecast report provides a key input to the overall planning, budgeting and operating activities of NS Power to fulfil customer load. Specifically, the Load Forecast:

- forms the basis, in part, for future capital work planning;
- provides load-related information to Integrated Resource Planning ("IRP") activities;
- forms the basis, and is a major source of inputs, for IRP-related load forecasts;
- is used in Demand Side Management ("DSM") potential studies and DSM Resource Plans as a modelling input; and
- forms a basis, in part, for rate making decisions.

Given the breadth and reach of their potential short-term and long-term impacts, incremental improvements in the accuracy of the Load Forecast must be pursued. In support of achieving this objective, E1 is offering several key recommendations in its evidence.

The evidence is divided into two subject areas:

- Electrification; and
- Demand Response.

3. ELECTRIFICATION

NS Power has introduced a significant electrification adoption forecast within its 2022 Load Forecast. Many of the technologies and assumptions used in NS Power's electrification scenario interact with both energy efficiency and demand response. As Nova Scotia's DSM Administrator, E1 has identified several issues which it believes can be of value in refining the currently modelled electrification scenario. NS Power described the electrification scenario work as follows:

> "*As part of the 2020 IRP Action Plan, NS Power has worked with third party consultant E3 to develop forecasts for space heating and EV uptake that will allow the province to meet stated emissions goals and EV sales targets over the next 20 years. This work uses stock rollover models to assess uptake required under scenarios that meet goals, without assuming any specific changes to regulations or incentives, though both are possible in the timeframe of the current 10-year load forecast*."[1]

Compared to the 2021 Load Forecast, the 2022 Load Forecast shows higher energy system requirements and system peak demand. Table 1 below compares the average annual energy and peak demand changes in the 2021 Load Forecast and the 2022 Load Forecast.

[1] M10569, N-1, 2022 Load Forecast Report, page 15, lines 3-8.

Table 1: Comparison of Average Annual Changes in Net System Requirement and System Peak Demand in the 2021 and 2022 Load Forecast

	2021 Load Forecast[2]	2022 Load Forecast[3]
Average annual energy net system requirement change	-0.1%	+0.3%
Average annual system peak demand change	+0.2%	+1.6%

In response to NSUARB IR-36, NS Power attributed increases forecasted in energy requirement, system peak demand, and firm peak demand as "*primarily due to higher expectations for space heating and EV adoption than in previous load forecasts. These expectations are driven by assumptions and targets regarding carbon reduction.*"[4]

E1 IR-4 (b) asked, *"[d]oes NS Power anticipate the market is likely to follow the trajectories as modelled by E3 without any additional market interventions?"* NS Power responded that, *"the trajectories modeled were designed to meet the end state (e.g. 2050 economy-wide net zero) and in some cases interim goals that are prescribed by environmental legislation and policy, while accounting for equipment lifetimes and targeting a smoothed transition to reduce pressure in any given year on limited resources such as equipment supply chains and installers."*[5]

Crucially, a market-based analysis has not been completed to assess how customers are likely to respond based on the current electrification technologies available to them and their respective costs and incentives. A market-wide potential study would typically assess this question and help identify what level of marketing and incentives may be required to achieve provincial and federal policy objectives. It would also provide options for achieving these objectives subject to certain metrics, such as lowest cost, or maximum cost-effectiveness. An example of a market-wide potential study is National Grid's energy efficiency, energy optimization, and demand response

[2] M10109, N-1, 2021 Load Forecast Report, page 7, line 11 and page 8 line 4.
[3] M10569, N-1, 2022 Load Forecast Report, page 8, line 13 and page 9 line 4.
[4] M10569, N-4, NSPI (NSUARB) RIR-36, page 1 of 1, lines 10-12.
[5] M10569, N-3, NSPI (E1) RIR-4, page 2 of 2, lines 7-11.

potential studies for electricity, natural gas, propane, and fuel oil.[6]

For Nova Scotia, Energy + Environmental Economics ("E3") and NS Power have modelled one electrification scenario that would achieve provincial and federal policy objectives; however, it has not been demonstrated that this scenario is in line with where the market is headed with no intervention, or that it is the only path available to achieve provincial and federal objectives.

In other jurisdictions, meeting electrification targets based on policy has been a challenge. Understanding market potential can mitigate the risk of overestimating future rates of technology adoption. For example, since 2016 domestic heat pumps in the United Kingdom ("UK") have received financial support from the Renewable Heat Incentive (RHI) tariffs. The RHI serves as the primary policy instrument to accelerate low-carbon heating in the UK. Under the RHI, households that have installed a heat pump could claim these tariffs quarterly for seven years based off the dwelling's heat demand.

