Massachusetts Electric Company
and Nantucket Electric Company
each d/b/a National Grid
D.P.U. 23-150
Exhibit NG-MM-NC-1
November 16, 2023
H.O. Tassone

PRE-FILED DIRECT TESTIMONY

OF

MARK E. METIZEN, Ph.D. AND NICHOLAS A. CROWLEY, MS

Performance-Based Ratemaking Panel

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TESTIMONY OF PERFORMANCE-BASED RATEMAKING PANEL

MARK E. METIZEN, PH.D. AND NICHOLAS A. CROWLEY, MS

I. Introduction

Q. Dr. Meitzen and Mr. Crowley, please state your full names and business address.

A. Our names are Dr. Mark E. Meitzen and Mr. Nicholas A. Crowley. Our business address is 800 University Bay Drive, Suite 400, Madison, Wisconsin 53705.

Q. On whose behalf are you submitting this testimony?

A. In this proceeding, we are testifying on behalf of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid (referred to hereafter as the "Company").

Q. Dr. Meitzen, by whom are you employed and in what capacity?

A. I am a Senior Consultant with Christensen Associates. Christensen Associates is an economic research and consulting firm with expertise in the design and application of incentive regulation plans across a number of network industries and with 40 years of experience in utility industries.

Q. Please summarize your educational background and business experience?

A. I have a Bachelor of Science degree in economics from the University of Wisconsin-Oshkosh and a Master of Science from the University of Wisconsin-Madison. I received

my Ph.D. in economics from the University of Wisconsin-Madison. I have been at Christensen Associates since 1990. Prior to that, I was a regulatory economist at Southwestern Bell Telephone Company (now AT&T) in St. Louis, Missouri, and I was a member of the economics faculty at the University of Wisconsin–Milwaukee and Eastern Michigan University. Among my various duties at Christensen Associates, I have consulted with firms in several network industries, including the telecommunications, electricity, postal and railroad industries. I have consulted with these industries on a variety of issues including incentive regulation, productivity, costing and pricing. I have also sponsored testimony on these issues in regulatory proceedings.

I have co-authored a number of other productivity studies conducted by Christensen Associates, including a recent study prepared on behalf of EPCOR in Alberta, Canada and productivity analysis on behalf of AT&T, which was filed with the Federal Communications Commission. I have also performed numerous analyses for former regional Bell Operating Companies, the United States Telephone Association, the National Cable Television Association, and all the major telecommunications companies in Canada. I have analyzed incentive regulation issues for various network industries including the telecommunications, electric utility and postal industries. I also directed the Christensen Associates team that analyzed incentive-regulation options for the privatization of Peru's telecommunications industry.

Among the articles and reports that I have written, I have recently co-authored three articles on performance-based ratemaking ("PBR") in the electric utility industry (including one with Mr. Crowley).[1] I have also published articles on total factor productivity ("TFP"), incentive regulation in network industries (electricity, gas, and telecommunications) and cross-subsidization issues in the electric utility industry. I am a principal author of a study of U.S. railroad competition issues commissioned by the U.S. Surface Transportation Board. My curriculum vitae is attached as Exhibit NG-MM-NC-2.

Q. Have you previously testified before the Department of Public Utilities?

A. Yes, I have. I have sponsored a TFP study and testified on PBR issues in four proceedings before the Massachusetts Department of Public Utilities (the "Department") on behalf of NSTAR Electric Company d/b/a Eversource Energy in D.P.U. 22-22;[2] on behalf of Boston Gas Company and the former Colonial Gas Company d/b/a National Grid (together, "Boston Gas") in D.P.U. 20-120;[3] on behalf of Massachusetts Electric Company and

[1] Nick Crowley and Mark Meitzen, "Measuring the Price Impact of Price-Cap Regulation Among Canadian Electricity Distribution Utilities," *Utilities Policy,* 72 (2021); Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "The Alphabet of PBR in Electric Power: Why X Does Not Tell the Whole Story," *The Electricity Journal*, 30 (2017) 30-37; and Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "Debunking the Mythology of PBR in Electric Power," *The Electricity Journal,* 31 (2018) 39-46.

[2] Direct Testimony of Mark E. Meitzen, Ph.D., and Nicholas A. Crowley, D.P.U. 22-22, January 14, 2022; and Rebuttal Testimony of Mark E. Meitzen, Ph.D., and Nicholas A. Crowley, D.P.U. 22-22, June 10, 2022.

[3] Direct Testimony of Mark E. Meitzen, Ph.D., and Nicholas A. Crowley, D.P.U. 20-120, November 13, 2020; and Rebuttal Testimony of Mark E. Meitzen, Ph.D., and Nicholas A. Crowley, D.P.U. 20-120, April 23, 2021.

Nantucket Electric Company d/b/a National Grid in D.P.U. 18-150;[4] and, on behalf of NSTAR Electric Company and Western Massachusetts Electric Company, each d/b/a Eversource Energy in D.P.U. 17-05 (together, "NSTAR Electric").[5]

Q. Mr. Crowley, by whom are you employed and in what capacity?

A. I am a Senior Economist with Christensen Associates.

Q. Please summarize your educational background and business experience?

A. I have a Bachelor of Science degree in economics, as well as a Master of Science degree in economics from the University of Wisconsin-Madison. I began working at Christensen Associates in 2016. Prior to joining this firm, I was an economist in the Department of Pipeline Regulation at the Federal Energy Regulatory Commission ("FERC"), where I assisted with energy industry benchmarking, the incentive regulation of oil pipelines,[6] and the review and evaluation of natural gas pipeline rate cases. In these roles, I have worked extensively with FERC data, and other federal data, for the development of cost benchmarks for power systems, in measuring industry TFP, and the development of marginal cost models filed before regulatory authorities in the United States and Canada.

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[4] Direct Testimony of Mark E. Meitzen, Ph.D., D.P.U. 18-150, November 15, 2018; and Rebuttal Testimony of Mark E. Meitzen, Ph.D., D.P.U. 18-150, April 22, 2019.

[5] Direct Testimony of Mark E. Meitzen, Ph.D., D.P.U. 17-05, January 17, 2017; and Rebuttal Testimony of Mark E. Meitzen, Ph.D., Dennis L. Weisman, Ph.D., and Carl G. Degen, D.P.U. 17-05, May 19, 2017.

