# New Hampshire Potential Study

## Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023

### Volume I: Narrative Report

**Prepared for:**

New Hampshire Evaluation, Measurement and Verification Working Group

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## About Dunsky

Dunsky provides strategic analysis and counsel in the areas of energy efficiency, renewable energy and clean mobility. We support our clients – governments, utilities and others – through three key services: we **assess** opportunities (technical, economic, market); **design** strategies (programs, plans, policies); and **evaluate** performance (with a view to continuous improvement).

Dunsky's 30+ experts are wholly dedicated to helping our clients accelerate the clean energy transition, effectively and responsibly.

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# Executive Summary

This report presents the results of the New Hampshire potential study. The study provides a statewide overview of modeled potential for savings from energy efficiency and active demand programs over the 2021-2023 period.

The report is divided into four volumes, as outlined below:

- **Volume I:** Energy Efficiency and Active Demand Potential Study Narrative Report
- **Volume II:** Energy Efficiency and Active Demand Potential Study Appendices
- **Volume III:** Residential Market Baseline Study
- **Volume IV:** Non-Residential Market Baseline Study

Volume I provides a summary of the potential study results including key savings and budget metrics. Volume II provides and overview of study methodologies and key inputs, with the exclusion of market inputs. The study's market inputs were developed using the residential and non-residential market baseline studies completed as a component of the project, contained in Volumes III and IV.

The focus of the narrative report is on energy savings from electricity and natural gas, and on electric active demand savings. The study also quantified delivered fuel savings (including oil, propane, and kerosene) as well as peak demand savings (i.e. passive demand reductions) for electric measures, and these results are included Volume II of the report (Appendix D and Appendix E for energy efficiency and active demand results, respectively).

### 1.1.1 Study Limitations

Several study limitations which should be considered by the reader are noted below.

**Non-Residential Sector Primary Data**
The scope of the non-residential baseline study did not include comprehensive on-site data collection. Where New Hampshire specific data was not available, the Dunsky team has ensured that assumptions used in the study reflect New Hampshire conditions to the greatest extent possible by leveraging data from nearby jurisdictions and adjusting it using targeted primary data collection efforts, focused primarily on key lighting and HVAC measures. The potential study results are highly dependent on the data inputs, and consequently additional data collection will be instrumental in checking the validity of these assumptions.

**Measure List and Replacement Schedule**
The cost-effective achievable potential is based on a set of technologies and measures approved by the client. While the study seeks to provide a comprehensive view of the opportunities available in New Hampshire over the 2021-2023 study period, not all conceivable measures were included in the analysis, and instead the study focused on those expected to be cost-effective during the period, available in the market, and having the potential to be promoted through energy efficiency initiatives. For equipment-based measures, the study focused on a replace-on-failure schedule and largely did not consider the opportunity for early retirement of still-functioning equipment. NHSaves can pursue these opportunities in order to claim savings which would have materialized at a later stage. Additional

discussion of measure replacement schedules is included in the Energy Efficiency Potential Results chapter under the Measure Types heading.

### Lighting Measures

Considering the uncertainty related to the evolution of the lighting market, and related to the timing of any additional adjustments to federal or state-level lighting standards, the Dunsky team applied the assumptions developed by the New Hampshire Utilities with regards to lamps savings. Fundamentally, the assumptions used for the potential study only consider the natural evolution of market preference for LED technologies, and do not assume that new lighting standards will come in effect during the study period. For purpose of the analysis, and in accordance with utilities assumptions, the model assumes an increased natural adoption of LEDs through the study period, with a significantly higher natural adoption of LEDs in the residential sector.

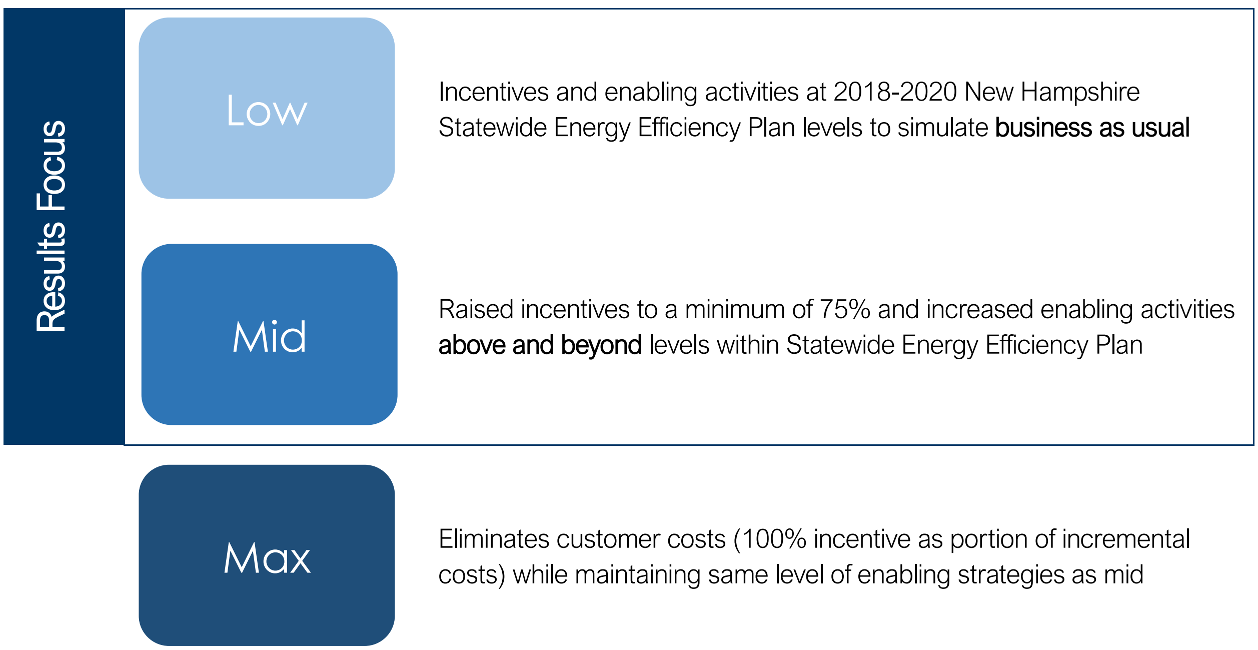
### COVID-19

The study was initiated in September 2019, prior to the onset of the COVID-19 pandemic. The lasting economic impacts of COVID-19 are still unclear but are likely to result in a significant economic slowdown. Both economic slowdowns and new social distancing practices are expected to serve to increase barriers for efficiency programs. The results provided in this report are based on pre-COVID-19 market conditions. An assessment of COVID-19 pandemic impacts on the achievable potential results is included in Section 2.5: COVID-19 Sensitivity Analysis in the main body of the report.

# E.1 Energy Efficiency

The potential for utility investment in energy efficiency programs was assessed at the Technical, Economic and Achievable levels using Dunsky's proprietary Demand and Energy Efficiency Potential (DEEP) model. Three achievable potential scenarios were assessed, each corresponding to differing levels of investments in incentives and enabling activities. The modeled scenarios align closely with existing NHSaves programs, but in some cases include novel or emerging measures not offered in current programs.  The model also does not apply any program budget constraints, thereby assessing the expected participation possible based customer economics and market barriers.  Figure 1 below outlines the three achievable potential scenarios considered in this study.

*Figure 1. Achievable Potential Scenarios*




The detailed results presented in this executive summary focus primarily on the low and mid scenarios given that these scenarios are most closely in-line with anticipated 2021-2023 NHSaves program budgets. For brevity, results are primarily presented for the first and final years of the study, 2021 and 2023. Results for three scenarios and all three years of the study are included in Appendix D of Volume II of the report, and Appendix C of Volume II includes the detailed program settings assumptions associated with each scenario.

## E.1.1 Electric Utility Program Savings

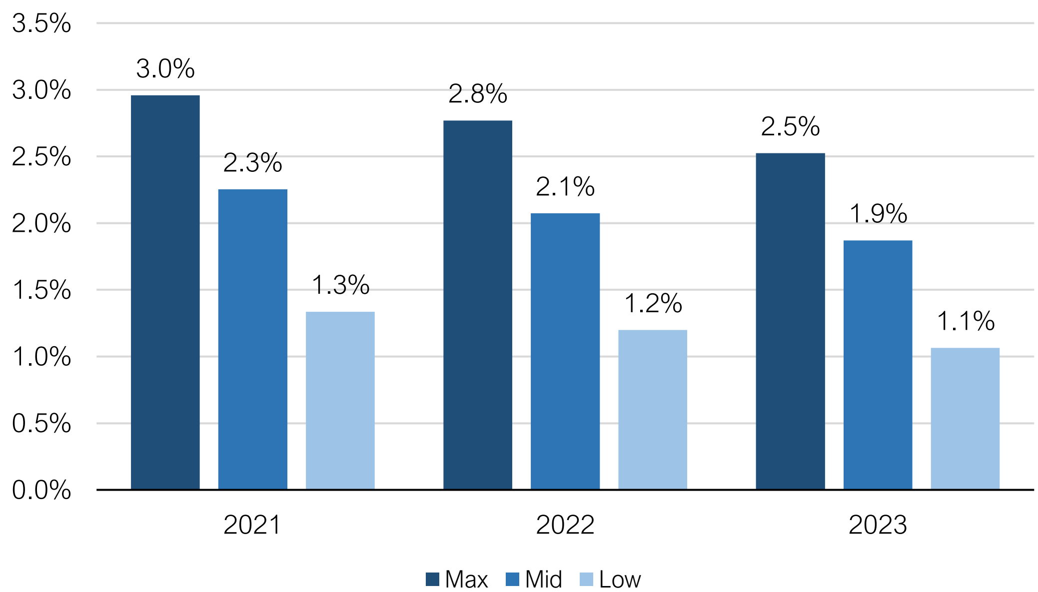
The study estimates that efficiency programs can procure between 143 GWh (low) and 315 GWh (max) of incremental annual savings in 2021, between 128 GWh and 198 GWh of incremental annual savings in 2022, and between 115 GWh and 263 GWh of incremental annual savings in 2023, as outlined in Table 1 below. For context, NHSaves programs achieved portfolio-wide electric savings of 124 GWh in 2019.

*Table 1. Annual Incremental Electric Program Savings by Scenario, Year*

| Scenario | 2019 Electric Savings (GWh) | 2021 Electric Savings (GWh) | 2022 Electric Savings (GWh) | 2023 Electric Savings (GWh) |
|---|---|---|---|---|
| Max | | 315 | 198 | 263 |
| Mid | | 240 | 220 | 198 |
| Low | | 143 | 128 | 115 |
| Actual Program | 124 | | | |

Savings as a percent of sales is one of the target metrics included in the NHSaves three-year program plans. Below, Figure 2 presents the modeled potential electricity savings as a percent of electricity sales for the first and last years of the study.

*Figure 2. Electricity Savings as a Percent of Sales*[1]




Savings range from 1.1% of sales to 3.0%, varying by scenario and year. For context, 2019 actual kWh savings represented 1.17% of 2019 sales. The modeled savings as a percent of sales show a decrease across all scenarios in the final year of the study. The decrease in savings seen across all scenarios over time is primarily a result of reduced claimable lighting savings in the residential sector.

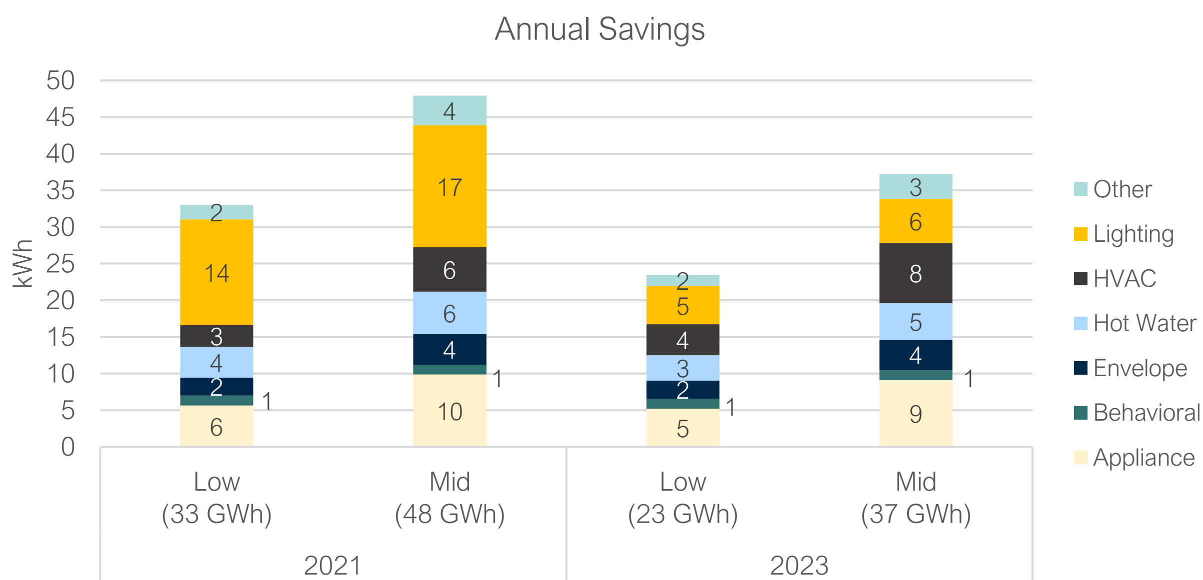
### Residential

Figure 3 below presents annual residential savings by end use for years 2021 and 2023 under the low and mid scenarios. It shows that as the study progresses lighting savings comprise a decreasing portion of the overall savings. Moreover, end uses other than lighting tend to show a larger increase between the low and mid scenario. This results from investments in programs which increase incentives and fund

[1] Savings are shown as percent of forecasted sales in that year (e.g. 2021 savings are shown as a percent of 2021 sales, 2023 savings as a percent of 2023 sales).

enabling strategies, improving customer cost-effectiveness and reducing market barriers to customer participation.

*Figure 3. Annual Residential Electricity Savings by End Use, Low and Mid Scenario*




Note: The 'Other' category includes advanced power strips and pool pumps

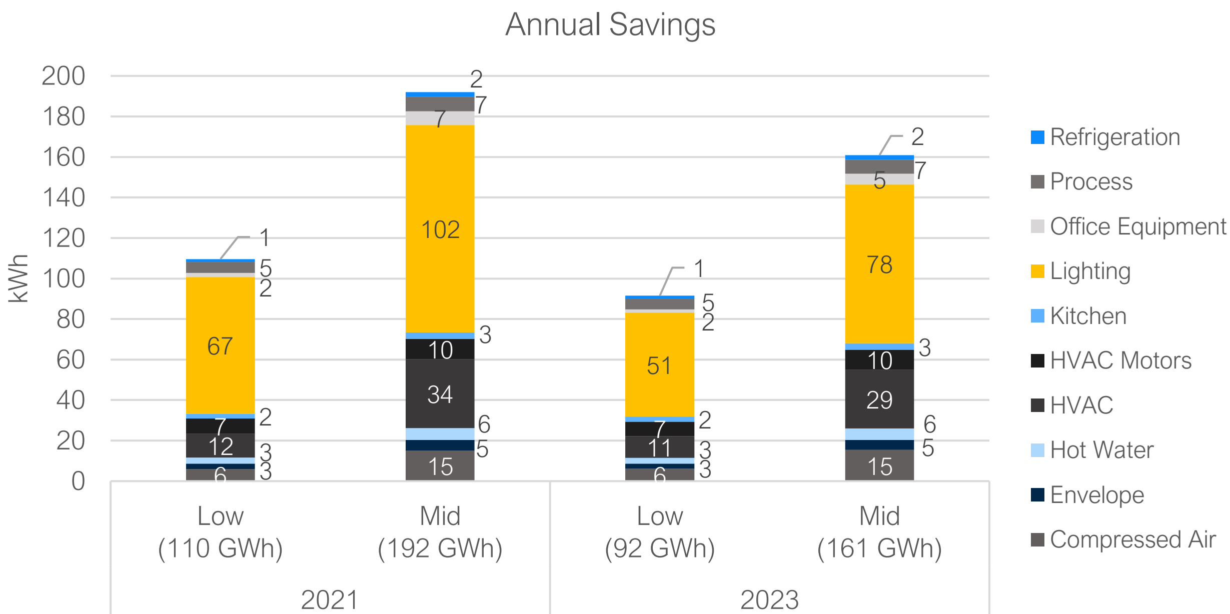
Lighting remains an important end use under both the low and mid scenarios in 2021, however these savings decline over time as natural adoption decreases claimable savings opportunities. Those end uses with low cost-effectiveness and high market barriers see the greatest growth between the low and mid scenarios in response to increased program incentives and increased spending on enabling strategies, notably the 'other', HVAC, and appliance end uses. Key measures include advanced power strips, refrigerators and refrigerator recycling, heat pump and electric resistance clothes dryers, and mini-split and groundsource heat pumps.

The hot water end use to represents considerable savings under both scenarios. Key measures include thermostatic restrictor shower valves, low flow showerheads, heat pump water heaters, and faucet aerators.

## Non-Residential

Figure 4 below presents annual non-residential savings by end use for the years 2021 and 2023 under the low and mid scenarios. It shows that overall, non-residential savings continue to be derived primarily from lighting measures, and that these are largely sustained over the study period.

*Figure 4. Non-Residential Annual Electricity Savings by End Use, Low and Mid Scenario*




Although natural uptake of tubular LEDs (TLEDs) is increasing in the non-residential sector, there has not yet been the same level of market transformation as has been seen with A-lamps and speciality bulbs. As a result, programs that promote efficient commercial lighting technologies are expected to continue to offer signfiicant savings potential over the study period.

Under the low scenario, non-lighting end uses do not grow between 2021 and 2023. As lighting savings decrease, savings from other end uses remain constant or – in the case of HVAC measures – actually decrease, reducing savings overall.

Moving from the low to the mid scenario, however, growth can be noted across the end uses. Beyond lighting, HVAC shows the greatest absolute growth between low and mid scenarios, followed by compressed air and office equipment, indicating that these end uses represent considerable pools of savings available for programs to capture. Non-residential savings from increased equipment efficiency have diminished greatly from historic levels as a result of improved equipment standards. Instead, non-residential opportunities are increasingly focused on control and optimization of equipment and operational measures, including variable frequency drives, retro-commissioning, strategic energy management, and energy management systems, all of which show increased potential under the mid scenario.

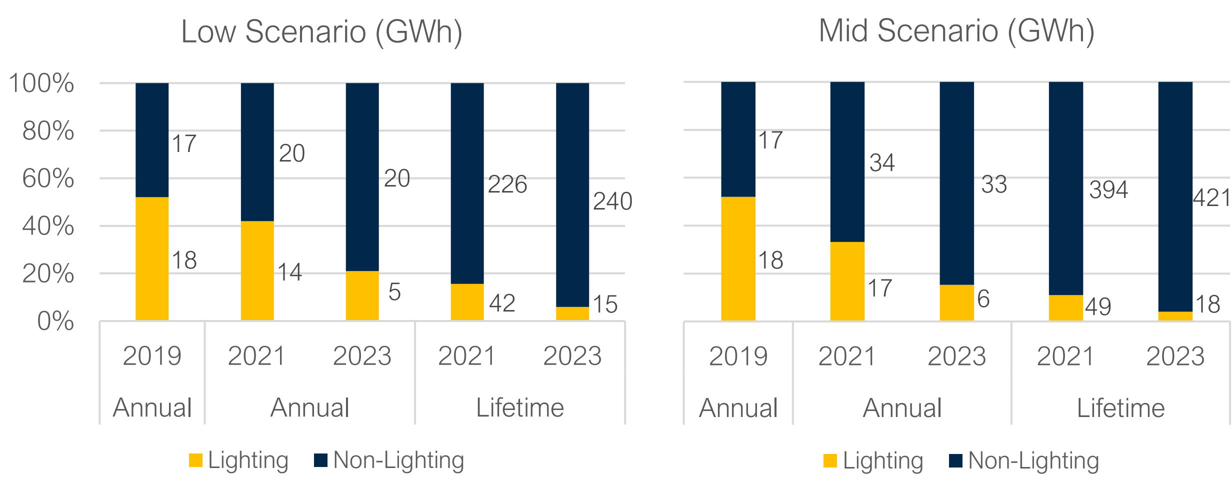
## E.1.2 Summary of Lighting Savings

Given the historical importance of lighting savings in efficiency programs and the rapidly evolving lighting market, particular attention was paid to assessing lighting's contribution to the overall program savings.

### Residential Lighting Savings

In the residential sector, lighting accounts for 42% of annual program savings in 2021 but declines to just 21% by 2023 under the low scenario. Similarly, under the mid scenario lighting declines from 33% of annual savings in 2021 to 15% in 2023. Under both scenarios, the relative and absolute lighting savings decrease from actual 2019 program achievements.

*Figure 5. Lighting as a Share of Overall Residential Annual Savings for Low and Mid Scenario*

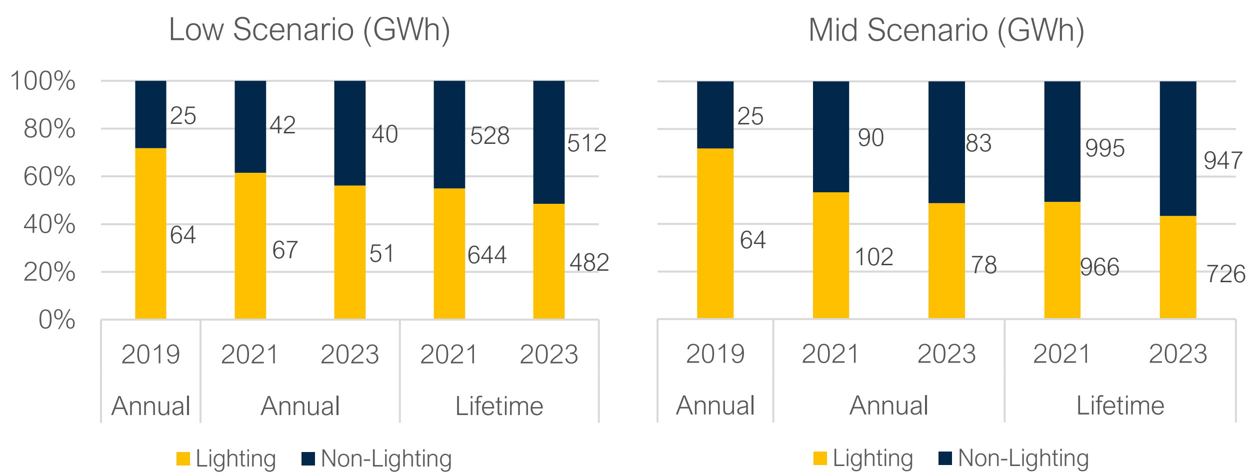



These declines are a result on the lighting market's continued transformation, leading to increased natural adoption LED technologies. The share of savings represented by lighting also decreases from the low to the mid scenario as a result of the mid scenario's increased incentives and investments in enabling strategies, which promotes the adoption of more non-lighting measures. Lighting makes up a smaller portion of lifetime savings given the relatively short measure life of residential lighting measures.

