Rate and Bill Impacts of Vermont Energy Efficiency Programs

From Proposed Long-Term Energy Efficiency Scenarios 2014-2034

Prepared for the Vermont Public Service Department

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EXECUTIVE SUMMARY

Introduction

This report estimates the rate and bill impacts of the long-term energy efficiency scenarios modeled by Vermont Energy Investment Corporation ("VEIC") on behalf of Efficiency Vermont ("EVT") and by Burlington Electric Department ("BED").[1] Cost-effective energy efficiency ("EE") resources will typically result in higher rates but lower bills on average. This report investigates just how much higher those rates might be, in order to illustrate the magnitude of the higher rates relative to the lower bills.

The concerns that are typically raised about rate impacts are essentially customer equity concerns. Efficiency program participants may experience higher rates but lower bills, while non-participants may only experience the higher rates. Therefore, in order to understand fully the equity issues raised by energy efficiency programs, it is necessary to consider three related impacts of the programs. First, how much are rates likely to increase over the long-term? Second, how much are bills likely to be reduced by the energy efficiency? Third, what portion of customers is likely to participate in the efficiency programs and thereby experience net bill savings? Providing answers to all three of these questions can help illustrate how customers will fare overall under the long-term energy efficiency scenarios modeled.

Note that this analysis is not intended to estimate the particular rate or bill impacts that might occur in any one year, or for any one customer type, or for any one efficiency program. Several simplifying assumptions 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. Consequently, the presentation focuses on the long-term trends and general conclusions regarding typical customers.

Scenarios and Methodology

Three different energy efficiency futures are analyzed in this report, based upon the scenarios described by the Vermont Public Service Board ("PSB" or "Board") in its September 30, 2013 Order. These include the following:

- Scenario 1: Acquisition of all economically achievable potential through level budgets over 20 years (which is referred to as the Low Case);
- Scenario 2: Acquisition of all economically achievable potential through the extension of the current 2012 through 2031 Demand Resource Plan ("DRP") through 2034 (which is referred to as the Base Case); and
- Scenario 3: Ramp up to 3% savings relative to annual electric energy usage by year 2019, and maintenance at that level through 2034 (which is referred to as the High Case).

[1] EVT submitted its models on December 6, 2013; BED submitted its models on January 9, 2014.

A "No EE Case" is also analyzed, where it is assumed that no new energy efficiency programs are implemented in the future. This is purely a hypothetical case to allow for an illustration of the impact of the Base Case energy efficiency activities relative to a future with no new efficiency investments.

The analysis begins by making a long-term forecast of the electricity rates of BED and EVT (which is based on the rest of Vermont combined). These rates are broken out into relevant components, including generation, transmission, distribution, the energy efficiency charge, and other components. Then, estimates are made as to how each of these rate components is likely to change over time in each of the different energy efficiency scenarios. While the impacts are estimated on an annual basis, the presentation emphasizes the long-term average trends.

A long-term forecast is made of the likely bill impacts of the EVT and the BED efficiency programs under the different scenarios. For each sector, the average bill impacts are estimated across all customers within that sector, estimating the average impact across both program participants and non-participants. Estimates are also made of the average bill impacts for those customers who participate in key programs.

Customer participation is assessed by estimating customer participation rates, i.e., the percentage of eligible customers that participate in an energy efficiency program. In understanding participation rates, it is important to assess the extent to which customers participate in multiple programs. There is limited information available at this time on repeat participation, and therefore the participation results should only be used to draw general conclusions.

Highlights and General Conclusions

Rate Impacts

- For EVT, long-term average rate impacts in the Base Case are expected to range from 0.5% for the business demand customers to 2.9% for the residential customers.
- For BED, long-term average rate impacts in the Base Case are expected to range from 1.9% for the business demand customers to 3.5% for the business non-demand customers.
- Avoided capacity, transmission, and distribution costs will cause downward pressure on rates over the long-term. For example, on average over the 30-year study period, for an EVT business demand customer, when comparing the Base Case to the No EE Case, avoided capacity costs make up 39% of the decrease in rates, avoided distribution costs make up 41% of the decrease in rates, and avoided transmission costs make up 18% of the decrease in rates.
- The price suppression effect (i.e., DRIPE) has a very limited impact on reducing rates to Vermont customers. This is primarily due to the fact that Vermont makes up a small portion of the New England wholesale electricity market.
- The recovery of lost revenue (i.e., the recovery of fixed costs over a lower volume of retail sales due to efficiency savings) is the primary reason that average long-term rates increase with increased efficiency savings. It is difficult to estimate the impact of

recovering lost revenue for many reasons. In this analysis, the estimates of the lost revenues associated with distribution costs may be somewhat overstated, because it is assumed for simplicity and consistency that all distribution lost revenues are recovered in rates even though this may not be true in all cases. Consequently, the rate increases may be overstated, and the bill reductions may be understated.

- Efficiency programs will likely result in less of an increase in rates if they create a large amount of capacity savings relative to energy savings. The rate impacts decrease with greater increases in capacity savings relative to energy savings because (a) there are less energy savings that would result in the recovery of lost distribution revenues; and (b) there are greater capacity savings that would result in higher avoided capacity, transmission, and distribution costs. This effect is demonstrated by comparing the business non-demand customer rate impacts, with relatively high energy savings, to the business demand rate impacts, which indicate a decrease in rates in later years.

Bill Impacts

In general, scenarios with greater efficiency savings result in greater bill savings. For EVT, average bill savings in the Base Case are expected to range from 1.9% for business demand customers to over 5.9% for residential customers. For BED, average bill savings in the Base Case are expected to range from 3.6% for residential customers to 5.6% for business non-demand customers.

Note that both the business demand and business non-demand bill impact results are approximations, due to the need to make several simplifying assumptions. The reasons for, and implications of, this are provided in Section 2. Consequently, these bill impact results should be used with caution.

Participation Rates

This report includes only a limited analysis of participation rates, due to limited data. One of the key challenges to participation analysis is in understanding the extent to which customers participate in programs multiple times, either within a program within a year, across programs within a year, or across years. To the extent that customers participate in programs multiple times, the estimates of participation rates will be lower than those presented in this report.

It is generally recognized that customers participate in efficiency programs multiple times; thus our estimates of participation rates overstate the actual portion of customers that receives efficiency services. Nonetheless, participation results are presented here because they are an important component of understanding the implications of rate and bill impacts of energy efficiency programs. It is hoped that the analysis presented here will lead to more detailed participation analyses in the future.

Note that there is an important relationship between estimated participation rates and estimated bill savings. To the extent that customers participate in multiple programs, they will experience greater program-specific bill savings than those presented in this report, by experiencing greater energy savings from additional programs. Therefore, to the extent our estimates of participation rates are overstated, our estimates of program-specific bill reductions will be comparably understated.

There are several general conclusions from our analysis of participation rates:

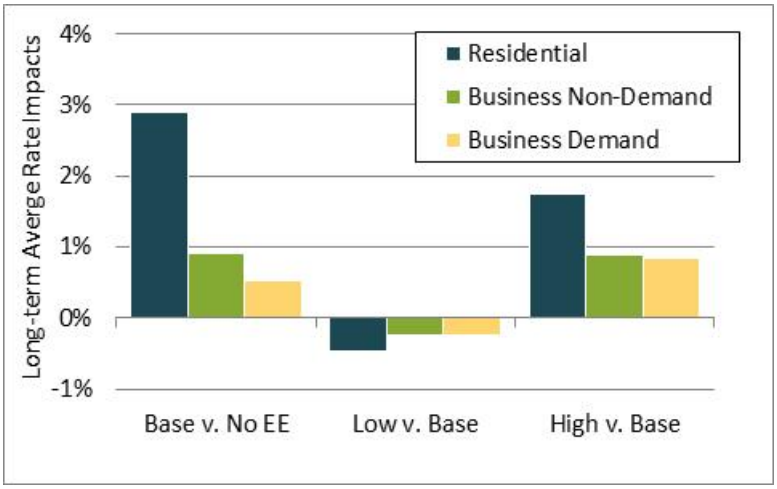
- The Low Case results in a modest reduction in participation relative to the Base Case.
- The High Case results in a significant increase in participation relative to the Base Case.
- Many customers are expected to participate in multiple programs within a year, across multiple years, or both.
- The majority of customers are expected to participate in the Efficient Products program, as indicated by participation rates that exceed 100% early in the study period.
- The Existing Homes program participation rates reach 54% to 93% for EVT, and 78% to over 100% for BED.
- The Existing Facilities program participation rate reaches over 100% of eligible customers, in all three cases, for both EVT and BED. These implausibly high results are due to (a) simplified assumptions regarding future participation rates; and (b) repeat participation across programs, especially across years.

Efficiency Vermont Results

Figure ES.1 presents a summary of the average long-term rate impacts for the three sectors, under different efficiency scenarios. The first set of bars illustrates the magnitude of the total impact of the Base Case relative to implementing no future efficiency programs, while the other two sets of bars compare the rate impacts across the different efficiency scenarios modeled by EVT.

The first set of bars indicates that average long-term rates in the Base Case are expected to be greater than rates in the No EE Case. When comparing the Base Case to the No EE Case, the average rate increases are expected to be 2.9% for residential, 0.9% for business non-demand, and 0.5% for business demand.

Figure ES.1 EVT Long-Term Rate Impacts by Sector; Scenario Comparisons



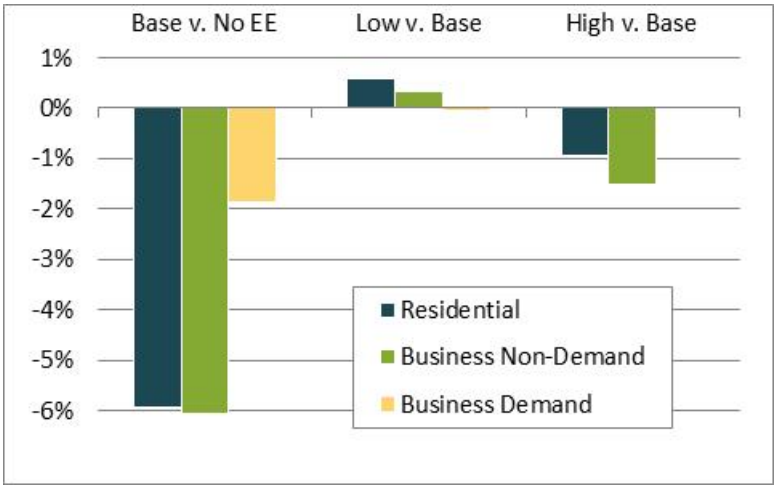
The second set of bars indicates that rates in the Low Case are estimated to be slightly less than rates in the Base Case. When comparing the Low Case to the Base Case, the average rate decreases are expected to be 0.5% for residential, and roughly 0.2% for business non-demand and business demand.

Finally, the third set of bars indicates that rates in the High Case are estimated to be greater than rates in the Base Case. When comparing the High Case to the Base Case, the average rate increases are expected to be 1.8% for residential, 0.9% for business non-demand, and 0.8% for business demand.

Figure ES.2 presents the long-term average bill impacts for each sector, in terms of the percent change in bills per customer per month, by the different scenarios. The bill impacts are calculated by taking the percent change between each sector's electricity costs before accounting for energy efficiency impacts, and each sector's electricity costs after accounting for energy efficiency impacts. These bill impacts account for both the impacts of increased rates (as indicated in Figure ES.1) and the reduced bills, across all customers within a sector on average.

As the figure shows, customers in the Base Case relative to the No EE Case are estimated to see average bill decreases. Customers in the Low Case relative to the Base Case are expected to experience either small bill increases or essentially no impact.

Figure ES.2 EVT Long-Term Average Bill Impacts by Sector; Scenario Comparisons



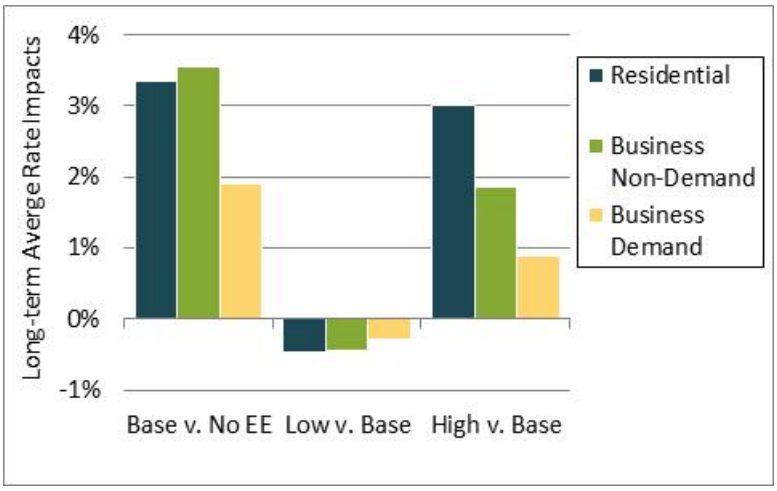
In the High Case relative to the Base Case, residential and business non-demand customers are expected to see bill decreases, but business demand customers are expected to experience a slight increase in bills. This slight increase in bills for business demand customers is probably due to several simplifying assumptions that were made in this analysis, and thus are probably not a good indication of the actual impacts on these customers. First, it was assumed that these customers would not experience reductions in their demand costs as a result of participating in efficiency programs, due to limited data. This could result in significantly understating the potential bill reductions for these customers. Second, we combine the efficiency savings assumptions for both business non-demand and demand customers, again due to limited data. This could also lead to understating the potential bill reductions for these customers, who are typically larger and more able to implement efficiency savings than smaller customers.

Burlington Electric Department Results

Figure ES.3 presents a summary of the average long-term rate impacts for the three sectors under different efficiency scenarios. The first set of bars illustrates the magnitude of the total impact of the Base Case relative to implementing no future efficiency programs, while the other two sets of bars compare the rate impacts across the different efficiency scenarios modeled by BED.

The first set of bars indicates that average long-term rates in the Base Case are expected to be greater than rates in the No EE Case. When comparing the Base Case to the No EE Case, the average rate increases are expected to be 3.4% for residential, 3.5% for business non-demand, and 1.9% for business demand.

Figure ES.3 BED Long-Term Rate Impacts by Sector; Scenario Comparisons

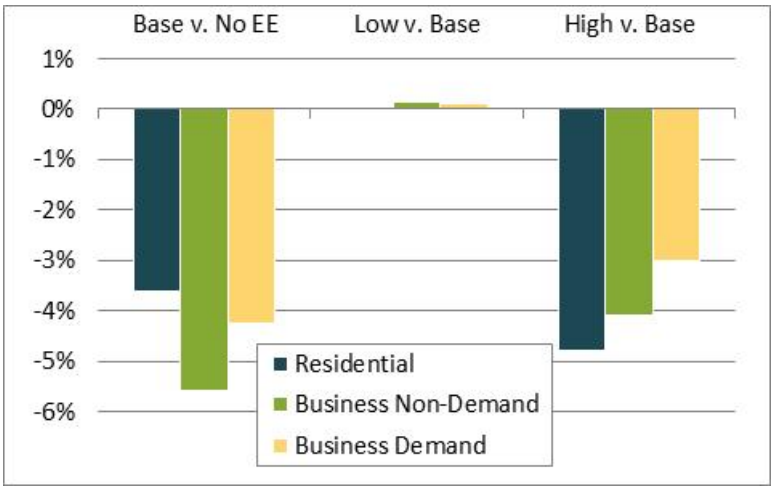


The second set of bars indicates that average long-term rates in the Low Case are estimated to be slightly less than rates in the Base Case. When comparing the Low Case to the Base Case, the average rate decreases are expected to be 0.5% for both residential and business non-demand, and 0.3%, for business demand.

Finally, the third set of bars indicates that average long-term rates in the High Case are estimated to be greater than rates in the Base Case. When comparing the High Case to the Base Case, the average rate increases are expected to be 3.0% for residential, 1.9% for business non-demand, and 0.9%, for business demand.

ES.4 presents the long-term average bill impacts for each sector, in terms of the percent change in bills per customer per month, by the different scenarios. The bill impacts are calculated by taking the percent change between each sector's electricity costs before accounting for energy efficiency impacts, and each sector's electricity costs after accounting for energy efficiency impacts. These bill impacts account for both the impacts of changes in rates (as indicated in Figure ES.3) and changes in bills, across all customers within a sector on average.

Figure ES.4 BED Long-Term Average Bill Impacts by Sector; Scenario Comparisons



As the figure shows, in the Base Case relative to the No EE Case, all customers are expected to see average bill reductions. In the Low Case relative to the Base Case, customers are expected to see either small bill increases or essentially no impact at all. Finally, in the High Case relative to the Base Case and much like the Base Case relative to the No EE Case, all customers are expected to see average bill reductions.

Note that both the business demand and business non-demand results are approximations, due to the need to make several simplifying assumptions. The reasons for, and implications of, this are provided in Section 2. Consequently, these results should be used with caution.

Recommendations

As mentioned above, customers that participate in energy efficiency programs will generally have lower bills than customers that do not participate. As such, the breadth of customer participation is a key component in understanding the implications of rate and bill impacts.

We recommend that the Energy Efficiency Utilities ("EEUs") collect and report better data on customer participation. This should include better data on the customers that are eligible to participate in each program, as well as those who participate in each program. It should also include better estimates of the extent to which customers participate in efficiency programs multiple times, within a year and/or across the years.

Collecting better data on customer participation allows for a more complete understanding of how well customers are being served by the efficiency programs. Better customer participation data can shed light on what portion of customers are experiencing bill reductions as opposed to bill increases. It can illustrate how well each program is reaching its intended population, potentially identifying opportunities to serving those populations more comprehensively. Finally, better data on the extent to which customers participate more than once, or not at all, can help address some of the key questions regarding customer equity.

1. INTRODUCTION

On June 10, 2013, pursuant to 30 V.S.A. §§ 209(d) and (e), the Vermont Public Service Board opened a proceeding to develop the second long-term Demand Resources Plan. The DRP is a set of year-by-year values for demand-side electricity resource-acquisition savings goals, as well as resource-acquisition budgets and non-resource-acquisition ("NRA") and other costs by calendar year for a 20-year period (2015 through 2034). The DRP process will result in a set of long-term assumptions pursuant to which each Energy Efficiency Utility shall operate.

The Vermont EEUs are Efficiency Vermont, operated by Vermont Energy Investment Corporation, and Burlington Electric Department. BED is the municipal department of the City of Burlington and has been implementing energy efficiency programs in its service territory since the 1990s. Efficiency Vermont is a third-party energy efficiency program administrator and implements energy efficiency in all of the Vermont service territories except for BED.

On December 6, 2013 and on January 9, 2014, EVT and BED filed respectively their electric resource acquisition modeling for stakeholder review and comment. The Vermont Public Service Department ("PSD" or "Department") contracted with Synapse Energy Economics, Inc. ("Synapse") to provide technical input and expertise associated with reviewing and commenting on EVT's and BED's budget and savings recommendations with regard to rate and bill impacts.

This report provides estimates of the rate and bill impacts of these long-term energy efficiency scenarios. Cost-effective energy efficiency resources will typically result in lower bills but higher rates. This analysis investigates just how much higher those rates might be, in order to illustrate the magnitude of the higher rates relative to the lower bills.

The concerns that are typically raised about rate impacts are essentially customer equity concerns. Efficiency program participants may experience higher rates but lower bills, while non-participants will only experience the higher rates. Therefore, in order to fully understand the equity issues raised by energy efficiency programs, it is necessary to consider three related impacts of the programs. First, how much are rates likely to increase over the long-term? Second, how much are bills likely to be reduced by the energy efficiency? Third, what portion of customers is likely to participate in the efficiency programs and thereby experience net bill savings? Providing answers to all three of these questions can help illustrate how customers will fare overall under the long-term energy efficiency scenarios.

Note that the analysis is not intended to estimate the particular rate or bill impacts that might occur in any one year, or for any one customer, or for a particular efficiency program. Several simplifying assumptions are made out of necessity, and the actual rate or bill impacts for a specific customer or year can vary from the estimates here. Consequently, the presentation is focused on the average, long-term trends, and the general findings regarding typical customers.

2. METHODOLOGY & ASSUMPTIONS

2.1. Scenarios

On September 30, 2013, the Board issued an Order determining the budget and energy savings scenarios the EEUs should analyze in their DRPs to facilitate the Board's decision regarding statewide short- and long-term electric budgets and goals. The Board-ordered scenarios are:

- Scenario 1: Acquisition of all economically achievable potential through level budgets (adjusted for inflation) over 20 years (referred to in the Synapse analysis as the Low Case);
- Scenario 2: Acquisition of all economically achievable potential through the extension of the current 2012 through 2031 DRP through 2034, with the 2032 through 2034 annual budgets increased at the same rate as the average year in 2018 through 2031 (referred to in the Synapse analysis as the Base Case); and
- Scenario 3: Ramp up to 3% savings relative to annual electric energy usage by year 2019 and maintaining that level through 2034 (referred to in the Synapse analysis as the High Case).

In response to the Board's directives, the rate and bill impact models compare these three scenarios to a fourth scenario: a "No EE Case" that assumes that no new energy efficiency programs are implemented. This is purely a hypothetical case to allow for an illustration of the impact of the Base Case energy efficiency activities relative to a future with no new efficiency investments. There are no new energy savings in this case, no changes to consumption relative to forecasted consumption, and therefore no changes to forecasted rates or bills. The No EE Case is not a forecast of a future that is likely to happen; it is merely a reference scenario.

The rate and bill impact models calculate the difference between these cases to estimate the impacts of one scenario versus another. Specifically, the following scenarios are compared:

- The Base Case to the No EE Case.
- The Low Case to the Base Case.
- The High Case to the Base Case.

Figures 2.1 through 2.4 summarize the program costs and savings associated with each of the three scenarios included in the long-term energy efficiency scenarios modeled by EVT and BED. The savings represent annual incremental savings at the generator, net of free-ridership and spillover impacts, as provided by EVT and BED for purposes of this rate and bill analysis. Costs represent total program costs in constant 2013 dollars, including non-resource acquisition and other costs.[2]

[2] All costs presented in this report are in constant 2013 dollars, unless otherwise noted.

This cost and savings information is helpful for placing context around the rate and bill impact analysis, as the differences in savings and costs in each of the scenarios drive some of the rate and bill impact results when comparing across the scenarios. The figures illustrate the following key points:

- The savings and costs in the Low Case are modestly lower than the savings and costs in the Base Case.
    - For EVT, on average over the 20-year term, savings in the Low Case are about 8% less than the savings in the Base Case, while costs in the Low Case are about 15% less than costs in the Base Case.
    - For BED, on average over the 20-year term, savings in the Low Case are about 6% less than the savings in the Base Case, while costs in the Low Case are about 15% less than costs in the Base Case.

