STATE OF NEW YORK

PUBLIC SERVICE COMMISSION

Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation d/b/a National Grid for Electric Service.	Case 17-E-0238
Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation d/b/a National Grid for Gas Service.	Case 17-G-0239

DIRECT TESTIMONY

OF

UIU AMI PANEL

Dated: August 25, 2017
Albany, New York

UTILITY INTERVENTION UNIT
DIVISION OF CONSUMER PROTECTION
NYS DEPARTMENT OF STATE
99 WASHINGTON AVENUE
SUITE 640
ALBANY, NY 12231-0001
www.dos.ny.gov

I. INTRODUCTION AND OVERVIEW OF TESTIMONY

Q. Would the Panel please state their names and business addresses?

A. **(Johnson)** My name is Ben Johnson, and my business address is 5600 Pimlico Drive, Tallahassee, FL 32309.

(Collar) My name is Gregg C. Collar, and my business address is 99 Washington Avenue, Suite 640, Albany, NY 12231-0001.

Q. By whom are you employed, in what capacity, and what are your professional backgrounds and qualifications?

A. **(Johnson)** I am employed as a consulting economist and president of Ben Johnson Associates, Inc.®, an economic research firm specializing in public utility regulation. My background and qualifications are set forth in my testimony as part of the UIU Rate Panel.

(Collar) I am a Utility Program Analyst with the Utility Intervention Unit (UIU) of the New York State Department of State's Division of Consumer Protection. My background and qualifications are set forth in my separate direct testimony.

Q. What is the nature of this testimony?

A. We discuss the proposal of Niagara Mohawk Power Corporation d/b/a National Grid (Niagara Mohawk or the Company) to invest in Advanced Metering Infrastructure (AMI). We recognize and support the Public Service Commission's (PSC or the Commission) policy of upgrading to more sophisticated meters consistent with the Commission's Reforming the Energy Vision (REV). (See Case 14-M-0101, Order Adopting a Ratemaking and Utility Revenue Model Policy

Framework, Issued and Effective May 19, 2016 (REV Ratemaking Order). However, UIU has several concerns about Niagara Mohawk's plan for deploying AMI. Our testimony is focused on specific aspects of the Company's AMI plan, as reflected in the Electric and Gas Advanced Metering Infrastructure Business Case For Niagara Mohawk Power Corporation d/b/a National Grid, dated April 28, 2017 (Niagara Mohawk AMI Business Case).

We focus on a handful of issues not extensively discussed in the Niagara Mohawk AMI Business Case and suggest further exploration using the benefit cost modeling capabilities the Company developed. UIU's silence on other AMI-related issues does not indicate support or opposition to the remainder of the Company's plan for investing in AMI. We reserve the right to respond on rebuttal to other AMI-related issues the parties may raise.

Q. How is your testimony organized?

A. Our testimony has eight sections. This first section is an introduction to the forthcoming testimony. Second, we summarize our recommendations. Third, we discuss background information concerning AMI and the importance of thoroughly scrutinizing the Benefit Cost Analysis (BCA) for the proposed AMI investments, including appropriate sensitivity scenarios. Fourth, we discuss the estimated cost-benefit analysis. Fifth, we discuss the estimated costs included in Niagara Mohawk's BCA for AMI. Sixth, we discuss the Company's estimated AMI benefits. Seventh, we discuss the timing of Niagara Mohawk's proposed AMI investments. Eight and finally, we discuss the Company's benefit to cost ratios.

II. SUMMARY OF RECOMMENDATIONS

Q. Would you please briefly summarize your recommendations?

A. Our overarching recommendation is that more analysis must be done before the Commission endorses the Company's AMI plan. To facilitate this information gathering, we recommend the Company enhance its BCA model to better support sensitivity testing and complex scenarios.

First, the Company should provide the ability to accurately assess alternative deployment schedules, to measure the impact of both unscheduled and scheduled delays in specific parts of the implementation plan, and other timing-related issues. This will make it feasible to study the optimal timing of AMI deployment and allow the Commission and other parties to examine in detail what would happen if problems are encountered during specific stages of the planning and deployment process.

Second, the Company should add multiple, explicit, category-specific contingency factors in the model. This would enable the Company and other interested parties to experiment with various scenarios, thereby acquiring a deeper understanding of the risk that items might have been overlooked, or that individual cost estimates might have been significantly underestimates.

We also recommend that the AMI plan not be approved until after detailed analyses of bill impacts have been developed and studied. Given how low some of the SCT ratios are, it is important to understand how many customers will enjoy a net benefit from AMI, and how many will be burdened with added costs that outweigh the benefits they will enjoy. Further, the Commission should give careful thought to the question of whether time-of-use rates are implemented on

an "opt-in" or "opt-out" basis, and the associated uncertainties concerning the timing and magnitude of how customers will react to either option. This has a major impact on the BCA bottom line; unless the Commission commits to an opt-out approach, there is a high risk that the AMI project will have societal costs in excess of societal benefits.

In sum, unless significant behavioral modification occur, AMI will not yield the level of benefits needed to ensure that the costs are justified. This is one area where the passage of time may greatly illuminate our understanding of the dynamics involved. Over time, Niagara Mohawk and other utilities will learn more about this issue and the policy trade-offs as a result of ongoing REV pilot projects. More information will provide greater assurance that the benefits will exceed the costs by a wide margin. Until that assurance can be provided, it would be better to postpone any firm decisions concerning AMI deployment in Niagara Mohawk's service area.

