COMMONWEALTH OF MASSACHUSETTS

DEPARTMENT OF PUBLIC UTILITIES

D.P.U. 26-50

REBUTTAL TESTIMONY OF THE TOTAL FACTOR PRODUCTIVITY STUDY, COST BENCHMARKING STUDY, AND PERFORMANCE-BASED REGULATION EVALUATION PANEL

Nicholas A. Crowley, CFA and Daniel McLeod, Ph.D.

IN SUPPORT OF

Total Factor Productivity Study,

Cost Benchmarking Study,

and

Performance-Based Regulation Evaluation

EXHIBIT NG-CAEC-Rebuttal-1

June 17, 2026

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REBUTTAL TESTIMONY OF NICHOLAS A. CROWLEY AND DANIEL MCLEOD

I. Introduction

Q. Please introduce the members of the panel.

A. The panel is comprised of Nicholas A. Crowley, CFA and Daniel P. McLeod, Ph.D, of Christensen Associates Energy Consulting ("CA Energy Consulting").

Q. Have you previously submitted direct testimony in this proceeding?

A. Yes. We submitted direct testimony in this proceeding on January 16, 2026, in support of Boston Gas Company d/b/a National Grid's ("Boston Gas" or the "Company") initial filing in this matter. Specifically, we provided the results of our total factor productivity ("TFP") study in support of the Company's proposed X factor for its revenue per customer ("RPC") cap in the performance-based ratemaking ("PBR") mechanism. In addition, we provided a cost benchmarking study to inform a recommended consumer dividend.

II. Purpose of Testimony

Q. What is the purpose of your testimony?

A. Our rebuttal testimony responds to the direct testimony submitted to the Department of Public Utilities ("Department") in this proceeding by the Office of the Attorney General's ("AGO") witness Michael W. Deupree[1] in the following areas:

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1 Exh. AG-MWD-1.

- Mr. Deupree states that PBR mechanisms "fail to promote cost efficiencies." We have provided evidence that, in fact, indexed cap regulation corresponds to faster productivity growth and benefits to customers.[2] We will provide additional evidence from other jurisdictions.
- Mr. Deupree recommends that the revenue cap formula under which Boston Gas will operate during the five years between 2027 and 2031 incorporates an X factor of zero percent. This recommendation is not based on an empirical measurement of industry productivity and is therefore inconsistent with the principles of regulatory economics that underly the PBR framework. Constraining investment below observed industry needs goes beyond incentivizing efficiency; it also weakens the Company's ability to make optimal resource allocation decisions and to pursue the cost-efficiency measures that PBR is intended to encourage .
- Mr. Deupree recommends a consumer dividend of 0.30 percent. This recommendation is based on flawed benchmarking analysis and contradicts precedent.

[2] Exh. NG-CAEC-1.

III. PBR Provides Cost Efficiency Incentives

Q. Mr. Deupree recommends that the Department reject the Company's proposed PBR mechanism ("PBRM"). What is the basis for this recommendation?

A. The basis for Mr. Deupree's recommendation to reject the Company's proposed PBR framework appears to be a claim that PBR mechanisms do not result in cost efficiencies among utilities. Mr. Deupree states:

> I recommend that the Department reject the Company's proposed PBRM. PBRMs are designed to provide utilities with financial incentives to reduce costs while increasing productivity. However, as the natural gas industry becomes less productive overtime relative to the overall economy, PBRMs ultimately fail to promote cost efficiencies and instead allow utilities to increase rates faster than inflation.

Q. Has Mr. Deupree provided evidence that PBR frameworks fail to promote cost efficiencies?

A. No. Mr. Deupree has not provided any empirical or theoretical support for the statement that PBR frameworks fail to promote cost efficiencies. This statement is inaccurate and not consistent with well-established industry evidence.

Q. What are the findings of empirical studies on productivity and rate outcomes of utilities operating under indexed cap regulation?

A. Our direct testimony in Exhibit NG-CAEC-1 provides evidence that indexed cap regulation does, in fact, correspond with improved utility productivity and rate outcomes for customers.[3] We cited academic studies containing evidence from the United Kingdom and Canada that indicate indexed regulation promotes cost efficiencies and corresponds to

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[3] Exh. NG-CAEC-1, at 10.

lower utility rates for customers. Numerous papers studying the indexed cap regulation of telecommunications companies have demonstrated that indexed cap regulation corresponds to productivity growth and lower rates.[4]

Q. Since the submission of your direct testimony in January, have any additional empirical studies on this matter been published in peer-reviewed academic journals?

A. Yes. In April 2026, a new study was published in the *Journal of Regulatory Economics* that reviewed data from Dutch electricity distribution utilities during the period 2000 to 2024. This study, by Dr. Paul H. L. Nillesen and Cambridge University professor Michael Pollitt, found that incentive regulation that adjusts rates according to a mechanism beyond the utility's control, as the Company's proposed PBR plan would do, corresponded with productivity improvements across the industry. The study quantified €4 billion of savings to customers attributable to indexed regulation during the 25-year period.[5] In addition, we have conducted research regarding Canadian gas distribution utilities operating under indexed cap regulation and found that all three large gas distribution utilities in our study (FortisBC Energy Inc., ATCO Gas, and Enbridge Gas Distribution) exhibited productivity

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[4] See, for example: Eckenrod, Sarah. "Incentive Regulation in Local Telecommunications: The Effects on Price Markups." *Journal of Regulatory Economics*, vol. 30, no. 2, 2006, at 217–231, https://link.springer.com/article/10.1007/s11149-006-0012-7;

Ai, C., and Sappington, D. E. M. (2002), The impact of state incentive regulation on the U.S. telecommunications industry, *Journal of Regulatory Economics*, *22*(2), at 133–160.

