Rate and Bill Impact Analysis of Rhode Island Natural Gas Energy Efficiency Programs

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CONTENTS

1. INTRODUCTION

National Grid commissioned Synapse Energy Economics, Inc. (Synapse) to develop a Microsoft Excel-based analytical tool to assess the long-term rate and bill impacts of its Rhode Island energy efficiency natural gas programs. The tool is designed to analyze annual and long-term rate and bill impacts from energy efficiency programs implemented over a course of three years. This tool will help inform National Grid's 2021–2023 Three-Year Energy Efficiency Program Plan and its 2021 Annual Program Plan. It can also be easily updated for subsequent prospective and retrospective analyses in assessing how the Plans meet the requirements of Least Cost Procurement Law and the Least Cost Procurement Standards.

This report accompanies the natural gas rate and bill impact (RBI) model and is meant to serve as a guide to using the model and revising it going forward. This report provides documentation of assumptions and methodologies underlying the model and basic instructions for National Grid to update the model for future energy efficiency proceedings.

1.1. Importance of Rate and Bill Impact Assessments

Rate and bill impact assessments are a key component in determining the overall impacts of energy efficiency to Rhode Island. Rate and bill impact assessments can assess potential cost-shifting between customers from energy efficiency programs that are planned or implemented in Rhode Island. This helps National Grid and the stakeholders address potential equity concerns by assessing the extent to which different types of customers benefit from or are affected by energy efficiency programs and whether the expected rate increases are acceptable.

Traditional utility rate impact analyses typically compare current rates to proposed rates. For efficiency resources, it is useful to review rates and bills in the absence of any efficiency as a hypothetical case to illustrate the impact of energy efficiency activities relative to a future without new efficiency investments. Compared to the short-term, year-over-year rate impacts National Grid historically included in its efficiency plans, the RBI analysis provides a holistic view of the impacts efficiency programs have on customers. Energy efficiency programs impact utility rates in several ways. First, they will create upward pressure on rates due to the energy efficiency program charge and the recovery of lost revenues resulting from energy savings. Second these programs create downward pressure on rates as a result of avoided utility system costs.[1] Typically the net impact of these factors taken together will lead to a reduction in bills for the average customer, despite any increase in rates. Customers that participate in efficiency programs will see greater bill savings, while non-participants may experience

[1] National Efficiency Screening Project (NESP). "National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources," Edition 1 Spring 2017, Appendix C, available at https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

higher bills. Therefore, rate impacts of efficiency resources are a matter of customer equity between customers who participate in efficiency programs and those who do not.

A thorough understanding of the implications of energy efficiency resources requires analysis of three important factors: rate impacts, bill impacts, and participation impacts.

- *Rate impacts* indicate the extent to which rates change for all customers due to utility energy efficiency programs. This includes upward pressure on rates from program cost and lost revenue recovery, as well as downward pressure on rates from avoided utility system costs.
- *Bill impacts* indicate the extent to which customer bills might be reduced for those customers that implement efficiency measures and how bills will be impacted for non-participating customers.
- *Participation impacts* indicate the portion of customers that will experience bill changes due to program participation over multiple years.

Taken together, these three factors indicate the extent to which customers will benefit from energy efficiency resources, in both the near and longer terms, and the extent to which these resources impact equity across customer segments.

National Grid already conducts a participation impact analysis for its natural gas programs. The Company and stakeholders should use the combined results of the RBI model, the participation impact model, and the benefit-cost assessment (BCA) model to review the overall impacts of the natural gas energy efficiency program plan. For example, the *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources* recommends the comparison of (a) the magnitude of bill reductions to program participants against (b) the magnitude of any rate and therefore bill increases to non-participants, as well as (c) the portion of customers expected to experience bill increases (non-participants) and bill decreases (participants).[2] Such an approach allows stakeholders to appropriately assess the customer equity impacts of efficiency programs.

It is important to not use the results of the RBI model in isolation as they exclude several key benefits of energy efficiency. For example, the price of carbon is not fully accounted for in National Grid's natural gas rates. Efficiency programs reduce carbon and other greenhouse gas emissions, which are not accounted in this model but are accounted for in the BCA. Likewise, the gas efficiency programs create non-energy benefits and electricity savings that are not accounted for in this model but are included in the BCA. The results of the RBI model, participation model, and BCA should be reviewed together to assess the full impacts that efficiency programs will have in Rhode Island.

[2] NESP, page 123.

1.2. Summary of Model

Model Components

The model is built to analyze rate and bill impacts from natural gas energy efficiency programs in Rhode Island for four customer types: residential, income-eligible, small commercial, and large commercial and industrial (large C&I). The model quantifies the annual and long-term impacts of National Grid's annual and three-year natural gas energy efficiency plans at the program level and at the sector level in terms of the following three metrics.

1. *Long-term rate impacts.* The model includes all avoided costs that might exert downward pressure on rates, as well as any factors that might exert upward pressure on rates. It estimates rate impacts over the long term to capture the full period over which the efficiency savings occur. The resulting impacts are provided in terms of annual net change in rates in dollars-per-therm, annual percent change in rates, and long-term net change in levelized rates over a 24-year period.

2. *Typical participant energy savings.* The model includes average annual energy savings for program participants and for all customers on average in terms of a percent reduction in annual consumption. The resulting energy savings are shown in annual therm savings and annual percent change in energy usage.

3. *Typical bill impacts.* The model calculates average annual bill impacts for program participants, all customers, and non-participants. It considers the long-term rate impacts and energy savings for each program and the four customer types. The resulting bill impacts are shown in terms of levelized long-term average dollar change in bills, net-present value of long-term dollar change in bills, and long-term average percent change in bills.