III. ADVANCED METERING

Q. Can you please briefly explain your understanding of AMI?

A. Yes. AMI includes digital meters that measure and record electricity usage data hourly (or more frequently), and facilities that provide two-way communication between electric and gas companies and their customers.

A. Impact on Operations

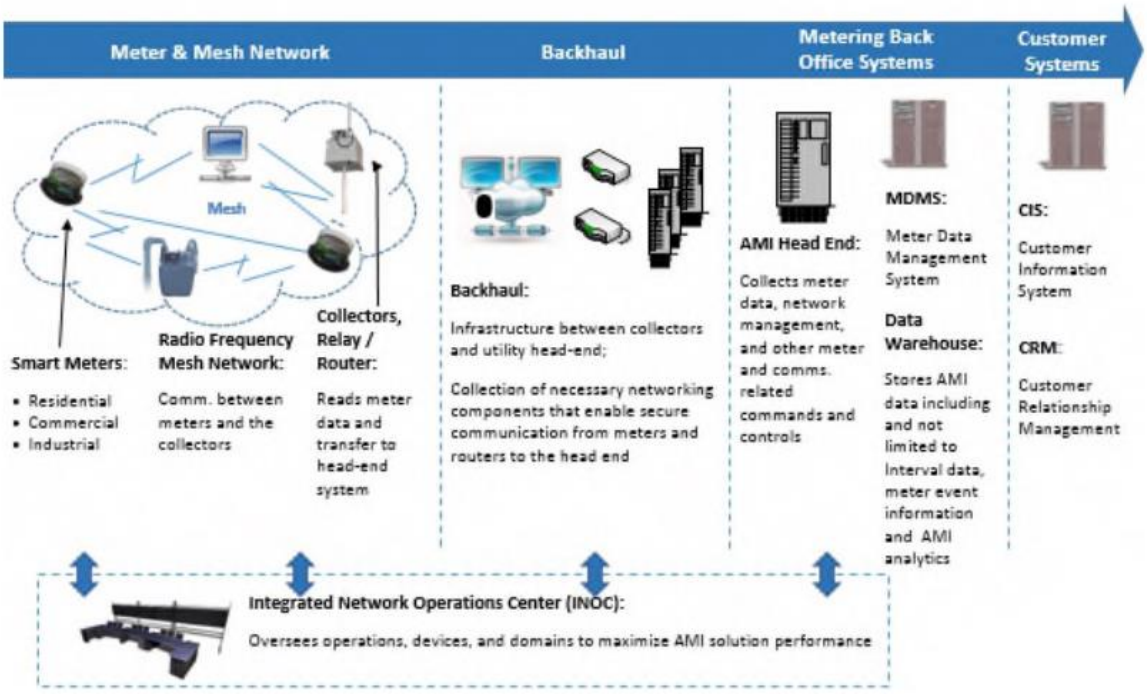
Q. Aside from metering, does AMI offer operational benefits?

A. Yes. AMI offers many benefits, compared to traditional meters. Many of these benefits relate to the utility's ability to communicate with the meter from a central location, thereby eliminating the need to send an employee to read the meter each month, turn the power on when a new tenant moves into an apartment building, or turn it off when the tenant moves out or fails to pay the bill (after due notice). The Company has identified many other benefits, both small and large. It also describes some hard-to-quantify advantages to investing in state-of-the-art metering as they relate to REV.

> Niagara Mohawk . . . proposes full service territory deployment of Advanced Metering Infrastructure ("AMI") to include electric and gas smart meter technology, as well as supporting infrastructure and systems. Such deployment builds the foundation to support fundamental change in the energy future of the Company's customers, the electric and gas distribution system and the State of New York. (Niagara Mohawk AMI Business Case, page 4.)

Q. Are you familiar with the overall architecture of the proposed AMI system?

A. Yes. The following diagram is helpful. (See Niagara Mohawk AMI Business Case, April 28, 2017, page 15).



As this diagram makes clear, AMI is a complex computerized system with many different parts and extensive new hardware and software that need to function well together. The meters must work well with the Company's data management and billing systems and everything must interconnect with a Radio Frequency Mesh Network, which includes connections to a cellular telecommunications carrier and potentially other backhaul communications lines (not explicitly shown in the diagram).

Q. Is there a connection between AMI and REV, as it relates to the Company's operations?

A. Yes. The information technology deployed through AMI can play a part in facilitating the emergence of new market participants, more widespread deployment of Distributed Energy Resources (DERs), and other fundamental

market transformations. If well-designed and successfully implemented, AMI could be fundamental to the Company's future role as the provider of Distributed System Platform (DSP) services in the same way that meters, structures, and wires were fundamental to its role as the provider of electrical distribution services. AMI could assist with the Commission's REV objectives:

> By investing in AMI, National Grid will be taking a key step toward achieving the "Reforming the Energy Vision" (REV) objectives discussed in the Public Service Commission's ("Commission") Order Adopting Regulatory Policy Framework and Implementation Plan 1 and enabling the Company to assume the role of the Distributed System Platform Provider (DSP). (Niagara Mohawk AMI Business Case, page 1.)

The Company's AMI proposal may also provide an opportunity to expand into profitable new computer technology-based services:

> By investing in AMF [Automated Meter Functionality], National Grid will be taking a key step toward achieving these REV objectives as well as enabling the Company to assume the role of the DSP. In this role, utilities will construct, operate, and maintain highly integrated technology platforms, allowing the incorporation of third-party owned DERs, which can include DR, EE, storage, and on-site generation. These technologies will be tightly integrated into the utilities' distribution infrastructure. (Niagara Mohawk AMI Business Case, pages 12-13.)

