Matter No. M09519

In the Matter of an Application by Nova Scotia Power Incorporated for Approval of CI C0010778 – Smart Grid Nova Scotia Project

EVIDENCE OF

PAUL CHERNICK AND JOHN D. WILSON

ON BEHALF OF

THE CONSUMER ADVOCATE

Resource Insight, Inc.

FEBRUARY 19, 2020

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I. Identification

Q: Mr. Chernick, please state your name, occupation, and business address.

A: I am Paul L. Chernick. I am the president of Resource Insight, Inc., 5 Water St., Arlington, Massachusetts.

Q: Summarize your professional education and experience.

A: I received an SB degree from the Massachusetts Institute of Technology in June 1974 from the Civil Engineering Department, and an SM degree from the Massachusetts Institute of Technology in February 1978 in technology and policy. I have been elected to membership in the civil engineering honorary society Chi Epsilon, and the engineering honor society Tau Beta Pi, and to associate membership in the research honorary society Sigma Xi.

I was a utility analyst for the Massachusetts Attorney General for more than three years and was involved in numerous aspects of utility rate design, costing, load forecasting, and the evaluation of power supply options. Since 1981, I have been a consultant in utility regulation and planning, first as a research associate at Analysis and Inference, after 1986 as president of PLC, Inc., and in my current position at Resource Insight. In these capacities, I have advised a variety of clients on utility matters.

My work has considered, among other things, the cost-effectiveness of prospective new electric generation plants and transmission lines, retrospective review of generation-planning decisions, ratemaking for plant under construction, ratemaking for excess and/or uneconomical plant entering service, conservation program design, cost recovery for utility efficiency programs, the valuation of environmental externalities from energy production and use, allocation of costs of service between rate classes and jurisdictions, design of retail and whole-

sale rates, and performance-based ratemaking and cost recovery in restructured gas and electric industries. My professional qualifications are further summarized in Exhibit PC/JW-1.

Q: Have you testified previously in utility proceedings?

A: Yes. I have testified more than 350 times on utility issues before various regulatory, legislative, and judicial bodies, including utility regulators in thirty-seven states and six Canadian provinces, and two U.S. Federal agencies. This testimony has included the review of many utility-proposed power plants and purchased-power contracts.

Q: Have you previously testified before this Board?

A: Yes. I testified in over 25 Board proceedings, as listed in my resume. I have also assisted the Consumer Advocate in preparing comments and developing positions in numerous proceedings and stakeholder processes.

Q: Mr. Wilson, please state your name, occupation, and business address.

A: I am John D. Wilson. I am the research director of Resource Insight, Inc., 5 Water St., Arlington, Massachusetts.

Q: Summarize your professional education and experience.

A: I received a BA degree from Rice University in 1990, with majors in physics and history, and an MPP degree from the Harvard Kennedy School of Government with an emphasis in energy and environmental policy, and economic and analytic methods.

I was deputy director of regulatory policy at the Southern Alliance for Clean Energy for more than twelve years, where I was the senior staff member responsible for SACE's utility regulatory research and advocacy, as well as energy resource analysis. I engaged with southeastern utilities through regulatory

proceedings, formal workgroups, informal consultations, and research-driven advocacy.

My work has considered, among other things, the cost-effectiveness of prospective new electric generation plants and transmission lines, retrospective review of generation-planning decisions, conservation program design, ratemaking and cost recovery for utility efficiency programs, allocation of costs of service between rate classes and jurisdictions, design of retail rates, and performance-based ratemaking for electric utilities.

My professional qualifications are further summarized in Exhibit PC/JW-2.

Q: Have you testified previously in utility proceedings?

A: Yes. I have testified more than a dozen times before utility regulators in the Southeast U.S. and appeared numerous additional times before various regulatory and legislative bodies.

Q: Have you previously testified before this Board?

A: No.

II. Introduction and Summary

Q: On whose behalf are you testifying?

A: Our testimony is sponsored by the Nova Scotia Consumer Advocate.

Q: What is the purpose of your testimony?

A: We review aspects of NS Power's application for approval of CI C0010778 – Smart Grid Nova Scotia Project. Specifically, our testimony addresses the following topic areas:

- NS Power's classification of forecast expenditures as capital costs.
- Treatment of decommissioning costs in capital project budgets.