Figure 2.1 EVT Portfolio Savings for the Three Scenarios

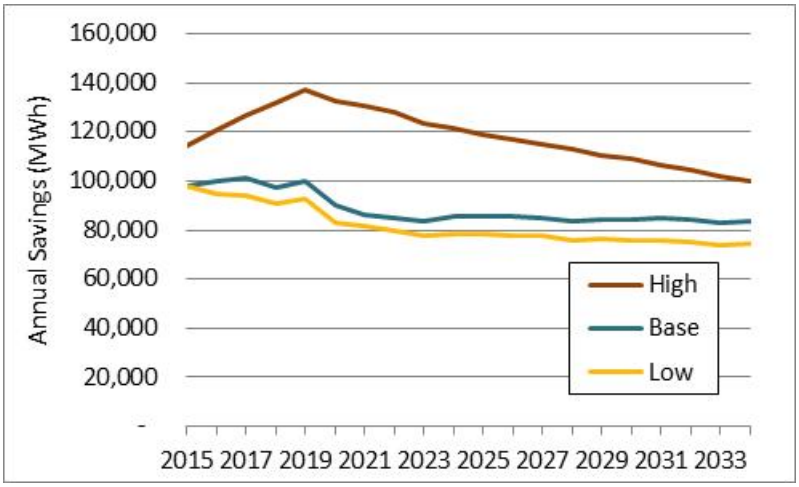
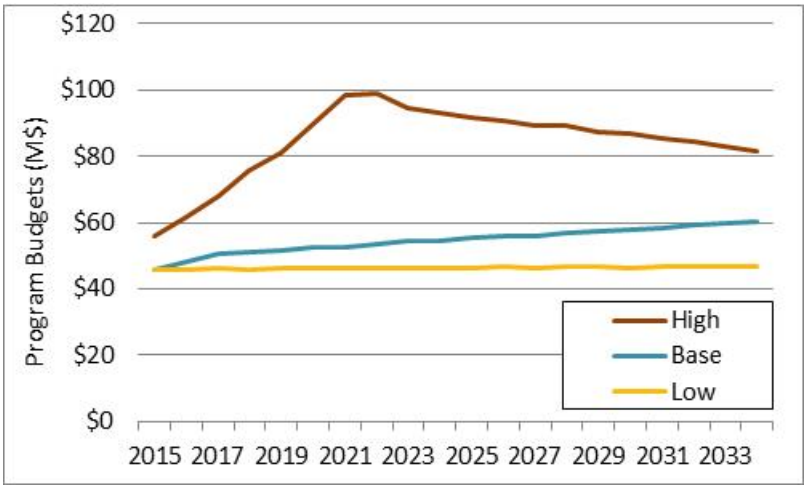


Figure 2.2 EVT Portfolio Energy Budgets for the Three Scenarios



- The savings and costs in the High Case are significantly higher than the savings and costs in the Base Case.

- For EVT, on average over the 20-year term, savings in the High Case are about 33% higher than the savings in the Base Case, while costs in the High Case are about 55% higher than costs in the Base Case.
- For BED, on average over the 20-year term, savings in the High Case are about 67% higher than the savings in the Base Case, while costs in the High Case are about 73% higher than costs in the Base Case.

Figure 2.3 BED Portfolio Savings for the Three Scenarios

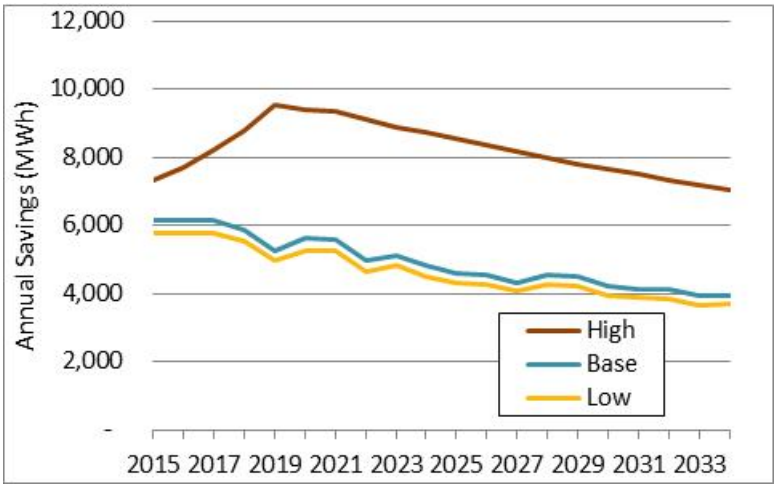
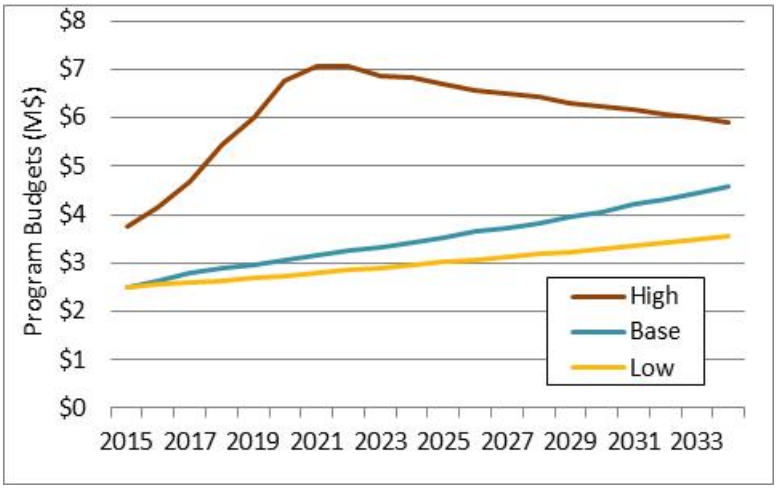


Figure 2.4 BED Portfolio Energy Budgets for the Three Scenarios



2.2. Customer Types

For both EVT and BED, three separate rate and bill impact analyses are provided—one for each customer type. The three customer types correspond to three primary rate classes: residential, commercial non-demand, and commercial demand. The residential programs proposed in the DRPs are used in the residential rate and bill analysis.

The business efficiency programs proposed in the DRPs presented a number of challenges in the rate and bill impact analyses because they serve four different rate classes: commercial non-demand, commercial demand, industrial non-demand, and industrial demand. The efficiency programs do not target rate classes explicitly (nor is it being suggested that they should take such an approach), which made it difficult to separately identify how the rates and bills of the four types of commercial and industrial ("C&I") customers are impacted as a result of the efficiency programs.

To address this concern, two important decisions were made. First, the rate and bill impacts for industrial non-demand and industrial demand customers are not modeled. The limited industrial customers in Vermont have very specific usage patterns and efficiency opportunities. Such an analysis is beyond the scope of this project, as the data availability and specific nature of industrial customers makes it difficult to model or produce their average rate and bill impacts. Some of these larger customers are more likely to participate in energy efficiency programs given the amount they consume, thereby providing greater efficiency opportunities, and because they have dedicated account managers who focus on energy usage and savings.

However, the business energy efficiency programs serve both commercial and industrial customers. In particular, the energy savings are the result of both commercial and industrial customers participating in the efficiency programs. Because of this the commercial models are referred to as the "business non-demand" and "business demand" models.

Second, it was decided that the business programs in the DRPs would be applied in their entirety to both the commercial non-demand and commercial demand analyses. In other words, the business non-demand analysis includes all the costs and all the savings of the C&I efficiency programs, as if all C&I customers were in this rate class. Similarly, the business demand analysis also includes all the costs and all the savings of the C&I efficiency programs, as if all C&I customers were in this rate class. Neither of these scenarios represent what actually happens in practice, because the C&I programs serve both types of customers. Nonetheless, it was deemed that making a distinction between these two rate classes would be useful for indicating the different rate impacts to each, and that this methodology provides a reasonable illustration of the impacts on the two rate classes.

The distinction between business non-demand and business demand customers has more implications for the bill impact analysis than for the rate impact analysis. In general, there are fewer demand participants than non-demand participants, and the demand participants have more efficiency savings on average per project than the non-demand participants. Consequently, taking an average across both types of customers will not be representative of an average participant of either type. This is one of the reasons why the two customer types were not combined into a single average business customer.

Further, as noted throughout this report, it is very difficult to identify and analyze an average commercial customer. Even within the business non-demand class and the business demand class, there is a wide range of customer types, customer usage levels, and customer ability to reduce consumption. These differences make it challenging to estimate and present participant bill impacts in percentage terms.

Given the assumptions described above, all of the bill analyses for business customers should be reviewed with some caution and an understanding that the results are meant to be illustrative, rather than indicate the precise impact on any particular customers' rates and bills.

2.3. Time Periods

There are three time periods used in the rate and bill impact models as referenced throughout this report. They are defined below.

- The base year is the starting year for the analysis. The same value of 2015 is applied in all cases.
- The EE period is the period of time in which efficiency programs are implemented and costs experienced. The same value of 20 years (2015 through 2034) is applied in all cases. This is consistent with the implementation period for the upcoming 20-year plan.
- The study period builds upon the EE period to include the time period for which savings and benefits attributed to the efficiency programs will be experienced. The same value of 38 years (2015 through 2052) is applied in all cases. This builds upon the 20 years of implementation by adding 18 years to fully capture the savings of the measures installed in the first 20 years. This is not to suggest that all measures have a measure life of 18 years. Each measure has its own measure life assumption. However, as the study period assumption is applied to all of the models, a period is selected that is long enough to capture all of the savings from all measures in all sectors. For the purpose of this analysis, measure life is only determined at the customer sector and portfolio levels, and is calculated for each year in the 20-year period by dividing lifetime savings by annual savings.[3] This approach provides an average measure life that is used to estimate the number of years into the future that the annual savings should extend for each year of the EE period.

2.4. Calculating Rate Impacts

Establishing Rates

The rate impact calculations start with current electric rates. This section describes how those current rates are determined, and how they are then forecasted throughout the study period. This exercise provides the rates in the No EE Case.

Determining Current Rates

To determine the rates currently in effect in Vermont, the 2012 billing revenues, sales, and customer counts were reviewed and analyzed. Specifically, this information was used to determine the current customer charge and the current all-in energy charge.

[3] Lifetime savings were not provided by EVT and BED in their long-term energy efficiency scenario models. The EEUs provided lifetime savings at the meter net of free-ridership and spillover for purposes of this analysis.

For EVT, state average billing revenue and data is utilized to determine current rates, while BED's current rates are calculated using its own billing revenue and data.

First, the revenues are converted to 2013 dollars using an actual 2012 to 2013 inflation rate of 1.5%.

Second, the revenue in 2013 dollars is divided by either customers or sales to calculate the two different rates. Specifically, the customer charge is calculated by dividing customer charge revenue by the number of customers in 2012. The all-in energy charge is calculated by dividing the energy and capacity revenue by the sales in 2012.

For business demand customers, a demand rate is also calculated by dividing 2012 capacity revenue in 2013 dollars by 2012 peak kW. This rate, in cents per kW, is converted to cents per kWh. This is done by multiplying the demand rate (in cents per kW) by the average demand volume for commercial demand customers (in kW), providing the dollar amount a commercial demand customer would pay for the demand charge. This dollar amount is then divided by the average energy consumption for the demand customer (in kWh) to provide the rate in terms of cents per kWh.

Unbundling the Energy Charge

As Vermont utilities are vertically integrated, the electricity charge is a bundled rate that includes all rate components. For purposes of the rate and bill analysis, the all-in energy charge described above was broken out into four rate components so that each of the rate components can be adjusted individually. The rate components include a generation charge, a transmission charge, a distribution charge, and a charge for other taxes and fees.[4]

It is assumed that EVT's current all-in energy charge is 58.1% generation, 16.7% transmission, 16.7% distribution, and 8.5% other taxes and fees. It is assumed that BED's current all-in energy charge is 47.7% generation, 12.7% transmission, 25.8% distribution, and 13.8% other taxes and fees. The breakouts are based on electric utilities annual financial reporting, which is based on FERC Form 1.[5] These percentages were applied to the all-in energy charge to determine the different rate components.

Forecasting Electricity Prices

Once current rates are established, rates are forecasted for the study period by applying escalation rates to the generation, transmission, distribution, and demand rate components, as follows:

[4] The transmission charge is intended to capture the New England regional network service transmission costs that are set each year and charged to all of the transmission owners in New England. The distribution charge includes all of the costs that are not included in the other charges.

[5] This annual report provided to the Federal Energy Regulatory Commission ("FERC") includes spending by category and plant investment by category. Expenses that are miscellaneous or not defined are allocated based on the weighted average of main categories. Revenues received from customer service charges are broken out, and the remaining costs are used to calculate the resulting ratios.

- Generation charge. Specific annual growth rates that vary year by year are used to forecast generation costs (and therefore charges). The annual growth rates for generation costs are based on the avoided energy and capacity costs in the 2013 Avoided Energy Supply Costs Study, and are calculated as the annual percent change in avoided wholesale energy and capacity costs.
- Transmission charge. The annual growth rates for transmission costs (and therefore charges) are based on the annual percent change in the forecasted regional network service rates in the ISO New England 2013 Regional System Plan. The values applied are 3% in 2016, 7% in 2017, and 1% annually from 2018 through the end of the study period.
- Distribution and demand charges. The distribution and demand costs (and therefore charges) are assumed to remain constant in real term, i.e., to increase with inflation only. In practice, these charges will only be increased as a result of a rate case. This average annual growth rate assumption implies that there is a rate case every year to adjust rates, which does not happen in practice. Consequently, this rate forecast is a better indicator of long-term trends than of the rates in any one year.
- Customer charge, fees, and taxes. It is assumed that these charges remain constant in real terms throughout the study period. Such charges may increase over time, but not as a result of efficiency programs. The assumption to hold these costs constant could lead to rate and bill impacts that are understated over the long-term.

In the future, actual electricity prices may vary from the forecasts based on these assumptions. Nonetheless, these assumptions provide a reasonable price forecast that can be used for the purpose of benchmarking the impacts of the energy efficiency programs.

Adjusting Rates for Energy Efficiency

This section is divided into three sub-sections. The first section provides background information on how energy efficiency programs impact rates in general. The second section summarizes the approach used to calculate rate impacts from energy efficiency. The final section specifically explains how rates are adjusted for energy efficiency in Synapse's rate and bill analysis.

How Energy Efficiency Impacts Rates

Energy efficiency can lead to increased rates due to the recovery of program implementation costs, as well as to the recovery of lost revenues due to reduced sales. Energy efficiency can also help lower rates by avoiding different types of electricity system costs. There are five different categories of avoided costs: avoided energy costs, price suppression benefits, avoided capacity costs, avoided transmission costs, and avoided distribution costs.

Both the costs and benefits from energy efficiency have different impacts on each of the different rate components. Typically, energy efficiency increases rates due to program implementation costs and recovery of lost revenue. Energy efficiency also decreases rates due to avoided cost benefits.

The costs and benefits are forecasted for the EE period to identify the impact on rates over the long-term. The costs and benefit for the efficiency programs proposed in the Base, Low, and High Cases differ from each other, which leads to different rate impacts for each scenario.

Overview of Methodology: Top Down versus Bottom Up

Energy efficiency rate impact analyses (to the extent that they are done at all) typically calculate rate impacts using a method we refer to as a "Top Down" approach. This means that rates prior to energy efficiency impacts are determined by dividing pre-efficiency costs over pre-efficiency sales to produce a rate. Then, a post-energy efficiency rate is calculated to include the impacts of energy efficiency, which uses the same approach (i.e., costs divided by sales provides a rate). The difference between the rates pre- and post-efficiency provides the rate impact. This is a conventional approach, and is the approach used by VEIC in their review of energy efficiency rate and bill impacts in the last DRP (Vermont Energy Investment Corporation 2011, pp 15-16).

This Top Down approach is useful in that it provides a simple and transparent methodology to illustrate rate impacts. However, this approach is limited in that it oversimplifies how rates are determined in practice, and how they are affected by energy efficiency. In particular, the Top Down approach overstates the recovery of lost revenues, because it essentially assumes that all post-efficiency revenues are recovered in the post-efficiency price, when this does not necessarily occur in practice.

In order clarify this point it is useful to provide a little background on prices and the recovery of lost revenues. Energy efficiency reduces electricity sales, and thereby also reduces utility revenue. In general, the sales levels used to set electricity prices do not account for future efficiency savings. Therefore, when efficiency programs reduce the sales to levels below what was assumed when prices were set, the utility will experience "lost revenues."

The extent to which these lost revenues will eventually be recovered in rates depends upon several factors. For example, if a utility is allowed revenue decoupling, then it can essentially recover lost revenues through the decoupling adjustment. If a utility has frequent rate cases, then it will have significantly less lost revenues, because lost revenues occur in the years between rate cases. If a utility is able to sell some of its owned generation or if its contracted power is freed-up because of energy efficiency savings, then it may be able to offset some or all of its lost revenues from ratepayers with new revenues from other sources.

In addition, the extent to which these lost revenues need to be recovered in rates also depends on some important factors. If all of a utility's costs were variable costs, then lost revenues would not create a problem and would not need to be recovered in rates. That is, if all costs were variable, then savings from energy efficiency would reduce costs and reduce revenues by a comparable amount, and the utility would be financially neutral – generally speaking.

But all of a utility's costs are not variable; a portion of them are fixed. A utility needs to be able to recover a portion of the lost revenues sufficient to pay for its fixed costs. Therefore, the amount of lost revenues that needs to be recovered in rates is based on that portion of revenues that is necessary to recover fixed costs.

Returning now to the Top Down approach, this methodology does not distinguish between fixed and variable costs. It assumes that *all* costs that remain in place in the efficiency scenario (after adding in efficiency costs and removing avoided costs) are recovered in rates. Consequently, it overstates the recovery of lost revenues, because not all of the revenues that are "lost" need to be recovered. Only the

lost revenues associated with fixed costs in rates need to be recovered. This is especially true for the generation component of rates, which is also the largest single component of rates. A large portion of generation costs are variable, and therefore does not need to be recovered when sales are reduced by energy efficiency savings.

Note further that generation prices are not actually determined the way that is implied by the Top Down approach (even if a utility were to have a rate case every year). In practice, generation prices are based on generation costs, which may be based on some combination of owned-power plants, bi-lateral purchases, and purchases from the wholesale energy markets. Some Vermont utilities have a fuel and purchased power adjustment charge that allows variable energy prices to flow straight through to customers. These generation costs that flow through the fuel and purchased power charges do not result in lost revenues when efficiency savings reduce sales, because they are entirely variable costs.

Given the limitations and the over simplicity of the Top Down approach, an alternative approach is used in this report to calculate rate impacts; something that we refer to as a "Bottom Up" approach. The rationale behind the Bottom Up approach is to more accurately reflect the way that rates are actually calculated and affected by efficiency programs. Specifically, the impact of energy efficiency on each component of rates is isolated and analyzed, including both avoided costs and lost revenue components. The methodology for estimating the impact on each rate component is described below.

- Generation. The Vermont electric utilities rely upon several sources for their generation, including owned power plants, bi-lateral purchases, and purchases from the New England electric wholesale market. Therefore, generation rates are based on a combination of market prices, supply contracts, and utility-owned generation. The generation rate is affected both by avoided capacity costs as well as price suppression effects. It is assumed that there are no lost revenues associated with generation costs. This is clearly a simplifying assumption because a portion of generation costs might be fixed – the extent to which this is true depends upon whether the generation is based on owned power plants, bi-lateral purchases (and the type of contract), or market purchases. On the other hand, a Vermont utility might be able to sell generation to make up for some or all of the generation revenues lost from ratepayers. It is assumed here that there are no lost revenues associated with generation costs, for simplicity purposes, and to be able to apply a consistent approach throughout the analysis. Therefore, the post-efficiency generation rate is estimated as the pre-efficiency generation rate, less capacity avoided costs, less energy and capacity price suppression effects.

- Transmission. Transmission rates for pool transmission facilities are set for the entire New England region. Each load serving entity in New England pays the same charge for pool transmission facilities. This New England network transmission charge is updated each year, to reflect annual changes to costs and sales levels. In this way, any lost transmission revenues from one year are corrected for in the following year, and thus are mostly recovered. (This is comparable to having a rate case every year). In addition, efficiency also helps avoid future transmission investments, so transmission rates are reduced by avoided transmission costs. Therefore, the post-efficiency transmission rate is estimated as the pre-efficiency transmission rate, plus transmission lost revenue, less transmission avoided costs.

- Distribution. Distribution rates for Vermont utilities are set through periodic rate cases. In general, distribution costs are mostly fixed, which means that energy efficiency savings will result in lost distribution revenues. The extent to which any one utility in Vermont will recover these lost revenues will depend upon several factors, such as how frequently the utility has a rate case or whether a utility is allowed a decoupling adjustment. For simplicity purposes, and to be able to apply a consistent approach throughout the analysis, it is assumed here that utilities have rate cases every year, which allows them to recover all distribution lost revenues. This is clearly a simplifying assumption, which is likely to overstate the rate impacts associated with distribution rates, in some instances. The post-efficiency distribution rate is estimated by applying the Top Down approach to the distribution costs and sales. In other words: (a) the post-efficiency distribution costs are equal to the pre-efficiency distribution costs minus avoided distribution costs; (b) the post-efficiency sales are equal to the pre-efficiency sales minus the efficiency savings; and (c) the post-efficiency price is equal to the post-efficiency distribution costs divided by post-efficiency sales.

- EE charge. The EE charge is estimated as the total efficiency costs for a customer sector divided by the customer sector's post-efficiency sales. There are no efficiency costs in the No EE Case.

- Customer charge. The customer charge is a fixed dollar-per-customer charge and therefore is not affected by reduced sales. Consequently, this charge is assumed to be the same in all cases.

- Other charges. Other charges, such as for taxes, are assumed to be not affected by reduced sales. Consequently, this charge is assumed to be the same in all cases.

This Bottom Up approach to calculate rate impacts from energy efficiency programs in this study is described in more detail in the following section.

Calculating the Rate Adjustments from Energy Efficiency

To develop a forecast of future rates for the Low, Base, and High Cases, the different impacts from energy efficiency are accounted for separately. Each rate adjustment affects each rate component differently. How each rate adjustment is added to the different rate components and the effect that each rate adjustment has on the rate components is identified below.

Specifically, this section explains in detail how post-efficiency rates are determined for the energy efficiency charge, generation charge, transmission charge, distribution charge, other charge, and the customer charge. All of these charges are summed together to produce a total adjusted rate.

Gross Sales, Net Sales, and Savings

The assumptions used to estimate gross and net sales are essential to understanding how rates are adjusted for efficiency. We use the term "gross" sales to refer to sales without the energy efficiency savings included (pre-efficiency), and "net" sales to refer to sales after the efficiency savings are included (post-efficiency).

The 2015 through 2034 gross sales for EVT are from VELCO forecasts, using the No Demand Side Management Sales Forecast. The 2015 through 2034 gross sales for BED are from its 2012 Integrated Resource Plan. For years beyond 2034, gross sales are projected using the average annual percent change in sales in the last five years of the forecast provided (i.e., 2029 through 2034). Gross sales are the same in all four of the efficiency scenarios.

