BEFORE THE
PUBLIC SERVICE COMMISSION OF MARYLAND

IN THE MATTER OF THE APPLICATION OF BALTIMORE GAS AND ELECTRIC COMPANY FOR ADJUSTMENTS TO ITS ELECTRIC AND GAS BASE RATES	**)** **)** **)**	**CASE NO. 9406**

Direct Testimony of Maximilian Chang

On Behalf of Maryland Office of People's Counsel

February 8, 2016

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I. INTRODUCTION AND PURPOSE OF TESTIMONY

Q Please state your name, business address, and position.

A My name is Maximilian Chang. I am a Principal Associate with Synapse Energy Economics, an energy consulting company located at 485 Massachusetts Avenue, Cambridge, Massachusetts.

Q Please summarize your work experience and educational background.

A My experience is summarized in my resume, which is attached as Attachment MPC-1. I am an environmental engineer and energy economics analyst who has analyzed energy industry issues for more than seven years. In my current position at Synapse Energy Economics, I focus on economic and technical analysis of many aspects of the electric power industry, including: (1) utility reliability performance and distribution investments, (2) nuclear power, (3) wholesale and retail electricity markets, and (4) energy efficiency and demand response alternatives. I have been an author and project coordinator for the 2011 and 2013 biennial New England Avoided Energy Supply Component reports used by energy efficiency program administrators in the six New England states to evaluate energy efficiency programs.

Q Please describe Synapse Energy Economics.

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

Synapse's clients include state consumer advocates, public utilities commission staff, attorneys general, environmental organizations, federal government agencies, and utilities.

Q On whose behalf are you testifying in this case?

A I am testifying on behalf of the Maryland Office of People's Counsel (OPC).

Q Have you submitted testimony in other recent regulatory proceedings?

A Yes. I have previously testified before the District of Columbia Public Service Commission, the Massachusetts Department of Public Utilities, and the Maine Public Utilities Commission. I have also filed testimony before the Delaware Public Utilities Commission, Hawaii Public Utilities Commission, New Jersey Board of Public Utilities, and the United States District Court District of Maine.

Q Have you testified in front of the Maryland Public Service Commission previously?

No, I have not.

Q What is the purpose of your direct testimony?

A My direct testimony summarizes the alternative assumptions and adjustments to Baltimore Gas and Electric's (the Company) benefit-to-cost analysis summarized in the direct testimony of William Pino and the direct and supplemental testimony of Michael Butts. OPC Witnesses Paul Chernick and Peter Lanzalotta analyze other aspects of the Company's assumptions; they provided me with adjustments to make in the calculations that are summarized in my testimony. The fact that I do not comment on every aspect of the Company's benefit-to-cost analysis and calculations should not be interpreted to mean that I agree with those aspects.

Q What data did you rely upon to prepare your testimony and figures?

A I relied primarily on the direct testimony, exhibits, and work papers of the Company witnesses. I also relied upon the document record established in the Commission's Case 9208 and the Company's responses to various data requests.

Q Do you have any data responses to attach to your testimony?

A Yes. I am attaching cited data responses provided by the Company as Attachments MPC-2 and MPC-3 (Confidential).[1]

[1] This excludes some additional confidential attachments provided by the Company that I only use as reference within my testimony.

Q Was your testimony prepared by you or under your direct supervision?

A Yes.

II. CONCLUSIONS AND FINDINGS

Q Please summarize your conclusions and findings regarding the projected costs and benefits of the Company's Smart Grid Initiative.

A The following summarizes my conclusions and findings:

- My analysis indicates that the Company's Smart Grid Initiative has a present value benefit-cost ratio of 0.75 based on: 1) assumptions of benefits and costs described in detail in my testimony and in the testimony of OPC Witnesses Paul Chernick and Peter Lanzalotta; and 2) the Commission's determination of cost categories in Case 9208. Adjusting the Company's analysis to include more reasonable assumptions and cost categories from Case 9208 shows that the benefits from the Initiative are substantially less the Company's projections.

- The uncertainties in the assumptions of benefits in the Company's Smart Grid Initiative are described in detail in Witnesses Chernick and Lanzalotta's testimonies. Approximately 44 percent ($578 million) of the projected total benefits of the Smart Grid Initiative hinge on the Company's assumption regarding avoided energy and capacity costs, and energy and capacity price mitigation benefits. Approximately 43 percent ($248 million) of the market-side benefits are attributed to the Company's Smart Energy Manager® program, based primarily on paper reports directly mailed to customers.

- The Company's reported failure rate of its Smart Grid Meters is twice the rate originally anticipated by the Company. I recommend that the Commission investigate this specific issue in order to determine if premature meter failure may impact the Company's Smart Grid Initiative.

- Based on the findings from our benefit cost analysis showing that the Company's Smart Grid Initiative is not cost-effective, I recommend that

the Commission disallow the $193 million difference between our estimates of costs and benefits of the Company's Smart Grid Initiative. The $193 million cost disallowance would ensure that the Company's Smart Grid Initiative will cause no harm to ratepayers.

Following the Company's nomenclature, Witness Chernick's testimony provides a detailed analysis of the assumptions associated with elements of the Company's market-side benefits, and Witness Lanzalotta provides an analysis of the assumptions associated with elements of the Company's operational-side benefits.

III. HISTORY OF BGE SMART GRID DEPLOYMENT

Q Please describe your understanding of the history of BGE's initial Smart Grid Initiative.

A In 2009, BGE filed a petition (Case 9208) to deploy smart grid across its electric and gas service territory. In its initial filing, BGE estimated that the benefit-to-cost ratio would be 2.4 on a net present value basis (3.2 nominal), and stated the Company anticipated to apply for a $200 million Department of Energy (DOE) Smart Grid Investment Grant Program.[2] In its Order No. 83410, the Commission identified a number of concerns about the Company's Smart Grid Initiative:

> We have concerns about other aspects of BGE's business case as well. Although the Proposal boasts a "robust" Total Resource Cost ("TRC") benefit-to-cost ratio of 3.2 (inclusive of DOE funding), a TRC ratio is only as useful as the assumptions on which it is based. On the projected cost side of the cost-benefit equation, the Company's business case does not include many costs that are inherent in, or will inevitably flow from, the Proposal. It does not include the approximately $100 million in undepreciated value of existing, fully operational meters that would be retired before the end of their useful lives, for example, or the estimated $60 million it will cost the Company for the new billing system necessary to implement the R-SEP rate schedule. Nor does it include the cost of in-home display devices, which easily could exceed another $100 million dollars, or the cost of new customer appliances that the Company projects will one day be able to communicate with the proposed "smart meters." And it does not include

[2] Baltimore Gas and Electric. Application of Baltimore Gas and Electric Company for Authorization to Deploy a Smart Grid Initiative and to Establish a Surcharge Mechanism for the Recovery of Costs. Case 9208. July 13, 2009. Page 2.