- Justification for the selection of the Siemens Energy System Platform.

We also have several suggestions for changes to the project scope.

III. Classification of Capital Investments

Q: How does NS Power propose to classify costs in the Smart Grid Nova Scotia Project?

A: NS Power is proposing that the entire project be classified as a capital project.

Q: Do you agree with classifying the entire project as a capital project?

A: No. A substantial portion of the costs of this project are not appropriately classified as capital investments because they will not result in placing assets in service. For reasons we discuss below, about two-thirds of the estimated costs relate to project components that we recommend be classified as expenses. About one-third of the costs relate to the community solar farm and electric vehicles, which we agree should be classified as capital assets.[1] We summarize the costs of each project component and summarize our recommendations as to cost classification in Table 1.

[1] Program costs, interest and overhead associated with the community solar farm and electric vehicles may also be treated as a capital asset. These costs are not broken out by project component in the application.

Table 1: Project Component Costs, NS Power Depreciation Rate Request, and Recommendation

Description	Total Estimate	NS Power Share	NS Power Depreciation Request	Recommendation
ESP Software	[redacted]	$2.0 M	Unspecified	Expense
Community Solar Garden	[redacted]	$2.4 M	4% solar	Capital Asset
Commercial Sites	[redacted]	[redacted]	4% solar / 10% battery	Expense
Distributed Batteries	[redacted]	$1.7 M	10%	Expense
EV Smart Chargers	[redacted]	[redacted]	6.67%	Expense
Electric Vehicles	[redacted]	[redacted]	10%	Capital Asset
Other Program Costs	3,852,946		Unspecified	Expense
Total Costs	**$ 18,954,043**			
Contributions	($ 11,900,419)			
Total Capital Work Order	**$ 7,053,622**	**$ 7.1 M**		

Sources: NS Power application, p. 36 and Appendix A, p. 5.
NS Power, response to NSUARB IR-7(a).
NS Power Share component costs include Other Program Costs.
NS Power, response to NSUARB IR-3.

Q: What are the terms of NS Power's payment for the Energy Services Platform?

A: NS Power will pay Siemens [redacted] million for software licensing and deployment. Siemens is providing a discount of [redacted] off the software licensing cost.[2] Access to the Energy Services Platform (ESP) software being developed by Siemens is limited to the project term (through March 2023), and NS Power will be able to "access future commercial software via annual licensing for Siemens ESP, including hosting and operation. The annual pricing will be dependent upon the scope of NS Power's use of the ESP."[3]

Q: Why do you recommend that the Energy Services Platform software fee be classified as an expense?

A: The ESP software should not be qualified as a capital asset. While the project timeline indicates that the ESP will be utilized beginning in 2020, it is evident from the project application and responses to IRs that the ESP will be under

[2] NS Power application, Appendix A, p.5; NS Power response to Synapse IR-3.

[3] NS Power, response to CA IR-1.

development throughout the project period. Furthermore, it will not be available to NS Power after the project is complete unless an annual license is purchased. Finally, the fact that Siemens' normal contract terms are for annual license fees also indicates that the software is not a long-term capital asset.

Q: Why do you agree that the Community Solar Garden is appropriately classified as a capital project?

A: The Community Solar Garden is a generation asset that will remain under the control and ownership of NS Power, so it is appropriately classified as a capital asset. NS Power costs related to the community solar garden include purchase of land, batteries, solar panels, and installation.[4]

Customers will not own any portion of the community solar garden. NS Power will provide customers an "opportunity to purchase solar energy produced from the solar garden."[5] Participation in the project is potentially available to all customers of NS Power, although in recognition of Amherst's donation of land, initial recruitment of participants will be directed to Amherst residents and businesses.[6]

Q: Is there any part of the Community Solar Garden budget that should be eliminated?

A: Yes. The budget includes significant funds for land. NS Power has provided information that the land will be provided by the Town of Amherst.[7] Hence, the project budget should be revised to reflect this reality.

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[4] Based on additional discussions with NS Power, we understand that this installation will also include meteorological equipment.