The energy and capacity savings information included in the modeled scenarios for each year are used throughout the rate and bill analysis, including calculating the difference between gross and net sales. The savings are used at both the customer sector and program levels, depending on the analysis, as identified throughout this report.[6] The analysis considers savings at the meter that are net of free-ridership and spillover, rather than gross savings or savings at the generator level.[7] Because savings are determined at the meter, line loss values are applied to the avoided cost estimates discussed below to account for the line loss benefits associated with efficiency programs.

In the Base, Low, and High Cases, net sales are equal to the gross sales minus the customer sector's energy savings in each of the respective efficiency scenarios. For each of these cases, streams of energy savings for each year in the EE period are produced through the duration of the sector's average measure life.[8] Energy savings are summed across implementation years during the study period and subtracted from the gross energy sales forecast to derive the net energy sales forecast. In the No EE Case, net sales are equal to the gross sales since there are no energy savings in this case.

Energy Efficiency Charge

Ratepayers are the only funding source for electric energy efficiency in Vermont. Therefore, the electric energy efficiency costs to ratepayers are equal to the total energy efficiency budget. Efficiency budgets are the sum of resource acquisition costs and non-resource acquisition and other costs.

EVT and BED provided the resource acquisition costs for the Base, Low, and High Cases as part of their long-term energy efficiency scenario models. The costs were provided in 2015 dollars, and so were converted to 2013 dollars using the same annual inflation rate (2%) applied to the 20-year electric scenario modeling results filed in the current DRP Proceeding.

[6] Note that residential and business savings are included in each other's models, as it is necessary to sum savings across sectors to appropriately evaluate price suppression effects (as discussed below).

[7] Note that the savings provided by EVT and BED in their long-term energy efficiency scenarios are at the generation level, not at the meter level. BED directly provided at the meter savings for purposes of the rate and bill impact analysis. EVT provided line loss factors for converting generation level savings to meter level savings. The line loss factors provided by EVT are 10.05% for winter peak, 9.07% for winter off-peak, 10.22% for summer on-peak, and 7.99% for summer off-peak. On average, generation level savings were decreased by approximately 8.6% to determine meter-level savings.

[8] The average measure life is estimated annually on a customer sector basis, and is calculated by dividing lifetime savings by annual savings.

The Department provided the NRA and other costs, which include non-resource acquisition costs, operations fees, evaluation costs, fiscal agent costs, and audit funds. At the time this rate and bill analysis was conducted, NRA and other costs had not yet been estimated for the 2015 through 2034 DRP. The NRA and other costs associated with the 2012 through 2031 DRP were used instead. These costs were provided in nominal dollars, so were converted to 2013 dollars using the real inflation rate for 2012 (2.1%) and for 2013 (1.5%), and then a 2% annual inflation rate was applied for the reminder of the EE period.

The total energy efficiency costs (the sum of program budgets and NRA and other costs) were divided between the residential and C&I customer sectors consistent with how costs are collected from the two customer sectors in rates, which differs from how costs are actually spent on the customer sectors. The total efficiency costs are divided between customer sectors based on the Board's recommended sector split schedule. EVT's NRA and other costs are divided 49% to residential and 51% to business, while BED's NRA and other costs are divided as 25% to residential and 75% to business, consistent with revenue collections breakdowns for each utility.

The final energy efficiency charge is calculated by dividing the customer sector's costs by the sector's net sales for each year in the EE period. It is included in the model as an individual rate component, and has the effect of increasing rates.

Generation Charge

The steps used to calculate generation rates post-efficiency are as follows: determine the initial generation rate prior to efficiency effects, determine rate impacts from avoided capacity and from price suppression, and then subtract from the initial rate the avoided capacity and price suppression rate impacts. Each of these steps is described below.

First, generation rates prior to efficiency effects are determined as described in the Establishing Rates section above. The initial generation rates are the same across all four cases for each customer type.

Second, the rate impacts of avoided capacity and price suppression are determined. For avoided capacity, the dollar benefits associated with avoided capacity costs are calculated by multiplying the avoided capacity cost rates by the customer sector's annual demand savings in each efficiency scenario for each year. The avoided capacity costs rate are the Vermont-specific avoided capacity cost rates, in constant 2013 dollars, as reported in the 2013 AESC Study. A line loss factor of 2.32% is applied to the avoided capacity costs rate, based on the line losses from the ISO distribution point at which avoided costs are calculated, as approved by the PSB. The avoided capacity benefits in dollars are divided by net energy sales for the customer sector to provide an avoided capacity cost rate impact.

Similarly, benefits from energy and capacity price suppression are determined. The price suppression values are based on the Vermont-specific 2015 vintage intrastate Demand Reduction Induced Price Effect ("DRIPE") values, in constant 2013 dollars, as reported in the 2013 AESC Study.

For capacity price suppression, the capacity DRIPE values in the 2013 AESC Study are multiplied by annual demand savings for the customer sector in each efficiency scenario for each year to provide the dollar benefits associated with capacity price suppression.

For energy price suppression, a weighted average energy price suppression rate is calculated for each year from 2015 to 2043 by weighting the winter peak, winter off-peak, summer peak, and summer off-peak intrastate value for 2015 vintage measures using residential load shapes in the residential model and business load shapes in the business models.[9] This rate is multiplied by the customer sector's cumulative energy savings in each year to provide the dollar benefits associated with energy price suppression.

The dollar benefits for energy and capacity price suppression are summed together and then divided by the net energy sales for all sectors to provide a price suppression rate impact. The sales for all sectors are used because price suppression affects rates across all customer sectors, not just the customer type that is being analyzed.

The rates used for both the avoided capacity costs and price suppression benefits are extended through the study period in the same way. This is done by averaging the previous five years' annual rate of increase in avoided costs and applying it to the previous year's avoided cost rate. For example, the avoided capacity costs in 2044 are determined by taking the average annual increase in avoided capacity costs from 2038 through 2043, and increasing the 2043 avoided capacity cost value by that value.

Finally, the avoided capacity and price suppression rates are subtracted from the initial generation rate to provide the post-efficiency generation rate. Both the avoided capacity and price suppression rates decrease the initial generation rate.

Transmission Charge

The steps used to calculate post-efficiency transmission rates are very similar to the steps taken to calculate post-efficiency generation rates. Specifically, the steps are to determine the initial transmission rate prior to efficiency effects, determine a rate for avoided transmission, determine a rate for transmission lost revenue, and then subtract from the initial rate the avoided transmission rate and add the transmission lost revenue. Each of these steps is described below.

First, transmission rates prior to efficiency effects are determined as described in the Establishing Rates section above. The initial transmission rates are the same across all four cases for each customer type.

Second, rate impacts are determined for avoided transmission and for transmission lost revenue. For avoided transmission, the dollar benefits associated with avoided transmission costs are calculated by multiplying the avoided transmission cost impacts by the customer sector's annual demand savings in each efficiency scenario for each year. The avoided transmission cost rate impacts are the Vermont-

[9] The load shapes were provided by EVT for purposes of this analysis, for the both residential and business sectors. The same load shapes are used in the EVT and BED analyses.

specific transmission avoided cost rates of $48 per kW-year in 2012 dollars for both EVT and BED, as approved by the Board.[10] The values are converted to 2013 dollars using an actual 2012 to 2013 inflation rate of 1.5%. A line loss factor of 10.29% is applied to the avoided transmission cost rate, based on the line losses from the ISO distribution point at which avoided costs are calculated, as approved by the PSB. The avoided transmission benefits in dollars are divided by net energy sales for the customer sector to provide an avoided transmission cost rate impact.

The transmission lost revenue recovery rate impact is calculated by first determining the transmission costs (in dollars) required after efficiency impacts. To do this, the pre-efficiency transmission costs are calculated by multiplying the pre-efficiency transmission rate component by the customer sector's pre-efficiency energy sales. Then, the avoided transmission costs (in dollars) are subtracted from the pre-efficiency transmission costs to provide the transmission costs after efficiency.

Then the post-efficiency transmission costs are divided by net energy sales, and also by gross energy sales. The difference between these two ratios provides the transmission lost revenue rate (in cents per kWh). Finally, EVT's and BED's share of regional demand is applied to this rate. This formula assumes that Vermont is responsible for only its share of the regional transmission costs, which is defined as its share of regional demand. As applied in the modeling, EVT's share of regional demand is 3.89% and BED's is 0.26%. This is the average 120 month 50/50 forecast of EVT's and BED's share of monthly demand. Although changes are anticipated in the share of regional costs allocated to Vermont due to the significant ramp up of energy efficiency in Vermont and in other states in the region, this assumption is held constant as changes to this assumption are not expected to have a significant impact on the results of this analysis.

Finally, the avoided transmission rate is subtracted from the initial transmission rate while the transmission lost revenue recovery is added to it, which provides the post-efficiency transmission rate. The avoided transmission cost decreases the initial transmission rate, while the transmission lost revenue recovery increases it.

Distribution Charge

The distribution charge is calculated differently from the generation and transmission charges. It is assumed that distribution costs are primarily fixed costs, and that utilities will need to recover the distribution lost revenues in order to recover their fixed distribution costs. The method described below for calculating the distribution charge is based on the presumption that all of the Vermont electric utilities will be able to collect distribution lost revenues immediately. In other words, the Top Down methodology for calculating rate impacts is applied to the distribution portion of rates.

Vermont electric utility distribution rates are not all treated this way in practice. Green Mountain Power has an alternative regulation structure that allows for most of the lost revenue to be recovered. The

[10] See 2013 AESC Study, Exhibit G-1, Summary of Electric Utilities' T&D Cost Survey.

other electric utilities do not have such a mechanism, and thus will not recover lost revenues in the way that it has been modeled. Nonetheless, this methodology is reasonable for purposes of these analyses, and is used for simplicity and consistency throughout the analyses.[11]

Note that to the extent that distribution rate adjustments do not allow for recovery of distribution lost revenues, the estimate of distribution rate impacts will be overstated, perhaps significantly. Therefore, when interpreting the results of this analysis, it is important to recognize that the estimates of rate increases may be somewhat overstated, and the estimates of bill reductions may be comparably understated.

The post-efficiency distribution charge is calculated by first determining post-efficiency distribution costs. To do this, both the pre-efficiency distribution costs and the benefits for avoided distribution costs need to be determined, as explained below. The avoided distribution cost benefits are subtracted from the pre-efficiency distribution costs to provide the post-efficiency distribution costs. The post-efficiency distribution costs are divided by net sales to provide the post-efficiency distribution charge.

The pre-efficiency distribution costs are the distribution rates prior to efficiency effects (as described in the Establishing Rates section above) multiplied by the customer sector's gross energy sales.

The dollar benefits associated with avoided distribution costs are calculated by multiplying the avoided distribution cost rates by the customer sector's annual energy savings in each efficiency scenario for each year. The analysis uses Vermont-specific distribution avoided costs of $110.09 per kW-year for EVT and $0 per kW-year for BED in 2012 dollars as approved by the PSB.[12] The values are converted to 2013 dollars using an actual 2013 inflation rate of 1.5%. A line loss factor of 10.29% is applied to the avoided distribution cost rates, based on the line losses from the ISO distribution point at which avoided costs are calculated, as approved by the PSB.

Other Charge

The other charge is not affected by energy efficiency programs, and therefore experiences no change as part of the rate and bill analysis.

The other charge is calculated as described in the Establishing Rates section above (i.e., 8.5% of EVT's all-in energy charge, and 13.8% of BED's all-in energy charge). This rate is held constant (in real terms) throughout the study period.

Customer Charge

The customer charge is not affected by energy efficiency programs, and therefore experiences no change as part of the rate and bill analysis.

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[11] Note that this methodology is more realistic than using the Top Down approach to estimating rate impacts, which essentially assumes that *all* components of electricity rates are decoupled.

[12] See 2013 AESC Study, Exhibit G-1, Summary of Electric Utilities' T&D Cost Survey.

The customer charge is calculated as described in the Establishing Rates section above (i.e., customer charge revenue divided by number of customers). This provides a rate in dollars per month, which is converted to dollars per kWh by dividing it by the average monthly consumption for the customer type. This rate is then held constant (in real terms) throughout the study period.

2.5. Calculating Bill Impacts

How Energy Efficiency Impacts Bills

In general, program participants experience most of the direct benefits of efficiency programs through reduced bills. By participating in energy 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 from lower electricity consumption. The combination of reduced electricity consumption and the rate impacts discussed above provide the bill impact for program participants.

By not installing efficiency measures, non-participants electricity consumption is unchanged from efficiency programs. A non-participant's bill is only impacted by the rate impacts. Therefore, a non-participant experiences bill impacts that are proportional to the rate impacts.

To address the different bill impacts customers may experience, the rate and bill impact analysis models three types of customers: non-participants, program participants, and average customers. As the names imply, a non-participant does not participate in any efficiency program, a program participant participates in at least one energy efficiency program, and average customers represent an average bill across all customers.

The rates for these three types of customers are the same within each scenario. Across each scenario, rates vary due to differences in efficiency costs and savings.

Average Monthly Consumption

Before determining a bill impact from efficiency, the initial consumption level for an average customer within each of the customer types (i.e., residential, business non-demand, business demand) is determined. The initial average monthly consumption is the same in each of the efficiency scenarios, and for the three types of participants modeled (i.e., participant, non-participant, average customer). The initial average monthly consumption is calculated differently for residential and business customers.

For residential customers, the customer average monthly usage is determined based on historical customer consumption patterns, as provided by EVT and BED for purposes of this rate and bill impact analysis. Two different consumption levels are applied for residential: one for residential and one for multi-family or low income customers. For EVT, it is assumed that residential customers use 574 kWh a month, and residential multi-family or low-income customers use 430 kWh a month. For BED, it is assumed that residential customers use 415 kWh a month and residential multi-family or low-income customers use 354 kWh a month.

For business customers, commercial and industrial customers present a wide range of monthly consumption patterns. Therefore, it is much more difficult to define a "typical" or even an average commercial or industrial customer compared to residential monthly consumption. To address these challenges, example customers were selected to represent the business non-demand and business customer types.

Two different consumption levels are applied for business non-demand and business demand-customers: one for business customers and one for business new construction customers. The following assumptions were made for business consumption levels:

Business Customers' Average Monthly Consumptions	Unit	EVT	BED
Non-Demand Energy	kWh	8,083	8,083
Non-Demand New Construction Energy	kWh	12,125	16,167
Demand Energy	kWh	23,052	11,526
Demand Capacity	kW	75	75
Demand New Construction Energy	kWh	34,578	23,052
Demand New Construction Capacity	kW	75	75

Non-Participant Bill Impacts

In both the residential and business analyses, non-participants experience bill impacts that are proportional to the rate impacts. For example, if rates are expected to increase by 1% on average over the long-term, then non-participants' bills will also increase by 1% on average over the long-term. In all scenarios, non-participant monthly savings are assumed to be zero; therefore, the non-participant monthly consumption is unchanged and is the same in all four efficiency scenarios. Non-participant monthly bills are calculated by multiplying the adjusted rate in each scenario by the monthly consumption.

Participant Bill Impacts

Program participants experience bill impacts that are the combined effect of the rate impacts and the decrease in energy consumption as a result of the efficiency savings. For example, if rates are expected to increase by 1% on average over the long-term, and the customer participates in an efficiency program that is expected to reduce energy consumption by 7% on average over the long-term, then the participants' bills will be reduced by 6% on average over the long-term.

To calculate a program participant's bill, average monthly energy savings for a typical participant are calculated for each program. These average energy savings are subtracted from a customer's initial monthly consumption (explained above) to provide the participant's new monthly consumption. The participant's new monthly consumption is multiplied by the adjusted rate in each efficiency scenario to provide the participant's monthly bill.

To determine the participant's bill impact, the participant's new bill is subtracted from the bill of a non-participant. The differences in participant bills between the No EE, Base, Low, and High Cases are due to different savings per participant by program and different adjusted rates.

In general, the savings per participant is calculated by dividing the program's annual energy savings by its participants in each year, and then dividing again by 12. Because the different efficiency scenarios assume different savings and participation levels, the savings per participant are different in each scenario.

However, the one important exception to this calculation is that the savings per participant for a business non-demand participant in the Existing Facilities program are determined using a different method. An analysis of a business participant's bill impacts is significantly more challenging than for the residential participant. Because commercial and industrial customers present a wide range of monthly consumption patterns, they have different efficiency opportunities, so the energy efficiency programs provide various levels of savings per participant.

To address this concern, the bill impact analysis for a business participant focuses on one example participant: a non-demand customer (a small grocery store in this instance) that participates in the Existing Facilities program. This example customer saves 8,280 kWh (about 9%) annually through the life of the measures installed (approximately 12 years for EVT's Base Case) after participating in the Existing Facilities program. This one example participant is meant to provide an illustration of how this type of customer's bill might be affected from participating in the Existing Facilities program.

It is also important to note that no adjustments were made to business demand customer's demand usage (in kW) as a result of efficiency savings, due to insufficient information about how much a typical customer's peak consumption would decline as a result of energy efficiency. This understates the business demand customers' bill savings, because many efficiency programs and measures will reduce peak demand usage. This is an important conservatism in our methodology that should be remembered when reviewing the bill impact results of the business demand customers.

Average Customer Bill Impacts

For the average customer, the bill impacts represent an average across all customers within each customer type. It is important to note the average customer does not represent a specific customer. Instead, it is intended to provide an indication of how customer bills on average are affected by the energy efficiency programs.

The average customer bill impacts are estimated using the same methodology as described above for participant bill impacts. The bills in the efficiency cases are calculated by multiplying the relevant customer monthly usage (incorporating the efficiency savings) by the relevant electricity rate (incorporating the efficiency rate impacts). These bills are then compared to the bills in the respective efficiency scenarios.

However, while the savings per participant used in the participant bill impact analysis are based on the specific savings and participants in each program, a different approach is needed to determine the savings per average customers. This is calculated by dividing the customer sector's annual energy savings by the number of customers within that customer sector.

As noted above, the business non-demand and demand analyses assume that the business program costs and savings apply either entirely to non-demand customers, or entirely to demand customers. Because of this approach, the saving per average customer is the same for both customer types, which likely overstates non-demand customers' savings and understates demand customers savings (assuming that there are fewer demand participants than non-demand participants, and that the demand participants save more on average per project than the non-demand participants). An average across both types of customers will not be representative of an average participant in either scenario. This is an important assumption to remember when reviewing the average business customer bill impacts.

The 2015 through 2034 residential customer counts for EVT are from VELCO forecasts, and for BED are from its 2012 Integrated Resource Plan. For years beyond 2034, residential customer counts are projected using the average annual percent change in customer counts in the last five years of the forecast provided (i.e., 2029 through 2034). Customer counts are the same in all four of the efficiency scenarios.

2.6. Participation Impacts

As customers that participate in energy efficiency programs have lower bills than customers that do not participate, the breadth of customer participation is a key component in understanding a rate and bill impact analysis.

To analyze participation, the historical (i.e., 2002 through 2012) program participants are reviewed from EVT's and BED's annual reports. In both of their annual reports over the years, EVT and BED have noted that participants are counted by summing unique physical locations (sites, as defined by the EEU) where efficiency measures have been installed and verified for the reporting period. For multifamily projects, participants are counted by summing the number of individual dwelling units.

The future levels of program participation are also reviewed. For the purposes of the rate and bill analysis, EVT and BED provided program level participants for each year and for each of the three efficiency scenarios in their modeled scenarios. Where information was not available, such as with participants for certain EVT programs, participants are extrapolated based on values in 2012 and/or historical program averages.

Specifically, EVT provided participant information for Residential New Construction, while BED provided participant estimates for all programs. For EVT's Residential Existing Homes and Residential Efficient Products programs, participants were projected using the same savings per participant as achieved in 2012. For EVT's Business New Construction and Business Existing Facilities programs, participants were projected using the same cost per participant as achieved in 2012.

Holding these assumptions constant throughout the 20 year period leads to implausible results, as discussed in more detail in the Program Participation section below. For the business programs especially, it is more likely that the cost per participant will increase over time, as hard-to-reach customers are targeted and repeat participants exhausts the more cost-effective efficiency opportunities. Holding these assumptions constant throughout leads to participant estimates that are significantly overstated. This is especially true given that customers repeat in multiple programs multiple times over the course of the 20 year period.

It is difficult to accurately quantify participants, especially when accounting for repeat participation across programs and across years. Customers frequently participate in multiple programs in a single year, and will also participate in programs in more than one year over time. For example, many customers participate in the Efficient Products program and the Existing Homes program. This is an important consideration to remember when reviewing bill impacts as well as participation impacts.

Annual participation levels are summed to determine cumulative participation over the historical and future periods. The program level cumulative participants are then divided by the customers that are eligible to participate in each of the respective programs. The cumulative participation rate is assessed historically and for each of the three efficiency scenarios.

Eligible customers for each program are defined below.

- Residential New Construction: Includes all residential customers. This approach overstates the amount of eligible customers, and thereby underestimates the cumulative participation rate. The historical and projected new building starts in Vermont were considered as an alternative estimate of eligible participants, but that approach included too much uncertainty.

- Residential Existing Homes: Includes all residential customers. This approach is likely reflective of the customers that are actually eligible to participate in the program, although low-income customers and participation may need to be considered in more detail, which is beyond the scope of this project.

- Efficient Products: Includes all customers. This approach is likely reflective of the customers that are actually eligible to participate in the program. However, as discussed in more detail later in the report, the participation results especially for EVT indicate that there are more participants in the program than there are customers. This could be due to how participants are counted, how eligible participants are counted, and repeat customer participation over the years.

- Business New Construction: Includes all commercial and industrial customers. Similar to Residential New Construction, this approach overstates the amount of eligible customers, and thereby underestimates the cumulative participation rate. The historical and projected new building starts in Vermont were considered as an alternative estimate of eligible participants, but that approach included too much uncertainty.

- Business Existing Facilities: all commercial and industrial customers. This approach is likely reflective of the customers that are actually eligible to participate in the program.

The split between commercial and industrial customers and participation may need to be considered in more detail in future analyses.

In order to produce an accurate representation of the percentage of customers that participate in programs, it is necessary to account for those customers that participate in more than one program, both within a year and across years. However, this analysis has not been able to account for those customers that participate in more than one program, either within a year and/or across years. Therefore, these participation rates presented in this report likely overstate actual participation rates, particularly for the Efficient Products Program.

3. RATE & BILL IMPACT RESULTS OVERVIEW

Sections 4 and 5 provide the results of the Synapse rate and bill analysis using both EVT's and BED's energy efficiency data and information. These sections are structured to review the results for residential, business non-demand, and business demand customers. Within each customer type section, the rates and bills are presented for both for the Base Case relative to the No EE Case, as well as compared across all scenarios.

Before diving into the results, it is helpful to present background information on the figures shown within each customer type. This background information is presented once here simply to avoid duplication within each of the customer type sections for both BED and EVT (e.g., six times). There are a number of important points made here that should be considered when reviewing the specific results within each customer type section. The specific results are discussed in more detail within each customer sector.

