New Hampshire Rate, Bill, and Participation Impact Analysis

A User's Guide to the RBP Models

Prepared for the New Hampshire Evaluation, Measurement, and Verification Working Group

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1. INTRODUCTION

Rate, bill, and participation (RBP) impacts are key components to assessing the financial impacts and customer equity of energy efficiency programs. The end results of an RBP impact analysis can help inform program priorities, program design, and whether and how to address any equity issues raised by the energy efficiency program. The National Standard Practice Manual (NSPM)—a comprehensive framework for assessing the cost-effectiveness of energy efficiency resources—provides guidance and recommendations on analyzing RBP impacts.[1]

As described in the NSPM, efficiency resources create upward pressure on rates as a result of program cost recovery and lost revenues, as well as downward pressure on rates as a result of avoided utility system costs. In general, the net impact of acquiring efficiency resources is lower average customer bills, despite any increase in rates. Those customers who participate in an efficiency program will typically experience lower bills, while those that do not participate may experience higher rates and consequently 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 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 support for efficiency resources. 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 install efficiency resources 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.

Taken together, these three factors indicate the extent to which customers will benefit from efficiency resources and the extent to which efficiency resources may lead to distributional equity concerns. It is

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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.

See also, Synapse Energy Economics, Inc. "New Hampshire Cost-Effectiveness Review," October 14, 2019, Chapter 7, available at: https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2019-10-31_STAFF_NH_COST_EFFECTIVENESS_REVIEW.PDF.

critical to estimate the rate, bill, and participation impacts properly and to present them in terms that are meaningful for considering distributional equity issues.

1.1. Using the Models

We recommend, consistent with the NSPM's guidance, that stakeholders view the combined results of the RBP, and not fixate on each rate, bill, and participation result in isolation. For example, New Hampshire stakeholders should compare (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.

RBP and Cost-Effectiveness Analyses

New Hampshire stakeholders recently completed a robust process to review and modify the state's cost-effectiveness test for screening efficiency resources.[3] The NSPM provides stakeholders with guidance on how to view cost-effectiveness and RBP results in tandem when determining whether to invest ratepayer funds in efficiency resources. In general, the cost-effectiveness analysis should account for all future avoidable costs and other benefits, while the RBP analysis should assess the customer equity impacts of the efficiency resource. The RBP results should never be included as an input to cost-effectiveness assessments.

There is no bright line that stakeholders can use to determine an appropriate balance across the different analyses. Instead, stakeholders will need to determine this balance through review and discussion, with guidance and final approval by the New Hampshire Public Utilities Commission (Commission or PUC). This determination could include a qualitative comparison between cost-effectiveness and RBP impacts. For example, stakeholders could assess whether any expected long-term rate impacts are warranted, considering cost-effectiveness results, bill reductions, and participation rates.[4]

If stakeholders deem the rate impacts of the utilities' proposed efficiency programs to be unacceptable, then the utilities could modify the proposed programs to better balance cost-effectiveness and

2 NESP, page 123.

3 See, Synapse Energy Economics, Inc., "New Hampshire Cost-Effectiveness Review, Application of the National Standard Practice Manual to New Hampshire," Prepared for the New Hampshire Evaluation, Measurement, and Verification (EM&V) Working Group, October 14, 2019.

4 NESP, 2017, Appendix C.5.

customer equity. To address customer equity issues, the utilities could take any of the following actions:[5]

- Expand efficiency programs and budgets to serve more participants
- Identify customer groups that have not participated as much as other customer groups in recent years and design programs to reach those customers
- Shift priority from programs that have low participation rates to those that have higher participation rates
- Set customer participation targets alongside the energy savings targets when developing efficiency plans
- Require customers to pay a larger portion of the incremental efficiency costs, for example through on-bill financing
- Seek third-party sources of funding to support efficiency programs

Recognizing Other Benefits

An RBP analysis examines efficiency's impact on customers and customer equity. However, there are other factors that could influence a customer's total energy bill that an RBP analysis may not include. This is the case for the RBP analyses developed for New Hampshire utilities.[6] Stakeholders should consider these additional benefits when reviewing efficiency plans, in addition to the cost-effectiveness and RBP results.

First, an RBP analysis typically addresses electric or gas utility rates and bills, based on the rates for the utility implementing the efficiency programs. Utilities in states like New Hampshire implement efficiency programs in a fuel neutral manner, achieving savings from other fuels, including propane, oil, and natural gas if implemented by an electric utility or electricity if implemented by a gas utility. As such, New Hampshire utilities provide additional energy bill savings to customers consuming other fuels. The RBP results do not consider these customer benefits.

Second, the price of carbon is not fully accounted for in New Hampshire electric or gas utility rates. Efficiency programs reduce carbon and other greenhouse gas emissions, which is not accounted for in

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5 NESP, 2017, Appendix C.5.

Synapse Energy Economics, Inc., "New Hampshire Cost-Effectiveness Review, Application of the National Standard Practice Manual to New Hampshire," Prepared for the New Hampshire Evaluation, Measurement, and Verification (EM&V) Working Group, October 14, 2019, Section 7.1.

6 New Hampshire's utilities are Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty Utilities (Liberty or LU), New Hampshire Electric Cooperative, Inc. (NHEC), Public Service Company of New Hampshire d/b/a Eversource Energy (Eversource or ES), Unitil Energy Systems, Inc. (Unitil or UES), and EnergyNorth Natural Gas, Inc. d/b/a Liberty Utilities and Northern Utilities, Inc.

the New Hampshire RBP analysis. The cost to reduce greenhouse gas emissions the same amount through generation resources other than efficiency would be costlier to ratepayers.

Illustrative Analysis

Compared to the short-term, year-over-year rate impacts utilities historically include in their efficiency plans, the RBP analysis provides a holistic view of the impacts efficiency programs have on customers. The RBP results are illustrative as they provide expected average rate impacts among modeled customer classes. Each customer will experience a different bill impact depending on his or her involvement with the efficiency programs.

The use of illustrative in this report refers to the fact that the RBP analysis is to provide a reasonable estimate of the average rate and bill effects of efficiency programs for an average customer. 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 avoided capacity and transmission and distribution is likely to differ from the assumptions in the model. Due to these factors, the analysis is illustrative and provides approximate impacts for average customers in each customer class. It is not intended to replace or replicate the detailed analyses utilities undertake when calculating rates for efficiency cost recovery through the System Benefit Charge (SBC) for electric utilities or the Local Distribution Adjustment Clause (LDAC) for gas utilities. Utilities should continue to provide those analyses for regulatory review.

1.2. New Hampshire RBP Analysis

In 2018, as part of the New Hampshire utilities' update to the 2019 plan year of their 2018–2020 three-year efficiency plan approved by the Commission, the New Hampshire utilities were required to undertake a detailed bill impact analysis of efficiency programs. The Commission required that the analysis include rate impacts, bill impacts, and participant impacts.[7] In September 2019, the New Hampshire utilities hired Synapse Energy Economics, Inc. (Synapse) to assist the Evaluation, Measurement, and Valuation (EM&V) Working Group in developing Excel-based rate, bill, and participation impact models to assess the long-term impacts of efficiency resources implemented by New Hampshire's electric and gas utilities.

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7 "2018-2020 New Hampshire Statewide Energy Efficiency Plan, Settlement Agreement," Docket No. DE 17-136, December 13, 2018, pages 18-19, available at https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2018-12-13_EVERSOURCE_SETTLEMENT_AGREEMENT.PDF.

See Commission Order No. 26,207 in Docket DE 17-136, page 10.

"New Hampshire Statewide Energy Efficiency Plan, 2019 Update," Docket DE 17-136, September 14, 2018, available at https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2018-09-14_EVERSOURCE_UPDATED_EE_PLAN.PDF.

In 2019 and 2020, Synapse worked with the New Hampshire utilities and the EM&V Working Group to create the RBP models. We drafted the Excel models, and the utilities and the EM&V Working Group reviewed the draft models and provided feedback through periodic conference calls.

Synapse created three primary models: an electric rate and bill impact model, a gas rate and bill impact model, and a participation model. This report accompanies those models, providing stakeholders information on our key assumptions and a high-level overview of our methodology. In this report, we focus primarily on the electric and gas rate and bill impact models. We address the participation model in Section 7.

We worked with the New Hampshire utilities to gather the necessary efficiency and rate data, including data related to rate structures, current rates, efficiency plans, avoided costs, and historical program participation. In general, we used 2019 rate data and efficiency data from the utilities' 2020 update to their 2018–2020 three-year energy efficiency plans. We used this data to build the models, provide placeholder assumptions to troubleshoot the models, and provide stakeholders with illustrative results.

On April 1, 2020, the New Hampshire utilities filed the first draft of their 2021–2023 three-year energy efficiency plan. As part of that plan draft, the utilities included the results of the rate and bill impact models. The utilities populated and confirmed all inputs included in the models, including the efficiency assumptions to reflect their proposed 2021–2023 programs.

1.3. Future Modeling

We designed models that the New Hampshire utilities can update and use in future efficiency proceedings. We engaged the EM&V Working Group on model functionality and design elements to ensure the models' longevity.

- *Utility-specific.* The models support separate analyses by each New Hampshire utility using utility-specific data. We streamlined the models to make them easy for the utilities to populate for different efficiency scenarios and rate classes.
- *Well-documented*. Throughout the workbooks, we include notes on model functionality, definition of inputs, source information where applicable, and notes on key assumptions. For example, on the "Overview" tab, we explain the purpose of each tab within the model and note key model assumptions used throughout the model. For each input on the "R&B Inputs" tab, we provide a definition and explanation of how the inputs are used in the model.
- *Instructions.* On the "Instructions" tab, we provide basic model instructions to the utilities for updating the models for future efficiency proceedings, including how to populate the models with utility-specific efficiency and rate data. In this report we provide additional guidance to the utilities and stakeholders on populating and using the models.

2. RATE AND BILL IMPACTS: MODEL OVERVIEW

The New Hampshire rate and bill impact models analyze the long-term impact on rates and bills from a utility's three-year energy efficiency plan. 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, we then provide long-term bill impacts for different types of customers.

2.1. Model Scenarios

The electric and gas rate and bill impact models are dynamic, able to estimate rates and bills for a variety of scenarios.

Electric and gas models. We developed separate models for gas and electric utilities, given differences in avoided costs and rate structures for the two fuel types.

Five utilities. When drafting the models, we analyzed impacts for the three electric utilities and two gas utilities regulated by the New Hampshire PUC.[8] This allowed us to troubleshoot the model inputs and results, as well as confirm all utilities could use the models in future proceedings. Ultimately, we expect each utility will make a utility-specific version of the models and maintain the model inputs to reflect current rates and efficiency data.

Four rate classes. Each model can analyze and provide results for four different rate classes. We attempted to build the models such that the utilities could analyze many of their current rate class structures, including block rates or seasonal rates. We modeled residential, low-income, small commercial, and large commercial rates as a representation of customers impacted by efficiency programs.