The model compares two scenarios: (1) a scenario in which no efficiency resources are implemented over the next three years, and (2) a scenario that reflects National Grid's proposed investment in efficiency over the same period. The model is also structured so that the Company can add a third scenario to compare an alternative to the proposed investment in efficiency.

The manner in which the RBI model analyzes rate and bill impacts, including the above components and overarching methodology, is aligned with the existing electric RBI model currently used by National Grid for assessing rate and bill impacts of its electric energy efficiency programs.

Model Documentation and Future Use

Throughout the model there is documentation on its functionality, definition of inputs, source information where applicable, and notes on key assumptions.

- The "Instructions" tab includes basic model instructions on updating the model for future efficiency plans, including how to populate the model and how to revise the model in the future. The Appendix to this report provides additional guidance on populating and using the model.

- The “Overview” tab includes an explanation of the purpose of each tab within the model and notes key model assumptions used throughout the model.
- The “R&B Inputs” tab provides a definition for each key input and explanation of how the inputs are used in the model. The tab includes notes and file source information.
- The “Yr1” tab and subsequent “Yr2”, “Yr3”, and “YrAll” tabs include a “Calculation Notes” column that explains the formula and inputs for each row.

The instructions and documentation in the model will enable National Grid to update it for future efficiency proceedings. The model is built so that it can be easily adapted to accommodate future programmatic changes. This includes the addition of new avoided cost categories, changes to program offerings, and changes to rates.

Model Limitations

The purpose of the RBI model is to provide a useful data point in the overall assessment of energy efficiency plans and how they meet the requirements of the Least Cost Procurement Standards. The model results are also useful for considering any tradeoffs that might exist between cost-effectiveness and rate impacts. The RBI results represent high-level and approximate expected average rate impacts among modeled customer classes.

While the RBI analysis provides a reasonable estimate of the average rate and bill impacts of efficiency programs for an average customer, it is not intended to replace or replicate the detailed analyses National Grid undertakes when calculating natural gas rates. This is due to several simplifying assumptions that had to be applied for model functionality. For example, actual rate impacts could be different from the modeled impacts if rates are not adjusted annually for lost revenues. In addition, the timing of the impact of demand reduction induced price effects (DRIPE) and demand charge impacts are likely to differ from the assumptions in the model. Further, the model is intended to provide a view of rate and bill impacts at a higher level of aggregation than the individual customer level. Each customer will experience a different bill impact depending on his or her involvement with the efficiency programs and individual energy usage patterns.

Due to these factors, the RBI results should not be viewed as detailed predictions of rate or bill impacts for any one year, or for any one customer. Instead, they are meant to be approximate, expected impacts on average or typical customers, program participants, and program non-participants over the long term. These results are meant to provide a high-level indication of how well customers are being served by the energy efficiency programs, and to identify opportunities to improve the way that customers are served by the efficiency programs.

2. MODEL OVERVIEW

The RBI model analyzes the long-term impact on rates and bills from annual and three-year natural gas energy efficiency plans. The long-term rate impacts include avoided costs that exert downward pressure on rates, as well as efficiency costs and lost revenue that exert upward pressure on rates. Using the resulting rate impacts, the model then provides long-term bill impacts for different types of customers and programs. This section provides a high-level overview of the methodology and calculations used to develop the rate and bill impacts in the model. Further detail, documentation, and instructions are provided in RBI model workbook to enable National Grid to revise and update the model as needed for future efficiency programs.

2.1. Model Scenarios

The RBI model estimates rates and bills for a variety of scenarios.

Four customer classes. The model provides results for four different customer classes: residential, low-income, small commercial, and large C&I. These model scenarios were chosen to align with recent history of bill impact analysis for energy efficiency plans. The model allows for a variety of different rate class structures, including demand rates and seasonal rates to reflect the breadth of rates in National Grid's Rhode Island service territory.

Two efficiency scenarios. The model compares two forward-looking scenarios:

- No New Efficiency: a scenario in which no new efficiency resources are implemented in Rhode Island over the next three years.
- Proposed Efficiency: a scenario that reflects National Grid's proposed energy efficiency plan over the same period.

Traditional utility rate impact analyses typically compare current rates to proposed rates. For efficiency resources, it is useful to review rates and bills in the absence of any new efficiency resources, as a hypothetical case to assess the impact of energy efficiency activities relative to a future without new efficiency investments. The model can also be adapted to include one or more alternative efficiency scenarios, with either more or less energy efficiency than the proposed plan amount. A comparison between the proposed efficiency scenario and alternative efficiency scenarios can help to analyze the tradeoffs between realistic and potential options.

Customer bill impacts. Customers will experience different bill impacts, depending on their participation in efficiency programs. The model presents bill impacts for different types of customers: non-participants, average customers, average sector portfolio participants, and program-specific participants.

2.2. General Assumptions

The model includes several simplifying assumptions that were necessary to avoid over-complicating the model and to reduce the level of precision implied in the results. These assumptions mirror those used in the existing electric RBI model used by National Grid.

The key assumptions used throughout the model are as follows:

- *Forward-looking.* The model is forward-looking only. The model analyzes the proposed energy efficiency plan in isolation. The model does not account for costs or adjustments in revenues from previous energy efficiency plans, which are not impacted by the forward-going choices regarding efficiency program design or expenditures. To the extent that prior years' efficiency savings are included in the load forecast, those savings are included as they would continue with or without the proposed efficiency plan.