Base Case vs. No EE Case: Rate Figures

Two figures are presented that summarize the rate impacts from the Base Case relative to the No EE Case: the Rate Impacts by Component figure (Figures 4.1. 4.8, and 4.15 EVT, and 5.1, 5.8, and 5.15 for BED), and the Net Rate Impacts figure (Figures 4.2, 4.9, and 4.16 for EVT, and 5.2, 5.9, and 5.16 for BED).

The Rate Impacts by Component figures provide the rate impact of comparing the Base Case to the No EE Case over the entire study period (i.e., 2015 through 2043). These figures provide the rate impact by each rate component that is affected by the energy efficiency programs, in terms of cents per kWh. The Net Rate Impacts figures present the net impacts of all the components combined, in terms of percent change in rates.

Efficiency costs are incurred through 2033, while the benefits and lost revenue from those investments extend through 2043 because the average measure life for measures is 10 years in the final year of the DRP. The rate impacts decrease significantly after 2034, when the energy efficiency costs are no longer included in rates.

Both figures also present the average long-term rate impacts with a dashed black line. The average long-term rate impact represents the average impact over all the years of the study period, capturing both the upward and downward impacts on rates. The average long-term rate accounts for rates in 2015 through 2043.

As indicated in the Rate Impacts by Component figures, the transmission lost revenue recovery, distribution lost revenue recovery, and energy efficiency charge contribute to the rate increases, with the energy efficiency charge making up the majority of the rate increase. As noted above, the estimates of distribution lost revenue are overstated because it is assumed for simplicity that all Vermont electric

utilities have decoupled distribution rates, which is not the case. Consequently, the rate impacts are likely to be lower than those presented here.

The price suppression, avoided transmission costs, avoided distribution costs, and avoided capacity costs contribute to the rate decreases, with avoided capacity costs and avoided distribution costs making up the majority of the rate decrease. The price suppression effect has a very small impact on the rates in Vermont, primarily because Vermont makes up a relatively small portion of the New England system.

Base Case vs. No EE Case: Bill Figures

While all customers will experience the rate impacts described within each customer type section, different customers will experience different bill impacts, depending upon whether they participate in any of the efficiency programs, and which program they participate in. Therefore, the bill impacts are estimated separately for several types of residential and business programs offered by EVT.

Business customers typically range in size with differing consumption patterns. Business customers can range from a small "mom and pop" store to a big box store to a large industrial facility. Such a range of consumption patterns makes it especially challenging to identify an average customer, and therefore an average program participant. While non-demand business participants are likely to be smaller customers with smaller consumption than large industrial facilities, there is still a range of program participation options available to such customers, from small prescriptive projects to complex custom projects.

Nonetheless, example participants have been evaluated to provide an illustrative example of how a participant's bill might be affected from participating in the business efficiency program. This analysis is by no means intended to represent the typical bill impact a business customer will experience from the energy efficiency long-term scenario analyses.

Two figures are presented that summarize the bill impacts from the Base Case relative to the No EE Case: the Average Monthly Consumption Impacts figure (Figures 4.3, 4.10, and 4.17 EVT, and 5.3, 5.10, and 5.17 for BED), and the Average Monthly Bill Impacts figure (Figures 4.4, 4.11, and 4.18 EVT, and 5.4, 5.11, and 5.18 for BED).

The Average Monthly Consumption Impacts figures present the average monthly energy savings for a typical participant in each of the programs (either residential or business), in terms of percent change in monthly consumption. The Average Monthly Bill Impacts figure presents the average monthly bill impacts for a typical participant in each of the programs (either residential or business), in terms of percent change in monthly bills. The energy savings in the Average Monthly Consumption Impacts figures combined with the rate impacts provide the total bill impact presented in the Average Monthly Bill Impacts figures.

Both of these figures present the impacts on all customers on average, while the Average Monthly Bill Impacts figures also provide the bill impacts of non-participants. The results presented in both figures include the average energy savings and bills savings over the entire study period.

4. EFFICIENCY VERMONT RESULTS

4.1. Residential

Base Case vs. No EE Case

Rate Impacts

As indicated in Figures 4.1 and 4.2, the highest net rate impact is experienced in 2017 at 1.2 cents per kWh or 7%, whereas over the study period, the average rate increase is 0.8 cent per kWh or 3%. In later years, the savings in rates from avoided costs are enough to offset the rate increases from lost revenue, such that there are net rate decreases.

Figure 4.1 EVT Residential Rate Impacts by Component (c/kWh)

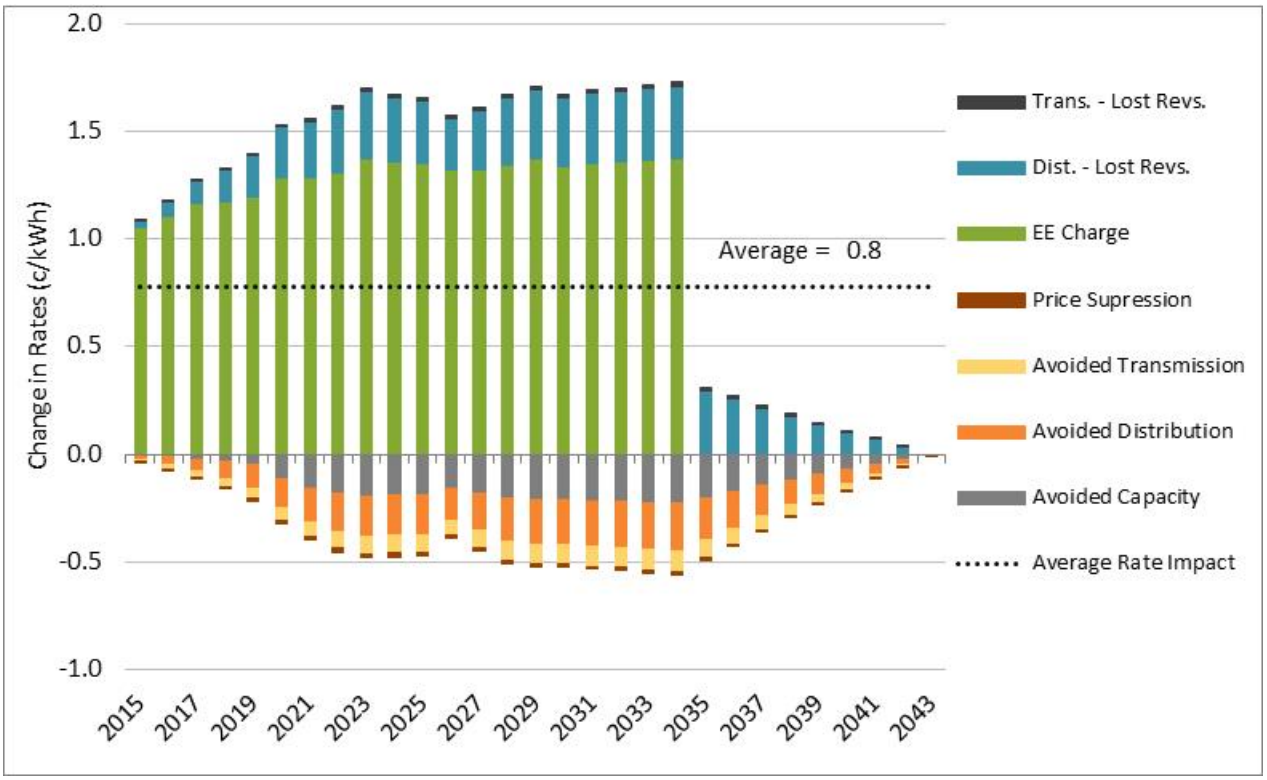
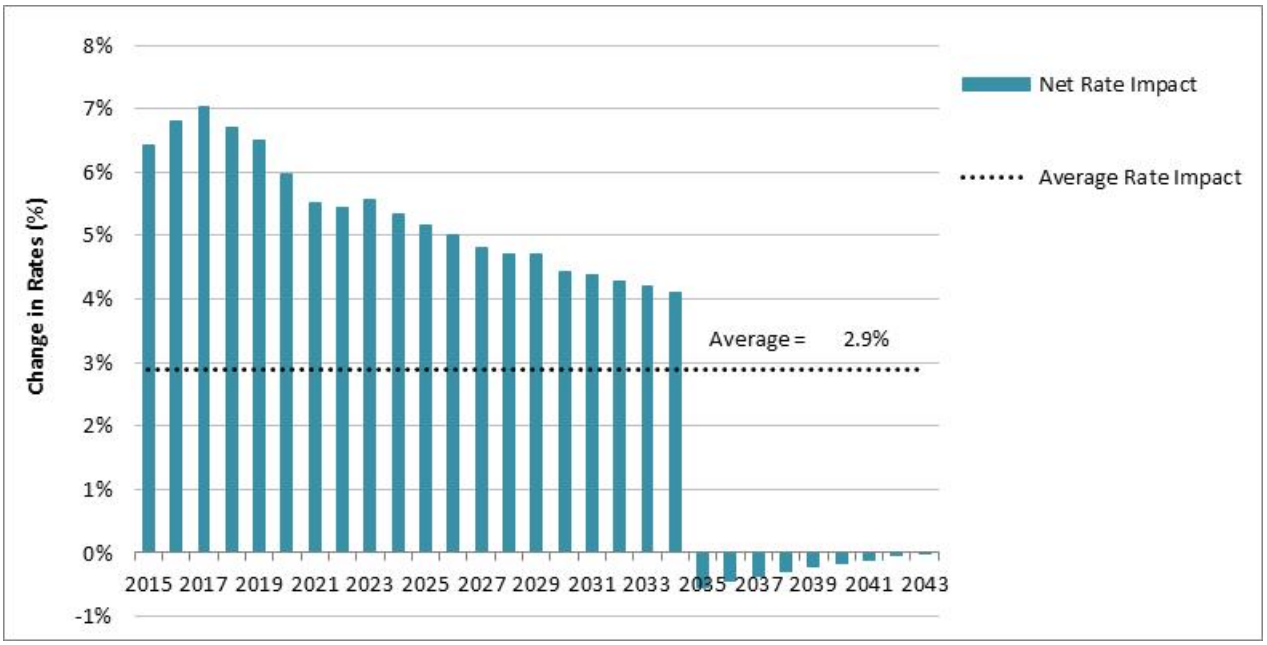


Figure 4.2 EVT Residential Net Rate Impacts (percent of total rate)



Bill Impacts by Program

As indicated in Figures 4.3 and 4.4, the Low Income Single Family and Residential New Construction programs offer the largest bill reductions for residential customers. The Existing Homes program offers around a 13% bill reduction, while the Efficient Products program is expected to provide a 1.7% bill reduction.

Non-participants see bill increases of approximately 3%, which is due to the increase in rates with the absence of efficiency savings. The "all customers" result indicates that all customers on average, including both participants and non-participants, will see bill reductions of roughly 6%. Again, these bill impacts are likely understated due to the lost revenue accounting issues described above.

Note that customers frequently participate in multiple programs in a single year, and will also participate in programs in more than one year over time. For example, many customers participate in the Efficient Products program as well as the Existing Homes program. For those customers that participate in more than one program, bill savings will be higher than those presented in the figures above. Similarly, the bill impacts below represent the average bill impact over the entire study period. Customers that participate in the same program or multiple programs over the 20-year term of the plan will see additional bill savings over time.

As is true when estimating any type of average, any one customer will see bill savings higher or lower depending on their actions within each program and across years. It is important to emphasize that the results presented above are indicative of the impacts for averaged-sized customers that experience typical levels of energy savings. Different customers who adopt different efficiency measures will experience different bill impacts than those presented here.

Figure 4.3 EVT Residential Average Monthly Consumption Impacts (percent)

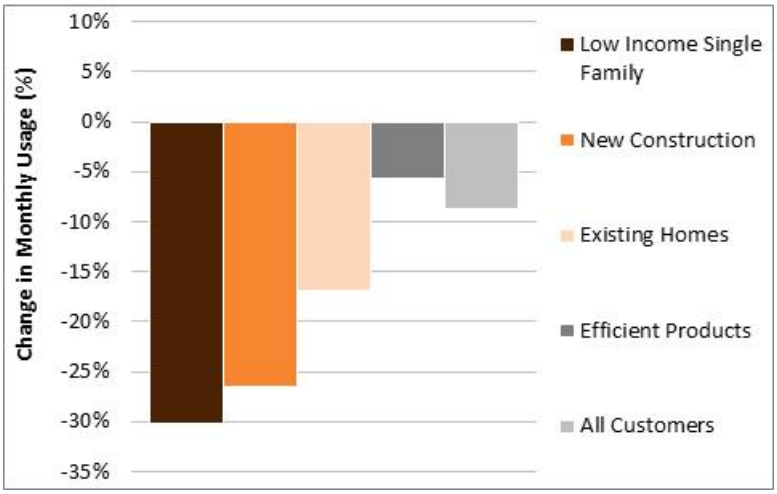
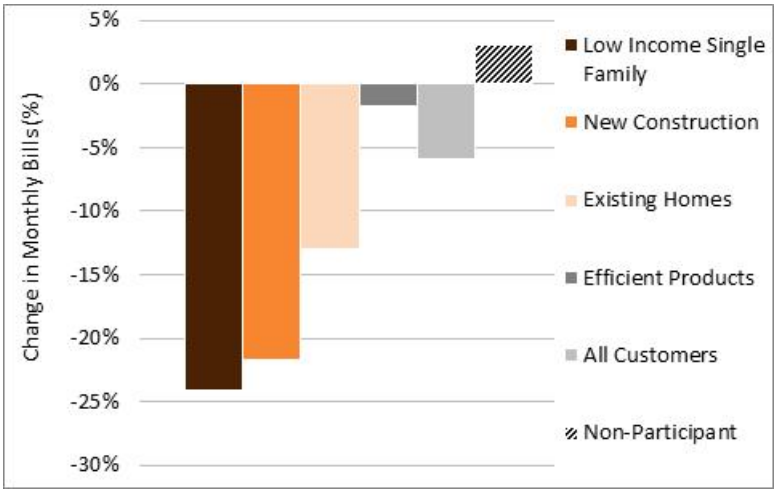


Figure 4.4 EVT Residential Average Monthly Bill Impacts (percent of bill)



Scenario Results

Figures 4.5 and 4.6 provide the rate and bill impacts for the residential customer sector across the four different scenarios analyzed. As indicated, rates are expected to increase over time regardless of energy efficiency costs and savings. The No EE Case results in the lowest electric rates, whereas the High Case results in the highest rates. There is very little difference between the rate impacts of the Base Case and the Low Case. The increase in rates from 2018 through 2021 is from the increase in avoided energy and capacity costs in those years, due to changes in the energy system demands and market conditions.

Conversely, average customer bills are highest under the No EE Case, and lowest under the High Case. Again, there is little difference between the bill impacts of the Base Case and the Low Case. The decrease in bills in the efficiency scenarios as compared to the No EE Case is the result of savings accumulating over the course of the plan. In the later years of the plan, savings fade out as measures

reach the end of their useful lives, until the bills converge together towards the end of the forecasted period.

Figure 4.5 EVT Residential Rate Impacts of Four Scenarios

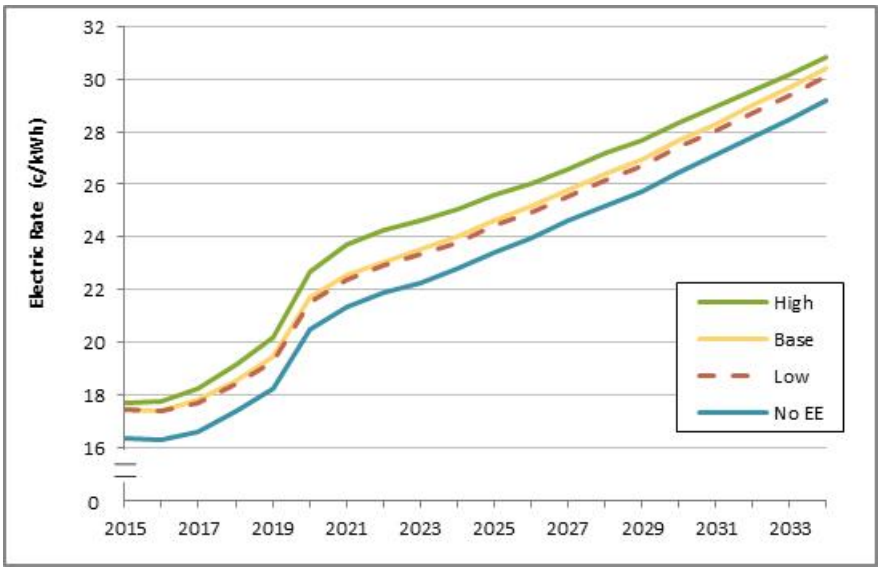


Figure 4.6 EVT Residential Average Bill Impacts of Four Scenarios

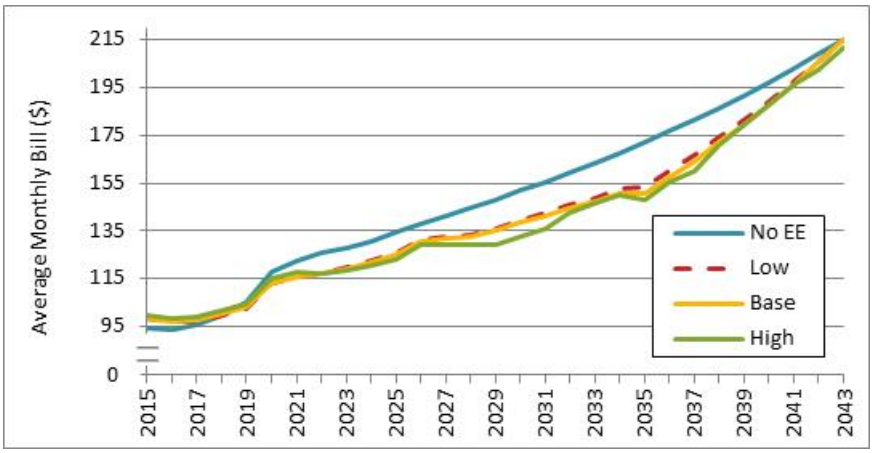
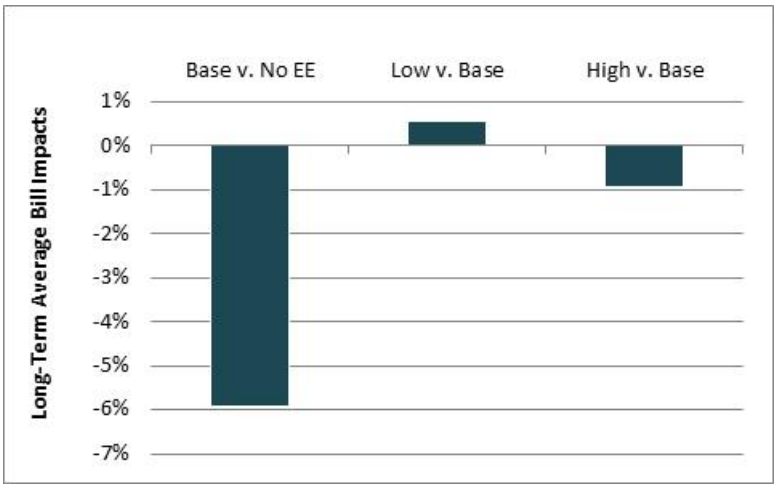


Figure 4.7 presents average monthly bills for all residential customers under the different scenario comparisons. For these calculations, the average monthly bill impacts are estimated across all customers, both program participants and non-participants. Residential monthly bills averaged over the study period will be lower as the proposed level of energy efficiency savings increases. As indicated in the figure, average monthly bills in the Base Case will be about 5.9% lower than in the No EE Case, will be roughly 0.6% higher in the Low Case relative to the Base Case, and will be about 0.9% lower in the High Case relative to the Base Case.

Figure 4.7 EVT Residential Average Long-Term Bill Impacts, by Scenario



4.2. Business Non-Demand Customers

Base Case vs. No EE Case

Rate Impacts

As indicated in Figures 4.8 and 4.9, the highest rate impact is experienced in 2016, because avoided costs from energy savings have not yet accumulated to offset the increase in rates. The rate impact in 2016 is at $0.7 cents per kWh or nearly 5%, whereas over the study period, the average rate increase is $0.2 cents per kWh or almost 1%. In later years, the savings in rates from avoided costs are enough to offset the rate increases from lost revenue, such that there are net rate decreases.

Compared to residential results, business non-demand customers have lower net rate impacts. This is due to the fact that business non-demand customers generally have lower energy savings and greater demand savings than residential customers. As a result, business non-demand customers have lower lost revenue than residential customers, as these costs are based on energy savings. Business non-demand customers also have higher avoided cost benefits than residential customers as most of these benefits are calculated based on demand savings.