Three efficiency scenarios. The models compare three forward-looking scenarios:

- No New Efficiency: a scenario in which no new efficiency resources are implemented in New Hampshire.
- Proposed Efficiency: a scenario that reflects a utility's proposed investment plan in efficiency based on its accompanying benefit-cost screening models.
- Alternative Efficiency: a scenario that reflects an alternative investment strategy for efficiency that can be defined by the utilities and stakeholders.

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

[8] New Hampshire Electric Cooperative offers energy efficiency services as part of the statewide plan, but is not regulated by the NH PUC in the same way as the investor-owned utilities and is not included in this analysis.

hypothetical case to illustrate the impact of energy efficiency activities relative to a future without new efficiency investments. It is also useful to compare rates and bills of proposed efficiency investments to an alternative proposal, to illustrate the impact different efficiency program portfolios have on customers' rates and bills.

Four customer bill impacts. Customers will experience different bill impacts, depending on their participation in efficiency programs. The models present bill impacts for four different types of customers: non-participants, average customers, high-savings participants, and low-savings participants. See Section 5.3 for more information.

2.2. General Assumptions

We made simplifying assumptions when developing the rate and bill impact models to avoid over-complicating the model and to reduce the level of precision implied in the results. Again, the rate and bill impact models are not meant to replicate a utility's detailed rate modeling, but instead provide an illustrative look at how efficiency programs impact customers on average.

A few primary assumptions used throughout the models are as follows:

- *Forward-looking.* The models are forward-looking only. The models analyze the proposed three-year plan in isolation, including all long-term impacts from those three years of utility investment. The models do not account for costs, or adjustments in revenue from previous efficiency programs, which are not impacted by the forward-going choices regarding efficiency program design or expenditures. To the extent that prior year's efficiency savings are included in the load forecast used by each utility, those savings are included. The participation model is the exception in that it analyzes historical data.

- *Retail-level savings.* We assume all energy savings (in kilowatt-hours (kWh), kilowatts (kW), and therms) are at the retail level, and not at the generation level, wholesale level, or source level. This is consistent with how the utilities typically provide data in their energy efficiency plans and rate cases.

- *Real dollars.* We present all values and results as either a net-present value (NPV) over the study period using a real discount rate or as a levelized value.[9]

[9] At the time of this report the model uses a real discount rate of 1.41 percent to calculate the NPV, which is based on a nominal discount rate of 3.25 percent and an inflation rate of 1.81 percent as included in the utilities' July 1, 2020 draft three-year plan. These values should be updated as needed to match future energy efficiency plans.

3. Rate and Bill Impacts: Methodology

Using the rate and bill inputs (see Section 5), the models calculate pre-efficiency and post-efficiency rates and bills to determine the impact of efficiency programs on customers.

The details of the rate and bill calculations are on the "Yr1," "Yr2," "Yr3," and "YrAll" tabs of the models (referred to in this report as the "Calculations" tabs). The models perform the same calculations for each rate class, for each year, and for the proposed and alternative scenarios, although they adjust for each of these variables in the calculations. Each row in the "Calculations" tabs includes notes indicating the calculations performed for that row. We will not repeat that level of detail in this report. Instead, below, we summarize at a high-level the calculations the models make to estimate rate and bill impacts.

3.1. Rate Impacts

The models separately analyze the impact that efficiency programs have on each rate component. For electric, the rate components are the SBC, distribution, transmission, and generation. For gas, the rate components are distribution, LDAC, and cost of gas.

The models adjust 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).[10] Using the electric transmission rate as an example, the models start with the pre-efficiency transmission rate, add lost transmission revenues, and subtract avoided transmission costs to determine the post-efficiency transmission rate. The difference between pre- and post-efficiency transmission rate is the transmission rate impact.

We address lost revenue calculations in more detail in Section 4.1.

Avoided Costs

The utilities enter benefits directly into the rate and bill impact models from their energy efficiency benefit-cost screening models. The benefit-cost screening models calculate lifetime benefits using avoided energy costs and the proposed efficiency savings. The rate and bill impact models convert lifetime benefits into annual benefits using the weighted average measure life for the customer sector. They also convert the benefits to ensure results are in real dollars.

Electric Rate Calculations

The electric rate impacts are determined by subtracting the post-efficiency rate from the pre-efficiency rate. The post-efficiency rates are determined as follows.

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[10] The exception to this calculation is distribution lost revenue, as explained in the *Distribution Lost Revenue* section.

Distribution. The post-efficiency distribution rate accounts for distribution avoided costs and lost revenue. The formula is:

$$\frac{Post\text{-}efficiency\ distribution\ revenue\ (\$)}{Post\text{-}efficiency\ sales\ (kWh\ or\ kW)}$$

where:

- Post-efficiency distribution revenue is the pre-efficiency distribution revenue less distribution avoided costs (all in $).
- Post-efficiency sales are the pre-efficiency sales less efficiency savings (all in kWh or kW).
- Pre-efficiency sales include all past savings from prior efficiency programs. It does not account for the impact of the efficiency plan being modeled or any future efficiency plans beyond the plan being modeled.

Transmission. The post-efficiency transmission rate accounts for transmission avoided costs and lost revenue. The formula is:

$$\begin{aligned}&Pre\text{-}efficiency\ transmission\ rate\ (\$/kWh\ or\ \$/kW)\\&+ \text{-}avoided\ transmission\ rate\ (\$/kWh\ or\ \$/kW)\\&+ transmission\ lost\ revenue\ rate\ (\$/kWh\ or\ \$/kW)\end{aligned}$$

where:

- Pre-efficiency transmission rate is the utility's transmission rate for the rate class ($/kWh or $/kW).
- Avoided transmission rate is the avoided transmission costs ($) divided by post-efficiency sales (kWh or kW).
- Transmission lost revenue rate is calculated using the same methodology used to calculate distribution lost revenue rate (see Section 4.1).

Generation. The post-efficiency generation rate accounts for energy Demand Reduction Induced Price Effect (DRIPE), avoided capacity costs, capacity DRIPE, and reliability. The models do not include avoided energy costs in the generation rate impacts, because avoided energy costs impact customers' bills only, not the generation rate. The avoided energy costs are only realized when a customer participates in an efficiency program and reduces their consumption. Therefore, the formula is:

$$\begin{aligned}&Pre\text{-}efficiency\ generation\ rate\ (\$/kWh)\\&+ \text{-}energy\ DRIPE\ rate\ (\$/kWh)\\&+ \text{-}avoided\ capacity\ rate\ (\$/kWh)\\&+ \text{-}capacity\ DRIPE\ rate\ (\$/kWh)\end{aligned}$$

where:

- Pre-efficiency generation rate is the utility's standard offer generation rate for the rate class ($/kWh).
- All avoided cost rates ($/kWh) are the indicated avoided costs ($) divided by post-efficiency sales (kWh).

SBC rate. The post-efficiency SBC rate is simply equal to the SBC rate necessary to support the proposed electric efficiency programs and does not include the distribution or transmission lost revenues. The changes to distribution and transmission rates are calculated separately, as described in the formulas on page 9 above.

Gas Rate Calculations

The gas rate impacts are also determined by subtracting the post-efficiency rate from the pre-efficiency rate. The post-efficiency rates are determined as follows.

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. In their benefit-cost screening models, the New Hampshire gas utilities use avoided gas costs that include an estimate for the retail margin. In the rate and bill models, we assume the retail margin represents about 6 percent of total avoided gas costs, which is the percent the retail margin comprises within the *Avoided Energy Supply Components in New England 2018 Report* (AESC).[11] The formula for the post-efficiency distribution rate is:

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

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).

LDAC (excluding energy efficiency portion). The post-efficiency LDAC accounts for changes in sales. In the model, this rate does not include energy efficiency cost recovery. In practice, the utilities include efficiency cost recovery within their LDAC rates. Otherwise, efficiency programs do not modify a utility's non-efficiency LDAC revenue. The formula is as follows:

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

$$\frac{LDAC\ revenue\ (\$)}{Post\text{-}efficiency\ sales\ (therms)}$$

where:

- LDAC revenue is the utility's pre-efficiency LDAC rate without efficiency cost recovery ($/therm) multiplied by the pre-efficiency sales (therms) for the rate class.
- Post-efficiency sales are the pre-efficiency sales less efficiency savings (all in therms).

Energy efficiency portion of LDAC. The efficiency portion of the LDAC is equal to the rate necessary to support the proposed gas efficiency programs. This is the equivalent to the SBC rate for the electric efficiency programs.

Cost of gas. The post-efficiency cost of gas rate accounts for gas DRIPE. The models do not include avoided gas costs in the cost of gas rate impacts, because avoided gas costs impact customers' bills only and not the cost of gas rate. The formula is:

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

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).

3.2. Bill Impacts

The models calculate bill impacts for electric and gas utilities and for each customer sector using the same methodology. They compare the bill of a non-participant in the No New Efficiency scenario to the bills for each customer type (non-participant, average customer, high-savings participant, and low-savings participant) using the post-efficiency rates and adjusting the typical customer's consumption to reflect the type of customer modeled.

Using a high-savings participant as an example, the models first determine the customer's post-participation consumption by reducing the typical customer's consumption for the rate class by the savings a high-savings participant is expected to save in a month (for electric utilities) or a year (for gas utilities).[12] For example, if a residential electric customer typically consumes 600 kWh per month, and that customer saves 60 kWh per month after participating in the efficiency programs, then their new consumption is 540 kWh per month.

[12] The utilities determine the participant's savings for each rate class (see *Participant Bill Savings*).

The models then multiply the resulting consumption by the post-efficiency rates from the Proposed or Alternative Efficiency scenario. The resulting bill for the high-savings participant accounts for both the rate impact and the change in consumption from participating in the program.

The models compare the high-savings participant's bill to the bill of a non-participant in the No New Efficiency scenario. The non-participant's bill in the No New Efficiency scenario is the typical customer's consumption for the rate class multiplied by rates that assume no new efficiency programs in the future. The difference between the two bills provides the high-savings participant bill impact.

4. RATE AND BILL IMPACTS: KEY ASSUMPTIONS

In this section, we highlight key modeling assumptions we made when developing the rate and bill impact models for New Hampshire.

4.1. Lost Revenue and Decoupling

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, lost revenue adders, 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.[13]

All New Hampshire utilities recover lost revenues that result from efficiency programs.[14] Liberty Gas has implemented a decoupling mechanism, and Liberty Electric has proposed decoupling in its current rate case.[15] Eversource and Unitil (both gas and electric) collect lost revenue through the energy efficiency components of the electric SBC and gas LDAC rates. For simplicity and consistency, the RBP analysis assumes that rates and bills reflect annual changes in utility costs. In effect, the model assumes annual rate adjustments through a decoupling mechanism. In reality, utilities that are not decoupled would have occasional rate cases, after which point the avoided costs and the expected lost revenues from energy efficiency programs implemented in the previous years would be reflected in rates. Choosing this approach allows the RBP to have the same structure for all utilities (whether decoupled or not) and avoids the need to add assumptions regarding when future rate cases will occur.