B. Impact on Customers

Q. What will be the impact of AMI on customers?

A. The impact of AMI will vary depending on their individual circumstances. The most positive impact will tend to be felt by customers who use a large volume of energy and can shift their usage away from critical peak hours, assuming they are willing

to take advantage of the enhanced flow of information and pricing options AMI affords.

Whether customers benefit depends on many different factors, including their willingness and ability to modify their consumption patterns in response to newly available price signals or market offerings and – most especially – the amount of energy they use each month. The more energy they use, the more likely they are to benefit from AMI.

Q. Can you provide any insights into how and why benefits will vary, depending on each customer's situation?

A. Yes. The benefits of AMI will flow primarily as a function of energy usage and secondarily as a function of the customer's ability and willingness to take advantage of new market offerings and technologies. Because of this secondary complication, the extent to which any one customer – or any type of customer – will benefit from AMI cannot be easily predicted. It is unknown whether anticipated benefits will exceed the costs of AMI implementation.

The decision to move forward AMI should be based on net benefits to society. The Commission acknowledged this fact when it decided that AMI and other REV investments will primarily be guided by the costs and benefits to society as a whole as reflected in the Societal Cost Test ("SCT"):

> The Commission adopts SCT as the primary measure of cost effectiveness under the BCA Framework. The SCT recognizes the impacts of a DER or other measure on society as a whole, which is the proper valuation. New York's clean energy goals are set in recognition of the effects of pollutants and climate change on society as a whole, and only the SCT

> would both properly reflect those policies and create a framework for meeting those goals. (Case 14-M-0101, Order Establishing the Benefit Cost Analysis Framework, Issued and Effective January 21, 2016 (BCA Framework Order) p. 12).

Nevertheless, it is unknown whether anticipated benefits will exceed the costs of AMI implementation. Thus, we think it is important to ensure that the benefits of AMI will outweigh the costs to society by a reasonably large margin.

We also understand that some customers may not receive the full benefit for a system they are paying for. The disparity between those customers who benefit versus those who do not may be greatly exacerbated if the project just barely passes the SCT. Unless the societal benefit to cost ratio exceeds 1.0 by a wide margin, many customers could be worse off.

IV. ECONOMIC BENEFIT COST ANALYSIS

Q. What is an economic benefit cost analysis?

A. A BCA is a highly structured, objective, well-established technique for helping resolve difficult issues involved with planning and budgeting projects that serve the broad public interest – projects where traditional capital budgeting techniques tied to standard profit-maximization analysis will not suffice. Formal economic cost-benefit analyses have been widely used to assess the desirability of many different types of public infrastructure projects for more than 50 years. The United States Army Corps of Engineers, which helped originate the concept, has been using cost-benefit analysis since the early 1900's.

For example, benefit cost analysis is useful in deciding how much to budget for flood control and other public works projects because it provides an objective

way of evaluating and comparing competing proposals for new dams, levees, and other potential projects in various locations. Benefit cost analysis can reduce the role of political decision making by identifying which projects are financially worth pursuing in the face of budget constraints. Since the early 1960's, economists have developed an extensive body of literature on the subject, exploring many subtle and arcane aspects of the analytical process that can prove useful when tackling overwhelmingly difficult tasks.

Q. Do you have some concerns related to Niagara Mohawk's economic benefit cost analysis in this proceeding?

A. Yes. Additional scenarios need to be studied, and some revisions to the Company's AMI plan may be needed before the Commission endorses it. If the AMI plan is approved as filed, the Company's rate base will be hundreds of millions of dollars larger in future proceedings. The Company's stockholders will benefit from this investment, regardless of how well it pans out in practice, since customers reimburse AMI-related costs and stockholders earn a return on this investment.

If the cost estimates are inaccurate or the benefits less than expected, the adverse impact of any mistakes will fall on customers, not stockholders. Accordingly, Niagara Mohawk's support for AMI investments should not be determinative. If important, lingering questions remain unanswered by the end of this proceeding, we believe it would be better to postpone a final decision on the AMI plan, rather than risk the adverse consequences of a poorly timed, poorly planned, or inefficiently deployed investment in AMI.

Accordingly, the Commission should not simply consider whether the proposed AMI investment is consistent with the goals of REV, or whether the BCA meets the minimum requirements specified in the Commission's BCA Framework Order or the Company's Revised BCA Handbook.

Properly applied, economic benefit cost analysis provides a systematic, sophisticated tool ensuring that the aggregate economic benefits from the Commission's efforts to advance the public interest will exceed the cost to society of striving to achieve policy goals. While the mechanics of the process may be unfamiliar to some, the underlying principles are similar to the ones that explain how competitive firms strive to maximize profits, which in turn leads to greater economic efficiency and benefits for society as a whole. Here, the key difference is that the immediate goal is not to maximize Niagara Mohawk's profits, but to maximize the Net Present Value of the stream of probable future benefits to its customers if the Company is authorized to invest in AMI.

V. AMI COSTS

Q. Can you please briefly summarize the societal costs which have been identified in the Company’s BCA?

A. Yes. The following table summarizes the Net Present Value of the stream of costs which are projected to occur over the 20-year time horizon used in the BCA.

Societal Costs	Net Present Value ($ Millions)
Meter Equipment and Installation	$ 292.3
Communication Equipment and Installation	12.7
IT Platform and Ongoing IT Operations	226.6
Project Management Operations	76.4
Total	$ 608.0

As can be seen in this table, the two largest cost categories are for (1) purchasing and installing the meters, and (2) the computer hardware and software systems used to handle and process the flow of information provided by (and to) the meters.

