Review of New Brunswick Power's Application for Approval of an Advanced Metering Infrastructure Capital Project

In the Matter of the New Brunswick Power Corporation and Section 107 of the Electricity Act

Matter No. 452

Prepared for the New Brunswick Energy and Utilities Board Staff

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EXECUTIVE SUMMARY

The New Brunswick Energy and Utilities Board Staff (EUB Staff) commissioned Synapse Energy Economics (Synapse) to review New Brunswick Power Corporation's (NB Power or the Company) $92 million Advanced Metering Infrastructure (AMI) Capital Project proposal to procure and deploy AMI in its service area. On a present value basis, NB Power claims that its current AMI business case has total costs of $109.6 million and total benefits of $140.7 million, for a positive net benefit of $31.1 million. In the benefit-cost analysis for this project, NB Power assumes benefits from reduced or eliminated costs associated with manual meter reading, meter service orders, load research, outage restoration, customer inquiries, net metering, and other functions. It also assumes implementation of initiatives to leverage AMI's capabilities. Costs in the business case include capital, operating, and installation costs for AMI meters, Meter Data Management (MDM), Customer Information System (CIS), Work Force Management (WFM), Enterprise Service Bus (ESB), and contingencies on specific cost types.

We find that NB Power's AMI proposal raises several concerns. The proposal does not appear to capture the latest AMI technology and features because it relies on a stale, nearly three-year-old procurement. Further, it appears that the Company did not fully consider the viability of alternatives, including a partial rollout. In addition, we are concerned that the proposed investment will put the Company in a modestly worse financial position in the near term while producing uncertain benefits in the mid-to-long term future. We note also that NB Power's proposal to write off the meters to be replaced raises concerns about customer rate impacts and may violate general ratemaking principles.

Overall, the proposal lacks sufficient detail in several key areas. NB Power does not describe the technology that will be used to deliver data to customers or the rationale for the latency between energy usage and data delivery. It also omits important details about certain benefits and is vague about how it will leverage AMI in the future to generate additional benefits for its customers.

We find that NB Power has presented a proposal that, under plausible conditions, would result in benefits to ratepayers. However, we have identified numerous concerns with claimed benefits and estimated costs. These concerns include:

- The benefits associated with reduced meter accuracy losses have not been properly framed; improvements in accuracy, to the extent that they occur, are likely to represent an equity benefit, rather than an increase in net benefits to society as a whole.
- The High Bill Alert program has not been designed, and estimates of savings for this program are poorly supported and may be overstated.
- The load limiting program has not been designed, raises equity concerns, and should not be included as a benefit.

- The estimate of benefits from distribution network losses is poorly supported, as NB Power does not have historical data related to distribution system losses resulting from over- and under-sized assets.

- System integration costs may be understated, and the contingency does not appear to adequately address the risk that these costs could be higher than forecast.

- The avoided costs of the Non-AMI CVR program are not well supported and could be understated.

- An increase in distributed generation could negatively impact savings associated with CVR.

- The load forecast used as input in calculating the benefits of each program does not consider the overlapping energy savings from the variety of AMI-based programs that have simultaneous benefits. Also, key inputs to the study that rely on the load forecasts and load profiles may have been inaccurately estimated.

- The forecast spike in net metering in the mid 2020's is poorly supported, and thus these benefits could be overstated.

In addition, NB Power's analysis uses inconsistent assumptions for different benefits.

Under alternative but still plausible conditions, the proposed AMI might not provide net benefits to customers. This could occur, for example, if the benefits from High Bill Alert or distribution network losses are less than expected, or system integration costs are higher than estimated by NB Power. The sensitivity analyses provided by NB Power either do not represent a reasonably broad range of plausible outcomes or do not consider scenarios in which more than one cost and benefit type has unfavorable results.

We consider an illustrative scenario with poor performance in some of the particularly uncertain or risky AMI cost and benefit areas. We find that the business case becomes negative with a reduction in meter accuracy losses, load limiting, High Bill Alert and distribution network losses benefits and an increase in system integration costs. While there are other, unquantified benefits that are likely to result from implementation of AMI, NB Power has not provided enough information on the unquantified benefits to allow the Board to consider how they might affect the business case.

An approval of the proposed investment would likely shift the risk onto ratepayers. Given this, and that the Company's business case is not entirely clear on the net benefits of the proposed AMI, we recommend that the Board conditionally approve the investment contingent on the Company submitting a revised application that meets the following conditions:

- The revised application provides better documentation and justification for the proposal and addresses all the concerns raised in our report.

- The revised application includes a new benefit-cost analysis which removes or reduces any benefits that are too questionable, e.g., reduces the value of the reduced losses, and includes a more reasonable estimate of costs.

- The revised application should include a detailed set of metrics consistent with our recommendations, along with a plan for reporting and presenting the results consistent with our recommendations.

If the Board decides that the business case documentation is sufficient for an investment of this magnitude and that the cost and benefit estimates are reasonable despite the issues discussed above, then it should approve the proposed AMI. In that case, however, we recommend that the Board take steps to increase the likelihood that the AMI will provide net benefits to customers by applying a set of metrics to the AMI program.

1. INTRODUCTION

1.1. Purpose

The New Brunswick Energy and Utilities Board Staff (EUB Staff) commissioned Synapse Energy Economics (Synapse) to review New Brunswick Power Corporation's (NB Power or the Company) Advanced Metering Infrastructure Capital Project proposal. Our task was to review, critique, and make recommendations to the New Brunswick Energy and Utilities Board (the Board) on NB Power's proposal.

1.2. Qualifications

The authors' qualifications are summarized below. Additional information regarding Synapse Energy Economics and the authors is available at: www.synapse-energy.com.

Synapse Energy Economics

Cambridge, Massachusetts-based Synapse Energy Economics is a research and consulting firm specializing in energy, economic, and environmental topics. Since its inception in 1996, Synapse has grown to become a leader in providing rigorous analysis of the electric power sector for public interest and governmental clients.

Synapse's staff of 35 includes experts in energy and environmental economics, benefit-cost analysis, transmission and distribution, resource planning, electricity dispatch and economic modeling, energy efficiency, renewable energy, rate design and cost allocation, risk management, environmental compliance, climate science, and both regulated and competitive electricity and natural gas markets. Several of our senior-level staff members have more than 30 years of experience in the economics, regulation, and deregulation of the electricity and natural gas sectors. They have held positions as regulators, economists, and utility commission staff.

Services provided by Synapse include economic and technical analyses, regulatory support, research and report writing, policy analysis and development, representation in stakeholder committees, facilitation, trainings, development of analytical tools, and expert witness services. Synapse is committed to the idea that robust, transparent analyses can help to inform better policy and planning decisions. Many of our clients seek out our experience and expertise to help them participate effectively in planning, regulatory, and litigated cases, and other forums for public involvement and decision-making.

Synapse's clients include public utility regulators throughout the United States and Canada, offices of consumer advocates, attorneys general, environmental organizations, resource providers, foundations, governmental associations, public interest groups, and federal clients such as the U.S. Environmental Protection Agency and the Department of Justice. Our work for global clients has included projects for the United Nations Framework Convention on Climate Change, the World Bank, the Global Environment Facility, and the International Joint Commission, among others.

Alice Napoleon

Alice Napoleon is a senior associate at Synapse Energy Economics. Since joining Synapse in 2005, Ms. Napoleon has provided economic and policy analysis of electric systems and emissions regulations on behalf of a diverse set of clients throughout the United States and in Canada. She has co-authored dozens of reports and led major projects for the U.S. Environmental Protection Agency on quantifying the benefits of clean energy resources and for the U.S. Department of Energy (DOE) on strategic energy management. In collaboration with the Industrial Energy Analysis group of Lawrence Berkeley National Laboratory, she managed the development of program design resources for energy efficiency program administrators to incorporate DOE's 50001 Ready into their portfolios.

Ms. Napoleon works at the leading edge of alternative utility regulation, providing ongoing consulting services in New York's Reforming the Energy Vision (REV) process. She co-authored a report on utility performance incentive mechanisms for the Western Interstate Energy Board (WIEB). In Nova Scotia, she provided evidence regarding Nova Scotia Power's applications for approval of an advanced metering infrastructure (AMI). For the New Jersey Division of Rate Counsel, she reviewed and provided critical analysis of Rockland Electric Company's proposal to implement AMI throughout its New Jersey service territory in support of Tim Woolf's testimony before the New Jersey Board of Public Utilities.

Ms. Napoleon has provided testimony and testimony assistance before public utility commissions across the United States and Canada, including in California, Delaware, Illinois, Kentucky, Missouri, New Jersey, Nova Scotia, South Carolina and Virginia. She conducted extensive research on current federal weatherization and ratepayer-funded low-income electric energy efficiency program efforts in U.S. states and submitted testimony regarding program design and administration of low-income energy efficiency services in South Carolina and Nova Scotia. Ms. Napoleon provided extensive and ongoing expert analysis and support for the State of New Jersey regarding its state- and utility-administered residential, low-income, commercial, and industrial energy efficiency and combined heat and power programs. As a part of this effort, she conducted expert analysis, drafted testimony, and provided litigation support for the state regarding program design, budgets, performance, marketing, evaluation, cost-benefit analysis, and overlap between utility- and state-administered programs.

Ms. Napoleon previously worked at Resource Insight, Inc. where she supported investigations of electric, gas, steam, and water resource issues, primarily in the context of reviews by state utility regulatory commissions. She holds a Masters in Public Administration from the University of Massachusetts at Amherst and a BA in Economics from Rutgers University.