We use the term “recovery of lost revenue” throughout the rate and bill impact models and this report to refer to recovery of fixed costs over fewer sales, regardless of how a how utility recovers those costs.

Model Assumptions

In this section, we summarize at a high level our approach to calculating lost revenues. In the sections that follow, we explain in detail our modeling assumptions and calculations for both distribution and transmission (electric utilities only) lost revenue.

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13 NESP, page 114.

14 See, NH Lost Base Revenue (LBR) Working Group, “New Hampshire Energy Efficiency Calculation of Lost Base Revenue For Measures installed beginning in 2019,” Docket No. DE 17-136, August 29, 2018.

15 See Docket Nos. DG 17-048 and DE 19-064.

Simplified approach. In general, the models use simplified approaches to calculate lost revenue. We use simplified methods because we intend for the rate and bill impact model to provide stakeholders with an approximate estimate of rate and bill impacts, not exact rate impacts.

Comparison to utility approach. We do not recreate the exact formulas used by the New Hampshire utilities to calculate lost revenues. The rate and bill impact models could become outdated if utilities adjust their recovery mechanisms relatively soon.[16] It would over-complicate the models to replicate the utilities' different calculation methods, especially the differences between lost revenue calculated through the SBC or LDAC rates or a decoupling mechanism. For example, decoupling mechanisms often also account for changes in rates that occur for reasons other than efficiency resources. The primary difference between the lost revenues calculated in the utilities' SBC or LDAC rates and the rate and bill impact model is that the utilities account for savings as they are acquired over the course of the installation year. In the rate and bill impact model, we essentially assume all savings are acquired on January 1 of the installation year. The utilities also use an average distribution rate across rate classes, while we use the distribution rate associated with the specific rate class.

Applicable to all recovery mechanisms. The lost revenue calculations we use in the rate and bill impact model are applicable to all New Hampshire utilities, regardless of whether the utility has implemented a decoupling mechanism or collects lost revenue through a rate adjustment mechanism. This approach allows the utilities to use a common rate and bill impact model.

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. But utilities have both variable and fixed costs, and a utility needs to recover the fixed costs despite lower sales from efficiency savings. As explained in more detail below, we estimate lost revenues associated with fixed costs only.

Three-year plan in isolation. In order to isolate the impacts on rates and bills from the proposed three-year plan, we do not account for lost revenues from the programs implemented in previous years, which varies from the utilities' lost revenue calculations. This way, stakeholders can review how the proposed efficiency 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 in bills between pre- and post- efficiency would not vary much if the prior lost revenues were included in both the No EE and EE 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. One of our simplifying assumptions is that the utilities recover energy efficiency lost revenue every year in the year the lost revenue occurs. In practice, there is often a regulatory lag

16 At the time we developed the model, two New Hampshire utilities had open rate cases where decoupling mechanisms were potentially subjects for further investigation.

from when the utilities experience the reduction in sales and when they can adjust rates to collect the lost revenue from efficiency programs. However, the New Hampshire utilities that collect lost revenue through the SBC or LDAC rate adjust those rates annually, so there is less of a lag.

Distribution Lost Revenue

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

We calculate distribution lost revenue based on the difference in pre-efficiency and post-efficiency sales, as summarized in the following equation.[17] 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.

$$\frac{Post\text{-}efficiency\ Revenue\ (\$)}{Post\text{-}efficiency\ Sales\ (kWh)} - \frac{Post\text{-}efficiency\ Revenue\ (\$)}{Pre\text{-}efficiency\ Sales\ (kWh)}$$

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 the utilities.
- Post-efficiency sales are the pre-efficiency sales less the proposed savings from efficiency.

Transmission Lost Revenue (electric utilities only)

ISO New England sets the transmission rates for pool transmission facilities for the entire New England region. Each load-serving entity in New England (including each New Hampshire electric utility) pays the same rate for pool transmission facilities.[18] Utilities then collect these costs from ratepayers through their respective transmission charges.

ISO New England updates the New England transmission charge each year to reflect annual changes to costs and sales. Any lost transmission revenues from one year are corrected in the following year, and thus are mostly recovered.

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17 We show kWh in the equation, but we use the same calculation for kW and therms when calculating lost revenue from electric demand distribution rates and from gas distribution rates, respectively.

18 See, e.g., ISO New England, "New England Control Area Transmission Services and ISO-NE Open Access Transmission Tariff General Business Practices," August 8, 2019, available at: https://www.iso-ne.com/static-assets/documents/2016/05/rto_bus_prac_sec_2.pdf.

ISO New England sets the same rate for all load-serving entities. Therefore, the actions of one load-serving entity are felt by all load-serving entities in the region. If New Hampshire utilities reduce load through efficiency programs and thereby create lost transmission revenue, all load-serving entities in New England experience a transmission rate increase to recover any fixed transmission costs. However, New Hampshire ratepayers will only see a small share of that increase once it is distributed across all load-serving entities.

In the rate and bill impact analysis, we focus only on impacts to New Hampshire ratepayers from energy efficiency resources. When calculating transmission lost revenue, we estimate the New Hampshire-specific portion of lost revenues created by New Hampshire utilities implementing efficiency programs. We do this by estimating New Hampshire's portion of regional transmission demand, which we estimate is 9.54 percent using ISO New England data.[19]

4.2. Electric Capacity

For the electric rate and bill impact model, we assume all types of peak demands are coincident with each other. In practice, there are different types of capacity impacts, with different capacity definitions assumed by efficiency program planners, infrastructure system planners, and utilities when designing rates. For example:

- *Generation* costs are based on ISO New England's Forward Capacity Market charge, which assesses costs based on a utility's load during the annual peak hour on the regional transmission system.
- *Transmission* charges for pooled transmission facilities are based on the monthly peak load for each transmission provider.
- *Distribution* costs are specific to each distribution utility's system.

The peak usage for generation, transmission, and distribution can occur at different times. Further, customer demand charges are often based on a customer's highest demand in a month or year, which could differ from generation, transmission, and distribution peaks. Finally, efficiency program capacity savings are typically coincident with generation peak periods.

To accurately account for each capacity definition in the electric rate and bill impact model, the utilities would need to provide very detailed data. The utilities would need to provide the coincidence of the customer's monthly peak usage relative to the generation peak, which likely requires hourly customer usage and savings data. Utilities would also have to estimate savings coincident with each type of peak (generation, transmission, and distribution). Due to the complexities in obtaining this data and the fact

19 ISO New England, "Monthly Regional Network Load Cost Report November 2019," January 14, 2020, page 25, Table 7-1, available at: https://www.iso-ne.com/static-assets/documents/2019/01/2018_11_nlcr_final.pdf.

that the benefit-cost models do not distinguish between these different peaks, we do not think this level of detail is necessary in estimating average rate and bill impacts.

4.3. Three-Year, Long-Term Impacts

The New Hampshire utilities plan and implement three-year energy efficiency plans. We built the rate and bill impact models such that the model user can view calculations and results for each individual year of the plan and for the three years combined.

We calculate rate and bill impacts over the long term, meaning for the life of the efficiency measures installed. For the New Hampshire utilities, there are several programs with measures that extend out to 25 years—such as those included in the HVAC and EnergyStar Homes programs. In order to account for measures that extend beyond the average measure life of the efficiency program portfolio, we use 25 years as the study period for each individual year, which results in a 27-year study period for the three-year plan term. We define "long-term" consistent with the study period of 25 years for each year of the plan term. Further details on the use of a long-term study period are provided in Appendix A.

4.4. Measure Life

We use a weighted average measure life to estimate the length of time that benefits and lost revenue will impact each rate class. Specifically, we divide lifetime savings by annual savings to determine the weighted average measure life at the sector level, and round to an integer number of years. By using a weighted average measure life in the rate and bill impact models, we assume all savings will expire at the end of the average measure life. Without conducting an analysis of each program within a sector, this is the optimal way to account for savings at the sector level.

In reality, each energy efficiency measure has a different measure life, and savings will gradually dissipate over an extended period. The utilities account for individual measure lives in their benefit-cost screening models. They calculate benefits using measure-specific lifetimes that range between 1 and 25 years. To account for the impact of measures that will continue producing savings beyond that average sector measure life, the long-term rate and bill impacts are calculated over a 25-year period as further explained in Appendix A.

Figure 1 illustrates the difference in savings over time using either an average measure life as calculated in the rate and bill models or the actual distribution of measure lives over time as included in recent benefit-cost screening models.[20] Using a weighted average measure life condenses the savings period

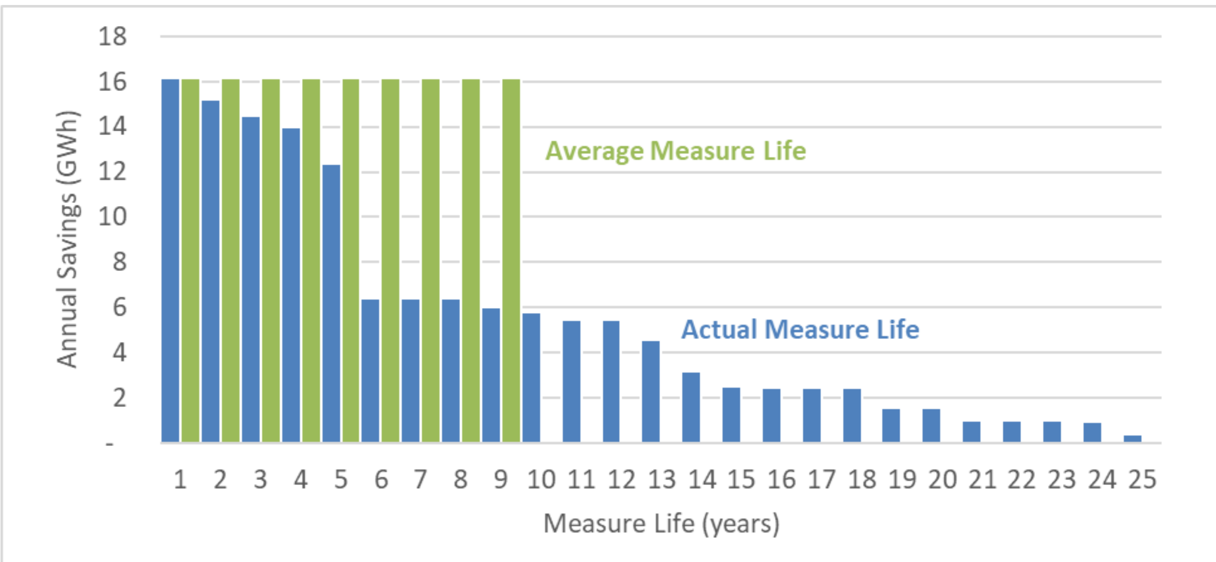
[20] To develop this figure, we used Eversource's residential savings from its 2020 plan update. We provide this figure to illustrate the difference in measure life calculations and its inclusion should not be a reflection on Eversource's savings data.

and assumes all savings occur within that weighted average at the level equal to the savings in the first year.