> the cost of retrofitting or replacing the emerging technology the Company proposes to install – technology that never has been tested in a full-scale deployment – in the event it becomes obsolete far earlier than its projected 10-to-15 year useful life (footnotes removed).[3]

While the Commission rejected the Company's initial petition, the Commission left open the opportunity for the Company to resubmit its application:

> Therefore, we invite BGE to submit an alternative proposal that mitigates and more fairly allocates between the Company and its customers the risks that the reality of this project will not reflect the projections BGE has provided to this Commission.[4]

The Company filed a petition to reconsider it Smart Grid Initiative in July 2010. In its reconsideration petition, the Company conducted a re-analysis that incorporated the Commission's recommendations and also incorporated the award of $200 million from the DOE's Smart Grid Investment Grant. In addition, the Company included additional costs, such as legacy meter costs, as directed by the Commission. The resulting changes—excluding the Commission's recommendation of additional costs—increased the benefit cost ratio to 3.7 on a present value basis (4.4 nominal).[5] While the Commission ultimately approved the Company's revised petition, the Commission noted that:

> We recognize that BGE's ultimate obligation is to deliver a cost-effective AMI system, including the necessary communication and customer education. We find it reasonable to expect that BGE will deliver a cost-effective AMI system before cost recovery will be incorporated into rates, and the Company's customers should not be required to pay in full, with a return, if the system does not meet that essential standard. We recognize that there is inherent uncertainty that the level of benefits projected, particularly the supply-side benefits, will actually be realized. If the final system falls short of being cost effective, we will hold a fair and appropriate proceeding to determine what cost recovery outcome the public interest requires.[6]

[3] Maryland Public Service Commission. Order 83410. June 21, 2010. Page 6.
[4] Maryland Public Service Commission. Order 83410. June 21, 2010. Page 54.
[5] Maryland Public Service Commission. Order 83531. August 13, 2010. Page 17.
[6] Maryland Public Service Commission. Order 83531. August 13, 2010. Page 39.

It is with this foundation that I analyze the Company's benefit-cost analysis in this proceeding.

IV. COST BENEFIT ANALYSIS OF COMPANY'S CURRENT PETITION

Q Please summarize the Company's benefit-cost analysis presented in this proceeding.

A Witness Pino summarizes the results of the Company's Smart Grid Initiative benefit-cost analysis on pages 16 and 17 of his direct testimony. Witness Butts provides an updated summary of the Company's benefit-cost analysis in his supplemental testimony. It is my understanding that the Company used a Total Resource Cost (TRC) to evaluate its Smart Grid Initiative, consistent with the Company's benefit-cost analysis in Case 9208. Under this approach, the Company compared projections of the total cost of the Smart Grid Initiative, regardless of who paid for which costs, to projections of its total benefits, regardless of who received which benefits. He projected these costs and benefits over the period 2009–2025, and then calculated their net present value (NPV) and nominal value.

Q Please discuss the projected costs of the Company's Smart Grid Initiative.

A Witness Pino estimates the projected cost of the Smart Grid Initiative will be $677 million, with a NPV of $622 million.[7] Witness Butts updates this amount to be $713 million, with a NPV of $654 million.[8] The updated amount consists of $687 million in capital expenditures and $165 million in O&M expenses, before adjustments of $199 million for the DOE Smart Grid Investment Grant award.[9] In addition, this projection does not include any incremental costs associated with the Company's legacy meters.[10]

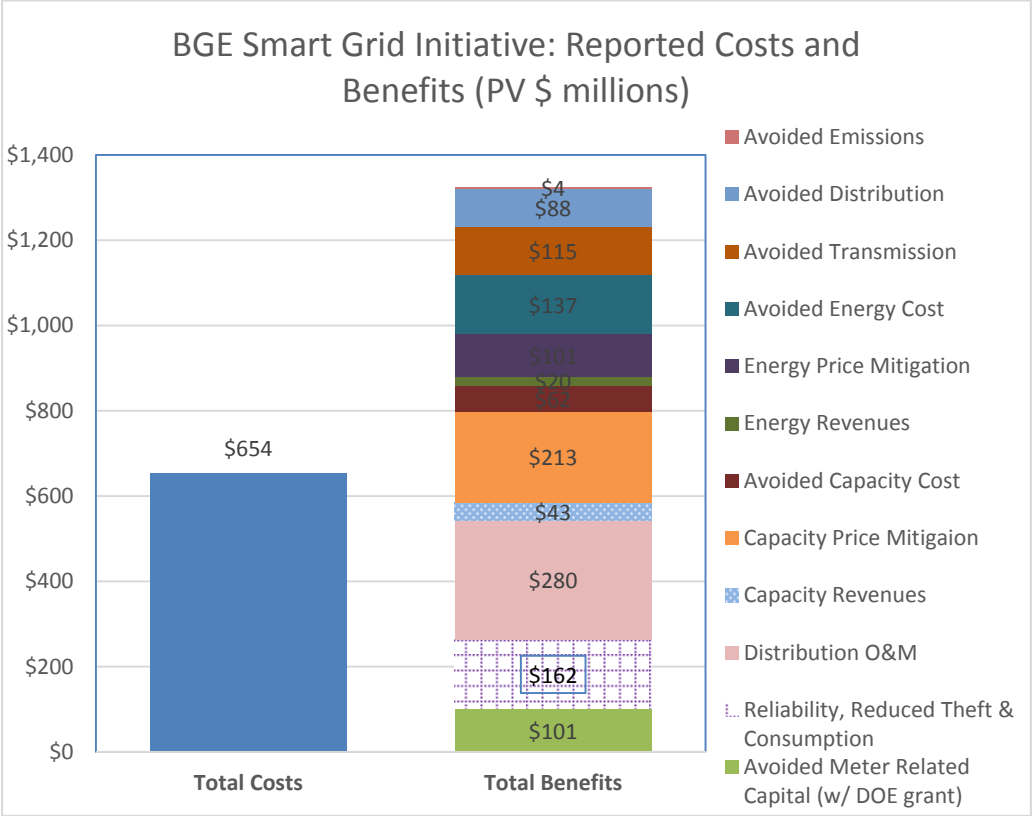
[7] Direct Testimony of William Pino. November 9, 2015. Table 1. Page 16.
[8] Supplemental Testimony of Michael Butts. January 5, 2016. Table 1. Page 2.
[9] Staff 6-2. Att-01-CostEffectivenessModel.xslx (Summary page).
[10] BGE Response to OPC Data Requests 11-1 and 13-01.

Q How do the projected benefits compare to the projected costs in the Company's petition?

A Witness Pino estimates that the Company's Smart Grid Initiative will produce $1,659 million in benefits, with a NPV of $1,319 million.[11] Witness Butt's Supplemental Testimony revises the benefits slightly to $1,665 million in benefits, with a NPV of $1,324 million.[12] The initial projected benefits and costs produce a TRC benefit-to-cost ratio of 2.1 (2.5 nominal).[13] The Company's supplemental testimony results in an adjusted benefit-to-cost ratio of 2.0 (2.3 nominal).[14] The Company's estimate reflects 12 benefit and eight cost categories. The NPV of these projections are summarized in Figure MPC 1 below**.** The projected costs are presented in the first bar. The second bar shows the projected benefits attributed to the Company's Smart Grid Initiative.

Figure MPC 1. Reported Costs and Benefits of BGE Smart Grid Initiative

[11] Direct Testimony of William Pino. November 9, 2015. Table 1. Page 16.
[12] Staff 6-2. Att-01-CostEffectivenessModel.xslx (Summary page).
[13] Direct Testimony of William Pino. November 9, 2015. Table 1. Page 16
[14] Supplemental Testimony of Michael Butts. January 5, 2016. At 2:8.



Q Mr. Chang, you provide several benefit-cost ratios in your discussion of the history of the Company's Smart Grid Initiative. Please explain.