- *Retail-level savings.* The natural gas savings (therms) are at the retail level, and not at the source level. This is consistent with how National Grid typically provides data in its energy efficiency plans and rate cases.

- *Real dollars.* The model presents all values and results as either a levelized value or a net-present value (NPV) over the study period using a real discount rate.

- *Long-term study period.* The rate and bill impacts are calculated over a long-term study period that is meant to capture the full measure life for implemented measures. The same value of 24 years is applied to each sector and each program within a sector. This is not to suggest that all measures have a measure life of 24 years. Each measure has its own measure life assumption. However, as the study period assumption is applied to all programs, a period is selected that is long enough to capture all the savings from all measures in all sectors. For the purpose of this analysis, measure life is only determined at the program level, and it is calculated for each year by dividing lifetime savings by annual savings. This approach provides an average measure life that is used to estimate the number of years into the future that the annual savings should extend for each program and each sector.

2.3. Calculating Rate Impacts

The model adjusts each rate component by the corresponding cost increase or decrease from efficiency programs: avoided costs (decreases rates), lost revenue recovery (increases rates), and efficiency cost recovery (increases rates).

Establishing Rates

The "R&B Inputs" tab should be populated using the most current natural gas rates, customer counts, and sales forecast available. These inputs establish the basis for the No New Efficiency scenario. The sales forecast should exclude future anticipated new energy efficiency program savings in order to

isolate the impacts of the current plan. The forecast can include savings still occurring from prior years' efficiency programs, as is typical of National Grid's forecasts.

The inputs for the residential, income-eligible, and small commercial rate classes can be derived directly from inputs cited in the model. Customer counts and sales are escalated over the study period using expected annual growth rates specified as inputs to the model.

Large C&I Sector Adjustments

Several adjustments need to be made to rate inputs for the large C&I customer sector. Customers under multiple rate classes are eligible to participate in the large C&I program portfolio. Therefore, model inputs for this sector should be weighted based on the rate classes of customers most likely to participate in National Grid's large C&I program portfolio.

Large C&I rates should be weighted by the rate classes most likely to participate in the Large C&I programs. The model currently weights these inputs by participant energy savings for each rate class over the most recent two years (2018–2019). While small commercial customers can participate in Large C&I programs, they should not be included in the weighting as they are assessed separately in the model.

For large C&I customers, the demand charge also needs to be included in the rates. Large C&I customers pay a monthly demand charge per therm of a customer's maximum average daily quantity (MADQ) from the most recent November through April period based on historical billing data. To calculate demand charge impacts, we developed two peak-demand-related factors separately for the average customer and non-participant, and then for program participants, as follows:

- *Peak Load Factor for all large C&I customers*: We developed a peak load factor for the entire large C&I customer sector (applicable to average customers and non-participants in the model) by taking the total average annual consumption for a rate class (average annual consumption multiplied by number of customers) divided by the total peak consumption for each rate class (MADQ multiplied by customers) multiplied by 365 days. The model uses this factor to estimate peak day gas usage for this customer sector. This factor is provided in the "R&B Inputs" tab.

- *Program-Specific Peak Load Saving Factor:* Unlike for electric energy efficiency programs, peak load impact data are not currently available for natural gas measures. Applying the average load factor equally across programs, as calculated for all large C&I customers, would likely either over- or under-state a program's impact on peak demand. To create a reasonable assumption of each large C&I program's contribution to reductions in peak demand, we assumed that peak load savings are similar to annual energy savings on a relative scale. We therefore developed program-specific peak load saving factors in a percentage in the "EE Inputs" tab by taking the annual savings for a program divided by the annual sales in Year One. The resulting percentage is then applied to Total Peak Day Use for all customers in the "Yr1", "Yr2", and "Yr3" tabs to determine a reasonable estimate of each program's peak demand savings.

Adjusting Rates for Energy Efficiency

The section below provides background information on how energy efficiency programs impact rates in general. It also explains how rates are adjusted for energy efficiency within the RBI model.

How Energy Efficiency Impacts Rates

Energy efficiency can lead to increased rates due to the recovery of program implementation costs, as well as to the recovery of lost revenues due to reduced sales. Energy efficiency can also help lower rates by avoiding different types of utility system costs. For the natural gas sector, there are currently two categories of avoided costs that impact rates: avoided retail margin costs, and price suppression benefits (DRIPE).[3]

The model forecasts the costs and benefits for the study period to identify the impact on rates over the long term. Specifically, the impact of energy efficiency on each component of rates is isolated and analyzed, including both avoided costs and lost revenue components. The methodology for estimating the impact on each rate component is described below.

Calculating the Rate Adjustments from Energy Efficiency

The model determines the gas rate impacts by subtracting the post-efficiency rate from the pre-efficiency rate. The post-efficiency rates are determined as follows for each component of National Grid's natural gas rates.

Distribution

The post-efficiency distribution rate accounts for the retail margin within avoided gas costs and lost revenue. The retail margin represents the portion of distribution costs that are avoidable based on reductions in natural gas usage from efficiency measures. National Grid uses avoided gas costs that include an estimate for the retail margin as included in the Avoided Energy Supply Components in New England 2018 Report (AESC).[4] In order to isolate value of avoided retail margin, we used the AESC report to approximate that the avoided retail margin represents 11 percent of the total avoided gas commodity costs for residential customers and 8 percent for commercial customers. The resulting avoided retail margins are included in post-efficiency rates. The formula for the post-efficiency distribution rates taking into account the avoided retail margins is:

[3] Avoided gas commodity costs (supply costs) are an avoided cost; however, they are not included because avoided gas costs impact customers' bills only and not the gas supply (cost of gas) rate.

