# Nova Scotia Utility and Review Board

**IN THE MATTER OF** *The Public Utilities Act*, R.S.N.S. 1989, c.380, as amended

## M11539

## Evidence of Board Counsel Consultant Robert Fagan, Synapse Energy Economics

### Nova Scotia Power Incorporated
### Battery Energy Storage System (BESS) Project
### Capital Cost Approval Application

April 4, 2024

NON-CONFIDENTIAL

## Introduction and Qualifications

**Q Please state your name and occupation.**

A My name is Bob Fagan. I am a Vice President at Synapse Energy Economics, Inc. ("Synapse"). My business address is 485 Massachusetts Avenue, Suite 3, Cambridge, Massachusetts 02139.

**Q Please describe Synapse Energy Economics.**

A Synapse is a research and consulting firm specializing in energy and environmental issues, including electric generation, transmission and distribution system reliability, ratemaking and rate design, electric industry restructuring and market power, electricity market prices, stranded costs, efficiency, renewable energy, environmental quality, and nuclear power.

Synapse's clients include state consumer advocates, public utilities commission staff, attorneys general, environmental organizations, federal government agencies, and utilities. Synapse also occasionally works on behalf of certain clean energy providers.

**Q Please summarize your work experience and educational background.**

A I have worked at Synapse for over 19 years, beginning as a Senior Associate and rising to my current position as Vice President. I am a mechanical engineer by training, with a BS degree from Clarkson University (then Clarkson College) and an MA in Energy and Environmental Studies from Boston University. I have worked in or adjacent to the electricity industry for over 35 years, the last 30 years in a consulting capacity. My work focuses primarily on examining the technical and regulatory aspects of electric utility industry resource planning and related matters.

I have worked on behalf of the Nova Scotia Utility and Review Board Counsel on numerous occasions since 2005, when I first addressed open access transmission tariff (OATT) issues in Nova Scotia Power's (NS Power's) original filing of its OATT. In the intervening years I have worked on energy efficiency, resource planning, Maritime Link and other matters in different proceedings before the Nova Scotia Utility and Review Board.

A copy of my current resume is provided as Exhibit 1.

**Q On whose behalf are you testifying in this case?**

A I am testifying on behalf of Board Counsel, for the Nova Scotia Utility and Review Board.

**Q Have you testified previously before the Utility and Review Board?**

A Yes. I have testified on behalf of Board Counsel in several proceedings and participated in Integrated Resource Plan proceedings in Nova Scotia numerous times over the past two decades, beginning in 2005.

**Q What is the structure of your testimony?**

A After this introductory section, I state the purpose of my testimony and summarize my findings. I then examine each of six issue areas, including Directives from the Electricity Act, Consistency/Alignment with the IRP and the Clean Power Plan, Performance/Functionality, Project Costs, Depreciation/Sustainability, and Contract Structure/Procurement Process. I review NS Power's Application and how they address each issue. Lastly, I provide specific recommendations to the NS UARB on the BESS Capital Application.

## Purpose and Summary Findings

**Q What is the Capital Cost Approval Application?**

A NS Power's Application describes its planned process and technical elements for the battery energy storage system (BESS) installation, which consists of three sites each hosting a 50 MW BESS. It also describes the costs, available incentives from the Canadian government's Smart Renewables and Electrification Pathways (SREP) program, and low interest financing available for a portion of the project through the Canada Infrastructure Bank (CIB).

**Q What is the purpose of your testimony in this proceeding?**

A The purpose of my testimony is to address NS Power's request for approval of expenditures to deploy the battery energy storage project described in the Capital Cost Approval Application ("Application"). I examine the major issue areas in NS Power's Application, with a particular focus on i) the alignment of the proposed project with the resource plans evaluated by NS Power in the Evergreen IRP proceedings and Nova Scotia's Clean Power Plan, ii) a review of the underlying gross costs and costs net of Canadian government programs that allow for reduced revenue requirements from NS Power ratepayers, and iii) the planned operation of the project and how it supports Nova Scotia's 2030 Clean Power Plan, in particular the need to integrate increasing amounts of renewable energy onto the grid, while phasing out the use of coal for electricity production by 2030.

**Q What are your summary findings?**

A I find that NS Power's BESS project is supportive of Nova Scotia's 2030 Clean Power Plan resource pathway, is in alignment with the preferred portfolio of NS

Power's most recent Evergreen IRP update, and the project's completion is in the best interest of Nova Scotia Power ratepayers.