### Non-Residential Lighting Savings

In the non-residential sector, lighting continues to play a central role in driving program savings, accounting for 61% of annual savings in 2021 and 56% in 2023 under the low scenario. Under the mid scenario, greater adoption non-lighting measures supported by increased incentive levels reduce the role of lighting, which contributes 53% of 2021 savings and 49% of 2023 savings. Absolute lighting savings increase from historic 2019 savings levels, but non-lighting measure savings increase as well. As a result, lighting saving under the modeled scenarios account for smaller portion of overall savings as compared to 2019 program levels.

*Figure 6. Lighting as a Share of Overall Non-Residential Annual Savings for Low and Mid Scenario*




Key non-residential lighting measures include linear LEDS, LED luminaires, and lighting controls. Lighting controls offer a considerable opportunity for programs[2] but will require specialized program delivery to ensure controls are properly installed and calibrated, to increase customer education, and to avoid technical challenges such as product compatibility.

### E.1.3 Natural Gas Utility Program Savings

The study estimates that efficiency programs can procure between 206 thousand MMBtu (low scenario) and 517 thousand MMBtu (max scenario) of incremental annual savings in 2021, between 206 thousand MMBtu and 514 Thousand MMBtu of incremental annual savings in 2022, and between 197 thousand MMBtu and 493 thousand MMBtu of incremental annual savings in 2023, as outlined in Table 2 below. For context, the NHSaves programs achieved portfolio-wide natural gas savings of 209 Thousand MMBtu in 2019.

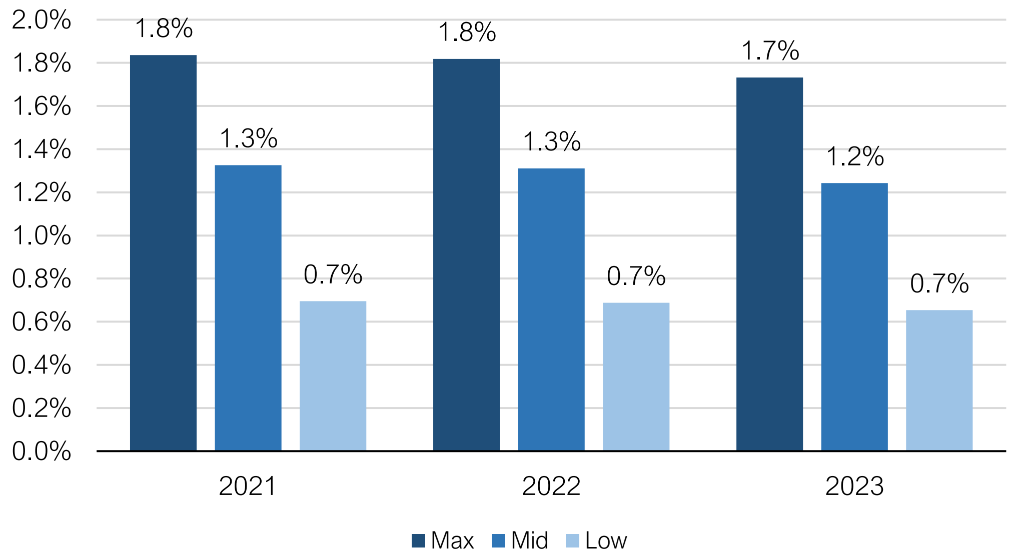
*Table 2. Annual Incremental Natural Gas Program Savings by Scenario, Year*

| Scenario | 2019 Natural Gas Savings (Thousand MMBtu) | 2021 Natural Gas Savings (Thousand MMBtu) | 2022 Natural Gas Savings (Thousand MMBtu) | 2023 Natural Gas Savings (Thousand MMBtu) |
|---|---|---|---|---|
| Max | | 517 | 514 | 493 |
| Mid | | 378 | 376 | 360 |
| Low | | 206 | 206 | 197 |
| Actual | 209 | | | |

Figure 7 below presents the modeled potential natural gas savings as a percent of natural gas sales for the first and last years of the study.

[2] Controls represent 22% of average annual 2021-2023 potential under the low scenario, 33% under the mid scenario.

*Figure 7. Natural Gas Savings as a Percent of Sales[3]*



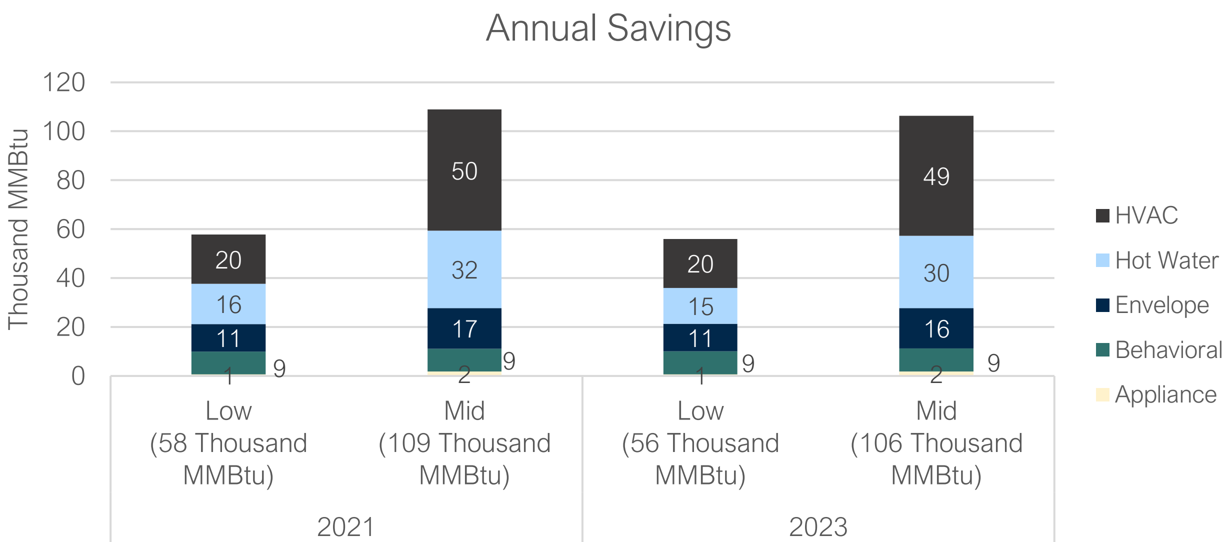

Savings range from 0.7% of sales to 1.8%, varying by scenario and year. The modeled savings as a percent of sales show a decrease across all scenarios in the final year of the study. This decrease is primarily a result of a new Federal standard for furnaces coming into effect in 2023, which shifts the baseline and decreases claimable savings.

### Residential

Within the residential sector, the majority of natural gas savings result from increased space heating efficiency – either through HVAC equipment or envelope improvements. Figure 8 below presents annual residential savings by end use for the years 2021 and 2023 under the low and mid scenarios.

[3] Savings are shown as a percent of forecasted sales in that year (i.e. 2021 savings are shown as a percent of 2021 sales, 2023 savings as a percent of 2023 sales).

*Figure 8. Residential Annual Natural Gas Savings by End Use, Low and Mid Scenarios*



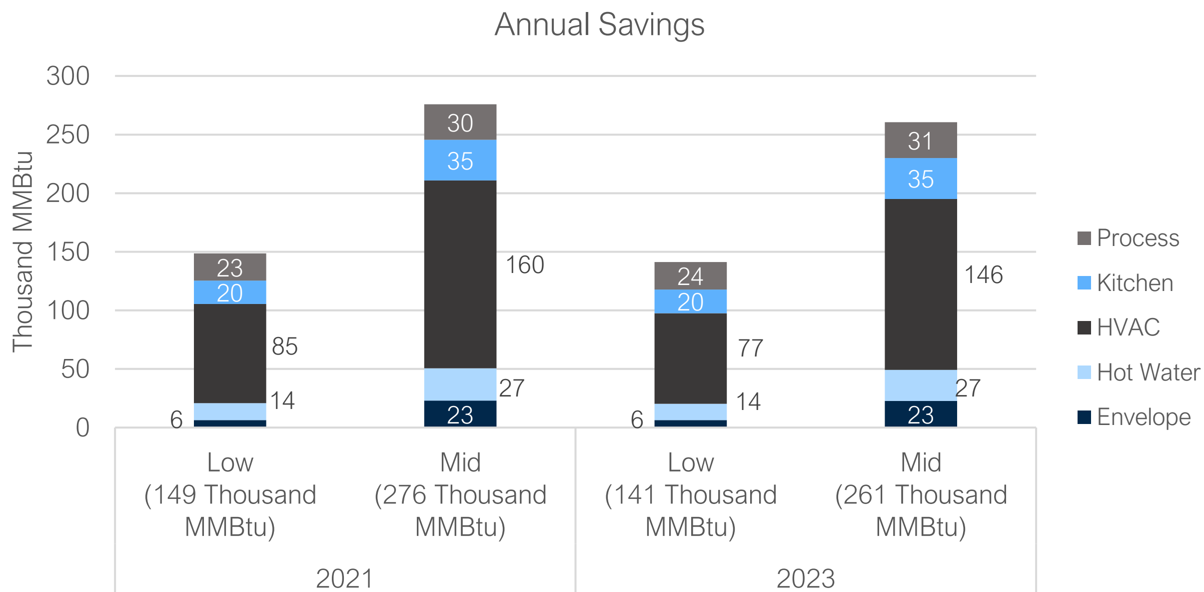

The HVAC end use is the largest single source of residential natural gas savings under both the low and mid scenarios in 2021 and 2023, and shows considerable growth between the low and mid scenarios. Key HVAC measures include furnaces, boilers, and wi-fi thermostats. The hot water end use represents the next largest end use, which is currently largely untapped by programs. Key measures include low flow fixtures (faucets and showerheads), along with efficient water heaters.

Envelope savings grow more slowly between low and mid scenarios but maintain a large share of annual savings under both scenarios, indicating limited responsiveness of measures in this end use to further incentive improvements and enabling strategies. Key envelope measures include insulation and incentives for new construction, although savings also arise from air sealing and efficient windows.

### Non-Residential

The HVAC end use represents the majority of non-residential natural gas savings. Figure 9 below presents annual non-residential savings by end use and scenario for years 2021 and 2023.

*Figure 9. Non-Residential Annual Natural Gas Savings by End Use, Low and Mid Scenarios*




HVAC savings are derived primarily from various heating equipment measures (including condensing make-up air units, waste heat recovery, and rooftop units). A drop in HVAC savings can be seen in 2023 when the Federal standard for furnaces comes into effect, shifting the baseline and decreasing claimable savings.

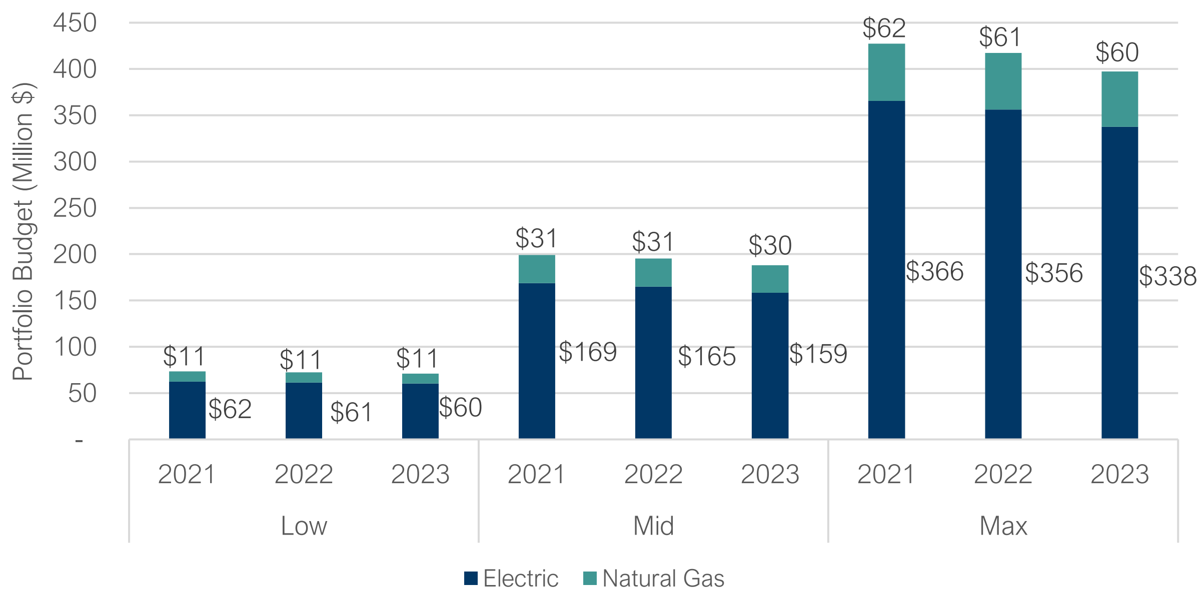
Envelope savings show the highest relative change between low and mid scenario, while process savings grow at a slower rate between the low and mid scenarios than the other end uses but remain a considerable opportunity (particularly on an annual savings basis). Process measures include steam traps, controls, and assorted custom measures.

The kitchen end use also shows high potential. Key measures include fryers, convection ovens, and dishwashers. As would be expected, kitchen opportunities are focused in specific segments and would likely benefit from targeted program campaigns.

### E.1.4 Portfolio Costs and Benefits

The study estimates that efficiency program costs will range between $73 and $428 million in 2021, and $71 and $398 million in 2023 depending on the scenario. Similar to current efficiency spending, the majority of this budget is forecasted to be directed toward the electric efficiency programs (which also includes delivered fuel measures) as seen in Figure 10 below.

*Figure 10. Estimated Program Costs by Year, Scenario*




Relative to 2019 NHSaves programs, which had a total budget of $57 million, the study results indicate that higher spending levels will be needed to achieve the savings potentials across all scenarios. In addition to larger budgets, the average cost of per unit savings increases under all scenarios for both electric and natural gas programs, outlined in Table 3 below.

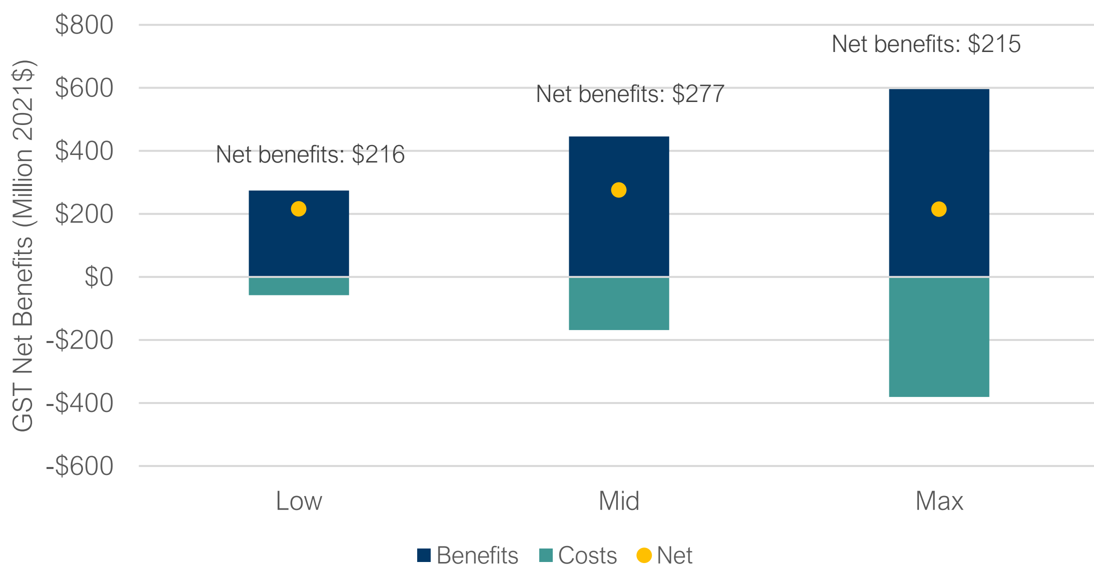
*Table 3. Average Estimated Savings Unit Cost by Year, Scenario*

| Portfolio | Scenario | 2021 | 2022 | 2023 | Average | 2019 Results |
|---|---|---|---|---|---|---|
| $ per Incremental Annual kWh | Low | $0.43 | $0.47 | $0.52 | $0.47 | $0.38 |
| | Mid | $0.70 | $0.74 | $0.79 | $0.74 | |
| | Max | $1.15 | $1.21 | $1.27 | $1.21 | |
| $ per Incremental Annual MMBtu | Low | $54 | $54 | $56 | $55 | $48 |
| | Mid | $81 | $82 | $85 | $83 | |
| | Max | $119 | $120 | $125 | $121 | |

The increased costs over time under all scenarios can primarily be explained by the reduction in A-Lamp savings, which generally have low per unit savings costs. Between scenarios, the unit cost of savings will also increase for two further reasons. First, raising incentives will increase cost not just for newly acquired savings, but also for savings that would have been achieved under lower incentive levels and thus at a lower per unit cost. Second, the higher incentives and investments in enabling strategies may drive more uptake of measures with higher costs per unit savings. However, the precise magnitude of cost increases under these scenarios should be interpreted with a degree of caution given that fixed and variable program costs metrics are based on historical cost data and do not account for how these metrics may change in the future. In addition, program scenarios are not optimized for program spending, but rather all measures within a given program are assigned the same incentive level.

In all scenarios, investments in efficiency programs are seen to generate significant benefits. Based on the Granite State Test, the average benefits generated each program year range from $216 (low scenario) to $642 (max scenario) million as shown in Figure 11. The mid scenario shows the highest net benefits, which highlights the diminishing returns from increased spending under the max scenario, where participant costs are completely eliminated.

*Figure 11. 2021-2023 Average Lifetime Granite State Test Benefits Generated Each Year by Scenario*




## E.1.5 Key Takeaways – Energy Efficiency Programs

**Claimable lighting savings decline over the study period due to an evolving lighting market but remain an important component of non-residential programs.** As natural adoption of LEDs increases over time, program savings contributions from lighting decrease. This decline is most pronounced in the residential sector given the rapid evolution of the standard A-lamp and speciality lighting market. Non-residential lighting measures (notably tubular LEDs) have not seen the same level of market transformation as A-lamps and specialty bulbs, and consequently lighting continues to play an important role in non-residential programs. In addition to bulbs and fixtures, considerable opportunities to reduce hours of use through lighting controls are noted.

**There is room to grow electric efficiency program savings through other end uses as lighting savings decline.** In the residential sector, heat pump, appliance, and advanced power strip measures show potential for increased electric savings as program spending increases to mid scenario levels. In the non-residential sector, claimable savings opportunities from increased equipment efficiency have diminished greatly from historic levels as a result of improved equipment standards. Instead, electric savings opportunities transition to a focus on control and optimization of equipment and operational measures, including variable frequency drives, retro-commissioning, strategic energy management, and energy management systems.

**Improvements in space heating efficiency – both from HVAC equipment and envelope measures - represent a key source of natural gas savings across all sectors.** The residential sector savings are focused on heating equipment, wi-fi thermostats, insulation and air sealing measures. As with electric savings, non-residential natural gas savings are increasingly found in controls measures, including energy management systems, building management systems, and ventilation controls. Hot water is also noted to have considerable residential and non-residential savings opportunities that have been largely been untapped by programs to date, although this potential should be verified in the non-residential sector through additional New Hampshire-specific primary data collection.

**Programs will need to adjust in the face of transforming A-lamp and specialty lighting markets, which will impact program costs.** Relative to 2019 NHSaves programs, the study estimates an increase in spending across all achievable potential scenarios. In addition to larger budgets, the average cost of savings also increases for both electric and natural gas measures as lighting savings decrease and investments in incentives and enabling strategies grow. Even though budgets and per unit cost of savings increase, programs are expected to provide considerable net benefits to the state of New Hampshire.

**A high-level sensitivity analysis was performed to determine the impact that COVID 19 may have on the potential savings assessments described in this study.** Overall, it was found that COVID-19 could reduce overall savings by 20% to 41% in 2021 and 14% to 30% in 2023, although these reductions are highly dependent on the evolution of the COVID-19 pandemic.  It was also noted via recent survey efforts that this effects may be more pronounced in some segments than others.

# E.2 Active Demand Reduction Potential

The active demand reduction potential is assessed using Dunsky's Demand Response Optimized Potential (DROP) Model to determine potential impacts against New Hampshire's contribution to the ISO NE system annual peak demand. A standard peak day load curve is identified and adjusted to account for projected load growth and efficiency program impacts over the study period. Nine years of historical annual hourly load data are used to determine the timing, duration and magnitude of typical annual peaks.

The achievable potential is assessed under three scenarios, corresponding to varied active demand program approaches and levels of investment, to determine the resulting peak demand reduction impacts and benefits.

*Figure 12. Active Demand Program Scenario Descriptions*

| | |
|---|---|
| Low | Current active demand programs and incentives[4], when applied to the full applicable market as projected using current incentive levels applied to the DROP model's propensity curves. |
| Mid | Expanded active demand reduction programs including new measures, and increased incentives for existing measures that correspond to the mid-point between current incentives and the maximum scenario incentives, or – for new scenarios - benchmarked to other jurisdictions. |
| Max | Expanded DR programs, applying the maximum incentive level that still yield cost-effective measures as per a Granite State Test threshold of 1.0 |

In addition, a high-level assessment of the monthly peak reduction potentials was also conducted by determining the degree to which the annual peak load reduction program could be applied against each month's peak hour.

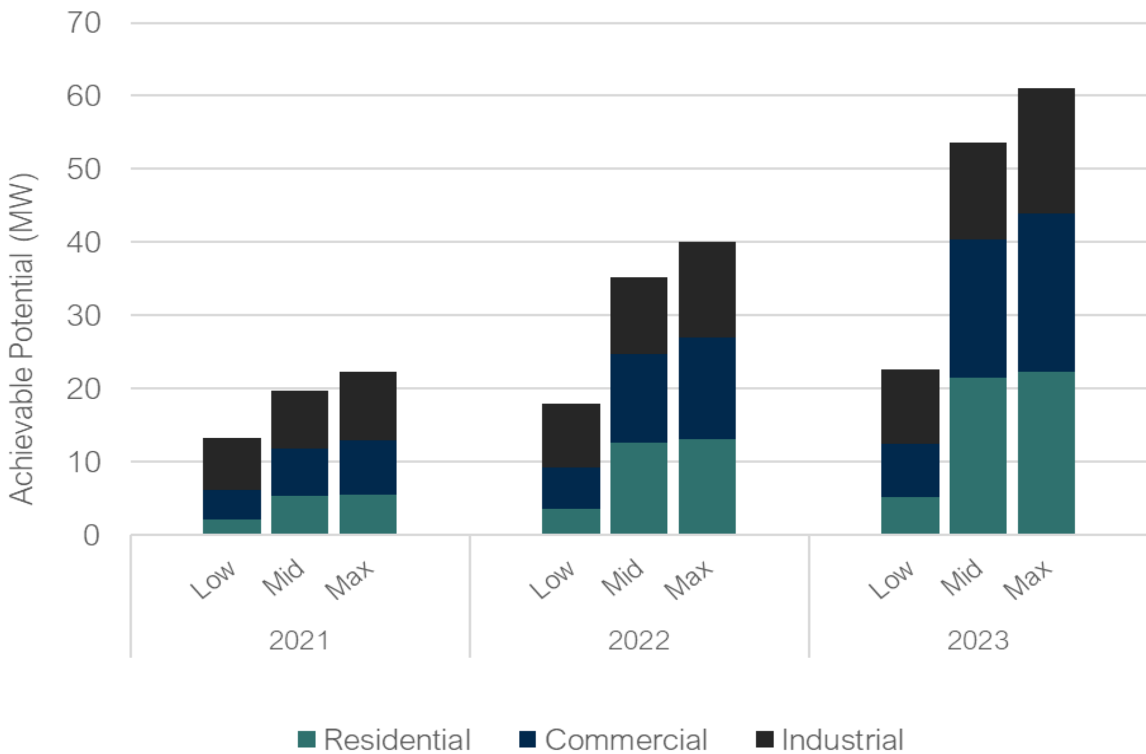
### E.2.1 Active Demand Reduction Potential Results

The overall achievable potential in each year for each scenario is presented below. These results represent the combined peak load reduction from all cost-effective programs assessed against the ISO-NE load curve, accounting for interactions among programs and ramp-up schedules for new measures and programs. A description of each measure and program, along with the individual measure technical and economic potentials in each market segment are provided in Appendix C.