Ben Havumaki

Ben Havumaki consults on topics including benefit-cost analysis, industry restructuring, and rate design, with a focus on new ratemaking approaches to maximize the benefits from the increasing share of distributed energy resources in the electric power system. Recent work includes comments in the New

York State REV proceeding on energy efficiency targets and incentives and comments in Mississippi in response to a proposed change to distributed solar compensation. Mr. Havumaki also coauthored a technical brief for the Lawrence Berkley Laboratory on best practices in benefit-cost analysis of utility proposals for grid modernization investments.

Mr. Havumaki holds a Masters in Applied Economics from the University of Massachusetts, where he received the Arthur MacEwan Award for Excellence in Political Economy, and a Bachelors from McGill University. His graduate thesis research focused on hybrid energy system design in Mauritius, investigating economic and technical prospects for storage hydropower under a full-decarbonization constraint. This work is reflected in an article in *Energy Policy* on full decarbonization for Mauritius by Mr. Havumaki and collaborators, published in October 2019. Mr. Havumaki also co-authored a benefit-cost analysis primer for the World Bank entitled "World Bank Water Management, Sanitation, and Conservation Projects in Developing Countries: A Guide to Cost-Benefit Analysis."

Divita Bhandari

Divita Bhandari provides research and consulting services on a wide range of energy and electricity issues. At Synapse, Ms. Bhandari has acquired significant experience with Value of Solar and Distributed Energy Resources (DER) studies. Recently, she worked with the Solar Energy Industries Association (SEIA) to assist in the New York Value of DER (VDER) proceeding. This work involved refining the methodologies and compensation mechanism associated with "Avoided D" i.e., the locational and temporal value of avoided distribution and transmission infrastructure investments through the load reduction provided by DERs. She has also worked with Lawrence Berkeley National Labs (LBNL), performing extensive research on grid modernization plans across U.S. utilities to feed into a benefit-cost analysis framework. This framework is intended to be used by public utility commissions, energy offices, utility consumer representatives, and other stakeholders in evaluating proposed utility grid modernization investments. In addition, Ms. Bhandari has worked on a variety of electricity sector modeling projects.

Prior to joining Synapse, Ms. Bhandari worked at DNV GL where she quantified the energy savings impacts associated with energy efficiency and demand response programs. While there, she also developed regression models using electric and gas consumption data for evaluation of key programs such as home energy reports, in-home energy assessments, and strategic energy management. She analyzed AMI data for the evaluation of peak load shaved through the control of residential air conditioners. Her early career was spent working as an electrical engineer on gas turbine, wind turbine, and solar product development.

Ms. Bhandari holds a Master of Environmental Management from the Yale School of Forestry and Environmental Studies, a Master of Science in Electrical Engineering (specializing in Electric Power Systems) from the Georgia Institute of Technology, and a Bachelor of Science in Electrical Engineering also from the Georgia Institute of Technology.

Tim Woolf

Tim Woolf has more than 35 years of experience analyzing technical and economic aspects of energy and environmental issues. Before returning to Synapse in 2011, he served four years as a commissioner at the Massachusetts Department of Public Utilities (DPU), where he played a leading role in developing the Commonwealth's aggressive clean energy policies.

Mr. Woolf's primary areas of focus include electricity industry regulation and planning, power sector transformation, technical and economic analyses of electricity industry systems, energy efficiency program design and policy analysis, renewable resource technologies and policies, clean air regulations and policies, and many aspects of consumer and environmental protection. He has extensive experience with all aspects of benefit-cost analysis and was the lead author of the *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources*.

In recent years he has focused on all topics related to power sector transformation, including: distributed energy resources, performance-based regulation, new utility business models, non-wires alternatives, and distribution system planning. He also addresses a variety of related ratemaking issues, such as rate design, dynamic pricing, net metering rates, and decoupling.

During his tenure as a commissioner at the Massachusetts DPU (2007 to 2011), he oversaw a dramatic expansion of ratepayer-funded energy efficiency programs, the implementation of decoupled rates for electric and gas companies, the promulgation of net metering regulations, an assessment of smart grid pilot programs, and the review of long-term contracts for renewable energy. He also served as the President of the New England Conference of Public Utility Commissioners from 2009 to 2010, a board member on the Energy Facilities Siting Board from 2007 to 2010, and a co-chair on the Utility Motivation Work Group of the State Energy Efficiency Action Network from 2009 to 2010.

A large portion of Mr. Woolf's career has been dedicated to the review and development of energy efficiency programs and regulatory policies. His work encompasses all aspects of energy efficiency program planning and implementation, including program design, avoided cost analyses, cost-benefit analyses, cost recovery, decoupling, utility performance incentives, integrated resource planning, and other relevant regulatory policies.

Mr. Woolf has testified as an expert witness in more than 45 state regulatory proceedings and has authored more than 60 reports on electricity industry regulation and restructuring. He represents clients in collaboratives, task forces, and settlement negotiations, and has published articles on electric utility regulation in *Energy Policy*, *Public Utilities Fortnightly*, *The Electricity Journal*, *Local Environment, Utilities Policy*, *Energy and Environment*, and *The Review of European Community and Environmental Law*.

Mr. Woolf holds an MBA from Boston University, a Diploma in Economics from the London School of Economics, and a Bachelors in Mechanical Engineering and a Bachelors in English from Tufts University.

1.3. Background and Overview

Background

NB Power began rolling out Automated Meter Reading (AMR) meters, which allow collection of data via a drive-by, over 15 years ago (Exhibit NBP 1.03, Evidence, p. 12). Currently, 72 percent of NB Power's existing meters are AMR. Analog meters, which must be read manually, make up the remaining 28 percent of meters (Exhibit NBP 1.03, Evidence, p. 11).

In Case No. 375, NB Power filed a proposal to implement AMI in its service territory. Working on behalf of EUB Staff, Synapse reviewed the Company's proposal and found that the proposed investment was not cost-effective based on the case presented by NB Power. In addition, we concluded that the proposal understated the cost of the proposed AMI rollout, overstated the benefits associated with the social benchmarking program, understated the potential benefits from conservation voltage reduction opportunities, and failed to account for the potential benefits from time-based pricing. Synapse recommended that the Board reject the Company's AMI proposal and require the Company file a new AMI proposal that addresses the issues raised in our expert report.

Summary of the Current Proposal

On August 1, 2019, NB Power filed an application with the Board for a $92 million capital project to procure and deploy AMI in its service area. The Board is required to review the prudence of this proposal since it exceeds the $50 million threshold for Board approval of a capital project under Section 107 of the Electricity Act.

The proposal consists of implementation of AMI, Meter Data Management (MDM), Customer Information System (CIS), Work Force Management (WFM), and Enterprise Service Bus (ESB). The procurement for the AMI meters and communication modules, communications network, and the head end system took place in Fiscal Year 2016/2017. The contract for these elements has been executed and is contingent on Board approval of the proposal (Exhibit NBP 1.03, Evidence, p. 23-24). Requests for proposals for the MDM system, meter installation services, and system integrator have been executed and vendors selected. Contract negotiations for these components have not been completed (Exhibit NBP 1.03, Evidence, p. 24).

On a present value basis, NB Power claims that its current AMI business case has total costs of $109.6 million and total benefits of $140.7 million, for a positive net benefit of $31.1 million (Exhibit NBP 1.03, Evidence, p. 20). This business case is based on a great many assumptions, including a 5.25 percent discount rate and a 17-year analysis period (Exhibit NBP 1.03, Evidence, p. 18-19).

NB Power assumes benefits associated with reduced or eliminated costs associated with manual meter reading, meter service orders, load research, outage restoration, customer inquiries, net metering, and others. It also assumes implementation of initiatives to leverage AMI's capabilities (Exhibit NBP 1.03, Evidence, p. 18-19).

Costs in the business case include capital, operating, and installation costs for AMI meters, MDM, CIS, and ESB. NB Power includes a contingency of 2 percent on fixed capital costs (which reflect meters and hardware for which the Company has a signed contract) and on operations, maintenance, and administrative costs. NB Power applies a 10 percent contingency on variable capital costs, and an additional 15 percent contingency on CIS, WFM, and ESB capital costs (Exhibit NBP 1.03, Evidence, p. 19 and 22). The business case analysis excludes sunk costs, including the undepreciated balances on existing meters and pre-engineering expenses incurred from 2017 to 2020 (NBP(NBEUB) IR-53, Exhibit NBP 2.01, Appendix B, p. 5).

2. GENERAL ISSUES

2.1. Accounting for Technological and Grid Changes

Dated Procurement Results

The procurement for the AMI meters and communication modules, communications network, and the head end system took place in Fiscal Year 2016/2017 (Exhibit NBP 1.03, Evidence, p. 23-24). This procurement was made through a consortium of Emera affiliates, including Nova Scotia Power Incorporated, Emera Maine, and Tampa Electric Company. The Company maintains that the joint procurement resulted in a $10 million reduction in vendor costs, as well as savings in legal expenses (Exhibit NBP 1.03, Evidence, p. 23). In response to discovery, NB Power provides evidence that the joint procurement resulted in capital and operations savings, based on the difference in the per meter quotes for NB Power's meter volume (365,000 meters) and the price for the consortium as a whole (1.8 million meters) (NBP(NBEUB) IR-25).

Notably, NB Power's evidence is based on data from the time of the initial procurement. It is possible, even likely, that either product costs have declined or meter features have improved since 2016/2017. As a case in point, NB Power did not evaluate compatibility with fiber optics in its implementation of AMI, because the ability to use physical network connections was not available at the time of the initial procurement. NB Power states that "The AMI meters purchased do not support tethered physical network connections such as Ethernet or Fiber Optic and were not an option at the time of the request for proposal" (NBP(NBEUB) IR-60).