**Directives from the Electricity Act Regulation**

**Q What are the prescribed battery energy storage requirements imposed on Nova Scotia Power associated with regulations under Section 4D of Electricity Act?[1]**

**A** Under Section 4D (9) of the Electricity Act, the Governor in Council can prescribe regulations concerning battery storage:

> (9) The Governor in Council may make regulations respecting any aspect of an energy-storage project or an energy-storage agreement under this Section, including
>
> (a) prescribing the eligible project, including structures, equipment, controls or other components of a project;
>
> (b) the time frame for entering into an agreement to purchase the output from a project;
>
> (ba) prescribing a project under subsection (2A);
>
> (bb) prescribing project terms and conditions under subsec-tion (4A);
>
> (c) obligations for data collection related to the use of the service, operations and economics of a project, and the format in which this information is to be provided to the Minister;
>
> (d) the minimum and maximum term for an agreement;

[1] *Electricity Act*. 2004, c. 25, s. 1.

(e) any other matter the Governor in Council considers necessary or advisable for the proper administration of the program.

The Governor in Council has prescribed energy storage regulations under section 4D of the Electricity Act,[2] on December 21, 2023, as follows:

**Prescribed energy-storage projects under Section 4D of Act**

**3** **(1)** The Nova Scotia Power Incorporated lithium-ion battery storage project is prescribed as an energy-storage project under Section 4D of the Act.

**(2)** Nova Scotia Power Incorporated must install three 50 MW 4-hour duration lithium-ion grid-scale batteries with an electricity storage energy rating of 200 MWh each.

**(3)** Each 50 MW battery must be housed in a separate facility.

**(4)** Nova Scotia Power Incorporated must install a facility adjacent to the substation in all of the following locations:

(a) Bridgewater, Lunenburg County;

(b) Canaan Road substation on White Rock Road, Kings County;

(c) Spider Lake, Halifax County.

**(5)** Nova Scotia Power Incorporated must prepare and file with the Board and the Minister an annual report for each year up to and including the year 2030, on the use of each battery project, including details about the services provided.

[2] Prescribed Energy-Storage Projects Regulations made under subsection 4D(9) of the *Electricity Act* S.N.S. 2004, c. 25 O.I.C. 2023-365 (effective December 21, 2023), N.S. Reg. 250/2023. Cited from https://novascotia.ca/just/regulations/regs/elecpesp.htm.

**Q Is it your understanding that NS Power's Battery Energy Storage System Project in this Capital Cost Approval Application is the prescribed energy storage project under the Electricity Act regulation?**

A Yes. The Capital Application reflects the planned installation of three specifically sited battery energy storage resources, whose initial installed capacity matches the requirement in the regulation. The project scope information was conveyed by NS Power to the Nova Scotia government, resulting in the specifics reflected in the regulation.[3]

**Q What is your understanding of the ways in which this Application for review before the NS UARB is different from other applications for capital expenditures?**

A It is my understanding that the Electricity Act regulation requiring NS Power to install certain amounts and types of a resource, at identified locations, is a highly specific regulation, and is not usual. It removes from NS Power the discretion to further consider (in this Application) the types, amount, and location of electric system resources that it seeks cost recovery approval from the NS UARB. However, it is notable that the specifics of the project itself were provided to the government, by NS Power; and it is also notable that the specific attributes of the project are in alignment with the preferred portfolio of resources of NS Power's most recent update to its Integrated Resource Plan, as I further describe here.

[3] NS Power Response to Consumer Advocate IR-1, "NS Power provided the government with its view on the optimal BESS Project scope and configuration, which is as reflected in the application."

**Consistency / Alignment with IRP and Clean Power Plan**

**Q How does the planned installation of NS Power's BESS project particulars, including all three sites, compare to NS Power's resource plan from its most recent integrated resource plan (IRP) update?**

**A** The 150 MW of BESS capacity in the Application represents a portion of the total BESS capacity indicated in the preferred portfolio from the IRP update, and its planned installation dates are within the timelines required for BESS resource implementation as indicated in the resource plan.