[5] Nillesen, Paul H. L., and Michael G. Pollitt, "Incentive Regulation and Distribution Network Performance: A Dutch Case Study (2000–2024)," Journal of Regulatory Economics, vol. 69, no. 1, 2026, https://link.springer.com/article/10.1007/s11149-026-09511-5.

improvements and lower total cost growth relative to a sample of similar companies not operating under indexed cap regulation.

Q. How do these studies relate to the PBR framework proposed by the Company?

A. The Company proposes to operate under an indexed cap PBR plan similar to the regulatory frameworks governing the companies studied in the academic sources we have cited. The key takeaway of these studies is that, across industries and across jurisdictions, regulated companies operating under yardstick regulation or indexed cap PBR frameworks exhibit faster productivity growth and/or provide benefits to customers relative to a benchmark group of companies operating under traditional regulation. The implication of this literature is that, over the long run, Boston Gas customers can be expected to experience slower rate growth under the proposed PBR framework than what they would experience under traditional cost-of-service regulation.

Q. Does a natural gas industry facing declining productivity growth as measured by a negative X factor mean the industry's operating efficiency is declining?

A. No. As explained in our direct testimony, the negative X factor resulting from the TFP study indicates that input costs to serve an individual gas customer have increased faster than inflation across the companies in the sample. The increase in input costs per customer does not indicate a decline in operational performance because the factors driving the increase in costs may not be related to operating performance. For example, increasing federal safety requirements and industry input price inflation are cost drivers outside the industry's control. An industry operating at the frontier of its operational efficiency may still have a negative X factor if the industry faces external cost pressures beyond its control.

Q. Mr. Deupree states that "a PBR framework that includes a negative X-factor is antithetical to the concept of PBR."[6] Is this true?

A. No. The revenue adjustment equal to I-X provides a company with relief from earnings attrition over a prolonged period between rate cases. It is the rate case stay-out period—not the value of the X factor—that provides the firm with cost efficiency incentives. A profit maximizing firm will experience cost efficiency incentives regardless of the X factor value, but it may not be able to manage for five years without a rate case if the X factor is set incorrectly.

Q. Do Mr. Deupree's examples regarding the efficacy of PBR in Massachusetts demonstrate that PBR has failed to provide benefits to customers?

A. No. Mr. Deupree states:

> […] when Bay State Gas Company moved to terminate its PBR Plan, it received a base rate increase significantly above the rate of inflation, and National Grid has previously received a base rate increase after terminating a PBR Plan. These examples show that LDCs subject to PBR Plans have historically failed to pass cost savings associated with greater operational efficiency, if any, to their customers.[7]

This statement claims that any rate increase above the rate of economy-wide inflation reflects a failure of PBR to provide benefits to customers. However, by excluding any

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[6] Exh. NG-AG-1-3 (a).

[7] Exh. NG-AG-1-3 (b).

comparison to a counterfactual (i.e., companies operating under traditional regulatory frameworks) these claims ignore the concept of *ceteris paribus*. Mr. Deupree does not provide information regarding the rate increases of similarly situated gas distribution utilities, which may, in fact, have been larger than those exhibited by Bay State Gas Company or National Grid. This is why any credible study on the efficacy of PBR requires a counterfactual group of utilities for comparison purposes.

Q. How would further declines in productivity in the natural gas industry affect the Company under the proposed PBR framework?

A. Mr. Deupree stated, "as the natural gas industry becomes less productive overtime relative to the overall economy, PBRMs ultimately fail to promote cost efficiencies." To the extent that industry productivity growth slows during the rate term relative to recent history, the recommended X factor would be considered conservative. This is because slower productivity growth across the industry would correspond to a more negative X factor, as gas distributors require more inputs to provide safe and reliable service to customers. Under a scenario in which productivity growth slows across the industry, the Company's revenue growth would be restricted more under the proposed X factor, which is based on historical data, than under an X factor calculated with contemporary-year data.

Moreover, a decline in productivity across the industry would not undermine the cost efficiency incentives of PBR. In fact, in the absence of PBR, a utility would be expected to exhibit slower productivity growth than a utility operating under indexed cap regulation. This is why we include a consumer dividend in the revenue cap formula: the Company is expected to perform better than the industry average under an indexed cap form of regulation, because most companies in the sample do not operate under such a framework. The consumer dividend reflects the degree to which the utility is expected to outperform the industry average rate of productivity growth. The inclusion of a consumer dividend in the revenue cap formula is an acknowledgement that the utility is expected to perform better than the average utility in the sample. A recommendation for a higher consumer dividend, like what the Attorney General has proposed, is equivalent to stating that the Company is expected to exhibit superior cost efficiency growth under the revenue cap framework. It is inconsistent to state that PBR does not provide cost efficiency incentives and also recommend a higher consumer dividend.