A. Cost Estimation Uncertainties

Q. Do you have any concerns about the cost estimates used in the BCA?

A. Yes. We assume the Company and its consultants have conscientiously tried to estimate these costs as accurately as possible. However, for the reasons mentioned earlier, these efforts do not eliminate our concern that some of the costs may be higher than estimated.

Given this inherent uncertainty, we are troubled that the Company has not provided any sensitivity analyses to allow the Commission and other parties to examine what will happen if various costs are underestimated, or unexpected problems are encountered that were not anticipated during the planning process.

We are also troubled that no explicit "contingency factor" was included in the BCA to allow for the possibility that items might have been overlooked or that some of the individual cost estimates may have been significantly underestimated. The absence of such a contingency factor raises serious concerns in this context, where the Company has limited experience with procuring and installing AMI meters.

Q. Do you have any other concerns about the cost estimates?

A. Yes. We are also concerned that the AMI plan appears to include newly developed software systems that will need to be specified, designed, coded, and integrated on a highly customized basis. While portions of this software may be available "off the shelf," there will undoubtedly be a significant amount of custom adaptation and integration required. Such customization is especially likely where, as here, AMI is envisioned as a critical component in a fundamental transformation of the Company's operations. While some ambitious software development and integration projects proceed smoothly on time and on budget, others do not.

The classic book "The Mythical Man Month" vividly demonstrates how difficult it can be to recognize problems within software development projects or to solve these problems once they become apparent. Adding more people to the project will not necessarily solve the problems – and can even make the problems worse. Given the history of cost over-runs and schedule delays encountered by even highly successful firms that specialize in software development (like Microsoft), there is no guarantee that Niagara Mohawk will be able to complete the software and systems-related portions of the AMI project on time and on budget.

Ratepayers will also bear the risk of cost over-runs for construction and installation of the mesh network hardware, as well as the cost of installing the meters. There is a risk of cost over-runs that could arise due to a myriad of potential sources, including (1) overlooking cost elements during the budgeting process, (2) underestimating component costs, (3) unanticipated technical problems encountered in the field, (4) difficulties obtaining regulatory approvals, (5) supply shortages, vendor difficulties or other delays in obtaining key pieces of equipment, and (6) unanticipated shortages of qualified labor, work stoppages, or other labor strife. Absent an iron-clad guarantee that the stockholders will absorb all costs exceeding the budgeted figures used in the BCA, it is critically important to evaluate the potential impact of these sorts of problems beforehand. The simplest method is to modify the BCA to allow a reasonably large contingency factor to be added to all cost components in the BCA. This would be a relatively simple step, which would facilitate different sensitivity runs. These sensitivity runs should be examined before reaching any firm conclusions about the Company's proposed AMI plan.

Ideally, the Company would provide detailed sensitivity analyses which focus on specific risks and combinations of risks, which study the potential impacts of specific scenarios or alternative cost assumptions, and which consider the odds that these problems might arise. Another benefit is that this analytical process may reveal opportunities to reduce risks, scale back or phase-in the riskiest parts of the plan, or to adjust other details of the plan to increase confidence in the cost estimates and reduce the risk of over-runs.

For a similar reason, discussions with software developers, system integrators, engineering firms and other vendors should be initiated to evaluate the extent to which they would be willing to contractually take responsibility for the risk of schedule delays or cost over-runs attributable to specific potential issues – and how much of a premium they would require to accept that risk.

B. Anticipated Economic Life

Q. Do you have any other specific concerns related to the cost portion of the BCA?

A. Yes. We believe the assumed economic life may be overly optimistic. In an industry where most major investments are used for 40 to 60 years, a life cycle of 20 years for meters and related equipment might seem conservative. But in this context, the more apt comparison might be with the typical life cycle of personal computers, cell phones, televisions, and other equipment that uses or connects to computers. We have all seen how rapidly the latest technology can become outmoded. Consumers should not be burdened with the choice of throwing away a perfectly good piece of equipment long before it wears out, or having to do without valuable new features and improvements that are commonplace in the more recent generations of equipment.

The Company has emphasized that AMI is increasingly being deployed around the country, but it also concedes that the technology, and the industry's use of the technology, is undergoing rapid change.

> In a broader historical context, it is important to note that the trend toward AMI, and these currently identified AMF capabilities, are still relatively new. New market participants, vendors, consultants, and ESCOs have been focused on electrical distribution like never

> before, resulting from the innovations currently being seen throughout the industry and being considered for implementation at National Grid. All indicators point to this trend continuing, if not escalating. While some of these capabilities are not yet known or possible to yet define, it is certainly reasonable to expect that use cases will emerge and utilize the information available from AMF.(Niagara Mohawk AMI Business Case, page 26.)

While the potential for new benefits and revenue streams is important, once the Company commits to a specific set of vendors, and a particular generation of technology, it may become "locked in" to that choice – watching while late adopters get the benefit of powerful new features and functions that are not backward compatible with the existing generation of meters.

No one can predict with 20-20 foresight whether the "state of the art" meters that are available in the next few years will support new features at a reasonable cost or whether these meters will seem obsolete after they have been in operation for just 10 or 15 years. Since technology can advance rapidly, and in unpredictable ways, there is no way to eliminate this risk (although the risk will gradually decline as the technology matures). Given that we are currently at the early stages of an ongoing transition, we think it is rather optimistic to assume a 20-year life for meters being installed at this stage. At a bare minimum, it is imperative to study the potential impact of this issue on the benefit to cost ratios to see what happens if the economic life of the system is assumed to be significantly shorter: 18, 15 or 12 years.