[4] Incentives were based on 2020 incentive levels from Eversource

Under the low scenario, which focuses on New Hampshire's current programs[5] expanded across the full applicable markets, the potential is estimated to grow from 14 MW in 2021 to 23 MW in 2023, which represents 1.0% of New Hampshire's statewide peak demand in 2023. Program spending is projected to range between $1 to $2 million per year, which is within range of the $1.5 of planned spending by New Hampshire utilities in 2020. The mid and max scenarios introduce new measures along with increased incentive levels, which leads to significant increases in the achievable potential, reaching 54 MW and 61 MW in 2023 respectively, representing 2.2% and 2.6% of New Hampshire's statewide peak demand. Based on these results, the scenario analysis indicates that expanding the number and types of programs offers significantly more peak reduction potential than simply expanding the current programs.

*Figure 13. Achievable Potential by Sector, Scenario, and Year*




The Granite State Test was applied to assess the cost-effectiveness of the active demand reduction programs, using a benefit-cost ratio threshold 1.0, and assuming a 9-year measure/program life with a 3-year contract cycle (to account for participant attrition and new recruitment costs).[6] Table 4 below provides the cost-effectiveness results for each scenario, accounting for the costs and benefits for both existing and newly added active demand reduction program capacity in each year.

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[5] Based on the Utilities' 2019 active demand programs

[6] It is assumed that after each contract cycle, some participants will drop out of the program (5% for C&I customers, 15% for BYOD programs and 10% for DLC programs)

*Table 4. Active Demand Reduction Program Granite State Test Results by Year*

| Scenario | 2021 | 2022 | 2023 |
|---|---|---|---|
| Low | 2.4 | 2.4 | 2.4 |
| Mid | 1.0 | 1.0 | 1.1 |
| Max | 0.7 | 0.7 | 0.8 |

The Granite State Test results show that while the max scenario provides the most peak reduction potential, the mid and low scenarios are more cost-effective. A few key observations are noted below:

- **The low scenario is cost-effective throughout the study period.** The Granite State Test values increase in later years as more participants enroll in the program, and as enrollment costs diminish.

- **The mid scenario is marginally cost-effective, but trends toward increased cost-effectiveness as the study period progresses.** This is because the expanded programs benefit from the upfront cost investments made in the initial years, and simply require customer incentives to maintain participation after that.

- **The max scenario does not prove cost-effective over the program lifetime.** More substantial upfront costs and higher annual incentives result in a portfolio does not pass the GST threshold for cost-effectiveness under New Hampshire's current framework.

Overall, these results show that there is remains a significant amount of cost-effective active demand reduction potential in New Hampshire - up to 61 MW of annual peak reduction by 2023, which is a 54 MW increase from the 2019 achieved reduction through current active demand reduction programs.

### E.2.2 Key Findings

Based on the findings in this report, four key takeaways emerge:

- **Expanding industrial and commercial curtailment offers the most active demand reduction potential.** The non-residential sector offers the most potential, and is the most cost-effective option to obtain further active demand reduction. Expanding the offer within the sector represents low-hanging fruit which can be realized via increased incentives ($/MW) and offering incentives to enable gas-fired backup generators to be engaged during peak events.

- **There is significant room for growth in the residential sector.** WiFi thermostats remain an important contributor to the residential achievable potential. This potential can be realized by leveraging customer-owned thermostats through a BYOD program and by reaching out to customers that have not adopted the advanced thermostat technology to provide them with fully subsidized devices under a multi-year DLC program contract. Integrating the efficiency incentives and annual active demand reduction program participation incentives could also serve to increase enrollment in the BYOD program even further. Residential pool pump DLC also contributes significantly to active demand reduction potential in the residential market (with smart pool pump, simple timer, and smart switch models).

- **An important part of the active demand reduction potential can be achieved on a monthly basis with an appropriate program design.** The results indicate that a little over half of the annual peak potential can be maintained on a monthly basis over the winter and shoulder seasons. Furthermore, from May though September the monthly peak approaches the annual peak as these months typically exhibit summer season peak day load curves with substantial late afternoon cooling demands.

- **Measures that can persist later in the afternoon should be prioritized.** With the advent of new loads such as electric vehicles or solar PV, the New Hampshire and ISO-NE peak hour appears to be shifting towards a later peak time (i.e. from 4pm to 5pm). When developing new programs and measures, close attention should be paid to ensure that they are able to deliver savings under the shifted peak timing.

Overall, these finding indicate that both expanding to new programs and increasing incentives have an important role in increasing active demand potential in New Hampshire.

# 2 Introduction

## 2.1 Study Overview

This report presents the results of the New Hampshire Potential Study. The study provides a statewide overview of modeled potential for savings from energy efficiency and active demand programs over the 2021-2023 period.

The project included primary data collection, described in the New Hampshire Market Baseline section below. The data collected was used as an input to the potential study modelling process, described in detail in Volume II of the report.

Eversource, Unitil, Liberty, and the New Hampshire Energy Cooperative ('the utilities') have been operating energy efficiency programs under the NHSaves brand since 2000. An Energy Efficiency Resource Standard was adopted in the state in 2016, requiring the utilities to file triennial plans, meet annual savings goals, and – as a long-term objective – capture all cost-effective energy efficiency in the state. The plans divide program design and funding by electric and gas utilities (with electric utilities also pursuing delivered fuel savings in the residential sector), and the presentation of results in this study reflect this split.

The potential study is a high-level assessment of electric, natural gas, and delivered fuel savings opportunities in the State of New Hampshire over the next three years, and the results are expected to inform the NHSaves 2021-2023 triennial plan. The main purpose of the potential assessment component of the study is to quantify the opportunities for energy efficiency and electric active demand. In addition to this objective, the potential study can also support:

- Resource planning
- Program planning
- State policy and strategies

While the potential study provides granular information such as savings for specific measures in specific building segments, the study is not a program design document meant to accurately forecast and optimize savings and spending through utility programs in a given future year. The study is meant to quantify the total potential opportunities that exist under specific parameters as defined under each scenario.

### 2.1.1 Report Structure

The report is divided into four volumes, as outlined below:

- **Volume I:** Energy Efficiency and Active Demand Potential Study Narrative Report
- **Volume II:** Energy Efficiency and Active Demand Potential Study Appendices
- **Volume III:** Residential Market Baseline Study

- **Volume IV:** Non-Residential Market Baseline Study

Volume I provides a summary of the potential study results including key savings and budget metrics. Volume II provides and overview of study methodologies and key inputs, with the exclusion of market inputs. The study's market inputs were developed using the residential and non-residential market baseline studies completed as a component of the project, contained in Volumes III and IV. The market baseline studies are also described briefly within the narrative report in the New Hampshire Market Baseline section.

### 2.1.2 COVID-19 Considerations

The study was initiated in September 2019, prior to the onset of the COVID-19 pandemic. The pandemic did not impact residential data collection activities but did interrupt data collection for the non-residential sector. This interruption is described in more detail in the Non-Residential Baseline Study section.

The lasting economic impacts of COVID-19 are still unclear but are likely to result in a significant economic slowdown. Both economic slowdowns and new social distancing practices can serve to increase barriers for efficiency programs. The results provided in this report are based on pre-COVID-19 market conditions. An assessment of COVID-19 pandemic impacts on the achievable potential results is included in Section 2.5: COVID-19 Sensitivity Analysis.

## 2.2 Data Sources and Uses

The study uses New Hampshire-specific data to populate the models used to estimate market potential. Where New Hampshire-specific data was not available or is insufficient, data from nearby jurisdictions was leveraged to fill gaps and produce a more robust representation of market parameters in the study.

| Data source | Application in study |
|---|---|
| Utility customer data | Customer data is used to determine the number of customers in each market segment. |
| New Hampshire market baseline survey data | Recent baseline survey studies conducted in New Hampshire (outlined in more detail in the following sections) are used to establish equipment penetration and saturations in the model for select end uses. |
| Utility Benefit Cost Ratio Models | The study uses measure-level benefit-cost ratio model workbooks provided by the utilities to derive avoided cost and other economic inputs, net-to-gross values and realization rates, as well as to benchmark results. |
| NHSaves program data | Historical program data is used to characterize programs for model input (e.g. incentive levels, administrative costs) and used to benchmark results. |
| Historical load | Historical hourly load data was used to assess peak demand and evaluate demand response potential. |

| Data source | Application in study |
|---|---|
| U.S. DOE Building Archetypes | Buildings archetypes, adjusted for New Hampshire climate and consumption, were used to provide end use breakdown and for quality control purposes. |
| Dunsky's Market Archetype | Where New Hampshire specific baseline data is not available (or was based on a low number of observations), baseline data from neighboring jurisdictions in the Northeast United States is leveraged and adjusted for New Hampshire specific attributes wherever possible. |

## 2.3 New Hampshire Market Baseline

### 2.3.1 Residential Baseline Study

The residential baseline study was conducted by Itron and characterized energy-using equipment in New Hampshire homes. The study also assessed the extent to which these equipment baselines differ from those in neighbouring jurisdictions.

The study used a mobile-optimized web survey to collect data on building characteristics, equipment saturation, and photos of equipment nameplates. The equipment nameplate photographs were then compared to an in-house database to verify key metrics ((including vintage, capacity, and efficiency).

The survey segmentation was broken down by utility, housing type (single-family vs. multifamily), and climate zone, and low-income customers were flagged. Detailed saturation and efficiency results from the study were used as inputs to the potential study and are provided in the report, the *New Hampshire Residential Baseline Study*.

### 2.3.2 Non-Residential Baseline Study

The scope of the non-residential baseline study did not include comprehensive on-site data collection. Instead, the team proposed an innovative approach which relied heavily on secondary sources from the numerous recent studies in neighboring jurisdictions. The Dunsky Energy Efficiency Potential model utilizes over 200 individual metrics for equipment saturation, penetration, and efficiency applied across each of the non-residential segments. For this study, the data sources vary by metric but generally fall into one of three categories:

- Value from a previous study in similar jurisdictions (Dunsky Northeast Market Archetype)
- Value derived directly from NH customers or data
- Value derived through engineering principles or professional judgment

The team initially populated each of the metrics with secondary research values from similar studies and then reviewed and adjusted key metrics according to the findings of the limited additional primary data collected for the study, with adjustments being made if additional research found New Hampshire to have unique values as compared to the pre-populated archetype. This primary data collection included interviews with 21 trade allies who have non-residential customers in both Massachusetts and New Hampshire who could speak about the sales activity and their perception of the evolution of the market/demand for efficient technologies in both markets and interviews with representatives from industrial facilities, and was supplemented through primary data collection included computer-assisted telephone interviews (CATIs) with C&I facility personnel.

The primary data collection for the non-residential sector was interrupted by the COVID-19 pandemic. As a result, the number of interviews with industrial customers and the number of CATI survey completes were much lower than originally planned[7]. In addition, the CATI surveys were focused on small non-residential customers. As a solution, the team compared these results to similar surveys that had recently been completed in Massachusetts to assess variation in customer responses based on size. The analysis found limited differences in responses due to customer size, and therefore concluded that the results collected for the small non-residential customers could be generalized to all sizes of non-residential customers.

In general, the team used equipment penetration and saturation data from Dunsky's Market Archetype, and adjusted metrics only when there was a compelling case to do so based on direct data or market knowledge. A detailed description of research activities and adjustments made are provided in the *New Hampshire Non-Residential Baseline Memo*. The specific metrics used as the commercial baseline, including their sources, are identified in the *New Hampshire Non-Residential Baseline Metrics Workbook*.

#### 2.3.2.1 Non-Residential Sector: Suggestions for Future Research

The primary research completed for this project focused on gathering data specific to end uses with high savings potential and/or markets that are evolving quickly, namely lighting and HVAC. Future primary research specific to New Hampshire will be important to ensure that the assumptions informing program design strategies are accurate. In particular, the following areas are recommended for additional data collection activities:

- Linear LED saturation
- Primary water heating fuels
- Primary space heating fuels

## 2.4 Study Limitations

**Non-Residential Sector Primary Data**

As noted in the New Hampshire Market Baseline section above, non-residential sector primary data collection was limited. Where New Hampshire specific data was not available, the Dunsky team has ensured that assumptions used in the study reflect New Hampshire conditions to the greatest extent possible by leveraging data from nearby jurisdictions and adjusting it using targeted primary data collection efforts, focused primarily on key lighting and HVAC measures. The potential study results are

[7] Interviews were completed with 35 customers out of a target of 75. The CATI survey only gathered 149 completes out of a target of 600.

highly dependent on the data inputs, and consequently additional data collection will be instrumental in checking the validity of these assumptions.

### Measure List and Replacement Schedule

The cost-effective achievable potential is based on a set of technologies and measures approved by the client. While the study seeks to provide a comprehensive view of the opportunities available in New Hampshire over the 2021-2023 study period, not all conceivable measures were included in the analysis, and instead the study focused on those expected to be cost-effective during the period, available in the market, and having the potential to be promoted through energy efficiency initiatives. For equipment-based measures, the study focused on a replace-on-failure schedule and largely did not consider the opportunity for early retirement of still-functioning equipment. NHSaves can pursue these opportunities in order to claim savings which would have materialized at a later stage. Additional discussion of measure replacement schedules is included in the Energy Efficiency Potential Results chapter under the Measure Types heading.

### Lighting Measures

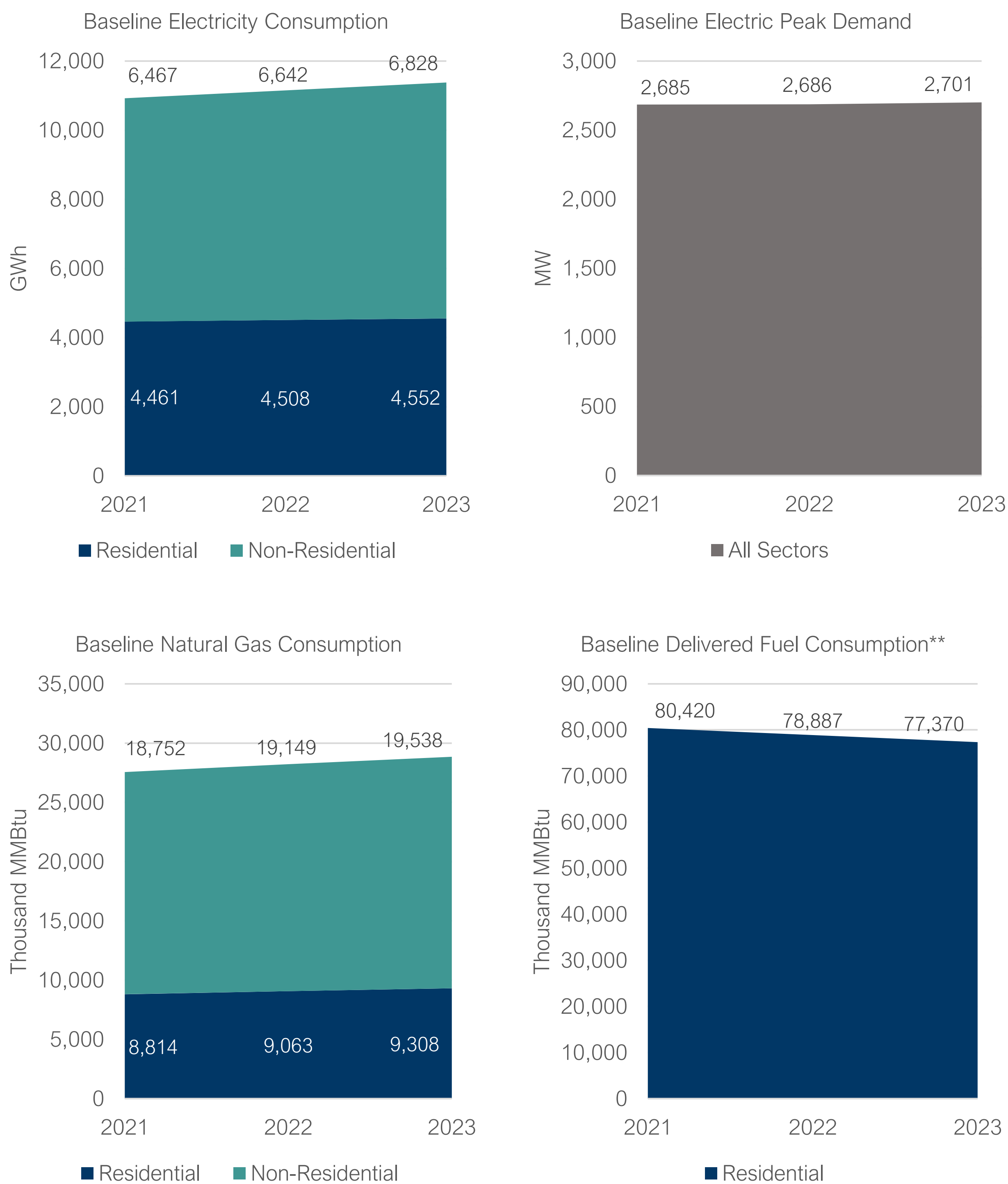
Considering the uncertainty related to the evolution of the lighting market, and related to the timing of any additional adjustments to federal or state-level lighting standards, the Dunsky team applied the assumptions developed by the New Hampshire Utilities with regards to lamps savings. Fundamentally, the assumptions used for the potential study only consider the natural evolution of market preference for LED technologies, and do not assume that new lighting standards will come in effect during the study period. For purpose of the analysis, and in accordance with utilities assumptions, the model assumes an increased natural adoption of LEDs through the study period, with a significantly higher natural adoption of LEDs in the residential sector.

## 2.5 Baseline Energy and Demand Forecasts

To understand the impact of the various measures analyzed in the potential study on overall energy consumption and demand in New Hampshire, the study establishes baseline energy and demand forecasts for the 2021-2023 period. The utilities provided electric and natural gas consumption and electric demand forecasts and delivered fuel forecasts were sourced from the Energy Information Agency. The study adjusted these forecasts to remove the projected impacts of existing and planned energy efficiency programs during the study period to avoid double-counting impacts estimated through the study.

Figure 14 below presents the adjusted baseline forecasts for each fuel type and electric peak demand. Electricity and natural gas consumption are expected to increase over the study period at annualized rates between 1% and 2%, while annual electric system peak demand is only forecasted to increase approximately 0.2% per year. Delivered fuel consumption in the residential sector is expected to decline at an annualized rate of 1.3% even in the absence of efficiency programming. These forecasts are used to illustrate the relative impacts of savings in each of the electric utility and gas utility-specific sections, as well as in the detailed data files.

*Figure 14. Baseline Energy and Peak Demand Forecasts*




*Forecasted peak demand provided by the utilities was not disaggregated by sector
**Delivered fuel forecasts were only developed for the residential sector as it is the only sector with delivered fuel-focused measures in the study

# 3 Energy Efficiency Potential Results

## 3.1 Chapter Overview

This section presents the achievable energy efficiency potential for electric and natural gas utilities in New Hampshire over the 2021-2023 period. The results focus on estimated energy savings for electricity and natural gas. The study also quantified delivered fuel savings (including oil, propane, and kerosene) as well as peak demand savings (i.e. passive demand reductions) for electric measures, and these results are included in Appendix D of Volume II of the report.

The first section of this chapter includes a description of the overall approach used to assess potential. The program-level results that follow are presented by utility type (electric and gas) and outline specific sector, segment, end use, and top measure opportunities available in New Hampshire over the 2021-2023 period.

The results provided in this report are based on pre-COVID-19 market conditions. An analysis that assesses the sensitivity of achievable potential savings to the COVID-19 pandemic is included in the COVID-19 Sensitivity Analysis section of this report.

### 3.1.1 Market Segments

The residential and non-residential sectors were split into segments for the purpose of the study. These segments are outlined in Table 5 below.

*Table 5. Market Segments Included in the Potential Study*

| Sector | Segment |
|---|---|
| Residential | Single Family |
| | Multifamily |
| | Low Income |
| Non-Residential | Campus/Education |
| | Food Sales |
| | Food Service |
| | Healthcare/Hospitals |
| | Lodging |
| | Manufacturing/Industrial |
| | Office |
| | Retail |
| | Warehouse |
| | Other |

### 3.1.2 Basis of Savings

Incremental annual program savings are the savings achieved in the first year of all measures incentivized through efficiency programs. Historically, utilities in New Hampshire have set efficiency targets and have developed efficiency plans in terms of incremental annual program savings. Incremental lifetime savings are expressed in terms of the savings expected over the entire useful lives of all measures incentivized through efficiency programs. The results in this chapter focus on savings on an incremental annual first-year basis. In some cases, the results also include incremental lifetime savings. These results do not include savings from interactive or secondary savings effects, although these savings are available in the detailed in Appendix D[8].

### 3.1.3 Measure Types

DEEP incorporates four types of measures: replace on burnout, early replacement, addition, and new construction/installation. DEEP treats each of these measure types differently when determining the maximum annual market available for phase-in potential. Provides a guide as to how each measure type is defined and how the replacement or installation schedule is applied within the study to assess the phase-in potentials each year.

*Table 6. DEEP Measure Type Descriptions*

| Measure Type | Description | Yearly Units Calculation |
|---|---|---|
| Replace on Burnout (ROB) | An existing unit is replaced by an efficient unit after the existing unit fails.<br>*Example: Replacing burned out bulbs with LEDs* | The eligible market is the number of existing units divided by EUL. |
| Early Replacement (ER) | An existing unit is replaced by an efficient unit before the existing unit fails. These measures are generally limited to measures where savings are sufficient enough to motivate a customer to replace existing equipment earlier than its expected lifespan.<br>*Example: Replacing a functional, but inefficient, furnace* | The eligible market is assumed to be a subset of the number of existing units based on a function of the equipment's EUL and remaining useful life (RUL) |
| Addition (ADD) | A measure is applied to existing equipment or structures and treated as a discretionary decision that can be implemented at any moment in time.<br>*Example: Adding controls to existing lighting systems, adding insulation to existing buildings* | The eligible market is distributed over the estimated useful life of the measure using an S-curve function. |
| New Construction/ Installation (NEW) | A measure that is not related to existing equipment.<br>*Example: Installing a heat-pump in a newly constructed building.* | The eligible market is measure-specific and defined as new units per year. |

In this study, only a small number of measures were characterized as early replacement measures. In general, early replacement measures are limited to those where energy savings are sufficient to motivate a

[8] As an example, electric impacts from measures included in non-electric programs would increase savings by 2% overall in 2021 under the low scenario.

customer to replace existing equipment significantly before the end of its expected life. This is generally limited to measures with long EULs and a large difference between existing installed efficiency and baseline efficiencies for new equipment (e.g. furnaces and boilers) as the early replacement of these measures can create additional savings through the early retirement of particularly inefficient equipment. Current NHSaves programs may incentivize customers to replace equipment before it actually ceases to function or maintenance costs become excessive, in effect accelerating the acquisition of savings which would have materialized in the future at the expense of increased costs.