A The Company's presentation of the Smart Grid Initiative has changed based on input assumptions for projected costs and benefits, and actual costs and benefits experienced by the Company during installation. I do note that the Company's estimate of the benefit-to-cost ratio has fallen from 3.7 when the Company first proposed its Smart Grid Initiative to 2.1 based on current costs and projections. OPC Witness Chernick's testimony addresses how and why the Company's projected avoided costs would be lower using different assumptions.

V. BENEFITS

Q Please discuss the Company's projected Smart Grid Initiative benefits.

A As shown in Witness Pino's Table 1 and updated in Witness Butt's Table 1, the Company categorizes its estimates of benefits into two main categories: 1) market-side benefits and 2) operational benefits.

Q Please elaborate upon the Company's projected Smart Grid Initiative market-side benefits.

A The market-side benefits are projected benefits attributed to savings in the future. The Company estimates that these benefits have a present value of $578 million ($746 million). When compared to the Company's costs, the market-side benefits, by themselves, result in a benefit-to-cost ratio of 0.88.[15] As I noted previously, the Company's estimate of market-side benefits represents approximately 44 percent of the overall total projected Smart Grid Initiative benefits. The Company presents the market-side benefits in two subcategories: 1) peak demand reductions (capacity), and 2) energy reductions (savings).[16] The Company estimates that the Smart Energy Rewards (SER) program will provide $321 million in benefits, the Smart Energy Manager (SEM) program will provide $249 million in benefits, and improvements to the Peak Rewards program will yield $9 million in benefits. These benefits are presented in Figure MPC 2.[17]

Figure MPC 2. Summary of Present Value of Smart Grid Initiative Market-Side Benefits

	Peak Demand Savings (millions $, PV)			Energy Savings (millions $, PV)				
	Capacity Revenue	Avoided Capacity Cost	Capacity Price Mitigation	Energy Revenue	Avoided Energy Cost	Energy Price Mitigation	Avoided Emissions Cost	TOTAL
SER	$42	$51	$198	$19	$6	$5	$0	**$321**
SEM	$0	$11	$8	$0	$130	$96	$4	**$249**
PR	$1	$0	$6	$1	$1	$0	$0	**$9**
Total	**$43**	**$62**	**$213**	**$20**	**$137**	**$101**	**$4**	**$578**

However, other OPC witnesses and I have concerns with several of the Company's estimates, and I do not believe that the SEM benefits should be included in the benefit-to-cost analysis.

[15] Supplemental Testimony of Michael Butts. January 5, 2016. Table 1. Page 2.
[16] Direct Testimony of William Pino. November 9, 2015. Table 2, Page 17.
[17] Staff 6-2, Attachment 15. Market Benefits Tab.

Q Why do you say that the SEM benefits should not be included?

A While the SEM program has generated energy and capacity savings, these savings should not be attributed to the Company's Smart Grid Initiative, as these savings could have been achieved without any of the smart grid investments made by the Company. The primary component of the SEM program is the Home Energy Reports (HERs), which provide customers with information on their energy consumption as shown in OPC 14-10 Attachment 1.[18] However, these HERs simply show customers' monthly energy consumption as compared with their neighbors', and do not require smart grid investments to implement.[19]

Q Have Home Energy Reports been implemented where smart meters have not been installed?

A Yes. The Company implemented its HER pilot program for 25,000 residential customers from October 2010 to September 2011, prior to full deployment of the Smart Grid Initiative.[20] In addition, other utilities without smart meters frequently provide HERs to their customers. For example, Massachusetts has not yet installed smart meters, yet both National Grid and NSTAR (now Eversource) have implemented the same type of HERs as BGE. National Grid began implementing its program in 2009, while NSTAR began its program in 2010.[21, 22] Examples of other utilities that have implemented HERs without smart meters include Connecticut Power and Light, Southern Maryland Electric Cooperative (SMECO) and Potomac Edison (PE).

Q Does the Smart Grid Initiative enhance the savings from Home Energy Reports?

A No, it does not appear that the Company's Smart Grid Initiative investment has improved the savings achieved by the HERs, contrary to the Company's

[18] OPC 14-10 Attachment 1 provides an example.
[19] Staff 8-10.
[20] BGE Response to OPC DR 14-03.
[21] https://ngma.opower.com/ei/app/index.html.
[22] https://energyreportsma.opower.com.

assertion.[23] In fact, implementation of the Smart Grid Initiative was followed by two years of lower energy savings than were achieved prior to the Smart Grid Initiative.

Q Please elaborate.

A Specifically, the Company reports that the 2010-2011 HER pilot program resulted in savings of approximately 1.2 percent (or 1 percent when adjusted to represent the total population of customers).[24, 25] When the HER program was implemented in conjunction with smart meters, however, the HER savings initially dropped. In 2013, the average savings rate was 0.74 percent, while in 2014 the average savings rate was 0.99 percent.[26] Both of these savings rates are lower than the results of the Company's pilot program, prior to full implementation of the Smart Grid Initiative. However, in 2015, the Company estimates that the average savings rate will be 1.42 percent, which is higher than the pilot program savings.[27]

In general, the BGE HERs savings fall toward the low end of the typical range of savings from HERs of 1 to 2 percent.[28] For example, the weighted average electricity savings rate for HERs in Massachusetts is 1.52 percent, as shown in Figure MPC 3 below. As noted above, the Massachusetts utilities have not implemented widespread smart meters. Connecticut Light & Power's (now Eversource) pilot HER program generated 1.7 percent savings in the first year and 1.8 percent savings in the second year without smart meters.[29] In Maryland,

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[23] Staff 8-25.
[24] HER Pilot Report, Maillog No. 135240, October 31, 2011.
[25] OPC 14-3.
[26] Navigant Consulting, *2013 BGE SEM Program Evaluation Report*, May 9, 2014; and Navigant Consulting, *2014 BGE SEM Program Evaluation Report*, May 13, 2015, provided in response to Staff DR 8-24 (Attachments 1 and 2).
[27] OPC 14-3.
[28] *Id*, page 3. "In other studies, this type of information has stimulated customers to reduce their energy use, creating average energy savings in the 1% to 2% range, depending on local energy use patterns."
[29] NMR Group, Inc., Tetra Tech, Hunt Allcott. *Evaluation of the Year 1 CL&P Pilot Customer Behavior Program Final Report*, March 4, 2013, available at http://www.neep.org/sites/default/files/resources/FINAL%20CLP%20Behavioral%20Year%201%20Program%20Report%20030613.pdf and NMR Group, Inc., Tetra Tech. *Evaluation of the Year 2 CL&P Pilot Customer Behavior Program (R2) Final Report*, August 8, 2014, available at

SMECO and Potomac Edison have reported savings of approximately 1.4 percent.[30]

Figure MPC 3. Savings Rates for Home Energy Reports in Massachusetts

Cohort	Percentage Savings*	Participants
NGRID Group 2009	2.37%	24,005
NGRID Group 2010	1.58%	65,170
NGRID Group 2010 Added	2.32%	23,805
NGRID Group 2011	2.51%	99,446
NGRID Group 2011 Added	1.57%	60,605
NGRID Group 2012	2.20%	86,898
NGRID Group 2012 Dual	1.56%	12,621
NGRID Group 2013	1.31%	324,002
NGRID Group 2013 Email	0.50%	46,105
NGRID Group 2014	0.90%	94,874
NSTAR Group 2010 Dual	0.20%	18,660
NSTAR Group 2011 Dual	0.56%	8,451
NSTAR Group 2012a	2.16%	55,857
NSTAR Group 2012b	2.06%	17,033
NSTAR Group 2013 Dual	1.29%	37,801
NSTAR Group 2013b	1.12%	65,798
NSTAR Group 2013 Dual	1.57%	20,991
NSTAR Group 2014	0.79%	8,637
Average	**1.48%**	
Weighted Average	**1.52%**	