Q. Is Mr. Deupree correct when he states that utilities under PBR will be allowed to increase rates faster than inflation?

A. No. Mr. Deupree states that: "Since the X-factor is subtracted from inflation, a negative productivity offset would allow rates to increase faster than the overall rate of inflation in the economy as measured by GDP-PI."[8] This statement is not accurate. In fact, the proposed I-X mechanism will adjust the Company's total *allowed revenue requirement* for distribution service at an annual percentage above inflation. To clarify, however, increasing total allowed revenues at a certain annual percentage is not equivalent to increasing rates at the same annual percentage. The Company has not proposed to operate under revenue-per-customer decoupling, and the I-X adjustment does not include a growth

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8 Exh. AG-MWD-1, at 14.

factor. In theory, under such a framework, customer rates could adjust by a percentage *less than the rate of inflation* if the number of customers served by Boston Gas expanded sufficiently.

The X factor we have recommended in our direct testimony reflects industry data. Required revenues for gas distribution utilities have indeed grown faster, on average, than the rate of economy-wide inflation in recent history. The proposed I-X formula reflects the expectation that this trend will continue during the five-year revenue cap term. If a revenue cap X factor were set equal to zero, even as the empirical results demonstrate a required X factor of negative 1.36 percent, a utility's allowed revenue growth would be substantially lower than the industry average. We are not aware of evidence demonstrating that Boston Gas expects the Company's costs to grow substantially more slowly than the industry average (although the Company will have to find a way to improve its efficiency to accommodate the consumer dividend and lack of growth factor in the revenue cap formula).

Therefore, in addition to providing a utility with an appropriate growth rate in revenue during a rate stay-out period, an empirically calibrated revenue cap formula provides information to the utility, regulators, and stakeholders. The percentage equal to I-X explicitly quantifies the *revenue per customer* growth required by the average utility in the industry. If the I-X formula were to be set with an arbitrary X factor, rather than an X factor set according to empirical productivity results, the revenue cap plan would be disregarding the principles of economics and would be unlikely to succeed; but, additionally, the revenue cap formula would no longer convey any meaningful information.

Q. What does the X factor signify in the absence of an adjustment for the growth in number of customers?

A. If the revenue cap formula does not include an adjustment for customer growth, the revenue cap does not adjust total revenue by an amount consistent with economic principles. If customer growth is positive, the revenue cap formula will adjust rates more slowly than required under the theory of indexed cap regulation. If customer growth is negative, the revenue cap formula will adjust rates more quickly than required under the theory of indexed cap regulation.

To be concrete, the Company has proposed a framework under which base revenue will grow at a slower rate than the industry average, because the proposed I-X formula includes a consumer dividend and does not include a growth factor. Without a growth factor, the Company's base revenue growth will be slower than the recommended percentage by an amount equal to the consumer dividend plus the growth rate in the Company's customer counts (which was +1.38 percent during the study period's 15-year average). Therefore, if the Company's growth rate in customer counts during the PBR term equals its historical average, the company would experience allowed revenue growth 1.58 percent (0.20 + 1.38 percent) slower than the industry's historical required average revenue growth.

While the proposed formula may provide the Company with revenue growth in excess of economy-wide inflation during the PBR term, base revenue growth will be below what theory would predict is required and below the industry average.

Q. If the Company's proposed PBR framework were rejected, as Mr. Deupree suggests, what would be the expected growth rate in the Company's allowed revenue over the next five-year period?

A. It is not possible to predict how the Company's revenue requirement would change over a five-year period in a traditional cost-of-service framework, under which the Company would be permitted to file a rate case at any time. However, if the Company's revenue requirement were to adjust in alignment with the industry average, that adjustment would equal I-X+G. In contrast, the Company's proposal is to adjust base revenues by I-X-CD, which is slower than the industry average.

IV. <u>The X Factor is a Central Component of the Revenue Cap Formula</u>

Q. What is Mr. Deupree's recommended X factor?

A. Mr. Deupree has stated that the Department should reject the X factor of negative 1.36 percent and adopt a PBRM with a zero percent X factor.

Q. What is the basis for Mr. Deupree's recommended X factor?

A. Mr. Deupree has stated that recent decisions by the Department provide precedent for X factor values equal to zero percent. Mr. Deupree states: "the Department's recently approved X-factors reflect an understanding of the problematic position of approving a negative productivity offset in the context of PBR."[9] Mr. Deupree cited dockets D.P.U. 22-22, D.P.U. 23-80 and D.P.U. 23-81, stating that: "The Department has not approved a negative X-factor since the Company's prior rate case in D.P.U. 20-120."[10]

Q. Are the regulatory frameworks cited by Mr. Deupree reflective of the PBR framework proposed by the Company?

A. No. Mr. Deupree is correct that the Department has accepted X factors that deviate from the empirical measure of industry productivity; however, these examples are not similar to the PBR framework proposed by the Company.