[6] Five-Year Review of the Oil Pipeline Index. Issued: December 17, 2015. 153 FERC ¶ 61,312.

I recently co-authored an article with Dr. Meitzen on the impact of price-cap regulation on Canadian electricity distribution utilities.[7] My curriculum vitae is attached as Exhibit NG-MM-NC-2.

Q. Mr. Crowley, have you previously testified before the Department?

A. Yes. Most recently, I filed written testimony on behalf of Fitchburg Gas & Electric Company, d/b/a Unitil, providing expertise on TFP and benchmarking as a component in the company's PBR rate application.[8] I also testified with Dr. Meitzen on behalf of NSTAR Electric Company d/b/a Eversource Energy in D.P.U. 22-22;[9] and on behalf of Boston Gas Company and the former Colonial Gas Company each d/b/a National Grid in D.P.U. 20-120.[10] I also calculated TFP measures for the electricity sector and developed indexes for use in performance-based ratemaking in proceedings before the Department on behalf of the Company in D.P.U. 18-150[11] and on behalf of NSTAR Electric in D.P.U. 17-05.[12] I

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[7] Nick Crowley and Mark Meitzen, "Measuring the Price Impact of Price-Cap Regulation Among Canadian Electricity Distribution Utilities," *Utilities Policy,* 72 (2021).

[8] Direct Testimony of Nicholas A. Crowley, D.P.U. 23-80 and 23-81, August 17, 2023.

[9] Direct Testimony of Mark E. Meitzen, Ph.D., and Nicholas A. Crowley, D.P.U. 22-22, January 14, 2022; and Rebuttal Testimony of Mark E. Meitzen, Ph.D., and Nicholas A. Crowley, D.P.U. 22-22, June 10, 2022.

[10] Direct Testimony of Mark E. Meitzen, Ph.D., and Nicholas A. Crowley, D.P.U. 20-120, November 13, 2020; and Rebuttal Testimony of Mark E. Meitzen, Ph.D., and Nicholas A. Crowley, D.P.U. 20-120, April 23, 2021.

[11] Direct Testimony of Mark E. Meitzen, Ph.D., D.P.U. 18-150, November 15, 2018; and Rebuttal Testimony of Mark E. Meitzen, Ph.D., D.P.U. 18-150, April 22, 2019.

[12] Direct Testimony of Mark E. Meitzen, Ph.D., D.P.U. 17-05, January 17, 2017; and Rebuttal Testimony of Mark E. Meitzen, Ph.D., Dennis L. Weisman, Ph.D., and Carl G. Degen, D.P.U. 17-05, May 19, 2017.

also assisted in the allocated cost-of-service study performed by Christensen Associates for NSTAR Electric in D.P.U. 22-22.[13]

II. Purpose of Testimony

Q. What is the purpose of your testimony?

A. This testimony will explain certain elements of the Company's second-generation PBR proposal, focusing particularly on empirical calculations of industry cost trends and rates of inflation in the broader economy. The analysis contained in this testimony informs the proposed cap on revenues associated operation and maintenance ("O&M") expenses. The testimony will also explain why the capital portion of the plan is proposed to be regulated under a separate Infrastructure, Safety, Reliability, and Electrification ("ISRE") Mechanism. The Company's proposed approach to capital differs both from the first-generation PBR recovery of capital under the revenue cap formula and also differs from the K-bar approach currently used by Eversource. A cost benchmarking analysis and a detailed discussion of the capital recovery mechanism can be found in Dr. Lawrence R. Kaufmann's testimony (Exhibit NG-LRK-1), while a comprehensive description of the proposed second-generation PBR framework can be found in the Company's pre-filed

[13] Direct Testimony of Bruce Chapman, *Allocated Cost-of-Service Study,* D.P.U. 22-22, January 14, 2022.

direct testimony of the Comprehensive Performance and Investment Plan ("CPI Plan") testimony (Exhibit NG-CPIP-1).

Q. How is your testimony organized?

A. Following these introductory sections, Section III provides an overview of the Company's proposed hybrid PBR plan, referred to as the "Comprehensive Performance and Investment Plan," or the "CPI Plan." Section IV provides a description of the proposed I-X revenue cap for O&M-related allowed revenues and Section V presents the I factor and X factor results for the O&M revenue cap. Section VI discusses how the Company proposes to establish its annual capital-related revenue requirement. Section VII presents our summary and conclusions.

Q. Do you have any Exhibits in addition to this written testimony?

A. Yes. In addition to this testimony (Exhibit NG-MM-NC-1: Testimony of Dr. Mark Meitzen and Mr. Nicholas Crowley), our Professional Qualifications can be found in Exhibit NG-MM-NC-2. Relevant workpapers can be found in Exhibit NG-MM-NC-3 (Confidential).

III. <u>Overview of the Company Plan</u>

Q. Please describe the key components of the Company's proposed PBR framework.

A. The Company has been operating under a PBR framework with a revenue cap since 2019 in the Commonwealth of Massachusetts. In the present filing, the Company proposes to continue operating under PBR over the five-year period between 2024 and 2029,

integrating certain changes to its first-generation PBR plan that will allow the Company to maintain dependable, high-quality electricity service under enhanced cost and performance incentives relative to traditional cost of service regulation. The proposed second-generation PBR framework maintains an indexed-based cap on the revenue requirement associated with O&M expenses, much like the first-generation plan. The revenue requirement associated with capital, however, will no longer be subject to an indexed cap. Instead, under the proposed approach, incremental capital recovery will involve annual filings with penalties and incentives that ensure prudent and efficient installation of distribution plant. The Company also proposes to add new PBR elements to its PBR framework in the form of performance incentive mechanisms ("PIMs").

Q. Why is the Company proposing changes to the structure of its PBR plan?

A. As detailed in the Company's pre-filed direct testimony of the CPI Plan Panel, Exhibit NG-CPIP-1, and Dr. Kaufmann, Exhibit NG-LRK-1, circumstances for the Company have changed since the inception of its first-generation PBR plan and are expected to change over the course of the next PBR plan period. In particular, the Company has demonstrated that its future expected capital needs will deviate dramatically from the revenue recovery expected under an I-X revenue cap. The I-X formula uses historical industry data that does not reflect the upcoming expansion in investment resulting from anticipated increases in load due to the Electric Sector Modernization Plan ("ESMP"), adequate levels of network

replacement, nor the significant rise in construction costs that have outpaced general inflation. The Company has determined that the structure of the PBR plan needs an update to reflect the Company's changing circumstances. Such changes align with PBR plans throughout North America. Regulators across jurisdictions have explicitly recognized that PBR plans should reflect the unique circumstances of the utility being regulated.[14,15,16] As explained below, the Department has shown in prior filings that it acknowledges this basic principle.