The 2023 Evergreen IRP update results were submitted by NS Power in M11307 on October 17, 2023, in its Reply Submission. NS Power stated the following at page 5:

> NS Power's current planning does not anticipate that the Atlantic Loop will be available by 2030. As demonstrated in the 2023 10 Year System Outlook report, the Company's central planning case is consistent with Evergreen IRP scenario CE1-E1-R2, which does not include the Atlantic Loop. **Using scenario CE1-E1-R2 as the basis for system planning** allows NS Power to act on investments corresponding to the updated Evergreen IRP Action Plan and 2030 Resource Development Plan (Figure 9 of the Evergreen IRP Update) to meet 2030 decarbonization targets, and leaves open the ability to further study various regional integration opportunities post-2030. [**emphasis** added]

**Q What resources are contained in Evergreen IRP Scenario CE1-E1-R2, for the next decade?**

**A** The table below, from NS Power's data tables available on their IRP website,[4] indicates the resource mix from Scenario CE1-E1-R2, from 2025 through 2035.[5]

**Scenario CE1-E1-R2 Nameplate Capacity of Supply Resources**

| Generator | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Existing Coal Retirements | 0 | 0 | 0 | 1 Units | 3 Units | 3 Units | 0 | 0 | 0 | 0 | 0 |
| Existing Gas Retirements | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas - New CTs & Recips | 0 | 0 | 0 | 150 | 450 | 450 | 450 | 470 | 620 | 620 | 770 |
| Gas - Conversion | 0 | 0 | 0 | 0 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Diesel CTs | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 |
| Domestic Hydro | 374 | 374 | 374 | 374 | 374 | 374 | 374 | 374 | 374 | 374 | 374 |
| Tidal | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| Biomass | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| Wind | 919 | 1297 | 1497 | 1697 | 1897 | 2097 | 2297 | 2497 | 2697 | 2844 | 2994 |
| Solar | 203 | 203 | 202 | 202 | 203 | 203 | 203 | 203 | 202 | 202 | 203 |
| Maritime Link Blocks | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 |
| Synchronous Condensers | 0 | 30 | 40 | 90 | 140 | 140 | 200 | 200 | 200 | 200 | 200 |
| Firm Imports | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nuclear | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HFO - Conversion | 0 | 0 | 0 | 0 | 0 | 459 | 459 | 459 | 459 | 459 | 459 |
| Hydrogen | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Battery 4H | 0 | 30 | 40 | 90 | 140 | 140 | 200 | 200 | 200 | 200 | 200 |

*NS Power Evergreen IRP results, 2023, Scenario CE1-E1-R2.*

The resource mix seen in the above table includes 4-hour battery energy storage resources (cumulative) of 40 MW in 2027, 90 MW in 2028, 140 MW in 2029 and 2030, and 200 MW in the years from 2031 through 2035. The full table includes 200 MW of 4-hour battery storage resources through 2048, and then increases the battery resource to 320 MW in 2049, and 400 MW in 2050 (the last year of the IRP analysis).

[4] https://irp.nspower.ca/files/key-documents/annual-evergreen-materials/evergreen-IRP-Final-Modeling-Results-Data-Tables-2023.xlsx

[5] Scenario CE1-E1-R2 nomenclature means earlier year (2035) achievement of net zero carbon emissions (CE1), vs. 2050 achievement (CE2); current policy (i.e., higher peak impacts) of electrification trends, E1, vs. lower peak impacts with a "hybrid peak" mitigation scenario (E2); and R2 is "no Atlantic Loop", vs. R1 which would include the Atlantic Loop as an alternative/supplemental source for renewable energy from Quebec.

NS Power's application for these three BESS projects envisions a 2025 completion for the first two projects (100 MW), and a 2026 completion for the third project. While this is an accelerated installation compared to the specific modeling results from Scenario CE1-E1-R2, the Evergreen IRP results illustrated a range of "optimal" pacing for battery energy storage system deployment under different sensitivities. For example, under the scenario with a higher level of distributed resources (e.g., solar PV), and no Atlantic Loop, the IRP modeling calls for the highest level of battery resource installation, at a pace requiring more than 500 MW of BESS resources by 2030 (Scenario CE1-E1-R2-HDER). Other sensitivities show increased or decreased pacing and total magnitude of battery installation, as shown in the table below.