### 3.1.4 Approach

The study assesses energy efficiency potential using Dunsky's proprietary Demand and Energy Efficiency Potential (DEEP) model. DEEP employs a bottom-up modelling approach that evaluates thousands of measure-market combinations, applying program impacts (e.g. incentives and enabling activities that reduce customer barriers) to assess energy savings potentials across multiple scenarios. Rather than estimating potential based on the portion of each end use that can be reduced by energy-saving measures and strategies (often referred to as a 'top-down' approach), DEEP applies a highly granular calculation methodology to assess the energy savings potential for each measure-market segment opportunity in each year.

DEEP assesses three levels of energy savings potential: technical, economic, and achievable.

- **Technical potential** is all theoretically possible energy savings resulting from measures included in the study. Technical potential is assessed by combining measure and market characterizations to determine the maximum amount of savings possible in the absence of constraints such as cost-effectiveness screening, market barriers, or customer economics.

- **Economic potential** is a subset of the technical potential that only includes measures that pass cost-effectiveness screening. Economic screening is performed at the measure level and only includes costs related to the measure. Economic screening does not include general program costs.

- **Achievable potential** is the energy savings resulting from customer adoption of energy-savings measures which have passed through the economic potential screening. Rooted in the United States' Department of Energy (U.S. DOE) adoption curves[9], DEEP defines annual adoption rates based on a combination of customer cost-effectiveness and market barrier levels. Customer cost-effectiveness is calculated within the model based on inputs from measure and program characterization as well as economic and adoption parameters. The achievable potential scenarios included in this study are described in the following section.

This report focuses on achievable potential savings as it is most relevant to program planning, however technical and economic savings are also included in Appendix D of Volume II of the report.

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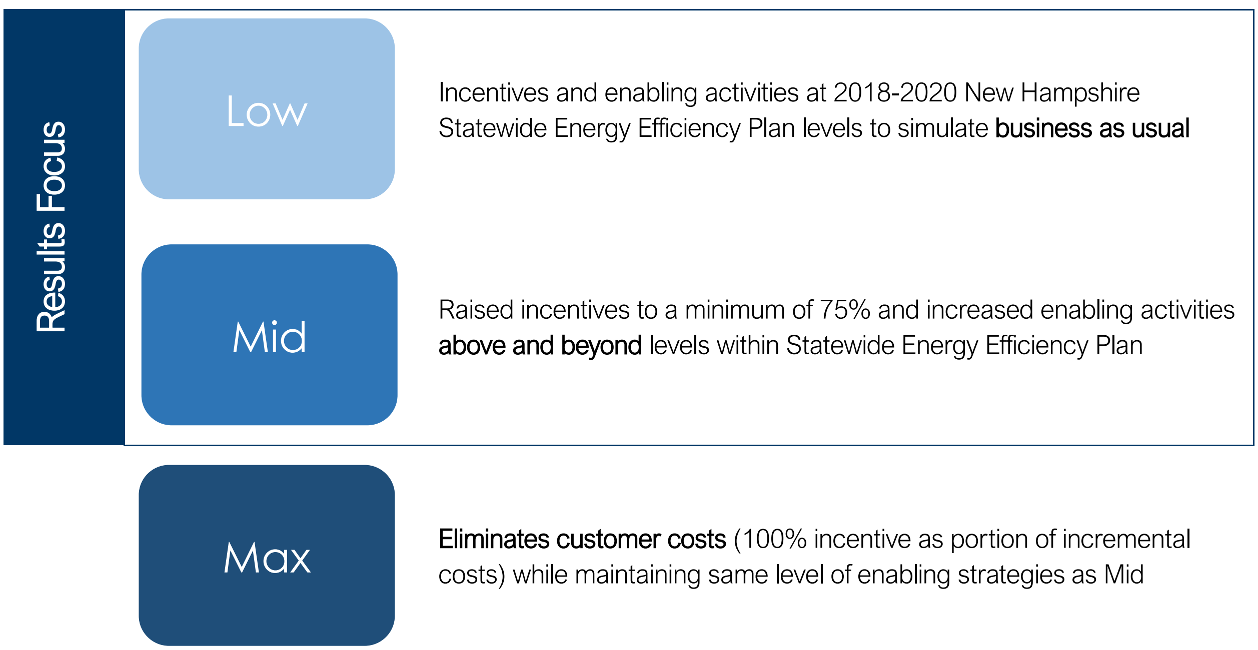
[9] The USDOE uses this model in several regulatory impact analyses. An example can be found in http://www.regulations.gov/contentStreamer?objectId=090000648106c003&disposition=attachment&contentType=pdf, section 17-A.4.

Appendix A of Volume II of the report includes an in-depth overview of the energy efficiency potential study methodology.

#### 3.1.4.1 Achievable Potential Scenarios

The potential study includes three achievable potential scenarios. Program settings – namely incentive levels and enabling activities (*see comment box below*) – define the achievable potential scenarios. The modeled programs align closely with existing NHSaves programs, but in some cases includes measures not currently offered through programs; this allows for the assessment of achievable savings in New Hampshire through novel measure offerings. Figure 15 below outlines the three achievable potential scenarios considered in this study. The results presented in the sections that follow focus primarily on the low and mid scenarios given that these scenarios are most closely in-line with anticipated 2021-2023 NHSaves program budgets. Results for all three scenarios are included in the detailed study data tables in Appendix D of Volume II of the report, and Appendix C includes the detailed program settings assumptions associated with each scenario.

*Figure 15. Achievable Potential Scenarios*



Achievable Potential Scenario Settings

**Incentive Levels:** Program incentives address the barriers to measure adoption associated with upfront cost, covering part or all of the incremental cost associated with a high-efficiency measure. Incentive levels are characterized as a percentage and represent the portion of measure incremental costs that they cover.

**Enabling Strategies:** Non-financial barriers to measure uptake also exist and prevent consumers from adopting high-efficiency equipment. This means that programs must go beyond incentive strategies to address other non-economic barriers to customer participation. Barrier reductions can be achieved through enabling activities that streamline program participation including but not limited to:

- Direct install programs
- Contractor training and support
- Upstream programs
- Targeted marketing
- Building and home energy labeling requirements
- Financing Programs

The program scenarios assessed in this study capture the impact of current enabling strategies included in NHSaves programs by calibrating the Low scenario achievable potentials to current portfolio savings. The potential impact of investing further in enabling strategies is assessed under the Mid program scenario, where additional barrier level reductions are applied over and above the Low scenario where possible. While the potential study does not identify the specific enabling strategies engaged or the associated barriers addressed, the results are intended to provide a quantitative assessment of additional savings that can be captured through enabling strategies.

### Comparison of Low Scenario and Historic Program Assumptions

While the Low Scenario program incentive and cost assumptions were developed based on the 2018-2020 Statewide Energy Efficiency Plan, several inputs or assumptions used to assess the achievable energy efficiency potential for 2021-2023 are materially different from the 2018-2020 DSM periods. The following table present some of those differences.

| Study Component | Notes |
|---|---|
| Cost-Effectiveness Test | The 2018-2020 DSM plan cost-effectiveness was assessed using the TRC, while the 2021-2023 Study uses the Granite State Test. This can lead to more measures meeting the cost-effectiveness threshold due to the exclusion of customer costs from the analysis. |
| Measure Coverage and Delivery Strategies | The final study measure list, reviewed and approved by the NHSaves EM&V Working Group, includes a larger suite of measures than the 2018-2020 Programs. Key |

| | |
|---|---|
| | measures included in the potential study that have not been historically been offered by NHSaves programs, or did not have dedicated offers, include advanced power strips, several water savings measures, building energy management and retro-commisioning, among others. |
| Budget Considerations | The Potential Study analysis was not constrained by available budget. As such, all measures meeting the cost-effectiveness criteria are included and adoption of measures was not constrained or limited due to budget considerations. In addition, although NHSaves program administrators are required to reserve 20% of program budgets for income qualified programs, this requirement was not considered in the study. |
| LED Lighting Measures Assumptions | The lighting measures assumptions applied in the potential study differ significantly from those assumptions in the 2018-2020 DSM Plan. Some specific examples are included below:<br><br>• In the 2018-2020 DSM plan, lighting NTG value assumptions remained high and were constant over time. In the potential study, all residential and non-residential LED technologies use net-to-gross (NTG) factors that decline over the three years of the study, reflecting increased natural adoption of the technologies.<br><br>• All lighting measure savings assumptions were revised to align with the latest utility assumptions, notably with regards to delta watts and hours of use. This leads to some significant differences with values used for the 2018-2020 DSM plan. |
| Other Measures Assumptions | Impact factors such as realization rates have been updated since the 2018-2020 DSM Plan. |

## 3.2 Electric Utility Program Savings

This section presents the achievable potential for electric savings from electric utility programs. The results primarily focus on the low and mid scenarios, given that these scenarios are most closely in-line with anticipated 2021-2023 NHSaves program budgets. For brevity, results are primarily presented for the first and final years of the study, 2021 and 2023. Complete results for all three scenarios and all three years of the study are included in Appendix D of Volume II of the report.

### 3.2.1 Basis of Savings

This section provides an overview of electric utility program savings potential. The electric savings presented here represent the savings achieved through electric measures and *do not* account for electric savings achieved through natural gas measures due to interactive or secondary savings effects.

The savings are adjusted gross savings at the meter, with some exceptions for specific lighting measures in cases where the utilities provided approved net-to-gross values. The specific net-to-gross assumptions used in the study are provided in Appendix C of Volume II of the study.

### 3.2.2 Savings as a Percent of Sales

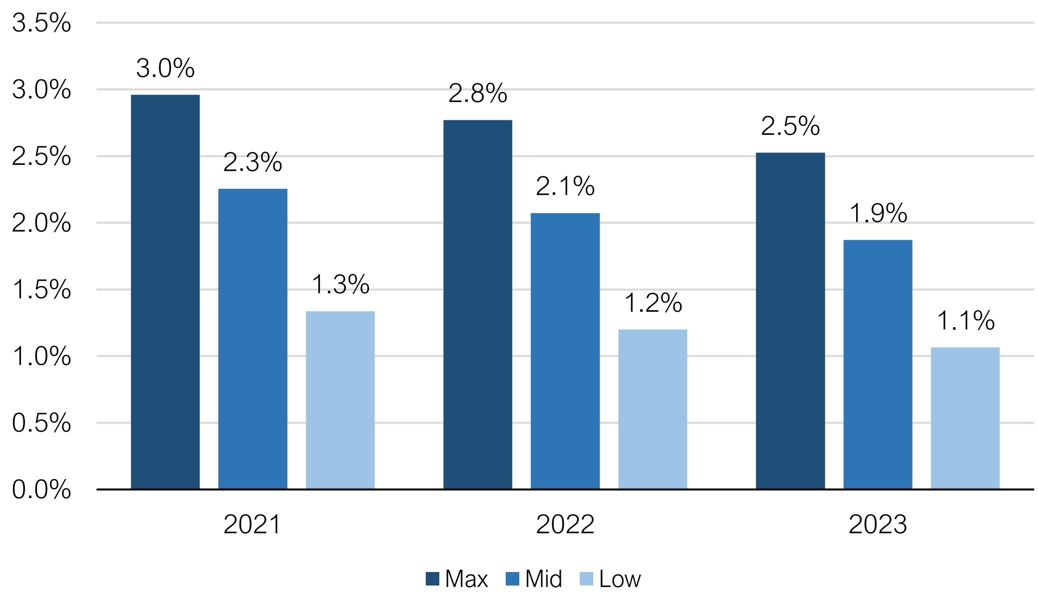
The study estimates that efficiency programs can procure between 143 GWh (low) and 315 GWh (max) of incremental annual savings in 2021, between 128 GWh and 198 GWh of incremental annual savings in 2022, and between 115 GWh and 263 GWh of incremental annual savings in 2023, as outlined in Table 7 below. For context, NHSaves programs achieved portfolio-wide electric savings of 124 GWh in 2019.

*Table 7. Annual Incremental Electric Program Savings by Scenario, Year*

| Scenario | 2019 Electric Savings (GWh) | 2021 Electric Savings (GWh) | 2022 Electric Savings (GWh) | 2023 Electric Savings (GWh) |
|---|---|---|---|---|
| Max | | 315 | 198 | 263 |
| Mid | | 240 | 220 | 198 |
| Low | | 143 | 128 | 115 |
| Actual Program | 124 | | | |

Savings as a percent of sales is one of the target metrics included in the NHSaves three-year program plans. Below, Figure 16 presents the modeled potential electricity savings as a percent of electricity sales for the first and last years of the study.

*Figure 16. Electricity Savings as a Percent of Sales*[10]




Savings range from 1.1% of sales to 3.0%, varying by scenario and year. For context, 2019 actual kWh savings represented 1.17% of 2019 sales. The modeled savings as a percent of sales show a decrease across all scenarios in the final year of the study. This decrease is primarily a result of decreased savings from lighting measures in the residential sector, as outlined further in the sections that follow.

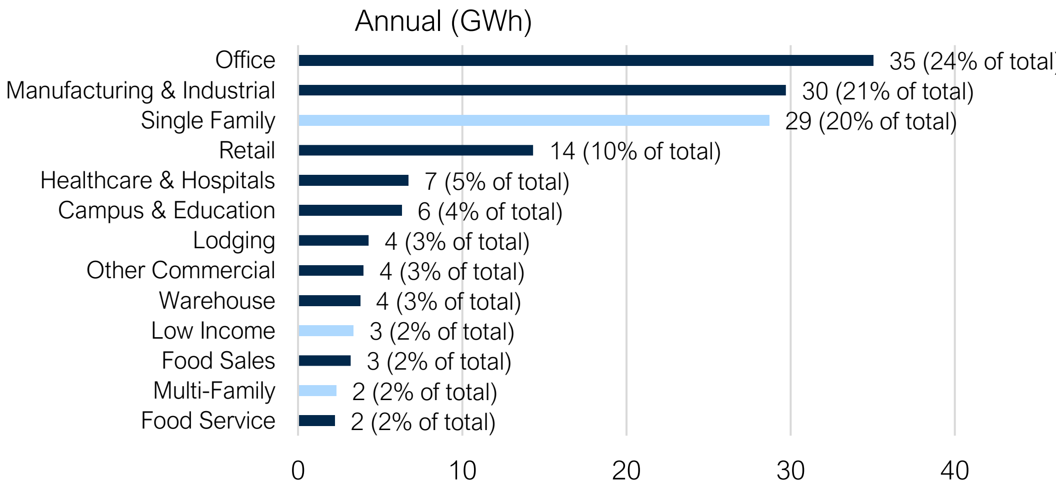
### 3.2.3 Savings by Segment

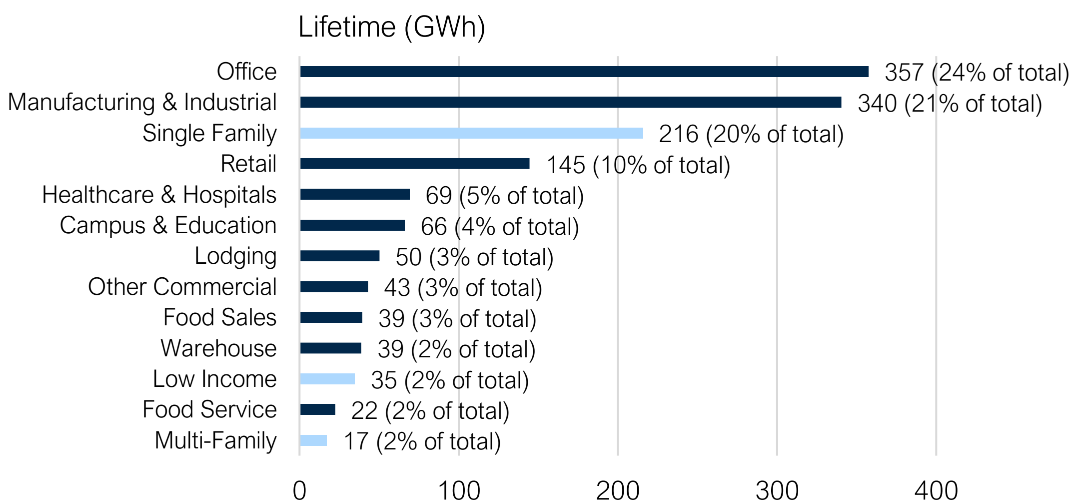
This section provides an overview of the forecasted savings by segment under the low scenario in 2021. Results are provided for annual and lifetime savings. The mid scenario shows similar trends to the low scenario with respect to the top saving segments and share of savings by sector and consequently has been excluded from this section.

The non-residential sector, which includes commercial, institutional, and industrial customers, is forecasted to account for approximately 60% of total electricity consumption throughout the study period (as seen in the Baseline Energy and Demand Forecasts section). Under the low scenario, the non-residential sector also represents the majority of both annual and lifetime electric savings (76% of annual savings and 81% of lifetime savings), as seen in Figure 17 below. The residential share of annual savings is larger than the residential share of lifetime savings (24% compared to 19%). This is due to a number of high-savings potential measures in the residential sector having short measure lifetimes, including – notably – home energy reports, which represent the sixth highest annual saving measure across all residential measures in 2021.

[10] Savings are shown as percent of forecasted sales in that year (e.g. 2021 savings are shown as a percent of 2021 sales, 2023 savings as a percent of 2023 sales).

*Figure 17. 2021 Annual and Lifetime Electricity Savings by Segment[11], Low Scenario*




At the segment level, the office and manufacturing/industrial segments represent the bulk of electric efficiency opportunities – collectively 45% of both annual and lifetime savings. Single family, retail, and healthcare & hospitals are within the top five segments on both an annual and lifetime basis.

### 3.2.4 Residential

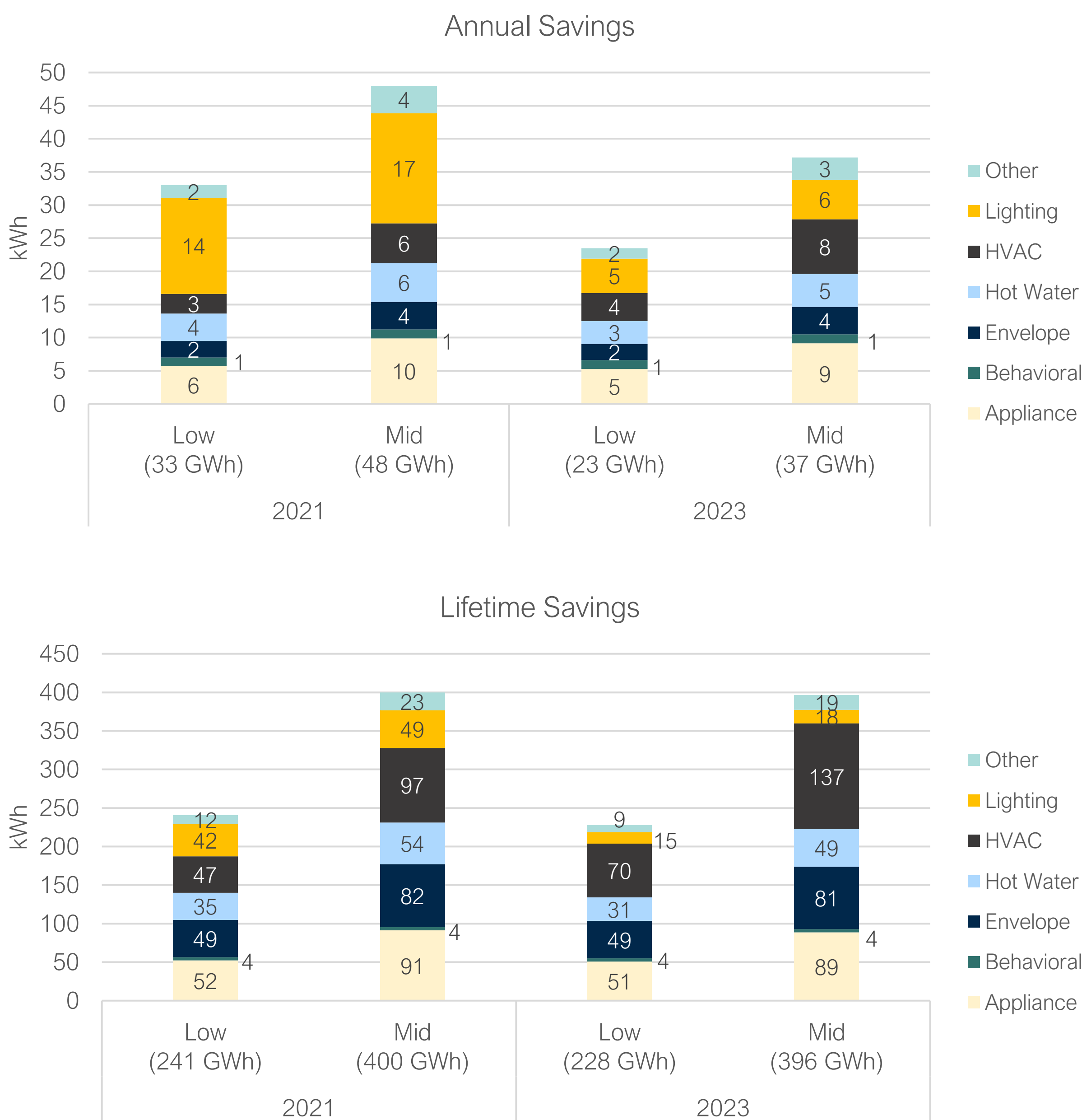
This section presents detailed results for the residential sector (including low income), outlining savings potential by end use and highlighting top measures. Results are included for both the low and the mid scenarios.

[11] As part of the study, customers were categorized into segments. Given the reliance on secondary data in the non-residential portion of the study, segment definitions were constrained, and segmentation in the study may differ from internal utility segmentation of customers. A full description of the segmentation process was provided in the *Commercial Segmentation Memo.*

## 3.2.4.1 Savings by End Use

For the residential sector, annual savings are distributed among multiple end uses. Savings are increasingly diverse as the study progresses due to a reduction in lighting savings. Moreover, end uses other than lighting tend to show a larger increase between the low and mid scenario. This results from investments in programs which increase incentives and fund enabling strategies, improving customer cost-effectiveness and reducing market barriers to customer participation. Figure 18 below presents annual and lifetime residential savings by end use and scenario for years 2021 and 2023.

*Figure 18. Annual and Lifetime Residential Electricity Savings by End Use, Low and Mid Scenario*




Note: The ‘Other’ category includes advanced power strips and pool pumps

Lighting remains an important end use under both the low and mid scenarios in 2021, as elaborated on further in the Summary of Lighting Savings section. The study assumes declining NTG values for lighting in alignment with the utility benefit cost ratio models[12]. This results in fewer net achievable savings from lighting with each subsequent study year and decreased overall sector savings over time as a result of reduced lighting savings under both scenarios.