Q. Is it common for PBR plans to be modified over time?

A. Yes. PBR is not a "one size fits all" approach to utility regulation, which means that plans can differ both between utilities and within any given utility across time. In fact, electric and gas utility PBR frameworks are almost never the same across multiple generations. Modifications may arise as PBR plan performance is evaluated and as utility circumstances change. Also, regulators regularly reassess PBR designs to accommodate new policy objectives. For example, in its first-generation revenue cap, FortisBC electric ("FBC")

[14] "A PBR plan should recognize the unique circumstances of each regulated company that are relevant to a PBR design." Guiding Principle 4 from the "Distribution Performance-Based Regulation," Alberta Utilities Commission, Decision 2012-237, September 12, 2012, p. 7.

[15] "The MRP should recognize the unique circumstance of FortisBC that are relevant to the MRP design." Guiding Principle 3 from the "Application for Approval of a Multi-Year Rate Plan for the Years 2020 through 2024," British Columbia Utility Commission, Decision and Orders G-165-20 and G-166-20, June 22, 2020, p. 168.

[16] Distribution utilities in Ontario have the opportunity to select from a menu of PBR options, including on "Customer Incentive Regulation" option which allows for considerable tailoring to particular utilities.

adjusted its total revenue requirement using an I-X formula, much like the Company and Eversource operated in their initial PBR plans. In establishing the second-generation PBR plan, however, FBC demonstrated that the formula could not sustainably provide revenue recovery for prudently incurred capital costs over the five-year PBR term. Consequently, the British Columbia Utilities Commission determined that FBC could remove capital expenditures from the revenue cap, instead recovering all capital expenditures on a forecasted basis.

Similarly, in its second-generation PBR application in D.P.U. 22-22, Eversource demonstrated that the I-X revenue cap would not provide sufficient revenue to support capital needs over the duration of its five-year PBR term. To allow for adequate cost recovery, the Department approved a capital supplement mechanism known as K-bar, which provides additional capital recovery based on a formulaic carry-forward of Eversource's own historical capital spending.

Other jurisdictions that operate under PBR have established widespread changes across PBR generations. For example, all distribution gas and electric utilities in Alberta have been operating under PBR since 2014. Under the first-generation framework, capital trackers allowed utilities to recover revenue for eligible capital spending. However, in setting the second-generation PBR framework (2018 through 2023), the Alberta Utilities Commission established the K-bar mechanism to minimize regulatory filings associated

with trackers.[17] PBR in Ontario is currently in its fourth generation, with each generation incorporating various revisions to adjust for contemporary industry conditions.[18]

Q. What are the changing circumstances that prompted the Company to propose changes in the structure of its second-generation PBR plan?

A. The Company is facing several significant upward pressures on capital investment. First, the costs of construction have surged even more in recent years than economy-wide inflation, as will be discussed below. Second, as explained in the Company's CPI Plan testimony, there has been an upward trend of Customer Requests and Public Sector Requirements, which are required, time-sensitive work. Third, the Company is integrating into its CPI Plan the needs for investment to accommodate rapid beneficial electrification as required by the ESMP legislation and plan,[19] which will be filed with the Department on January 29, 2024. Lastly, the Company has identified the need, as explained in its CPI Plan testimony, to improve asset conditions across its system to prepare for electrification and increase reliability for that envisioned greater reliance on the electric distribution system for everyday needs of heat and transportation.

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[17] AUC 20414-D01-2016, December 16, 2016, at 7.

[18] "Renewed Regulatory Framework for Electricity Distributors: A Performance-Based Approach," Report of the Board, Ontario Energy Board, October 18, 2012.

[19] See Exhibit NG-CPIP-1 for a discussion of the company's Electric Sector Modernization Plan (ESMP).

Q. How is the Company proposing to change its second-generation PBR plan?

A. The primary proposed change in the structure of the Company's second-generation PBR plan is to bifurcate its revenue adjustments into two basic components: (1) O&M-related allowed revenue and (2) capital-related allowed revenue. The Company proposes to cap O&M-related allowed revenue adjustments by an I–X PBR formula, as in the first-generation plan. As part of the O&M revenue recovery plan, the Company also proposes a "Y factor" to recover a limited amount of capital-related O&M expenses. For capital recovery, the Company proposes to determine capital-related allowed revenue increases through an annual filing with the Department. In contrast to a PBR plan where the company's total revenue requirement is adjusted by an I-X formula, the Company's proposed second-generation plan determines O&M allowed revenue and capital allowed revenue with separate mechanisms. The components of the Company's PBR plan addressed in this testimony are the I factor and the X factor. Details on the Company's comprehensive PBR framework can be found in the CPI Plan testimony in Exhibit NG-CPIP-1.

Q. Why is the Company proposing to separate the determination of O&M-related allowed revenues and capital-related allowed revenues?

A. As detailed in the Company's CPI Plan testimony and the testimony of Dr. Kaufmann, the reason for not proposing the status quo revenue cap formula from the Company's first-generation PBR plan is that the Company foresees significant capital investment

requirements over the term of the plan that cannot be adequately addressed by the I–X formula nor by capital supplements like K-bar both within its core capital budget and the investment to implement the ESMP as proposed. The Company considered its options under PBR and determined the best approach to a second-generation PBR plan would be to employ different performance-based approaches to O&M and capital. The indexed based approach to O&M revenues incentivizes efficient management of operations and maintenance spending, while the annual capital funding mechanism provides for adequate capital recovery with incentives for efficient spending, given the increase in capital required to support the Commonwealth's climate objectives. This proposed approach maintains enhanced incentives relative to traditional cost of service and adheres to existing PBR principles. The proposed approach is also similar to other PBR plans recently in use in North America.