[4] See 2018 AESC Study, pages 43-44 and Appendix C. This can be adjusted in the model to account for future AESC results.

$$Distribution\ Rate = \frac{Post\text{-}efficiency\ distribution\ revenue\ (\$)}{Post\text{-}efficiency\ sales\ (therms)}$$

where:

- Post-efficiency distribution revenue is the pre-efficiency revenue less the retail margin within avoided gas costs (all in $).
- Post-efficiency sales are the pre-efficiency sales less efficiency savings (all in therms).

Cost of Gas

The post-efficiency cost of gas rate accounts for gas DRIPE. The model does not include avoided gas costs in the cost of gas rate impacts. This is because the cost of gas, often referred to as gas commodity or supply, is a pass-through expense. National Grid purchases gas supply from producers and re-sells it to the customer at the same price. The value of avoided gas costs is only realized by an efficiency program participant when they reduce their consumption, which will be reflected in lower bills. The formula is:

$$Cost\ of\ Gas = Pre\text{-}efficiency\ cost\ of\ gas\ rate\ (\$/therm) - gas\ DRIPE\ rate\ (\$/therm)$$

where:

- Pre-efficiency cost of gas rate is the utility's cost of gas rate for the rate class.
- Gas DRIPE rate is the gas DRIPE benefit ($) divided by post-efficiency sales (therm).

Energy Efficiency Program Charge

The post-efficiency energy efficiency program charge is simply equal to the program charge as proposed in National Grid's plan. This is the charge needed to support the proposed efficiency programs.

Distribution Adjustment Clause

The model assumes no change to the Distribution Adjustment Clause (DAC) due to energy efficiency. While in reality the DAC rate changes to account for factors including any over- or under-collections of revenue under National Grid's Revenue Decoupling mechanism, the model calculates lost revenues separately as described in more detail below.

Demand Charge (Large C&I Sector)

We assume the revenue requirement associated with the demand charge will not be affected by any avoided costs due to the implementation of energy efficiency measures as there is no avoided gas capacity cost. If, in the future, an avoided cost for gas capacity is developed, it can be incorporated into the model. Currently, the model calculates the post-efficiency demand charge by dividing the same revenue requirement for demand charge by the post-efficiency peak demand gas usage (i.e., maximum average daily quantity or MADQ) over the course of 12 months because the MADQ charge is applied every month. This formula is shown below.

$$Demand\ Charge = \frac{Demand\ charge\ revenue\ (\$)}{Post\text{-}efficiency\ MADQ\ (therms) x\ 12\ Months}$$

Due to the fact that the peak day gas usage will be reduced after energy efficiency, but the revenue requirement will remain the same, the demand charge in dollars-per-therm will increase after energy efficiency implementation. The model accounts for this change in the bill impacts. To ease comparability with the other components of rates, the model also converts this calculated demand charge in dollars-per-MADQ into dollars-per-annual-gas-sales to use for estimating bill impacts associated with the demand charge impacts from energy efficiency. This method was applied because determining a peak day usage for an average customer is challenging and could result in inaccurate demand charge impacts.

Accounting for Lost Revenues

Overview of Methodology

The term "lost revenue" refers to the revenue that utilities do not recover from ratepayers because of reduced sales from energy efficiency programs. When regulators take steps to allow utilities to recover lost revenues resulting from efficiency programs through mechanisms such as rate cases, revenue decoupling, or other means, it will create upward pressure on rates. If this upward pressure on rates exceeds the expected downward pressure from reduced utility system costs resulting from efficiency programs, then rates will increase, and vice versa.[5]

Isolating fixed costs. If a utility only had variable costs, then there would be no lost revenues. The utility would be financially neutral to energy efficiency investments because efficiency savings would reduce costs and revenues by a comparable amount. However, utilities have both variable and fixed costs, and will need to recover those fixed costs despite lower sales from efficiency savings. As explained in more detail below, the RBI model calculates lost revenues associated with fixed costs only.

Annual and Three-year plan in isolation. To isolate the impacts on rates and bills from the proposed energy efficiency plan, the RBI model does not account for lost revenues from the programs implemented in previous years. (This is a difference from National Grid's lost revenue calculations, which include previous years.) This allows for the model results to show how the proposed efficiency

[5] NESP, page 114.

plan will impact rates and bills over the long term, without the influence of prior or future plans. The approach to not include lost revenues from previous years will likely understate rates and bills slightly. However, the net change in rates and bills between pre- and post- efficiency would not vary much if the prior lost revenues were included in both the No New Efficiency and Proposed Efficiency scenarios. It is important to note this method is only appropriate for the purpose of reviewing the impacts of the energy efficiency plan and is not intended to be used as a substitution for a traditional utility rate impact assessment.

Annual reconciliation. A simplifying assumption used in this model is that National Grid will recover energy efficiency lost revenue every year in the year the lost revenue occurs. In practice, there is often a regulatory lag from when a utility experiences the reduction in sales and when it can adjust rates to collect the lost revenue from efficiency programs.

Calculating Distribution Lost Revenue

Most of National Grid's distribution costs are fixed costs, associated with past investments in the natural gas distribution system. Therefore, these fixed costs should be recovered through a lost revenue recovery mechanism.