Load Forecast

We have concerns that the load forecast is used inappropriately. The load forecast used as input in calculating the benefits of each program does not take into account the overlapping energy savings from the variety of AMI-based programs that have simultaneous benefits. We are also concerned that key inputs to the study that rely on the load forecasts and load profiles may have been inaccurately estimated.

The load forecast forms the basis for a number of the calculated benefits from the AMI program. The key benefits impacted by the load forecast include the following:

1. Distribution network losses. The distribution network losses benefits are calculated at 0.25% of the load for residential, industrial, and general service customers.
2. Meter accuracy losses. The benefits from reduced meter accuracy losses are estimated at 0.5% of the load for residential, industrial, and general service customers.
3. High Bill Alert service. The benefits associated with High Bill Alert services is estimated at 0.7% of the residential load.

An overestimation of the load in any of these benefit categories would result in an overestimation of the total benefits to the overall AMI capital project. However, in addition to impacting each of these programs individually, NB Power may be double-counting energy savings from each of the overlapping programs that are dependent on the load forecast. Not adjusting the load forecast appropriately to account for the incremental savings from the conservation programs (High Bill Alert and CVR program) would result in an inaccurate inflation of the benefits in other categories that are dependent on the load forecast. This concern regarding the impact of double-counting of the savings has not been addressed sufficiently by NB Power.

In addition to directly impacting the benefits, there are key inputs in the AMI business case that are dependent on the load forecasts and the load profiles. For example, calculation of the CVR factor is dependent on the load profiles and the amount of Distributed Generation (DG) on the system (Exhibit NBP 3.01, Appendix D.A., p. 5). An inaccurate estimate of load profile and DG would impact that CVR factor, which is currently estimated to be 0.5. As stated by Kinetrics, "The present low penetration of Distributed Generation (DG) may facilitate CVR, but further consideration should be given to the interaction of CVR schemes and DG if higher levels of DG penetration are anticipated." A lowering of the CVR factor due to inaccurate load profiles or underestimated DG penetration would result in a lower energy savings from the AMI-based CVR program.

2.2. Vagueness in the Proposal

Overall, this proposal suffers from a lack of sufficient detail in several key areas. NB Power does not describe the technology that will be used to deliver data to customers or the rationale for the latency between energy usage and data delivery. It also omits important details about certain benefits and is vague about how it will leverage AMI in the future to generate additional benefits for its customers.

The Company mentions a customer portal "enabled by AMI to facilitate viewing of daily consumption and the provision of alerts (such as High Bill Alert service) to aid in managing consumption" (Exhibit NBP 1.03, Evidence, p. 22). While the benefits of the High Bill Alert program are monetized by NB Power and represent a significant component of overall proposal net benefits, it appears that the value of a customer portal goes beyond just serving as a platform for high bill alerts. NB Power also asserts that its AMI program will produce qualitative benefits through "increased customer control, choice, and innovation," which presumably all depend upon the portal (Exhibit NBP 1.19, Appendix G, p. 6).

Unfortunately, the utility has not detailed how this portal will function, or even specified its technological form. In response to interrogatories, NB Power subsequently asserts about the portal that, "The solution design will be completed during the implementation phase of systems deployment, so at present the technical decisions have not yet been made" (NBP(NBEUB) IR-13 (a)). It appears that the Company is considering both a standalone device and a web-based interface. Similarly, when asked about the latency in data availability, NBP indicated that, "The latency of data transfer will depend on several factors, including vendor solution design and configuration of the AMI communication infrastructure" (NBP(NBEUB) IR-13 (b)). Without more details on these central issues, it is difficult to evaluate whether the proposal is truly cost-effective and maximizes net benefits.

Lack of Detail about Benefits

NB Power has not provided sufficient detail about specific benefits. For example, the Company has not detailed how its High Bill Alert program will function. Nor has it offered any substantive context from other jurisdictions to justify any program design specifications and projections for future benefits. We discuss issues in benefit projections in greater detail in the following sections.

Lack of Detail about Leveraging AMI for Future Applications

AMI may serve as a powerful foundation for future value-added applications, but NBP has not provided sufficient detail on how it may leverage AMI to increase customer benefits.

Leveraging AMI for Distributed Generation

NB Power projects a rapid increase in solar net metering over the next decade. In particular, the forecast shows an unexplained spike in 2027, with a year-over-year increase of over 150 percent. In 2028, there is a 77 percent increase in solar net metering systems (NBP(NBEUB) IR-78).

In NBP(NBEUB) IR–45, NB Power indicates that it "is undertaking or plans to undertake" the following initiatives related to distributed generation:

- An analysis of the value provided by distributed generation
- A review of net metering and embedded generation policies
- A review of rate designs in support of EUB Matter 357 – NB Power Rate Design
- Development of requirements for distributed generation connection
- Development of distributed generation controls
- Development and implementation of a distributed energy management system
- Automation of billing processes for net metering customers
- Smart Community Projects (Shediac)

Notably, NB Power does not indicate the status of these initiatives. Beyond status, it is not clear how NB Power plans to use AMI to maximize efficiency in integrating new DG installations. Some of the initiatives could be geared toward smoothing DG integration—e.g., interconnection requirements, DG controls, and the distributed energy management system—but the lack of description and details leaves their purpose, scope, and granularity up for interpretation.

Leveraging AMI for Electric Vehicles

There has been an uptick in electric vehicle (EV) sales in the province. From 2016 to 2018, the number of registered EVs has grown on average by over 55 percent per year (NBP(NBEUB) IR-14(a)). In 2019, the increase in registered EVs jumped 79 percent from January to June. If EV registrations in the second half of the year keep track with the first half, 2019 EV registrations will increase by over 150 percent over 2018 registrations.

NB Power expects the EV market in New Brunswick to continue growing. According to NB Power's projections, EV registrations will rise 440 percent over 10 years from 2019/2020 to 2028/2029. Likewise, NB Power expects electricity sales for EV charging to grow dramatically, from 0.6 GWH in 2019/2020 to 27 GWh in 2028/2029—a 44-fold increase (NBP(NBEUB) IR-14(b)). However, electricity sales for EV charging remains a relatively small portion of total energy supply, about 0.2 percent in 2028/29 (Exhibit NBP 06.02 NBP(NBEUB) IR-70, p. 4 and 59).

AMI can give the Company a better picture of the electric system. NB Power notes that an important benefit of AMI is that it provides "the data necessary to understand the impact of dynamic load changes caused by DERs and enable NB Power to sustain energy service levels to all customers" (NBP 1.03, p. 14). But these insights do not, by themselves, shape demand. Without ratemaking and other interventions, new loads, such as from EVs, could exacerbate existing system peaks or create new ones.

We are aware that a stakeholder process is currently underway to review and make recommendations on ratemaking. We do not know the extent to which this process is considering the increase in EVs and DG on the system.

If the AMI investment is approved, we encourage the Board to revisit the findings of the stakeholder process in the future, to account for the capabilities and improved visibility afforded by AMI.

2.3. Treatment of Uncertainty

NB Power engaged Navigant Consulting, Ltd. (Navigant) to perform an independent third-party assessment of the AMI business case and benefit-cost model (Exhibit NBP 2.01, Appendix B, p. 1). As a part of the assessment, Navigant conducted a sensitivity analysis on three of the claimed benefits (participation rate in the High Bill Alert program, distribution network losses reduction, and AMI contribution to CVR energy savings) and three of the cost categories (meter installation costs, system integration costs and utility labor costs to run AMI systems). Sensitivities were also run on model-wide assumptions including the escalation rate for costs and benefits, discount rate, meter life, and opt-out rate (Exhibit NBP 2.01, Appendix B, p. 2). See Table 1 for a summary of the variables considered in the analysis.

Table 1. Sensitivity analysis assumptions

Key Sensitivity Variables	% of Costs or Benefits	Low	Base	High
Key Benefit Sensitivities				
Conservation Voltage Reduction *Electricity Savings Attribution to AMI*	11.6%	0%	20%	30%
High Bill Alert *Participation Rate*	10.9%	60%	90%	95%
Distribution Network Losses *Reduction in Electricity Generation*	10.7%	0.10%	0.25%	0.50%
Key Cost Sensitivities				
Meter Installation Costs *Electric Meter Installation Costs*	9.1%	n/a	-	+25%
System Integration Costs, CIS & ESB *Total Costs*	7.6%	n/a	-	+100%
AMI Operations Team *Number of AMI Managers*	7.1%	n/a	-	+ 2 Managers
Financial / Project Sensitivities				
Escalation Rate	n/a	1.5%	2%	2.5%
Discount Rate	n/a	4.0%	5.25%	6.5%
Meter Life	n/a	n/a	15 years	20 years
Opt-Out Rate	n/a	n/a	0%	2%

While Navigant's analysis considered the High Bill Alert participation rate, it did not consider another key assumption for this program—the savings rate per participant. As discussed in Section 3.1, there is uncertainty about the rate of savings from the proposed High Bill Alerts program. In light of this uncertainty, it is not clear why Navigant did not run a sensitivity on the assumed savings rate.

An additional concern with the Navigant analysis is that Navigant did not model any combined cases, e.g., considering the impact of low avoided distribution network losses and high system integration costs. Each sensitivity adjustment was tested independent of all others (NBP(NBEUB) IR-89).

In response to discovery, NB Power provided "best" and "worst" cases for each of the costs in Table 3.2 of the Evidence and summed all of the worst-case and best-case impacts (NBP(NBEUB) IR-20). These cost scenarios are provided in Table 2, below.