IV. The Revenue Cap Formula for O&M-Related Allowed Revenue

Q. What are the components of the proposed cap on the Company's O&M-related allowed revenue?

A. The O&M revenue cap consists of an inflation factor (the "I factor"), an O&M adjustment factor or productivity factor (the "X factor"), and a consumer dividend. As well, the Company proposes to include a Y factor to recover limited O&M costs related to certain capital expenditures that will occur over the CPI Plan term.

In this section, we provide a description of the I factor and explain how the related X factor is determined. We also explain that the proposed Y factor, which is described in detail in the Company's CPI Plan testimony (Exhibit NG-CPIP-1), is a reasonable addition to the PBR framework. The empirical X factor results are provided in Section V.

Q. How is the I factor determined for the proposed O&M revenue cap?

A. The inflation factor for the O&M revenue cap is based on a composite of labor and non-labor input price indexes designed to match the inflation rate of distribution utility O&M expenses. To address labor-related input price changes, a regional Employee Cost Index will be used.[20] This is a regional labor index of wages and salaries paid to utility employees. Non-labor input price changes are addressed by a Producer Price Index for Electric Utilities ("PPI-Electric Utilities").[21] These separate indexes are weighted together by the proportion of the Company's O&M associated with labor and non-labor costs, respectively. For example, in 2022, the Company found that 44.4 percent of O&M expenses were associated with labor, while the remaining 55.6 percent of O&M costs were associated with non-labor expenses. The composite input price inflation factor would therefore consist of the ECI-Northeast, weighted 44.4 percent, and PPI-Electric Utilities, weighted 55.6 percent.

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[20] ECI data published here: https://www.bls.gov/regions/northeast/data/xg-tables/ro1xg04.htm.

[21] PPI data published here: https://www.bls.gov/ppi/databases/.

Q. Why is GDP-PI not the appropriate index for the Company's second-generation inflation factor?

A. To answer this question, it is instructive to consider the derivation of the revenue cap formula, defined by inflation minus an X factor. The I-X formula is derived from a basic economic assumption about the nature of revenues and costs in a competitive market. Namely, that the percentage change in revenues equals the percentage change in costs over time. This equivalence can be decomposed into the component elements of revenues and costs—where revenue equals the prices customers pay times the quantities purchased by customers, and costs equal the input prices paid by the firm times the input quantities purchased by the firm.

Q. Please provide this derivation using mathematical notation.

A. The formula is derived as follows. Under competitive conditions, the growth in the revenue of the industry ($\%\Delta R_I$) is equal to the growth in its cost ($\%\Delta C_I$):

$$\%\Delta R_I = \%\Delta C_I \quad (1)$$

Because revenue equals output price times output quantity, the rate of revenue change can be decomposed into the rate of output price change ($\%\Delta P_I$) plus the rate of output quantity change ($\%\Delta Y_I$):

$$\%\Delta R_I = \%\Delta P_I + \%\Delta Y_I \quad (2)$$

Similarly, because cost equals input price times input quantity, the rate of cost change can be decomposed into the rate of input price change ($\%\Delta W_I$) plus the rate of input quantity change ($\%\Delta Q_I$):

$$\%\Delta C_I = \%\Delta W_I + \%\Delta Q_I \quad (3)$$

Combining equations (2) through (3) implies that, under competitive conditions, output prices will increase at a rate equal to input price inflation minus the rate of TFP growth (defined as the change in the quantity of total output less the change in the quantity of total input, i.e., $\%\Delta Y_I$ - $\%\Delta Q_I$):

$$\%\Delta P_I = \%\Delta W_I - (\%\Delta Y_I - \%\Delta Q_I) = \%\Delta W_I - \%\Delta TFP_I \quad (4)$$

where $\%\Delta TFP_I$ represents the rate of industry TFP growth. Equation (4) is simply the "I – X" cap formula where I = $\%\Delta W_I$ and X = $\%\Delta TFP_I$.

Q. Please explain how this derivation relates to the choice of the I factor.

A. Of these four elements, the inflation factor reflects the input prices paid by the firm. If the inflation factor does not reflect the firm's input prices, the X factor must be adjusted so that the I-X formula reflects the beginning assumption that changes in revenues equal

changes in costs. For example, the Company's first-generation PBR plan set the revenue cap using an I factor defined by an economy-wide output price index, GDP-PI. Since this inflation measure is an economy-wide output price measure, the X factor was then adjusted using TFP differentials and input price differentials to account for the fact that the price index was not a utility input price index. In the Company's proposed second-generation PBR framework, the revenue cap applies only to the O&M-related revenue requirement. This means that the X factor is set using an adjustment factor that incorporates only O&M inputs over time and does not include any growth in capital inputs. In other words, the X factor is not based on TFP, but a productivity-adjacent measure. Given that the X factor must adjust for a productivity and input price differential if the I factor reflects economy-wide output prices and given that the X factor does not reflect TFP in this case, an input price measure of inflation is more appropriate. An input price measure obviates the need for finding an appropriate economy-wide productivity-adjacent factor based only on operating expenses to use for the purpose of calculating a differential.

Q. Does a composite input price index affect the calculation of the X factor?

A. Yes. As explained above, when the I factor is based on an industry-specific input price index, the X factor no longer requires a TFP growth and input price differential with respect to the broader economy. This is because the inflation measure does not reflect output price

changes in the broader economy, but instead reflects input price changes faced by the utility. This simplifies the calculation of the X factor.[22]

Q. How is the X factor determined for the O&M revenue cap?

A. The X factor for purposes of calibrating an O&M-only revenue cap is constructed using FERC Form 1 data for a sample of 19 electric utilities in the northeastern United States over the fifteen-year period from 2008 to 2022. As in a TFP growth study, the O&M revenue adjustment factor is calculated by subtracting industry input growth from industry output growth. However, for an X factor with this narrower scope, applied to a revenue cap that excludes capital-related revenues, the calculation does not include capital as an input. Therefore, the study is by definition not a TFP growth study (since the "Total" in "Total Factor Productivity" refers to a study that includes all inputs). Furthermore, as stated above, unlike X factor calculations in prior PBR proceedings, the X factor in this application does not contain an input price and TFP growth differential relative to the broader U.S. economy because the proposed I factor reflects industry input prices. A detailed description of the calculation of this X factor can be found in Appendix I.