VI. AMI BENEFITS

Q. Can you please briefly summarize the societal benefits which have been identified in the Company's BCA?

A. Yes. The following table summarizes the Net Present Value of the stream of costs which are projected to occur over the 20-year time horizon in the BCA under the Company's most conservative set of benefit assumptions.

Societal Benefits (Opti-In/Low Savings)	Net Present Value ($ Millions)
Avoided O&M	$ 117.8
Avoided AMR O&M	21.2
Avoided AMR Capital	254.4
Net Avoided GHGs	72.7
Avoided Distribution Losses	21.8
Avoided Energy	70.2
Avoided Generation Capacity	25.8
Total	$ 583.9

Q. Has the Company provided any sensitivity studies which show other levels of benefits?

A. Yes. The Company has provided sensitivity studies concerning two important issues. The first issue is whether customers are "nudged" into accepting Time of

Use (TOU) pricing by treating the new rate design as the default option and requiring them to take affirmative steps to remain on their existing rate.

> The Company has evaluated an opt-out scenario where, by default, a large percentage of customers will be enrolled in these pricing programs, as well as an opt-in scenario, in which customers must choose to enroll on the rate. (Niagara Mohawk AMI Business Case, page 32.)

The benefits summarized in the table above reflect the "opt-in" assumption, while the following table shows the impact of the scenario using the more aggressive "opt-out" approach.

Societal Benefits (Opt-Out / Low Savings)	Net Present Value ($ Millions)
Avoided O&M	$ 117.8
Avoided AMR O&M	21.2
Avoided AMR Capital	254.4
Net Avoided GHGs	90.7
Avoided Distribution Losses	21.8
Avoided Energy	120.1
Avoided Generation Capacity	103.3
Total	$ 729.2

The "Opt-Out" approach is projected to generate substantially higher benefits to society because the "opt-out" approach has the effect of shifting the inertia in favor

of time of day pricing. Such a shift helps overcome the natural reluctance of consumers to try something unfamiliar, particularly since they will have no way of knowing whether they use more energy during peak hours than the average consumer, and will have no way of intuitively sensing whether the TOU rate will cost them more than the traditional rate to which they are accustomed. Given this uncertainty, many customers will be reluctant to make the switch. With the opt-out approach, the risk of customers experiencing higher bills is increased because some customers may have personal or professional circumstances that do not allow them to change their usage patterns to respond to the new price signals. However, the Company could take actions such as "shadow billing," where customers receive full information about what billing under the TOU rate would have been given their existing usage level and timing of consumption for 12 months before the TOU roll-out so customers can make informed decisions about whether they might benefit from enrolling in (or opting out of) a TOU program. (See Guidance for Utilities Commissions on Time of Use Rates: A Shared Perspective from Consumer and Clean Energy Advocates, July 15, 2017, at 28, http://www.uspirg.org/sites/pirg/files/reports/TOU-Paper-7.17.17.pdf).

The second issue is closely related: the extent to which customers on the new TOU rates modify their behavior in response to the new price signals, and the size of the resulting shift away from using electricity during peak hours.

> Through educational initiatives and pricing signals designed to encourage efficient consumption behavior, over time customers will proactively shift portions of their energy consumption to times of day where energy rates are lower, thereby resulting in reductions in their electric bills. (Niagara Mohawk AMI Business Case, page 32).

The previous tables used the "low" scenario (assuming customers are slow to modify their usage). The following table shows the analogous benefits under the "high" usage modification scenario, assuming the new rates are applied only to customers who "opt-in" to TOU rates.

Societal Benefits (Opt-In / High Savings)	Net Present Value ($ Millions)
Avoided O&M	$ 117.8
Avoided AMR O&M	21.2
Avoided AMR Capital	254.4
Net Avoided GHGs	78.7
Avoided Distribution Losses	21.8
Avoided Energy	70.2
Avoided Generation Capacity	58.1
Total	$ 638.1

These results can be compared to the those assuming most customers are migrated to the new rates by default, and that many of them subsequently modify their usage in response to the new price signals.

Societal Benefits (Opt-Out / High Savings)	Net Present Value ($ Millions)
Avoided O&M	$ 117.8
Avoided AMR O&M	21.2
Avoided AMR Capital	254.4
Net Avoided GHGs	114.6
Avoided Distribution Losses	21.8
Avoided Energy	186.6
Avoided Generation Capacity	232.4
Total	$ 948.8

Q. The differences between the various scenarios are quite significant. What has the Company said about the underlying factors that drive these differences?

A. The Company's witnesses do not comment extensively on this subject, but they highlight the key factors that influence the variation in sensitivity runs.

> The benefits from the Company's illustrative TVP [Time Variable Pricing] program will result from savings in generation capacity costs and savings in energy costs. (Niagara Mohawk AMI Business Case, page 32.)
>
> The level of benefits achieved will be directly related to the 1) number of enrolled customers and 2) the level of customer response to the new price signals and the resulting peak and energy savings. (Niagara Mohawk AMI Business Case, page 33.)

Despite its importance to the BCA bottom line, there is little data available that predicts how customers will react to time of day price signals – whether their main

reaction will be to avoid the new rates or to embrace the feeling of empowerment the new rates provide (assuming they have the flexibility to adopt their usage accordingly). Whether customers on the new rates will aggressively respond by adopting strategies for shifting their consumption away from the peak hours or whether they will be unable to respond to these pricing signals due to personal or professional circumstances are unknowns. Significant behavior modification will occur, but in the absence of more experience, the results cannot be forecasted with a high degree of confidence.