The hot water end use represents considerable savings under both scenarios on both an annual and a lifetime basis. Key measures include thermostatic restrictor shower valves, low flow showerheads, heat pump water heaters, and faucet aerators, as outlined in the Top Measures section that follows. Those end uses that include measures with long lifetimes, such as HVAC and envelope, also provide consistent lifetime savings under both scenarios.

*Figure 19. Residential Electric End Use Savings - Growth between Low and Mid Scenarios in 2021 (GWh)*

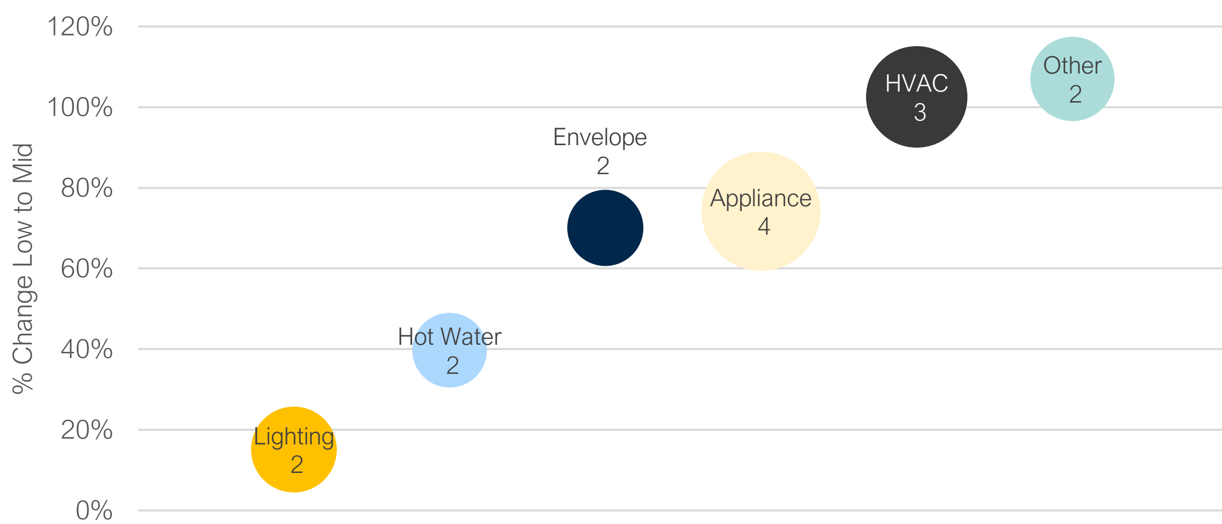



Figure 19 above illustrates growth in achievable savings between the low and mid scenarios for each end use in the residential sector. The relative change in savings between the low and mid scenarios is provided on the vertical axis, while the magnitude of absolute change is illustrated by the bubble-size. A high relative change indicates high sensitivity to program design changes between the low and mid scenarios (namely in response to increased incentives and reduced market barriers) while a larger absolute change represents a larger volume of savings between scenario. Should NHSaves programs decide to pursue increased program spending compared to the low scenario, understanding the relative and absolute impacts on savings from increased investments will allow the program administrators to target growth opportunities.

Although absolute lighting savings increase under the mid scenario, lighting savings see the lowest relative increase in savings across all end uses. This is due to lighting measures being already being quite cost-effective under the low scenario and facing low market barriers, leading to limited growth in savings as a result of mid scenario program design. Other end uses have lower participant cost-effectiveness and higher market barriers, and consequently see greater growth between the low and mid scenarios, notably

[12] The NTG value assumptions are included in Volume II. For the purpose of this report, they reflect assumptions used in the July 1st benefit-cost ratio models.

the ‘other’, HVAC, and appliance end uses. When assessing both the relative and absolute growth opportunity, the HVAC and appliance end uses are top candidates for for increased program spending. As noted in the top measure section that follows, key measures include refrigerators and refrigerator recycling, heat pump and conventional clothes dryers, and mini-split and groundsource heat pumps.

#### 3.2.4.2 Top Measures

Table 8 below outlines the top residential measures on an annual savings basis for the first and last years of the study. Results are shown for both the low and mid scenarios. Additional details related to the baseline and efficient conditions are provided in Appendix D of Volume II of the report.

*Table 8. 2021 Residential Top Measures by Annual Electricity Savings, Low and Mid Scenario (Lighting Measures Highlighted)*

| 2021 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (GWh) | Measure | Savings (GWh) |
| LED A-Lamp (Interior) | 8.21 | LED A-Lamp (Interior) | 9.47 |
| LED Bulbs (exterior) | 2.42 | Refrigerator Recycle | 3.39 |
| LED Specialty - Reflectors (Interior) | 2.38 | Advanced Power Strips | 3.06 |
| Refrigerator Recycle | 1.90 | LED Specialty-Reflectors (Interior) | 2.75 |
| LED Specialty-Candelabras, Globes (Interior) | 1.36 | LED Bulbs (exterior) | 2.65 |
| Home Energy Report | 1.34 | Refrigerator | 1.85 |
| Advanced Power Strips | 1.21 | Water Heater - Heat Pump Water Heater | 1.76 |
| Thermostatic Restrictor Shower Valve | 1.20 | LED Specialty-Candelabras, Globes (Interior) | 1.62 |
| Low Flow Shower Head | 1.19 | Thermostatic Restrictor Shower Valve | 1.56 |
| Refrigerator | 1.06 | Thermostat Wi-Fi | 1.47 |
| Water Heater - Heat Pump Water Heater | 0.84 | Home Energy Report | 1.34 |
| Low Flow Faucet Aerator | 0.84 | Low Flow Shower Head | 1.30 |
| Pool Pump | 0.76 | Heat Pump Clothes Dryers | 1.22 |
| Air Sealing | 0.69 | Air Sealing | 1.08 |
| Thermostat Wi-Fi | 0.66 | Insulation - Attic | 1.06 |
| New Home Construction | 0.59 | Pool Pump | 1.01 |
| Clothes Washer | 0.59 | Clothes Dryer | 1.01 |
| Mini-split Ductless Heat Pump (DMSHP) | 0.58 | Mini-split Ductless Heat Pump (DMSHP) | 0.99 |
| Ground Source Heat Pump (GSHP) | 0.53 | Low Flow Faucet Aerator | 0.96 |
| Air Purifier | 0.49 | Ground Source Heat Pump (GSHP) | 0.94 |

*Table 9. 2023 Residential Top Measures by Annual Electricity Savings, Low and Mid Scenario (Lighting Measures Highlighted)*

| 2023 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (GWh) | Measure | Savings (GWh) |
| LED A-Lamp (Interior) | 2.96 | LED A-Lamp (Interior) | 3.42 |
| Refrigerator Recycle | 1.75 | Mini-split Ductless Heat Pump (DMSHP) | 3.14 |
| Home Energy Report | 1.46 | Refrigerator Recycle | 2.62 |
| Refrigerator | 1.36 | Advanced Power Strips | 2.39 |
| Advanced Power Strips | 1.08 | Refrigerator | 1.87 |
| Thermostatic Restrictor Shower Valve | 0.94 | Water Heater - Heat Pump Water Heater | 1.79 |
| Low Flow Shower Head | 0.93 | Thermostat Wi-Fi | 1.44 |
| LED Bulbs (exterior) | 0.92 | Home Energy Report | 1.36 |
| LED Specialty - Reflectors (Interior) | 0.87 | Heat Pump Clothes Dryers | 1.25 |
| LED Specialty-Candelabras, Globes (Interior) | 0.86 | Thermostatic Restrictor Shower Valve | 1.21 |
| LED Specialty - Reflectors (Interior) | 0.85 | Air Sealing | 1.05 |
| Air Sealing | 0.68 | Insulation - Attic | 1.04 |
| Thermostat Wi-Fi | 0.66 | Clothes Dryer | 1.02 |
| Low Flow Faucet Aerator | 0.65 | Ground Source Heat Pump (GSHP) | 1.01 |
| New Home Construction | 0.60 | Low Flow Shower Head | 1.01 |
| Pool Pump | 0.60 | LED Specialty - Reflectors (Interior) | 0.99 |
| Clothes Washer | 0.59 | LED Bulbs (exterior) | 0.96 |
| Ground Source Heat Pump (GSHP) | 0.57 | Pool Pump | 0.94 |
| Air Purifier | 0.50 | Clothes Washer | 0.88 |
| Heat Pump Clothes Dryers | 0.50 | Low Flow Faucet Aerator | 0.74 |

Although lighting measures remain prevalent among top overall residential measures, increased program spending under the mid scenario results in a greater share of savings from non-lighting measures[13]. In 2021, program changes under the mid scenario result in greater savings from measures previously experiencing limited customer cost-effectiveness and/or barriers.

By 2023, most lighting measures under the low scenario place lower on the top measure list than in 2021 as their potential decreases due to increased natural adoption, which reduces claimable savings. Savings from other measures on list remain relatively constant, leaving a gap in overall program savings.

[13] Under the low scenario, lighting measures account for 42% of savings in 2021 and 21% of savings in 2023. Under the mid scenario, lighting measures account for 33% of savings in 2021, and 15% of savings in 2023.

Appliance, HVAC, hot water, and 'other' end uses provide consistent savings, and refrigerators and refrigerator recycling, water restricting devices, and advanced power strips are measures with consistent potential across all three study years[14].

The top list under the mid scenario includes several measures with higher upfront cost and/or barriers that do not show up under the low scenario. This includes heat pumps, heat pump water heaters, heat pump clothes dryers, and Wi-Fi thermostats. Adoption of these measures demonstrate a higher sensitivity to increased incentives and/or barrier reduction strategies.

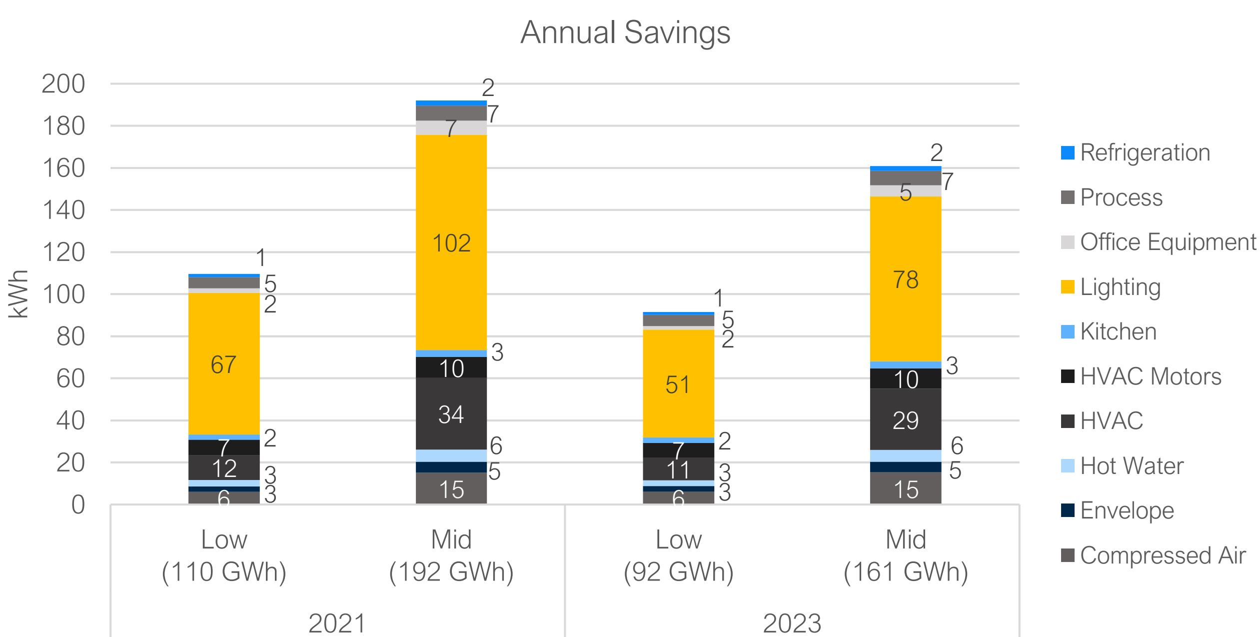
### 3.2.5 Non-Residential

This section presents detailed results for the non-residential sector, outlining savings potential by end use and highlighting top measures.

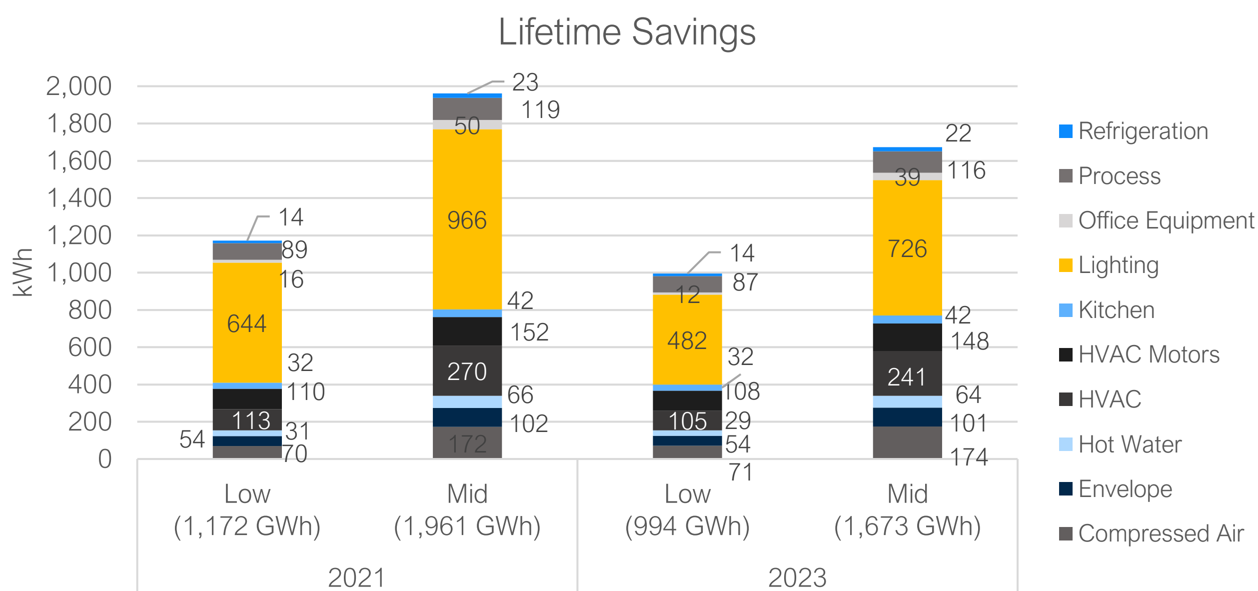
#### 3.2.5.1 Savings by End Use

The non-residential sector continues to rely heavily on lighting savings on both an annual and lifetime savings basis. The share of overall savings represented by non-residential lighting is also more constant between annual and lifetime savings than is seen in the residential sector. This is a result of the long lifetimes associated with most non-residential lighting measures, notably linear lamps and controls. Figure 20 below presents annual and lifetime non-residential savings by end use and scenario for years 2021 and 2023.

*Figure 20. Non-Residential Annual and Lifetime Electricity Savings by End Use, Low and Mid Scenario*



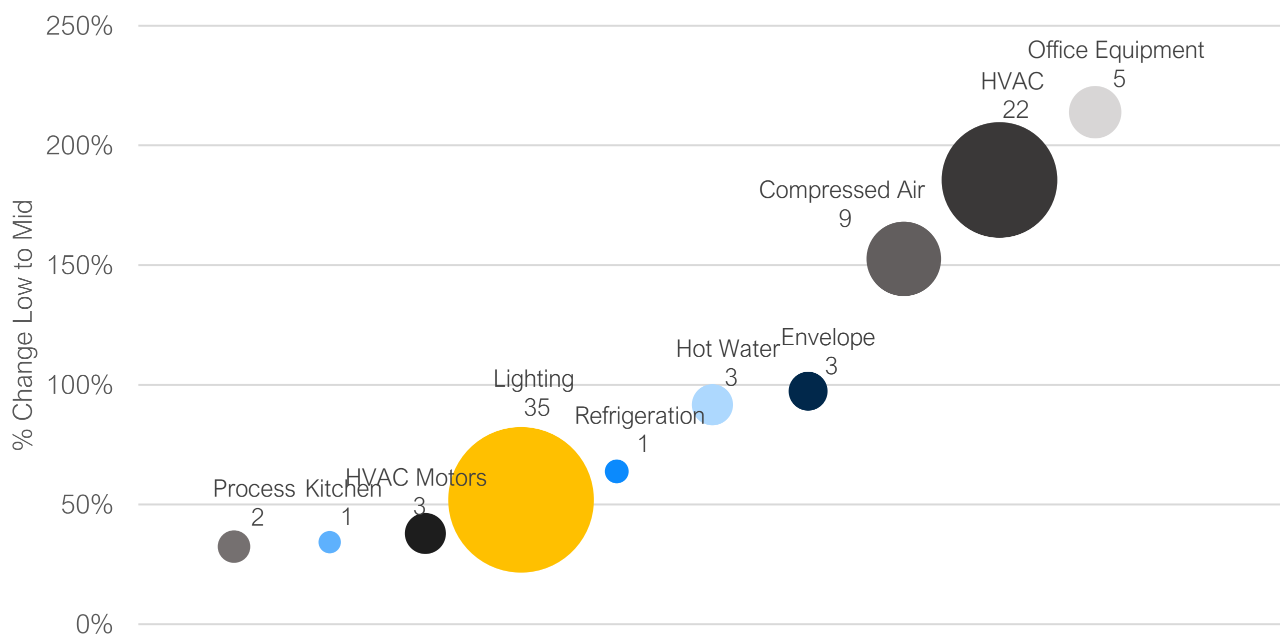

[14] To provide additional context on these measures, it should be noted that electric hot water penetration is relatively high in New Hampshire at 34%. It should also be noted that the stock of refrigerators in New Hampshire is relatively old, with 20% of all refrigerators being more than twelve years old. In addition, 12% of the refrigerator stock represents either a 2nd or 3rd household refrigerator.




Although natural uptake of tubular LEDs (TLEDs) is increasing, there has not yet been the same level of market transformation as has been seen with A-lamps and speciality bulbs. As a result, programs that incentivize efficient efficient commercial lighting technologies are expected to continue to offer signficiant potential over the study period.

Under the low scenario, non-lighting end uses do not grow between 2021 and 2023. As lighting decreases, savings from other end uses remain constant or  - in the case of HVAC – actually decrease, reducing savings overall. Moving from the low to the mid scneario does result in growth across all end uses, however, as seen in Figure 21 below.

*Figure 21. Non-Residential Electric End Use Savings – Growth between Low and Mid Scenario in 2021 (GWh)*



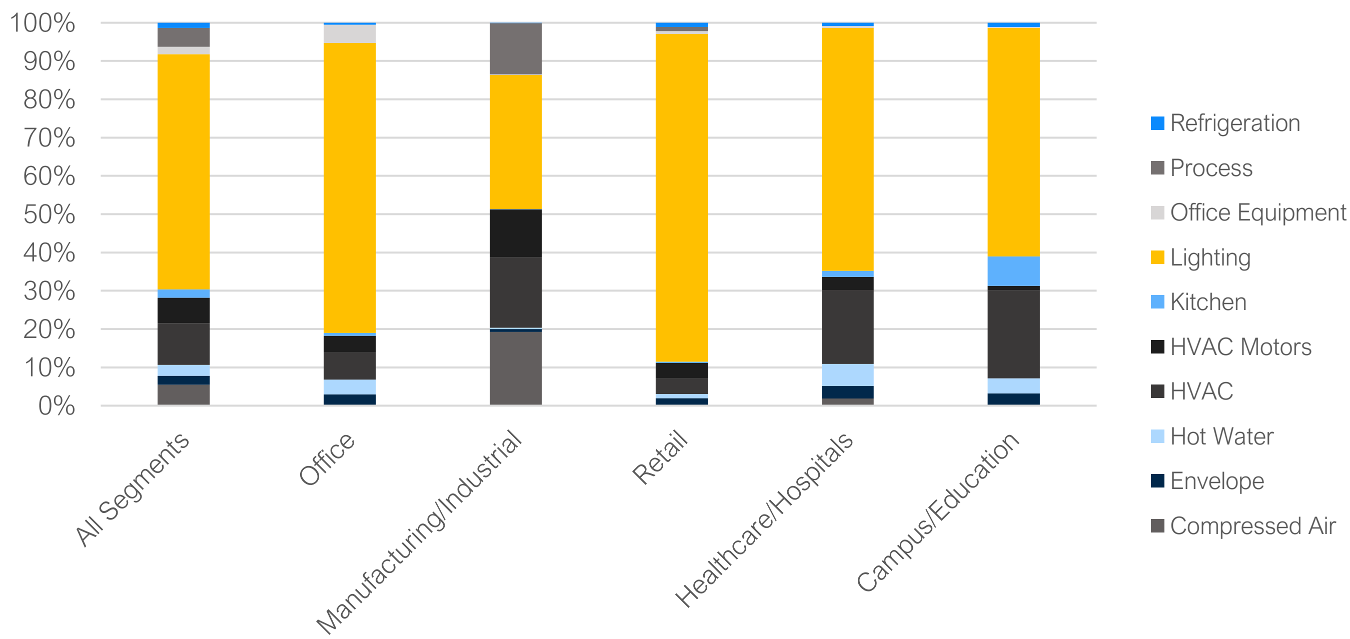
As with the residential section, Figure 21 above illustrates growth in achievable savings between the low and mid scenarios for each end use in the non-residential sector, with the relative change in savings between the low and mid scenarios provided on the vertical axis and the magnitude of change illustrated by the bubble-size.

Beyond lighting, HVAC shows the greatest absolute growth, in large part through control or operational measures, as noted in the top measures section that follows. HVAC is followed by compressed air and office equipment, where top measures include high efficiency air compressors and advanced power strips, respectively. Collectively, these end uses represent considerable pools of savings available for programs to capture.

Although hot water is a smaller portion of savings, hot water measures have not featured prominently in past programs, and this end use could be a promising source of savings moving forward. These findings are strongly tied to the basic assumption regarding saturation of electric water heating equipment in the non-residential sector, however, which is an area where additional primary research in New Hampshire could be beneficial.

Given the large number of segments in the non-residential sector, Figure 22 below shows the end use breakdown for the top five saving segments. Focusing on annual savings for the low scenario in 2021, the end use savings by segment are compared to the sector overall.

*Figure 22. 2021 Annual Electricity Savings by End Use for Top-Saving Non-Residential Segments, Low Scenario*




Note: The mid scenario shows a very similar distribution of segment-specific end use savings, so only the low scenario is included here

*Table 10. 2021 Annual Electricity Savings for Top-Saving Non-Residential Segments, Low Scenario*

| | All Segments | Office | Manufacturing/ Industrial | Retail | Healthcare/ Hospitals | Campus/ Education |
|---|---|---|---|---|---|---|
| Low Scenario Total Savings (GWh) | 110 | 35 | 30 | 14 | 7 | 6 |

The manufacturing and industrial segment (the second highest saving segment overall) is considerably less dependent on lighting than the non-residential sector overall. Opportunities in this segment are focused on process savings, HVAC (which includes retro-commissioning, strategic energy management, and various HVAC equipment and controls), and compressed air[15]. Across all top segments, HVAC opportunities are considerable, with variable frequency drives and control devices representing strong HVAC and HVAC motor growth opportunities for NHSaves.