**Battery Resource Nameplate Capacity by Scenario**

| Scenario | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2035 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| CE1-E1-R1 | 40 | 90 | 100 | 100 | 100 | 100 | 100 | 100 | 370 |
| CE1-E1-R1 AAT | 0 | 30 | 30 | 50 | 100 | 100 | 140 | 140 | 230 |
| CE1-E1-R1 BD | 0 | 10 | 10 | 20 | 70 | 70 | 160 | 170 | 200 |
| CE1-E1-R1 BPDSM | 0 | 20 | 50 | 50 | 100 | 100 | 100 | 100 | 210 |
| CE1-E1-R1 DACC | 0 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 200 |
| CE1-E1-R1 DH | 0 | 80 | 120 | 120 | 120 | 120 | 120 | 120 | 840 |
| CE1-E1-R1 HDER | 0 | 40 | 80 | 120 | 120 | 120 | 120 | 120 | 1,280 |
| CE1-E1-R1 HFPP | 0 | 20 | 30 | 30 | 30 | 30 | 30 | 30 | 310 |
| CE1-E1-R1 LFPP | 0 | 0 | 0 | 10 | 30 | 30 | 30 | 30 | 200 |
| CE1-E1-R1 MMDSM | 0 | 20 | 30 | 30 | 40 | 40 | 70 | 70 | 240 |
| CE1-E1-R1 WI | 0 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 270 |
| CE1-E1-R2 | 0 | 30 | 40 | 90 | 140 | 140 | 200 | 200 | 400 |
| CE1-E1-R2 DACC | 0 | 30 | 40 | 110 | 110 | 110 | 200 | 200 | 360 |
| CE1-E1-R2 DH | 0 | 60 | 80 | 100 | 160 | 160 | 200 | 200 | 430 |
| CE1-E1-R2 HDER | 0 | 120 | 160 | 240 | 440 | 560 | 800 | 800 | 1,720 |
| CE1-E1-R2 MMDSM | 10 | 20 | 30 | 30 | 30 | 30 | 200 | 200 | 430 |
| CE1-E2-R2 | 0 | 50 | 100 | 100 | 130 | 130 | 200 | 200 | 330 |
| CE1-E2-R2 HBHR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 240 |
| CE1-E2-R2 MMDSM | 0 | 0 | 0 | 0 | 110 | 110 | 200 | 200 | 230 |
| CE1-E3-R1 | 0 | 10 | 10 | 10 | 10 | 10 | 100 | 100 | 230 |
| CE1-E3-R2 | 0 | 0 | 0 | 10 | 100 | 100 | 200 | 200 | 430 |
| CE2-E1-R1 | 0 | 0 | 0 | 0 | 10 | 10 | 30 | 30 | 430 |
| CE2-E1-R2 | 0 | 30 | 40 | 60 | 110 | 110 | 200 | 200 | 390 |
| CE2-E1-R2 DH | 0 | 0 | 10 | 20 | 30 | 140 | 200 | 200 | 430 |

*Synapse, compilation based on NS Power Evergreen IRP nameplate capacity results for battery resources.*

Roughly half of the scenarios included the Atlantic Loop as a resource, with capacity and energy sourced from Quebec and with the costs of a new transmission line to Quebec included in the results. The other half of the scenarios did not include the Atlantic Loop, and instead of renewable energy from Quebec, the scenarios included significant increases in wind energy from onshore resources in Nova Scotia. Synapse provided comments on NS Power's Evergreen IRP results in M11307,[6] which include the summary information on the resource quantities by scenario seen in the tables above.

**Q What is the currently planned resource deployment path in Nova Scotia's Clean Power Plan?**

**A** The resource deployment path of Nova Scotia's Clean Power Plan includes more than 1,000 MW of additional wind power resources by 2030, expected large scale solar resources of at least 300 MW, small scale solar resources through the Commercial Net Metering Program and the Community Solar program, 300-400 MW of battery energy storage resources, a new Reliability Tie transmission line to New Brunswick, fast-acting generation resources, emergency and reliability backup through oil and gas conversions at coal plants, and electrification and demand management (to reduce peak load growth).[7]

[6] *Synapse Comments on Nova Scotia Power Updated Action Plan and Roadmap (August 2023).* https://uarb.novascotia.ca/fmi/webd/UARB15, Matter 11307, Exhibit N-3, August 8, 2023.

[7] *Nova Scotia's 2030 Clean Power Plan*, a presentation by the Nova Scotia Department of Natural Resources and Renewables, https://beta.novascotia.ca/sites/default/files/documents/1-3582/nova-scotia-clean-power-plan-presentation-en.pdf. Slide 21.

**Q Do the three NS Power BESS projects in this Capital Application align with Nova Scotia Power's most recent IRP results?**

A Yes. While the exact pacing of the installations is slightly different than the modeling results, the underlying substance of the IRP result is directly supported by the BESS project.

**Q Do the three NS Power BESS projects in this Capital Application align with Nova Scotia's underlying Clean Power Plan?**

A Yes, they form a subset of required resources. NS Power presented a report in compliance with the NS UARB's directive in M11017, *The Path to 2030*,[8] which contains a listing of its expected Clean Power Plan Resources (Figure 1, page 6), including the 150 MW of BESS from this Capital Application deployed in 2025-2026, in addition to another 250 MW of energy storage resources under Provincial Section 4D and 4D Projects for implementation between 2026 and 2028.