[22] For an exposition of the relationship between the specification of the I factor and its effect of the specification of the X factor, see Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "The Alphabet of PBR in Electric Power: Why X Does Not Tell the Whole Story," *The Electricity Journal*, 30 (2017) 30-37

Q. Is the O&M adjustment factor a measure of "partial factor productivity"?

A. The X factor for the O&M revenue cap is an "O&M adjustment factor" based on the growth of O&M inputs relative to output growth. This has in some cases been termed "partial factor productivity" ("PFP") because it does not include all inputs (namely capital) of a TFP study. We note that because the value of O&M PFP is conditional on the quality and quantity of capital input growth that is paired with O&M growth to produce output growth. In other words, changing the quality or quantity of capital input growth that is used in conjunction with O&M input growth will yield a different O&M "PFP" result. Because physical capital and operating costs are intertwined, productivity associated with only certain inputs is difficult to measure. Thus, the O&M adjustment factor can be thought of as a partial factor productivity measure if it is understood that the value of this PFP is dependent on the value of unmeasured inputs (i.e., capital) and that changes in unmeasured inputs will change the value of this PFP.

Q. What is the Company's proposed Y factor mechanism?

A. The Company proposes to include a Y factor that allows for recovery of incremental operating expenses arising from capital work over the PBR term. The proposed Y factor maintains an incentive for cost efficiency by limiting the recovery of these capital-related O&M costs to 4.0 percent of the cost of capital additions. The Company proposes to target its O&M expenditures related to capital at 4.0 percent.

Q. Why is the Company proposing to include a "Y factor"?

A. The Y factor is a common element of PBR plans in North America, currently in use by utilities in British Columbia, Alberta, and Ontario. As described above, the Company has proposed to include a Y factor as a component of its PBR formula in order to recover certain O&M costs related to capital inputs put in place over the PBR term. The proposed Y factor provides the Company with necessary funding to support its capital infrastructure while imposing incentives for cost efficiency. This incremental O&M cost recovery is necessary because of an increase in O&M input quantities that are not captured by the inflation factor nor by the X factor. Inflation will not capture the increase in input quantities associated with increased O&M spending, because inflation measures a change in prices, but not a change in quantities. The X factor will not capture the input quantity increase either, because TFP growth reflects historical O&M data from peer utilities. While X serves as an attrition relief mechanism over the five-year PBR term, and will cap O&M costs associated with normal business operations, the historical O&M cost growth of peer utilities does not necessarily reflect the future experience of National Grid over its upcoming PBR term because of the Company's upcoming policy-driven capital expenditures.

Q. Does the proposed Y factor reduce the incentives provided by the I-X formula?

A. No. For O&M expenditures related to normal business operations, the Company's allowed revenue growth will be limited by the I-X formula. For this reason, the Company has the same incentives to contain these costs as it would have if the PBR plan did not include a Y factor. The Y factor is applied only to O&M costs associated with capital additions. Furthermore, the recovery of these Y factor-specific O&M costs also have a cap, as described above. The cap on Y factor cost recovery incents the Company to strive for cost efficiency on the subset of O&M costs related to capital expenditures. Cost recovery under the Y factor is a distinct element of the Company's PBR framework that does not inhibit any of the efficiency incentives provided by the revenue cap formula, and includes its own performance incentives in the form of a cap on capital-related O&M cost recovery.

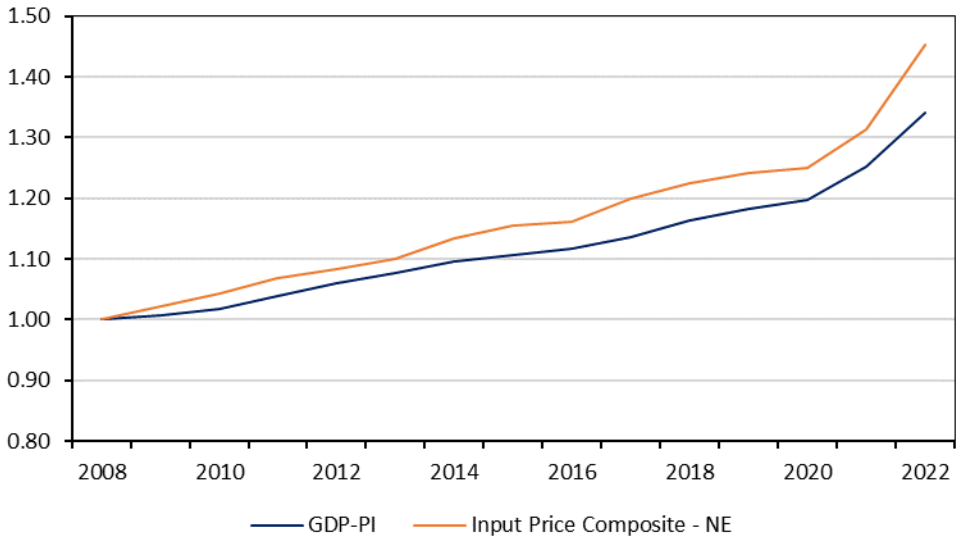
V. I Factor and X Factor Results for the O&M Revenue Cap

Q. Please compare the I factor used in the Company's first-generation plan and the I factor proposed for the Company's second-generation plan.

A. In the Company's first-generation PBR plan, the I-X formula used GDP-PI as the inflation factor to adjust the Company's total revenue requirement. The proposed second-generation plan imposes a revenue cap only on the revenue requirement associated with O&M, and proposes an inflation factor based on the Company's input price growth. This second-generation I factor consists of both labor-related costs and non-labor-related costs,

weighted by the Company's labor and non-labor O&M. Figure 1, below, shows how these inflation rates have compared between the years 2008 through 2022.

Figure 1: GDP-PI and Composite Input Price Inflation Factors (2008-2022)



Q. Please provide a forecast of these inflation rates over the PBR plan.

A. Christensen Associates is not aware of a published source for regional ECI or for PPI-Electric forecasts. In lieu of public data, we have performed a tailored forecast using an autoregressive integrated moving average ("ARIMA") model. This model relies on historical price index trends to predict future years. Table 1 below provides the forecast results.