To test the robustness of this assumption, we conducted a sensitivity analysis where we first used the actual distribution of residential program measure lives over time from the benefit-cost screening models in the electric rate and bill impact model. We then compared that to using a weighted average measure life in the model. We found that rate and bill impacts using the actual measure life distribution compared to the use of a weighted average measure life at the sector level were within 1 percent of each other in the early years of the analysis period, and the long-term averages were within 2.5 percent.

While the actual measure life distribution approach is more accurate, we found our simplified approach balances accuracy with the illustrative nature of the rate and bill analysis. It is an appropriate method to illustrate the impacts on customers' rates and bills over the long term.[21]

Figure 1. Annual savings using an average measure life or actual measure lives



4.5. Conclusion

The simplifying assumptions described above have been made out of necessity, and the actual rate or bill impacts for a specific customer or year can vary from the estimates here. For these reasons, the assumptions used in this analysis are meant to provide an approximate indication of the rate and bill impacts that will occur over the long term from the implementation of an energy efficiency plan. 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

[21] Alternatively, the utilities would need to enter measure life-specific savings into the rate and bill impact models, and we would have calculated benefits in the model using avoided costs. We find the benefit-cost screening tools are a more appropriate model for calculating benefits.

impacts. As such, 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. The results of this model are not intended to replace or replicate the detailed analyses utilities undertake when calculating rates for efficiency cost recovery through the SBC for electric utilities or the LDAC for gas utilities.

5. Rate and Bill Impacts: Inputs and Considerations

In this section, we provide an overview of the types of inputs the utilities need for the rate and bill impact models and explain items stakeholders and utilities should consider when determining those inputs.

5.1. Energy Efficiency Inputs

The “EE Inputs” tab of the rate and bill impacts models is where utilities should enter the efficiency data used throughout the model. The utilities provide efficiency inputs for each year of the plan and by customer sector for both the Proposed Efficiency scenario and the Alternative Efficiency scenario. The utilities should determine all efficiency inputs and can work with the EM&V Working Group as needed to estimate certain inputs that are more subjective, such as the Alternative Efficiency scenario inputs.

Proposed and Alternative Efficiency Scenarios

For the Proposed Efficiency scenario, we anticipate that the utilities will populate the inputs with data directly from their benefit-cost screening models. All the efficiency inputs are within the benefit-cost screening models, and the utilities could add a new tab to their screening models with the rate and bill impact data already formatted for input into the rate and bill models. This would make it easy for the utilities to update the rate and bill impact models once they finish measure-level planning in the screening model.

The Alternative Efficiency scenario could represent any efficiency scenario chosen by the utilities and the EM&V Working Group. As examples, the utilities could model the impact from more heat pumps and weatherization, a general 20 percent budget increase, or fewer lighting measures.

We worked with the EM&V Working Group to develop two options for inputting the Alternative Efficiency scenario into the models. Under one option, the utilities use percentages to adjust the Proposed Efficiency scenario for budget, cost of saved energy, and savings per participant (using the "% Change" option in the dropdown menu on the “EE Inputs” tab). The other option has all the same inputs as the Proposed Efficiency scenario. With this option, the utilities model a different set of efficiency inputs in an alternative benefit-cost screening analysis, and manually enter the values into the rate and bill impact model (using the "User Input" option in the drop-down menu on the “EE Inputs” tab). This second option could be used, for example, if a stakeholder wanted to see the impact on rates and bills from investing in more fuel switching technology than the utilities include in their proposed efficiency plans. The utilities could adjust the fuel switching assumptions directly within the benefit-cost screening analysis, then add those new results as inputs to the rate and bill impact models.

Input Detail

Below, we identify the energy efficiency inputs for both the electric and gas rate and bill impact models. We also indicate how we use each input throughout the rate and bill impact models.

Utility Costs: the utility's cost to implement the efficiency programs that are paid by ratepayers. We do not use these costs within the rate calculations explicitly. Instead, the efficiency portion of the SBC or LDAC rate is used throughout the model for the rate impact calculations. We use the utility costs to adjust the Alternative Efficiency scenario SBC or LDAC rate, regardless of which Alternative Efficiency scenario input method the utilities use.

EE Portion of SBC or LDAC Rate: the efficiency portion of the SBC or LDAC rate (in $/kWh or $/therm) the utility proposes to collect from ratepayers.[22] We use this rate to determine the upward pressure on rates from energy efficiency in the years the three-year plan is implemented. This method isolates the impact of the energy efficiency charge and does not include the lost revenue recovery portion of the SBC or LDAC rate. Section 4.1 describes the calculation of lost revenue recovery.

Electric Savings (Net): annual and lifetime energy savings (in MWh or MMBTU), as well as summer capacity (in kW) in the electric model. We use savings for many purposes throughout the models—including calculating average measure life, adjusting pre-efficiency sales to determine post-efficiency sales and bill reductions for the average customer.

Utility System Benefits: the utility system benefits for electric and gas utilities. For electric utilities, the benefits include distribution, transmission, energy, energy DRIPE, capacity, capacity DRIPE, and reliability. For gas utilities, benefits include avoided gas and gas DRIPE. We reduce the utilities' revenue requirements for each rate type by the corresponding benefits to determine rate impacts over the long term, using the average measure life of efficiency measures installed in each customer sector.

5.2. Rate Inputs

The "R&B Inputs" tab of the rate and bill impact models is where the utilities enter their rate and bill data used throughout the model. The utilities provide rate inputs such as sales, number of customers, and current rates for each of the four modeled rate classes.

We structured the models so the utilities can analyze different rate structures, such as demand rates for electric utilities and seasonal rates for gas utilities. As such, not all inputs will be applicable to every rate class.

22 At the time we developed the models, stakeholders in New Hampshire were considering adjusting how the utilities calculate the efficiency rates. In previous years, the utilities calculated a single rate for all electric or gas utilities that was applicable to all rate classes. For the 2021–2023 Plan, stakeholders were considering other approaches, such as amortizing the rate or using a distinct rate for each utility and rate class. As a result, instead of calculating an efficiency rate within the models directly, we made the efficiency rate an input into the models.

For gas utilities, the model calculates annual rate and bill impacts. 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.

For electric utilities, the model calculates monthly bill impacts.

Input Detail

For each of the four modeled rate classes, the utilities provide two types of inputs: rate class data and current rates. Below, we define those inputs, explain how the inputs are used within the models, and identify any distinctions between the electric and gas models.

Each model has definitions of every input on the “R&B Inputs” tab, which describe how inputs are used throughout the model. Given the number of inputs and the variations between the electric and gas models, we have not repeated that level of detail in this report. Instead, the high-level overview below describes the general categories of inputs the utilities need to provide and highlights considerations for stakeholders to discuss when populating the rate inputs.

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. Utilities have the option to enter customers for a single year or for multiple years.[23] The models use this data to estimate bill savings for the average customer.
- *Sales:* the sales (in kWh or therms) for the rate class. As with the customer inputs, the utilities have the option to enter sales for a single year or multiple years. Gas utilities enter sales for both the summer and winter periods. Sales are a key model input, as the models use sales data throughout to calculate rate impacts.
- *Peak Demand:* the annual customer peak demand for the rate class. This input is included in the electric model only and is only applicable if the electric rate class uses demand charges. If the rate class uses demand charges, then the model uses the peak demand data similarly to how it uses the sales data to determine rate impacts. As noted in Section 4.2, the model assumes the customer peak demand coincides with system peak demand. However, the model is set up to allow the user to adjust the percentage to a utility-specific customer coincident peak that differs from the system peak.
- *Typical customer usage:* the typical energy consumption for the rate class, either in monthly kWh and kW for electric rate classes or in annual summer and winter therms for gas rate classes. The value should be relatively consistent with the typical customer

23 If entering customers for multiple years, the utility does so on the “Multi-Year Inputs” tab of the model.

usage the utilities use when calculating bill impacts in other rate-setting proceedings. The models use this data to estimate bill impacts.

- *Rate Type Data:* for rate classes that use block or peak period pricing, the threshold consumption levels and billing determinants (e.g., sales by the different blocks). The models use 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 models use 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 models convert dollars per month to dollars per kWh or therm to put all monthly or annual charges in consistent units for the purpose of presenting results in terms of dollars per kWh or therm. The customer charge is not impacted by energy efficiency, but the models use it to calculate the total percent change in rates and bills.

- *Distribution Charges:* the utility's distribution rates for the rate class, broken into blocks or other pricing periods as needed. For electric utilities, the distribution charges include not only distribution rates, but, where applicable, rates for stranded costs, storm recovery costs, and the Electric Assistance Program (EAP) portion of the SBC. The electric utilities do not combine these rates into the distribution rates, but the rates are similarly impacted by energy efficiency resources and represent fixed costs that will result in lost revenue. Therefore, as a simplifying assumption, the models group the rates together when calculating the rate and bill impacts.

- *Transmission Charges (electric only):* the electric utility's transmission rates for the rate class, broken into blocks or other pricing periods as needed.

- *Supply Charges (electric only):* the current electric supply charge for the utility's service territory for the rate class.

- *EAP Information (electric only):* inputs for the low-income rate, such as the discount from the electric rate, and the consumption threshold for applying the low-income discount. This information is specific to the low-income rate class for electric utilities only. See *Electric Low-Income Rates*, below.

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

- *Cost of Gas Charge (gas only):* the gas utility's summer and winter gas rates for the rate class.

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.[24] We designed the rate and bill impact models 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. We worked with the utilities to identify the rate class that should represent each customer sector while drafting the models.

C&I Rate Classes

Electric and gas utilities typically have multiple rate classes for C&I customers, reflecting the varied energy use profiles for C&I customers. Further, C&I rate classes can be more complicated than residential or low-income rate classes. As examples, some utility C&I customers take service under demand charges, block rates, time-of-use rates, or other complex rate designs. Another complicating factor is that the rate designs for commercial classes vary across utilities.

In general, we recommend modeling the rate classes for which most customers take service, to understand the rate and bill impacts most customers could experience from energy efficiency resources.

Electric Demand Rates

The rate class modeled for a customer sector could impact the rate and bill impact results, especially for electric rate classes that use demand rates. The rate and bill impacts for a specific rate class can be driven by the balance between energy and demand rates and energy and demand efficiency savings.

An electric commercial rate class could be structured to collect revenue primarily through demand charges, and the efficiency programs serving that customer sector could save a higher portion of energy than demand. As a result, the rate impact for the rate class may be impacted differently from a rate class that does not have demand charges.