Figure 4.8 EVT Business Non-Demand Rate Impacts by Component (c/kWh)

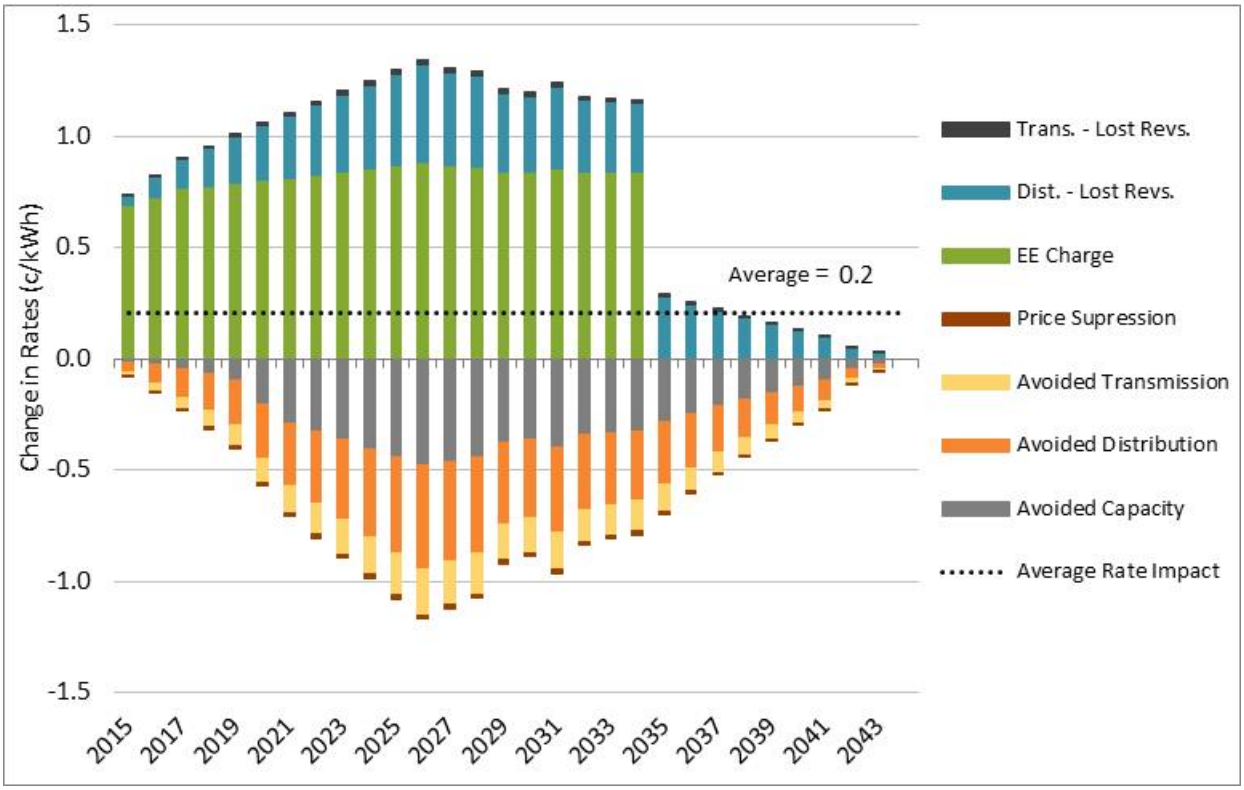
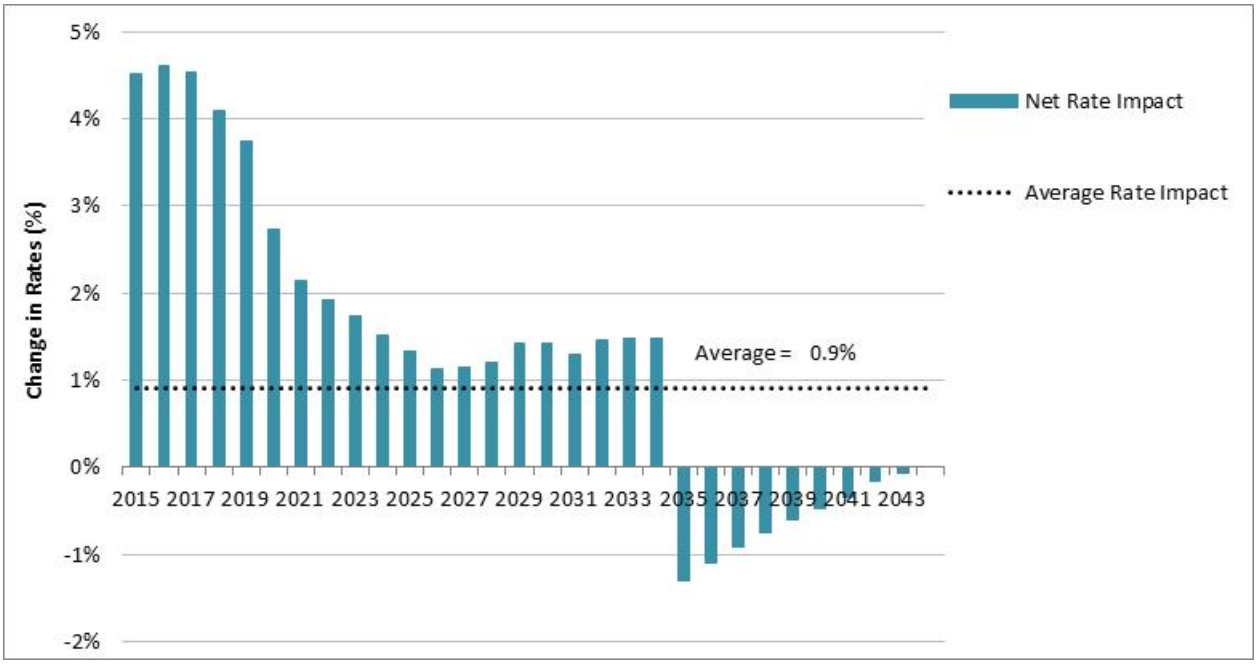


Figure 4.9 EVT Business Non-Demand Net Rate Impacts (percent of total rate)



Bill Impacts by Program

As indicated in Figures 4.10 and 4.11, New Construction participants save approximately 15% of their monthly consumption, which results in a bill decrease of about 11%. Existing Facilities participants save approximately 6% of their monthly consumption, which results in a bill decrease of about 4%. Non-participants experience bill increases of 1%, consistent with the rate increase of 1%. All customers on average fall between non-participants and participants, experiencing energy consumption savings of approximately 7%, resulting in bill reductions of about 6%.

As noted above, the bill impacts presented below represent example participants that have been evaluated to illustrate how a participant's bill might be affected from participating in the business efficiency programs. Any particular business non-demand customer might experience bill impacts that are quite different from the illustrative impacts presented below.

Figure 4.10 EVT Business Non-Demand Average Monthly Consumption Impacts (percent)

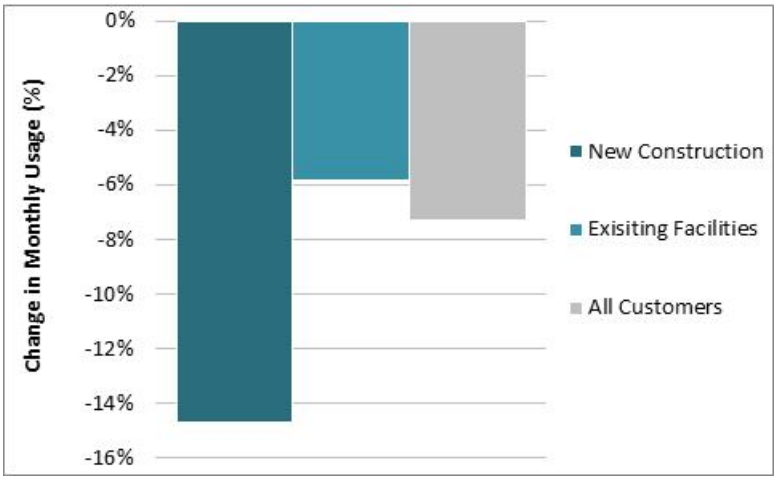
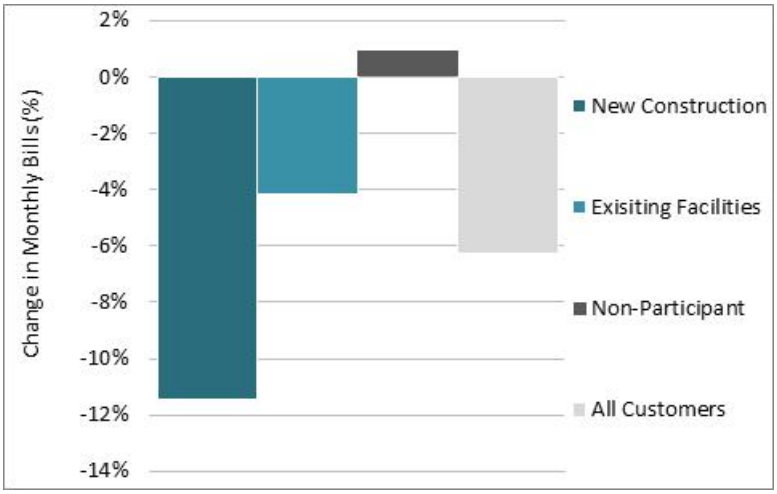


Figure 4.11 EVT Business Non-Demand Average Monthly Bill Impacts (percent of bill)



Scenario Results

Figures 4.12 and 4.13 provide the rate and bill impacts for the business non-demand customer sector across the four different scenarios analyzed. As indicated, rates are expected to increase over time regardless of energy efficiency costs and savings. While all of the rates are fairly consistent, the No EE Case results in the lowest electric rates, whereas the High Case results in the highest rates. There is very little difference between the rate impacts of the Base Case and the Low Case. The increase in rates from 2018 through 2021 is from the increase in avoided energy and capacity costs in those years, due to changes in the energy system demands and market conditions.

Conversely, average customer bills are highest under the No EE Case, and lowest under the High Case. Again, there is little difference between the bill impacts of the Base Case and the Low Case. The decrease in bills in the efficiency scenarios as compared to the No EE Case is the result of savings accumulating over the course of the plan. In the later years of the plan, savings fade out as measures reach the end of their useful lives, until the bills converge together towards the end of the forecasted period.

Figure 4.12 EVT Business Non-Demand Rate Impacts of Four Scenarios

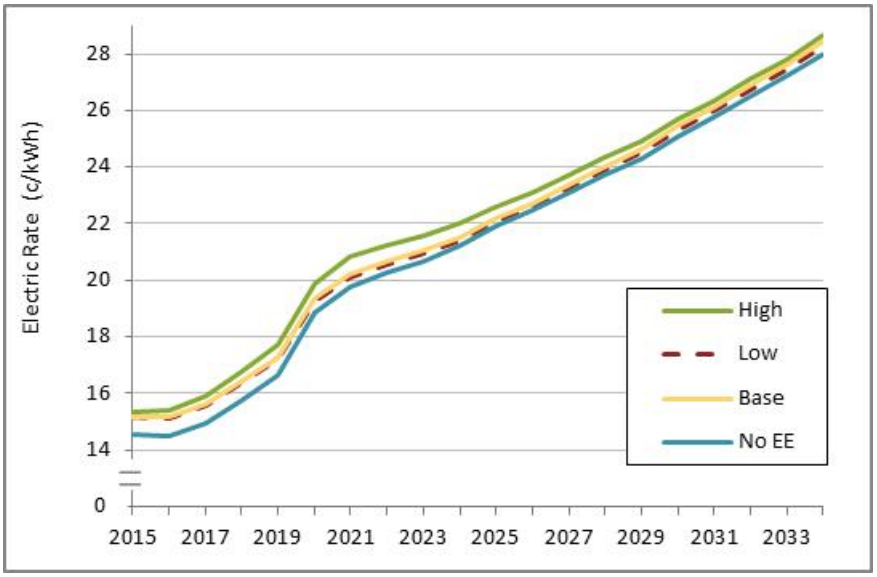


Figure 4.13 EVT Business Non-Demand Average Bill Impacts of Four Scenarios

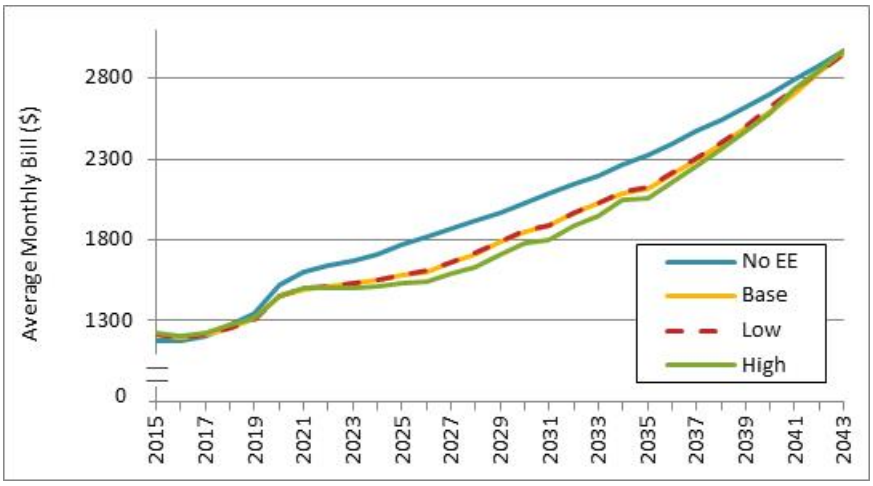
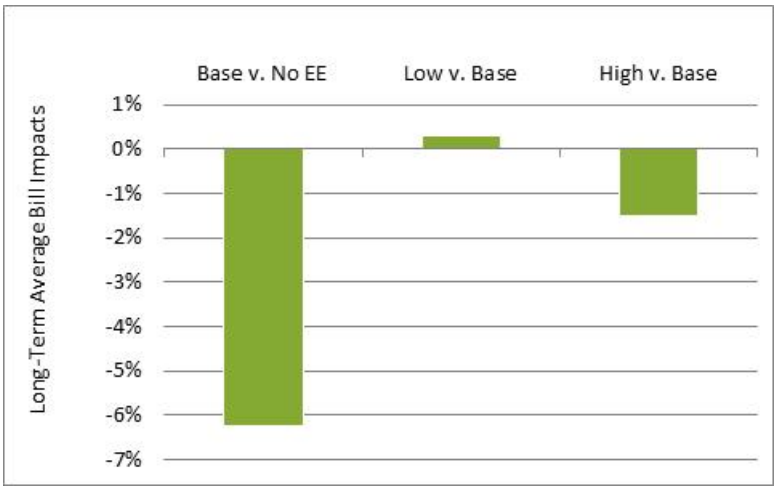


Figure 4.14 presents average monthly bills for all business non-demand customers under the different scenario comparisons. For these calculations, the average monthly bill impacts are estimated across all customers, both program participants and non-participants. In general, monthly bills averaged over the study period will be lower as the proposed level of energy efficiency savings increases. As indicated in the figure, average monthly bills in the Base Case will be 6.2% lower than in the No EE Case, will be about 0.3% higher in the Low case relative to the Base Case, and will be about 1.5% lower in the High Case relative to the Base Case.

Figure 4.14 EVT Non-Demand Average Long-Term Bill Impacts, by Scenario



4.3. Business Demand Customers

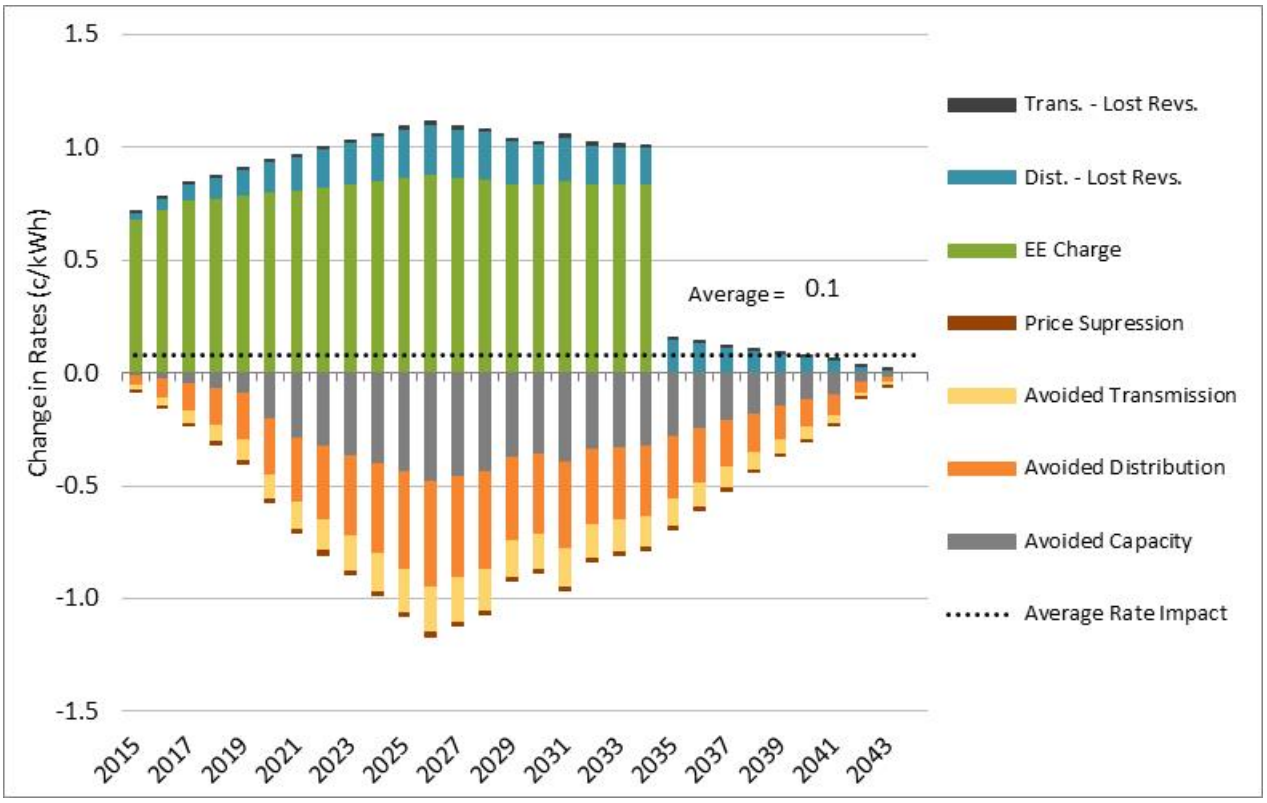
Base Case vs. No EE Case

Rate Impacts

As indicated in Figures 4.15 and 4.16, the highest rate impact is experienced in the first year of the plan (2015), because energy savings, and thus avoided costs, have not yet accumulated to offset the increase in rates. The rate impact in 2015 is at $0.6 cents per kWh or 5%, whereas over the study period, the average rate increase is $0.1 cents per kWh or 0.5%. In later years, the savings in rates from avoided costs are enough to offset the rate increases from lost revenue, such that there are rate decreases.

Compared to business non-demand results, business demand customers have lower net rate impacts. This is due to the fact that the rate structure for business demand customers collects a greater portion of revenues from fixed charges and a smaller portion from variable charges. In addition, business demand customers apparently have greater demand savings relative to energy savings than business non-demand customers. As a result of these two factors, business demand customers have lower lost revenue impacts than business non-demand customers, as well as higher avoided cost impacts.

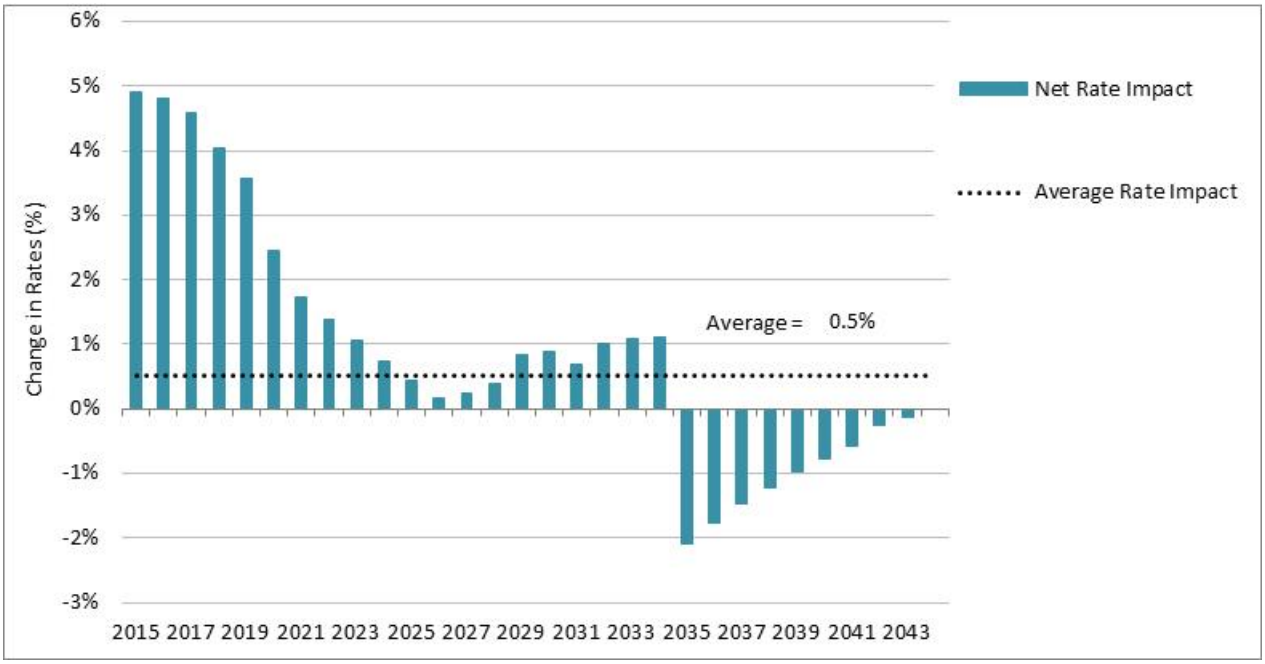
Figure 4.15 EVT Business Demand Rate Impacts by Component (c/kWh)



This result also helps explain the shape of the net rate impact in Figure 4.16, where the rate increase is quickly mitigated by the avoided cost benefits, such that the net rate impact is 0.2% in 2026. The net

rate impact increases again after 2026, as savings reach a peak in 2026 and then taper off, likely due to the increasing cost of saved energy.

Figure 4.16 EVT Business Demand Net Rate Impacts (percent of total rate)



Bill Impacts by Program

As indicated in Figures 4.17 and 4.18, New Construction participants save almost 5% of their monthly consumption, which results in a bill decrease of almost 4%. Existing Facilities participants save 2% of their monthly consumption, which results in a bill decrease of about 1%. Non-participants experience bill increases of 0.5%, consistent with the rate increase of 0.5%. All customers on average fall between non-participants and participants, experiencing energy consumption savings of approximately 2.5%, resulting in a bill decrease of about 1.9%.

As noted above, the bill impacts presented here represent example participants that have been evaluated to illustrate how a participant's bill might be affected from participating in the business efficiency programs. Any particular business demand customer might experience bill impacts that are quite different from the illustrative impacts presented below.

Figure 4.17 EVT Business Demand Average Monthly Consumption Impacts (percent)

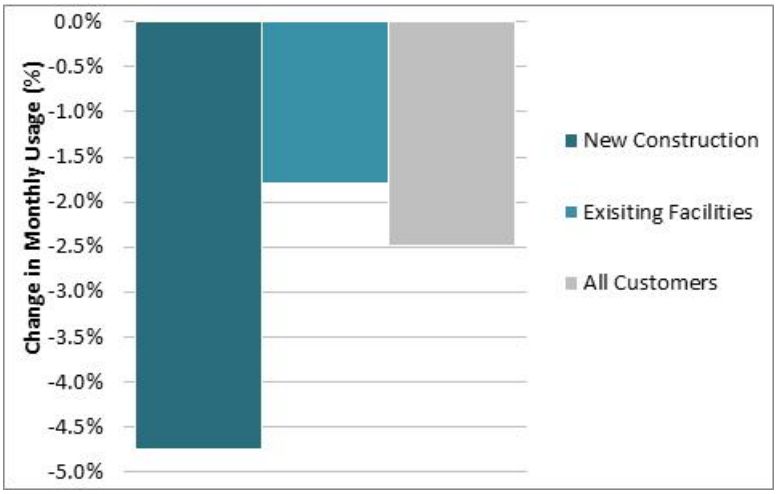
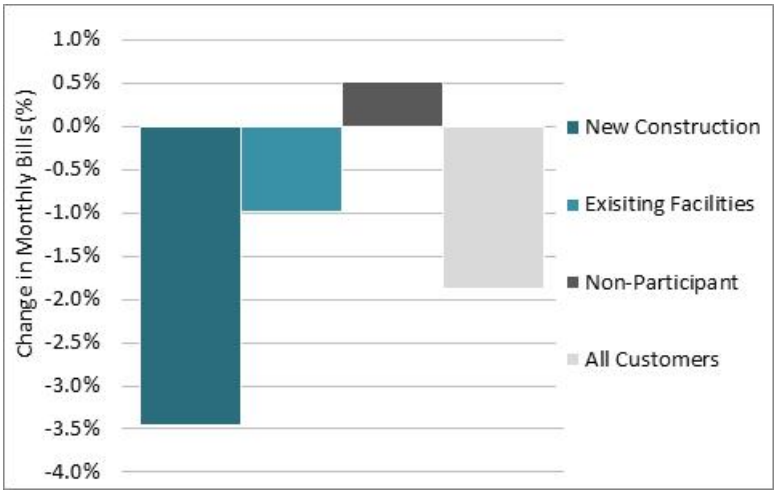


Figure 4.18 EVT Business Demand Average Monthly Bill Impacts (percent of bill)



Scenario Results

Figures 4.19 and 4.20 provide the rate and bill impacts for the business demand customer sector across the four different scenarios analyzed. As indicated, rates are expected to increase over time regardless of energy efficiency costs and savings. All of the rates are within about 1 cent per kWh of each other in each year. There is a larger variance between the No EE Case rate and the rates in the efficiency scenarios in the earlier years when the program costs are first introduced in rates, and then converge toward each other in the later years. The increase in rates from 2018 through 2021 is from the increase in avoided energy and capacity costs in those years, due to changes in the energy system demands and market conditions.