Table 2. NB Power's lower and upper case present value costs

	Present Value Costs	Lower (worst case)	Upper (best case)	Variance
3.2.1	AMI Capital	$50.1	$49.2	$0.9
3.2.2	AMI Operating	$11.5	$11.2	$0.3
3.2.3	MDM Operating	$10.1	$9.9	$0.2
3.2.4	Meter Installation Capital	$9.9	$9.0	$0.9
3.2.5	CIS/WFM/ESB Capital	$8.4	$6.6	$1.8
3.2.6	MDM Capital and AMI Project Team	$7.3	$6.7	$0.6
3.2.7	CIS/ESB Operating	$6.0	$5.8	$0.2
3.2.8	Corp Services & Other Capital	$2.8	$2.7	$0.1
3.2.9	Utility Tax	$2.6	$2.4	$0.2
3.2.10	Corp Services & Other Ops	$0.7	$0.7	$0.0
3.2.11	Pre-Engineering Capital	$0.1	$0.1	$0.0
	Total	$109.6	$104.3	$5.2

The assumptions underlying the best and worst cases have not been described. NB Power states that "[t]he costs in Table 3.2 represent the worst-case scenario as it includes contingencies for each cost. The best case is that none of the Project Contingencies are required" (NBP(NBEUB) IR-20). Based on NB Power's explanation, and the narrow range between the best- and worst-case outcomes, it appears that the contingency may be the only difference between the two cases. NB Power's assumption that the contingency represents the range of best- and worst-case outcomes implies that there are no possible outcomes in which the costs exceed the budgeted amount plus the contingency. While it is possible that the budgeted cost plus contingency would be adequate in a *likely* set of outcomes, it is easy to imagine outcomes in which the cost categories without signed contracts and contract caps could exceed budgets by large amounts—well more than the 26.5 percent maximum contingency on any one cost item (Exhibit NBP 1.03, Evidence, p. 22). Indeed, Navigant's sensitivity analysis considers a 100 percent increase in system integration costs (Exhibit NBP 2.01, Appendix B, p. 30). While Navigant's high cost assumption may be more reasonable, as noted previously, Navigant did not consider any cases in which more than one factor performs poorly.

Another factor that does not appear to be considered in NB Power's analysis is risk of project delay. NB Power indicates that not having access to adequate staffing resources is a critical risk to the AMI project. This is because it requires knowledge and support from a wide variety of areas within the Company, many of which are technical and in high demand (NBP (NBEUB) IR-17(a)). The impact of this risk can be an increase in both the cost and duration of the project by more than 30 percent (NBP (NBEUB) IR-17(a)). While the Company has taken steps to mitigate this risk by procuring outside legal and system integrator services, the need for internal staff to participate in decision-making and perform other critical functions—and the risk that staff will not be available when needed—remains.

Likewise, in NBP(NBEUB) IR-46, NB Power notes large, adverse impacts associated with a delay in implementation of AMI. While NB Power uses these financial costs as an argument for moving forward now, delays are a likely if not inevitable part of any large, multi-faceted project. While some of the financial risks associated with a delay would likely fall on the vendor once a contract is signed, others would not. For example, the loss of personnel to retirement or other opportunities would be a risk with any project delay, not just one that occurs before the contract is signed.

Notably, NB Power has not conducted field trials. Instead, the Company has set up a test lab connected to some of its back-end systems (NBP(NBEUB) IR-16). While the test lab should bring some issues to light, field trials would provide the Company with a better picture of the complications that are likely to arise during the rollout. NB Power has claimed that their ability to engage the system integrator in advance is limited due to the requirement to stay within 10 percent of the total cost of the AMI capital project prior to EUB approval (NBP (NBEUB) IR-26). Conversely, without having done these trials, NB Power has a less accurate picture of system integration challenges, risks, and the ultimate costs.

NB Power also provided best and worst cases for each of the benefits in Table 3.5 of the Evidence (NBP(NBEUB) IR-20). The results of these benefit scenarios are provided in Table 3, below.

Table 3. NB Power's lower and upper end present value benefits

				Difference	
Present Value Benefits	Lower End ($ million)	Current ($ million)	Upper End ($ million)	Current - Low ($ million)	Upper - Current ($ million)
Reduced Manual Meter Reading and Meter Services Orders	$39.90	$39.90	$39.90	$0.00	$0.00
Avoided Meter Replacement Costs	$21.60	$22.00	$22.00	$0.40	$0.00
Conservation Voltage Reduction	$15.80	$16.20	$16.70	$0.40	$0.50
High Bill Alert Service	$10.30	$15.40	$16.20	$5.10	$0.80
Distribution Network Losses	$15.00	$15.00	$30.00	$0.00	$15.00
Meter Accuracy Losses	$9.40	$11.50	$14.40	$2.10	$2.90
Avoided Cost of Load Research Program	$5.20	$5.20	$5.20	$0.00	$0.00
Avoided Cost of Net Metering Program	$4.40	$4.80	$4.80	$0.40	$0.00
Avoided Cost of Meter Services Manager Salary	$1.80	$1.80	$1.80	$0.00	$0.00
Avoided Cost of Meter Reading Vehicles	$1.80	$1.80	$1.80	$0.00	$0.00
Outage Restoration (Crew Management)	$1.60	$1.60	$1.60	$0.00	$0.00
Reduced Customer Inquiries	$1.40	$1.40	$1.40	$0.00	$0.00
Avoided Cost of Handheld System	$1.40	$1.40	$1.40	$0.00	$0.00
Unbilled / Uncollectable Accounts	$1.20	$1.20	$1.20	$0.00	$0.00
Avoided Cost of Meter Reading Supervisor	$1.00	$1.00	$1.00	$0.00	$0.00
Reduced Overtime for Meter Service Orders	$0.60	$0.60	$0.60	$0.00	$0.00
Total	$132.40	$140.70	$160.00	$8.30	$19.30

As shown in Table 3, total benefits included in the proposal (labeled "current") are $140.7 million. The sum of the lower end benefits is $132.4 million, $8.3 million less than total benefits in the proposed, base case. The sum of the upper end benefits is $160.0 million, $19.3 million more than total benefits in NB Power's proposed case.

The benefits included in the proposal are not the midpoint between the lower-end and upper-end benefits. This may indicate that NB Power has taken a conservative approach by selecting assumptions that are more in line with the lower end. However, as with costs, it is not clear whether these scenarios represent best and worst cases. Furthermore, while NB Power appears to be taking a conservative approach with some individual benefit categories, it is not with others. For example, as discussed in Section 3.1, the benefits from the High Bill Alert program may be overstated. In this case, NB Power has apparently used optimistic assumptions to arrive at a present value benefit of $15.4 million—much closer to the upper-end benefits of $16.2 million than the lower-end benefits of $10.3 million. A uniformly conservative approach would result in smaller total benefits and reduced net benefits for the lower-end case.

2.4. Financial Position of the Company

NB Power expects AMI to make its financial position worse in the short to mid run, but to improve it over the long run. NB Power projects an increase in net earnings over the 2021 to 2030 period in the case with AMI (the 10-Year Plan case) compared to a case without AMI (NBP(NBEUB) IR-01). The extent to which the longer-term risks associated with AMI-enabled future revenue streams have been considered is not clear. Uncertainty increases further into the future, and other, unanticipated factors could impact the breakeven point and benefits and costs of the AMI investment.

2.5. Alternatives Considered

NB Power has not conducted a thorough analysis on alternatives for rolling out AMI. Since a large portion of the existing meters have not reached end of life (NBP (NBEUB) IR-53a) a complete analysis comparing the different rollout possibilities is required to justify a full meter rollout across NB Power territory in the short timeframe.

NB Power provided the results of an analysis of a partial rollout of AMI in its service area (150,000 meters). The business case model for the partial rollout (NBP (NBEUB) IR-02b) includes a number of assumptions that are inconsistent with the assumptions in the full rollout business case model (Exhibit 1.07). The inconsistencies include use of a lower marginal cost of power in the partial rollout business case (NBP (NBEUB) IR-02b, “Key Assumptions” tab) than was used to calculate the benefits in the business case model for the proposed full AMI rollout (Exhibit 1.07, “Key Assumptions” tab). A higher marginal cost of power (such as the value used in the full rollout business case) would result in higher benefits. This lower marginal cost of power could be understating the benefits of implementing the partial business case and should be clearly justified.

In addition, the load forecasts for the business cases are different. The load forecast for the full rollout business case is higher (Exhibit 1.07, “Key Assumptions” tab, and NBP (NBEUB) IR-02b, “Key Assumptions” tab). NB Power should provide full justification for the difference in load between each of the business cases, since this would also understate the benefits of the partial rollout business case. Finally, the benefits of the partial rollout are not calculated over the same time period as the full rollout business case—the NPV benefits for the partial rollout business case are calculated through 2033 whereas the NPV benefits for the full rollout business case are based on a calculation through 2036 (NBP (NBEUB) IR-02b, “E_Benefits_Summary Table” tab, and Exhibit 1.07). Any other assumptions and methodologies that differ between the business cases need to be clarified for purposes of comparison.

In addition to these larger inconsistencies, the classification of programs into benefit categories is different between the business cases. For example, the full rollout business case has a benefit category related to the High Bill Alert program, while the partial rollout business case does not. In addition, the key inputs associated with the partial rollout business case are not available in a separate tab as they are in the case of the full rollout business case (See tab “Inputs” in Exhibit 1.07) which makes comparison between the business cases difficult.