[5] NS Power, response to NSUARB IR-18.

[6] NS Power, response to CA IR-7.

[7] NS Power, response to NSUARB IR-9.

Q: What assets does NS Power propose to acquire for the vehicle-to-grid portion of the project?

A: NS Power plans to install up to four vehicle-to-grid EV smart chargers and purchase up to four compatible EVs.[8] Nova Scotia Community College and Dunsky will assist with this testing. NSCC campuses have "micro-grid research facilities that can be isolated from the NS Power grid during testing. … Once the project is complete, the vehicles will be retained by NS Power."[9] The compatible EVs are required because only two newer model vehicles have bi-directional charging capability, and NS Power's existing vehicles do not have this capability.

Q: Why do you agree that the vehicle-to-grid related assets are appropriately classified as a capital project?

A: As the vehicles are a service-related asset that will remain under the control and ownership of NS Power, they are appropriately classified as a capital asset. After the study is complete, presumably the vehicles will be used by NS Power for the benefit of all customers. As we understand it, NS Power will also continue to own the smart chargers.

Q: Please describe how NS Power proposes to purchase, install, and recover costs for behind-the-meter equipment.

A: NS Power proposes to install rooftop solar and battery storage at four host commercial customer facilities, and 200 distributed batteries and 200 EV smart chargers at businesses or homes. The solar panels, battery storage and EV chargers will be located behind customer meters, and customers "will continue to

[8] NS Power, proposal p. 24.

[9] NS Power, response to NSUARB IR-8.

be billed at their existing NS Power rate."[10] NS Power explains that it must install this equipment "in order to ensure that they can be installed and tested in a variety of use cases, to fully vet the monitoring and control capabilities of the ESP," and that "Without NS Power ownership of the assets, impacts to the project as a result of a change to customer circumstances would be greater with respect to the availability for testing."[11]

NS Power intends to own and depreciate the solar photovoltaic arrays for a life of 25 years, batteries for a life of 10 years and EV chargers for a life of 15 years.[12] Since the project is expected to be completed in March 2023, most of the life of these assets will be outside the study period. NS Power will make a "Determination of the treatment of the assets … at project close depending on the outcomes of the Project."[13] It is not clear how NS Power expects to interact with the host customers after 2023.

Q: Should these behind-the-meter assets be purchased by NS Power and costs recovered through a capital project?

A: No. We recommend against NS Power owning assets behind customer meters unless there is a very compelling reason to do so. There are practical and proven alternatives to ownership, which would reduce NS Power exposure to risks that

[10] NS Power, responses to NSUARB IR-18, IR-21, and IR-22.

[11] NS Power, response to NSUARB IR-15. NS Power also provides reasons that existing commercial solar installations would present complications.

[12] NS Power proposal, p. 34; and NS Power response to NSAURB IR-7(a). NS Power's intent is not entirely clear for the EV smart chargers, since NS Power also states that its program will "likely provide customers an incentive in exchange for utility control of EV charging using a smart charger." NS Power response to NSAURB IR-18.

[13] NS Power, response to NSUARB IR-1.

are outside its control, potentially resulting in unnecessary costs being passed on to customers.

Q: What are the practical and proven alternatives to ownership?

A: Regulators have generally preferred to encourage competitive supply of these technologies, rather than allow utilities to dominate the market with ratebased investments. Instead, the purchase and installation of the assets should be the legal responsibility of the participating customer. To facilitate that purchase and installation, NS Power could:

- Identify a list of qualified installers, with pre-approved installation fees and performance standards including utility inspection and acceptance;
- Require use of project-specific equipment at fixed prices;
- Provide substantial incentive payments;
- Lease back the equipment for the duration of the project, if necessary for the project objectives; and
- Tie incentives to contract terms that meet the project objectives.

These (or similar) practices would provide NS Power with the capability to fully achieve project objectives. In many utilities, customers have demonstrated a high level of interest in these behind-the-meter technologies, particularly photovoltaics.

Q: Is utility ownership of behind-the-meter assets common?