**Performance and Functionality**

**Q What the core functional attributes of the BESS projects in this Capital Application?**

A The core functionalities - all of which are highly critical to support the Provincial transition to increased amounts of renewable energy and closure of coal-fired generation plants - are specifically described in the Application's Appendix C

[8] NS Power's report *The Path to 2030* is available on the NS UARB site under M11017, but is also directly available here https://www.halifaxexaminer.ca/wp-content/uploads/2023/12/92447.pdf.

(redacted version).[9] They include the following five resource attributes, taken verbatim from the Appendix:

**1. Dispatchable firm capacity**: The BESS can provide reliable capacity for a continuous duration of 4 hours at full output to meet peak system demand. The proposed BESS would store 600 MWh of energy, enabling up to 4 hours of continuous output at 150 MW (or longer durations at lower output levels; i.e. 50 MW for 12 hours, or myriad additional capacity/duration combinations) for inclusion in the generation dispatch schedule between recharge cycles.

**2. Energy time shifting, or "arbitrage"**: The BESS will allow NS Power to store low-cost energy purchased and generated off-peak and utilize that to displace energy that would otherwise be generated or purchased during higher cost on-peak periods. NS Power's typical operation would charge the BESS during high wind/low load situations (predominantly overnight) and economically dispatch the BESS during high load/low wind situations (predominantly evening or morning peaks). This functionality directly enhances the value of intermittent renewable resources by converting their intermittency to high value period dispatchability.

**3. Grid frequency and voltage support**: The BESS will be able to sense and respond to fluctuations in system frequency to mitigate system-level frequency spikes or dips because of changes in generation or load and thus maintain grid stability to ensure reliable and continuous flow of electricity across the grid. The BESS can also provide system voltage support by adjusting reactive power production or absorption in order to meet local system requirements and respond to disruptions in other areas of the grid. The BESS can provide this support automatically, supporting typical grid voltage and frequency fluctuations or correcting for an atypical event such as loss of a generation source or loss of a significant load.

[9] NS Power, BESS Project Capital Cost Approval Appendix C, pages 2-3.

**4. Grid flexibility through response to controlled set points:** The NS Power System Operator will determine set points for active and reactive power levels which the BESS will then be able to automatically respond to, instantaneously offsetting increases and decreases in customer load and resulting changes in system current and voltage. The main objective of such "P/Q" (i.e. active power and reactive power) set points is to balance the system generation and load keeping the system frequency within the limits prescribed by the ECC.

**5. Spinning reserve**: Spinning reserve is generation capacity that is online, synchronized to the grid and able to respond quickly to sudden changes in load or unexpected events, such as an unplanned generation outage. The proposed BESS will provide nearly instantaneous response by being able to immediately inject power onto the grid during such an event, and without any associated fuel (including carbon) costs. This service can be provided whenever the BESS is producing energy below its maximum capacity, including when idle or charging.

**Q Why are these core functionalities critically important?**

**A** Battery energy storage system projects are often considered primarily as a means to store energy when production is less expensive (or renewable-based) and make it available at other times, especially during peak periods. This is directly reflected in the second attribute above.

However, the other attributes noted by NS Power in the Appendix reflect a combined multi-functional grid support capability that provides nearly instantaneous response for both day-to-day "normal" and less-frequent contingency events (regular, and extreme), in support of core frequency, voltage, and load following requirements – often in a fully automated mode, but also amenable to manual dispatch if or as required by NS Power. These combined capabilities render the resource highly valuable for supporting reliability, while simultaneously allowing it to displace the use of older, less efficient, dirtier, and often costlier resources that currently provide the functionality noted.

While 150 MW in total is not sufficient to fully displace the use of other, older supply assets to provide these functions, NS Power is likely to learn invaluable lessons associated with this first 150 MW tranche. As more BESS resources are made available, provision of ancillary service functionality can continue to transition to those resources as appropriate, and NS Power can directly support not only the new renewable energy assets interconnecting to the grid but can relax the need to sustain older, less efficient, lower performing[10] (and likely costlier) resources.