*All savings are after the channeling adjustment (which removes double-counting with other programs)

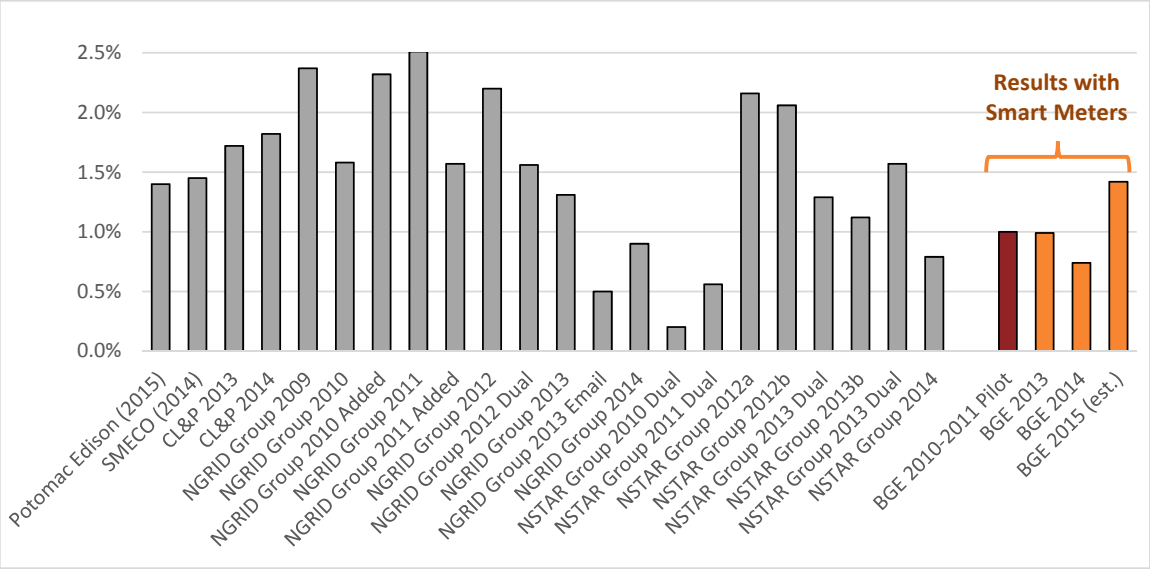
Source: Navigant Consulting, Inc. and Illume Advising, LLC, Memorandum to the Massachusetts Program Administrators and Energy Efficiency Advisory Council regarding the Massachusetts Cross-Cutting Behavioral Program Evaluation Opower Results, March 2015, available at http://ma-eeac.org/wordpress/wp-content/uploads/Behavior-Program-Impact-Evaluation-Memo.pdf.

http://www.energizect.com/sites/default/files/Evaluation%20of%20Year%202%20CL%26P%20Pilot%20Behavior%20Pgm%20(R2),%20Final%20Report,%208-8-14.pdf.

[30] Calculations for SMECO based on reported sales from EIA form 861 and SMECO's Semi-Annual Q3/Q4 Report, (ML 164134). Potomac Edison reports 1.4 percent savings in its 2015 Semi-Annual EmPOWER Maryland Report for the period of January 1 – June 30 (Case No. 9153), dated July 31, 2015 (ML 172112).

Figure MPC 4 below contrasts BGE's savings before and after the Smart Grid Initiative with the savings achieved by National Grid, NSTAR, Connecticut Light & Power, SMECO, and Potomac Edison none of which have implemented a similar smart grid initiative.

Figure MPC 4. Comparison of BGE Savings with Savings of Utilities without Smart Grid Initiatives



Sources: Navigant Consulting, Inc. and Illume Advising, LLC, Memorandum to the Massachusetts Program Administrators and Energy Efficiency Advisory Council regarding the Massachusetts Cross-Cutting Behavioral Program Evaluation Opower Results, March 2015; HER Pilot Report, Maillog No. 135240, October 31, 2011; Navigant Consulting, *2013 BGE SEM Program Evaluation Report*, May 9, 2014; and Navigant Consulting, *2014 BGE SEM Program Evaluation Report*, May 13, 2015, provided in response to Staff DR 08-24 (Attachments 1 and 2).

Q Have the smart grid-enabled tools available through the Smart Energy Manager platform enhanced energy savings?

A No, it does not appear that the smart grid-enabled tools have materially impacted energy savings. First, as noted above, energy savings during 2013 and 2014 were actually lower than prior to the roll-out of the Company's Smart Energy Manager platform. Second, online portals and related tools typically have low customer

engagement levels.[31] For example, during BGE's HER pilot, only 2 percent of customers visited the website.[32] Similarly, BGE reports that only "a small subset of customers, approximately 50,000 [4 percent], have taken the time to update their home profile information through the web portal."[33] Such low engagement numbers imply that the incremental impact of the smart-grid enabled on-line tools is small. Finally, other than hourly energy usage data, the tools available on the Company's web portal do not appear to require smart grid capabilities.

Q If the savings from the SEM program could have been achieved without the Smart Grid Initiative, should they be included in the Company's cost-effectiveness analysis?

No. I recommend that both the costs and the benefits of the Company's SEM program be removed from the Company's cost-effectiveness analysis. This would reduce the SEM market-related benefits by $251 million,[34] and other SEM-related benefits by $26 million, as discussed in the following sections. In addition to removing these benefits, $24 million in costs associated with the SEM program should also be removed.

Q Do you have concerns regarding other market-side benefits claimed by the Company?

A Yes. It appears that the Company has over-stated demand and energy savings attributable to the Smart Energy Rewards (SER) program.

Q Why do you believe that the savings attributable to the SER program are overstated?

A The Company used regression analysis to estimate the average demand reduction per customer during Energy Savings Days. The Company then calculated the total

[31] See, for example, the comments of the evaluators in NMR Group, Inc., Tetra Tech. *Evaluation of the Year 2 CL&P Pilot Customer Behavior Program (R2) Final Report*, August 8, 2014, page XIII.
[32] HER Pilot Report, Maillog No. 135240, October 31, 2011, page 8.
[33] BGE response to OPC DR 14-12.
[34] Removing the SEM-related peak and energy reductions from the Company's market benefits model ("StaffDR06_02-CONFAtt15-MarketBenefits.xlsx") also leads to a $5 million reduction in SER market benefits. This effect appears to be mostly due to a shift in the capacity obligation after SEM-related peak reductions are removed, as represented in the Company's model.

reduction by multiplying the per customer reduction by the total number of eligible SER customers and then multiplying by the percentage of eligible SER customers earning a Peak Time Rebate (PTR).[35] Since 78 percent of customers earned a Peak Time Rebate, the Company used this percentage to calculate the total savings attributable to the SER program. However, the Company does not appear to have accounted for free-ridership – those customers who randomly decreased load, instead of decreasing load due to the SER program. Such customers would be included in the 78 percent who received bill credits.

Q Is free-ridership known to be an issue with Peak Time Rebate programs?