Average customer bills are highest under the No EE Case. There is relatively little difference between the bill impacts of the Base Case and the Low Case, or the Base Case and the High Case. The decrease in bills in the efficiency scenarios as compared to the No EE Case is the result of savings accumulating over the

course of the plan. In the later years of the plan, savings fade out as measures reach the end of their useful lives, until the bills converge together towards the end of the forecasted period.

Figure 4.19 EVT Business Demand Rate Impacts of Four Scenarios

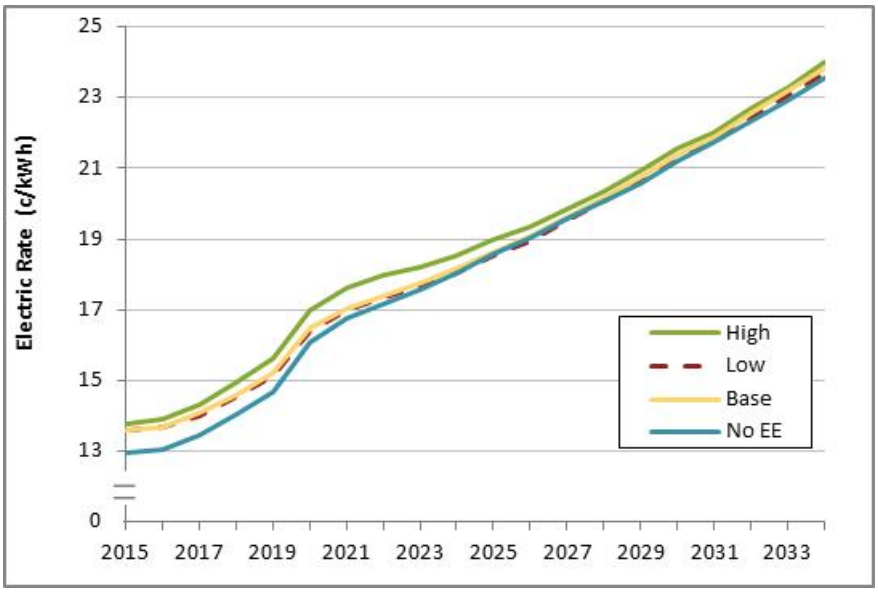


Figure 4.20 EVT Business Demand Average Bill Impacts of Four Scenarios

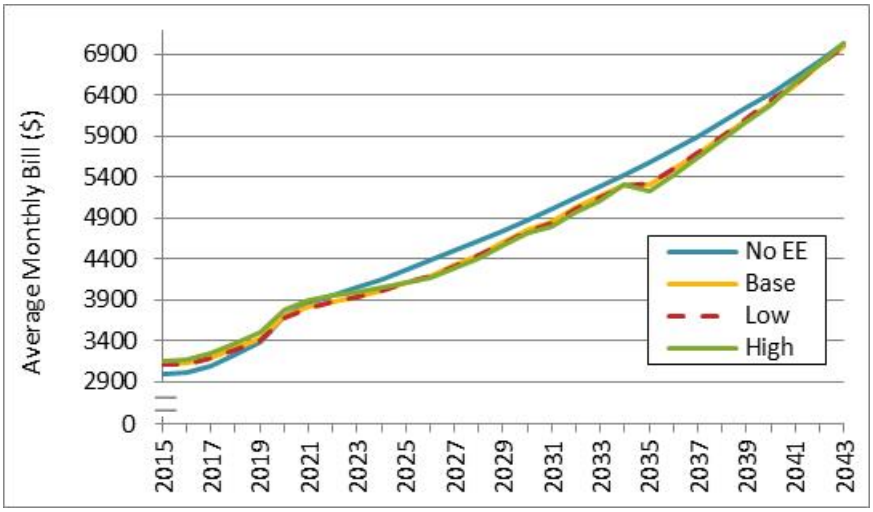
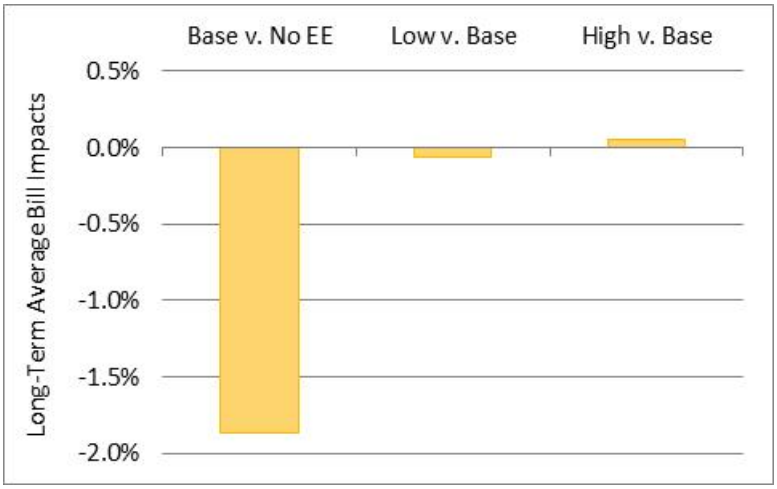


Figure 4.21 presents average monthly bills for all business demand customers, under the different scenario comparisons. For these calculations the average monthly bill impacts are estimated across all customers, both program participants and non-participants.

As with the other customer sectors, monthly bills in the Base Case will be less than those of the No EE Case, by about 1.9%. The Low Case will result in slightly lower bills relative to the Base Case, and the High Case is expected to result in slightly higher bills than the Base Case.

This slight increase in bills for demand customers in the High Case is probably due to several simplifying assumptions that were made in this analysis, and thus are probably not a good indication of the actual impacts on these customers. First, it was assumed that these customers would not experience reductions in their demand costs as a result of participating in efficiency programs, due to limited data. This could result in significantly understating the potential bill reductions for these customers. Second, we combine the efficiency savings assumptions for both business non-demand and demand customers, again due to limited data. This could also lead to understating the potential bill reductions for these customers, who are typically larger and more able to implement efficiency savings than smaller customers.

Figure 4.21 EVT Business Demand Average Long-Term Bill Impacts, by Scenario



5. BURLINGTON ELECTRIC DEPARTMENT RESULTS

5.1. Residential

Base Case vs. No EE Case

Rate Impacts

As indicated in Figures 5.1 and 5.2, the highest rate impact is experienced in 2019 at 1.0 cents per kWh or 6.2%, whereas over the study period, the average rate increase is 0.8 cents per kWh or 3.4%. In later years, the savings in rates from avoided costs are not enough to offset the rate increases from lost revenue, so rate increases are experienced in every year of the study period.

Figure 5.1 BED Residential Rate Impacts by Component (c/kWh)

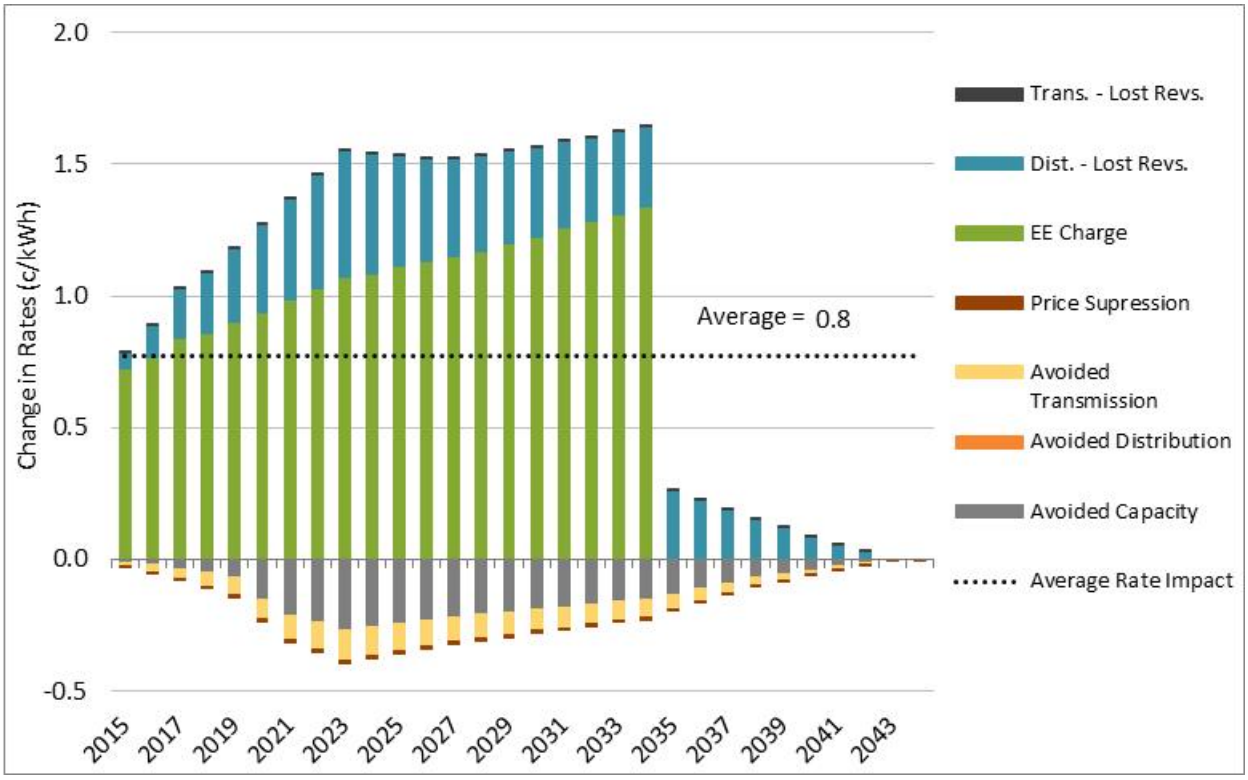
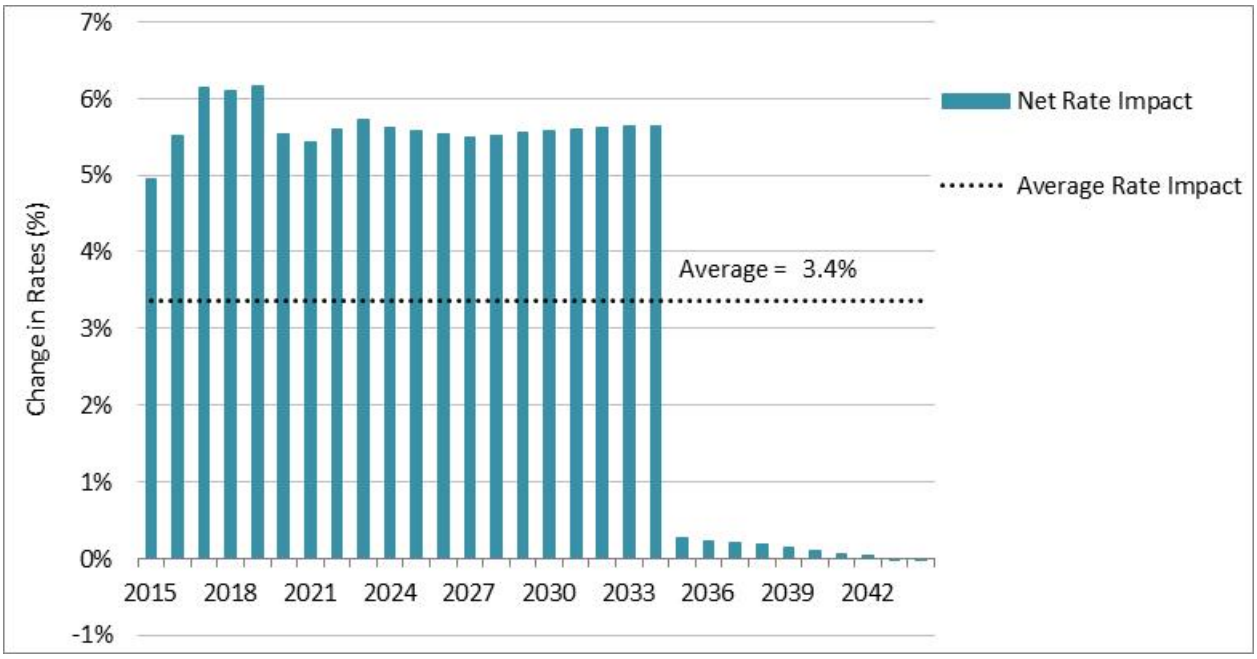


Figure 5.2 BED Residential Net Rate Impacts (percent of total rate)



Bill Impacts by Program

As indicated in Figures 5.3 and 5.4, the Low Income Single Family and Residential New Construction programs offer the largest bill reductions for residential customers, while the Existing Homes program offers roughly a 6% bill reduction, and the Efficient Products program offers about a 0.6% bill reduction.

Non-participants see bill increases of approximately 3.4%, which is due to the increase in rates with the absence of efficiency savings. The "all customers" result indicates that all customers on average, including both participants and non-participants, will see bill decreases of roughly 3.6%. Again, these bill reductions are likely understated due to the lost revenue accounting issues described above.

Note that customers frequently participate in multiple programs in a single year, and will also participate in programs in more than one year over time. For example, many customers participate in the Efficient Products program and the Existing Homes program. For those customers that participate in more than one program, bill savings will be higher than those presented in the figures here. Similarly, these bill impacts represent the average bill impact over the entire study period. Customers that participate in the same program or multiple programs over the 20-year term of the plan will see additional bill savings over time.

As is true when estimating any type of average, any one customer will see bill savings higher or lower depending on their actions within each program and across years. It is important to emphasize that the results presented above are indicative of the impacts for averaged-sized customers that experience typical levels of energy savings. Different customers who adopt different efficiency measures will experience different bill impacts than those presented here.

Figure 5.3 BED Residential Energy Savings (percent of consumption) by Program

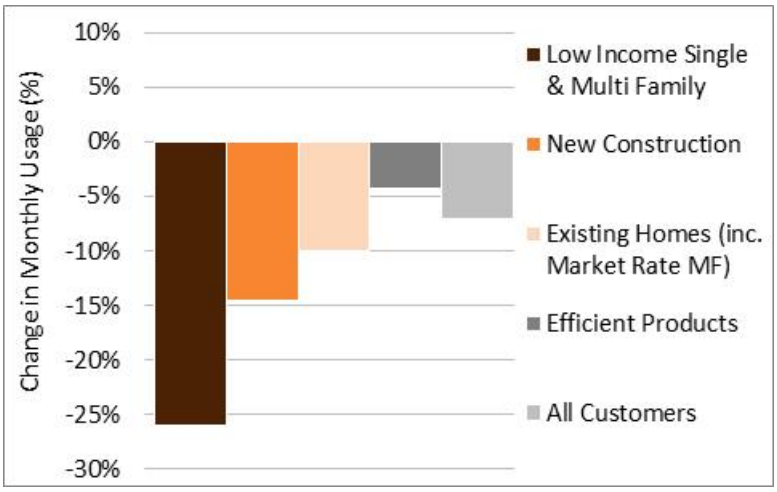
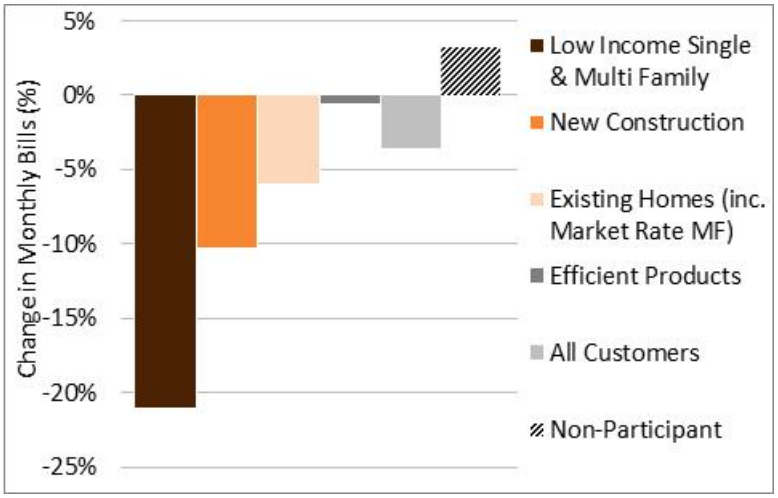


Figure 5.4 BED Residential Bill Impacts (percent of bill) by Program



Scenario Results

Figures 5.5 and 5.6 provide the rate and bill impacts for the residential customer sector across the four different scenarios analyzed. As indicated, rates are expected to increase over time regardless of energy efficiency costs and savings. The No EE Case results in the lowest electric rates, whereas the High Case results in the highest rates. There is very little difference between the rate impacts of the Base Case and the Low Case. The increase in rates from 2018 through 2021 is from the increase in avoided energy and capacity costs in those years, due to changes in the energy system demands and market conditions.

Conversely, average customer bills are highest under the No EE Case, and lowest under the High Case. Again, there is little difference between the bill impacts of the Base Case and the Low Case. The decrease in bills in the efficiency scenarios as compared to the No EE Case is the result of savings

accumulating over the course of the plan. In the later years of the plan, savings fade out as measures reach the end of their useful lives, until the bills converge together towards the end of the forecasted period.

Figure 5.5 BED Residential Rate Impacts of Four Scenarios

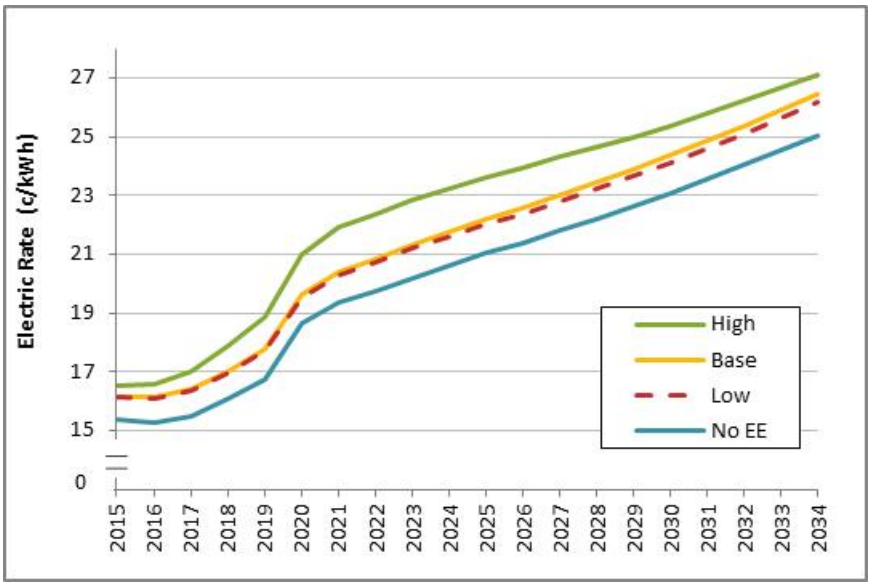


Figure 5.6 BED Residential Average Bill Impacts of Four Scenarios

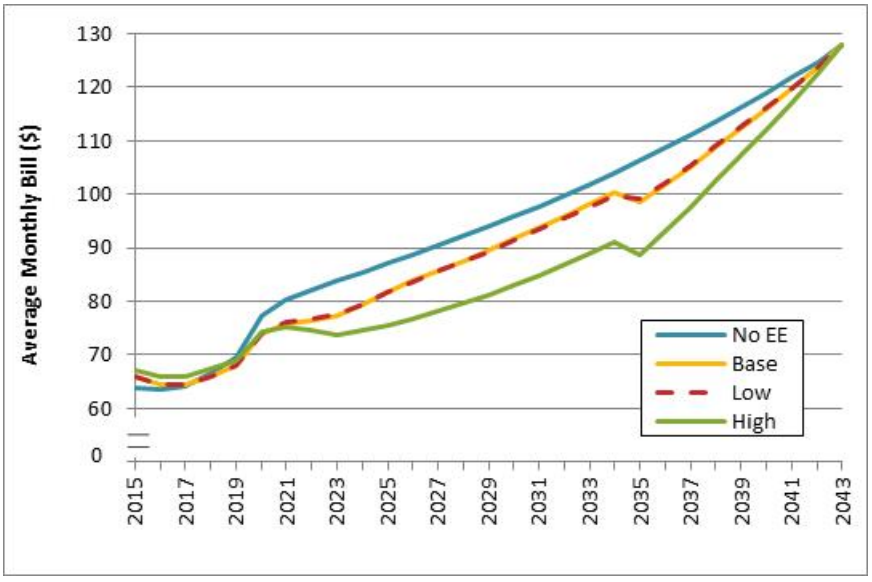
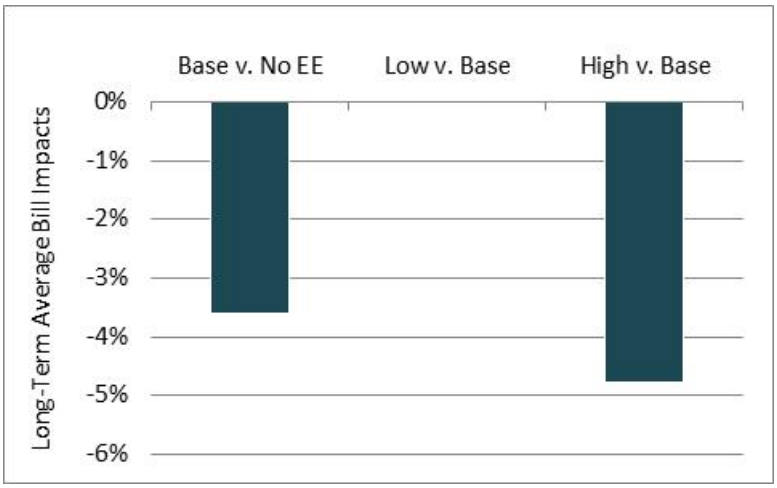


Figure 5.7 presents average monthly bills for all residential customers under the different scenario comparisons. For these calculations, the average monthly bill impacts are estimated across all customers, both program participants and non-participants.

Average monthly bills in the Base Case will be about 3.4% lower than in the No EE Case, and will be about 4.8% lower in the High Case relative to the Base Case. There is little difference in average monthly bills between the Base Case and Low Case.