The UK Climate Change Committee's target was, and still is, to reach deployment levels of 600,000 heat pumps per annum in existing homes and 300,000 heat pumps per annum in new homes by 2028, reaching 1 million installations per annum across all homes by 2030.[7] However, even with incentivization through the RHI tariffs, heat pump deployment has fallen consistently below expectations. To highlight this issue, the Regulatory Assistance Project ("RAP") noted in its report, entitled "Getting on Track to Net Zero" that "*the 2013 impact assessment for the domestic scheme suggested that the that the domestic RHI would support 491,000 heat pumps by the original end of the scheme in April 2021. At the end of November 2020, however, only*

[6] Massachusetts Energy Efficiency, Electrification, and Demand Response Potential Study for 2022-2024, Appendix C: Potential Studies, dated April 16, 2021, https://ma-eeac.org/wp-content/uploads/Appendix-C-Potential-Studies.pdf ; https://ma-eeac.org/wp-content/uploads/Appendix-C-Potential-Studies.pdf

[7] Climate Change Committee, The Sixth Carbon Budget, The UK's path to Net Zero, page 115, https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf.

62,492 heat pumps had been accredited."[8] This amounts to less than one-sixth of the domestic heat pumps intended by the original end date.

The challenges experienced in the UK illustrate how the market can differ from policy targets and objectives. Careful analysis and planning are needed to develop market-based interventions that will facilitate policy objectives while optimizing grid flexibility and minimizing ratepayer costs in the process.

In response to Synapse's request to provide the full report and supplemental materials relating to this electrification work, NS Power directed stakeholders to Appendix E of the 2022 Load Forecast Report, as well as two excel attachments.[9] Stakeholders were not provided an opportunity to review detailed assumptions, and the materials provided to date appear insufficient to fully understand the scenario assumptions. E1 further describes two specific concerns it has with the electrification scenario in the 2022 Load Forecast below in sections 3.2 and 3.3 below.

While the new electrification scenario used in the 2022 Load Forecast was designed to achieve climate change policy goals and indicates that such a scenario will grow both load and system peak, several aspects of it remain unknown to stakeholders. Not only are there many uncertainties as to the reasonableness that this scenario will occur in the Nova Scotia market, there remains ambiguity surrounding the modelling assumptions used in its development. Basing short- and long-term planning decisions, including capital investments, on this scenario is concerning without further examination.

3.1 Heat pump modelling

In its 2022 Load Forecast, NS Power stated the capacity of heat pumps in the residential and

---

[8] RAP, Getting on track to net zero, a policy package for a heat pump mass market in the UK, page 8 https://www.raponline.org/wp-content/uploads/2021/03/RAP-Heat-Pump-Policy-0324212.pdf

[9] M10569, N-6, NSPI (Synapse) RIR-42 page 1 of 1, lines 12-15.

commercial models are assumed to decline as a function of coefficient of performance (“COP”), which causes greater reliance upon backup electric resistance heating with lower efficiency during the coldest hours.[10]

E1 posed several questions to NS Power in IR-09 to better understand the backup heating system assumptions modelled as outside air temperature decreased. NS Power, in its response to E1 IR-09, indicated that all heat pumps “lock out” below -7°C and only the auxiliary heating source, electric resistance, serves the load below these temperatures. Modeling assumes no contributions from heat pumps below -7°C.[11]

In Econoler 2020-2022 DSM Measure Assessment, 2021 Evaluation Edition, mini-split heat pump (MSHP) and central air source heat pump (CASHP) unitary peak demand savings were calculated using a peak demand savings engineering calculation. The calculations used were the following:

- the rated heating capacity of the heat pump at an outdoor air temperature of -15°C;
- COP of baseline electrical resistance (COP = 1.0); and
- COP of the installed heat pump at -15°C (from specification sheets).[12]

The implementation and use of cold climate heat pumps appears to be becoming the standard in climates similar to Nova Scotia’s. For example, since January 2021, systems eligible for a Green Heat rebate must appear on the Northeast Energy Efficiency Partnerships (NEEP) cold climate heat pump list and have a COP greater than or equal to 1.75 at -15°C.[13] The NEEP list identifies air source heat pumps that are best suited to heat efficiently in cold climates[14] and has been adopted by several organizations active in jurisdictions with climates similar to Nova Scotia’s

[10] M10569, N-1, 2022 Load Forecast Report, page 39, lines 13-14.
[11] M10569, N-3, NSPI (E1) RIR-09, page 3 of 4, lines 3-5.
[12] M10473, 2021 DSM Programs Evaluation Reports, EfficiencyOne, Final DSM Reports: 2020-2022 DSM Measure Assessment, page 54 and 56. Filed March 31, 2022.
[13] M10473, 2021 DSM Programs Evaluation Reports, EfficiencyOne, Final DSM Reports: Existing Residential Program, page 55.
[14] https://neep.org/heating-electrification/ccashp-specification-product-list

climate, including but not limited to, Efficiency Vermont, Massachusetts Clean Energy Center, National Grid, Efficiency PEI, and Energy Star.