> For example, customers will need to fully understand the cost implications of consuming electricity during hot summer days, as compared to a springtime morning, as well as how specific technology and program offerings can help them manage their energy costs. With this in mind, the Company evaluated both High and Low scenarios that vary assumptions about peak reductions and reduction in on-peak energy use. (Niagara Mohawk AMI Business Case, page 33.)

This is one area where the passage of time may greatly illuminate our understanding of the dynamics. With time, Niagara Mohawk and other utilities will gain more experience through their ongoing REV pilot projects.

Q. Are there any other uncertainties with respect to benefits that the Company has not extensively modeled using sensitivity studies?

A. Yes. Niagara Mohawk has not provided any sensitivity results for unpredictable other aspects of its benefit estimates. Hourly marginal generation costs may not follow the precise patterns assumed in the BCA. To illustrate, the gap between NYISO market prices during on-peak and off-peak hours may change in unanticipated ways that diverge from BCA assumptions due to the impact of

increased behind the meter and distributed solar generation and modifications of consumer behavior in other parts of the state due to REV. To the extent these phenomena have not been accurately forecast, they will affect the level of benefits reflected in the BCA. This suggests a need for additional sensitivity modeling.

The Commission should not endorse the AMI plan without first requiring the Company to test the sensitivity of the calculated benefits and, where available, use more sophisticated modeling. Hundreds of millions of dollars are at stake. The Company has invested in a sophisticated, detailed model to analyze benefits and costs. With some additional effort, a thoughtful analysis of these issues can be developed to show the sensitivity of the BCA results to a range of potential uncertainties.

VII. DEPLOYMENT SCHEDULE

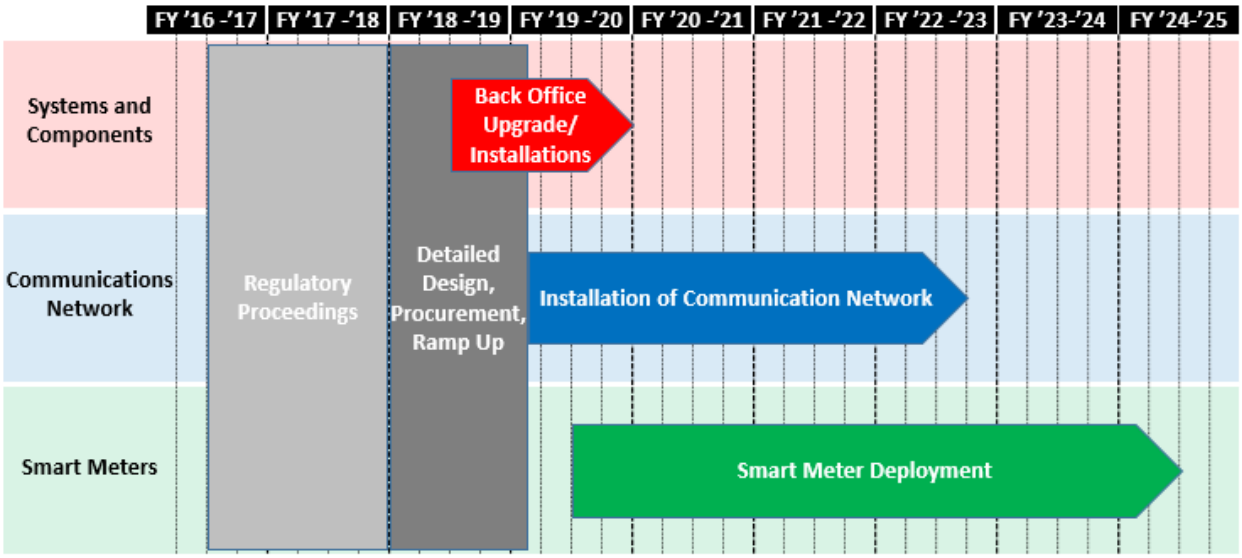
Q. Do you have any other concerns which can be addressed through additional sensitivity modeling?

A. Yes. The proposed schedule has not been proven to be optimal; better quantification of the impact of unplanned circumstances might prevent the schedule from being achieved. These two concerns are intertwined; if the planned schedule is optimal, then any deviation from the plan will by definition increase costs, or reduce benefits, or both. The schedule used in the Company's reported BCA results was described as follows:

> The Company proposes a five-and-a-half year AMI program implementation as illustrated in Figure 1- -3 below. Over the year-and-a-half period beginning in the middle of fiscal year 2019 and extending through fiscal year 2020, the Company will complete the design,

> procurement and back-office systems installation phase of the project. During this phase the Company will staff a project management organization and conduct a formal design and procurement process that will involve the development of a detailed customer engagement plan, system requirements including integration, process design, change management program, and meter deployment plan. The Company will use its procurement process to select software, equipment, and support vendors for the program.
>
> Following design and procurement the back-office information technology systems and communications infrastructure will be installed. This will involve building and testing the end-to-end solutions, development of procedures and training materials, organization implementation, including training of field and office personnel, development of communication materials, and initiation of meter deployment communications. (Niagara Mohawk AMI Business Case, page 4.)

While this plan seems reasonable, we can envision circumstances in which it might be difficult to meet some of these target dates – due to the type of risks discussed earlier. It would be useful to see the impact on costs if significant unplanned delays are incurred – for instance, the effect of holding an inventory of meters that cannot be used in a timely manner due to unexpected problems encountered with the communications network, or the software systems needed to make the meters useful.