The model calculates a distribution lost revenue rate based on the difference in pre-efficiency and post-efficiency sales, as summarized in the following equation. This method isolates the change in sales from efficiency while maintaining the fixed, post-efficiency revenue requirement, such that the rate impact for lost revenues is based on the change in sales only.

$$Distribution\ Lost\ Revenue = \frac{Post\text{-}efficiency\ Revenue\ (\$)}{Post\text{-}efficiency\ Sales\ (therms)} - \frac{Post\text{-}efficiency\ Revenue\ (\$)}{Pre\text{-}efficiency\ Sales\ (therms)}$$

where:

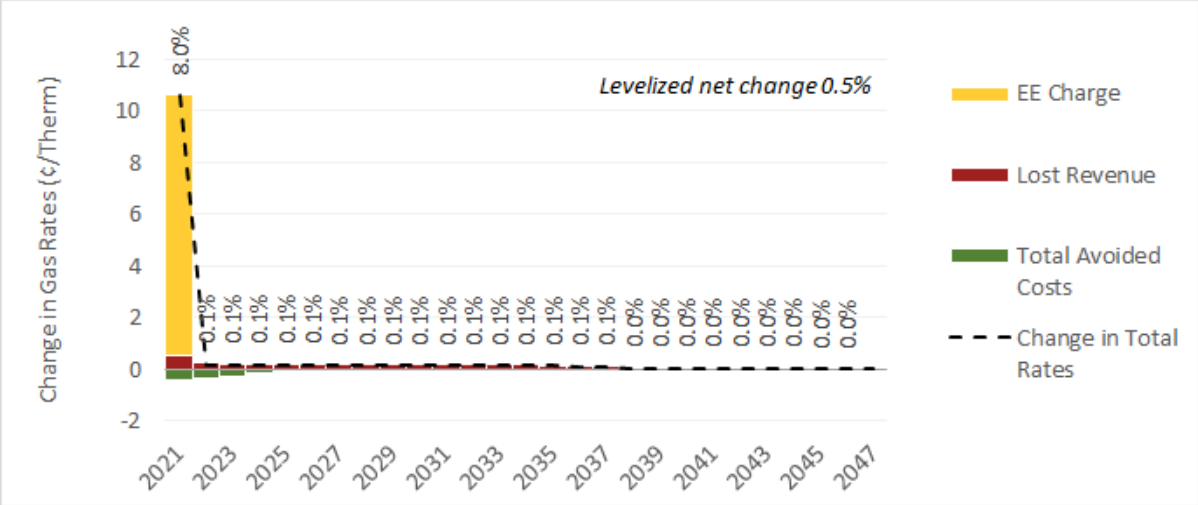
- Post-efficiency revenue is the pre-efficiency distribution revenue less any avoided distribution costs.
- Pre-efficiency sales are the sales as entered into the model by National Grid.
- Post-efficiency sales are the pre-efficiency sales less the proposed savings from efficiency.

Model Output

The model provides a graphical summary of the long-term levelized change in rates for each customer segment. Figure 1 below, uses values from a previous National Grid energy efficiency plan to provide an example of long-term changes in rates due to residential energy efficiency programs. As shown in the yellow bar, customer rates increase in Year One due to the efficiency program charge. The recovery of lost revenues, shown in the red bar, also creates upward pressure on rates over time due to reduction in natural gas consumption from efficiency. However, over the life of implemented efficiency measures, the avoided costs created by natural gas savings, shown in green, create downward pressure on rates.

Accounting for all these effects over the study period, the net change in rates is a small increase of 0.5 percent for this customer segment.

Figure 1. Sample graph: long-term change in rates – Proposed EE vs No EE



2.4. Calculating Bill Impacts

How Energy Efficiency Impacts Bills

All customers experience a rate impact from efficiency programs, which results in a bill impact.

Program participants will experience most of the direct benefits of efficiency programs due to a reduction in energy usage from the implemented efficiency measures, which in turn lowers their bills. The mix and quantity of efficiency measures implemented by a participant will impact the size of the bill reduction from lower natural gas consumption. The combination of reduced natural gas consumption and the rate impacts discussed above generate the bill impact for program participants.

Non-participants do not implement efficiency measures and therefore do not realize a reduction in consumption. A non-participant's bill is only impacted by the rate impacts. Therefore, a non-participant experiences bill impacts that are proportional to the rate impacts.[6]

To address the different bill impacts customers may experience, the RBI model analyzes three types of customers: non-participants, program participants (at sector and program levels), and average customers. A non-participant does not participate in any efficiency program, a program participant

[6] It should be noted that non-participants for the purpose of this model represent customers that did not participate in the 2021–2023 efficiency plan being modeled. It is possible that these customers participated in prior energy efficiency program years or will participate in future years.

participates in at least one energy efficiency program, and average customers represent an average bill across all customers.

Average Annual Consumption

Before determining bill impacts from efficiency, the model determines the initial consumption level for an average customer within each sector based on sales and customer counts. As detailed in the subsections below, the methods for sectors differ. Natural gas consumption is higher in the winter months due to its use as a heating fuel. Therefore, usage is calculated separately over the winter months (November-March) and summer months (April-October) as defined by National Grid's tariffs.[7]

Residential, Income-Eligible, and Small Commercial Sectors

For the residential, income-eligible, and small commercial sectors, the model calculates the average usage by dividing sales by the number of customers for both summer and winter periods. The average usage per customer will be the same across non-participants, participants, and average-customers within a sector prior to energy efficiency implementation.

Large C&I Sector

Similar to determining large C&I rates, specific adjustments are also needed to calculate the average annual consumption for the large C&I customer sector. The model assumes all C&I rate classes except for small commercial are included in the large C&I sector. This creates a wide range of usage patterns across eligible customers based on customer segments. For example, this segment may contain a business primarily using natural gas for heating or a large industrial customer using gas for manufacturing processes. Applying the average usage across all cases would not be accurate given the differences across programs. To create reasonable assumptions of usage patterns for each program that most accurately capture the diversity of participation across this sector, the average customer, average participant, and non-participant, the following method is applied.