The NS Power On-Bill Financing Study Update (M09321) dated December 13, 2019 also suggests that NS Power has recognized the benefits of cold climate heat pump market adoption. In the filing, NS Power affirmed that NSUARB accepted NS Power's proposal to modify its heat pump program by stating, "*The Board accepts NS Power's proposal to modify its heat pump financing program during the study period to only include high efficiency heat pumps with a coefficient of performance greater than 1.5 at -15 degrees Celsius or colder*".[15]

Given the current understanding and program accessibility of cold climate heat pumps, E1 is concerned that the modelling methodology employed in the 2022 Load Forecast, in particular the reliance on electric resistance heating below -7◦C, may not accurately forecast future peak demand associated with heat pumps and may be driving up forecasted peak load. An over-estimated system peak may cause NS Power to plan for capacity that does not materialize.

E1 recommends the heat pump modelling in the load forecast be updated to reflect the current adoption trends of cold climate heat pumps with a minimum COP of 1.75 at -15°C, and the removal of any 'lock-out' temperature that is not aligned with the COP performance of modelled heat pumps.

3.2 Alternative heating systems

In its 2022 Load Forecast, NS Power has assumed approximately 100% of residential customers and 90% of commercial customers transition to heat pumps with electric resistance back-up systems.[16] In its response to E1 IR-05 (b), when asked to confirm if these changes are expected to be market-driven, NS Power stated, *"[t]he model is not based on economic uptake. It is based*

[15] M09321, P701, On-Bill Financing Study Update, December 13, 2019, page 1 of 14.
[16] M10569, N-1, 2022 Load Forecast Report, page 36 and 37, Figures 20 & 21.

on the changes required in the space heating sector to meet emission reduction targets."[17] *In response to E1 IR-05 (c), NS Power said, "[o]ther heating technologies are not included in this model as heat pumps have greater efficiency than resistive heating and can be widely deployed"*.[18] This space heating forecast has a significant impact on peak load forecast.

NS Power did not provide any evidence on why 100% heat pump saturation was required to meet provincial and federal policy objectives. Moreover, there are a variety of back-up systems that could be used in combination with heat pumps to achieve the same policy goals that may have the same, if not greater, likelihood of market uptake. These alternative systems, such as electric thermal storage ("ETS") units, wood and pellet stoves as supplemental heat, and gas heating systems as supplemental heat, would have a different impact on load and would likely have a different combination of system investment requirements.

Given that the 2022 Load Forecast indicates peak load is growing faster than net system requirement energy (reference Table 1 above), it will be important to consider heating technologies' peak flexibility, in addition to their overall efficiency. This is especially true in the context of a net-zero grid with very low carbon emissions, but with a greater need for grid flexible resources. The RAP paper "Heating Without the Hot Air: Principles For Smart Heat Electrification", lists four principles for integrated heat decarbonization. [19] The first principle is put efficiency first, while the second is to recognize the value of flexible heat load. The paper further states,

> *"Analysis of the UK's energy system has shown that flexibility provided by an optimal combination of demand-side response (i.e., flexible load), storage, electricity interconnection and dedicated peaking plants (electricity generation only used at times of particularly high demand) could reduce the cost of electricity*

[17] M10569, N-3, NSPI (E1), RIR-05, page 1 of 1, lines 24-25.
[18] M10569, N-3, NSPI (E1), RIR-05, page 1 of 1, lines 27-28.
[19] Rosenow, J., and Lowes, R. Regulatory Assistance Project. Heating without the Hot Air: Principles for Smart Heat Electrification (2020), page 13. https://www.raponline.org/wp-content/uploads/2020/03/rap-rosenow-lowes-principles-heat-decarbonisation-march-2020.pdf

> *decarbonization. Further analysis has highlighted the potential for flexibility in residential sector energy use, including that associated with heat electrification, to reduce decarbonization costs."*[20]