In addition to the inconsistencies between the partial and full rollout business cases, NB Power suggests that geographic concentration of meters is required in order to make limited deployment “economically viable.” The Company states, “Selective meter replacement based on meter age or functionality is not feasible because AMI radio mesh communication requires a concentration of meters in a geographic area. Since both analog and AMR meters are dispersed across the province, there are no concentrated geographic areas that make a limited deployment economically viable” (NBP (NBEUB) IR-53). However, no study has been conducted to specifically understand the geographic concentration needs and whether it is necessary to geographically deploy a “required” concentration of meters to make the business case economically viable. In response to a request for such a study, NB Power responded that “With respect to the potential for higher opt-out levels in specific geographic areas, NB Power has not conducted additional studies to determine the threshold for “financial viability” (NBP(NBEUB) IR-97).

Based on the above, a partial rollout option comparable to the full rollout case has not been provided. It appears that NB Power did not fully investigate a partial rollout option. In the absence of well-supported alternative rollout options, there is no clear justification for a full rollout.

2.6. Consistency in Inputs and Assumptions

Optimizing benefits from an AMI implementation is a complex undertaking that calls for holistic system planning and modeling. As we discussed previously with respect to NB Power’s load forecast, certain key inputs wield a significant influence over multiple distinct categories of benefits. These benefits in turn may interact with each other.

It is critical that consistent assumptions be used in the benefit-cost analysis. However, we note that the utility appears to have used inconsistent assumptions in its business case to formulate its projections of different benefits and costs. For example, NB Power used different future analog meter replacement scenarios in its calculation of two benefits: the avoided meter replacement benefit and the avoided meter accuracy losses benefit. We address this specific issue in greater detail in later sections.

3. Issues with NB Power's Projected Benefits

3.1. High Bill Alert Program Benefit

The proposed High Bill Alert program provides a new benefit stream not included in Matter 375. NB Power estimates that the total value of these benefits will be $15.4 million (present value) over the program life—approximately 11 percent of the present value benefits claimed by the utility. NB Power does not report any incremental costs associated with deployment of the program.[1]

In response to the first interrogatories to NB Power from the Board, the Company explains that a similar program was not included in its previous AMI proposal because NB Power "did not contemplate offering this program at the time" (NBP (NBEUB IR-80 (a)).

As described by NB Power, the High Bill Alert program assists enrolled customers in reducing their energy usage by notifying them when their electricity consumption is on track to exceed normal levels (Exhibit NBP 1.03, Evidence, p. 27). The benefit estimate in turn is dependent upon several key inputs. NB Power assumes a 10 percent opt-out rate and a 0.70 percent energy savings per enrolled customer. Savings are valued using the average marginal cost of power.

The size of the overall benefit value asserted by NB Power is highly sensitive to the utility's assumptions about program participation and energy savings. Regarding the assumed energy savings, Dunsky Energy Consulting notes that, "...there is currently limited information available regarding verified energy savings from other high bill alert programs" (Exhibit NBP 1.11, Appendix C, p. 2). In support of its energy savings assumption, Dunsky cites a recent case from Nova Scotia in which the provincial regulator approved Nova Scotia Power's estimate of 0.75 percent energy savings per program participant. This factor, according to Dunsky, is very similar to the results of a randomized controlled trial conducted by Oracle with a utility in the American Midwest.

Dunsky suggests that Nova Scotia's results should be applicable to New Brunswick because the two provinces are generally similar, and that two key distinctions—the greater penetration of electric space heating in New Brunswick and lesser affluence of its population—are likely to be offsetting. The assumption is that greater reliance on space heating in New Brunswick will reduce the impact of the High Bill Alert program, while the province's comparatively lesser means will make it more responsive to alerts. Yet there is no basis for concluding that these factors are in fact operating in equal and opposite directions. Indeed, it is not even clear that the New Brunswick's less affluent population is likely to be more responsive to high bill alerts than Nova Scotia's. Perhaps those New Brunswick residents with fewer disposable dollars have already constrained their energy consumption to the extent possible, for

[1] The program would most likely be subject to separate cost-effectiveness screening, and so the issue of associated costs would necessarily be subject to scrutiny. While NBP (NBEUB) IR-131 provides preliminary benefit-cost analysis, a full review should be undertaken.

example, by leveraging the consumption and bill data already provided through NB Power's Home Energy Alert program.

As such, there is no robust basis for assuming that New Brunswick's results will be similar to Nova Scotia's projections.

Dunsky's assumed 10 percent program opt-out rate is similarly not supported by any robust evidence from the field. As Navigant Consulting noted in its sensitivity analysis of NB Power's business case, "…the assumption of a 90% customer response rate [is] potentially high" (Exhibit NBP 2.01, Appendix B, p. 12). This input may in fact be reasonable, but it deserves further review.

Navigant suggests that Dunsky's participation rate assumption could be reasonable with sufficient customer education efforts from NB Power. Yet NB Power has not detailed how it plans to educate customers on this program, and it has also not provided detail on the design of the portal and any in-home data display—both of which may influence the efficacy of high bill alerts.[2] It is incumbent on NB Power to provide this necessary detail so that the Board can properly evaluate the projected costs and benefits of this program along with other AMI functionalities.

3.2. Avoided Meter Accuracy Losses and Reduced Theft Benefit

The utility asserts that installing new AMI meters will correct for "accuracy losses" in its existing stock of aging meters. As meters age, the Company explains, they tend toward under-measuring electricity consumption. With new AMI meters, the utility will be able to accurately gauge consumption at all sites and will reap new revenues from previously unmetered energy units. NB Power suggests that the avoided meter accuracy losses be valued at the retail rate, since they will result in new retail revenues for the utility.

In the current case, NB Power estimates the present value of the AMI benefits from avoided meter accuracy losses at $11.5 million, equivalent to over 8 percent of total benefits or 37 percent of the total claimed net benefit of the AMI investment. The estimate provided by NB Power in this proposal represents an increase of about $5.7 million over the estimated value of this benefit in Matter 375. This discrepancy is due to a change in valuation methodology; in Matter 375, these avoided losses were valued based on avoided and/or deferred capacity, and fuel and purchased power costs (Exhibit NBP 1.08, Appendix Ai, and NBP (NBEUB) IR-42).

[2] In NBP(NBEUB) IR-38, NB Power states that the final design and functionality of the High Bill Alert service has not been chosen. Yet several design variables may affect the behavioral response achieved through the High Bill Alert program. As the Company illustrates in its response to NBP(NBEUB) IR-119, existing high bill alert programs are variable in their designs, with differences in how data is delivered, how frequently, and with what degree of customizability. Moreover, programs may be either opt-in or opt-out. It is not surprising then to see a large spread in reported savings, ranging among NB Power's sample of programs from 0.7 percent to 1.8 percent. While the programs in these jurisdictions surely differ in other important ways, it also seems likely that differences specific to the high bill alert program designs are playing a role in the different savings rates achieved in each of the jurisdictions.

There are several potential issues with NB Power's assessment of this benefit:

(1) It is not clear that NB Power's portrayal of the beneficiaries—who benefits, and why—is correct.

(2) We are concerned with using the retail rate to value incremental kWh reads.

(3) The utility's projection for how much new energy will be metered once the aging analog infrastructure is replaced requires careful review. We discuss each of these issues below.

Determining the Beneficiary

The greatest concern with NB Power's assessment of this benefit is in its portrayal of who benefits (first and second issues). The utility explains that newly metered energy units, which under the status quo are being consumed but not paid for, will generate new revenues that will be recovered by the Company. Since these incremental sales will be priced at the retail rate, NB Power asserts that this is the appropriate factor for use in valuing this benefit. While correcting for meter reading issues may in fact result in an increase in revenues for the Company, this is apt to be a temporary phenomenon. Since NB Power is able to come in for rate adjustments on an annual basis, it is reasonable to surmise both that current rates effectively provide the utility with its revenue requirement in spite of some undercounting, and that this is achieved through slight inflation of rates above where they would be if all energy units consumed were accurately metered.

Therefore, while replacing slow meters with accurate ones might produce an influx of revenues for the Company, this new revenue tranche would be temporary. It would also likely represent a surplus above the utility's revenue requirement. NB Power suggests as much in indicating that it expects that correct metering would ultimately result in reduced rates for all customers (NBP(NBEUB) IR-42).

Critically, the issue with unmetered energy appears to be an equity one. Under the status quo, if NB Power is successful in collecting its revenue requirement, then rates must necessarily account for the effect of unmetered energy. Effectively, this means that rates are likely a bit higher than they would be if all customers paid for all energy that they consumed—a dynamic that is not unlike theft or other distribution system losses. The result is cross-subsidy from customers with accurate meters to those with slow meters. The first cohort pays more than they should on a cost-of-service basis, while the second cohort pays less than their due. In any case, to the extent that replacing aging meters changes rates to their proper cost-of-service level, the benefit that is conferred on the system is one of equity, with no direct relationship to the retail energy rate and with no clear increase in net benefits to society as a whole.

Issues in NB Power's Accounting for this Benefit

Setting aside the issue of how to properly characterize and value the benefit of avoided meter accuracy losses, we now consider NB Power's analysis on its own terms (second and third issues).

First, we consider the utility's estimate that replacing its stock of analog meters with AMI will lead to a 0.5 percent increase in kWh reads. This figure derives from a 2010 EPRI white paper and is based upon field results in which utilities have seen increases of between 0.5 percent and 1.0 percent in reads following upgrading meters to AMI (Exhibit NBP 1.03, Evidence, page 28). The projected increase in reads associated with AMI is also supported by NB Power's Meter Quality Assurance shop (Exhibit NBP 1.05, Attachment 1, page 6).

It is not clear that the cited EPRI white paper actually supports NB Power's conclusions. The utility asserts that the white paper finds that utilities which have upgraded their metering infrastructure may see between a 0.5 and 1.0 percent increase in kWh reads (Exhibit NBP 1.03, p. 28). While we were unable to find any mention of these figures in the report, there is other data provided that may cast some light on the question of meter accuracy deterioration.