We would also like to see more detailed modeling going in the other direction: the impact of further compressing the deployment phase should be studied. In the context of facilities that will have a useful economic life of 40 to 60 years, a four-year deployment schedule may seem conservative. AMI is a complex, computerized system that may have a useful life of as little as 10 years before it starts to become outdated due to new technologies and market transformations that arise in the intervening years. In this fundamentally dynamic economic context, the physical durability of the equipment, the maximum battery life, and similar considerations may not control the economic life. Given this context, a four-year deployment schedule strikes us as potentially sub-optimal.

Without detailed sensitivity testing, the impact of faster deployment cannot be estimated. We recognize that a shorter deployment schedule could modestly increase the expected cost of installation on a per-meter basis. However, the cost of the meters themselves might decline, due to improved purchasing power and reduced holding costs under an abbreviated deployment schedule.

The potential impact on the average life cycle of system components if the entire system is deployed more rapidly and then replaced more rapidly should be studied. We anticipate this may reduce costs because the gap between the oldest meters and newest meters will be shortened at the end of the system's life. Since the entire investment is designed and operated as an integrated system, the need to replace older meters will likely create added economic pressure to replace the entire system, including relatively new meters that have not been used as much as the oldest ones. Huge investments in AMI technology could be wasted at ratepayer expense if the deployment schedule is not carefully studied and optimised, accounting for the likelihood that the current generation of AMI technology will become economically obsolete well before it must be replaced due to physical deterioration.

VIII. BENEFIT TO COST RATIOS

Q. Have you compared the estimated benefits to the estimated costs?

A. Yes. We compared them using benefit to cost ratios, where the benefits are used in the numerator and the costs are used in the denominator. If more benefits exceed the costs, there will be a higher ratio.

A. Ratios as Filed

Q. What is your initial response to the benefit to cost ratios Niagara Mohawk calculated?

A. We are troubled that many of the calculated ratios are close to 1.0. This is concerning in the scenarios that assume an "opt-in" policy with respect to time

variant pricing. The Company-calculated Societal Cost (SCT), Utility Cost Test (UCT), and Ratepayer Impact Measure (RIM) ratios are summarized below:

Scenario		Benefit / Cost Ratios		
As Filed by Niagara Mohawk		**SCT**	**UCT**	**RIM**
Opt-in/Low Savings	LI	0.96	0.81	1.02
Opt-in/High Savings	HI	1.05	0.90	1.14
Opt-out/Low Savings	LO	1.20	1.06	1.34
Opt-out/High Savings	HI	1.56	1.44	1.82

Q. Does it matter how close the results come to 1.0 as long as they exceed this threshold?

A. Yes. The closer the SCT benefit to cost ratio is to 1.0, the smaller the amount of net surplus (benefits in excess of costs) available to Niagara Mohawk's customers. The narrowness of these results suggest two reasons for concern. First, the costs may exceed the benefits to society, since the numbers in this table are estimates. Second, these ratios indicate that many people may not benefit from AMI, such as the typical small-to-average size residential customer or small business.

Q. Will these types of customers receive benefits from AMI?

A. They will receive some benefits – for instance, their power may resume more quickly after an outage. However, the expected value of those benefits is likely less than the amount they will pay for AMI – particularly if many of the AMI costs

are allocated and recovered on a relatively uniform per-customer basis. For instance, meter investment is likely to be recorded in the traditional meter account, which has historically been allocated and recovered from customers largely on a uniform, per-meter basis. Costs in these accounts are likely to continue to be uniformly distributed, but the benefits will be distributed in a very different manner. As a result, larger customers will obtain benefits far in excess of their allocated share of the costs, while smaller customers will obtain benefits that are less than their share of the costs.

The benefits of AMI will be unevenly distributed, with a concentration flow of benefits going to tech-savvy customers and those customers that use a lot of energy. This problem would be lessened if there were a wider margin of benefit over costs available for distribution. For example, if the societal benefit to cost ratio were double the levels shown in the above table, there would be twice as many benefits being spread to customers so on balance more customers would end up receiving benefits that exceeded their share of the costs.

Q. Can you please elaborate on why additional study is needed when a project does not pass the SCT by a wide margin?

A. Primary reliance on the SCT does not mean that a project should automatically move forward just because a proffered BCA study indicates a project exceeds the minimum 1.0 threshold. Common sense tells us that a BCA study is based on estimates and no matter how carefully those estimates are developed, there sill remains room for human error.

This is a logical response – one that is similar to what a firm might do if it has a finite amount of capital available to deploy on new projects. Regardless of how sophisticated the firm's initial analysis may be, the underlying thought process is likely to involve an attempt to find the best projects that are expected to yield the biggest payoff. Different investment opportunities compete against each other – or at least some projects get the "green light" faster than others.

It makes sense for a firm to quickly "green light" projects that have anticipated benefits far exceeding their cost of capital. It also makes sense to give only a "yellow light" to projects that seem promising, but are not expected to be hugely profitable. Perhaps more information will be gathered, or additional pricing scenarios and other modifications to the initial plan might be evaluated to see if those projects might improve the odds of being solidly profitable. If the initial study did not fully explore all relevant scenarios, risks, and sensitivities more effort might be expended in fully evaluating these complications to better determine the odds that the project will not ultimately prove to be a mistake.

This sequential, cautious approach to projects with borderline upside potential is reminiscent of the process the Commission envisioned in its explanation of how the UCT and RIM tests can be useful to help identify situations where additional study is merited.