In the 2020 IRP Action Plan, NS Power identified that, *"[f]irm capacity resources will be a key requirement of the developing Nova Scotia Power system in both the near and long term".*[21]

E1 recommends that NS Power explore electrification scenarios that maintain or expand the use of the following technologies:

- **electric thermal storage (ETS) units to shift load to off-peak times and offer grid flexibility;**
- **wood and pellet stoves as supplemental heat for peak times; and**
- **gas heating systems as supplemental heat for peak times.**

These are proven technologies that could provide benefits in an electrification scenario. These technologies may also provide certain unique characteristics that appeal to customers. For example, some wood and pellet stoves have the capability of providing heat during power outages. In addition to accounting for customer's unique homes and preferences, modelling a diverse range of electric heating technologies may also reduce general risk from heavily relying on one particular technology.

E1 currently offers rebates on wood/pellet stoves and ETS units. These measures have the following evaluated unitary savings as outlined in Table 2:

[20] Ibid., page 13.
[21] Nova Scotia Power 2020 IRP. Filed November 27 2020, page 109. https://irp.nspower.ca/files/key-documents/final-irp-report/E3_NS-Power_2020_IRP_Report_final_Nov-27-2020.pdf

Table 2: Green Heat Unitary Peak Demand Savings

Measure	Green Heat Unitary Peak Demand Savings [W][22]
Wood Stoves/Fireplace Inserts with Electric Resistance/Heat Pump Baseline	4,000
Pellet Stoves/Fireplace Inserts with Electric Resistance/Heat Pump Baseline	4,000
Wood Furnaces/Boilers with Electric Resistance/Heat Pump Baseline	7,660
Pellet Furnaces/Boilers with Electric Resistance/Heat Pump Baseline	7,750
Electric Thermal Storage with Electric Resistance Baseline	1,185

4. DEMAND RESPONSE

E1 is offering comments on demand response because E1 has proposed a demand response program within its 2023-2025 DSM Plan. It is important to E1 that all demand response programs in the load forecast are consistently and accurately treated.

4.1 Demand Response plan in forecast

In the 2022 Load Forecast, NS Power states,

> "*DR savings amounts are based on the demand reduction amounts included in the 2020 Integrated Resource Plan (IRP), which evaluated an aggregation of DR programs. These programs were developed by E1 in its DSM Potential Study and were assessed as a Supply Side option in the IRP model. The individual programs within the 'Base' program are modeled and include Direct Load Control (DLC), Critical Peak Pricing (CPP) and BNI Curtailment. The achievable potential of these programs was used in the Load Forecast. NS Power's IRP action plan has targeted 75 MW of capacity for DR deployment by 2025. The estimates in the Load Forecast have been moved back by one year to align with the current program development*

[22] M10473, 2021 DSM Programs Evaluation Reports, EfficiencyOne, Final DSM Reports: Existing Residential Program, page 41. Filed March 31, 2022.

for both DLC and CPP."[23]

In E1 IR-11, E1 asked if the Demand Response program included in E1's 2023-2025 DSM Plan (as filed) had been used to update the 2022 Load Forecast. NS Power responded that, "*No, for the purposes of the forecast it was assumed that E1's proposed demand response measures are incorporated into the larger demand response program that is being developed as part of the IRP Action Plan."*[24]

As part of its 2023-2025 DSM Plan, E1 submitted a plan to achieve 18 MW of demand response capacity by 2025. The demand response modelling was completed by Guidehouse and was an update of the 2019 Potential Study. The 2023-2025 DSM Plan includes the following pathways: Direct Load Control (DLC), BNI Curtailment, Critical Peak Pricing (CPP) enabling technologies, EV charging control, and battery control.

E1 understands NS Power is forecasting 50 MW of demand response capacity by 2025.[25] While E1 has a plan to achieve 18 MW as outlined in its 2023-2025 DSM Plan as filed, it is unclear to E1 how the difference of 32 MW will be met. **For this reason, E1 recommends that NS Power provide a plan and explanation for the remaining demand response capacity, detailing the incremental program options to be utilized and how each relates to E1's demand response program options. If no such plan exists, then it is E1's recommendation that NS Power adjust the demand response assumptions in the 2022 Load Forecast accordingly.**

4.2 Consistent treatment of DR resources

The 2022 Load Forecast incorporates the following demand response programs:

- Large Industrial Interruptible Rider (LIIR);
- Extra Large Industrial Active Demand Control (ELIADC) tariff;

[23] M10569. NS Power 2022 Load Forecast Report, page 80 of 98, lines 19-27.
[24] M10569. NSPI (E1) RIR-11, page 1 of 1, lines 15-17.
[25] M10569, 2022 Load Forecast Report. page 81 of 98, Figure 54.