The white paper indicates that "The most common "failure" mode is reduced registration." However, it also notes that "Failure modes also exist that could cause an electromagnetic meter to run fast but are less common" (Exhibit NBP 5.10, NBP(JDI) IR-10a, p. 5). The paper then illustrates the results of large sample studies. First, a graph is presented based on a sample of 400,000 meters showing that meter registration declines at an increasingly steep rate with age, reaching an average of approximately 97.25 percent at 20 years. A second graph, apparently based on the same sample, shows that 98.6 percent of all meters from this sample (two standard deviations above and below the mean) were within 2 percent registration (Id, p. 6).

Unfortunately, NB Power has not demonstrated that the data presented in the EPRI paper are applicable to its stock of meters. The average age and model characteristics of the analog stock may be critical factors in determining whether, and to what extent, metering inaccuracy arises. It is worth noting too that the EPRI white paper acknowledges meter failure in the opposite direction—over-registering energy resulting in excessive bills. It is not clear whether NB Power has considered over-registration in meters too. While its estimated meter accuracy loss factor may account for both slowing and speeding-up of reading, this matter has not been satisfactorily addressed.

Moreover, we have concerns about NB Power's assumptions about the baseline, non-AMI scenario that are used in calculating the total energy savings for this benefit. Whatever the extent to which NB Power's analog stock of meters under-reads energy, the benefit that is claimed for AMI in resolving this issue through replacement of old meters with new, accurate ones must be calculated with respect to expected future accuracy losses over the course of the entire business case period—not the current, status quo condition. Therefore, NB Power's plans to replace analog meters in a non-AMI baseline scenario is a key input, which also factors into the calculation of the avoided meter replacement benefit. To the extent that the Company will replace analog meters in a non-AMI scenario, the resulting meter accuracy improvements should be reflected (subtracted from) the meter accuracy gains that are attributed to AMI.

NB Power does not appear to have used consistent input assumptions for future baseline analog meter replacements across these two benefits. In response to the second interrogatories from the Board, the

Company indicated that if it were to use the meter-replacement assumptions from the Avoided Meter Replacement benefit in the Meter Accuracy benefit, the net present value of this benefit would fall by $3.2 million (NBP(NBEUB(IR-99)).

Finally, even within NB Power's framework for this benefit, there is concern about using the current retail rate to value newly read energy. As the utility explains, should all consumed energy be billed, retail rates would be expected to fall. It is thus not clear why the utility has chosen to use current, rather than future (corrected) retail rates to value this benefit.

3.3. Conservation Voltage Reduction

Conservation Voltage Reduction (CVR) is a technology that reduces energy consumption by optimizing the voltage levels. The energy savings benefit obtained from CVR programs are often achieved through AMI meters. The quantity of energy savings that can be achieved by such programs depend on a number of factors including the load profiles, the nature of the end uses on the system and the topology of the distribution system within the territory.

Based on the study conducted by Kinetrics, the benefits attributed to the CVR program through installation of the AMI meters have a present value of $16.2 million over the program life (Exhibit NBP 3.01, Appendix D.A. and Exhibit NBP 3.02, Appendix D.B.). There are two categories of benefits that have been estimated under the CVR program: (1) the avoided energy from implementation of the CVR program and (2) the avoided cost from a Non-AMI CVR program.

Although the benefit categories may be appropriate, the immediate concern regarding the Non-AMI CVR program is its significant cost and its inclusion as an avoided costs (benefit) without a complete benefit-cost analysis or a rigorous analysis of the lower cost alternatives. The total capital cost of implementing the Non-AMI CVR program is estimated at approximately $20 million (Appendix D.B, Table 6-2). The incremental capital and operating cost of the Non-AMI CVR program (over the AMI-based program) has been estimated at net present value of $9 million and included directly as a benefit (in the form of an avoided cost). The energy savings-related benefits are based directly on the incremental savings of the AMI-based CVR program over the Non-AMI CVR program, which are estimated at a net present value of $7 million. The $9 million in avoided costs of the Non-AMI CVR program plus the $7 million in energy savings from the AMI-based CVR program result in the total $16.2 million in benefits of the AMI-based CVR program.

Lack of transparency on how the Non-AMI program costs and benefits were assessed raises questions as to whether this avoided cost (included as a benefit) has been overestimated. Further, it is not clear if the savings from the Non-AMI CVR program have been accurately assessed in order to ensure that the incremental benefits attributed to an AMI-based program have not been inflated. Without a complete analysis of the Non-AMI CVR program, it is difficult to validate the full benefits associated with the AMI-based program.

In addition, the cost of the end of the line sensors was based on pricing obtained from Grid 20/20 for the OptaNode sensors and DVI for licensing (Exhibit NBP 1.05, Attachment 1, p. 3) and no other alternatives were seriously considered or scoped for the Non-AMI CVR program (NBP(NBEUB) IR-94).[3]

3.4. Other Benefits

Load Limiting

Load limiting could be carried out by utilities either through the installation of physical load limiting devices or enabling load limiting through AMI meters. Load limiting by NB Power involves utilizing the AMI meter to limit the capacity of electric service at a customer's site to 15 amps (Exhibit NBP 1.05, Attachment 1, p. 15). Utilities appear to consider this level of service to be sufficient to allow enough electrical energy for a furnace fan to run and to provide the load-limited customer with heating service during the winter.[4] The load limiting program would be done in lieu of disconnection and therefore reduce the unbilled/uncollected bills incurred by the utility through disconnection.

NB Power quantified the benefit as the reduction in write-offs from avoiding disconnection of delinquent customers. The reduced write-offs from load limiting result in an estimated present value benefit of $1.2 million (Exhibit NBP 1.05, Attachment 1, p. 15). This benefit is based on limiting the load over one month during the winter (for a total of 14 days).

Load limiting programs have been proposed or implemented in other Canadian jurisdictions, including Manitoba Hydro[5] and EPCOR in Alberta[6]. In Ontario, load limiting appears to be prohibited. The Ontario Energy Board ordered that, "no electricity distributor may install a load limiting device in respect of a residential customer's premises solely by reason that the customer is in arrears on the payment of their electricity bill." [7] The Ontario order suggests that there are potential concerns with a load limiting program.

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[3] The OptaNode sensor was considered as an example of the voltage monitoring component of a non-AMI-based CVR system. Non-AMI-based CVR systems incorporate discreet voltage monitors placed at locations on feeders (as opposed to using the voltage monitoring feature of electronic smart meters in an AMI system). Other local voltage monitoring options were not assessed in the work reported in Exhibit NBP 3.02, Appendix D. Other technologies may have more, or fewer, features than the OptaNode. In this analysis, however, the point was to determine whether utilizing discreet voltage monitors could satisfy the requirements on the benchmark CVR system.

[4] Manitoba Hydro. 2009. Bill Assistance Report, p. 5. https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/gra_2010_2012/Appendix_44-Attachment_2.pdf.

[5] Manitoba Hydro. 2009. Bill Assistance Report. https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/gra_2010_2012/Appendix_44-Attachment_2.pdf.

[6] Alberta Utilities Commission. 2017. EPCOR Distribution & Transmission Inc.: 2017 Revised Terms and Conditions. http://www.auc.ab.ca/regulatory_documents/ProceedingDocuments/2017/22630-D01-2017.pdf.

[7] Ontario Energy Board. 2017. Winter Disconnections and Launch of Review of Customer Service Rules. https://www.oeb.ca/newsroom/2017/winter-disconnections-and-launch-review-customer-service-rules.

We have identified numerous issues associated with the program that have not been addressed. See NBP (NBEUB) IR-125. Some of the key issues concerning this type of program include:

1. It is not clear that the proposed load limiting program would ensure adequate heating during extreme weather conditions. There could be numerous variables that impact a customer's energy usage during the winter, and a blanket 15 amp limiting service has not been fully justified as being sufficient to meet winter electricity needs.
2. The program could have severe impacts on vulnerable and low-income customers. For example, consumers with medical conditions and/or disabilities will be impacted by such programs—including customers that require additional electricity service for operating medical equipment.
3. Electric heat load penetration in NB Power territory is 67 percent. Sixty-five percent of the energy sales in NB Power territory are attributed to electric heat and hot water.[8] This suggests that the number of customers impacted by a load limiting program could be large. It is not clear that the characteristics of the jurisdictions considering load limiting are similar enough to warrant comparison.
4. The AMI proposal does not address customer engagement and communication on the proposed load limiting program. Customers need clear communication on when and how the load will be limited in order to react to reduced service. This has not been addressed in the utility proposal.
5. Above and beyond the installation of the AMI meter and system, there would likely be incremental costs of implementing such a load limiting program (such as investment in load limiting software, customer communication and engagement, etc.). It is not clear if such costs have been quantified and included in the AMI business case.

Net Metering

For participants in the Company's net metering program, NB Power replaces existing meters with bi-directional meters that can measure both delivered and received energy. Because AMI meters would have this capability, the Company projects that it would avoid $4.8 million (present value) in costs for meters for the net metering program and associated back office work (NBP 1.03, Evidence, p. 30).

However, the Company's assumptions regarding the rate of growth of net metering customers, and thus meters which would incur capital and additional administrative costs under the case without AMI, has not been adequately justified. As noted in Section 2.1, solar net metering shows an unexplained spike in 2027.