Table 1: Forecasted GDP-PI and Composite Input Price Inflation Results (2023-2027)

Year	GDP-PI	Input Price Composite - Northeast
2024	1.2%	3.5%
2025	2.0%	3.5%
2026	2.4%	3.4%
2027	2.3%	3.3%

Q. Does the composite measure of input price inflation provide the Company with a larger revenue adjustment than GDP-PI?

A. No. Although the composite measure of utility input price inflation has exceeded the inflation rate of the broader economy, and although this trend is expected to continue in the future, the Company's proposed revenue cap contains an X factor that adjusts for these differences. If the Company were to use an economy-wide measure of inflation like GDP-PI, it would have to adjust its X factor to account for the difference between this inflation measure and input prices within the electric distribution industry. In the Company's first-generation PBR plan, as well as in the PBR plans in place for Eversource, this X factor adjustment was made. The use of an input price inflation measure does not result from expectations that this index will grow faster over the PBR term, but instead is recommended because the input price differential required for calibrating an X factor associated with an output price inflation measure like GDP-PI would be difficult or impossible to calculate for an O&M-only revenue cap.

Q. Please provide an overview of the elements included in the proposed X factor.

A. The proposed X factor equals the growth rate of industry inputs minus the growth rate of industry outputs over the period 2008 through 2022 for a sample of 19 utilities in the northeastern United States. Because the proposed PBR plan applies a revenue cap to O&M for an electric distribution utility, the inputs included in the X factor calculation are: distribution labor, distribution materials, customer accounts and sales labor, customer accounts and sales materials, A&G labor, and A&G materials. Importantly, these inputs do not include capital. This is because the I-X formula will apply only to the elements of the utility's revenue requirement other than capital. The output measure is each utility's average customers served for a given year. The O&M adjustment factor is calculated by subtracting an index of these inputs from an index of utility outputs. We have calculated these results for the northeast sample of 19 companies.

Q. Please provide the results of the X factor calculation for the Northeast Sample.

A. Table 2, below, provides the X factor results from 2008 to 2022 for the northeast sample of 19 utilities. Over the 15-year study period, the average O&M adjustment factor value equals +0.21 percent.

Table 2: O&M Adjustment Factor
Northeast Sample

Period	Output	Input	O&M Adjustment Factor
2008	-	-	-
2009	0.24%	3.92%	-3.68%
2010	0.61%	6.61%	-5.99%
2011	0.39%	4.86%	-4.47%
2012	0.28%	3.58%	-3.30%
2013	0.22%	-9.63%	9.85%
2014	0.55%	5.47%	-4.92%
2015	0.84%	-6.46%	7.30%
2016	0.26%	0.48%	-0.22%
2017	0.60%	-2.05%	2.64%
2018	2.03%	3.60%	-1.57%
2019	0.66%	-3.23%	3.88%
2020	0.46%	3.24%	-2.78%
2021	0.74%	-5.84%	6.58%
2022	1.01%	1.47%	-0.46%
Average	**0.64%**	**0.43%**	**0.21%**

Q. Please compare these results with a measure of TFP growth using the same industry sample.

A. An updated TFP growth study over the years 2008 through 2022 was conducted as part of this filing for comparison purposes. The results are found in Table 3. While the O&M adjustment factor equals +0.21 percent, revenue cap TFP growth equals +0.16 percent. The primary difference between these models is that the TFP growth model includes capital as an input, while the O&M adjustment factor excludes capital inputs. As a result, this

comparison demonstrates the downward pressure capital input growth has placed on measured industry productivity.

Table 3: Northeast Industry TFP Growth Rate[23]
2008-2022

Period	Output	Input	RC TFP
2008	-	-	-
2009	0.24%	2.63%	-2.38%
2010	0.61%	3.82%	-3.21%
2011	0.39%	1.96%	-1.57%
2012	0.28%	2.20%	-1.92%
2013	0.22%	-4.81%	5.03%
2014	0.55%	2.59%	-2.04%
2015	0.84%	-3.31%	4.15%
2016	0.26%	0.59%	-0.32%
2017	0.60%	-0.46%	1.06%
2018	2.03%	1.96%	0.06%
2019	0.66%	-1.34%	2.00%
2020	0.46%	2.47%	-2.01%
2021	0.74%	-2.52%	3.25%
2022	1.01%	0.88%	0.13%
Average	**0.64%**	**0.48%**	**0.16%**

[23] See Exhibit NG-MM-NC-3A, NortheastModel_TFP.xlsx (Confidential).

VI. Determination of the Company's Annual Capital Revenue Requirement

Q. How is the Company proposing that its annual capital revenue requirement be determined?

A. As detailed in the Company testimony, the Company will produce an annual capital revenue requirement filing.

Q. Why has the Company proposed this approach?

A. The Company has evaluated different approaches to operating under PBR in light of its current capital budgeting forecasts. In particular, the Company assessed the current status quo I-X formula, in which essentially all costs, including capital-related costs, reside under the revenue cap formula set with an empirical (i.e., negative) X factor. The Company also investigated the K-bar approach currently in use by Eversource. After estimating recovered revenues and comparing these revenues with forecasted costs, the Company determined that these alternatives did not adequately address the Company's anticipated capital needs over the next PBR term. This is explained in detail in the Company's CPI Plan testimony at Exhibit NG-CPIP-1.

Q. Why does the K-bar mechanism in use by Eversource not work for the Company as a capital supplement for its second-generation PBR framework?

A. The K-bar supplement allows a utility to recover revenues equal to the difference between historical trend capital expenditures and the actual revenues obtained under the I-X formula. One benefit of this mechanism is that it relies on historical capital expenditure

data, meaning K-bar revenues are largely exogenous to the company going forward through the PBR term. In addition, K-bar relies on a formula approach that is based on the company's past capital spending patterns. However, since the K-bar mechanism is backward-looking, the formula may not adequately account for future spending needs if the future does not match historical spending. This is the case for the Company. Over the coming PBR term, the Company must invest much more heavily in capital projects than investment trends in the recent past.