The AGO cites two proceedings, the most recent Eversource (electric) rate case in D.P.U. 22-22, and the most recent Fitchburg Gas & Electric rate case in D.P.U. 23-80/D.P.U. 23-81, which determined rates for both gas and electric service. In both proceedings, the Department approved a capital-related revenue supplement known as K-bar. The K-bar mechanism generally provides substantially more revenue than a company would obtain under a negative X factor without such a supplement, because it provides revenue on the basis of the utility's own historical capital spending trend. Therefore, the "effective X factor" (i.e., the percentage points above inflation by which rates adjust) for companies under K-bar tends to be more negative than an X factor based on industry productivity data, like the X factor proposed by Boston Gas.[11] In addition, Fitchburg Gas & Electric's gas

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[9] Exh. AG-MWD-1, at 14.

[10] Exh. AG-MWD-1, at 15.

[11] See for example: Meitzen, M. E., Schoech, P. E., & Weisman, D. L. (2017), The alphabet of PBR in electric power: Why X does not tell the whole story, *The Electricity Journal*, *30*(5), at 30–37.

operations revenue cap framework included revenue-per-customer decoupling, allowing for revenue increases tied to customer growth, which the Company's proposed revenue cap framework does not contain.

Mr. Deupree also cites a recent filing by Liberty Utilities.[12] In the most recent Liberty Utilities proceeding in D.P.U. 25-85, the Department approved a settlement that included revenue-per-customer decoupling and two rate base adjustments during the years 2027 and 2028.[13] The approved regulatory framework for Liberty Utilities does not adjust rates on the basis of factors beyond the Company's control and does not contain a five-year rate stay-out agreement.[14] The Liberty Utilities framework does not resemble the framework proposed by Boston Gas.

Boston Gas has not proposed to operate under a K-bar mechanism, has not proposed rate base adjustments comparable to those stipulated in the Liberty Utilities settlement agreement, and has not proposed to operate under revenue-per-customer decoupling or included a customer growth factor in its revenue cap formula. For these reasons, the examples of Department precedent provided by the AG are not comparable to the Company's proposed framework and should not be used as a basis for establishing Boston Gas's X factor.

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12 Exh. AG-MWD-1, at 15.

13 In fact, all gas companies in Massachusetts formerly operated under revenue-per-customer decoupling.

14 Liberty Utilities (New England Natural Gas Company) Corp., D.P.U. 25-85, at 26 (March 27, 2026).

Q. Has the Department stated that negative X factors are "problematic"?

A. No. Mr. Deupree has asserted the reason that the Department accepted X factors equal to zero percent is because the Department has found negative X factors problematic. This statement is not substantiated. In fact, the Department has consistently approved X factors based on empirical productivity analysis. The positive X factor approved in Docket D.P.U. 23-150 was based on an empirical measure of partial factor productivity. The only instances in which the Department has approved X factors of zero percent have been in proceedings in which the utility has requested a zero percent X factor along with substantial additional revenue support.[15] The Company has not proposed similar additional, broad-based revenue support in this proceeding.

Q. Is an X factor of zero percent appropriate in this proceeding?

A. No. The X factor is not an arbitrary component of the revenue cap formula and should not be set arbitrarily. As demonstrated by the discussion of the cases cited by Mr. Deupree, above, the Department has consistently recognized the appropriateness and need for adequate revenue support when implementing multi-year rate plans.

As discussed in the our direct testimony, a revenue cap formula takes the form I-X+G.[16] This formula is derived from the principle that in competitive markets, revenue growth equals cost growth. In a competitive market, if revenue were permitted to grow faster than costs, new firms would enter the market and drive down average revenue growth, whereas

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[15] Exh. NG-CAEC-1, Table 1.

[16] Exh. NG-CAEC-1, at 25.

if revenue grew slower than costs over time, firms would exit the market (i.e., they would go out of business). If the X factor is not set according to this principle using industry productivity data, revenue will not adjust according to the principles underlying indexed regulation.

Q. What is your conclusion regarding Mr. Deupree's X factor recommendation?

A. The AGO has not provided an empirical study of industry productivity in support of its X factor recommendation, even though an empirical study of productivity is a required element of a principled revenue cap formula. Applying a value of zero to the X factor would be arbitrary, just as setting the I factor equal to zero would be arbitrary. If Boston Gas were to operate under an X factor equal to zero, we would expect that the Company would require some form of supplemental revenue recovery similar to what the Department has accepted in past proceedings (e.g., K-bar). If designed properly, a framework with a zero percent X factor that also provides supplemental revenue could retain the cost efficiency incentives provided by an I-X revenue cap set according to empirical productivity analysis. However, the choice of a zero X factor would be arbitrary and the "effective X factor" in a framework with supplemental revenue (i.e., the allowed growth in revenue above the rate of inflation) might be more negative, as revenue growth could very well exceed inflation plus 1.36 percent under such a framework. A framework with a zero X factor coupled with K-bar is also less transparent to stakeholders, as the revenue allowance is no longer tied directly to industry cost trends (to evaluate relative Company performance relative to the industry, an "effective X factor" would have to be calculated and compared to the empirical X factor).