A: No. In most jurisdictions, utilities do not routinely own and rate-base this type of equipment. Our review of several reports that included case studies of behind-the-meter distributed energy resources found few examples of utility ownership

of the assets. Utilities usually use incentives or give-aways, or work through partners in the business of owning customer-sited assets.[14]

Similarly, the websites referenced by NS Power in its response to NSUARB IR-13 also supports our finding that few utility program designs involve utility ownership of behind-the-meter assets.

- **Green Mountain Power** – The battery storage program uses customer-owned equipment, equally split between utility and third-party installations. The utility installations are either sold or leased to the customer.
- **Liberty Utilities** – The battery program offers customers the choice of purchasing or leasing the battery.
- **AEP Ohio** – The EV charging program offers incentives for government, workplace, multifamily, and other public charging stations.[15]
- **PG&E** – The EV program is a rate design option for EV charging, with an additional one-time vehicle incentive, and assistance in obtaining other incentives.
- **Maui Electric** – The EV program is a rate design.

The only program cited by NS Power that involves utility ownership of behind-the-meter assets is Alectra's Power.House program. Alectra installed solar, battery storage, and a management system in 20 homes, for five years. Some of the key terms in Alectra's agreement with customers include:[16]

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[14] American Public Power Association, *Behind-the-Meter Energy Storage: What Utilities Should Know* (2019); and Smart Electric Power Alliance, *A Comprehensive Guide to Electric Vehicle Managed Charging* (May 2019), Appendix A.

[15] AEP's subsidiary, Kyte Works, offered a monthly EV charger subscription program, but appears to have suspended sales of that product. http://kyteworks.com/ We have not been able to determine whether Kyte Works had any special relationship to the AEP Ohio EV program.

[16] https://www.powerstream.ca/attachments/PowerHouse-Customer-FAQ-webversion.pdf.

- The utility controls and operates the system, and is solely responsible for system maintenance, and provides liability and damage insurance for the system.
- Electricians working in the home must be informed about the system and turn off a circuit breaker to the circuits served from the system.
- Equipment is tied to the title of the home, so the participation agreement is transferred to new homeowners.
- At the end of the five-year contract, participants have the opportunity to renegotiate the contract or have the equipment removed at the utility's expense.

The Alectra program is the exception, rather than the rule, in utility pilot programs for behind-the-meter distributed resources.

Q: What risks could NS Power assume if it takes long-term ownership of behind-the-meter assets?

A: We identified a number of concerns with NS Power ownership of behind-the-meter assets. These concerns are neither addressed in its application nor adequately resolved in the interrogatory responses.

- Which party will pay for make-ready electrical work at the customer site, such as electrical panel modifications, extensions of electrical wires, and patch and refinish work?
- If building code or safety issues are identified during installation, what will be the responsibility or liability assumed by NS Power to respond to those issues?
- If problems arise in the customer's electrical system after installation of NS Power's equipment:

- Will NS Power be responsible for correcting any effects on the customer's equipment?
- Will NS Power have legal rights to correct any response to those issues that affect its equipment?

- If a safety concern is identified after installation, what rights and obligations will NS Power have to address the problem or remove the system?
- If the host customer needs to relocate the equipment (e.g., to allow roof repairs or reconfigure the use of space), who is responsible for removing and replacing the equipment?
- If there is a change to customer circumstances, such as new ownership or tenancy:[17]
  - If the customer seeks to terminate electrical service and the new owner (or tenant) does not immediately initiate electrical service, will NS Power continue operating the equipment without any contribution from the host customer?
  - Will the new customer be obligated to give NS Power staff full access to the equipment, even if it interferes with their new intended use of the property?
  - What rights will the new customer have to withdraw from hosting the equipment?
- If an installation is terminated for any of the above reasons, how much of the cost would be salvageable?

[17] Particularly in the case of commercial customer locations, participation responsibilities that transfer with title or tenancy may be a concern if they could affect real estate marketing. This could affect customer willingness to participate in the project.

- Which party will make decisions about the timing and manner of decommissioning the equipment?

Q: Were these issues addressed in the Intelligent Feeder Project?

A: That is not clear. Any solutions developed in that pilot are not evident in the relevant documentation from Intelligent Feeder Projects matters (Matter Nos. M07981, M08512 and M09061).[18]

Q: Please summarize your conclusions and recommendations for behind-the-meter systems.