A Yes. For example, Southern California Edison (SCE) testified that approximately 80 percent of the credits from its PTR program were due to random reductions in load, rather than the result of the PTR program.[36] Further, in D.13-07-003, the California Public Utilities Commission cited Staff's concerns of significant free-ridership in the utilities' PTR programs, and directed the utilities to change their programs from a default-enrollment structure to an opt-in structure, as "only actively participating customers produce substantive load impacts."[37]

Q What percentage of SER participants can be considered "free riders"?

A One can make an assumption that a similar percentage of customers that randomly increased load relative to the baseline also randomly decreased load.

According to BGE's calculations, 78 percent of BGE customers earned a rebate by having lower load relative to the calculated baseline, implying that 22 percent

[35] Staff 6-2, Attachment 15. Market Benefits Tab.
[36] Testimony of R. Pardo and R. Thomas, Application No. A.11-06-007, Phase 2 of 2012 General Rate Case Revenue Allocation Proposals, Exhibit SCE-03, October 7, 2011, page 17.
[37] California Public Utilities Commission, Decision 13-07-003, in *Application of San Diego Gas & Electric Company for Approval of Demand Response Program Augmentations and Associated Funding for the Years 2013 and 2014*, July 16, 2013, page 27.

of customers did not reduce load relative to the baseline. Assuming a symmetric distribution of random increases in load and random decreases in load, it is reasonable to assume that 22 percent of eligible customers earned a rebate due to random load reductions. These customers earning rebates who are not actively participating should be categorized as free-riders. In other words, only 56 percent of customers are likely to have actively reduced load in response to the PTR incentive.

Q How does accounting for free riders impact the benefits attributable to the SER program?

By accounting for free riders, we have reduced the benefits of the SER program are reduced by 28.2 percent.[38] We have applied this reduction to Witness Chernick's estimated SER benefit of $74 million detailed in his testimony. The $53 million is reflected in our adjustments described below.

Q Please elaborate upon the Company's projected Smart Grid Initiative operational-side benefits.

A The operational-side benefits are projected benefits attributed to savings in the future from avoided distribution service O&M expenses and avoided future meter-related capital expenditures. The Company projects that these Smart Grid Initiative benefits have a present value of $746 million ($919 million nominal). The Company's projected operational-side benefits, by themselves, result in benefit-to-cost ratio of 1.14 when compared to the Company's projected Smart Grid Initiative present value cost of $654 million.[39] The present value components of the Company's operational-side benefits consist of:[40]

[38] 56%/78% = 71.8%, or a reduction of 28.2 percent.
[39] Supplemental Testimony of Michael Butts. January 5, 2016. Table 1. Page 2.
[40] Staff 6-2 Att-01-CostEffectivenessModel.xslx (Summary page).

- $231 million in avoided operation and maintenance expenditures associated with meter reading, meter operations, storms, and reduction in uncollectible write-offs;
- $162 million for reduced consumption on inactive meters;
- $115 million in avoided transmission infrastructure;
- $88 million in avoided distribution infrastructure;
- $50 million for the Company's Conservation Voltage Reduction program;
- $41 million in avoided capital expenditures for gas encoder receiver transmitter (ERT) batteries, legacy meter replacements, and storms; and
- $60 million from the DOE grant reimbursement for costs associated with the Company's PeakRewards program and Customer Care and Billing.

Q Please provide some additional comments on the Company's estimate of operational-side benefits.

A The largest component of the Company's estimate of projected operational-side benefits are the $231 million from avoided operation and maintenance expenditures associated with reduced meter reading expenses, meter operations, truck rolls during storms, and uncollectible write-offs. The next largest category are the combined benefits of $203 million for avoided transmission and distribution infrastructure costs. These benefits are further analyzed by OPC Witnesses Lanzalotta and Chernick. Witness Lanzalotta discusses his analysis of the Company's assumptions for avoided truck rolls. OPC Witness Chernick discusses his analysis of avoided transmission and distribution infrastructure costs. Both Witness Lanzalotta and Chernick have indicated that the Company's Smart Grid Initiative overstates avoided transmission and distribution benefits and both witnesses have provided me with adjustments that I have incorporated into my analysis of the benefit-cost model.

VI. SMART GRID INITIATIVE COST DETAILS

Q Do you include legacy meters in your benefit-cost analysis of the Smart Grid deployment?

A Yes, we have included the legacy meter costs in our benefit-cost analysis. As stated earlier in my testimony, in Order 83410, the Commission expressly stated the Company's earlier analysis did not include "the undepreciated value of existing, fully operational meters that would be retired before the end of their useful lives."[41] In Order 83531, the Commission noted:

> BGE contends that the Initiative remains cost-effective, as measured by the Total Resource Cost ("TRC") test, even if one were to include the costs of legacy meters, a new billing system, in-home display devices or additional consumer education beyond budgeted amounts in the calculation, which we believe are all appropriate costs to consider (footnotes removed).[42]

Consistent with the Commission's guidance, we therefore have included the legacy meter costs that BGE has excluded in its current benefit-cost analysis provided in response to Staff 6-2.

Q What value do you attribute to the book value of the legacy meter costs?

A BGE testified in Case Number 9208, its AMI deployment case, that there were approximately $100 million of legacy meter costs as of July 2010.[43] Without the benefit of a depreciation study to address the overall cost of the legacy meters, we also relied upon the Company's current estimate of $46 million for electric meters and $2 million for gas meters provided in response to OPC Data Request 13-1. Consistent with the Company's treatment of the legacy meters in Case 9208, we have treated the amount of $48 million as an NPV in our analysis.[44] From this data, it appears that BGE has already recovered at least $52 million from

[41] Maryland Public Service Commission. Order 83410. June 21, 2010. Page 6.
[42] Maryland Public Service Commission. Order 83531.August 13, 2010. Page 16.`
[43] Maryland Public Service Commission See Order 83531, August 13, 2010. Page 16.; and Testimony of Mark D. Case in Support of Application for Rehearing on Behalf of Baltimore Gas and Electric Company, Case No. 9208, Maryland Public Service Commission, July 19, 2010. Page 26. Table 2. ..
[44] See Footnote 5 of Testimony of Mark Case in Support of Application for Rehearing on Behalf of Baltimore Electric and Gas. July 19, 2010. Page 26.

ratepayers for retired legacy meter costs, plus BGE's normal rate of return. BGE also stated, in its response to OPC Data Request 27-5, that there will be additional costs as existing electromechanical meters are retired from service and replaced with AMI meters and modules.

Q Do you have concerns regarding the Company's estimates of operational costs associated with the Smart Grid program?

A Yes. I have concerns about the Company's experience with failed meters that may affect future costs associated with the Smart Grid program. In addition, the Company's experience with non-responsive customers in the deployment phase is concerning to me that I describe below and as I understand Witness Brockway discusses in her testimony that there remains approximately 90,000 hard-to-access meters that BGE could result in significant maintenance and installation costs once these meters need to be serviced and/or replaced.

Q Please describe your concern with failed meters.

A The Company states that in its benefit-to-cost analysis, the Company assumed a meter failure rate of less than 1 percent.[45] The Company then notes that in the four-year deployment period, it returned 25,539 meters to its vendor. Based on the total number of electric meters of 1,190,454, the percentage of failed or returned meters is actually 2.1 percent, or twice the anticipated number of failures.[46]

Q Why are you concerned about the increased percentage of failed meters?

A As noted by the Company, the increased number of failed or malfunctioning meters has resulted in an increased cost from $1.4 million originally projected in the cost-effectiveness analysis to approximately $2.0 million since April 2012.[47]

[45] OPC 11-6.
[46] Staff 10-13. I note that the response for Staff 10-13 is for all electric meters. As of September 30, 2015, BGE had installed 1,184,211 electric smart meters (metric #13).
[47] OPC 11-8.