- *Non-Participant, Average Customer, Average Large C&I Participant:* The average annual usage for these customer categories is calculated by weighting the annual usage by the customer counts across the large C&I rate classes. Customer counts were used instead of past participant energy savings to account for the larger number of lower usage customers that participate in the Multifamily Program. This method is appropriate in determining the impacts for the large C&I sector as a whole.

- *Large Commercial New Construction and Retrofit Programs:* The average annual usage for these two programs is calculated by weighting the annual usage across all large C&I

[7] The Narragansett Electric Company d/b/a National Grid. Rhode Island Public Utilities Commission Tariff. RIPUC NG-GAS No. 101. Available at: https://www.nationalgridus.com/media/pdfs/billing-payments/rigas_tariff.pdf.

rate classes by the rate classes most likely to participate in the Large C&I programs.[8] The model currently weights these inputs by participant energy savings for each rate class over the most recent two years (2018–2019). This is appropriate for these two programs as they have the largest number of annual participants and the most savings.

- *Multifamily Program*: The Multifamily Large C&I Program is unique to this sector. The customers participating in C&I Multifamily have varying rate classes and usage profiles. Analyzing historical participation in the Multifamily Program for recent years, the Medium commercial rate class (Rate 22) is the customer class that participates the most in this program. In addition, the average annual usage for past participants also most closely matches this Medium rate class. Therefore, the model assesses the Multifamily Program using the average annual usage for the Medium rate class.

Non-Participant Bill Impacts

Non-participants experience bill impacts that are proportional to the rate impacts. Non-participants do not implement efficiency measures in the year of analysis, and therefore do not reduce their energy consumption.[9] For example, if rates are expected to increase by 1 percent on average over the long term, then non-participants' bills will also increase by 1 percent on average over the long term.

Participant Bill Impacts

Program participants reduce their energy consumption by installing energy efficiency measures or changing behaviors that save energy, thereby lowering their bills. Efficiency measures vary in terms of the annual energy savings provided and the length of time those savings will continue to occur. The number and type of efficiency measures implemented, and their associated annual and lifetime energy savings, will determine the size of the bill reduction. Therefore, unlike non-participants, participants experience the combined effect of rate impacts and reduced energy consumption. This effect results in lower energy bills.

For example, if rates are expected to increase by 1 percent on average over the long-term, and the customer participates in an efficiency program that is expected to reduce energy consumption by 8 percent on average over the long term, then the participant's bills will be reduced by approximately 7 percent on average over the long term.

The RBI model calculates participant bill impacts at the program level and the sector portfolio level. For each program, the bill impact is calculated by subtracting the average annual energy savings from a customer's initial average annual consumption (explained above) to provide the participant's new

[8] The average annual usage for large C&I rate classes is obtained from the National Grid FY 2021 Gas Infrastructure, Safety, and Reliability Plan workbooks obtained from National Grid.

[9] Non-participants are defined as customers not participating in the plan being analyzed in the model. It is possible that these customers participated in prior energy efficiency program years or will participate in future years.

monthly consumption. The participant's new annual consumption is multiplied by the post proposed energy efficiency scenario rates to determine the participant's new annual bill.

To determine the participant's bill impact, the participant's new bill is subtracted from the total bill before energy efficiency (No New Efficiency scenario).

Large C&I Sector

For the large C&I sector, the model also calculates the change in a participant's peak demand charge. Calculating changes in customer demand across all large C&I programs presents challenges. This is due in part to the wide range in total energy usage and consumption patterns across this customer sector and the lack of visibility into how programs impact peak demand with current information. Thus, the RBI model estimates bill impacts separately for the participants in the two large C&I programs (New Construction and Retrofit) from the participants in the C&I Multifamily Program. Further, the model uses demand charges in the form of dollars-per-annual-gas-usage, as discussed above. In addition, the model uses different average usage levels and customer charges for these two separate C&I program segments. For the two large C&I programs, the model uses the average usage level and a customer charge that are weighted by annual energy savings across all large C&I customer classes.

For the C&I Multifamily Program, the bill impact calculation uses the customer charge, rates, energy usage, and peak demand specific to the Medium Rate Class (Rate 22) to more closely match the diverse set of customers participating in that program. To avoid adding another customer segment into the model just for Multifamily, the model applies a simplified approach to estimate changes in rates to use in this program's bill impact calculations. The model calculates the percent change in rates for the large C&I customer segment for each rate component (cost of gas, distribution, DAC). The resulting percentages are then applied to corresponding rates for the Medium Rate Class rates to estimate the post efficiency rates. These pre- and post-efficiency rates are then used in the calculation of the Multifamily bill impacts.