#### 3.2.5.2 Top Measures

Table 11 below outlines the top non-residential measures on an annual savings basis for the first and last years of the study. Results are shown for the low and mid scenarios.

*Table 11. 2021 Non-Residential Top Measures by Annual Electricity Savings, Low and Mid Scenario (Lighting Measures Highlighted)*

| 2021 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (GWh) | Measure | Savings (GWh) |
| LED Linear Tube | 18.74 | LED Linear Tube | 23.80 |
| LED Linear Luminaire | 18.42 | LED Linear Luminaire | 22.90 |
| Lighting Controls (Occupancy) | 6.82 | Retro-commissioning Strategic Energy Management | 18.97 |
| LED High Bay | 6.81 | Lighting Controls (Occupancy) | 12.71 |
| Lighting Controls (Daylighting) | 5.62 | Lighting Controls (Daylighting) | 8.59 |
| HVAC VFD - Pump | 4.24 | LED High Bay | 8.10 |
| Retro-commissioning Strategic Energy Management (RCx SEM) | 3.63 | Lighting Controls (Network) | 8.04 |
| LED Parking Garage (Exterior) | 2.97 | LED T12 Linear Tube | 6.79 |
| HVAC VFD - Fan | 2.68 | Advanced Power Strips | 6.66 |
| Air Receiver for Load/No Load Compressor | 2.56 | Air Receiver for Load/No Load Compressor | 5.84 |
| Fresh Air controlled by CO2 monitors | 2.42 | HVAC VFD - Pump | 5.52 |
| LED Pole Mounted (Exterior) | 2.41 | High Efficiency Air Compressor | 4.20 |
| LED T12 Linear Tube | 2.32 | LED Parking Garage (Exterior) | 4.19 |
| Advanced Power Strips | 2.12 | HVAC VFD - Fan | 4.05 |

[15] Additional details on energy savings opportunities in the industrial sector is provided in the *New Hampshire Non-Residential Baseline Memo*.

| 2021 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (GWh) | Measure | Savings (GWh) |
| Custom Processes | 1.70 | Fresh Air controlled by CO2 monitors | 3.75 |
| LED A-Lamp (Interior) | 1.56 | LED Pole Mounted (Exterior) | 3.26 |
| Low Flow Faucet Aerator | 1.55 | Water Heater - Heat Pump Water Heater (HPWH) | 2.80 |
| Motor Controls - Pumps | 1.53 | Custom Processes | 2.44 |
| Building Management System (BMS) | 1.42 | Building Shell Air Sealing | 2.15 |
| Motor Controls - Process | 1.37 | LED A-Lamp (Interior) | 2.03 |

*Table 12. 2023 Non-Residential Top Measures by Annual Electricity Savings, Low and Mid Scenario (Lighting Measures Highlighted)*

| 2023 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (GWh) | Measure | Savings (GWh) |
| LED Linear Luminaire | 14.05 | LED Linear Tube | 17.45 |
| LED Linear Tube | 13.77 | LED Linear Luminaire | 17.45 |
| Lighting Controls (Daylighting) | 5.50 | Retro-commissioning Strategic Energy Management (RCx SEM) | 14.81 |
| HVAC VFD - Pump | 4.14 | Lighting Controls (Occupancy) | 12.39 |
| LED High Bay | 4.03 | Lighting Controls (Daylighting) | 8.36 |
| HVAC VFD - Fan | 2.63 | Lighting Controls (Network) | 6.82 |
| Air Receiver for Load/No Load Compressor | 2.60 | Air Receiver for Load/No Load Compressor | 5.91 |
| LED Parking Garage (Exterior) | 2.52 | HVAC VFD - Pump | 5.37 |
| Fresh Air controlled by CO2 monitors | 2.16 | Advanced Power Strips | 5.19 |
| Advanced Power Strips | 1.68 | LED High Bay | 4.78 |
| Custom Processes | 1.67 | High Efficiency Air Compressor | 4.25 |
| LED Pole Mounted (Exterior) | 1.57 | HVAC VFD - Fan | 3.94 |
| High Efficiency Air Compressor | 1.35 | LED Parking Garage (Exterior) | 3.53 |
| Building Management System (BMS) | 1.26 | Fresh Air controlled by CO2 monitors | 3.35 |
| Air Source Heat Pumps (ASHP) | 1.26 | Water Heater - Heat Pump Water Heater | 2.84 |
| Air Entrainment Nozzle | 1.14 | LED T12 Linear Tube | 2.84 |
| Building Shell Air Sealing | 1.10 | Custom Processes | 2.38 |
| LED A-Lamp (Interior) | 1.08 | LED Pole Mounted (Exterior) | 2.11 |
| LED T12 Linear Tube | 1.02 | Building Shell Air Sealing | 2.09 |
| Dishwasher | 0.91 | Air Source Heat Pumps (ASHP) | 2.02 |

While TLED adoption is becoming more common in the luminaire and tube markets, significant commercial lighting opportunities remain available to be captured by programs. Lighting controls also feature prominently in the top measure list - Both occupancy and daylighting controls are in the top five measures across both scenarios and study years. Although lighting controls represent a growing opportunity, they also face notable challenges including limited cross-compatibility among products from different manufacturers, limited customer awareness of the options and benefits, and aiming to align re-lamping efforts with controls change outs. It should be noted that achieving savings from these measures will likely require investment to identify the most effective delivery strategies and to track product roll-out and development.

Beyond lighting, control or operational measures and manufacturing and industrial-focused opportunities feature prominently in the top measure lists. Notably, retro-commissioning and strategic energy management and advanced ventilation controls represent growing opportunities over time and between the low and mid scenarios. These measures, including advanced power strips and variable frequency drives, go beyond the strict improvement of the efficiency of equipment and instead focus on reducing run-times, in alignment with the transition underway for lighting end uses.

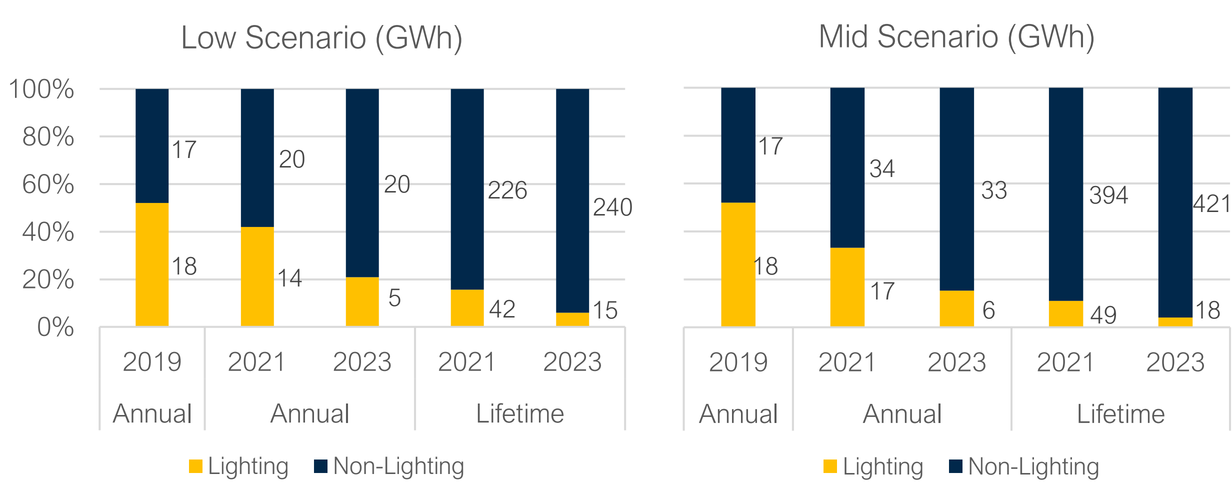
### 3.2.6 Summary of Lighting Savings

Given historical importance of lighting savings and the rapidly evolving lighting market, this section highlights key findings related to lighting, focusing on the years 2021 and 2023 and the low and mid scenarios.

#### 3.2.6.1 Residential Savings

Below, the share of overall annual and lifetime residential savings represented by lighting are provided for the low and mid scenarios. Lighting remains an important source of savings for residential programs, although less in later years of the study, less so under the mid scenario, and less so on a lifetime basis.

*Figure 23. Lighting as a Share of Overall Residential Annual and Lifetime Savings for Low and Mid Scenarios*



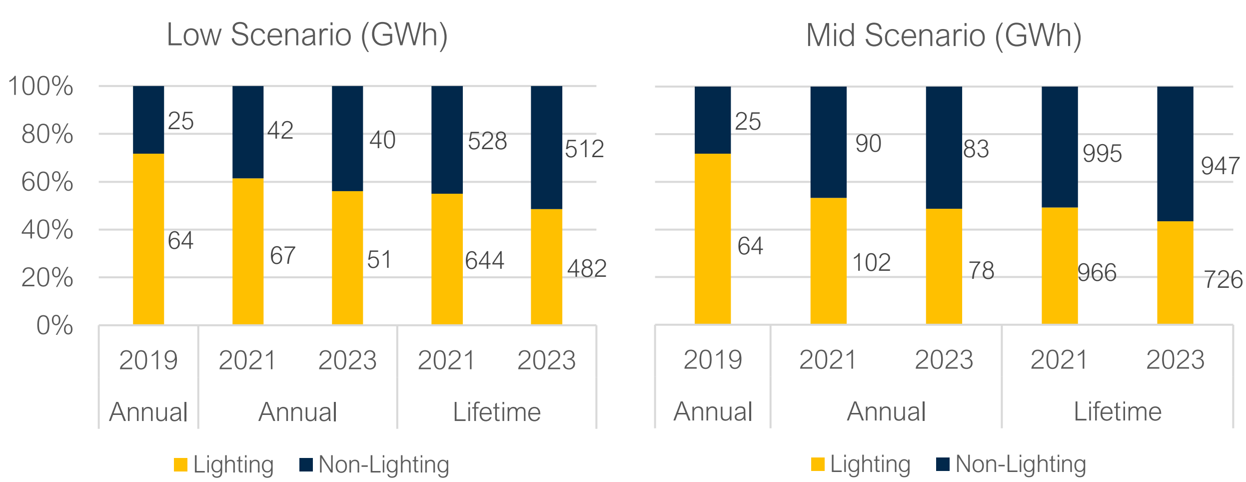

Under the low scenario, lighting accounts for 14 GWh of annual residential savings in 2021, slightly more than 40% of annual residential savings overall. Lighting makes up a smaller share of residential lifetime savings (16%). By 2023, lighting shrinks to 21% of annual low scenario residential savings and 6% of lifetime savings.

Moving from the low to the mid scenario, annual lighting savings grow on absolute basis to 17 GWh but represent a smaller share of overall savings (33% of annual residential savings overall) as incentives and enabling strategies are increased, promoting the adoption of measures in other end uses. By 2023, lighting represents 15% of annual savings and 4% of lifetime savings under the mid scenario. Under both scenarios, the relative and absolute lighting savings decrease from actual 2019 program achievements.

### 3.2.6.2 Non-Residential Savings

Below, the share of overall annual and lifetime non-residential savings represented by lighting are provided for the low and mid scenarios. Although Tubular LEDs (TLEDs) are becoming more common, they have not seen the same level of market transformation as has occurred with A-Lamps and specialty bulbs. As a result, lighting is forecasted to continue to play an important role in non-residential programs over the study period.

*Figure 24. Lighting as a Share of Overall Non-Residential Annual and Lifetime Electric Savings for Low and Mid Scenarios*



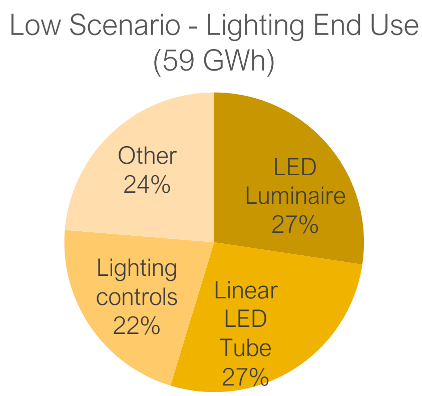

Under the low scenario, lighting accounts for 67 GWh of annual non-residential savings in 2021, approximately 60% of annual non-residential savings overall. At 644 GWh, lighting accounts for 55% of non-residential lifetime savings in 2021. By 2023, lighting remains an important, albeit slighting reduced, source of savings – 56% of total annual, and 49% of total lifetime.

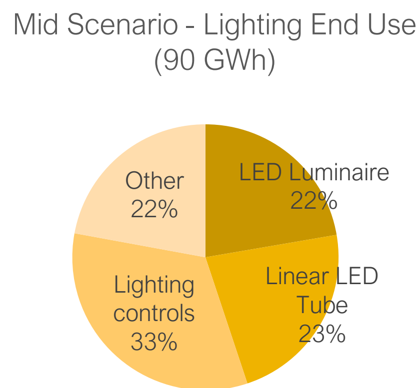
Moving from the low to the mid scenario, annual lighting savings grow on an absolute basis to 102 GWh but decrease on a relative basis (53% of annual non-residential savings overall). By 2023, lighting represents 49% of annual savings and 43% of lifetime savings. Absolute lighting savings increase from historic 2019 savings levels, but non-lighting measure savings increase as well. As a result, lighting saving under the modeled scenarios account for smaller portion of overall savings as compared to 2019 program levels.

Although linear lighting remains an important opportunity, the lighting end use also includes savings from lighting controls. Advanced lighting controls, including networked lighting, is a growing opportunity as new technologies and products integrate efficiency savings with increased functionality and non-energy benefits. These offer an emerging opportunity that also faces notable challenges including limited cross-compatibility among products from different manufacturers, limited customer awareness of the options and benefits, and timing re-lamping efforts with controls change-outs. Achieving the potential savings from advanced lighting controls will likely require investment to identify the most effective delivery strategies and tracking product development and roll-out.

Figure 25 provides an overview of the share of overall non-residential savings by lighting technology for the low and mid scenarios.

*Figure 25. Non-Residential Annual Lighting Savings by Technology and Scenario, Average over 2021-2023*




On average over the 2021 to 2023 period, lighting controls represent 22% of all lighting savings opportunities under the low scenario. This increases under the mid scenario where, on average, controls represent 33% of total annual lighting savings due to augmented incentives and implementation of enabling strategies.

### 3.2.6.3 Budget Implications

Under the mid scenario, lighting represents a smaller share of both residential and non-residential savings (on both an annual and a lifetime basis) in comparison to the low scenario. The mid scenario is associated with increased incentives (which improve customer cost-effectiveness) and additional enabling strategies (which reduce non-financial market barriers). This results in increased diversity of savings and a decreased dependence on lighting, but at an additional cost. Table 13 below outlines the low and mid scenario electric utility budget and savings for years 2021 and 2023.

*Table 13. Electric Utility Budget, Savings, and First Year Cost by Scenario and Year*[16]

| | | 2019 | 2021 | 2023 |
|---|---|---|---|---|
| Actual Program Spending | Electric Utility Budget (M$) | $46 | | |
| | Electric Utility Savings (GWh) | 123 | | |
| | $/kWh | $0.37 | | |
| Low Scenario | Electric Utility Budget (M$) | | $62 | $60 |
| | Electric Utility Savings (GWh) | | 144 | 116 |
| | $/kWh | | $0.43 | $0.52 |
| Mid Scenario | Electric Utility Budget (M$) | | $169 | $159 |
| | Electric Utility Savings (GWh) | | 242 | 200 |
| | $/kWh | | $0.70 | $0.80 |

The per kilowatt-hour cost of savings increases within each scenario between years 2021 and 2023 and between the low and the mid scenarios. As lighting savings decrease over time due to market transformation to LED baselines, programs – as a result of pursuing less cost-effective measures – are expected to either see fewer savings for a constant budget or will be required to increase budgets to unlock additional savings opportunities. These opportunities are explored in greater detail in the savings by end use and top measures sections that follow.

[16] The $/kWh values presented here represent the budget per incremental annual kWh (first year savings). Costs associated with lifetime measure savings would be considerably lower.

# 3.3 Natural Gas Utility Program Savings

This section presents the achievable potential for natural gas savings from natural gas utility programs. The results focus primarily on the low and mid scenarios, given that these scenarios are most closely in-line with anticipated 2021-2023 NHSaves program budgets. For brevity, results are primarily presented for the first and final years of the study, 2021 and 2023. Complete results for all three scenarios and all three years of the study are included in Appendix D of Volume II of the report.

## 3.3.1 Basis of Savings

This section provides an overview of natural gas utility program savings potential. The savings presented here represent the savings achieved through natural gas measures and do not account for natural gas impacts of electric measures due to interactive or secondary savings effects. The savings are adjusted gross savings at the meter.

## 3.3.2 Savings as a Percent of Sales

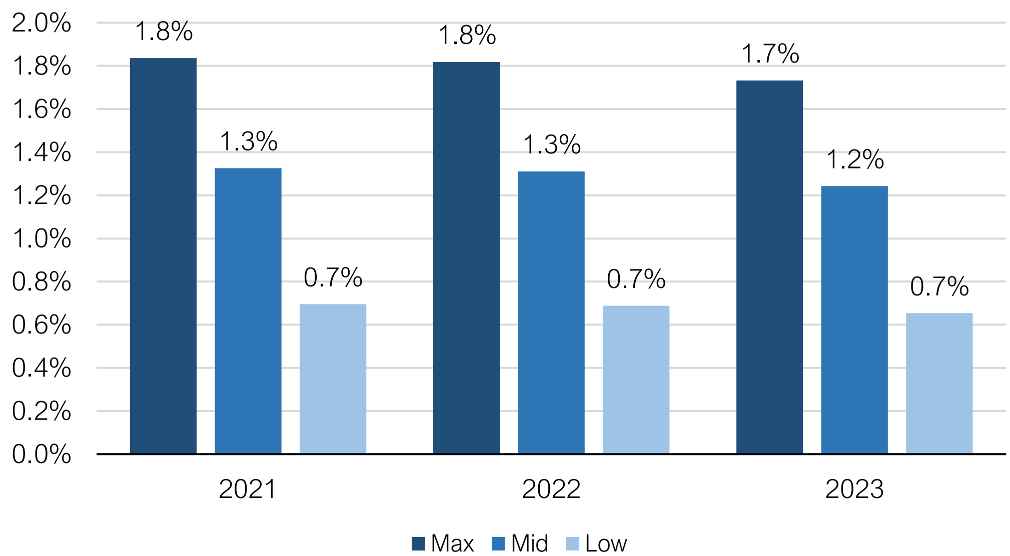
The study estimates that efficiency programs can procure between 206 thousand MMBtu (low scenario) and 517 thousand MMBtu (max scenario) of incremental annual savings in 2021, between 206 thousand MMBtu and 514 Thousand MMBtu of incremental annual savings in 2022, and between 197 thousand MMBtu and 493 thousand MMBtu of incremental annual savings in 2023, as outlined in the table below. For context, the NHSaves programs achieved portfolio-wide natural gas savings of 209 Thousand MMBtu in 2019.

*Table 14. Annual Incremental Natural Gas Program Savings by Scenario, Year*

| Scenario | 2019 Natural Gas Savings (Thousand MMBtu) | 2021 Natural Gas Savings (Thousand MMBtu) | 2022 Natural Gas Savings (Thousand MMBtu) | 2023 Natural Gas Savings (Thousand MMBtu) |
|---|---|---|---|---|
| Max | | 517 | 514 | 493 |
| Mid | | 378 | 376 | 360 |
| Low | | 206 | 206 | 197 |
| Actual | 209 | | | |

Savings as a percent of sales is one of the target metrics included in the NHSaves three-year program plans. Below, Figure 28 presents the modeled potential natural gas savings as a percent of natural gas sales for the first and last years of the study.

*Figure 26. Natural Gas Savings as a Percent of Sales*[17]




Savings range from 0.7% of sales to 1.8%, varying by scenario and year. The modeled savings as a percent of sales show a decrease across all scenarios in the final year of the study. This decrease is primarily a result of a new Federal standard for furnaces coming into effect in 2023, shifting the baseline and decreasing claimable savings.

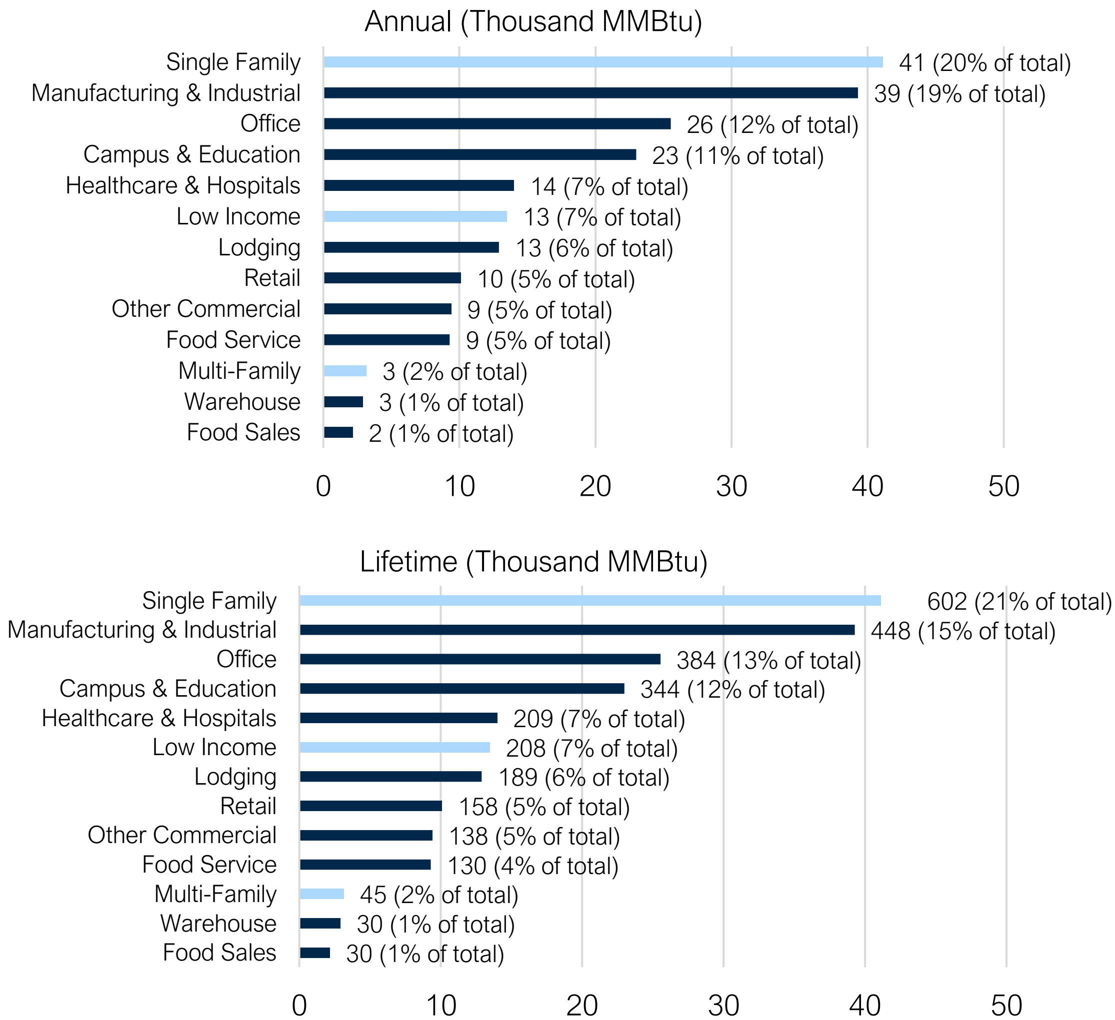
### 3.3.3 Savings by Segment

This section provides an overview of the forecasted savings by segment under the low scenario in 2021. Results are provided for annual and lifetime savings. The mid scenario shows similar trends to the low scenario with respect to the top saving segments and share of savings by sector and consequently has been excluded from this section.