Q Are failed meters accounted for in the benefit-cost analysis provided by the Company?

A The Company's response to Staff 6-2 provides a summary amount for failed meters in the worksheet: Cost-Effectiveness Test- Costs, within the workbook: SGCosts 2016-2025-Update-For-Actuals Final.xls Cost Effectiveness Test. However, it is unclear if the amount represents the current meter failure rate since the values are hard coded in the worksheet.[48]

Q Is the increased number of meter failure unique to BGE's program?

A No. I note that in Illinois, BGE's sister utility ComEd is also experiencing issues faced by BGE. In Case 15-0284, the Citizen Utility Board complaint states:

> The report also shows a higher than anticipated replacement for meters deployed, a higher than expected "unable-to-complete" installation rate, and difficulties in deploying the meters in downtown Chicago. ComEd notes a high early replacement rate for AMI meters: 5,963 replacements (2015 Report at 94) which means that over 1% of installed meters have been replaced. The report also notes that further information technology work would be needed to diagnose meter failures by type. The Commission should request additional information on why these meters are failing and how ComEd intends to address these failures.[49]

In its complaint, CUB has expressed concerns of a failure rate of 1 percent; this is well below the 2 percent experienced by BGE during its deployment period. The detailed quarterly smart grid metrics provided by the Company in Case 9208 currently do not include a metric for the number of failed/malfunctioning meters.

Q Do you have concerns with the Company's experience in deploying smart meters that necessitated the development of incremental communication outreach and incurring additional AMI deployment costs?

A Yes, I have concerns with the rollout of the Company's smart meter deployment focusing on non-responsive customers. While I do acknowledge that I have the benefit of hindsight and that deployment issues were raised in several of the

[48] Staff 6-02. ConfAttah04: SGCosts 2016-2025-Update-For-Actuals Final.xls Tab: Cost Effectiveness Test- Costs,. Rows 17-21.

[49] Illinois Commerce Commission. Complaint of the Citizens Utility Board Against the Commonwealth Edison Company Regarding the Utility's 2015 AMI Implementation Progress Report. Docket 15-0284. April 10, 2015. Page 5.

Commission's order in Case 9208, I do believe that the Company should have reasonably foreseen some difficulty that occurred with non-responsive customers when considering that the Company has a 30 percent incompletion rate for field jobs.[50]

Q Would you elaborate on the difficulties experienced by the Company during its smart meter deployment phase?

A As Witness Butts describes in his direct testimony on pages 16 through 18 of the Company's efforts to expand its communication and outreach programs to reach out to non-responsive customers. Later in his testimony on page 25, Witness Butts describes some of the difficulties of the opt-out (including non-responsive) customers had on projections for the cost of the smart grid program. Specifically, Witness Butts attributes that the opt-out process resulted in an increase of the cost to install by $16.6 million.[51] To highlight the severity of the issue, the Company reported to the Commission that the number of non-responsive customers (either those exhausted the 11-step process or at some stage of the 11 step process) was at 350,000.[52] As a point of comparison, the Company's quarterly metric as of June 30, 2014 indicated that the Company had installed 882,804 electric meters and 364,564 gas meters for a total of 1,246,768 meters.[53]

Q As a result of the opt-out process, did the Company have to engage additional vendors or modify contracts to address this deployment issue?

A Yes, the Company indicated that when the Commission initiated proceedings to consider the issue of opt-out customers, the Company engaged the services of Corix Utilities and then later Precision Pipeline Services.[54] These two firms

[50] OPC 28-1.
[51] Butts. Direct Testimony. 25:21-22.
[52] Baltimore Gas and Electric. Case 9208 Report of Baltimore Gas and Electric Company on Inaccessible Meters and Renewed Request for Default Enrollment. July 1, 2014. Page 1.
[53] Baltimore Gas and Electric. Case 9208: In the Matter of Baltimore Gas and Electric Company for Authorization to Deploy a Smart Grid Initiative and to Establish a Surcharge Mechanism for Recovery of Cost- Second Quarter 2014 Metrics Report of Baltimore Gas and Electric Company. August 14, 2014. Metrics 13 and 14.
[54] OPC 28-4

supplemented the effort of the original contractor, Grid One Solutions.[55] Grid One Solutions and Corix Utilities originally had unit contracts that later changed to time and materials to reflect the need for multiple visits.[56, 57] The amount paid for the two additional vendors and the additional scope change is approximately $17.34 million.[58].

Q Has the Company experienced difficulties with field jobs separate from smart meter installations?

A Yes, in response to OPC 28-1, the Company indicated that prior to the installation of smart meters it had experienced difficulty completing 30 percent of its field jobs.[59] The Company notes that the reasons and difficulties include:

> Access issues are wide-ranging and differ based on whether the equipment is located indoors or outdoors. Common examples are: customers not at home, locked doors and gates, unsecured animals, weather conditions, customer access refusals / breaking set appointments, tenants without access to equipment locations, etc.
>
> Historically, attempts to remedy these issues included: notification by telephone, letter, door hangers, outbound calls to schedule appointments, bill messaging and bill insert communications. However, in 2011, to resolve issues specifically related to meter access, BGE created the Meter Accessibility Program (MAP). This program implements a defined set of customer communications including letters, phone calls and field visits requesting that the customer provide access to BGE meters and/or remove obstructions. Ultimately, if a customer fails to provide access to BGE meters after repeated communication attempts, the customer's service can be terminated based on BGE access rights provided through COMAR and the Company's service tariffs. However, this program is not used to gain access solely for the purpose of installing a smart meter.

It is reasonable to infer that BGE's problems with accessibility for fields jobs would have also translated to its experience with smart meter deployment.

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[55] Ibid.
[56] A unit cost contract would be based on a set price per meter for the proposed scope of work. The contract may include different unit prices for different tasks. See OPC 28-4 Confidential Attachment for an example.
[57] Ibid.
[58] Ibid.
[59] OPC 28-1.

Q At end of June 30, 2014, what was the projected number of electric and gas meters targeted for installation?

A The Company had targeted that as of June 30, 2014 it was to have installed 1,085,200 electric meters and 587,500 gas meters for a total of 1,672,700 meters.[60]

Q What is the number of anticipated number of failures if you apply the 30 percent field job failure rate to the total number of targeted meter installed as of June 30, 2014?

A When I apply the 30 percent field failure rate to the total number of targeted installed meters, I arrive at 501,810 meters (501,810 = 1,672,700 * 0.30). The calculated value of a potential problem meter population based on the Company's experience with failed field job percentages should have informed the Company's process for addressing non-responsive customers.

Q Do you have concerns regarding the treatment of the Company's bill credits paid to participants of the Smart EnergyRewards® program, but collected from ratepayers?

A Yes, the Company states that bill credits are not included in its cost-effectiveness test since it considers the credits as intra-customer transfers.[61] While all ratepayers pay for the credits, participants in the SER program receive the benefit of the bill credits. This treatment is consistent with how our organization viewed bill credits in 2013.[62]

Q Do you still consider bill credits to be a transfer payment that should not be reflected in the benefit cost test?