Q. Why does I-X formula not work for the Company for its second-generation PBR framework?

A. The "total I-X revenue cap formula" is a formula applied to the Company's total revenue requirement, including capital. The X factor in a total revenue requirement cap relies on historical industry data for capital, labor, and materials, as well as utility outputs. The "total I-X" approach works best if the utility under PBR has similar capital needs relative to the broader industry. If the utility differs substantially in this regard, its capital needs may outpace (or lag) the industry average as measured by TFP growth. This is why the X factor in recent gas studies relied on regional gas utility TFP growth, instead of TFP growth across the United States: Northeastern gas utilities simply faced different conditions regarding capital replacement. If a peer group with similarly high capital demands cannot be found for the utility under PBR, the "total I-X" approach may result in an overly restrictive, potentially untenable regulatory regime.

Q. Are these other approaches to revenue adjustment still reasonable?

A. Yes, under the appropriate conditions. Given all the pros and cons and the environment that the Company currently finds itself in, the Company's proposed approach is reasonable, even though other approaches may be reasonable in other circumstances.

VII. Summary and Conclusion

Q. Could you please summarize your testimony?

A. We have found that the Company's proposed approach to separate O&M and capital recovery is reasonable and in line with industry practice. Maintaining only O&M-related revenues under a revenue cap is an approach that has been used elsewhere in North American PBR frameworks and provides the utility with a continued incentive to seek efficiency gains. We recommend a composite input price inflation measure based on a weighting of 44.4 percent ECI-Northeast and 55.6 percent PPI-Electric Utilities. Our analysis has determined the X factor associated with the O&M cap is +0.21 percent.

Q. Does this conclude your testimony?

A. Yes.

APPENDIX I: SETTING THE O&M ADJUSTMENT FACTOR

Overview

The proposed revenue cap in the Company's second-generation PBR framework applies only to O&M-related costs. See Exhibit NG-MM-NC-3B, Northeast Model (Confidential). As such, the *X* factor associated with this revenue cap is calibrated using O&M-related inputs. The output measure is customers. Mechanically, the calculation of the O&M adjustment factor resembles the calculation of Total Factor Productivity ("TFP"), but without including capital inputs.[24]

Specifically, the model incorporates customer accounts and sales expenses, as well as a portion of administrative and general ("A&G") expenses in the computation of Total Input. Customer accounts and sales expenses are incorporated into the model by including labor and materials expense for relevant FERC Form 1 accounts, as these accounts can be credibly attributed to the distribution function of the utilities.

A&G accounts require different treatment. A&G accounts reflect the costs of activities that span the functional components of the utility—e.g., distribution, transmission and generation. Therefore, the assignment of a portion of these expenses to the distribution

[24] This measurement of O&M inputs against customer-based outputs is sometimes referred to as a measure of "partial productivity." However, the name is misleading because "partial productivity" suggests that the calculation neatly captures the growth in output attributable strictly to O&M inputs, which is not the case.

function requires that these A&G expenses be apportioned to the utilities' functional components in a non-causal manner. Because there is not a causal relationship between the joint and common A&G expenses and the functional components of the utility, there is no economically unique or acknowledged method to assign these expenses to the distribution functions.

A listing of firms in the sample is provided in Figure A.2. FERC Form 1 sources for data used in the model is found in Figure A.1.

Output

The output measure in a TFP study used to calibrate a revenue cap is based on the number of customers served. In a revenue-per-customer cap, the number of customers is the "dual" output measure to the revenue per customer cap (that is revenue per customer times the number of customers equals total revenue). In a revenue-per-customer cap, revenues are allowed to increase by the percentage increase in the inflation factor, plus or minus the *X* factor, plus the increase in the number of customers. For the revenue cap proposed by the Company in this proceeding, this relationship also holds but revenues are not allowed to increase with the percentage increase in the number of customers. In this respect, the percentage change in customers is an implicit stretch factor in the revenue cap formula.

The data source for the output measure is the total count of customers served, found in the EIA 861 report called "Sales to Ultimate Customers." The file used in "Sales_Utl_Cust_XXXX.xlsx", where XXXX signifies the year. Bundled and Delivery customers are included.

Inputs

Distribution Labor

To measure distribution labor input, I base labor cost on the direct payroll distribution booked to electricity distribution operating and maintenance expenses found in the FERC Form 1 (see Figure A.1).

Distribution Materials

To measure distribution materials input, I base materials cost on operating and maintenance expense for distribution from FERC Form 1 less direct payroll distribution described above (see Figure A.1).

Customer Accounts and Sales Labor and Materials

The following FERC Form 1 accounts are used to determine customer accounts and sales expenses that are included in O&M expenses: the labor expense portion of customer accounts and sales expenses are line items in the FERC Form 1 (see Figure A.1).

Materials expenses for customer accounts and sales expenses are determined by the total O&M expenses for these accounts less the direct payroll distribution for these accounts (see Figure A.1).

Administrative and General Labor and Materials

A&G expenses are comprised of joint and common costs that pertain to activities that span a utility's functional components—distribution, transmission and production—and are not dedicated to the distribution function. Capturing any additional distribution-related costs that may be contained in these accounts comes at the expense of relying on additional and uncertain assumptions, and there is simply no economically unique approach to determining distribution-related costs from the joint and common A&G expense accounts. Economic literature recognizes that there is not a unique, economically causal method to allocate joint and common costs.[25] Allocations of joint and common costs are arbitrary from an economic perspective because it cannot be determined what portion of a joint and common input designed to provide multiple products or services is properly ascribed to a

[25] For example, see William J. Baumol, Michael F. Koehn, and Robert D. Willig, "How Arbitrary is 'Arbitrary'?—or, Toward the Deserved Demise of Full Cost Allocation," *Public Utilities Fortnightly* Volume 120, Number 5, September 3, 1987.

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single product or service. Accordingly, judgment is involved in any allocation of joint and common costs.

Conversely, from a regulatory perspective, a utility's distribution function is responsible for covering some portion of A&G costs. Therefore, this TFP study adopts a regulatory, non-economic apportionment principle for assigning A&G expenses to distribution. Specifically, the portion of joint and common A&G expenses allocated to the distribution function is determined by multiplying a firm's total A&G expenses for each year in the sample by the average percent of distribution plant relative to total plant across all years for that firm.

The labor expense portion of A&G expenses are line items in the FERC Form 1 (see Figure A.2.1). Materials expenses for A&G expenses are determined by the total expenses for these accounts less the direct payroll distribution for these accounts (see Figure A.2.1).