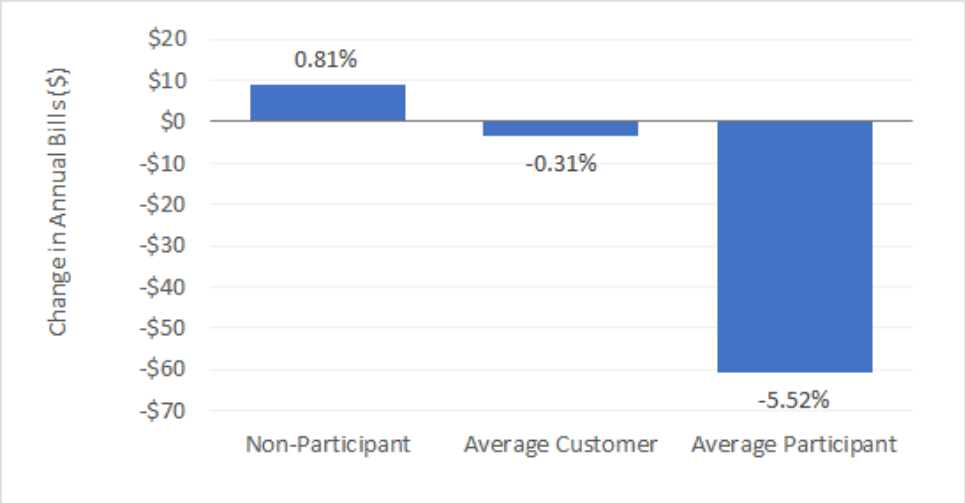
Average Customer Bill Impacts

An average customer represents an average bill across all customers, both non-participants and participants. It does not represent a specific customer or participant. Instead, it is intended to provide an indication of how the efficiency programs affect customer bills on average. The model calculates the average customer's bill "savings" for each customer sector as energy savings divided by customers.

Model Output

The model provides a graphical summary of the long-term levelized change in bills for each customer segment. Figure 2, below, uses values from a previous National Grid energy efficiency plan to provide an example for the low-income customer segment. The blue bar indicates the total change in bills (in dollars) over the 24-year study period and the text indicates the percent change in bills. As expected, the average low-income program participant will see greater bill saving than the non-participant due to the implementation of efficiency measures and the resulting reductions in natural gas usage.

Figure 2. Sample graph: long-term average change in bills – Proposed EE vs No EE



3. CONCLUSION

This RBI model provides an approximate indication of the rate and bill impacts that will occur over the long term from the implementation of a natural gas energy efficiency plan.

National Grid should use the results of the RBI model along with its participation impact assessment and BCA results to gain a holistic understanding of the impacts of its natural gas energy efficiency programs across customer segments. Assessing these three factors together will indicate the extent to which customers will benefit from energy efficiency resources and the extent to which these resources impact equity across customer segments. Incorporating other analyses into a holistic assessment of the proposed portfolio of programs will also help to capture benefits not included in the RBI model such as reduced carbon and other greenhouse gas emissions.

National Grid should update this model for each planning cycle based on new avoided costs, participation, and planning assumptions. As more granular avoided costs become available, the RBI model can be adjusted to include new values or other programmatic changes.

The results of the model are meant to provide a useful data point in the overall assessment of energy efficiency plans, and for considering any tradeoffs that might exist between cost-effectiveness and rate impacts. The results of this analysis should be viewed as general, long-term indications of rate and bill impacts, and not a precise forecast of impacts in any one year.

Appendix A. User Guide to Model Inputs

The details of the rate and bill calculations are on the "Yr1," "Yr2," "Yr3," and "YrAll" tabs of the model (referred to in this report as the "Calculations" tabs). The model performs the same calculations for each rate class, for each year, and for the Proposed Efficiency scenario, although the model adjusts for each of these variables in the calculations. Each row in the "Calculations" tabs includes notes indicating the calculations performed for that row. That level of detail is not provided in this report; however, below is a high-level summary of the key inputs and calculations used in the model to estimate rate and bill impacts.

1. Energy Efficiency Inputs

The "EE Inputs" tab of the RBI model is where National Grid should enter the efficiency data used throughout the model. These inputs come from the benefit-cost model, and the natural gas tables that are filed with efficiency plans.

Program Selection

The "EE Inputs" tab has a program selection tool for the first Program Year in "Column F" that is designated in red text. The model user can select one or more programs for the model to assess.

Input Detail

Below is a summary of the energy efficiency inputs for the RBI model and how each input is used throughout the model.

Program Costs: the utility's cost to implement the efficiency programs that are paid by ratepayers. These costs are only used to calculate the energy efficiency (EE) program charge if the program selection tool is used. For example, if the user includes all programs except for Home Energy Reports, the charge will be calculated without the costs associated with that program.

EE Charge: the rate ($/therm) proposed to be collected from ratepayers. This rate is used to determine the upward pressure on rates from energy efficiency program costs in the years the plan is implemented.

Gas Savings (Net): annual and lifetime energy savings (MMBTU) are used for many purposes throughout the model, including calculating average measure life and adjusting pre-efficiency sales to determine post-efficiency sales and bill reductions for the average customer.

Utility System Benefits: the utility system benefits include avoided gas and gas DRIPE. The model reduces National Grid's revenue requirements by gas DRIPE and uses avoided gas commodity costs to calculate the portion associated with avoided retail margin. These are entered in as the total lifetime avoided

costs into the "EE Inputs" tab and then are changed into annual values using a real discount rate over the life of the average program measure life.

2. Rate Inputs

The "R&B Inputs" tab of the RBI model includes the rate, sales, customer counts, and usage data used throughout the model. National Grid should provide rate inputs such as sales, number of customers, and current rates for each of the four modeled customer types.

The model is structured to incorporate a wide variety of rate structures across customer segments. For each customer segment, National Grid can include the appropriate variable rates, fixed rates, demand charges, and seasonable rates depending on what is applicable to that customer type.

The model calculates annual rate and bill impacts. However, gas rates, customer usage, and energy efficiency savings are typically seasonal, weighted towards higher winter heating demand. For this reason, the model separately identifies many of the gas rate and bill inputs by summer and winter, then combines them to determine weighted average annual impacts.