- Electric vehicle managed charging; and
- Other demand response activities (includes E1 demand response programs, critical peak pricing rates, and possibly other undefined demand response activities).

These demand response programs are incorporated into the load forecast in various ways. The full capacity value of the LIIR and ELIADC has been removed from the firm load; the electric vehicle managed charging program has been removed from peak demand entirely; and the other demand response activities have been removed from firm load after an application of a preliminary 0.48 effective load carrying capacity (ELCC) factor.

When asked to describe in what context it is appropriate to apply an ELCC factor to DR, NS Power responded that "*If the use of a particular DR resource is constrained to a relatively short duration per call, or if there is a limitation on the number of calls in a given period of time (e.g. per month or per year), the application of an ELCC factor is warranted*."[26]

E1 believes that this definition should be applied consistently to all demand response resources. In the case of LIIR, given the high availability of this resource, the ELCC is likely to be very close to 1 but it should still be considered given the program does not represent 'perfect capacity'. In the case of the managed electric vehicle charging program, which is considered to be "*…a combination of time-based rates and aggregator-based charge management*"[27], a preliminary ELCC value (e.g. 0.48) could be used as a placeholder and refined as the program design is completed.

In response to E1's IR-7 (e), NS Power provided several reasons why an ELCC factor is not required for the large industrial rider. These reasons and E1's responses are provided below:

> *"NS Power has the capability via real time telemetry and control/or interruption*

[26] M10569. NSPI (E1) RIR-7, page 2 of 3, lines 23–25.
[27] M10569. N-5, NSPI (SBA) RIR-9, page 1 of 2, line 19.

> *notifications and penalties to curtail customers on the interruptible rider, and, as such, has assurance of immediate (i.e. 10 minutes notice) capacity reduction capability. NS Power's Control Centre has the capability to ensure interruptible customers are not contributing to peak demand during emergency conditions, over long durations if necessary".*[28]

E1 does not believe ELCC should be excluded entirely given NS Power stated in response to SBA IR-6 (c) "*the ELCC analysis completed for the 2020 IRP did not consider response time as an input to the capacity value modeling*".[29] While the event duration and number of events for other demand response programs may vary, there is no reason to believe other demand response programs will be less reliable than LIIR for use cases such as operating reserve.

NS Power further stated in response to E1's IR-7 (e), *"[f]inally, the nature of curtailing interruptible customers is different from Demand Response, as residential customers may have periods of inelastic response during certain conditions (e.g. the eventual requirement for water or space heating)."*[30]

This appears to be the type of differences between demand response programs that an ELCC calculation would be designed to capture. NS Power implies that curtailing interruptible customers is fundamentally different from demand response activities. Interruptible loads are a form of demand response based on the Federal Energy Regulatory Commission (FERC) definition of demand response as: *"Changes in electric usage by demand-side resources from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or*

[28] M10569. NSPI (E1) RIR-7, page 3 of 3, lines 4–9.
[29] M10569. NSPI (SBA) RIR-6(c),page 2 of 2, lines 1-2.
[30] M10569. NSPI (E1) RIR-7, page 3 of 3, lines 9-12.

when system reliability is jeopardized."[31]

E1 recommends that NS Power apply the same framework when assessing the value provided by different demand response programs.

5. SUMMARY

What are the primary recommendations of the E1 evidence?

E1 makes the following recommendations:

1. That the heat pump modelling in the load forecast be updated to reflect the current adoption trends of cold climate heat pumps with a minimum COP of 1.75 at -15ºC, and the removal of any 'lock-out' temperature that is not aligned with the COP performance of modelled heat pumps.
2. That NS Power explore electrification scenarios that maintain or expand the use of the following technologies:
    a. ETS units to shift load to off-peak times and offer grid flexibility;
    b. wood and pellet stoves as supplemental heat for peak times; and
    c. gas heating systems as supplemental heat for peak times.
3. That NS Power provide a plan and explanation for the remaining demand response capacity required to satisfy the projected 2025 capacity, detailing the incremental program options to be utilized and how they relate to E1's demand response program options. If no such plan exists, then NS Power should adjust the demand response assumptions in the 2022 Load Forecast.
4. That NS Power apply the same framework when assessing the value provided by different demand response programs.

This concludes E1's evidence on this matter.

[31] https://www.ferc.gov/industries-data/electric/power-sales-and-markets/demand-response/reports-demand-response-and