Figure 5.7 BED Residential Average Long-Term Bill Impacts, by Scenario



5.2. Business Non-Demand Customers

Base Case vs. No EE Case

Rate Impacts

As indicated in Figures 5.8 and 5.9, the highest rate impact is experienced in 2017 at 0.9 cents per kWh or roughly 6%, whereas over the Study Period, the average rate increase is 0.8 cents per kWh or 3.5%. In later years, the savings in rates from avoided costs are enough to offset the rate increases from lost revenue, such that there are rate decreases.

Compared to residential results, business non-demand customers have similar rate impacts of about 3.5% over the long-term. The efficiency charge is higher for residential customers than for business non-demand customers due to the variances in sales and budgets for the two types of customers. The residential programs also have a higher cost per saved energy then business programs. However, the distribution lost revenue for business non-demand customers is higher than for residential customers due to the variances in distribution cost requirements and savings levels between the two customer types. As noted above, the distribution lost revenues are potentially significantly overstated, the impact of which is observed here. The differences in efficiency charge and lost revenue impacts between the customer types balance each other out such that the net rate impacts are similar.

Figure 5.8 BED Business Non-Demand Rate Impacts by Component (c/kWh)

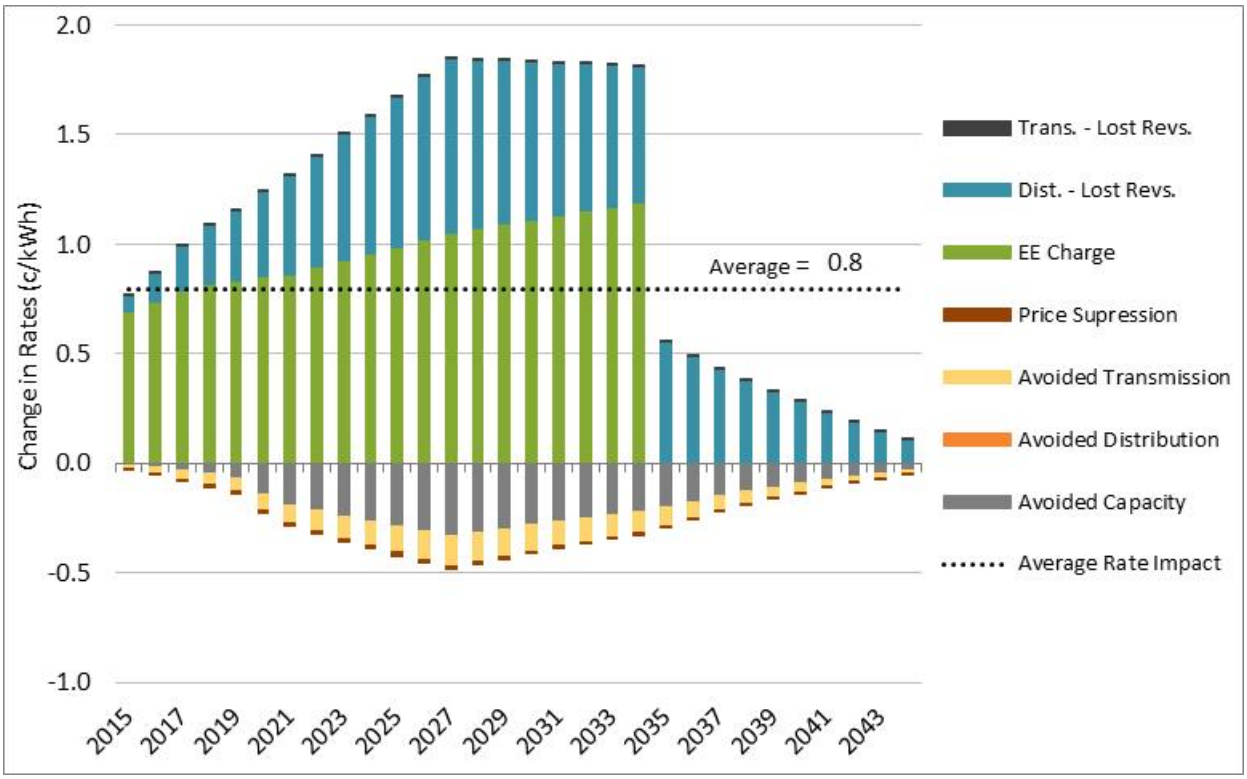
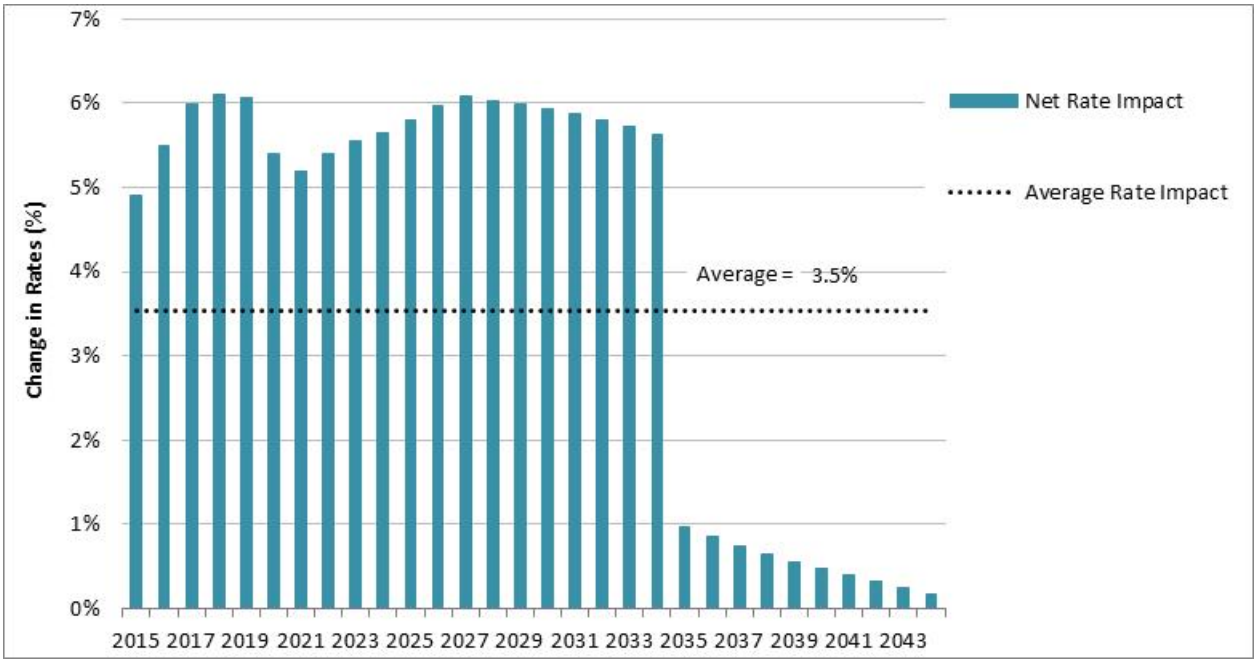


Figure 5.9 BED Business Non-Demand Net Rate Impacts (percent of total rate)



Bill Impacts by Program

As indicated in Figures 5.10 and 5.11, New Construction participants save approximately 19% of their monthly consumption, which results in a bill reduction of about 14%. Existing Facilities participants save approximately 6% of their monthly consumption, which results in a bill decrease of about 2%. Non-participants experience bill increases of 3.7%, consistent with the rate increase of 3.5%. All customers on average fall between non-participants and participants, experiencing bill savings of almost 9%, resulting in a bill decrease of almost 6%.

As noted above, the bill impacts presented below represent example participants that have been evaluated to illustrate how a participant's bill might be affected from participating in the business efficiency programs. Any particular business non-demand customer might experience bill impacts that are quite different from the illustrative impacts presented below.

Figure 5.10 BED Business Non-Demand Example Monthly Energy Savings (percent of consumption saved)

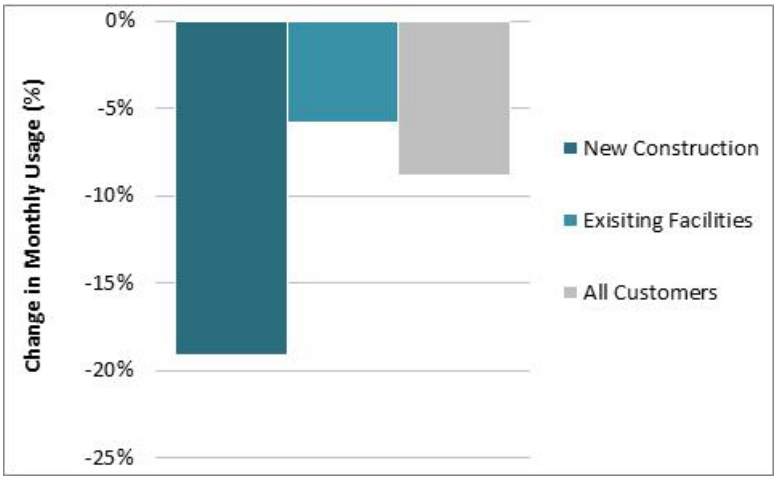
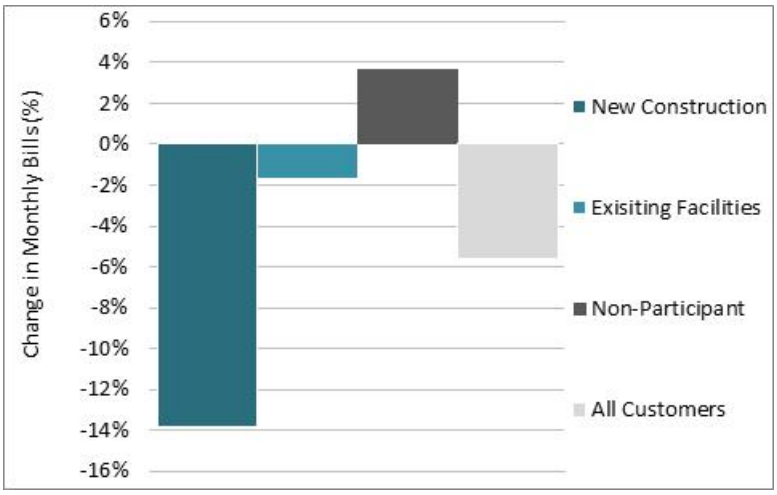


Figure 5.11 BED Business Non-Demand Example Monthly Bill Impacts (percent of bill)



Scenario Results

Figures 5.12 and 5.13 provide the rate and bill impacts for the business non-demand customer sector across the four different scenarios analyzed. As indicated, rates are expected to increase over time regardless of energy efficiency costs and savings. The No EE Case results in the lowest electric rates, whereas the High Case results in the highest rates. There is very little difference between the rate impacts of the Base Case and the Low Case. The increase in rates from 2018 through 2021 is from the increase in avoided energy and capacity costs in those years, due to changes in the energy system demands and market conditions.

Conversely, average customer bills are highest under the No EE Case, and lowest under the High Case. Again, there is little difference between the bill impacts of the Base Case and the Low Case. The decrease in bills in the efficiency scenarios as compared to the No EE Case is the result of savings accumulating over the course of the plan. In the later years of the plan, savings fade out as measures reach the end of their useful lives, until the bills converge together towards the end of the forecasted period.

Figure 5.12 BED Business Non-Demand Rate Impacts of Four Scenarios

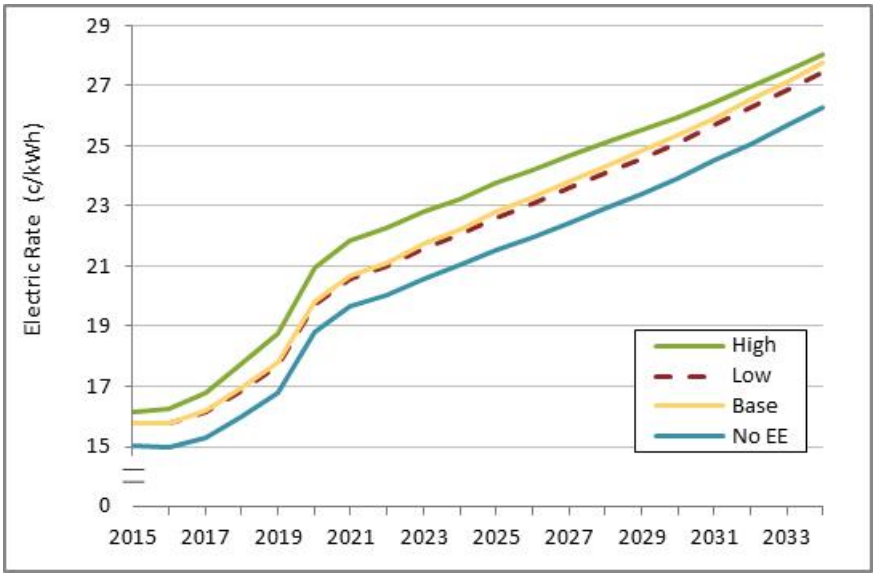


Figure 5.13 BED Business Non-Demand Average Bill Impacts of Four Scenarios

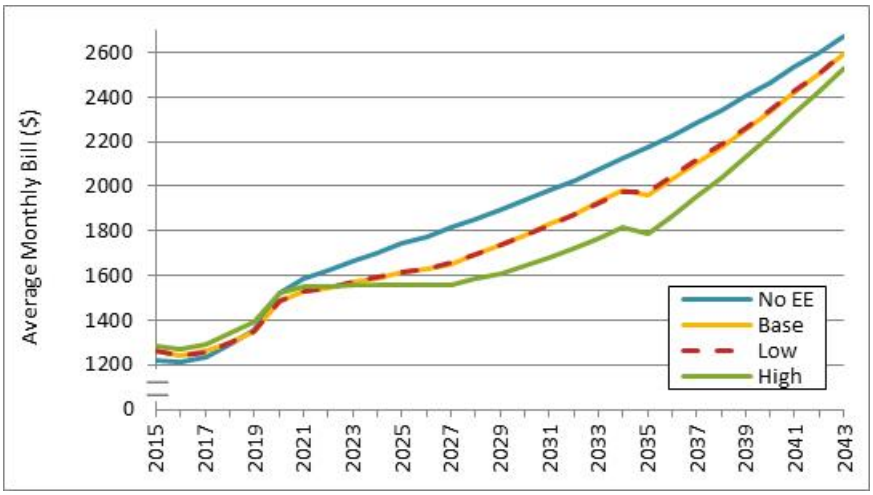
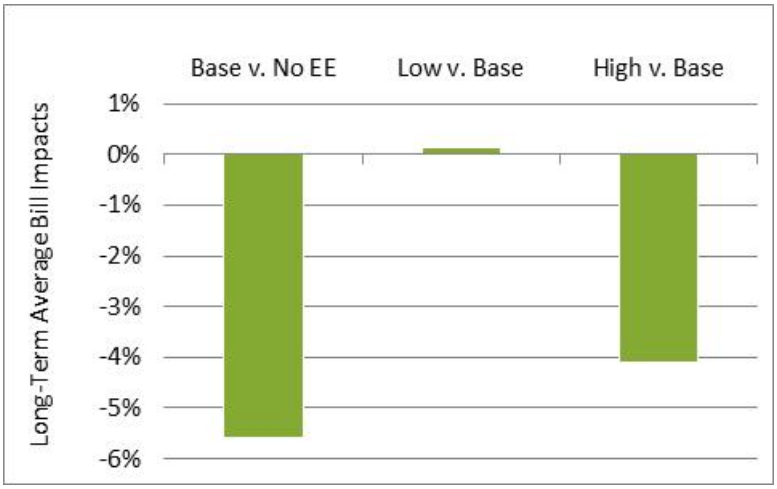


Figure 5.14 presents average monthly bills for all business non-demand customers under the different scenario comparisons. For these calculations, the average monthly bill impacts are estimated across all customers, both program participants and non-participants. In general, monthly bills averaged over the study period will be lower as the proposed level of energy efficiency savings increases. As indicated in the figure, average monthly bills in the Base Case will be 5.6% lower than in the No EE Case, and will be 0.1% higher in the Low Case relative to the Base Case, and will be about 4.1% lower in the High Case relative to the Base Case.

Figure 5.14 BED Business Non-Demand Average Long-Term Bill Impacts, by Scenario



5.3. Business Demand Customers

Base Case vs. No EE Case

Rate Impacts

As indicated in Figures 5.15 and 5.16, the highest rate impact is experienced in 2017 at 0.8 cents per kWh or 3.6%, whereas over the Study Period, the average rate increase is 0.6 cents per kWh or 1.9%. In later years, the savings in rates from avoided costs are enough to offset the rate increases from lost revenue, such that there are net rate decreases.

Compared to business non-demand results, business demand customers have lower net rate impacts. This is due to the fact that the rate structure for business demand customers collects a greater portion of revenues from fixed charges and a smaller portion from variable charges. In addition, business demand customers apparently have greater demand savings relative to energy savings than business non-demand customers. As a result of these two factors, business demand customers have lower lost revenue impacts than business non-demand customers, as well as higher avoided cost impacts.

Figure 5.15 BED Business Demand Rate Impacts by Component (c/kWh)

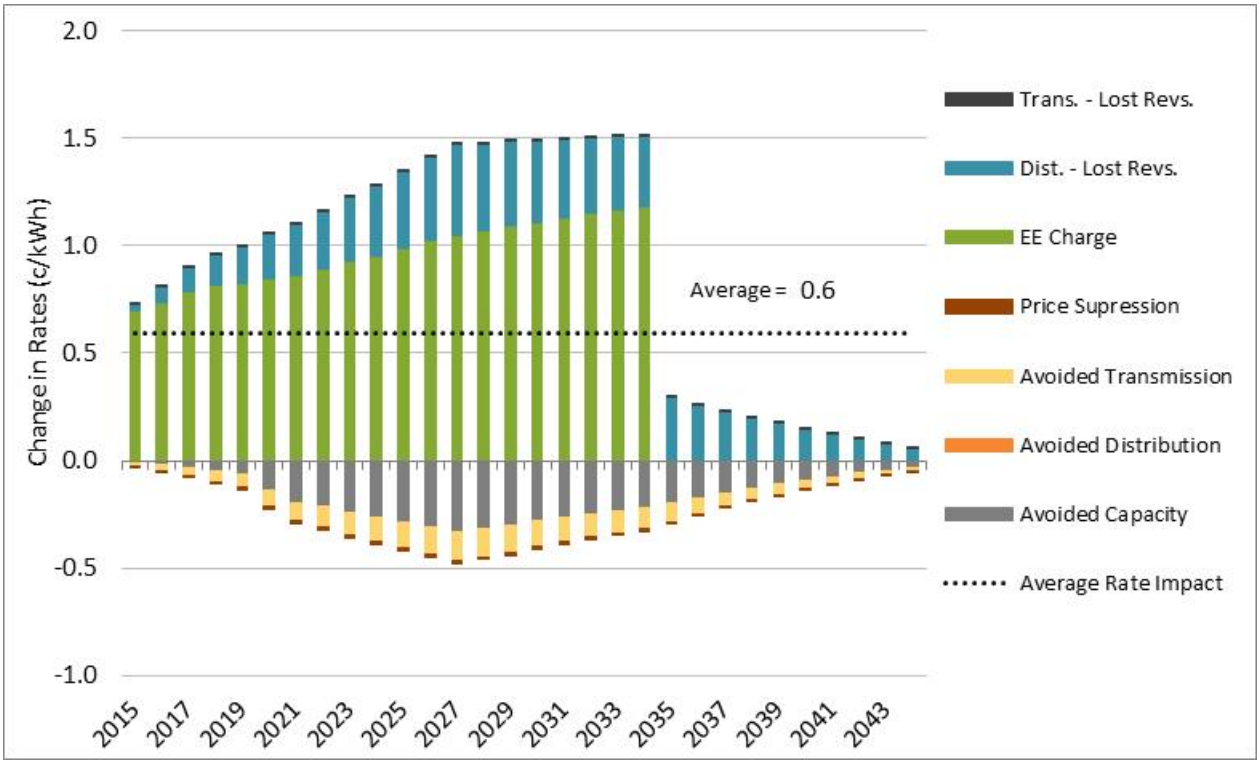
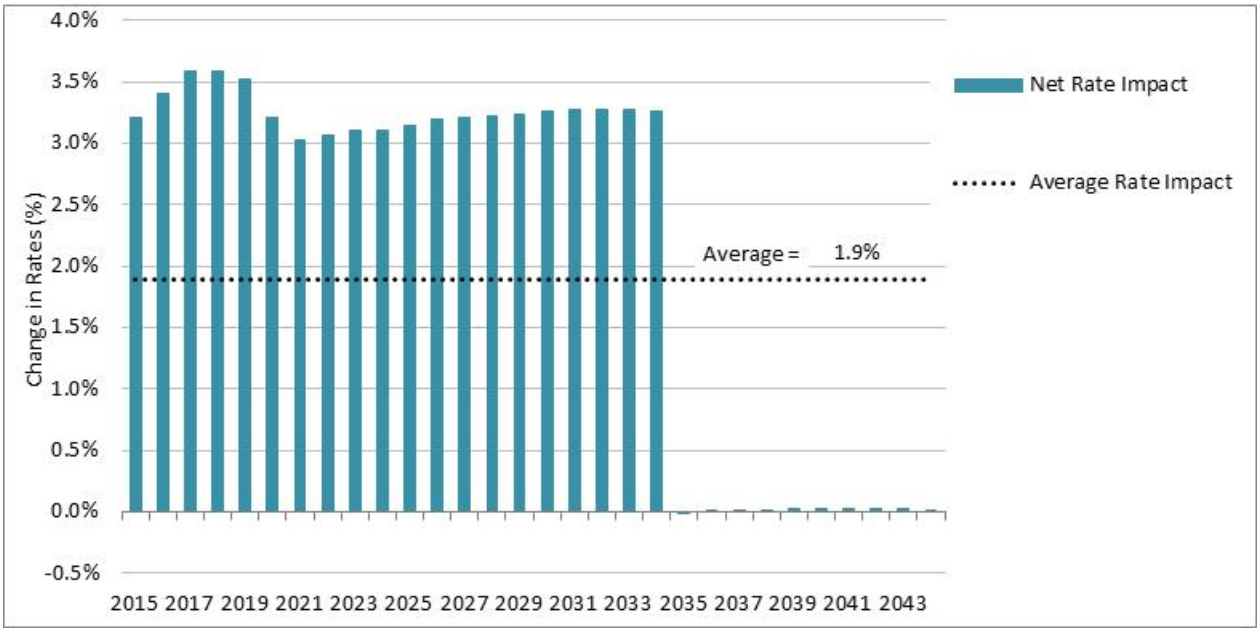


Figure 5.16 BED Business Demand Net Rate Impacts (percent of total rate)



Bill Impacts by Program

As indicated in Figures 5.17 and 5.18, New Construction participants save approximately 13% of their monthly consumption, which results in a bill decrease of over 9%. Existing Facilities participants save almost 6% of their monthly consumption, which results in a bill decrease of over 3%. Non-participants experience bill increases of 2%, consistent with the rate increase of 2%. All customers on average fall between non-participants and participants, experiencing bill savings of approximately 6%, resulting in a bill reduction of about 4%.