Similarly, customers with demand rates will see different bill impacts depending on the efficiency measures they install. For example, the transmission rate for Eversource's large C&I customers is demand-only (calculated on a per-kW basis), without an energy rate component (in kWh). If a large C&I participant installs efficiency measures with high energy savings and relatively low demand savings, that customer will not see a reduction in the transmission portion of its electric bill.

Electric Low-Income Rates

Unlike the gas utilities, the electric utilities do not have an explicit low-income rate class. Instead, they provide a discount to residential customers who qualify, as a subset of the residential rate class.

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[24] NESP, page 125.

The electric low-income bill discount ranges from 8 percent to 76 percent depending on the customer's income as a percent of federal poverty guidelines, which the utilities categorize into six tiers. For example, a customer in Tier 4 has an income between 101 and 125 percent of the federal income poverty guidelines and receives a 36 percent discount on their electric bill.[25] We drafted the electric model using the Tier 4 discount, but the utilities and stakeholders should review the number of customers taking service on the low-income rate and adjust the inputs to reflect the tier under which most customers take service.

For all tiers, the utilities apply the low-income discount to only the first 750 kWh the customer consumes in a month. In this way, the low-income discount functions like a block rate, which is how it functions in the electric rate and bill impact model.

Rate Input Considerations

Below, we highlight key inputs and assumptions that utilities and stakeholders should consider when populating the models and reviewing model results.

Annual Escalation Rates

For most inputs on the "R&B Inputs" tab, the models have an annual escalation rate that the utilities can use to forecast the input over the long term. For example, the utilities could assume that the number of customers in the rate class will increase 1 percent annually, or that the monthly customer charge will increase 0.5 percent annually.

In the draft models, we did not apply any of the escalation rates (i.e., we set them all to 0 percent), implying no annual growth for any of the rate class inputs. Since the model represents rates in real (inflation adjusted) terms, a 0 percent growth rate means that rates will escalate at the rate of inflation. Stakeholders can review and adjust these assumptions as appropriate by utility, rate class, and input.

Weighted Average Rate

Where the modeled rate class uses dynamic rates such as block rates for electric utilities or summer and winter rates for gas utilities, the models calculate a weighted average rate. This weighted average rate then becomes the rate used to determine rate impacts for the rate class. The models weight the rate components by the billing determinants (e.g., sales for each block period).

We calculate 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.

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[25] See, e.g., NHPUC Order No. 26,347 in Case No. DE 20-039, dated April 10, 2020 Unitil Electric Systems, Inc., https://unitil.com/sites/default/files/tariffs/SumofLI_06.01.20.pdf.

Electric: Energy and Demand Components

Some electric rate classes have both energy (kWh) and demand (kW) charges for the distribution and/or transmission component of the rate structure. For such rate classes, the electric utilities need to populate two additional inputs.

Revenue Allocated to Energy: The utilities need to indicate the amount of revenue that they allocate to the energy portion of the rate. The utilities should populate this percentage based on how they allocate revenue between energy and demand components for the rate class. The models use this percentage to allocate avoided distribution and transmission costs between the energy and demand rates. The impacts that avoided costs have on energy and demand rate components are likely to differ from the utilities' allocation of revenue requirements for past investments. For example, revenue requirements include fixed costs that are typically unavoidable (e.g., customer meters, distribution poles). However, using an allocation based on revenue requirements is a reasonable proxy, given that we do not know exactly how avoided costs will ultimately impact the utilities' rates.

Load Factor: The model for electric energy efficiency presents rate impact results in three different units—cents per kWh for energy-related cost impacts, dollars per kW for demand-related cost impacts, and cents per kWh for all cost impacts combined (both energy- and demand-related costs). For the "all in" cost impact in cents per kWh, the model uses a load factor to convert dollars per kW impact into cents per kWh to put all charges in consistent units. The models calculate the load factor based on the rate class' sales and peak demand use, but the utilities should review and confirm the resulting factor.[26] A load factor of 100 percent implies that the customer's load is completely flat, while a load factor of 1 percent implies that the customer primarily uses energy during the system peak hours, assuming the customer peak and the system peak occur during the same hours.

Other Considerations

Discount Rate

The model applies a real discount rate in determining the NPV and levelized change in rates and bills over the study period. The discount rate found in the "Lookups" tab is derived from the NH utilities' July 1 draft of the 2021-2023 Plan.

- Nominal discount rate is based on the June 2020 Prime Rate in accordance with the Final Energy Efficiency Group Report, dated July 6, 1999 in DR 96-150. Retrieved from http://www.moneycafe.com/personal-finance/prime-rate/
- Inflation rate is based on the inflation rate from Q1 2019 to Q1 2020, Retrieved from https://fred.stlouisfed.org/data/GDPDEF.txt

[26] The specific formula is sales (in kWh) divided by demand (in kW) that has been multiplied by the 8,760 hours in the year.

- Real Discount Rate = [(1 + Nominal Discount Rate)/(1 + Inflation Rate)] – 1

5.3. Bill Inputs

All customers experience a rate impact from efficiency programs, which results in a bill impact. However, customers that participate in the efficiency programs will see an additional impact on their bills through reduced consumption. In this section, we highlight some of the key inputs and considerations for the bill impact analysis.

Types of Customers

The models present bill impacts for four different types of customers: non-participants, average customers, high-savings participants, and low-savings participants.

Non-Participant: By not installing efficiency measures, non-participants' consumption is unchanged from efficiency programs, and their bills are only impacted by the rate impacts. Therefore, non-participants experience bill impacts that are proportional to the rate impacts.

Participant: By participating in efficiency programs, customers reduce their electricity consumption, thereby lowering their bills. The efficiency measures that a participant installs determine the size of the bill reduction. The combination of reduced electricity consumption and the rate impacts provide the bill impact for program participants.

Average Customer: 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 models calculate the average customer's bill "savings" for each customer sector as energy savings divided by customers.

Participant Bill Savings

A participant's bill impact could vary significantly depending on the number and type of efficiency measures installed. For example, a participant could install a single LED lightbulb which would provide modest bill reductions, or a participant could undertake a deep energy retrofit which would provide substantial bill reductions.

To account for such variation in participant bill impacts, the models account for two types of participants. The utilities and stakeholders can define these participants as they see fit, with corresponding estimated bill reductions. While we provide optionality within the model, we expect the utilities will estimate bill savings for a participant with a low level of savings and a participant with a high level of savings. Such an approach bookends the range of bill impacts experienced by participants, indicating to stakeholders that most participants will experience a bill impact within that range. Alternatively, stakeholders could agree to model an average participant and a high or low participant, or some other combination of potential program participants.

There are several methods the utilities could use to estimate the savings per participant for the two types of participants. The utilities could estimate savings per participant using historical participant savings data, calculating average savings per participant proposed in the plan for select programs, or through other means agreed upon with stakeholders. The participant savings could represent a customer that participates in a specific program, such as the Home Energy Reports program or the Home Performance with Energy Star program. Regardless of the method agreed upon by the utilities and stakeholders, it is important that model users remember the results are meant to be illustrative, and that each participant will have a different bill impact depending on the types of efficiency measures installed.

The "EE Inputs" tab provides the utilities two input methods for savings per participant: (1) a percent reduction in typical monthly or annual consumption (which the utilities provide as part of the rate and bill inputs), or (2) monthly savings in kWh, kW, or annual savings in therms. The utilities enter savings for each year of the plan, by customer type, for both the Proposed and Alternative Efficiency scenarios.[27] The models then use these savings assumptions to determine the bill impacts for the two types of participants.

[27] For the bill impact results for the three years of the plan combined, we assume a customer participates in the first year of the three-year plan at the level of savings indicated for the first year of the plan.

6. Rate and Bill Impacts: Example Results

The rate and bill impact models provide several outputs to summarize the impact of efficiency programs on customers' rates and bills, and they present rate and bill results in a meaningful context. For example, rate impacts are summarized in terms of cents per kWh, dollars per therm, dollars per month, and percent of total rates, while bill impacts are presented in terms of dollars per month and percent of total bill.

The sections that follow highlight some of the key model outputs that the utilities and stakeholders can use to asses customer equity impacts from the efficiency programs.

In the sample outputs below, we reference the utilities' 2021–2023 plan drafts from April 1, 2020 to illustrate the type of outputs included in the RBP models.[28] The April efficiency plans are not final and are subject to change. The results are illustrative only and are not intended to indicate the rate and bill impact results for any utility or plan.

For the purposes of illustration, we summarize results from Eversource's plan, and only for the residential rate classes.[29] The rate and bill impact results for the other utilities and rate classes can be found in the April efficiency plan draft. We show limited, focused results to provide consistency in this report, to reduce the volume of figures with similar results, and because the underlying data is subject to change based on the utilities' planning process.

6.1. Using the Results Tabs

We built the rate and bill impact results tabs to be dynamic for the year(s) modeled. The model user selects the plan year or the three-year total from the "Program Year(s)" drop-down menu to adjust the results. By default, the models are set to the three-year total to summarize the impact from the entire proposed plan.

If looking at results for a single year, the figures summarize the long-term impacts from investments made in that year. If looking at results for the three years in total, the figures summarize the long-term impacts from the utility's investments made over the three-year term.

6.2. Change in Revenue Requirements

To synthesize the rate impacts across the customer sectors, the models provide an indication of the net change in the utility's revenue requirement due to the proposed efficiency programs. The change in

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28 See, Draft 2021-2023 New Hampshire Statewide Energy Efficiency Plan, April 1, 2020, Attachment K.

29 We chose Eversource because it represents the largest electric utility in the state by sales volume.

revenue is dispersed across each rate class differently, depending on the efficiency programs and the rate class structures. Each rate class will experience a different change in revenue and therefore rate impact.[30] A summary of the change to revenue requirements can be found in the "Output Summary" tab of the models.

6.3. Summary Table

Each model provides a table summarizing the rate and bill impacts by year, customer sector, and Proposed Efficiency or Alternative Efficiency scenario shown on the "Output Summary" tab.[31] Table 1 provides an example of that summary table for Eversource's residential rate and bill impacts. A non-participating Eversource residential customer could see a 0.5 percent bill increase over the 27 years of the three-year plan, while a customer participating in an efficiency program with high-savings measures could see a bill decrease of -2.6 percent, and customers on average could see a slight bill increase of 0.02 percent. Though not shown here, the summary tables for the C&I sector provide the additional detail of changes in demand rates.

Table 1. Electric residential long-term levelized rate and bill impacts from 2021-2023 Draft Plan

Residential		Levelized Net Change
Change in Annual Rates		
Total Rates	*¢/kWh*	0.08
	%	0.5%
Change in Monthly Bills		
Non-Participant	*$*	$0.52
	%	0.5%
Average Customer	*$*	$0.02
	%	0.02%
Low Savings Participant	*$*	$0.17
	%	0.2%
High Savings Participant	*$*	-$2.90
	%	-2.6%

30 As we explain in Section 3.1, avoided electricity costs and avoided gas costs do not impact rates, and instead are accounted for in bill impacts. For the revenue requirement assessment, the models assume the utilities' revenue requirements will be impacted by changes in avoided electricity and avoided gas costs.