Table A.1: FERC Form 1 Data by Line Number

Page 354, FERC Form 1: "Distribution of Wages and Salaries"	
	Line Number
Distribution	23
Customer Accounts	24
Sales	26
Administrative and General	27

Pages 320-323, FERC Form 1: "Electric Operation and Maintenance Expenses"	
	Line Number
Total Power Production Expenses	80
Total Transmission Expenses	112
Total Distribution Expenses	156
Uncollectible Accounts	162
Total Customer Account Expenses	164
Total Sales Expenses	178
Franchise Requirements	188
Maintenance of General Plant	196
Total Administrative and General Expenses	197
Total Electric Operations and Maintenance Expenses	198

Pages 204-207, FERC Form 1: "Electric Plant in Service"	
	Line Number
Total Distribution Plant	75
Total Electric Plant in Service	104

Total Input

We construct the quantity index of total input for each firm and each year by using the multilateral Tornqvist indexing procedure.[26] The multilateral Tornqvist index has the form:

$$ln(X_{i,t}) = .5 \cdot \sum_{j=1}^{6} (sy_{jit} + \overline{sy_j}) \cdot (lnX_{jit} - \overline{lnX_j})$$

Where

i = firm (i = 1 … 19)
t = period (t = 2008 … 2022)
j = input (j = 1 … 6)[27]
$X_{i,t}$ = the quantity of total input for firm i in period t
X_{jit} = the quantity of input j for firm i in period t
sy_{jit} = the cost share of input j for firm i in period t

A bar above a variable represents the average value over all firms and all years.

Similarly, the price of total input is computed as a multilateral Tornqvist index of the prices of the individual inputs. The index formula has the form:

[26] The multilateral Tornqvist index was developed in D.W. Caves, L.R. Christensen, and W.E. Diewert, "Multilateral Comparisons of Output, Input, and Productivity Using Superlative Index Numbers," *The Economic Journal*, Vol. 92, 1982, at 73-86.

[27] As described above, the inputs are distribution labor, distribution materials, customer accounts and sales labor, customer accounts and sales materials, A&G labor, and A&G materials.

$$ln(P_{i,t}) = .5 \cdot \sum_{j=1}^{6} (sy_{jit} + \overline{sy_j}) \cdot (lnP_{jit} - \overline{lnP_j})$$

Where

i = firm (i = 1 … 19)
t = period (t = 2008 … 2022)
j = input (j = 1 … 6)[28]
$P_{i,t}$ = the price of total input for firm i in period t
P_{jit} = the price of input j for firm i in period t
sy_{jit} = the cost share of input j for firm i in period t

A bar above a variable represents the average value over all firms and all years.

Industry Total Output Growth, Total Input Growth, and the O&M Adjustment Factor

Once the quantity of output, the quantity of input, and the price of total input is computed for each firm and each year, one can determine the industry rates of growth. In computing industry rates of growth, each firm is weighted by the relative number of customers. Denoting the number of customers by CUST, the weighting factors for each firm are computed as follows:

$$s_{it} = \frac{CUST_{it}}{\sum_i CUST_{it}}$$

[28] As described above, the inputs are distribution labor, distribution materials, customer accounts and sales labor, customer accounts and sales materials, A&G labor, and A&G materials.

The industry rate of total output growth for the O&M adjustment factor is then derived from the following formula:

$$ln\left(Y_t/Y_{t-1}\right) = \sum_i s_i \cdot ln\left(CUST_{it}/CUST_{i,t-1}\right)$$

The industry rate of total input growth is likewise computed using the formula:

$$ln\left(X_t/X_{t-1}\right) = \sum_i s_i \cdot ln\left(X_{it}/X_{i,t-1}\right)$$

Lastly, the O&M adjustment factor is the difference between the industry rate of total output growth (given by the growth in customers) and the industry rate of total input growth:

$$\ln\left(OMAdj_t/OMAdj_{t-1}\right) = \ln\left(Y_t/Y_{t-1}\right) - \ln\left(X_t/X_{t-1}\right)$$

Sample

The northeast sample consists of 19 firms. In 2017, Western Massachusetts Electric Company was acquired by Eversource, and no longer reports a separate FERC Form 1. Figure A.2 shows change in the companies included in the study.

Figure A.2
Firms in Northeast Sample

Central Hudson Gas & Electric Corporation
The Connecticut Light and Power Company
Consolidated Edison Company of New York, Inc.
Duquesne Light Company
Green Mountain Power Corporation
Jersey Central Power & Light Company
Massachusetts Electric Company
Metropolitan Edison Company
The Narragansett Electric Company
New York State Electric & Gas Corporation
Niagara Mohawk Power Corporation
NSTAR Electric Company
Orange and Rockland Utilities, Inc.
PECO Energy Company
Pennsylvania Electric Company
Public Service Company of New Hampshire
Public Service Electric and Gas Company
Fitchburg Gas and Electric Light Company, Inc.
Liberty Utilities (Granite State Electric) Corp.

Supporting Documentation

An Excel workbook, Exhibit NG-MM-NC-3B Northeast Model.xlsx (Confidential), that shows the computations underlying the O&M adjustment factor results for the northeast sample. The worksheet "CPI" shows the downloaded Consumer Price Index, the worksheet "GDP-PI" shows the downloaded Gross Domestic Product Price Index, the worksheet "ECI" shows the downloaded Employment Cost Index.

The worksheet "Calculation" shows the calculations that underlie the O&M adjustment factor results for each firm and year. In the Calculation worksheet, Columns G through M show the computation of the price, quantity, and value of labor input. Columns O through R show the computation of the price, quantity, and value of labor input, specifically for Customer Accounts and Sales. Columns T through X show the computation of the price, quantity, and value of materials input, specifically for Customer Accounts and Sales. Columns Z through AC show the computation of the price, quantity, and value of labor input, specifically for Administrative and General expenses allocated by Plant. Columns AE through AI show the computation of the price, quantity, and value of material input, specifically for Administrative and General expenses allocated by Plant. Columns AK through AS show the computation of the price, quantity, and value of materials input. Columns AV through BX show the computation of the quantity of total input that results from the application of the multilateral Tornqvist index formula. Column BZ

through CB contains output information. The O&M adjustment factor is calculated in columns CD and CE. Lastly, the worksheet "Results" shows the final results for the northeast sample.