Distribution Network Losses

NB Power states that AMI will avoid distribution network losses associated with over- or under-sized assets and reduced theft (Exhibit NBP 1.03, Evidence, p. 28). NB Power claims benefits of $15 million associated with these reduced losses, amounting to almost 11 percent of total benefits or about 50 percent of the total claimed net benefit of the AMI investment. However, NB Power does not have

[8] Appendix D.A, Page 4.

historical data related to distribution system losses resulting from over- and under-sized assets (NBP(NBEUB) IR-40). Further, the data NB Power provides on historical theft support a relatively small savings—on the order of around $40,000 per year based on NB Power's known occurrences of power theft over the past seven years (NBP(NBEUB) IR-40). Thus, roughly 97 percent of the distribution network losses benefit is apparently due to enhanced sizing of system components. Further, the magnitude of the savings is poorly justified. In Exhibit 2.01, Navigant states that that "a loss reduction of this magnitude is reasonable and is consistent with the inputs in other comparable AMI business cases Navigant reviewed" (Exhibit NBP 2.01, Appendix B, p. 13). However, it is problematic to rely on an estimate from another jurisdiction as the sole source of an assumption.

4. ISSUES WITH NB POWER'S PROJECTED COSTS

4.1. System Integration

As noted previously, NB Power has not conducted field testing (NBP(NBEUB) IR-16).[9] NB Power states that, "should meter or network equipment fail NB Power acceptance tests, NB Power will not start deployment until issues are resolved by the vendor. This could cause a delay in the start of meter deployment. Through sector acceptance, NB Power will test meters and network equipment throughout the project. Failures in product testing could cause NB Power to stop deployment until issues are resolved" (NBP(NBEUB) IR-16). Given the lack of field testing and planning for system integration, the system integration costs put forth by the Company may be low.

NB Power suggests that the risk associated with system integration costs is fully captured by the contingency. The Company applies a 10 percent contingency on variable capital costs, and an additional 15 percent contingency on CIS, WFM, and ESB capital costs (Exhibit NBP 1.03, Evidence, p. 19 and 22) including system integration. When asked for justification of the specific contingency amount, the Company stated, "The vendor in question had responded with a fixed price bid, although, because negotiations are not yet complete, changes in scope may occur. The 15 per cent contingency was determined to be appropriate due to the fixed price bid, the fact that procurement is nearly complete and that the risk is manageable. A further 10 per[cent] contingency was added to the total System Integrator costs given that this is a variable capital cost, which is consistent throughout the model" (NBP(NBEUB) IR-110). Based on this, it appears that NB Power has not conducted a quantitative risk analysis to justify the specific amount of the contingency.

[9] The Company explains that planning has not commenced because "NB Power is required to stay within 10 per cent of the total cost of the AMI capital project prior to EUB approval" thus limiting NB Power's ability to engage the system integrator in advance (NBP(NBEUB) IR-26).

System integration will draw on both internal and external resources, and a contingency on a vendor bid will not capture the extent to which internal resources will be taxed. In light of these considerations, system integration costs may be higher than claimed by the Company.

5. RECOVERY OF UNDEPRECIATED BALANCES ON EXISTING METERS

If the Board approves the AMI investment, the currently installed meters will be removed from service. These meters have, on average, more than 10 years of economic useful life remaining (NBP(NBEUB) IR-53). Once removed, these meters will no longer be used and useful. NB Power expects that $15.6 million in remaining net book value will be written off (NBP 1.03, Evidence, p. 41). NB Power requests that a deferral account be established, to amortize the expense of the existing meters over a five-year period (NBP 1.03, Evidence, p. 41).

The existing meters represent an investment that has already been undertaken, i.e., it constitutes a sunk cost. The implementation of AMI has no impact on this cost, and thus it is appropriate to exclude it from the business case. Still, NB Power will be simultaneously recovering costs on the new AMI system and the meters being replaced. This raises two concerns: affordability and double recovery of metering costs.

Affordability concerns should have a bearing on the decision to proceed with the AMI investment, independent of the results of the business case. NB Power has not done a rate and bill impact analysis regarding the AMI investment but states that “the assessment completed indicates that the rate impacts of AMI over the next 10-year period are negligible” (NBP(NBEUB) IR-19). While it is plausible that rate impacts are small, this conclusion is unsupported without a rate and bill impact analysis.

Another concern is that allowing two sets of meters in rate base at the same time would create double recovery of metering costs. Assessing customers the full burden of an asset that is no longer used and useful is contrary to commonly accepted ratemaking principles. Other jurisdictions that have considered AMI investments have addressed this issue in different ways. The Nova Scotia Utility and Review Board and the Public Service Commission of Maryland both allowed their investor-owned utilities to recover costs of the existing meters to be replaced by AMI, but not the return on these meters (including the cost of debt).[10,11] In California, the Public Utility Commission granted Pacific Gas and Electric some return on legacy meters but at a rate below the typical return on equity. In making this decision, the Commission took into account that while the asset would no longer be used and useful, the Commission

[10] PSC of Maryland. June 3, 2016 order. In the Matter of the Application of Baltimore Gas and Electric Company for Adjustments to its Electric and Gas Base Rates. Case No. 9406.

[11] Nova Scotia Utility and Review Board 2018. Decision in the Matter of an Application by Nova Scotia Power Incorporated for approval of Capital Work Order CI# 47124 for its Advanced Metering Infrastructure Project in the amount of $133,228,952. M08349.

had encouraged the utility to switch to smart meters.[12] As another example, the Kansas Corporation Commission allowed Kansas City Power and Light Company to recover legacy meter costs over a 10-year amortization period but disallowed a return on the unamortized costs.[13]

While all of these decisions apply to investor-owned utilities, the ratemaking principles are relevant to NB Power nonetheless. In New Brunswick, the Board could disallow recovery of the cost of debt on the existing meters, deny the proposed five-year accelerated depreciation of the existing meters, or reduce the recovery of the remaining costs of the existing meters by some other means.

6. TRACKING METRICS AND REPORTING REQUIREMENTS

Since 2015, NB Power has been required to file quarterly updates on its AMI program implementation (NBEUB, Matter 271, Order 03131). The Company is already subject to five Key Performance Indicators (KPI) associated with the *Energy Smart NB* program, of which the AMI initiative is a part (NBP(NBEUB) IR-12). NB Power also reports that it has formulated plans for monitoring AMI deployment and achievement of benefits with metrics and other follow-up analyses (NBP(NBEUB) IR-16).

NB Power calls for metrics to track project execution, equipment deployment, and benefits (NBP(NBEUB)IR-16). NB Power also proposes additional metrics for customer engagement. Yet the Company provides little information about its plans to leverage AMI for future programs and applications, no less metrics to measure its progress in this aspect.

Metrics related to project execution and equipment deployment

The Company reports that it plans to track metrics for project execution to "specifically track progress through the project by the System Integrator and project execution team in terms of project milestones, cost/budget against a baseline, and schedule against a baseline" (NBP(NBEUB) IR-16). The planned metrics for equipment deployment will "track the progression of physical asset deployment in the field, and will be critical to measuring the performance of team installing communications infrastructure and meters on premises" (NBP(NBEUB) IR-16).

NBP suggests the following metrics related to the "transition from legacy meters to AMI meters" ((NBP(NBEUB) IR-10):

- Percentage of network infrastructure installed

[12] California Public Utilities Commission 2011. Decision on Pacific Gas and Electric Company Test Year 2011 General Rate Increase Request. Dockets U39MA.09-12-020, I.10-07-027.

[13] Kansas Corporation Commission 2015. Order on KCP&L's Application for Rate Change, Docket No. 15-KCPE-116-RTS, p. 21.

- Number of meters installed
- Percentage of opt-outs
- Number of meter-related calls to customer service both during and post deployment

Notably, these metrics do not address the timing of actual milestone achievement relative to planned, nor do they capture how actual project costs compare with planned project costs. Further, NB Power suggests that defining metrics be deferred until project execution once approval and engagement has occurred (NBP(NBEUB) IR-16).

Metrics related to specific benefits

NB Power describes a robust approach to following up on projected benefits:

> "Each benefit is assigned to a business (sic?) owner and a member of the Executive (sic?) who have been informed, educated and support the benefit and its calculation. The expectation has been set that each benefit will be tracked and monitored and that benefit owners will be held accountable for the achievement of their assigned benefit(s)…
>
> "…NB Power has a well-established investment governance framework for its capital projects. Major projects such as AMI have executive oversight committees that are responsible for establishing the strategic direction, business case review and the on-going monitoring of project progress. As part of the governance framework a Benefits Realization document is prepared after each project is closed. Once a project (greater than $1 million) is complete, a Benefits Realization Review must be conducted to determine if the expected benefits were achieved, explain any variances to the project budget, schedule and scope, and identify lessons learned" (NBP(NBEUB) IR-16).

This framework vests responsibility for achievement of individual benefits in key company personnel and using data to track progress. NB Power indicates that it will use the "unit(s) of savings as identified in the benefits sheets as the metrics to evaluate the benefit achievement" (NBP(NBEUB) IR-16). The utility plans to provide this data in conjunction with its required annual reporting through Matter 271. However, the "unit of savings" approach to metrics proposed by the Company lacks details on the specific types of benefits to be tracked and the units and methodologies for tracking them.

Customer engagement

NB Power has expressed commitment to continued customer education in support of its AMI program. In response to interrogatories, the Company indicates that it will be "attentive to customer feedback during and after the transition to AMI meters in an effort to gauge customer satisfaction and make adjustments to the implementation plan if warranted" (NBP(NBEUB) IR-10).