31 The utilities did not include this table in their April 1 plan drafts, but we provide example results here as it is an important output from the models.

6.4. Rate and Bill Impact Figures

The rate and bill impact models present various figures and results which may be of interest to stakeholders, including total rates and bills, percent changes in rates and bills, and bill impacts for each year of the three-year plan.

Figure 2 and Figure 3 illustrate two results from the models, summarizing rate and bill impacts, respectively, for residential programs. Both figures show results for all three years of the plan and represent the long-term average change in rates and bills for the Proposed Efficiency scenario relative to the No New Efficiency scenario. Additional utility-specific figures are found in the model. It is important to note that figures in the model for C&I rate classes with demand charges are based on taking demand charges (in $/kW) and converting them to energy charges (in $/kWh) using a rate class-specific load factor to include all rates in a single figure. However, the model generates a summary table in the "Output Summary" tab which presents rate impact results in three different units as explained above: cents per kWh for energy-related cost impacts, dollars per kW for demand-related cost impacts, and cents per kWh for all cost impacts combined (both energy- and demand-related costs).

In the figures below, we use Eversource's residential three-year plan as an example. The rate and bill impacts for other utilities and rate classes demonstrate a similar pattern, although the magnitude of each impact varies depending on the efficiency programs for the rate class and the rate class structures.

Figure 3 summarizes the change in rates for each year over the defined long-term study period of the residential efficiency programs proposed in the 2021-2023 Draft Plan, compared to if there were no Plan. We separately identify the change in rates as follows:

- Yellow bars: energy efficiency cost recovery associated with the efficiency plan through the SBC for electric utilities and through the LDAC for gas utilities
- Red bars: lost revenue associated with the efficiency plan
- Green bars: avoided costs associated with the efficiency plan
- Black dotted line with %: net change in rates, which accounts for the upward pressure on rates from efficiency costs and lost revenue recovery, and the decrease in rates from avoided costs. The percentage of net change in rates is shown in this table for each year above the dotted line.
- Text box: provides the levelized net change in rates.

As the figure shows, efficiency costs are recovered in the first three years of the plan, while benefits accrue each year over the long term. Savings, which impact both avoided costs and lost revenue, phase in during the first three years before phasing out at the end of each year's average measure life. In each year and over the long term, avoided costs and lost revenue almost net each other out. This impact combined with the three years of initial cost recovery results in a levelized net increase in rates of about 0.5 percent.

Figure 2. Eversource Proposed 2021-2023 Draft Residential Programs levelized long-term rate impacts[32]

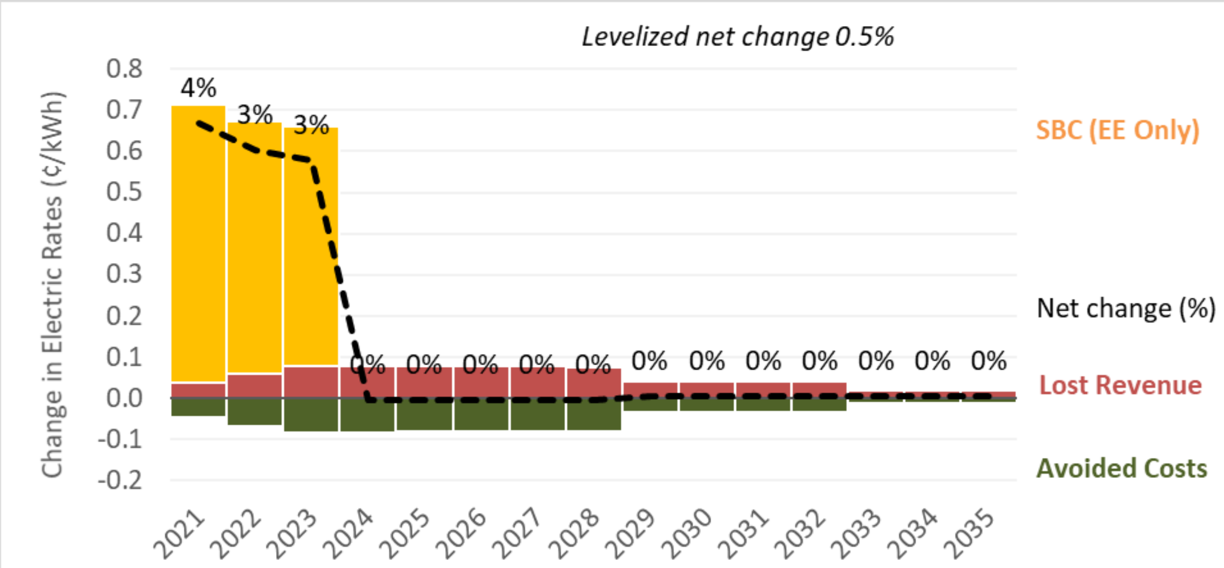
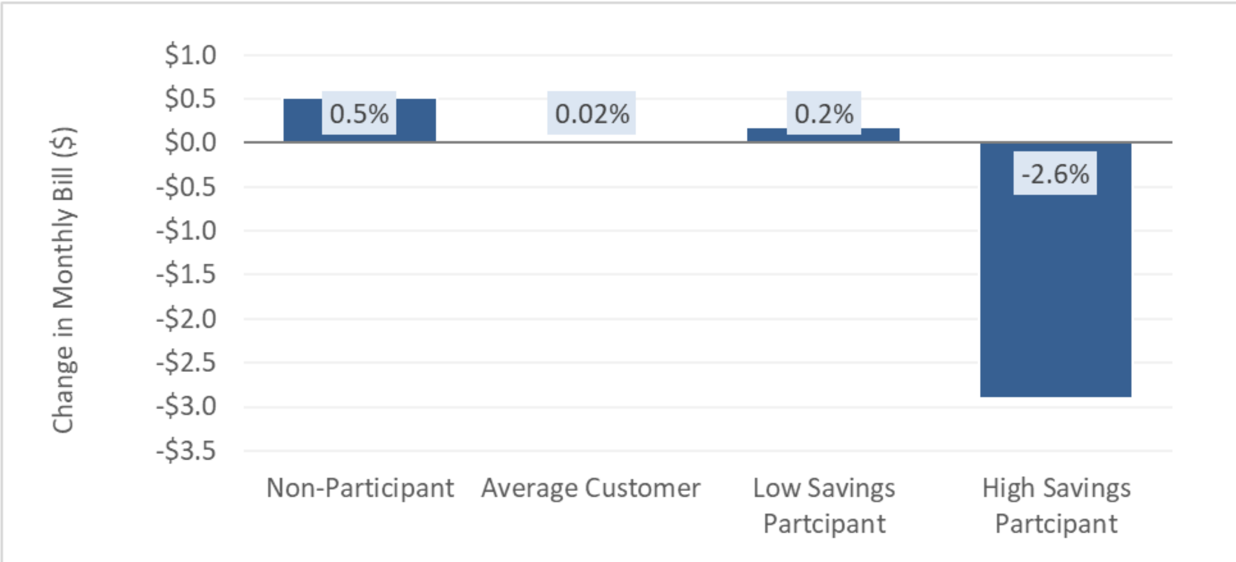


Figure 3 summarizes the bill impacts for each customer type as a total change in bills (in dollars) as shown in the blue bars, and as a percent change in bills, as shown in text boxes. The non-participant sees a 0.5 percent bill increase, consistent with the change in rates. Customers on average see almost no bill impact (a 0.02 percent increase). Participant bill impacts range from a slight increase of 0.2 percent to a decrease of 2.6 percent, depending on the efficiency measures the participant installs during the three-year plan.

[32] This figure is for illustration only and is not considered a final result.

Figure 3. Eversource Proposed 2021-2023 Draft Residential Program long-term bill impacts[33]



[33] This figure is for illustration only and is not considered a final result.

7. PARTICIPATION ANALYSIS

Customers that participate in efficiency programs will typically experience reduced bills while non-participants might experience increased bills. A comprehensive understanding of the equity issues raised by energy efficiency programs requires assessing the efficiency program participation rates to identify the extent to which some customers benefit more than others. We estimate participation rates based on the percentage of eligible customers that could participate in efficiency programs.

Analyzing program participation is complicated. Stakeholders need to consider issues such as customers participating across multiple programs within a year, customers participating in a single program but across multiple years, definitions for a participant in each program, and customer eligibility for each program.

7.1. Model Overview and Key Assumptions

We developed an Excel model to analyze efficiency program participation in New Hampshire. We developed this analysis separately from the rate and bill impact analysis models because the inputs and results vary between the two analyses. The participation model is intended to accompany the rate and bill impact model, as we explain in the *Using the Models* section.

The participation model is the same for both electric and gas distribution fuels because inputs are program-specific, and the utilities offer the same programs across fuel types. The model analyzes one utility at a time, and results are utility-specific. Like the rate and bill impact models, we expect each utility will make a utility-specific version of the participation model and maintain the model inputs to reflect current energy efficiency data.

The model presents results in terms of annual and cumulative participation by sector and program, both as a percent of eligible customers and in absolute terms (e.g., unique accounts participating).

Defining Participants

Ideally, the New Hampshire utilities should define participants as unique accounts for all programs. This is the ideal approach to defining program participants because it allows for proper accounting of customers that participate in multiple programs within a year or across years. This allows for an accurate comparison of participation rates across programs and years.

However, the definition of a participant could vary by efficiency program, and the utilities may find it challenging to identify unique participants depending on the program. As examples, participants in the residential Home Energy Reports program are relatively easy to define: participants are the number of homes that receive a report regarding the home's energy use. It could be more challenging for the utilities to identify unique participants in an upstream efficiency program, where the utilities cannot trace a product purchased from a store to a customer's home or business. In such instances, the utilities may need to make simplifying assumptions, such as that a customer purchases four lightbulbs per home.

Eligible Participants

To determine a participation rate, the model divides program participants by the number of customers who could have participated in a program (i.e., the eligible participants). For example, the pool of eligible participants for a residential program could be all the utility's customers taking service under the residential rate class. The definition for eligible participants could vary by program, especially within C&I programs for small and large customer, but the pool of eligible participants should remain consistent across each program by year.

Repeat participants

Customers can participate across multiple years within the same program, and/or across multiple programs within a year. For example, a residential customer could easily participate in both the Home Energy Reports program and the Home Performance with Energy Star program in a single year. Or, a customer could participate in the Energy Star Products program every year over a three-year plan or even multiple times within a single year.

If the participation model counted each customer every time he or she participated, the participation rate would be skewed and indicate more unique accounts participated than is the case. In some instances, customers can repeat participation frequently, resulting in a participation rate that exceeds the pool of eligible customers. This is especially the case with a program like Home Energy Reports, where many customers receive an energy report over multiple years. Similarly, the Energy Star Products program presents challenges for estimating repeat participants, because unique customers cannot be tracked for upstream programs. Such results do not help utilities and stakeholders assess the breadth of customers participating in efficiency programs who thereby reduce their energy bills.