A: Overall, NS Power's proposal to own equipment behind the meter and maintain it for 10 to 20 years seems to raise many potential problems without clear offsetting benefits. The long-term responsibility presents potential liabilities and complications without any identified offsetting benefits.

We recommend that the Board direct NS Power to revise its application to utilize incentives or leasing to encourage participation in the project, place ultimate responsibility for site safety and control with the property owner, and utilize appropriate contract language to ensure the project objectives are met.

The incentives, including subsidies of lease payments, should be treated as expenses, not capital investments. This is also more consistent with NS Power's statement of the project's longer-term objectives:

[18] NS Power, response to CA IR-22.

> Access to batteries and EV smart charging technology may not be affordable for some customers. NS Power anticipates that if the appropriate controls and programs are in place, potential cost sharing programs with customers for these assets will improve their adoption while allowing for NS Power control of those DERs. Cost sharing programs may include customer contribution to the capital cost of a battery or charger as an upfront contribution or monthly charges spread over time. The contribution made by participating customers would reflect the value they get directly from the device, and the contribution made by NS Power would reflect the value available to all customers.
>
> In this way, increased customer uptake of DERs that can be controlled by NS Power unlocks value sharing for not just participating customers but all NS Power customers, regardless of their participation. A purpose of the Smart Grid Nova Scotia project is to test these assumptions in order to determine whether these benefits can be achievable – thereby enabling DER adoption while mitigating cross-subsidization.[19]

Customer-owned solar systems, batteries and EV smart chargers would not be capitalized by NS Power, of course, and the incentive would usually be expensed. Leasing arrangements (whether through NS Power or a third party) would not normally be reflected in rates. We understand that the incentives or lease subsidies may need to be relatively generous in order to compensate customers for participation in the program, to attract customers rapidly and to allow lower-income customers to participate.

[19] NS Power, response to NSUARB IR-18(c).

IV. Decommissioning Costs

Q: How does NS Power treat decommissioning costs for the assets it proposes to acquire?

A: The proposed project does not include any recognition of the continued operation and eventual decommissioning of the assets acquired in the project.[20] The omission of decommissioning costs may be inconsistent with NS Power accounting policies, which appear to require creation of a cost of removal liability upon putting a facility into service.[21]

Q: What do you recommend for treatment of decommissioning costs?

A: The Board should direct NS Power to revise its project description to include its best estimate for the continued operation, and eventual decommissioning, of assets that it anticipates owning after the project has concluded in March 2023.

V. Selection of the Siemens Energy Systems Platform

Q: Why is NS Power proposing to use the Siemens Energy Systems Platform in the Smart Grid Nova Scotia Project?

A: As we understand it, NS Power selected the Siemens ESP for two reasons. First, Siemens developed the proposal for federal funding of the project and was thus able to facilitate financial resources.[22] That connection justified NS Power selecting the Siemens ESP without a competitive solicitation. Second, NS Power states that it selected the Siemens ESP system because, "Other commercially

[20] NS Power, response to NSAURB IR-1(c).

[21] NS Power, response to NSUARB IR-5, *2020 Annual Capital Expenditure Plan*, Docket M09499 (January 30, 2020).

[22] NS Power, response to SBA IR-4(a)(i)

available Distributed Energy Resources Management Systems (DERMS) are typically utility-only solutions and do not integrate customer-level interfaces."[23] Similarly, NS Power explains that, "Siemens intends for the solution to blend customer and utility functionality …"[24] Terms like "customer functionality" and "customer interfaces" usually refer to giving the host customer access to data, such as through a phone app or an in-house display, to monitor operations (e.g., solar output and battery charge level) and control some functions (e.g., require the battery to charge in advance of a storm). It is not clear whether NS Power is referring to the same concepts.

Q: What customer-level interfaces and functionality will be provided by the Siemens ESP?

A: NS Power's application does not directly state what customer functionality will be provided by the Siemens ESP or how customers will access this functionality. However, based on additional discussions with NS Power, we understand that even though the project scope does not include testing of these customer-level interfaces, NS Power anticipates adding these features after tests of utility-side ESP monitoring and control of DERs are complete. These features would be [redacted], and would focus on [redacted][25]

[23] NS Power response to NUSARB IR-10.