The non-residential sector, which includes commercial, institutional, and industrial customers, is forecasted to account for approximately 68% of total natural gas consumption throughout the study period (as seen in the Baseline Energy and Demand Forecasts section). Under the low scenario, the non-residential sector also represents the majority of both annual and lifetime natural gas savings (72% of annual savings, 71% of lifetime sales), as seen in Figure 27 below.

[17] Savings are shown as a percent of forecasted sales in that year (i.e. 2021 savings are shown as a percent of 2021 sales, 2023 savings as a percent of 2023 sales).

*Figure 27. 2021 Annual and Lifetime Electricity Savings by Segment[18], Low Scenario*




Single family is the top-saving segment on both an annual and lifetime basis, followed by manufacturing and industrial. The top five segments – also including office, campus and education, and healthcare and hospitals - collectively account for close to 70% of both annual and lifetime savings.

### 3.3.4 Residential

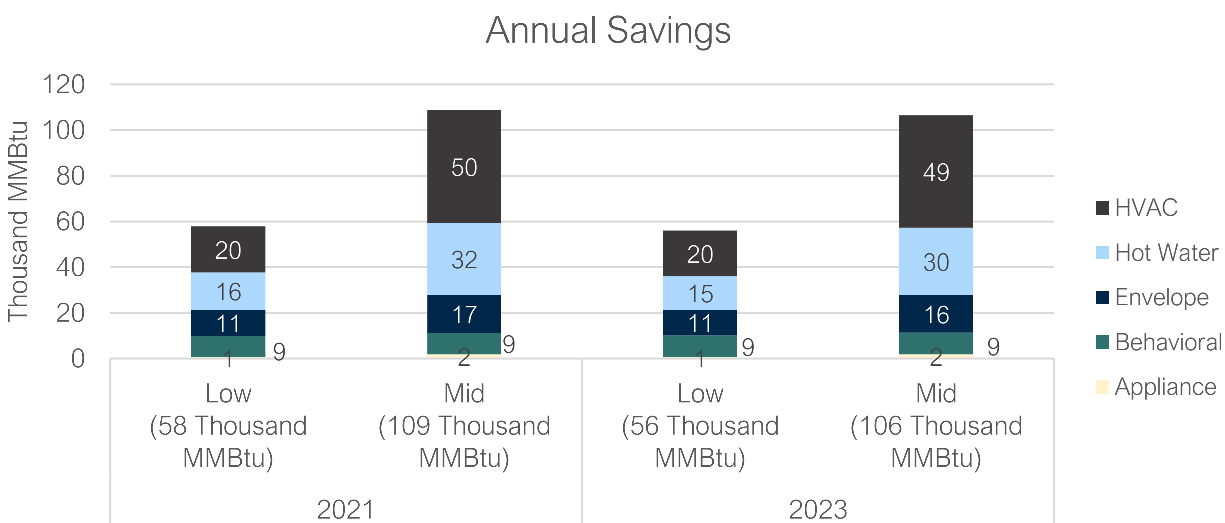
This section presents detailed results for the residential sector (including low income), outlining savings potential by end use and highlighting top measures. Results are included for both the low and the mid scenarios.

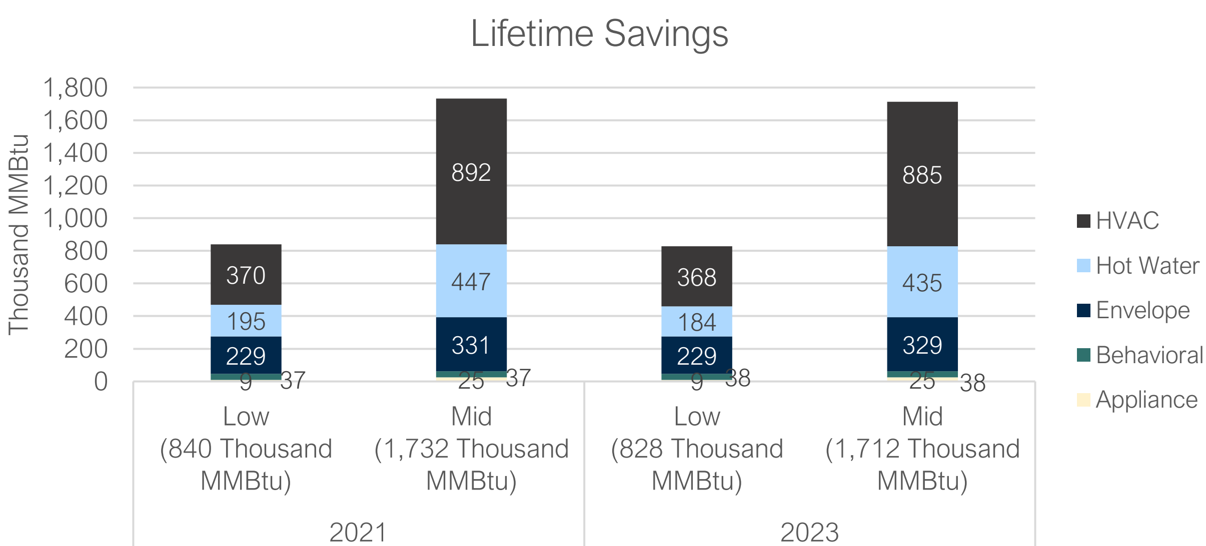
[18] As part of the study, customers were categorized into segments. Given the reliance on secondary data in the non-residential portion of the study, segment definitions were constrained, and segmentation in the study may differ from internal utility segmentation of customers. A full description of the segmentation process was provided in the *Commercial Segmentation Memo.*

#### 3.3.4.1 Savings by End Use

Within the residential sector, the majority of natural gas savings result from a reduction in energy associated with space heating – either through HVAC equipment or envelope improvements. Figure 28 below presents annual and lifetime residential savings by end use and scenario for years 2021 and 2023.

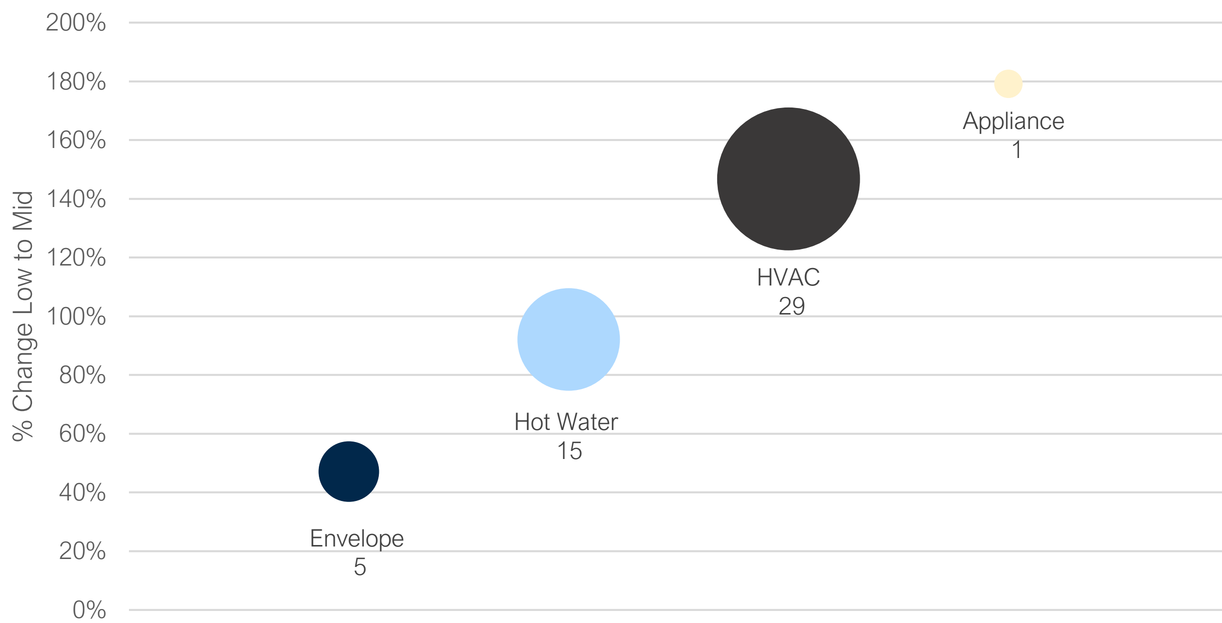
*Figure 28. Residential Annual and Lifetime Natural Gas Savings by End Use, Low and Mid Scenarios*




The HVAC end use is the largest single source of residential natural gas savings under both the low and mid scenarios in 2021 and 2023. As seen in Figure 29 below, this end use also shows considerable absolute and relative growth moving between the scenarios. As will be noted in the following section, specific measures with high potential include furnaces, boilers, and wi-fi thermostats.

*Figure 29. Residential Natural Gas End Use Savings – Growth between Low and Mid Scenario in 2021 (Thousand MMBtu)*




The envelope end use grows more slowly between low and mid scenarios but maintains a large share of annual and lifetime savings under both scenarios. Key envelope measures include insulation and incentives for new construction[19], although savings also arise from air sealing and efficient windows.

Beyond HVAC and envelope, notable opportunities are found in the hot water end use, which today is largely untapped by programs. Measures include low-flow showerheads, faucet aerators, and efficient water heaters.

Behavioural measures (i.e. home energy reports) show considerable incremental annual savings but have a limited influence on lifetime savings due to their relatively short lifetimes.

### 3.3.4.2 Top Measures

Table 15 below outlines the top residential measures on an annual savings basis for the first and last years of the study. Results are shown for both the low and mid scenarios.

*Table 15. 2021 Residential Top Measures by Annual Natural Gas Savings, Low and Mid Scenario*

| 2021 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (Thousand MMBtu) | Measure | Savings (Thousand MMBtu) |
| Home Energy Report | 9.4 | Furnace | 20.5 |
| Furnace | 8.8 | Water Heater - Tankless | 13.8 |

[19] The residential new construction measure incentivizes participants to build to the ENERGY STAR for homes building standard, assuming a baseline of 2018 International Energy Conservation Code (IECC).

| 2021 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (Thousand MMBtu) | Measure | Savings (Thousand MMBtu) |
| Water Heater - Tankless | 4.3 | Thermostat Wi-Fi | 11.6 |
| Duct Insulation | 3.9 | Home Energy Report | 9.4 |
| Water Heater - Storage | 3.6 | Boiler | 7.6 |
| Thermostatic Restrictor Shower Valve | 3.1 | Water Heater - Storage | 7.1 |
| Insulation - Attic | 2.9 | Duct Insulation | 5.6 |
| Low Flow Shower Head | 2.9 | Thermostatic Restrictor Shower Valve | 4.4 |
| Thermostat Wi-Fi | 2.9 | New Home Construction | 4.1 |
| New Home Construction | 2.8 | Air Sealing | 4.0 |
| Boiler | 2.8 | Low Flow Shower Head | 3.2 |
| Low Flow Faucet Aerator | 2.4 | Insulation - Basement | 2.9 |
| Air Sealing | 1.9 | Low Flow Faucet Aerator | 2.8 |
| Insulation - Wall | 1.6 | Efficient Windows | 2.5 |
| Efficient Windows | 1.4 | Heat Recovery Ventilator (HRV) | 2.3 |
| Heat Recovery Ventilator (HRV) | 0.9 | Insulation - Wall | 1.6 |
| Duct Sealing | 0.7 | Clothes Washer | 1.6 |
| Insulation - Basement | 0.7 | Insulation - Attic | 1.5 |
| Clothes Washer | 0.6 | Duct Sealing | 1.2 |
| Boiler Reset Control | 0.2 | Boiler Reset Control | 0.8 |

*Table 16. 2023 Residential Top Measures by Annual Natural Gas Savings, Low and Mid Scenario*

| 2023 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (Thousand MMBtu) | Measure | Savings (Thousand MMBtu) |
| Home Energy Report | 9.4 | Furnace | 20.5 |
| Furnace | 8.8 | Water Heater - Tankless | 14.0 |
| Water Heater - Tankless | 4.4 | Thermostat Wi-Fi | 11.4 |
| Duct Insulation | 3.8 | Home Energy Report | 9.4 |
| Water Heater - Storage | 3.7 | Boiler | 7.6 |
| New Home Construction | 2.9 | Water Heater - Storage | 7.2 |
| Thermostat Wi-Fi | 2.8 | Duct Insulation | 5.4 |
| Insulation - Attic | 2.8 | New Home Construction | 4.1 |
| Boiler | 2.8 | Air Sealing | 3.9 |

| 2023 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (Thousand MMBtu) | Measure | Savings (Thousand MMBtu) |
| Thermostatic Restrictor Shower Valve | 2.4 | Thermostatic Restrictor Shower Valve | 3.4 |
| Low Flow Shower Head | 2.2 | Insulation - Basement | 2.9 |
| Low Flow Faucet Aerator | 1.9 | Low Flow Shower Head | 2.5 |
| Air Sealing | 1.8 | Efficient Windows | 2.5 |
| Insulation - Wall | 1.5 | Heat Recovery Ventilator (HRV) | 2.3 |
| Efficient Windows | 1.4 | Low Flow Faucet Aerator | 2.2 |
| Heat Recovery Ventilator (HRV) | 0.9 | Clothes Washer | 1.6 |
| Duct Sealing | 0.7 | Insulation - Wall | 1.6 |
| Insulation - Basement | 0.7 | Insulation - Attic | 1.4 |
| Clothes Washer | 0.6 | Duct Sealing | 1.1 |
| Boiler Reset Control | 0.2 | Boiler Reset Control | 0.8 |

Moving from the low to the mid scenario, the largest changes in savings result from those measures with relatively low cost-effectiveness. This is due to measures that are less cost-effective being more sensitive to changes in barrier levels[20]. Examples of such measures include furnaces, boilers, water heaters, and Wi-Fi Thermostats.

Top measures are highly consistent between study years for both scenarios. No standards changes come into effect that would impact residential natural gas savings over the study period, so savings sources remain relatively constant over the study period within a given scenario.

Home energy reports provide high annual savings across all years and scenarios. As noted previously, however, the short lifetime of this measure limits their lifetime savings.

### 3.3.5 Non-Residential

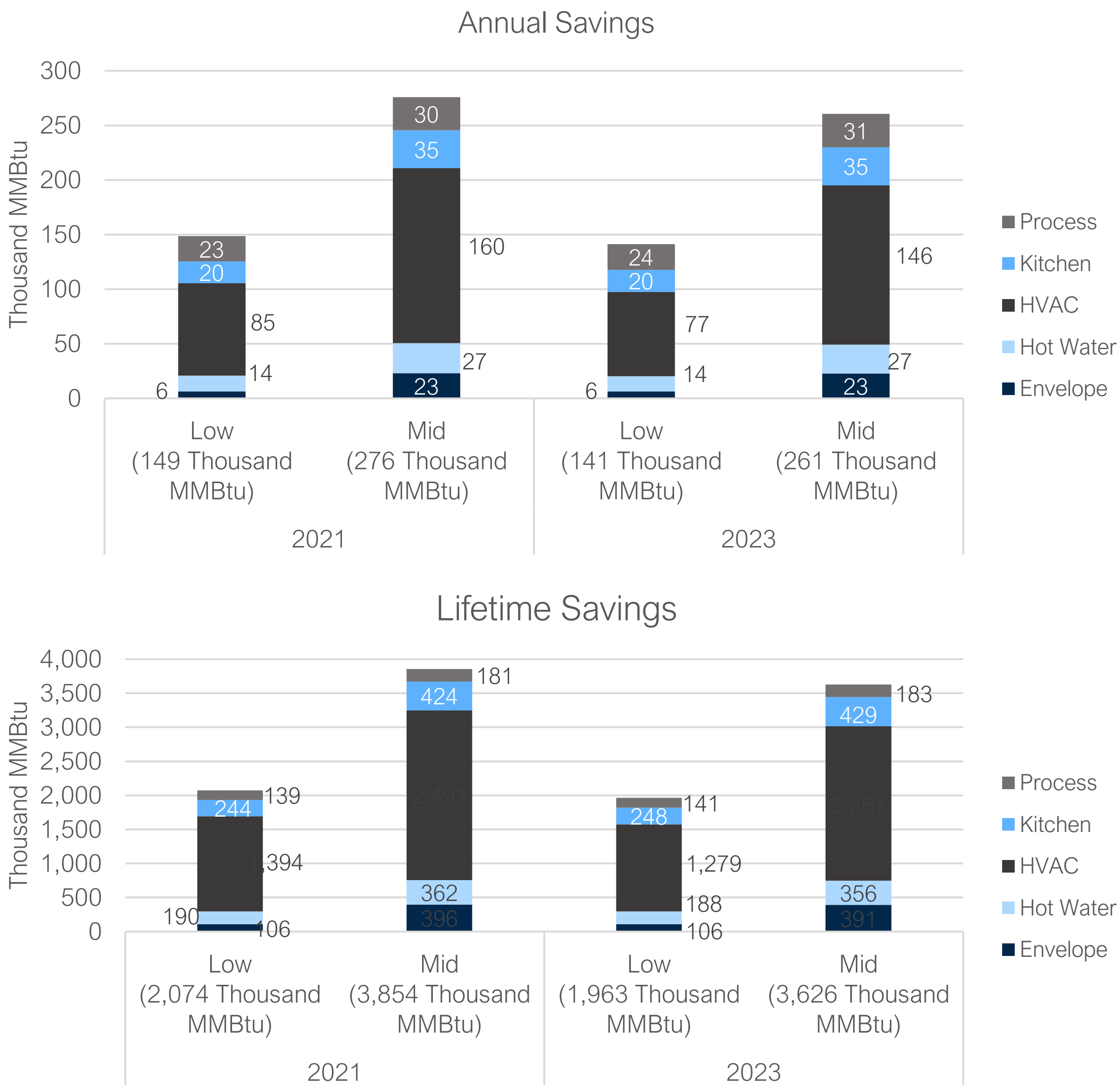
This section presents detailed results for the non-residential sector, outlining potential by end use and highlighting top measures.

#### 3.3.5.1 Savings by End Use

The HVAC end use represents the majority of non-residential natural gas savings on both an annual and lifetime basis. Figure 32 below presents annual and lifetime non-residential savings by end use and scenario for years 2021 and 2023.

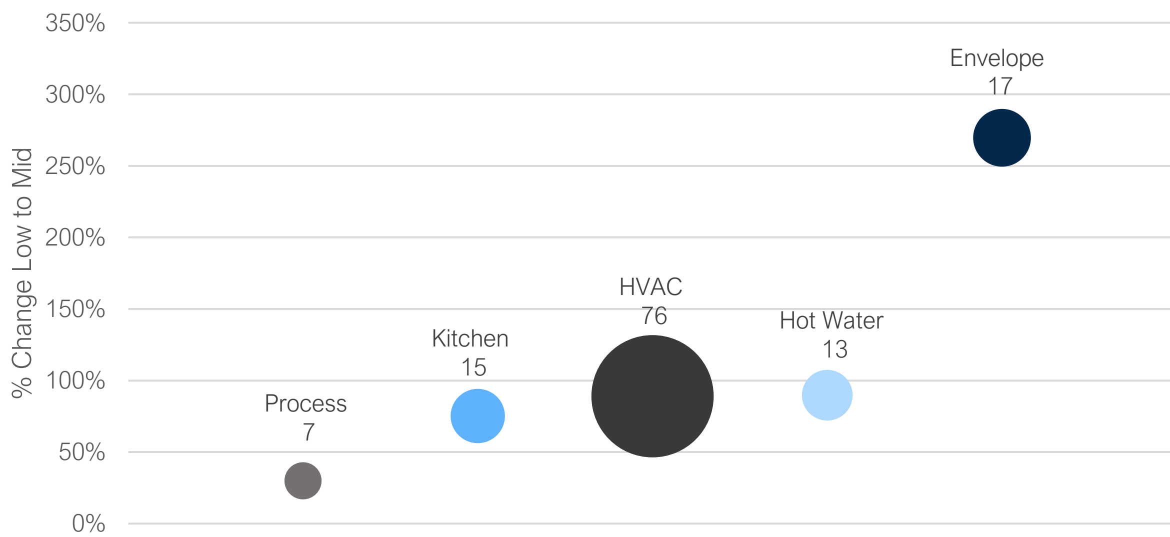
[20] For additional details on this, see call-out box ‘DEEP’s Adoption Methodology and Optimizing Program Savings’ in the Portfolio Costs and Benefits section.

*Figure 30. Non-Residential Annual and Lifetime Natural Gas Savings by End Use, Low and Mid Scenarios*




As with the residential sector, non-residential gas savings are dominated by HVAC measures both on an annual basis and on a lifetime basis. HVAC savings are primarily from various heating equipment measures, including condensing make-up air units, waste heat recovery, and rooftop units. A drop in annual HVAC savings can be seen in 2023 when the Federal standard for furnaces comes into effect, shifting the baseline and decreasing claimable savings. As seen in Figure 33 below, the HVAC end use also shows the greatest absolute growth between the low and mid scenarios.

*Figure 31. Non-Residential Natural Gas End Use Savings - Growth between Low and Mid Scenarios in 2021 (Thousand MMBtu)*




Envelope savings show the highest relative change between low and mid scenario, while process savings grow at a slower rate between the low and mid scenarios than the other end uses but remain a considerable opportunity (particularly on an annual savings basis). Process measures include steam traps, controls, and assorted custom measures.

The kitchen end use also shows high potential. Key measures include fryers, convection ovens, and dishwashers. As would be expected, kitchen opportunities are focused in specific segments, as seen below.

Given the large number of segments in the non-residential sector, Figure 32 below shows the end use breakdown for the top five saving segments. Focusing on annual savings for the low scenario in 2021, the end use savings by segment are compared to the sector overall.