We have tried to account for repeat participants in the participation model, isolating the number of unique accounts participating by program and by year. However, the analysis is only as sound as the utilities' participation data and the utilities' ability to isolate unique accounts.

Alternative scenario

We included an Alternative Efficiency scenario in the rate and bill impact models, but not in the participation model. We were uncertain the utilities could forecast participants for an alternative scenario that would be consistent with the alternative scenario modeled in the rate and bill impact analysis, depending on the complexity of an alternative scenario. We were also concerned that an alternative analysis could over-complicate the participation outputs, especially because the participation model is for a longer timeframe than the rate and bill impact analysis.

7.2. Inputs and Considerations

A participation analysis requires data indicating when a customer participated and in which program they participated. If the utilities do not currently have the data required to populate the participation model inputs, we recommend they begin collecting the data to complete the analysis for future efficiency programs. For example, the utility may not have historical planned and actual eligible participants, in which case planned and actual values can be the same. For future planning, however, utilities should be able to provide both planned and actual eligible participants.

We built the participation model such that customer-specific information (e.g., account number, street address) are not required inputs. However, the utilities may need to review such data prior to populating the model to correctly identify unique and repeat participants.

Below, we define and identify important considerations for each input. Some inputs are consistent across all utilities, which we pre-populated in the model. The other inputs are utility-specific and will depend on the utilities' historical and planned programs.

Pre-defined and pre-populated inputs

- *Year:* The participation model analyzes years 2017 through 2023. This analysis period varies from the rate and bill impact analysis, which is just for the three-year term of the proposed plan (2021–2023). We look at historical participation because cumulative participation is important for understanding long-term efficiency program impacts on customers' bills. For example, a customer could be a non-participant in the proposed three-year plan, but they may have participated previously. As such, that customer continues to offset the rate and bill impacts from the proposed plan, provided their efficiency measures are still in operation. We started the analysis in 2017 because the utilities confirmed that was the first year for which they could provide the requested data.[34] When updating the participation model for a new three-year plan, the utilities should not remove data for previous years, but instead should append the new plan data onto the existing analysis. This allows the utilities and stakeholders to view trends in participation over time and better assess the impact of the programs on customers' bills and customer equity over the long term.

- *Reporting Period:* The model includes both planned and actual participation. This differs from the rate and bill impact analysis, which analyzes planned data only. The model uses the actual participation data more than the planned data throughout. We provide a comparison of planned to actual participation for the program-specific analysis only.

- *Customer Sector:* The participation model analyzes residential, low-income, and C&I customer sectors. This is consistent with sector breakout the utilities use for their efficiency programs. The model then uses this input to summarize results by customer sector.

- *Program:* The model includes the efficiency programs the utilities have been implementing consistently since 2017: Home Energy Assistance, Energy Star Homes, Energy Star Products, Home Energy Reports, Home Performance with Energy Star, Large

[34] If the utilities find they can provide data even further back, we encourage them to update the model to accommodate those years.

Business Energy Solutions, Municipal Energy Solutions, and Small Business Energy Solutions.

Utility-specific inputs

Definitions, and information

The participation model is set up for each utility to enter in the below information. Each utility should make sure the below inputs match what it defined within the rate and bill impact model.

- *Equivalent Rate Class(es)*: The utilities should indicate which rate class(es) can participate in each program. This allows for comparison to the rate and bill impact analysis. It is important to note that the rate and bill impact analysis can only model one rate class per customer sector. The utility will have defined that rate class within its model.

- *Definition of Customers in Rate Class*: The utilities should indicate how they define the number of customers within a rate class, such as unique account, meter number, or something else.

- *Customers in Rate Class:* The utilities should indicate the number of customers taking service within the rate classes indicated under "Equivalent Rate Class(es)" for the indicated year. This allows for comparison to the number of eligible and annual participants.

- *Definition of Eligible and Participating Participants*: The utilities should indicate how they define both eligible and participating customers, such as unique account, meter number, or something else. The utilities should use the same definition for eligible customers and participating customers. Ideally, the utilities will define participants consistently with each other by program.

Participation data

The participation model uses the following data throughout to determine participation rates by sector and program.

- *Eligible Participants:* The utilities should indicate the number of customers that are eligible to participate in each program for the indicated reporting period and year, consistent with the definition of eligible participants. The number of eligible participants and the number of customers within the rate class could be the same, but do not have to be if the utility applies different definitions for the two types of data.

- *Annual Participants:* The utilities should indicate the number of customers that participated in each program or that the utility is expecting will participate in each program for the indicated reporting period and year, consistent with the definition of participating customers. This number should include all customers that participated in the year, including any repeat participants. The participation values are likely to be consistent with the participant numbers included in a utility's other planning documents and models, such as the benefit-cost screening model, and quarterly and annual reports.

- *Participants Across Multiple Programs:* The utilities should provide the number of customers who participated across multiple programs within the same customer sector for the indicated year and reporting period. The utilities should provide this value not by program but for the customer sector in total (residential, low-income, and C&I).[35] For example, if in 2017 a customer participated in both the Home Energy Reports program and the Energy Star Products program, then the utility should count that customer once in this input column. The model then subtracts these customers from the total annual participants for the customer sector such that each unique account is summarized in the sector-level results.

- *Participants Across Multiple Years:* The utilities should provide the number of customers who participated in the same program more than once since 2017 (the start of the participation analysis). The utilities should count a customer as a repeat participant for every subsequent year in which the customer participates in the program. For example, if a customer participates in 2017 and again in 2018 then that customer should be included in this input column for 2018. If that same customer participates again in 2019, it should be included in this input column for both 2019 and 2018.

For the last two data inputs on repeat participants, the utilities will need to forecast the expected repeat participants for each plan year and for each program. One approach the utilities could use for these projections is to assume a certain percentage of repeat participants based on historical program data, when such data is available.

7.3. Methodology

The participation model calculates both annual and cumulative participation rates. Annual participation rates represent the number of customers that participated in one year divided by the eligible participants that could have participated in that year. The model does not adjust the annual participants for repeat participation within the same program across multiple years but does adjust the annual participants for repeat participation across multiple programs at the sector level.

For the cumulative participation rate, the model estimates cumulative participation rates for each year and for the entire study period separately. The cumulative participation rate for each year is simply a sum of annual participation rates up to each individual year. The cumulative participation rate for the entire study period sums the annual participants and removes any participants who participated multiple times over the years and/or programs. It then divides the resulting unique participant count by eligible participants. For the sector participation rate, the model uses the eligible participants for the program in the sector with the most eligible participants. As mentioned above, the sector-level participation rates take into account repeat participant across multiple programs. The cumulative

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[35] Specifically, on the "Inputs" tab of the participation model, the sum of participants across all programs within the customer sector less the customers in the "Participants Across Multiple Programs" column should indicate the number of unique customers served for the year.

participation rates begin in 2017 and extend through the last year of the proposed three-year plan (in this case, 2023).

7.4. Example Results

The utilities did not include the results of the participation analysis in their April 1, 2020 draft plans. Therefore, we cannot provide results based on the latest expectations for efficiency programs in New Hampshire.

We worked with the utilities to gather participation information, but the utilities were unable to provide all required data at the time we drafted the participation model.[36] Where the utilities were unable to provide data, we used reasonable assumptions based on efficiency data in the 2020 update to the 2018–2020 plan and the rate and bill impact analysis. We held this data constant for each year and reporting period as placeholder assumptions to build the participation model and estimate theoretical results. Below, we provide illustrative participation results using these placeholder values.

Figure 4 illustrates the sector-level participation results, using Eversource's electric electric's C&I programs as an example. Although we use placeholder values, in theory, the 2017–2019 data should reflect actual participants, the 2020 data should be consistent with the 2020 update to the 2018–2020 plan, and the 2021–2023 data should be consistent with proposed participants for the new three-year plan.

Figure 4 below hypothetically illustrates that, by the end of 2023, about one-third of Eversource's eligible customers will have participated in efficiency programs. This is the portion of customers that will have experienced bill reductions instead of bill increases.

[36] Liberty provided planned 2018 data, Unitil provided planned and actual data for 2017 and 2018, and Eversource was still gathering participant data.