[24] NS Power response to CA IR-6.

[25] NS Power Response to CA IR-2, Confidential Attachment 2, pp. 4 and 11.

Q: Are these features available in competing software?

A: While the exact type of customer interface that NS Power expects Siemens to add in later releases may not yet be integrated into competing DERMS, many behind-the-meter solar and storage facilities do offer the features we described above. NS Power did not demonstrate that such interfaces could not be offered by competing systems. For example, the Intelligent Feeder Project provided a customer interface using the Tesla iPhone app, which was anticipated to be integrated with the Opus One GridOS.[26]

Q: What are the potential costs of selecting the ESP software?

A: NS Power has made a significant investment in the Opus One software used in the Intelligent Feeder Project, which it appears to be abandoning in the shift to the Siemens ESP system. NS Power is proposing to switch from Opus One GridOS to Siemens ESP through 2023, after which NS Power has not committed to any system. Frequent changes to the systems used to manage distributed energy resources, as NS Power notes in one response, requires shifting assets from one project to another. This complication requires "customer agreements that are in place … to be re-negotiated."[27]

Q: What do you recommend regarding the ESP software?

A: From a customer point of view, it seems inefficient to shift from one control system to another, with no clear advantages and with no assurance that there will not be a further shift in 2023. We recommend that the Board closely evaluate whether easier access to the federal funding is a sufficient basis to shift to a new, and as-yet incomplete, software platform.

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[26] NS Power response to CA IR-22, Attachment 4, pp. 5-6 and Attachment 5, p. 6.

[27] NS Power, response to E1 IR-6.

VI. Potential Changes to Project Scope

Q: Please summarize your findings with respect to the project scope.

A: Generally, we believe that Smart Grid Nova Scotia will assist NS Power in advancing its capabilities to integrate distributed energy resources into its operations. There are several areas in which the project scope could be improved. Excluding these items from the project scope of work could mean that NS Power will not consider exploring these capabilities until 2023. If NS Power finds these suggestions worthwhile, it is possible that any budget requirements could be met through cost savings resulting from the land contribution from Amherst and use of incentives or lease-back arrangements for behind-the-meter equipment.

Our suggestions relate to the following topics:

- Management of grid-connected renewable energy and storage
- Integration with AMI systems
- EV smart charging objectives and metrics
- Vehicle-to-grid study

Q: What do you suggest with respect to the management of grid-connected renewable energy and storage?

A: It appears that the ESP system is anticipated to have the capability to control larger resources than the small distributed resources included in the scope of work.[28] NS Power's Intelligent Feeder Project has already developed experience with the integration of intermittent renewable energy (wind) with energy storage technologies, and the proposed project "will leverage the data and learnings from

[28] NS Power, response to CA IR-21. This response specifically addressed battery storage. NS Power did not provide a definitive response to a question about other behind-the-meter systems. NS Power, response to CA IR-23.

the IPF … [using] the same internal resources from the IFP project team [who] will also be working on the storage portion of the Smart Grid Nova Scotia project."[29] NS Power should consider expanding the scope of work for the ESP system to include the capability to manage its current and future grid-connected renewable energy resources.

Q: What do you suggest with respect to integration with AMI systems?

A: It is not clear why NS Power did not choose to include AMI systems in the scope for EMS integration. NS Power notes that its integration could result in savings that would occur due to automating the billing process.[30] It would also appear that for homes with rooftop solar, battery storage, and EV charging, it would be an oversight to be unaware of customer load in real time. This would seem to be a critical data point for examining impacts on distribution system equipment, for example. We suggest that NS Power collect 5-minute data from behind-the-meter systems and from AMI meters at those customer sites for the duration of the study in order to have the data available for future research needs.

Q: What do you suggest with respect to the EV smart charging objectives and metrics?

A: NS Power's objective for the EV smart charging portion of its program is to "evaluate the benefit that ESP monitoring and control of the EV charging network provide in addressing the effects of EVs on peak demand by shifting charging to off peak or times or when most beneficial to the system and customers."[31] NS Power may wish to reach out to Maui Electric, which had

[29] NS Power response to NUSARB IR-21.