Input Detail

For each of the four modeled rate classes, there are two types of inputs: rate class data and current rates. These inputs are defined and explained below.

The RBI model includes definitions of every input on the "R&B Inputs" tab, which describe how inputs are used throughout the model. Instead of repeating those inputs and descriptions here, this appendix provides a high-level overview below.

Rate class data inputs are as follows:

- *Rate class name:* identifying information about the rate class modeled. This data is informational only and is not used in model calculations.
- *Customers*: the number of customers taking services under the rate class. National Grid has the option to enter customers for a single year or for multiple years.[10] The model uses this data to estimate bill savings for the average customer.
- *Sales:* the sales (in therms) for the rate class. As with the customer inputs, National Grid have the option to enter sales for a single year or multiple years. Users should enter natural gas sales for both the summer and winter periods. Sales are a key model input, as the model uses sales data throughout to calculate rate impacts. The sales forecast used for this input should not include anticipated savings from future energy efficiency plans.

[10] If entering customers for multiple years, National Grid should do so on the "Multi-Year Inputs" tab of the model.

- *Peak Load Factor (only applicable to large C&I):* This is the load factor used for calculating the maximum daily peak load for all-customers and non-participants for the large C&I customer sector in order to estimate demand charge related impacts.[11] This input represents the percentage of annual usage related to peak demand. It is calculated from National Grid's most recent Natural Gas ISR Plan ("Inputs") tab by taking the number of customers for each model-defined large C&I class and multiplying that by the MADQ contained in the tab to obtain the total MADQ for a rate class. Total usage is then calculated by multiplying the total usage by total customers for each rate class. The model then sums total MADQ and total usage across the rate classes. The load factor is then calculated by dividing total usage by total MADQ multiplied by 365. The model uses the resulting load factor to calculate Peak Day Use for all customers in the "Calculations" tabs for the large C&I customer sector.

- *Typical customer usage:* the typical energy consumption for the rate class, either in annual summer or winter therms. The value should be relatively consistent with the typical customer usage National Grid applies when calculating bill impacts in other rate-setting proceedings. The model uses this data to estimate bill impacts. See Section 2.4 in the main report for details on calculating typical usage for the large C&I segment.

- *Rate Type Data:* for rate classes that use block or peak period pricing, the model uses this information to determine weighted average rates for use in both the rate and bill impact analyses.

Current rate data inputs are as follows. The model uses these inputs to determine both the rate and bill impacts.

- *Customer or Meter Charge:* the minimum monthly charge per customer for the rate class. The model converts dollars-per-month to dollars-per-therm to put all monthly or annual charges in consistent units for the purpose of presenting results in terms of dollars-per-therm. The customer charge is not impacted by energy efficiency, but the model uses it to calculate the total percent change in rates and bills and total bill impacts.

- *Low-Income Home Energy Assistance Program (LIHEAP):* this is a monthly fixed charge billed to all customers as required by Rhode Island law. For the model, this charge is added to the customer charge. The combined monthly customer and LIHEAP charge are converted to dollars-per-therm for use in calculating change in rates and bills.

- *Distribution Charges:* the utility's distribution rates for the rate class, broken into pricing periods as needed.

- *Distribution Adjustment Charge (DAC):* the gas utility's summer and winter DAC rates for the rate class. The DAC recovers other operating and maintenance costs not reflected in the distribution charge.

[11] Program-specific peak load savings factor factors are calculated in the "EE Inputs Tab."

- *Cost of Gas Charge:* the DAC allows National Grid to annually adjust its rates for firm sales and transportation in order to recover, credit, or reconcile several categories of expenses.

Choosing Rate Classes

Rate impacts can be markedly different across different customer types. Therefore, it is useful to analyze the rate impacts for key customer sectors.[12] The RBI model is designed to analyze one rate class for each of the four key customer sectors: residential, low-income, small commercial, and large commercial. These four customer sectors are consistent with the sectors served by the utility's efficiency programs.

Large C&I Rate Classes

National Grid has multiple rate classes for large C&I customers, reflecting the varied energy-use profiles for these customers. Further, C&I rate classes can be more complicated than residential or low-income rate classes and typically have demand charges.

Therefore, the model should use rate classes for which most customers take service, to understand the rate and bill impacts most customers could experience from energy efficiency resources. The model currently uses large C&I rate classes weighted by energy savings achieved by the participants in the rate classes over the past two years. The exception is the Multifamily Program where the model uses the specific customer charge for the Medium Rate Class (Rate 22) to more closely reflect the diverse set of customers participating in that program.

Rate Input Considerations

Below are key inputs and assumptions that National Grid should consider when populating the model and reviewing its results.

Annual Escalation Rates

For most inputs on the "R&B Inputs" tab, the model has an annual escalation rate that National Grid can use to forecast the input over the long term. For example, National Grid can enter in a growth rate that indicates the number of customers in a rate class will increase 1 percent annually over the study period, or the monthly customer charge will increase 0.5 percent annually.

Since the model represents rates in real (inflation adjusted) terms, a 0 percent growth rate for gas rates means that rates will escalate at the rate of inflation.

[12] NESP, page 125.

Weighted Average Rate

Where the modeled rate uses summer and winter rates, the model calculates a weighted average rate. This weighted average rate then becomes the rate used to determine rate impacts for the rate class. The model weights the rate components by the billing determinants (e.g., sales for each block period).

The model calculates a weighted average rate because calculating rate and bill impacts for each dynamic rate structure would over-complicate the model calculations and imply a false level of precision.