In support of its *Communication and Engagement Strategic Plan*, NBP has specifically proposed to track the following:

- Customer surveys

- Employee surveys and feedback
- Web analytics
- Customer care statistics
- Media monitoring and analysis
- Issues and concerns tracking at all touch points (customer case, and external engagement such as public information sessions, community liaison committees, home shows, etc.)[14]

Deployment of future value-added offerings

As discussed before, the Company provides little information about its plans to leverage AMI for future programs and applications beyond what it has discussed in its application. NB Power mentions demand-side management (DSM) several times, but it is evident that the Company intends to provide many other value-added services in the future. In an interrogatory response, NBP offers only a nonspecific vision of these other offerings:

> "Once AMI is fully deployed, load profile data will be available for all customers in the province. The load profile data will be used along with customer segmentation data to design programs that customers want and will enrich customer experience with DSM…
>
> "The investment in AMI infrastructure is designed to enable new services and additional value throughout the meters' lifetime. This will lay the foundation for achieving the third KPI, Product and Services net income" (NBP(NBEUB) IR-12).

In response to a separate interrogatory, the Company indicates that it "…has not made specific decisions regarding programs and tools that will be implemented leveraging the capabilities enabled by AMI with the exception of the High Bill Alert Program" (NBP(NBEUB) IR-49).

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

NB Power's AMI proposal raises several concerns, both general issues and ones that can be readily quantified in the business case.

Regarding general issues, the proposal does not appear to capture the latest AMI technology and features because it relies on a stale, nearly three-year-old procurement. Further, it appears that the

[14] NB Power. *Smart Meters: Communications and Engagement Strategic Plan*. P. 10.

Company did not fully consider the viability of alternatives, including a partial rollout. In addition, we are concerned that the proposed investment will put the Company in a modestly worse financial position in the near term while producing uncertain benefits in the mid-to-long term future. NB Power's proposal to write off the meters to be replaced raises concerns about customer rate impacts and may violate general ratemaking principles.

Overall, the proposal lacks sufficient detail in several key areas. NB Power does not describe the technology that will be used to deliver data to customers or the rationale for the latency between energy usage and data delivery. It also omits important details about certain benefits and is vague about how it will leverage AMI in the future to generate additional benefits for its customers.

With respect to costs and benefits that can be readily quantified in the business case, NB Power has presented a proposal that, under plausible conditions, would result in benefits to ratepayers. However, we have identified numerous concerns with claimed benefits and estimated costs. These concerns include:

- Reduced meter accuracy represents a change in the distribution of costs rather than a true benefit and should not be included in the business case.
- The High Bill Alert program has not been designed, and estimates of savings for this program are poorly supported and are likely overstated.
- The load limiting program has not been designed, raises equity concerns, and should not be included as a benefit.
- The estimate of benefits from distribution network losses is poorly supported, as NB Power does not have historical data related to distribution system losses resulting from over- and under-sized assets.
- System integration costs may be understated, and the contingency does not appear to adequately address the risk that these costs could be higher than forecast.

In addition, we have identified issues that would likely have an impact on the business case:

- The avoided costs of the Non-AMI CVR program are not well supported and could be understated.
- An increase in distributed generation could negatively impact savings associated with CVR.
- The load forecast used as input in calculating the benefits of each program does not consider the overlapping energy savings from the variety of AMI-based programs that have simultaneous benefits. Also, key inputs to the study that rely on the load forecasts and load profiles may have been inaccurately estimated.
- The forecast spike in net metering in the mid 2020's is poorly supported, and thus these benefits could be overstated.

Under different plausible conditions the proposed AMI might not provide net benefits to customers. This could occur, for example, if the benefits from High Bill Alert or distribution network losses are less than expected, or system integration costs are higher than estimated by NB Power.

The sensitivity analysis conducted by Navigant did not model any scenarios in which two or more of cost and benefit types have unfavorable results. While NB Power did provide "best" and "worst" cases in response to discovery, this analysis does not represent a reasonably broad range of plausible outcomes.

Below we present an illustrative, alternate scenario for the AMI project. In this scenario, we consider some factors that appear to be particularly uncertain or risky: we remove reduced meter accuracy losses and load limiting benefits entirely, consistent with the reasons noted in the body of this report; High Bill Alert and distribution network losses benefits are reduced by 50 percent; and system integration costs are increased by 50 percent.

Table 4. Illustrative alternative AMI project scenario

	NB Power estimate	Adjustments for Alternative Scenario	Net benefit (cost) in Alternative Scenario
Adjustments to NB Power's estimates			
Meter accuracy losses	$11.5M	($11.5M)	-
Load Limiting/ unbilled/uncollectable	$1.2M	($1.2M)	-
High Bill Alert	$15.4M	($7.7M)	$7.7M
Distribution network losses	$15M	($7.5M)	$7.5M
System integration	($8.4M)	($4.2M)	($12.6M)
Sum of all other benefits and costs	($3.6M)	-	($3.6M)
Total	**$31.1M**	**($32.1M)**	**($1.0M)**

Importantly, as raised in Appendix G (Exhibit NBP 1.19), there are other, unquantified benefits that are likely to result from implementation of AMI. These other benefits may more than offset the net costs shown above. NB Power, however, has not provided enough information on the unquantified benefits to allow the Board to consider how they might affect the business case. Further, an approval of the proposed investment would likely shift the risk onto ratepayers.

In sum, we conclude that (a) the business case is not well documented or justified, (b) there are plausible future scenarios where the AMI investment might provide net benefits to customers, but (c) there are plausible conditions where it might not.

7.2. Recommendations

Given that the Company's business case is not entirely clear on the net benefits of the proposed AMI, we recommend that the Board conditionally approve the AMI. The Board should require the Company submit a revised application (within 60 or 90 days). The Board should put the Company on notice that it will approve the revised application if the following conditions are met:

- The revised application provides better documentation and justification for the proposal and addresses all the concerns raised in our report.
- The revised application includes a new benefit-cost analysis which removes or reduces any benefits that we think are too questionable, e.g., reduces the value of the reduced losses, and includes a more reasonable estimate of costs.
- The revised application should include a detailed set of metrics consistent with our recommendations, along with a plan for reporting and presenting the results consistent with our recommendations.

If the Board decides that the business case documentation is sufficient for an investment of this magnitude and the cost and benefit estimates are reasonable despite the issues discussed above, then it should approve the proposed AMI. In this case, however, we recommend that the Board take steps to increase the likelihood that the AMI will provide net benefits to customers by applying a set of metrics to the AMI program.

Establish tracking metrics and reporting requirements

If the Board decides to approve the investment, we recommend that it require the Company to report on an expanded set of metrics covering AMI deployment, utilization, and benefits, as well as customer engagement and deployment of future value-added offerings and technologies.

Reporting should build on the existing framework established in 2015 but should include additional metrics. As the AMI program is ancillary to the overall goals of the *Energy Smart* program and is anticipated to specifically support realization of its five KPIs, we stress that contribution of AMI to these KPI must also be reflected in the AMI metrics framework.

A complete metrics program should be implemented at the outset, should the Board approve NB Power's proposal, rather than deferring any portions to be formulated by the system integrator as suggested by the utility, or through any other future process. The Board should engage a stakeholder group to guide development of these metrics and should retain the authority to subsequently revise any of the existing metrics or to add new metrics. We also encourage the Board to require that all metrics reported by NB Power, including those unrelated to the AMI program, be collected and reported in a single online "dashboard" that is contextualized (compared against both baselines and targets over time) and easily accessible for customers and other stakeholders.

The AMI performance targets should be based on the assumptions made by NB Power in its business case (as one example, the projected incremental energy savings from the High Bill Alert program could serve as a metric target). This will allow the Board to monitor how well AMI is performing over time relative to the business case provided by the Company. This data should be displayed alongside performance data on the metrics dashboard.

In the following, we show NB Power's proposed metrics and our suggested metrics in the areas of AMI deployment and utilization, claimed benefits, customer engagement, and deployment of future value-added applications.

Table 5. Proposed and suggested AMI metrics

Performance area	NB Power metrics	Additional metrics
Transition from legacy meters to AMI meters	• Percentage of network infrastructure installed • Number of meters installed • Percentage of opt-outs • Number of meter-related calls to customer service both during and post deployment	• Timing of actual achievement of project milestones compared with planned timing of project milestones • Actual project costs compared with planned project costs (disaggregated to the level at which different contingency percentages were applied) • Customer satisfaction with transition from legacy meters to AMI meters (based on customer satisfaction surveys)
Achieving claimed benefits	No specific proposal	• Actual opt-out for High Bill Alert (number of customers) • Actual energy savings for High Bill Alert (kWh) • Actual incremental metered energy due to avoided meter accuracy losses (kWh) • Actual total avoided distribution system losses (kWh) • Actual avoided losses due to theft (kWh) • Actual meter reading labor expenses (nominal dollars) • Actual meter reading other O&M expenses (nominal dollars) • Actual AMI meter O&M expenses (nominal dollars) • Actual AMI meter failures (number) • Actual CVR savings (kWh) • Total net metering enrollment (number of systems) • Total net metering capacity (kW) • Outage restoration (estimated reduction in major event duration due to AMI) • Load limiting (number of disconnections for nonpayment)
Customer engagement	• Customer surveys • Employee surveys and feedback • Web analytics • Customer care statistics • Media monitoring and analysis • Issues and concerns tracking at all touch points	• Customer awareness of AMI benefits and features (percent of customers)
Deployment of future value-added applications and technologies	No specific proposal	• Smart thermostats (number of customers and customer saturation) • Home energy displays (number of customers and customer saturation) • Appliance control switches (number of customers and customer saturation) • Other demand response (number of customers and customer saturation) • Integration of renewable generation (GWh) • Expanded use of electric vehicles (number of vehicles) • Microgrids (number of customers served, percent of customers served)