Q. Is the revenue cap framework proposed by the Company appropriate?

A. The Company has proposed to operate under a revenue cap such that the Company's annual allowed revenue requirement adjusts by the rate of inflation, as measured by GDP-PI, and an X factor of negative 1.36 percent. However, as explained in our direct testimony, this revenue cap formula excludes a G factor. The derivation of the revenue cap formula concludes that the Company should adjust rates by a percentage equal to "I-X+G," where G reflects the growth in the number of customers served by the utility. If Boston Gas exhibits positive growth in the number of customers served, omitting the G factor results in slower revenue growth than the formula as derived according to economic principles. For this reason, we recommend that the Company's revenue cap include a G factor (see Exhibit NG-CAEC-1, Table 7).

Otherwise, we find that the Company's proposed revenue cap framework aligns with the principles of economics.

V. <u>A Consumer Dividend of 0.20 Percent is Appropriate</u>

Q. Please summarize the AGO's recommendation regarding the Company's proposed consumer dividend in the PBRM.

A. The AGO recommends that the Department reject the Company's proposed consumer dividend of 0.20 percent and continue the existing 0.30 percent consumer dividend (if the Company's PBRM is approved).

Q. What is the basis for this recommendation?

A. Mr. Deupree modifies the Company's unit cost benchmarking analysis and econometric cost benchmarking analysis and concludes that (1) contrary to the Company's claim, Boston Gas's performance has deteriorated compared to peer utilities over the term of the first PBR plan; and (2) Boston Gas is a below-average cost performer relative to its peers.

Q. Please summarize the AGO's unit cost benchmarking analysis.

A. Mr. Deupree compares the Company's unit costs to those of 22 northeast gas utilities over a 15-year period.[17] Mr. Deupree defines unit costs on both a volumetric basis (per dekatherm) and a per-customer basis and finds that the Company is historically a weak cost performer on both measures of unit cost. Furthermore, Mr. Deupree highlights that the Company's cost performance, as measured by its unit total cost ranking, has declined over its first PBR term.

Q. Please summarize the AGO's econometric cost benchmarking analysis.

A. Like the econometric analysis presented in Exhibit NG-CAEC-1, Mr. Deupree compares the Company's cost to the prediction of a model that incorporates cost-driving features of its operating environment. Mr. Deupree makes the following changes to the Company's model. First, Mr. Deupree estimates the AGO's model using 18 northeast gas utilities as opposed to the Company's nationwide econometric sample of 48 gas utilities.[18] Second,

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[17] This is a subset of the Company's Northeast sample, and Mr. Deupree does not explain his methodology for selecting this sample.

[18] Mr. Deupree appears to arrive at this sample of 18 utilities by confining his northeast sample to only those utilities with at least 100,000 customers.

Mr. Deupree removes population density and the share of leak-prone-pipe miles as explanatory variables. Third, Mr. Deupree replaces the cumulative change in the share of leak-prone-pipe miles with a year-over-year change. Fourth, Mr. Deupree adds system throughput as an explanatory variable. Fifth, Mr. Deupree uses alternative standard errors to measure the uncertainty of the model estimates. Mr. Deupree also changes the periods over which the Company's performance change is studied. Whereas the benchmarking analysis contained in Exhibit NG-CAEC-1 used 2017 through 2019 as the "pre-PBR period" and 2021-2023 as the "PBR period," Mr. Deupree reports two conflicting sets of results. One set of Mr. Deupree's results uses the periods of study chosen by the Company, while the other uses 2014 through 2018 as the pre-PBR period and 2019 through 2023 as the period over which the Company's performance under PBR is analyzed. From this latter analysis, Mr. Deupree claims that the Company "remains well above its predicted cost and is losing ground on administrative and general cost control."[19]

Q. Do you agree with Mr. Deupree's decision to limit the econometric benchmarking analysis to Northeast gas utilities?

A. No. Restricting the sample from 48 utilities in the Company's sample to just 18 utilities in the AGO's sample will increase the variance or statistical uncertainty around the results. This is because restricting the sample to just 18 companies removes a significant amount of information in the data about the relationship between a utility's costs and its operating

[19] Exh. AG-MWD-1, at 33, Lines 17-19.

conditions. Therefore, there is no reason to believe that Mr. Deupree's model is more accurate.

Furthermore, to the extent that the marginal cost of an additional customer or mile of replaced mains pipe differs between the average northeast distributor and the average national distributor, it is likely to be higher in the Northeast. In other words, the model coefficients are likely higher for companies in Massachusetts than companies in Georgia or Utah. This means that the model described in our direct testimony is conservative: at worst, by incorporating data from outside the Northeast, it will predict a cost level for the Company that is lower than the "ideal" prediction, implying a measured level of inefficiency for Boston Gas that is higher than the truth.