**Q Is the grid-forming functionality of the BESS resources important?**

**A** Yes. As noted in NS Power's response to information requests, the grid-forming capabilities complement the other attributes provided by the BESS resources. Grid-forming capabilities are noted by NERC to be "a relatively low-cost solution that helps ensure system-wide stability…" and NERC recommends "…implementing [grid forming capability] for all new [bulk power system] connected BESS…to mitigate any potential [bulk power system] reliability risks that could be posed under high IBR [inverter-based resources] penetration levels expected in the near future".[11]

**<u>Project Costs</u>**

[10] The near instantaneous response rate of utility-scale BESS resources surpasses the response rate of some of the other resources currently used to provide these functionalities.
[11] NS Power response to Synapse IR-4, page 3, quoting from a NERC (North American Electric Reliability Corporation) September 2023 *White Paper: Grid Forming Functional Specifications for BPS-Connected Battery Energy Storage Systems,* included as Attachment 1 to the IR response.

**Q How did you review the overall project costs associated with the NS Power BESS project?**

A We reviewed the Application itself, and responses to information requests, including review of the response to NS UARB request IR-11, confidential Attachment 1. Attachment 1 to that response is the NS Power Grid Battery Revenue Requirement model and contains detailed quantitative information on the projected costs and projected revenue requirements for the project. Our review of the revenue requirement model was undertaken to reconcile at a high level how the key cost parameters listed and explained in the Application were treated in the revenue requirement formulation. While NS Power did not estimate a rate impact associated with the BESS project, they did use a revenue requirements model to "evaluate customer benefit."[12]

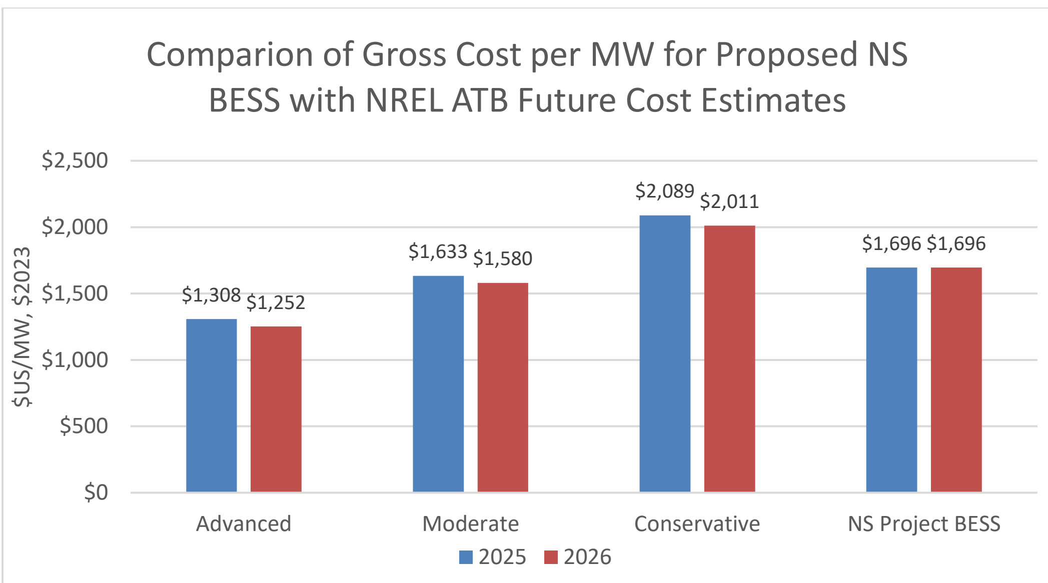
**Q What is the cost of the BESS project?**

A NS Power states that the forecasted gross capital cost of the BESS project is $354 million, for all three sites.[13] The net cost, after factoring in the SREP program funding of $111 million is $243 million, inclusive of AFUDC.[14] For 150 MW, this equates to a gross per unit cost of $2,360 per MW ($CA) for a 4-hour duration battery energy storage system. In US currency denominations, at an exchange rate of 1.35 Canadian to US dollars,[15] the gross cost is $1,748 per MW (in $2024). In real 2023 currency, the gross cost is roughly $1,696/MW ($US), which is seen in the graph that follows.

[12] NS Power response to Synapse IR-1 (c).
[13] NS Power Application, page 27.
[14] *Ibid*.
[15] Exchange rate on 3/28/2024. See for example, https://www.bankofcanada.ca/rates/exchange/currency-converter/.