A No, organizationally we have reconsidered our determination of the treatment of bill credits. While it is true that the credits are collected from all ratepayers and

[60] Baltimore Gas and Electric. Case 9208: In the Matter of Baltimore Gas and Electric Company for Authorization to Deploy a Smart Grid Initiative and to Establish a Surcharge Mechanism for Recovery of Cost- Second Quarter 2014 Metrics Report of Baltimore Gas and Electric Company. August 14, 2014. Metrics 13 and 14

[61] OPC 24-1.

[62] Wolf, T. et al. A Framework for Evaluating the Cost-Effectiveness of Demand Response. Prepared for National Forum of the National Action Plan on Demand Response. February 2013.

then paid to a subset of ratepayers who then participate in the program, the program is not costless. Participants of the SER program experience real costs associated with reduced thermal comfort by having to set their thermostats higher or having to re-arrange priorities in order to reduce electricity consumption during Smart Energy Reward periods. In other words, these ratepayers are being compensated for providing a service to the utility in the form of a load reduction, and these customers are being compensated for the costs that they incur to provide that service.

Q What has been the historical cost of bill credits associated with the SmartEnergy Rewards® program?

A The Company reports that since 2013, it has paid $23.9 million in bill credits associated with the SER program.[63] In our adjustment, we also include our calculated estimate of future bill credit payments. We would include that amount in our determination of cost effectiveness and also include our estimate of $129.8 million for future bill credits based on our estimate on the energy savings and the $1.25/kWh credit offered to participants. On an NPV basis, our adjustment results in an increase in costs by $101 million.

VII. ALTERNATIVE COST-EFFECTIVENESS ESTIMATE

Q Have you developed an alternative cost-effectiveness estimate for the AMI projects based on OPC's alternative assumptions?

A Yes. After adjusting the Company's estimates of benefits and costs based on alternative assumptions that OPC Witnesses Chernick, Lanzalotta, and I have made; I have arrived at a benefit-cost ratio of 0.75. This means that the investments are not cost-effective under OPC's adjustments.

[63] OPC 5-24.

Q What adjustments did you make to the Company's estimates of benefits?

A In my alternative analysis I have adjusted the estimates of benefits in the following ways in five broad categories (shown in Figure MPC 5):

- I have assumed no benefits associated with the Smart Energy Manager® (SEM) system. As I have explained previously, the benefits of this program could be achieved regardless of the existence of AMI. This results in a **reduction of $280 million** in present value of benefits.[64] This includes $245 million in direct market benefits from SEM, $26.5 million from associated transmission and distribution benefits, $3.7 million from associated emission benefits, and $5 million in indirect benefits on SER program impacts.[65]

- I have assumed no benefits associated with avoided transmission and distribution, per the testimony of OPC Witness Chernick. This results in a **reduction of $176 million** in present value of benefits.[66] This does not include the transmission and distribution reductions due to SEM, described above.

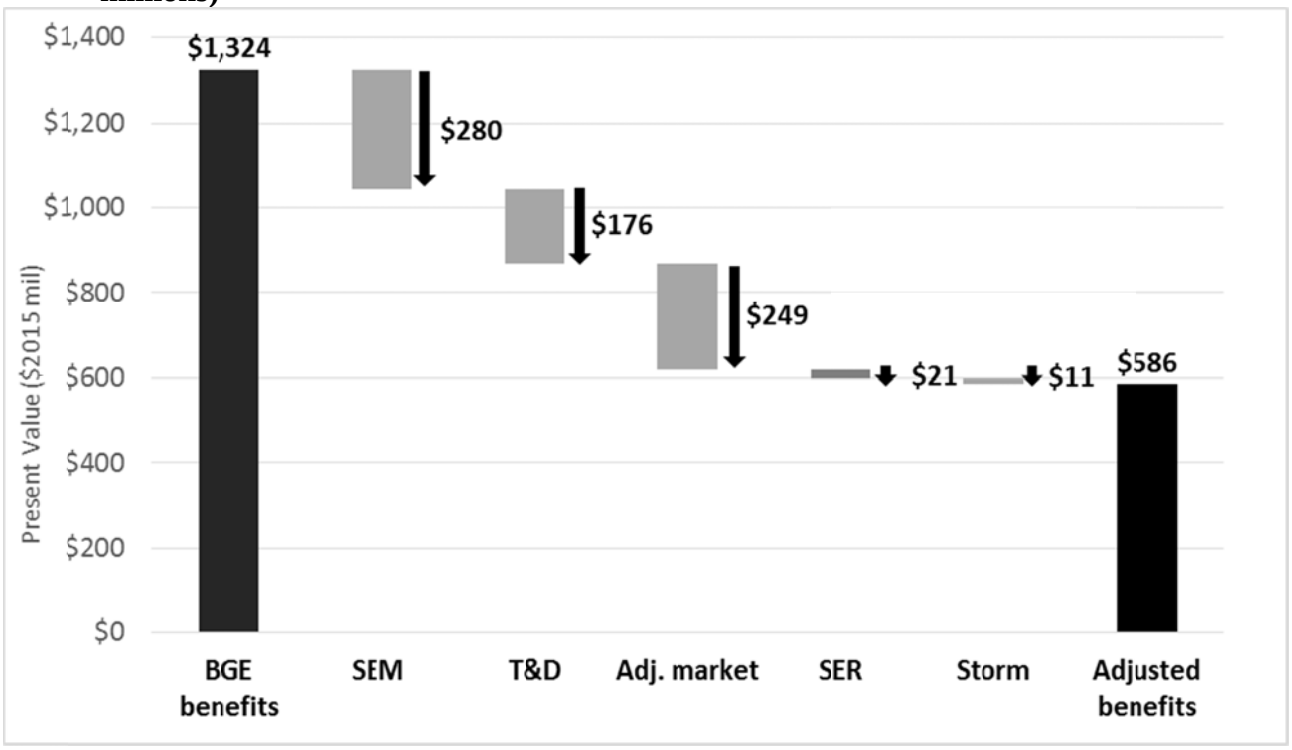
- I have included OPC Witness Chernick's adjusted market benefits—described further in his testimony. This results in a **reduction of $249 million** in present value of benefits.[67]

- I have adjusted the SER program benefits to exclude free ridership, as discussed previously in my testimony. This results in a **reduction of $21 million** in present value of benefits—incremental to previous SER benefit reductions.[68]

[64] Estimate derived from removing peak load and energy reductions attributed to SEM in "StaffDR06_02-CONFAtt15-MarketBenefits - SYNAPSE.xlsx."
[65] Id. Supra footnote 33.
[66] Direct Testimony of Paul Chernick.
[67] *Id.*
[68] This involves reducing SER benefits by 28% to exclude reductions from free-riders, i.e. reductions that would occur without the program's incentives. Supra footnote 37.

- Per the testimony of Peter Lanzalotta, I have adjusted the storm-related benefits estimate by 40 percent. This results in a **reduction of $11 million** in present value of benefits.[69]

Figure MPC 5. Adjusted Benefit Estimates (Present Value, $2015 millions)



Q What adjustments did you make to the Company's estimates of costs?