Q. Should population density and the share of leak-prone-pipe miles be removed from the model?

A. No. Mr. Deupree claims that two variables in the Company's model – population density and the share of leak-prone-pipe miles – are highly correlated, making their effects difficult to separately identify.[20] Mr. Deupree does not provide a formal statistical test to determine that such a correlation is indicative of a multicollinearity problem, as he claims. Instead, Mr. Deupree simply reports the correlation matrix of the regressors and concludes that a correlation coefficient of 0.68 is too large. However, this is insufficient to determine that

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[20] Exh. AG-MWD-1, at 28, Lines 2-6.

variables should be dropped from the model. As stated in an introductory textbook on statistics:

> Instead of inspecting the correlation matrix, a better way to assess multicollinearity is to compute the variance inflation factor (VIF). The VIF is the ratio of the variance of $\hat{\beta}_j$ when fitting the full model divided by the variance of $\hat{\beta}_j$ if fit on its own. The smallest possible value for VIF is 1, which indicates the complete absence of collinearity. Typically in practice there is a small amount of collinearity among the predictors. As a rule of thumb, a VIF value that exceeds 5 or 10 indicates a problematic amount of collinearity.[21]

The following table shows the VIF for each of the variables in the Company's model.

	Total Customers	*Population Density*	*Share of Leak-Prone Pipe Miles*	*Cumulative Reduction in Share of Leak-Prone Pipe Miles*
VIF	1.14	1.88	1.77	2.27

As shown in the table, all VIFs in the Company's econometric analysis are below or equal to 2.27. Because this is far below the recommended threshold for a multicollinearity problem of 5 to 10, this test rejects the AGO's claim that multicollinearity is an issue in the Company's econometric model. Therefore, dropping these variables from the model is not appropriate.

Q. Should the cumulative change in the share of leak-prone-pipe miles be replaced by a year-over-year change in the share of leak-prone-pipe miles?

A. No. As stated in response to Information Request AG-7-24, "a company's capital stock depends on its historical capital additions. Because a company's costs depend on its capital

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21 James, Gareth, et al., *An introduction to statistical learning: with applications in R*. Vol. 103, New York: springer, 2013, at 101.

stock, its costs are a function of its historical capital additions." By replacing the cumulative change with a year-over-year change as the AGO has done, the dynamic impact of capital investment on cost is not accounted for. For instance, suppose the Company had made significant investment to replace leak-prone pipe between 2016 and 2022, and did not make any such investment in 2023. The Company's cost to serve in 2023 will reflect capital-related costs like depreciation and interest on the investments from 2016 to 2022. However, because there was no change in the share of leak-prone pipe miles from 2022 to 2023, the AGO's model will not account for these higher costs, and therefore will be unable to explain the Company's costs in 2023 related to this historical investment. Such a model would unfairly attribute required mains replacement to poor cost performance.

Q. Should system throughput be added to the model?

A. The AGO has added a volumetric control to account for differences in throughput across utilities. It is not unreasonable to add system volume to the model. However, as explained below, given that the Company classifies no costs related to sales volume, we did not include this variable given its economic insignificance.

Q. Are the AGO's alternative standard errors necessary?

A. Mr. Deupree notes that the model's residuals exhibit serial correlation.[22] Serial correlation occurs when there exist unobserved time-invariant factors that influence a utility's cost, like terrain, weather, or the regulatory environment. Mr. Deupree argues that alternative

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[22] Exh. AG-MWD-1, at 28-29.

standard errors must be used to reflect the true uncertainty about the model's coefficient estimates. However, the purpose of the Company's econometric cost benchmarking study is to provide the best possible prediction of the Company's costs given its operating conditions, compare those predictions to the Company's actual costs, and analyze how the difference or "score" has changed after the Company adopted PBR. This "best possible prediction" is not impacted by the chosen standard errors. In other words, the chosen methodology for estimating standard errors does not impact the model's estimated coefficients. Nor does it impact the results summarized in Exhibit NG-CAEC-1, Table 6. It is worth noting that Mr. Deupree's chosen standard errors do not impact the AGO's results as summarized in Exhibit AG-MWD-3.[23]

Q. Please explain the AGO's claim that the Company's cost performance has deteriorated compared to peer utilities over the term of the first PBR plan.

A. Mr. Deupree states that his "analysis shows that, contrary to the Company's claim, Boston Gas' cost performance has deteriorated slightly when compared against peer utilities over the term of its first PBR plan."[24] Mr. Deupree supports this claim with two findings in his report. The first is based on his unit cost analysis and the second on the AGO's alternative econometric analysis.

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[23] Exh. NG-AG-1-8.

[24] Exh. AG-MWD-1, at 4, Lines 14-16.

Q. What evidence from the AGO's unit cost analysis supports this claim?

A. Referring to the Company's unit total cost, Mr. Deupree reports that "the Company's position has furthermore generally weakened in recent years, falling from 12th in 2020, to 17th in 2023."[25]

Q. Has this finding already been addressed in the Company's filed evidence?

A. Yes. A related finding was reported in Table 6 of Exhibit NG-CAEC-1. Boston Gas's average performance as measured by its unit total cost ranking fell slightly (one place in rankings) from the 2017 through 2019 pre-PBR period to the PBR period of 2021 through 2023. Specifically, its average rank fell in the Northeast sample from 19th to 20th out of 31 northeastern gas distributors, and from 73rd to 74th out of 86 companies in the National sample. Our direct testimony explains that,

> Because of infrastructure characteristics driving lifecycle maintenance and replacement work on the Company's gas distribution systems discussed in the pre-filed testimony of the Company's Capital Expenditures Panel, Exhibit NG-CAPEX-1, total cost performance is the less relevant measure of efficiency for purposes of benchmarking controllable unit costs against national and regional peers. [26]

Our direct testimony showed that once these factors are controlled for in the econometric model, Boston Gas's average rank improves over this period.