**Q How does this gross cost compare to the US National Renewable Energy Laboratory Annual Technology Baseline (NREL ATB)[16] projections of costs for utility scale battery storage projects of 4-hour duration, in-service in 2025 or 2026?**

**A** The NREL ATB lists trajectories of costs for “advanced”, “moderate”, and “conservative” categories of technological advancement and cost.[17] It projects these costs on a per unit basis through 2050. The current range of capital costs (in $2023 $US) for 2025 or 2026 installations is roughly $1,300 to $2,100 per MW, for a 4-hour duration utility-scale battery. The chart below shows this comparison.




*Source: Synapse, using 2023 NREL ATB and NS Power Application information.*

[16] The National Renewable Energy Laboratory Annual Technology Baseline (NREL ATB) is a widely-used US Department of Energy source for estimates of renewable energy resource and battery energy storage system resource costs in the industry. NS Power used this benchmark when considering cost assumptions for use in the Evergreen IRP update (see, e.g., slide 17 of the *2022 Evergreen IRP Updated Assumptions* slide deck, dated January 26, 2023). https://irp.nspower.ca/files/key-documents/annual-evergreen-materials/2022-Evergreen-IRP-Updated-Assumptions-January-2023-Update.pdf.

[17] The three categories refer to a “refer to a range of assumptions about technology advancement and associated cost and performance”, according to NREL. https://atb.nrel.gov/electricity/2023/index.

**Q How do the underlying costs of the BESS project compare to current market-based cost estimates for utility-scale BESS projects?**

**A** As seen in the graph above, the gross costs of NS Power's BESS project are roughly at the "Moderate" range, and well within the full range of estimated costs using benchmark values from the NREL ATB. NREL produces annual estimates of the expected cost trajectory for battery energy storage systems, as well as costs for solar PV, wind energy and other technologies. The Annual Technology Baseline or ATB cost information is public and is a useful benchmark to gauge the considered BESS project.

**Q How does the use of the Canada SREP program and low-interest debt financing from the Canadian Infrastructure Bank, and favorable tax treatment, affect the overall costs of the BESS project?**

**A** The net cost of the project after considering the $111 million SREP funding is to lower the capital costs by roughly 31.4%, to $243 million from $354 million. This percentage reduction from the gross cost is slightly less than the 33% reduction noted in Natural Resource Canada's approval letters to NS Power.[18] The SREP program does not include any reduction to the AFUDC component of costs.

The SREP program represents a dramatic reduction in costs otherwise directly borne by NS Power's ratepayers. I note that the Evergreen IRP results did not include such an effect when determining the optimum resource path,[19] which – as noted earlier in this testimony – includes a level of battery energy storage system projects that

[18] See, for example, Appendix D of the Application, page 1, concerning the Spider Lake site: "We are pleased to inform you that under the Smart Renewables and Electrification Pathways Program (the "Program"), your project has met the requirements for funding approval of an amount up to $43,333,333 or 33% of Total Project Costs, …"

[19] The Evergreen IRP update assumptions indicate that the modeling did include the investment tax credit (ITC) effect, but not the SREP effect. See slide 16 of the *2022 Evergreen IRP Updated Assumptions*.

reaches 200 MW by 2031, in the currently preferred portfolio for NS Power. The low-interest financing from the CIB for a portion of the costs reduces ratepayer costs for capital project financing, as absent the CIB investment, NS Power would earn a greater return on the debt portions of its financing, leading to increased ratepayer costs. The tax benefit reduces NS Power taxes,[20] and thus reduces the revenue NS Power would otherwise have to collect from ratepayers to cover the tax burden.

**Q Given these costs and these funding structures, are the projected BESS project net costs to ratepayers reasonable?**

A Based on the current information provided in the Application and included in the revenue requirements model,[21] which incorporates the effect of the SREP program, the CIB financing, and the tax treatment, yes, the net costs of the BESS project as projected are reasonable.

**<u>Depreciation / Sustainability</u>**

**Q What is the expected life of the BESS project and what additional capital costs beyond the initial costs are necessary to sustain the project as a reliable energy storage resource?**

A The expected life of the project is 20 years.[22] While NS Power plans for ongoing sustaining capital to offset expected technical degradation[23] of battery energy storage system resources,[24] it is not including such "augmentation" in the current

[20] NS Power response to NS UARB IR-11.
[21] NS Power response to Synapse IR-1 (d).
[22] NS Power response to NS UARB IR-7 (b) and NS UARB IR-36 (a).
[23] NS Power response to NS UARB IR-19 (a).
[24] These potential future sustaining capital costs are included in the revenue requirement model.

procurement process.[25] NS Power estimates a need for roughly $50 million across all three of the sites for sustaining capital over the period 2029-2043.[26]

**Q Is NS Power's proposed use of a depreciation rate of 5% for the BESS project, until a depreciation study can be completed, reasonable?**

A Yes. NS Power indicates that the resource will provide 7300 lifetime cycles of charging and discharging before significant degradation occurs,[27] which equates to roughly daily cycling for 20 years. Many parts of the proposed BESS project may have depreciation lifetimes longer than 20 years, while other aspects of the project will have lower lifetimes. I would anticipate and expect that a full depreciation study will provide refined estimates considering all of the component lifetimes of the BESS project.