> ...if the UCT or RIM tests so indicate, the utilities must inquire further into the actual impact of the DER or other measure on customer bills, beyond merely the impact on utility costs or rate structures. As NRDC and others point out, a more sophisticated rate impact analysis than that realized through RIM, which shows only if a rate decrease or increase will be realized without addressing the magnitude of the impact, is needed. A measure might reduce customer bills,

> leaving them better off, even if the UCT and RIM tests are not satisfied, or might be otherwise acceptable. Therefore, rejection of a measure that passes the SCT test in the overall context of REV is independent upon a complete bill impact analysis demonstrating that the impact of a measure on customer bills is of magnitude that is unacceptable. (Id., p. 13).

While the exact scope and intent of this provision is not entirely clear, it appears to be consistent with taking a slower, more measured approach to studying the consequences of projects that do not pass the SCT by a wide margin.

Q. Is additional computer modeling needed to accurately evaluate your concerns?

A. Yes. The Company's SCT analysis cannot accurately address some of these concerns without further enhancement. Additionally, the BCA analysis in Table 1 of AMI-2 shows the SCT lower than the RIM test. Yet, the BCA in the Company's Distributed System Implementation Plan in AMI-1 shows the SCT is higher than the RIM. The differences between the SCT and RIM BCA analyses should be investigated further.

The BCA model developed for the Company by its consultants provides a strong foundation for this effort, because it incorporates a wealth of useful detail, and some portions of the model have already been designed to test the sensitivity of the benefits and costs to certain issues – like whether it would be better to deploy AMI system-wide, or on a more selective geographic basis. However, the current iteration of the model cannot accurately test for other relevant scenarios – like determining the optimal timing of the project, whether it would be more cost-effective to compress the meter installation phase, or the impact of early retirement of the AMI system due to economic obsolescence.

None of this is meant as a criticism of the consulting firm that developed the model, or the employees within the Company who directed their efforts. To the contrary, we are favorably impressed by the results of their combined efforts. The model includes thousands of relevant inputs, which have been brought together in a well-organized manner. For issues of particular concern to the Company, the model enables the user to carefully examine the costs of each potential course of action and to compare those with alternatives. In turn, this allows the user to systematically compare the economic consequences of each course of action, before attempting to decide which approach will lead to the best outcome. All that is needed is to extend this modeling approach to analyze the issues we have identified in this testimony. For instance, the model is currently hard-wired to reflect the assumption that meters will have a useful life of 20 years. It does not offer the user an option of accurately testing the impact of a shorter economic life on cash flows, benefits and costs. This capability should be added, and the impact of a shorter life cycle carefully studied.

B. Alternate Scenarios

Q. Have you developed any information that might put these concerns into perspective?

A. Yes. We used a simplified approach to evaluate the potential impact of the concerns we have raised, to see if they are serious enough to justify the additional effort required to enhance the model to prepare more precise sensitivity runs.

We began by estimating the impact of an across-the-board 15% increase in costs:

Scenario		Benefit / Cost Ratios		
Assuming 15% Higher Costs		**SCT**	**UCT**	**RIM**
Opt-in/Low Savings	LI	0.84	0.70	0.89
Opt-in/High Savings	HI	0.91	0.79	0.99
Opt-out/Low Savings	LO	1.04	0.92	1.16
Opt-out/High Savings	HI	1.36	1.25	1.58

Next, we estimated the combined impact of an across-the-board 15% increase in costs and 5% reduction in benefits:

Scenario		**Benefit / Cost Ratios**		
Assuming 15% Higher Costs and 5% Lower Benefits		**SCT**	**UCT**	**RIM**
Opt-in/Low Savings	LI	0.79	0.67	0.84
Opt-in/High Savings	HI	0.87	0.75	0.94
Opt-out/Low Savings	LO	0.99	0.87	1.10
Opt-out/High Savings	HI	1.29	1.19	1.50

This simplified sensitivity analysis sees the project falling short of the minimum SCT threshold in three of the four scenarios. These results are concerning, and

we reiterate that more precise modeling is needed before firm conclusions can be drawn.

Q. Do you anticipate that the additional modeling you are recommending will lead to the conclusion that AMI should not be deployed in Niagara Mohawk's service area?

A. No. Rather, we anticipate a different result: a conclusion that further refinement of the plan was needed to ensure that the benefits exceed the costs by a wider margin. Before spending hundreds of millions of dollars, additional scenarios need to be analyzed in detail, along with relevant alternatives. This analytical process will increase confidence that the optimal course of action is being selected, and it is likely to help the Company identify specific improvements that can be made in its plan (particularly regarding timing) which will improve the ratio of benefits to costs.

A detailed “what if” analysis is needed of the type that was used to reach the conclusion that system-wide deployment is superior to selective geographic deployment. Careful consideration of multiple alternatives should be paid to various time-related aspects of the planning choices among other factors. We believe more effort should be applied to carefully study the pros and cons of waiting to deploy AMI for a few more years – waiting until AMI has been deployed in National Grid's affiliate companies in other states, or it has been widely deployed by other utilities in New York.

By thoroughly using the tools of economic benefit-cost analysis, questions concerning the optimal timing of the AMI deployment can be answered with a much higher degree of confidence. We believe this extra effort will ultimately lead to an

improved strategy which better maximizes net societal benefits, thereby increasing the number of Niagara Mohawk customers who benefit from AMI deployment.

Q. Does this conclude your direct testimony, which was prefiled with the Commission on August 25, 2017?

A. Yes.