A In my alternative analysis I have adjusted the estimates of costs in the following ways (shown in Figure MPC 6):

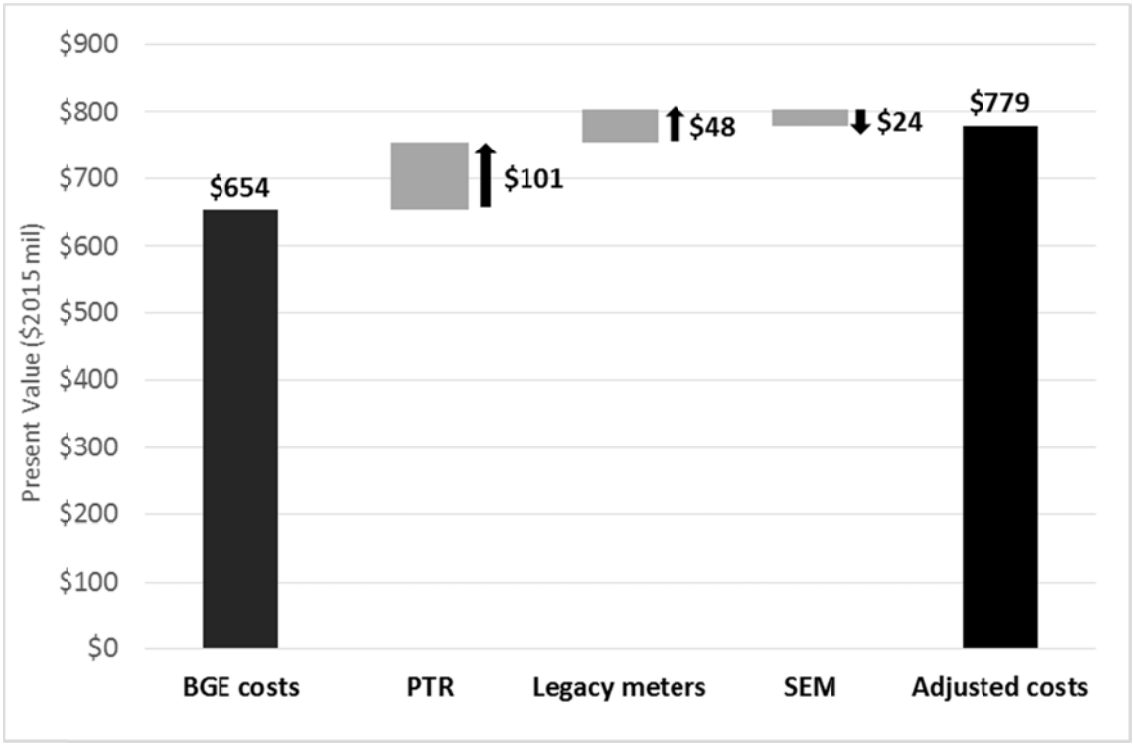
- I have included the cost of peak time rebate (PTR) bill credits, as discussed previously in my testimony. This results in an **increase of $101 million** in present value of costs.[70]

[69] Direct Testimony of Peter Lanzalotta.
[70] Synapse estimate based on Direct Testimony of William Pino, p.37-38.

- I have included the costs of electric and gas legacy meters, as recommended by the Commission in Order 83410. This results in an **increase of $48 million** in present value of costs.[71]

- In order to be consistent with the exclusion of benefits from SEM, I have also removed the costs associated with the program. This results in a **reduction of $24 million** in present value of costs.[72]

Figure MPC 6: Adjusted Cost Estimates (Present Value, $2015 millions)



Q How do your adjustments to benefits and costs affect the benefit-cost ratio of the AMI program?

A **Shown below in** Figure MPC 7, my adjusted benefits of $586 million is lower than my adjusted cost estimate of $678 million. This leads to an adjusted benefit-cost ratio of 0.75.

[71] Book value of meters provided in "OPCDR13_01-Attachment1.xlsx".
[72] Present value of SEM costs from "StaffDR06_02-CONFAtt04-SGCosts-2016-2025-UpdateForActuals-Final.xlsx," assuming half of "SER/SEM Marketing" costs apply to SEM.

This adjusted ratio is less than half the 2.03 benefit-cost ratio produced by the Company.[73] Put differently, the Company claims that more than two dollars of benefits are produced for every dollar invested, whereas my adjustments show that the investment never actually breaks even.

Figure MPC 7. Adjusted Benefits and Costs

Present Value ($2015 mil)	BGE	Adjusted estimate
Costs	$654	$779
Benefits	$1,324	$586
Net Benefits	$670	-$193
Benefit-Cost Ratio	2.03	0.75

Q Does your alternative cost-effectiveness estimate incorporate all of your concerns with the Company's estimate?

A No. My alternative analysis incorporates some—but not all—of my concerns with the Company's estimate of cost-effectiveness. For instance, I am not sure how the current meter failure rate of 2 percent will change as the Company's Smart Grid Initiative approaches the anticipated 15-year life of the installed smart meters.[74]

Q Is the Company's AMI program cost-effective?

A No. In my alternative analysis, I showed that AMI is short of breaking even with a benefit-cost ratio of 0.75. Given other concerns that have not been quantified, it is likely that the ratio is actually lower than my estimate.

Q Is the Company's AMI program beneficial to ratepayers?

A It is not based on our estimates of costs and benefits attributable to the Smart Grid Initiative. While the Company has produced a detailed rate or bill impact analysis of the program, my adjusted estimate of cost-effectiveness shows that the investment does not break even.

[73] Supplemental Testimony of William Butts. Table 1.
[74] OPC 11-4.

VIII. POLICY OPTIONS

Q Option for the Commission to Consider.

A My analysis shows that the Smart Grid Initiative costs $779 million and provides $586 million in benefits. Given the shortfall of benefits, the Commission should consider disallowing $193 million of the Company's costs. This adjustment would make the initiative break even under OPC's analysis. It is my understanding that Witness Brockway provides recommendations for the treatment of legacy meters should the Commission decided to exclude them as a cost in the benefit cost analysis. The Company should also provide a detailed revenue requirement analysis that projects impact of the initiative on ratepayers, including a breakdown of impacts on each class.

In addition, the Commission may consider other options including, but not limited to:

- Maintaining the current regulatory asset treatment for future Smart Grid Initiative costs; and
- Additional reporting of both benefits and costs going forward.

IX. RECOVERY OF EMPOWER MD SURCHARGES IN BASE RATES

Q Please summarize your concerns regarding the Company's proposal to roll EmPower MD surcharges into Base Rates.

A I am concerned that rolling the EmPower MD surcharge would reduce some transparency of the EmPower MD program. The surcharge mechanism can be reconciled every year to ensure funding for program costs. The Company's proposal to roll EmPower MD costs into base rates may effectively cap program costs in between rate cases. In addition, rolling the EmPower MD costs into rate base would allow the Company to earn a return on its EmPower MD costs. For these reasons, I recommend that the Commission should not allow the Company to roll its EmPower MD costs into base rates.

X. FINDINGS AND RECOMMENDATIONS

Q What are your findings?

A The benefit-cost analysis, as presented by the Company, has the following flaws:

1. The benefit-cost ratio is below one. The Company has overstated both market-side and operational benefits attributable to the Smart Grid program based on the testimony of OPC Witnesses Paul Chernick and Pete Lanzalotta. When I use alternate inputs developed by OPC and include the legacy meter costs as recommended by the Commission in order 83410, the benefit-cost ratio of the Company's Smart Grid Program is 0.75.
2. The Company's meter failure rate is twice as high as originally projected, and currently the Company does not have to report meter failures in its quarterly reports.

Q What are your recommendations for the Commission?

A I recommend, for the reasons explained in this testimony, that the Commission consider disallowing $193 million of the Company's costs for the initiative to break even. In addition, I recommend that the Commission require BGE to provide a revenue requirement impact assessment and regular analyses of the cost-effectiveness of the Smart Grid program going forward.

Q Does this conclude your testimony?

A It does.