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[25] Exh. AG-MWD-1, at 22, Lines 14-15.

[26] Exh. NG-CAEC-1, at 49-50, Lines 13-14; 1-2.

Q. What evidence from the AGO's econometric analysis supports the claim that the Company's cost performance has deteriorated compared to peer utilities over the term of the first PBR plan?

A. Mr. Deupree uses his alternative econometric model to compare the Company's performance over the 2014 through 2018 period with its performance over the 2019 through 2023 period.[27] Mr. Deupree uses this analysis to claim a "deterioration in relative cost efficiency."[28]

Q. Why are these periods inappropriate?

A. The Company adopted PBR in 2021, and was thus not under PBR for a significant portion of Mr. Deupree's chosen period of 2019 to 2023. Moreover, the Department has explicitly stated a preference for a three-year rolling average:

> The results of an annually updated benchmarking study, using a three-year rolling average of the most recent data, shall be used to set a new consumer dividend component over the PBR term. The updated benchmarking results will reward the Company for becoming more efficient and penalize the Company for becoming less efficient.[29]

Whereas our direct testimony presented 2017 through 2019 and 2021 through 2023 as the pre-PBR and PBR periods to be consistent with this preference, Mr. Deupree chose five-year periods to align with "the Company's proposed five-year performance-based

[27] Exh. AG-MWD-3, Schedule 9.

[28] Exh. AG-MWD-1, page 32, Line 2.

[29] Massachusetts Electric Company and Nantucket Electric Company, D.P.U. 18-150, at 62 (2019).

ratemaking plan."[30] This decision is not reasonable given that the AGO's historical five-year periods do not align with the Company's adoption of PBR. The Company operated under cost-of-service regulation during the 2014 to 2018 period and for two of the five years in the 2019 to 2023 period.

Q. Does the AGO provide alternative periods over which the Company's performance change is analyzed?

A. Yes. In Exhibit AG-MWD-3, Schedule 10, the AGO uses 2017 to 2019 as the pre-PBR period and 2021 to 2023 as the PBR period, which coincides with the Company's analysis.[31]

Q. What are the results of this analysis?

A. The AGO finds that Boston Gas's total cost performance, operation, maintenance, and administrative ("OM&A") cost performance, and operation and maintenance ("O&M") cost performance improved between 2017 to 2019 and 2021 to 2023 by 9.1 percent, 5 percent, and 31.1 percent, respectively. However, contrary to his own analysis, Mr. Deupree states:

> While both models show some improvement in O&M cost performance, neither model shows meaningful improvement in OM&A cost performance,

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[30] Response to Information Request NG-AG-1-5; additionally, as explained in Exhibit NG-CAEC-1, 2017 to 2019 was chosen as the pre-PBR period, rather than 2018 to 2020, in order "to mitigate the impacts of the COVID-19 pandemic and the merger between Boston Gas and the former Colonial Gas in 2020."

[31] Exh. AG-MWD-3, Schedule 10 incorrectly states that the periods studied were 2017 to 2019 and 2019 to 2023. As noted by the AGO in response to Information Request NG-AG-1-6: "Consistent with the corrected workpapers for Exhibit AG-MWD-3, Schedule 10, the correct periods analyzed by Mr. Deupree are 2017–2019 and 2021–2023. These periods were selected to mirror the comparison used in the Company's own benchmarking analysis."

and both models show that the Company's OM&A performance deteriorated between the pre-PBR and most recent periods.[32]

The AGO's own cited econometric analysis finds an improvement in OM&A cost performance. It is not clear why Mr. Deupree makes this statement and concludes that the Company is "losing ground on administrative and general cost control."[33]

Q. How does Mr. Deupree's unit cost analysis support his claim that Boston Gas is a below-average cost performer relative to its peers?

A. Mr. Deupree compares Boston Gas's unit costs to those of a sample of 22 northeast gas utilities over a 15-year period to show the Company is historically a weak cost performer on both a volumetric basis and on a per-customer basis.

Q. Why is unit cost measured on a volumetric basis not informative of cost performance?

A. System throughput is a weak predictor of costs. The Company's cost allocation study classifies 57.5 percent of system costs as demand-related and 42.5 percent of costs as customer-related. The Company classifies no costs as related to sales volumes.

Q. How does this differ from a study that defines unit costs on a per-customer basis?

A. Customer counts are a significant driver of gas distribution utility costs. As shown in Exhibit NG-CAEC-1, Table C1, an increase in total customers of 1 percent increases system costs by 0.842 percent, which is close to a one-to-one increase. Revenue-per-customer decoupling is common in natural gas distribution and assumes that the cost to

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32 Exh. AG-MWD-1, at 33, Lines 13-17.

33 Exh. AG-MWD-1, at 33, Lines 17-18.

serve is proportional to the number of customers. While a ranking of cost per customer is an imperfect reflection of cost performance because other factors also drive costs (such as the regulatory environment), a significant portion of what drives the gas distribution utility's costs is implicitly controlled for in a cost per customer comparison.