[30] See NS Power, response to NSUARB IR-12.

[31] NS Power application, p. 22.

difficulty in matching charging to high wind production in the middle of the night.[32]

A report on managed charging suggests that there may be technical difficulties with achieving this level of communication and control.[33] The report suggests that a number of utilities have already conducted pilot projects to test rate designs and methods for curtailing load during demand-response events, including customer notification. For example, data collection directly from vehicles was tested by Maui Electric, but "customers' vehicles were only available to respond less than half the time." Pepco studied reducing charge rates from Level 2 to Level 1 during a peak event but found the communication costs were too expensive. These and other study findings should inform the project design. [34]

NS Power's metrics for the EV smart charging program are meaningful, but fairly modest: simply counting the number of vehicles connected and identifying their state of charge.[35] NS Power should consider developing additional metrics aligned with its objectives.

Q: What do you suggest with respect to the vehicle-to-grid study?

A: Vehicle-to-Grid applications are less studied than managed charging using EV Smart Chargers, and NS Power will have less prior experience to build upon. Three issues that NS Power should consider are battery life, managed charging

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[32] Smart Electric Power Alliance, *A Comprehensive Guide to Electric Vehicle Managed Charging* (May 2019), Appendix A.

[33] *Id*.

[34] Benjamin K Sovacool et al., "The neglected social dimensions to a vehicle-to-grid (V2G) transition: a critical and systematic review," *Environmental Research Letters* (January 2018).

[35] NS Power response to NSUARB IR-28(b).

interconnection processes, and expansion to include medium or heavy-duty vehicles such as buses.

Depending on technology and practices, bi-directional charging may either enhance or degrade battery life.[36] The project proposal notes that bi-directional charging is not widely supported in the electric vehicle market, with only two models of passenger vehicles available with this capability.[37] It is not clear whether bi-directional charging is covered by the warranties on the Nissan Leafs that NS Power intends to use. If not, NS Power needs to build in budget contingency for impacts related to potential early battery retirement due to reduced life and safety considerations.[38]

Even though the bi-directional charging in this pilot program would occur at research laboratory locations, NS Power should seek to gain experience with issues that may arise in future commercialized interconnection and electrical permitting processes, since these issues will be different than solar generation or conventional charging.[39] NS Power's could ensure that it takes the managed chargers through a standard interconnection process in order to flag needed changes to accommodate this new technology. Similarly, NS Power should make sure that the operating schedules and control regimens are consistent with those that may be encountered in residential and commercial usage.

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[36] Kotub Uddin et al., "On the possibility of extending the lifetime of lithium-ion batteries through optimal V2G facilitated by an integrated vehicle and smart-grid system," *Energy* 133 (April 2017).

[37] NS Power response to NSUARB IR-8.

[38] Smart Electric Power Alliance, *A Comprehensive Guide to Electric Vehicle Managed Charging* (May 2019), p. 12.

[39] *Id*.

The few vehicle-to-grid studies that have been conducted have tended to focus on larger vehicles, perhaps because they offer more potential to directly benefit the distribution feeder. For example, PG&E studied managed charging in the medium and heavy-duty vehicle sectors.[40] In August 2019, two utilities announced managed charging pilots for school buses.[41] NS Power should consider evaluating one or more medium or heavy-duty vehicle to compare the performance of larger batteries to the smaller passenger vehicle batteries.

Q: Does this conclude your testimony?

A: Yes.

[40] *Id*.

[41] In August 2019, Dominion Energy Virginia announced a 50 bus vehicle-to-grid pilot, self-funded at $13.5 million. Jordan Pascale, *Dominion Energy Will Buy Virginia Electric School Buses … If They Can Use the Batteries,* WAMU (August 29, 2019). Also in August 2019, SDG&E received approval to assist school districts with a 10 bus vehicle-to-grid pilot. California Public Utilities Commission, *Decision Approving Settlement on Application*, Decision 19-08-026, Docket A.18-01-012 (August 15, 2019). (See also the testimony of David M. Goldgraben on behalf of SDG&E.)