**<u>LNTP Contract Structure and Procurement Process</u>**

**Q How is NS Power acquiring the BESS project?**

A NS Power is using an outside contractor, selected through an RFP process, to provide a turnkey project encompassing procurement and installation of the battery energy storage system components. NS Power is using a "Limited Notice to Proceed" (LNTP) contract structure to "secure a firm contract price for the engineering, procurement and construction of the BESS project".[28]

[25] NS Power response to Synapse IR-6 (b).
[26] NS Power response to Synapse IR-5 (d).
[27] NS Power response to NS UARB IR-18 (g) and Synapse IR-6 (a).
[28] NS Power Application, page 20.

**Q Does the LNTP contract structure help to ensure reasonable costs for ratepayers?**

A In my opinion, based on a review of the material available to date, yes. The LNTP structure provides assurance to ratepayers because it provides for "fixed cost pricing" for the main part of the project (i.e., the outsourced battery modules procurement) that avoids exposure to lithium carbonate market price fluctuations, secures manufacturing capability, and preserves the project schedule targets (which are important to secure the SREP funding).[29]

**Q What did NS Power do to ensure competitive procurement, and what is NS Power's ongoing process to ensure project implementation that is in the best interests of ratepayers?**

A NS Power worked with contractor DNV to structure a competitive RFP process.[30] The process resulted in a LNTP contract structure, and NS Power has instituted a "Decision Gate" project management approach to complete the procurement and installation in a way that NS Power asserts will mitigate identified risks and uncertainties, and "validate…confidence in the project cost estimate and schedule".[31] NS Power states that it includes risk management and "Lessons Learned and Continuous Improvement"[32] in this process.

[29] NS Power Application, pages 19-22; NS Power response to Synapse IR-10.
[30] NS Power Application, page 18.
[31] NS Power Application, page 15.
[32] *Ibid.*

**Q Will the use of this project management approach, and the LNTP contract structure ensure that the gross costs do not rise above the currently estimated $354 million?**

A NS Power does not provide an explicit, affirmative assurance that this will be the case, but does provide evidence that it is striving to reduce risks and complete the project on time.[33] In response to the NS UARB's question on the cost assurance, NS Power does state that there is a 75% probability that the cost estimate will not be exceeded, and a 25% chance that it may be exceeded.[34] NS Power notes a tighter estimate for the BESS contractor portion of the project (i.e, AACE (Association for the Advancement of Cost Engineering) Class Estimate of 1.0 and 2.0, which contain tighter ranges of expected costs than other Class Estimates used for non-BESS-contractor portions of the project cost).[35] Use of these tighter cost estimates for the bulk of the expected costs contributes to greater confidence in the ultimate project cost estimate.

## Recommendations

**Q What are your recommendations to the NS UARB, given your testimony points above?**

A Given the points I note above, in consideration of my review of NS Power's Capital Cost Application for its Battery Energy Storage System Project at this time, completion of the project is in the best interests of Nova Scotia ratepayers and I recommend the following:

1. Approval of NS Power's BESS project Capital Cost Application.

[33] NS Power Application, pages 14-22, and NS Power response to NS UARB IR-35.
[34] NS Power response to NS UARB IR-35 (d).
[35] NS Power response to NS UARB IR-35 (c).

2. Approval of an interim use of 5% as an overall depreciation level for the project, to be updated upon completion of a full depreciation study.
3. Close monitoring and regular reporting by NS Power on i) outcomes on the ongoing LNTP contract implementation, ii) final costs, and iii) external funding assurance (i.e., SREP and CIB financing) for the project.
4. NS Power reporting on the ongoing implementation of all aspects of the project development, including assurances that optimum operational control and communication between the Energy Control Center and the project locations has been instituted. The successful integration of increasing levels of renewable energy assets in Nova Scotia will depend on optimal operation of the BESS assets in coordination with the other generation assets in Nova Scotia.

**Q Does this conclude your testimony?**

**A** Yes.