Q. Please provide an example explaining why measuring cost performance using volumetric unit costs can be misleading.

A. Suppose two companies have identical total cost per dekatherm, but one company operates within a state that is introducing an energy efficiency ("EE") program, while the other is not. The company participating in the EE program will deliver less gas and experience a corresponding increase in cost per dekatherm, even though its actual cost performance has not changed. This is because cost does not fall commensurately with sales volumes as it does with changes in the total number of customers served. Mr. Deupree's analysis would claim that the company participating in an EE program is less efficient and should therefore face a higher consumer dividend.

Q. Does the AGO's unit cost study using per-customer unit costs show the Company is a below-average performer relative to its peers?

A. No. While Mr. Deupree has found that the Company's unit costs have historically been above the average unit cost of distributors operating in the Northeast,[34] a level comparison of the Company's unit cost to the average unit costs of the Northeast sample is not an accurate measure of the Company's level of cost efficiency.

[34] Exh. AG-MWD-1, at 22.

Q. What is a more appropriate peer group?

A. While imperfect, comparing the Company to gas distributors within the state of Massachusetts is more informative about relative cost efficiency, because state-specific cost driving factors are implicitly controlled for in this comparison. That is why, as supporting evidence for its recommendation of a 0.2 consumer dividend, the Company noted that Boston Gas was shown to have a lower cost per customer than Fitchburg Gas and Electric Company, which received a consumer dividend of 0.25 in D.P.U. 23-81.[35]

Q. Is this consistent with Department precedent?

A. Yes. In its determination of the consumer dividend for Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid, the Department stated:

> The benchmarking study presented in this proceeding determined that NSTAR Electric Company ('NSTAR Electric') is a more cost-efficient utility than National Grid, and, therefore, a consumer dividend greater than NSTAR Electric's approved 0.25 percent consumer dividend is warranted for National Grid.[36]

Q. What do the AGO's findings imply about the Company's cost efficiency level when a state-specific peer group is used?

A. Mr. Deupree's cost benchmarking study confirms that Boston Gas performs better than average in Massachusetts. As shown in Exhibit AG-MWD-3, Schedule 3, the Company performs better than the state average during the 2021 to 2023 period, and the Company's performance relative to the state average improved after transitioning to PBR.

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[35] Fitchburg Gas and Electric Light Company, D.P.U. 23-80 and 23-81, at 43. June 28, 2024.

[36] D.P.U. 18-150, Order, at 62-63.

Q. Does Mr. Deupree's econometric analysis allow him to conclude that Boston Gas is a below-average cost performer relative to its peers?

A. No. The "econometric score," or the difference between the Company's cost and its predicted cost from an econometric model, is not necessarily a reflection of the Company's level of cost efficiency. As stated in Exhibit NG-CAEC-1, "all benchmarking studies are confounded at least to some degree by unobservable variables. If the study does not control for every aspect of a company's exogenous operating conditions, then its estimate of cost efficiency will be biased." This is in part why the benchmarking analysis provided in our direct testimony focused on the recent historical *change* in Boston Gas's score, as summarized in Table 6 of Exhibit NG-CAEC-1. Changes in the Company's score implicitly control for any persistent cost driving variable like the regulatory environment, climate, terrain, and other idiosyncratic factors that are constant over time and difficult to measure.

Q. Please summarize your testimony as it relates to the AGO's claims that the Company is a below-average performer relative to its peers and its performance has deteriorated over its PBR term.

A. A comparison of the Company's unit costs to those of a peer group is only reflective of cost performance if that peer group faces similar operating conditions. Mr. Deupree's analysis confirms that the Company is a superior performer relative to distributors in Massachusetts. Exhibit NG-CAEC-1 presents evidence that the Company's cost performance improved after adopting PBR, and Mr. Deupree's own benchmarking study confirms this finding in Exhibit AG-MWD-3, Schedule 10.

Q. How do these findings relate to the recommended consumer dividend?

A. First, the Department has stated that, "the results of an annually updated benchmarking study, using a three-year rolling average of the most recent data, shall be used to set a new consumer dividend component over the PBR term. The updated benchmarking results will reward the Company for becoming more efficient and penalize the Company for becoming less efficient."[37] The Company has provided evidence that Boston Gas's performance improved during the most recent three-year period, which aligns with the years that Boston Gas operated under an indexed cap framework. The AGO's econometric analysis arrived at the same conclusion. Second, as a basis for the consumer dividend, the Department has used a recent comparison of the Company's unit cost to the unit costs of its peers within Massachusetts, and awarded a lower consumer dividend to the company with the lower unit cost.[38] The Company has noted that Boston Gas's recent performance as measured by cost per customer is superior to that of Fitchburg Gas and Electric Company, which operates with a consumer dividend of 0.25. Moreover, the AGO has found that Boston Gas has performed better than average when compared to its state peers.

VI. <u>Conclusion</u>

Q. Does this conclude your testimony?

A. Yes.

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37 D.P.U. 18-150, at 62.

38 D.P.U. 18-150, at 62-63.