As noted above, the bill impacts presented below represent example participants that have been evaluated to illustrate how a participant's bill might be affected from participating in the business efficiency programs. Any particular business demand customer might experience bill impacts that are quite different from the illustrative impacts presented below.

Figure 5.17 BED Business Demand Average Monthly Consumption Impacts (percent)

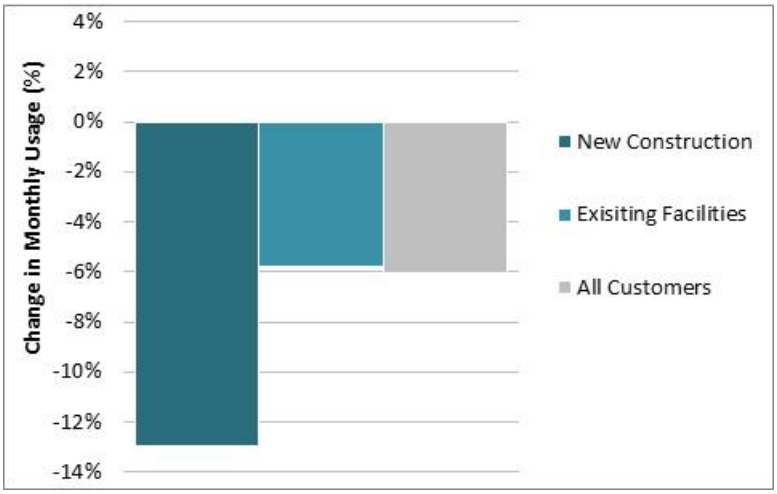
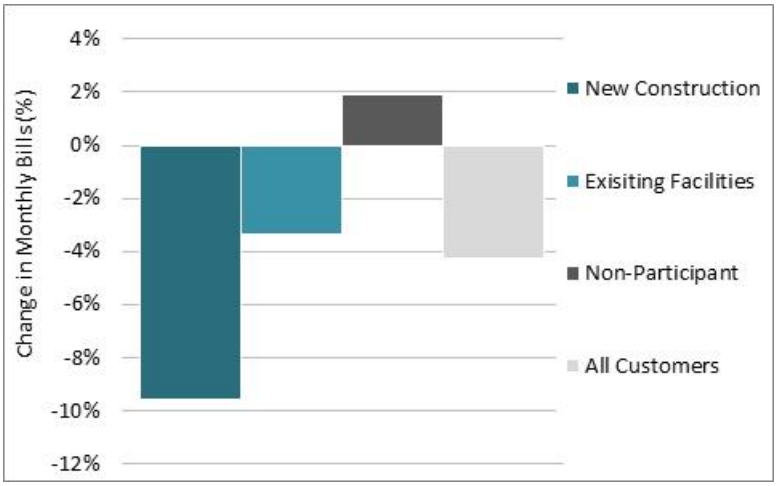


Figure 5.18 BED Business Demand Average Monthly Bill Impacts (percent of bill)



Scenario Results

Figures 5.19 and 5.20 provide the rate and bill impacts for the business demand customer sector across the four different scenarios analyzed. As indicated, rates are expected to increase over time regardless of energy efficiency costs and savings. The No EE Case results in the lowest electric rates, whereas the High Case results in the highest rates. There is very little difference between the rate impacts of the Base Case and the Low Case. The increase in rates from 2018 through 2021 is from the increase in avoided energy and capacity costs in those years, due to changes in the energy system demands and market conditions.

As noted above, the saving per average customer is the same for both business demand and business non-demand customer types, which understates business demand customers' savings, and therefore bills. This explains why the bills in the efficiency cases in Figure 5.20 are similar to each other. Bills may even be above the No EE Case bills in the earlier years as costs are introduced in rates, but efficiency savings take time to accumulate.

Figure 5.19 BED Business Demand Rate Impacts of Four Scenarios

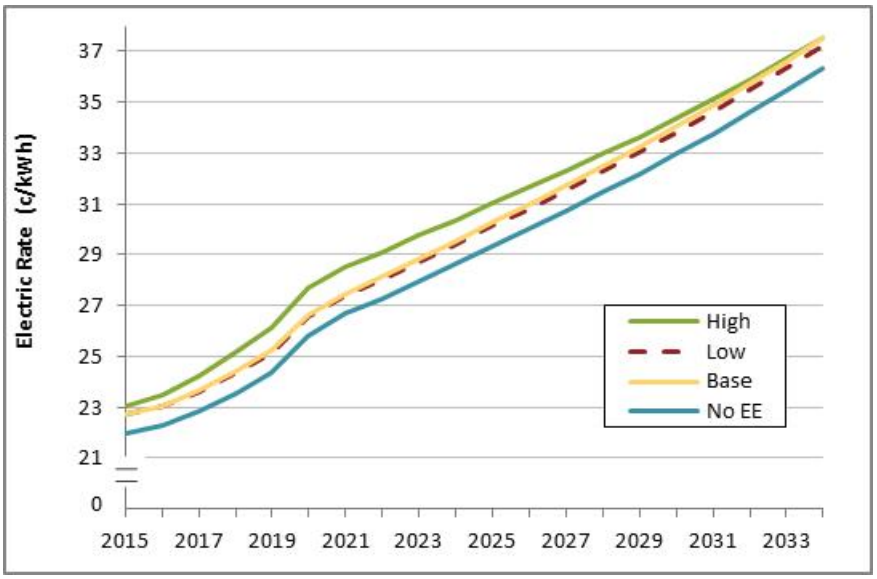


Figure 5.20 BED Business Demand Average Bill Impacts of Four Scenarios

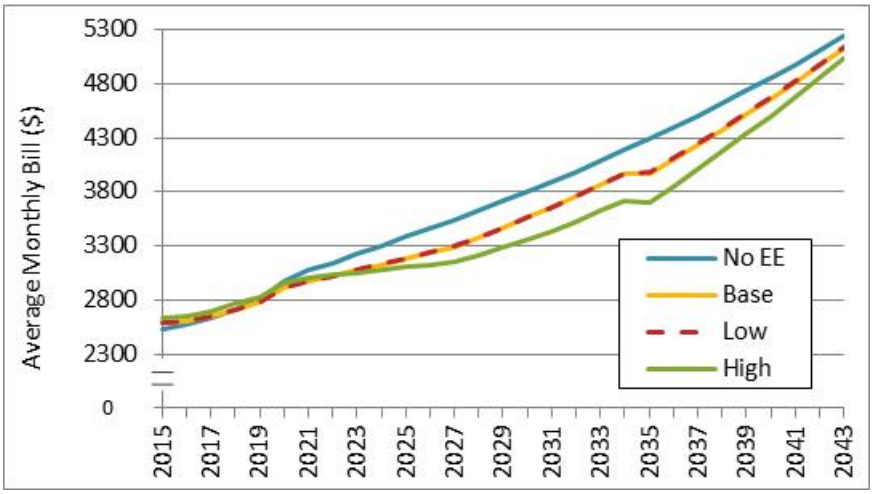


Figure 5.21 presents average monthly bills for all business demand customers, under the different scenario comparisons. For these calculations the average monthly bill impacts are estimated across all customers, both program participants and non-participants.

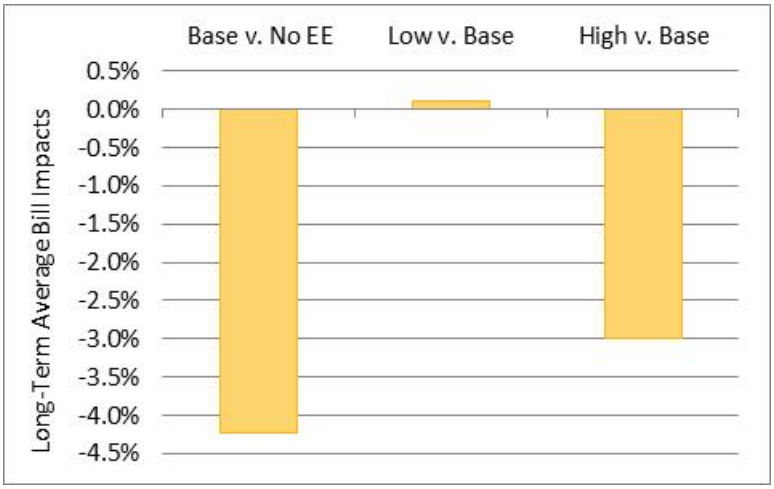
As with the other customer sectors, monthly bills in the Base Case will be less than those of the No EE Case, by about 4%. The Low Case will result in bills that are slightly higher than bills in the Base Case, and the High Case is expected to result in lower bills than the Base Case, by about 3%.

Again, the saving per average customer is the same for both business demand and business non-demand customer types. This likely understates demand customers savings (as there are likely fewer demand participants than non-demand participants, and the demand participants save more on average

per project than the non-demand participants). An average across both types of customers will not be representative of an average participant.

It is also important to note that business demand customers will experience demand savings by participating in energy efficiency programs. Such savings are not represented in this analysis, so the bill impacts are overstated. Also, larger customers are more likely to participate in energy efficiency programs given the amount they consume, thereby providing greater efficiency opportunities, and because they have dedicated account managers who focus on energy usage and savings

Figure 5.21 BED Business Demand Average Long-Term Bill Impacts, by Scenario



6. PROGRAM PARTICIPATION

As customers that participate in energy efficiency programs have lower bills than customers that do not participate, the breadth of customer participation is a key component in understanding the implications of rate and bill impacts. The breadth of participation is considered by estimating customer participation rates, which are the percentage of eligible customers that participate in an energy efficiency program. First, participation rates are estimated for historical efficiency programs, from 2002 through 2012. Then, participation rates are estimated for the future efficiency programs, under the three different efficiency scenarios.

In order to produce an accurate representation of the percentage of customers that participate in programs, it is necessary to account for those customers that participate in more than one program, both within a year and across years. This type of repeat participation occurs frequently—for example, when a residential customer purchases efficient products more than one time within a year, or when a residential customer participates in the Efficient Products program as well as an Existing Homes program.

However, this analysis does not account for repeat participation, due to limited data. Therefore, the results presented below are significantly overstated, because customers participate in multiple efficiency programs both within a year and across years. It is recommended that, going forward, EVT and BED collect more information on customers that participate in each of its programs so as to better understand repeat participation. Note that to the extent participation rates in this section are overstated, the bill savings presented in previous sections are understated because participating in multiple programs will result in greater bill savings than those presented above.

Figures 6.1 and 6.2 provide EVT and BED's historical (2002 through 2012) participation rates. As indicated in the figures, EVT's Efficient Products program has the highest cumulative participation rate, reaching 100% of eligible customers by 2012. The Business Existing Facilities program reaches roughly 31%, while the residential existing homes program reaches roughly 13%.

BED's Efficient Products program also has the highest cumulative participation rate, reaching over 60% of eligible customers by 2012. The Business Existing Facilities program reaches roughly 32%, while the Residential Existing Homes program reaches roughly 46%.

Note that both the Residential and Business New Construction program participation rates are estimated by dividing the participants by the number of total customers in that sector. Those programs can only serve new construction and major renovation opportunities, so one would expect these participation rates to be low relative to the entire customer base. As noted in Section 2, this approach overstates the amount of eligible customers, and thereby understates the cumulative participation rate. The historical and projected new building starts in Vermont were considered as an alternative estimate of eligible participants for these programs, but the projections were deemed to be too uncertain to use here.

Despite the difficulties in quantifying participation rates, the results indicate that EVT and BED's historical programs have successfully reached a substantive portion of customers in the Efficient Products program. This is not to suggest that EVT or BED's efficiency work is completed. There are likely to be customers that have not been served despite the high participation rate, as a result of repeat participation by some customers. Furthermore, new technologies become available on a regular basis, creating new opportunities for promoting cost-effective efficient products.

Figure 6.1 EVT Historical Program Participation Rates (2002–2012)

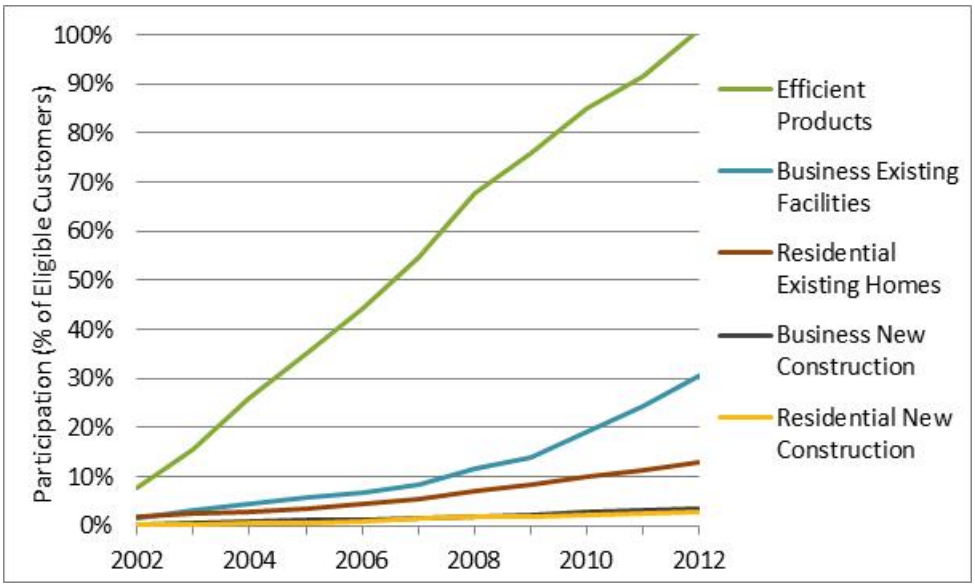
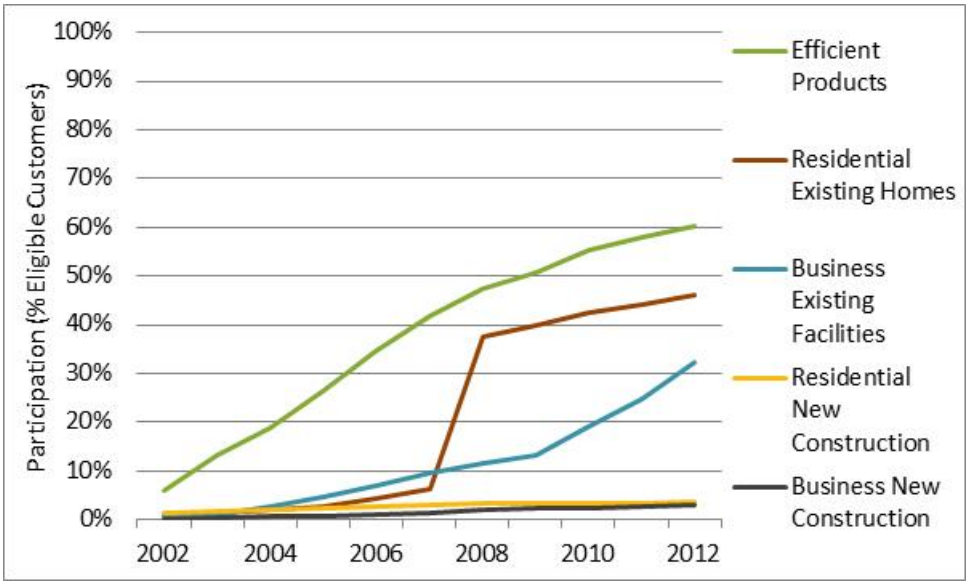


Figure 6.2 BED Historical Program Participation Rates (2002–2012)



Figures 6.3 and 6.4 present for EVT and BED the estimates of historical plus future participation rates for the Residential Existing Homes program, including the range of participation expected under the different efficiency scenarios.

For EVT, the Low Case is expected to reach 54% of eligible customers by 2034, while the Base Case is expected to reach 61% of eligible customers, and the High Case is expected to reach 93% of eligible customers. For BED, the Low EE Case is expected to reach 78% of eligible customers by 2034, while the Base Case is expected to reach 80% of eligible customers, and the High Case is expected to be over 100% of eligible customers. Note that accounting for repeat participation becomes even more important for estimates that go this far into the future. The estimates here should be considered to be on the high side.

The participation rates for the Low Case and the Base Case increase at a similar rate, with the Base Case reaching approximately 7% more eligible customers on average than the Low Case for EVT, and reaching approximately 1% more eligible customers for BED. The participation rate in the High Case increases at a much higher rate, reaching approximately 38% more eligible customers on average than the Base Case for EVT, and reaching approximately 16% more eligible customers on average for BED.

While the specific participant rate estimates are likely inaccurate given the caveats noted above, the figures still provide an indication of the direction for future participation under the proposed energy efficiency scenarios. When comparing the Low Case to the High Case, EVT expects to reach almost twice as many customers. Therefore, despite a greater rate increase when comparing the Low Case to the High Case, more customers are likely to experience bill decreases in the High Case due to the higher participation rate.

Figure 6.3 EVT Participation Rates by Scenario for Residential Existing Homes (2002–2034)

Figure 6.4 BED Participation Rates by Scenario for Residential Existing Homes (2002–2034)

Figures 6.5 and 6.6 present the estimates of historical plus future participation rates for the Business Existing Facilities program, including the range of participation expected under the different energy efficiency scenarios.

For EVT and BED, all three scenarios are expected to exceed 100% by 2034. The High case is expected to serve significantly more customers than the Low or Base case. Note that the participation rates exceeding 100% of eligible customers are implausible, and demonstrate the importance of properly accounting for repeat participation.

The participation rates for the Low Case and the Base Case increase at a similar rate, with the Base Case reaching approximately 8% more eligible customers on average than the Low Case for EVT, and reaching approximately 5% more eligible customers on average for BED. The participation rate in the High Case increases at a much higher rate, reaching approximately 27% more eligible customers on average than in the Base Case for EVT, and reaching approximately 39% more eligible customers on average for BED.

As noted above, EVT's business participants are estimated based on the 2012 cost per participant. This overstates the level of participation, as the cost per participant will increase over time, as hard-to-reach customers are targeted and repeat participants exhausts the more cost-effective efficiency opportunities. This is especially true given that customers repeat in multiple programs multiple times over the course of the 20 year period. This leads to participant estimates that are significantly overstated.

Again, while all of the participation values should be used carefully considering the concerns identified above, when comparing the Low Case to the High Case, EVT expects to reach approximately 60% more customers and BED expects to reach approximately 50% more customers. Therefore, despite a greater rate increase when comparing the Low Case to the High Case, more customers are likely to experience a bill decrease in the High Case due to the higher participation rate.

Finally, the forecasts of participation rates that significantly exceed 100% by as early as 2025 point to some important implications. First, EVT and BED should attempt to determine how much of the participation is due to repeat participation. If most of these high rates are due to repeat participation, then there may be a large portion of customers that are not being served over the long-term. If this is the case, then EVT and BED should consider investigating opportunities for reaching those unserved customers over the long-term.

Second, EVT and BED should, at some point, consider the implications of assuming that the current efficiency programs savings and participation rates can simply be extrapolated so far into the future. If the efficiency programs really do serve the vast majority of existing facilities in the not-too-distant future (which is not clear yet, given limited data), should the programs be redesigned to somehow serve this important sector differently?

Figure 6.5 EVT Participation Rates by Scenario for Business Existing Facilities (2002–2034)

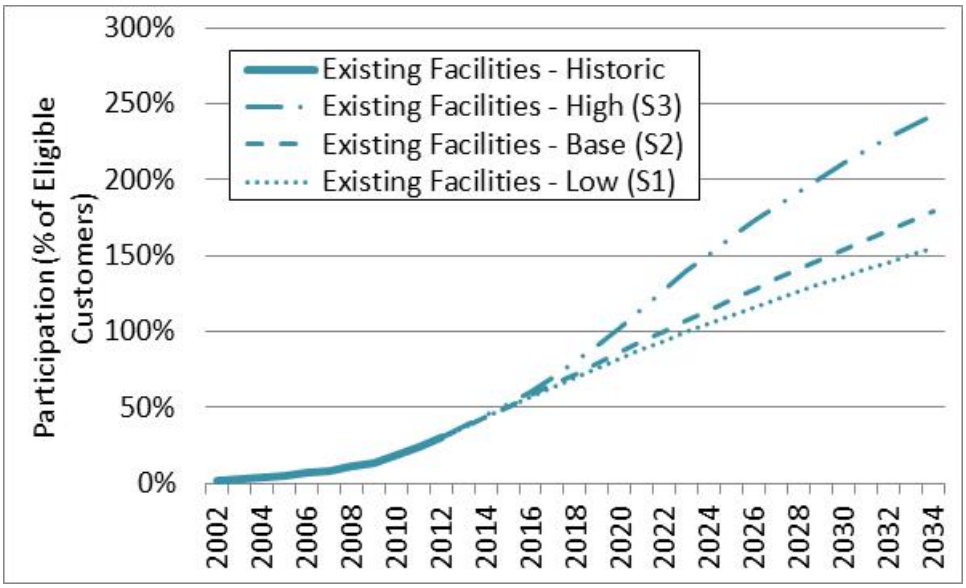
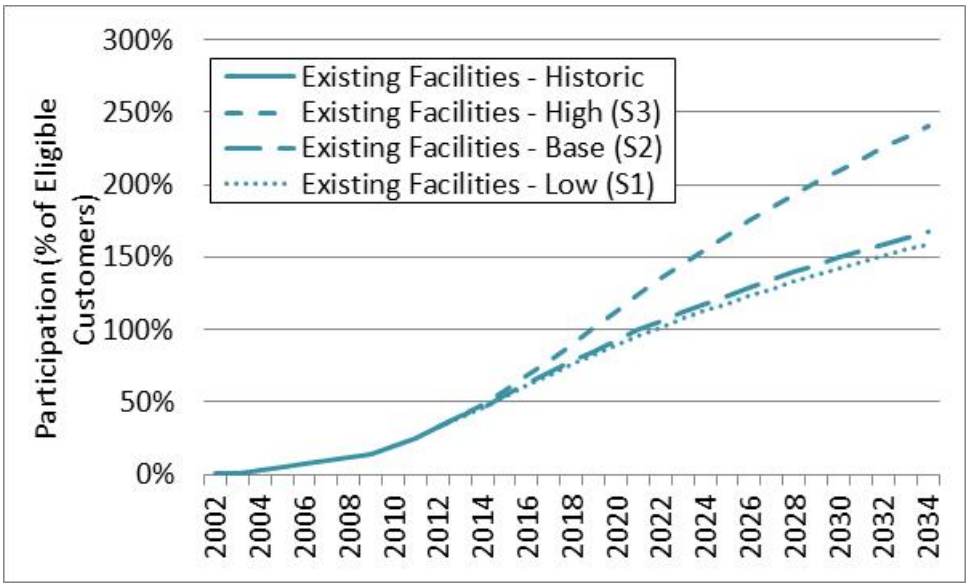


Figure 6.6 BED Participation Rates by Scenario for Business Existing Facilities (2002–2034)



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