Figure 4. C&I annual and cumulative participation

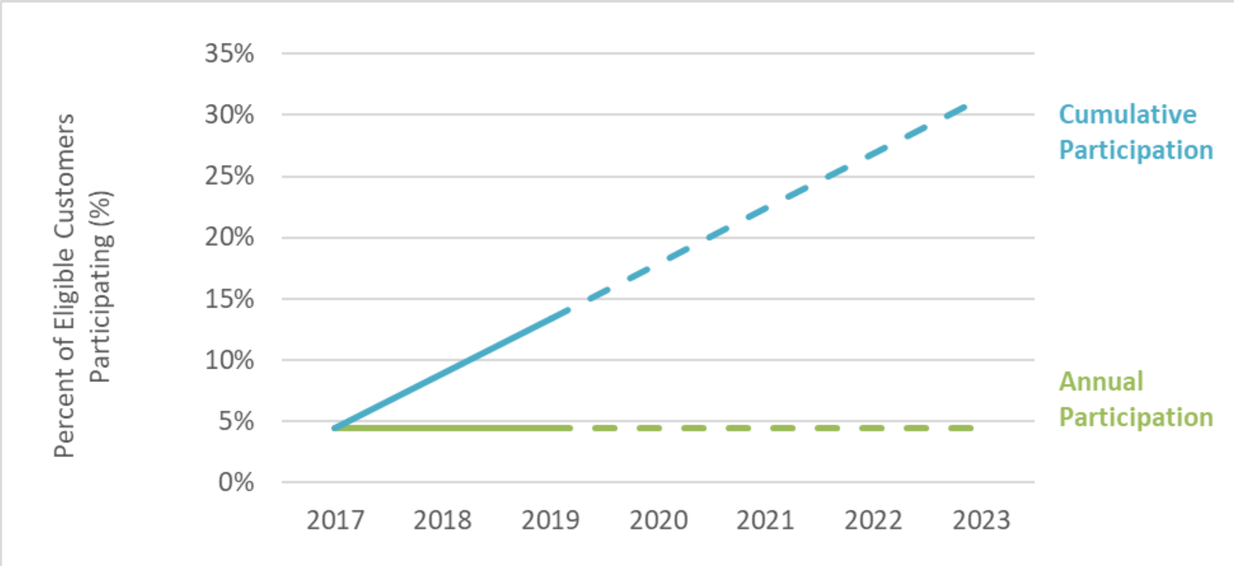


Figure 5. Sample Program Annual and Cumulative Participants

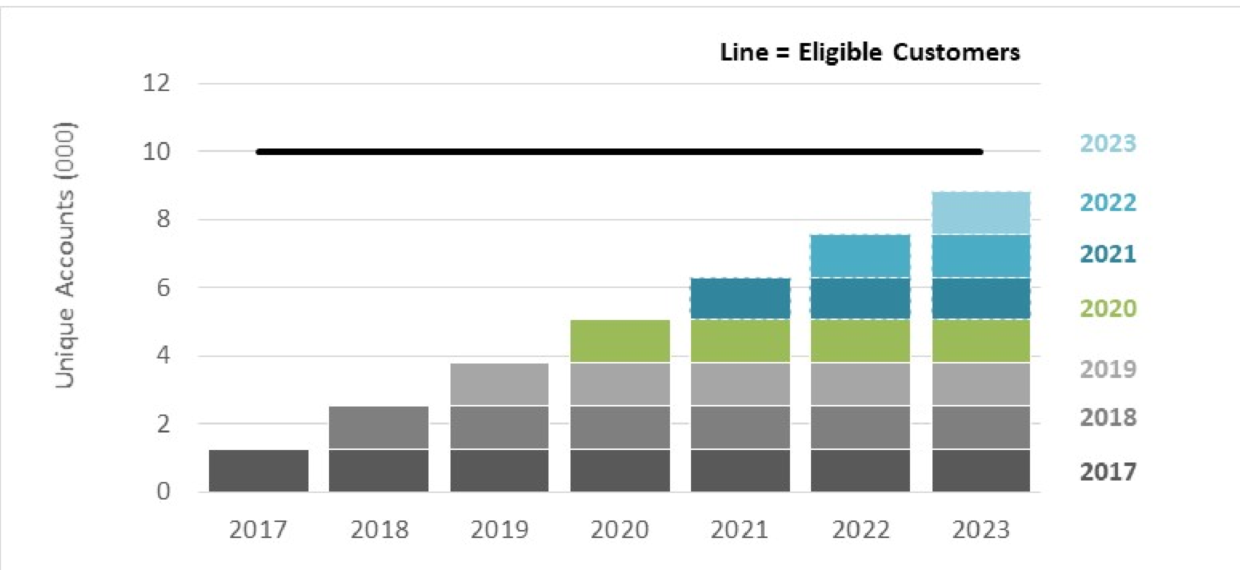
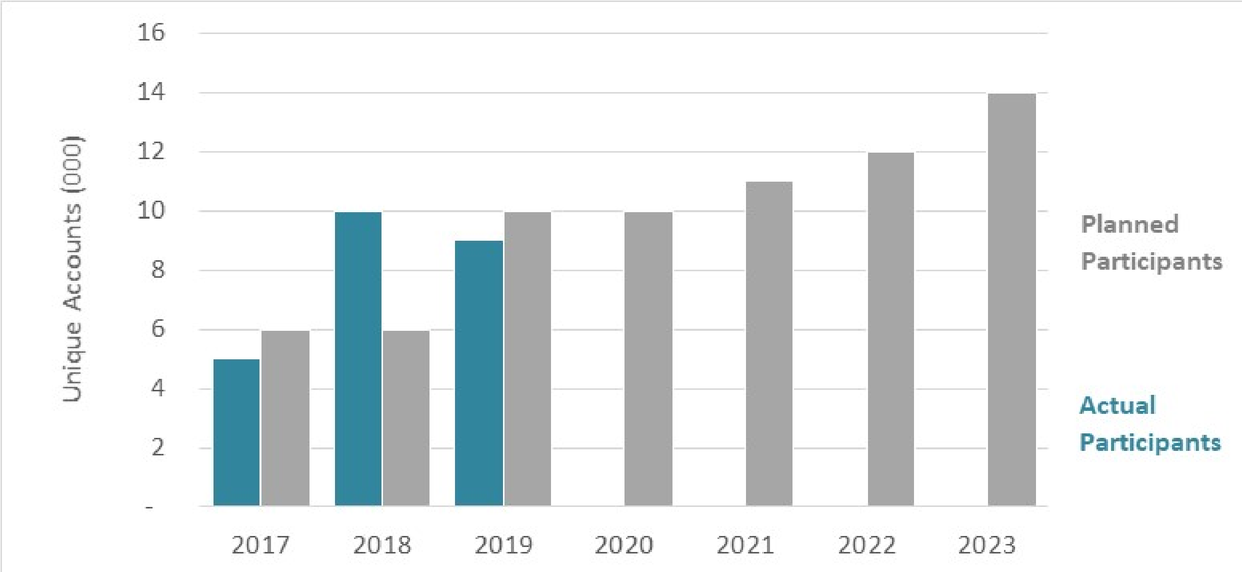


Figure 5 shows how many customers (defined for this program as unique accounts) participated in a hypothetical program in each year the program was offered and cumulatively over time. The horizonal line represents the total number of eligible customers that can participate in the program (in this sample 10,000). Depending on the program eligible customers could mean all residential customers, businesses below a certain annual usage, etc. This figure allows a utility to easily visualize the remaining potential for new participation within a program.

The participation model provides other participation results that may be of interest to stakeholders, including planned compared to actual participation rates as shown in Figure 6.

Figure 6. Actual versus planned participation



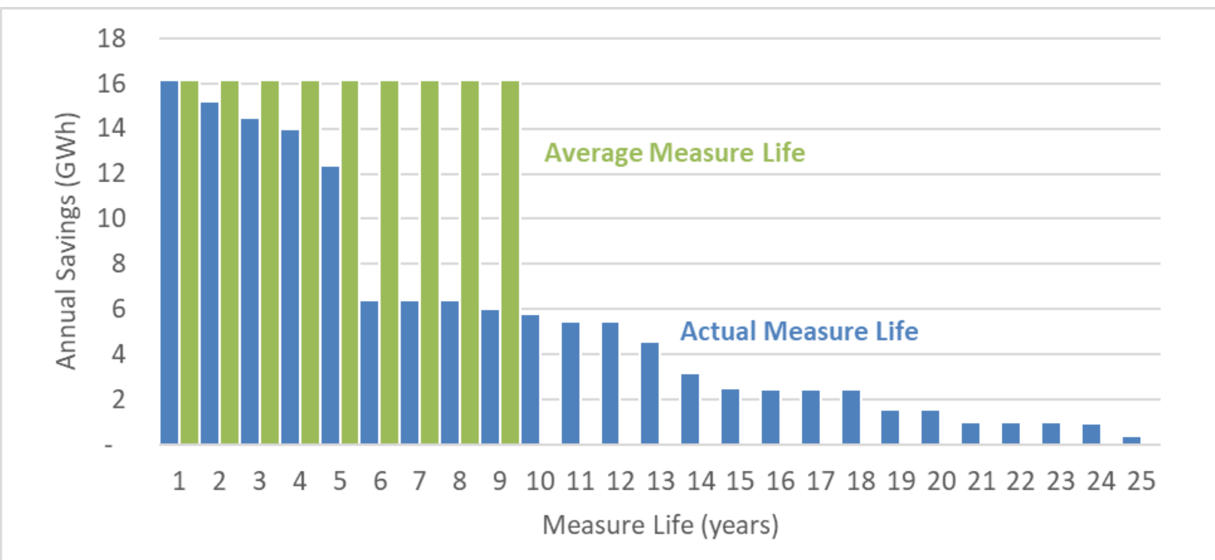
Appendix A. Long-Term Study Period

The RBI model includes several simplifying assumptions to allow for its use across the NH utilities and for the assessment of a three-year plan. One of the simplifications involves the use of a weighted-average measure life and a long-term study period.

The weighted average measure life is used in the model to estimate the length of time that benefits and lost revenue will impact each rate class from the installation of energy efficiency measures due to the three-year plan.

The use of a weighted average measure life in the model results in an assumption that all the energy savings will expire at the end of the average measure life. This condenses the savings period and assumes all savings occur within that weighted average at the level equal to the savings in the first year. However, in reality, each energy efficiency measure has a different measure life, and savings will gradually dissipate over an extended period. The difference is shown in Figure 7 below.[37]

Figure 7. Annual savings using an average measure life or actual measure life distribution



While the model required a simplified approach to calculating the measure life, it is important to still account for the fact that, in reality, certain measures will still be producing energy savings and impacting rates and bills over their longer-term lifetime. For example, the NH efficiency plans include several

[37] To develop this figure, we used Eversource's residential savings from its 2020 plan update. We provide this figure to illustrate the difference in measure life calculations and its inclusion should not be a reflection on Eversource's savings data.

programs with measures that continue to provide savings out to 25 years—such as those included in the HVAC and EnergyStar Homes programs. In order to account to measures that extend beyond the average measure life of the efficiency program portfolio, we use 25 years as the study period for each individual year, which results in a 27-year study period for the three-year plan term. The long-term rate and bill impacts are determined by taking the levelized value over the study period.

Levelizing these impacts over a 25-year period provides for more accurate results than if the impacts were assessed just over the weighted average measure life.

To highlight the accuracy of this approach, Table 2 below shows a stream of energy savings from a hypothetical efficiency program with an average measure life of 10 years. It highlights the difference in assessing impacts using the actual distribution of measure lives over time compared to using the weighted average approach.

The Actual Distribution column shows a stream of annual energy savings from Years 1 through 25, declining over time based on the actual measure life distribution over time. Whereas, the weighted average column shows annual savings impacts assuming 100 percent outputs through the first 10 years and zero in later years (which is the method used in the RBP model).

Table 2. Comparison of actual measure life distribution to the weighted average approach

Year	Actual Distribution	Weighted Average
1	100	100
2	95	100
3	95	100
4	95	100
5	95	100
6	90	100
7	90	100
8	50	100
9	50	100
10	25	100
11	25	0
12	25	0
13	25	0
14	25	0
15	15	0
16	15	0
17	15	0
18	15	0
19	10	0
20	10	0
21	10	0
22	10	0
23	5	0
24	5	0
25	5	0
Total	1000	1000
Measure life (years)	10	10
Levelized average over 10 years @1.5% discount rate	83	105
Levelized average over 25 years @1.5% discount rate	50	51

As the results show, when using the average measure life instead of the actual measure life distribution, the use of a longer-term study period enables more accurate results.

When levelized over the 10-year average measure life, the resulting value of 105 in the weighted average column ends up being much higher than the value we would expect if we used the actual distribution of measure lives over the course of 25 years (a value of 83). This approach overestimates the annual average savings impacts.

When the same method is applied for a 25-year period, the result of the weighted average is much closer to that of the actual measure life distribution (51 compared to 50).

As this example shows, the simplified approach provides an appropriate level of precision to fulfil the key purpose of the model, which is to provide an approximate indication of the rate and bill impacts that will occur over the long term from the implementation of an energy efficiency plan. This is especially true given the fact this model was built to assess the long-term rate and bill impacts at the sector level and not the program level.

While the model's approach is appropriate for assessing the long-term impacts of a three-year efficiency plan, the results of this analysis are not intended to replace or replicate the detailed analyses utilities undertake when calculating rates for efficiency cost recovery through the SBC for electric utilities or the LDAC for gas utilities.