*Figure 32. 2021 Annual Electricity Savings by End Use for Top-Saving Non-Residential, Low Scenario*

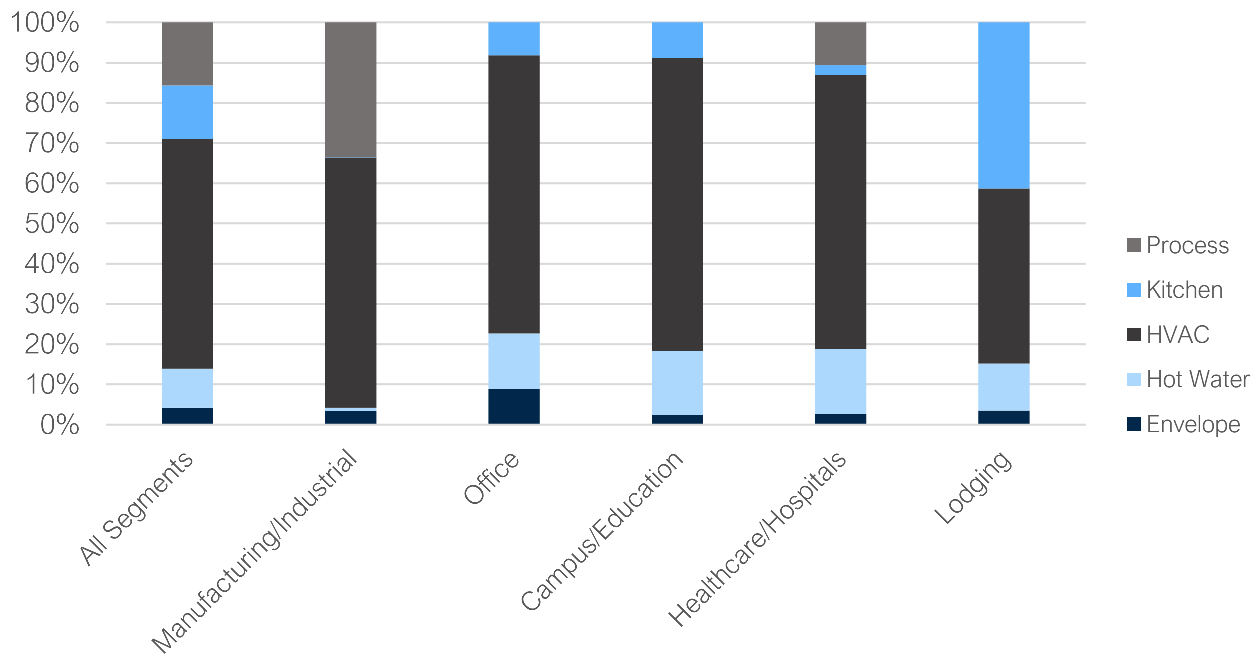



*Table 17. 2021 Annual Natural Gas Savings for Top-Saving Non-Residential Measures, Low Scenario*

| | All Segments | Manufacturing/ Industrial | Office | Campus/ Education | Healthcare/ Hospitals | Lodging |
|---|---|---|---|---|---|---|
| Total Savings (Thousand MMBtu) | 149 | 39 | 26 | 23 | 14 | 13 |

HVAC opportunities are considerable across all segments. Although slightly smaller in lodging, they remain close to half of the overall natural gas savings opportunities for this segment, and – at the high end – up to 73% of the opportunities associated with Campus/Education.

Targeted campaigns would be beneficial for some end uses. In particular, campaigns could focus on process savings in the Manufacturing/Industrial and Healthcare/Hospital segments and on kitchen savings in the Lodging, Office, and Campus/Education segments.

### 3.3.5.2 Top Measures

Table 18 below outlines the top non-residential measures on an annual savings basis for the first and last years of the study. Results are shown for both the low and mid scenarios.

*Table 18. 2021 Non-Residential Top Measures by Annual Natural Gas Savings, Low and Mid Scenario*

| 2021 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (Thousand MMBtu) | Measure | Savings (Thousand MMBtu) |
| Steam Trap | 23.2 | Steam Trap | 30.2 |
| Boiler | 18.3 | Boiler | 30.0 |
| Waste Heat Recovery | 11.9 | Waste Heat Recovery | 28.2 |
| Boiler Reset Control | 10.2 | Fresh Air controlled by CO2 monitors | 16.6 |
| Condensing Make Up Air Unit | 9.5 | Fryer | 16.4 |
| Fresh Air controlled by CO2 monitors | 8.8 | Building Shell Air Sealing | 15.1 |
| Fryer | 8.7 | Furnace | 14.2 |
| Volume Water Heater | 7.9 | Volume Water Heater | 13.0 |
| Furnace | 6.8 | Condensing Make Up Air Unit | 12.7 |
| Kitchen Demand Control Ventilation | 6.1 | Boiler Reset Control | 11.8 |
| Oven | 5.8 | Oven | 9.9 |
| Building Shell Air Sealing | 4.3 | Kitchen Demand Control Ventilation | 8.7 |
| Building Management System (BMS) | 3.6 | Energy Management System (EMS) | 6.4 |
| Energy Management System (EMS) | 3.1 | Building Management System (BMS) | 5.8 |
| Dishwasher | 2.3 | Condensing RTU | 5.2 |
| Condensing RTU | 1.9 | Insulation - Attic/Roof | 4.1 |
| Water Heater - Indirect | 1.8 | Infrared Broiler | 3.3 |
| Low Flow Faucet Aerator | 1.7 | Steam Boiler | 3.2 |
| Steamer | 1.6 | Water Heater - Storage | 3.0 |
| Efficient Windows | 1.5 | Efficient Windows | 2.9 |

*Table 19. 2023 Non-Residential Top Measures by Annual Natural Gas Savings, Low and Mid Scenario*

| 2023 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (Thousand MMBtu) | Measure | Savings (Thousand MMBtu) |
| Steam Trap | 23.54 | Steam Trap | 31 |
| Boiler | 18.62 | Boiler | 30 |
| Waste Heat Recovery | 11.71 | Waste Heat Recovery | 28 |
| Boiler Reset Control | 9.90 | Fryer | 17 |
| Condensing Make Up Air Unit | 9.68 | Fresh Air controlled by CO2 monitors | 15 |
| Fryer | 8.88 | Building Shell Air Sealing | 15 |

| 2023 | | | |
|---|---|---|---|
| Low | | Mid | |
| Measure | Savings (Thousand MMBtu) | Measure | Savings (Thousand MMBtu) |
| Fresh Air controlled by CO2 monitors | 7.95 | Volume Water Heater | 13 |
| Volume Water Heater | 7.91 | Condensing Make Up Air Unit | 13 |
| Kitchen Demand Control Ventilation | 5.98 | Boiler Reset Control | 11 |
| Oven | 5.83 | Oven | 10 |
| Building Shell Air Sealing | 4.21 | Kitchen Demand Control Ventilation | 8 |
| Building Management System (BMS) | 3.20 | Energy Management System (EMS) | 6 |
| Energy Management System (EMS) | 2.81 | Condensing RTU | 5 |
| Dishwasher | 2.34 | Building Management System (BMS) | 5 |
| Condensing RTU | 1.92 | Insulation - Attic/Roof | 4 |
| Water Heater - Indirect | 1.78 | Furnace | 4 |
| Steamer | 1.58 | Infrared Broiler | 3 |
| Low Flow Faucet Aerator | 1.51 | Steam Boiler | 3 |
| Efficient Windows | 1.49 | Water Heater - Storage | 3 |
| Infrared Broiler | 1.44 | Efficient Windows | 3 |

Top measures are highly consistent between study years for both scenarios with the exception of furnaces. In 2023, a new Federal furnace standard comes into effect, adjusting baseline efficiency levels and reducing claimable savings available for programs to capture.

In 2021, the highest growth measures between low and mid scenarios are those with lower cost-effectiveness. Notable measures include building shell air sealing, waste heat recovery, and furnaces.

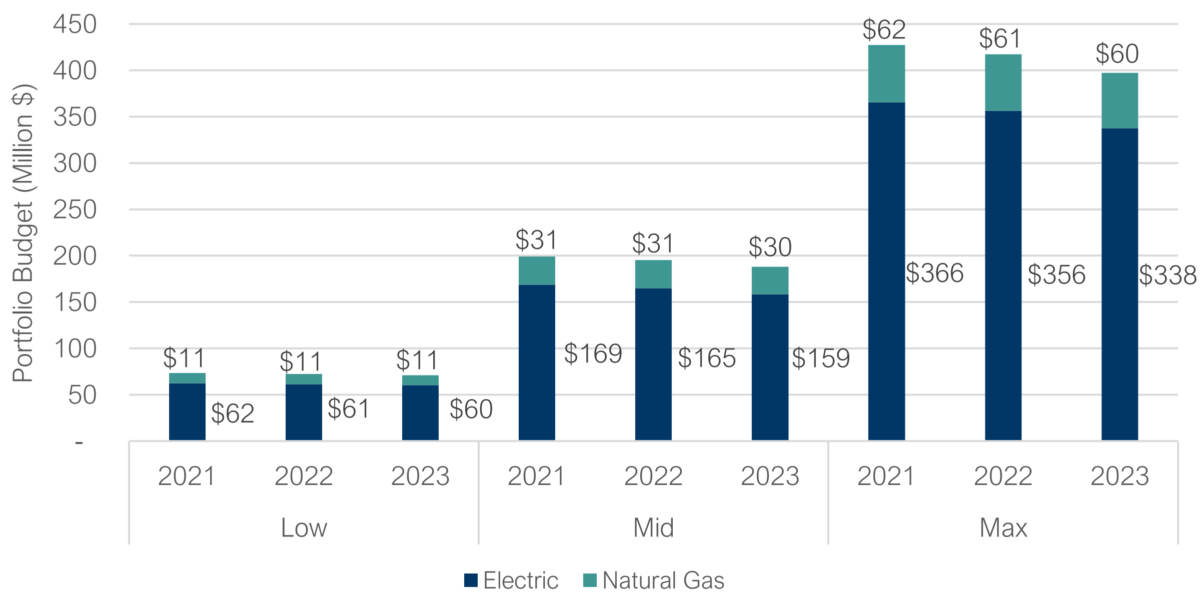
## 3.4 Portfolio Costs and Benefits

Overall, there is significant potential for energy efficiency in New Hampshire, although programs will be required to adjust in the face of transforming A-lamp and speciality lighting markets – program delivery, costs, and savings levels will be impacted. This section provides high-level cost and benefit projections for the achievable potential scenarios. While these projections may offer a valuable directional assessment of program opportunities and the associated costs over the study period, these are largely informed by past program designs and performance in New Hampshire. As the efficiency technology mix evolves and new delivery approaches and targeted measures are required, the actual costs and program balances could vary significantly from these projections.

### 3.4.1 Program Costs

The study estimates that efficiency program costs will range between $73 and $428 million in 2021, and $71 and $398 million in 2023. Similar to current efficiency spending, the majority of this directed toward the electric efficiency programs (which also includes delivered fuel measures) as seen in Figure 33. The body of the report focuses primarily on the low and mid scenarios given that these scenarios are most closely in-line with anticipated 2021-2023 NHSaves program budgets. The max scenario is included in the budget and overall savings values to provide a sense of magnitude associated with max program design, and full max scenario results are included in Appendix D of Volume II of the report.

*Figure 33. Estimated Program Costs by Year, Scenario*




Note: electric program costs include incentive and implementation costs for delivered fuel measures

Relative to 2019 NHSaves programs, which had a total budget of $57 million, the study estimates an increase in spending across all scenarios, as outlined in Table 20 below. Although the low scenario uses historic program incentive levels and costs, other input assumptions differ from historic program assumptions in an effort to capture projected future market changes. In particular, lighting net-to-gross values and realization rates differ between historic programs and the achievable potential scenarios in order to represent increased natural adoption of LED technologies. These assumptions, along with the inclusion of measures not currently found in program offerings and actual program budget constraints[21] account for differences between historic and achievable potential budgets.

*Table 20. Estimated Program Costs by Year, Scenario*

| Portfolio | Scenario | 2021 | 2022 | 2023 | Average | 2019 Results |
|---|---|---|---|---|---|---|
| Electric | Low | $62M | $61M | $60M | $61M | $47M |
| | Mid | $169M | $165M | $159M | $164M | |
| | Max | $366 | $356M | $338M | $353M | |
| Gas | Low | $11M | $11M | $11M | $11M | $10M |
| | Mid | $31M | $31M | $30M | $31M | |
| | Max | $62M | $61M | $60M | $61M | |
| Total | Low | $73M | $72M | $71M | $72M | $57M |
| | Mid | $200M | $196M | $189M | $195M | |
| | Max | $428M | $417M | $398M | $414M | |

In addition to larger budgets, the average cost of per unit incremental savings increases under all scenarios for both electric and natural gas programs, as seen in Table 21 below.

*Table 21. Average Estimated Savings Unit Cost by Year, Scenario*

| Portfolio | Scenario | 2021 | 2022 | 2023 | Average | 2019 Results |
|---|---|---|---|---|---|---|
| $ per Incremental Annual kWh | Low | $0.43 | $0.47 | $0.52 | $0.47 | $0.38 |
| | Mid | $0.70 | $0.74 | $0.79 | $0.74 | |
| | Max | $1.15 | $1.21 | $1.27 | $1.21 | |
| $ per Incremental Annual MMBtu | Low | $54 | $54 | $56 | $55 | $48 |
| | Mid | $81 | $82 | $85 | $83 | |
| | Max | $119 | $120 | $125 | $121 | |

The increased costs over time under all scenarios can primarily be explained by the reduction in A-Lamp savings, which generally have low per unit savings costs. Between scenarios, the unit cost of savings will also increase for two additional reasons. First, raising incentives increases the cost not just for newly acquired savings, but also for savings that would have been obtained under lower incentive levels and thus at a lower per unit cost. Second, the higher incentives and investments in enabling strategies may drive more uptake of measures with higher unit savings costs due to their lower savings to incremental cost ratios. However, the precise magnitude of cost increases under these scenarios should be interpreted with the following caveats:

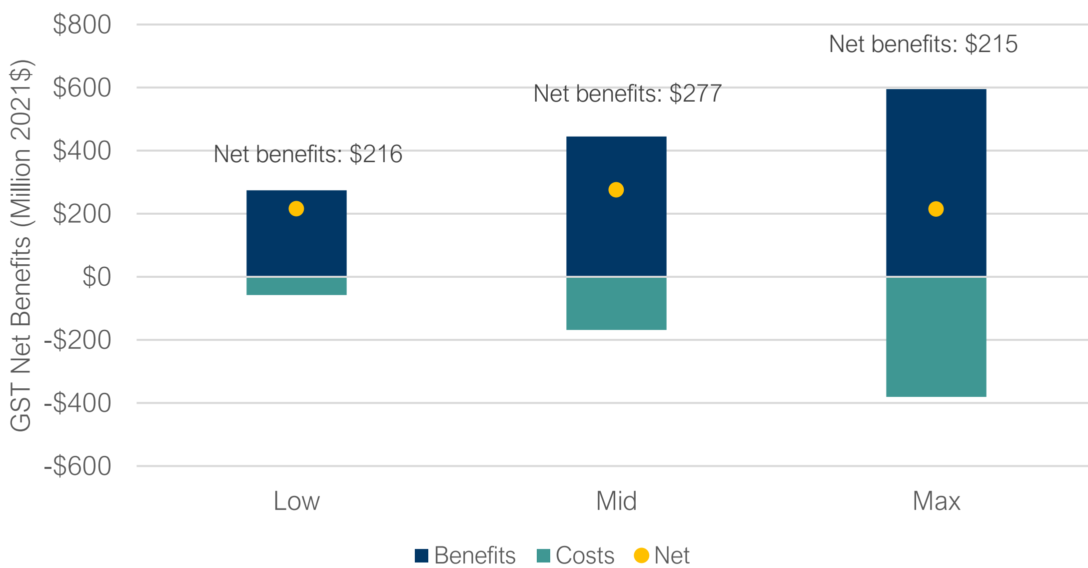
[21] Unlike actual NHSaves programs, the potential study program budgets are unconstrained. Modeled budgets grow to match available savings opportunities with no spending caps. Actual NHSaves programs also have restrictions associated with budgets that are not reflected in the potential study – notably a requirement for 20% of program budgets to be reserved for income qualified programs.

- **Cost estimates are based on historical cost data.** Fixed and variable cost inputs were developed based on historical spending data for NHSaves programs. These inputs do not vary over the study period to account for factors that may increase costs (e.g. higher labor or technology costs as programs increase demand for specific services and/or equipment drives up prices) or decrease costs (e.g. lower program implementation costs as programs mature and become more efficient or employ new delivery strategies). For example, utilities have historically placed emphasis on creating cost-effective lighting programs as this is where the majority of savings were found. However, as lighting savings decrease, utilities will likely begin focusing more on programs offering non-lighting savings, which will impact program implementation effectiveness and costs relative to current implementation practices today.
- **The program scenarios are not optimized for program spending.** For each achievable scenario in the DEEP model, incentive levels are set at the program level as a portion of the incremental costs for each eligible measure in the program. However, a real-world program design would likely set unique incentive levels for each measure, applying higher incentive levels for measures that may have had limited uptake in the past, and maintaining or lowering incentive levels for measures that meet their expected adoption. Section A.3.3 of the Appendix includes additional details regarding how a more granular approach to incentive setting could lead to significantly lower program spending at minimal expense of reducing savings.

### 3.4.2 Program Benefits

In all scenarios, efficiency savings create significant benefits. Based on the Granite State Test, the average benefits generated each program year range from $216 (low) to $642 (max) million as shown in Figure 35.

*Figure 34. 2021-2023 Average Lifetime Granite State Test Benefits Generated Each Year by Scenario*




The mid scenario shows the highest net benefits. This points to diminishing returns from increased spending on incentives under the max scenario, where participant costs are completely eliminated.

# 3.5 COVID-19 Sensitivity Analysis

## 3.5.1 Context

COVID-19 was declared a global pandemic mid-way through the study. There is a high degree of uncertainty surrounding the short and long-term impacts of the pandemic, and the degree to which energy efficiency programs will be impacted remains unknown. The COVID-19 sensitivity analysis was completed in order to provide insights regarding the sensitivity of achievable potential savings to changes in market conditions that may plausibly be expected as a direct result of the pandemic – decreased market sizes and increased barriers to efficiency activities. Note that indirect effects such as impacts on building occupancy, hours of use or other factors which would impact measure-level savings are not accounted for in this analysis.

As more is understood regarding the impact of the pandemic on both the residential and non-residential sectors, gauging this sensitivity is expected to help the utilities refine their understanding of how the study findings can be interpreted in the context of shifting market conditions.

## 3.5.2 Methodology

Within the potential model, the following parameters can be adjusted to assess the sensitivity of savings potential to predicted impacts from COVID-19:

- Market Size: The market size can be reduced to reflect fewer customers within a given segment due to temporary or permanent business closures.
- Barrier Levels: Barrier levels can be increased to reflect increased competition for capital, decreased resources, and other impediments to energy efficiency upgrades. [22]

These parameters were adjusted on a segment-by-segment basis using following steps:

1. Categorize each non-residential segment into one of three impact categories:
    a. Low: No anticipated business closures, increased barriers to efficiency
    b. Moderate: Anticipated short-term closures, increased barriers to efficiency
    c. High: Anticipated long-term closures, increased barriers to efficiency

   To categorize the segments, the Dunsky team reviewed available data regarding anticipated segment-specific impacts of the pandemic[23].

[22] The Barrier Levels refer to the Barrier Level selected on the adoption curves described in greater detail in Appendix A.

[23] The data used to complete the categorization included the US census small business pulse survey along with a research effort that was initiated by the utilities and led by Luth Research which contacted customers about their experiences with COVID-19. The detailed methodology is included in Volume II, Appendix C.

2. **Define high and low bounds for each of the three non-residential segment categories and for the residential sector**

   Next, the Dunsky team defined 'greater impact on savings' and 'lesser impact on savings' impact scenarios for each of the non-residential segment categories and for the residential sector as a whole. The settings are defined in Table 22 below.

*Table 22. Segment Categorization and Scenario Settings by Impact Category*

| Sector | Impact Category | Segments | Lesser Impact on Savings Scenario | Greater Impact on Savings Scenario |
|---|---|---|---|---|
| Non-Residential | Low | Food sales<br>Warehouse | **Market size:** No change<br><br>**Barriers:** Increase by 0.2 for all study years | **Market size:** No change<br><br>**Barriers:** Increased by 0.5 for all study years |
| | Moderate | Campus/Education<br>Healthcare/Hospitals<br>Lodging<br>Manufacturing/Industrial<br>Office<br>Retail<br>Other | **Market size:** Reduce 1st year market size by 10%, return 2nd and 3rd year markets to baseline size<br><br>**Barriers:** Increase by 0.5 for all study years | **Market size:** Reduce 1st year market size by 25%, return 2nd and 3rd year markets to baseline size<br><br>**Barriers:** Increase by 0.7 for all study years |
| | High | Food Service | **Market size:** Reduce market size by 10% for all study years<br><br>**Barriers**: Increase by 0.7 for all study years | **Market size:** Reduce market size by 25% for all study years<br><br>**Barriers**: Increase by 1 for all study years |
| Residential | N/A | N/A | **Market size:** No change<br><br>**Barriers:** Increase by 0.2 for all study years | **Market size:** No change<br><br>**Barriers:** Increased by 0.5 for all study years |

The analysis assumes COVID-19 will result in a reduction in adoption of efficiency measures through programs. The high and low impact scenarios provide gradations in the level of severity of savings reductions as a result of varying market conditions.

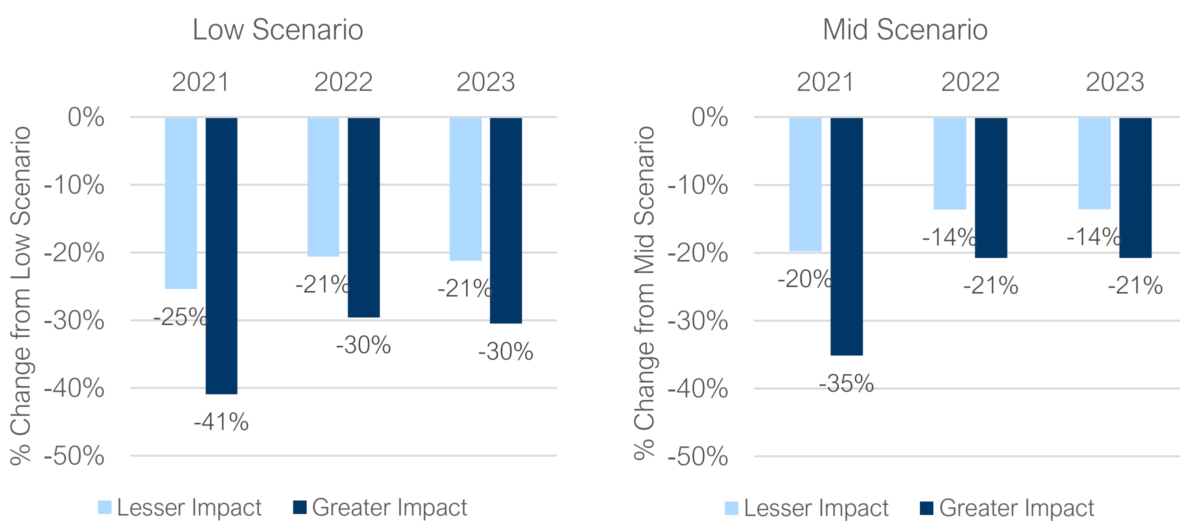
### 3.5.3 Results

In the sections that follow, the low and mid achievable potential scenarios are treated as baselines. The impacts under the 'lesser impact on savings' and 'greater impact on savings' scenarios are then compared to these baselines to understand the impact of changes to market sizes and barrier levels on achievable savings potential. It should be noted that this sensitivity analysis focuses on changes to the adoption of measures. Consideration of how changes to the per unit savings of measures may change as a result of COVID (through differing hours of use, for example) were considered out of scope for this assessment.

### 3.5.3.1 Electric Savings

The relative change in annual incremental electric savings from baseline (low and mid achievable potential scenarios) are included in Figure 35 below.

*Figure 35. Reduction in Savings from Low Achievable Potential Scenario (Left) and Mid Achievable Scenario (Right) by Year*

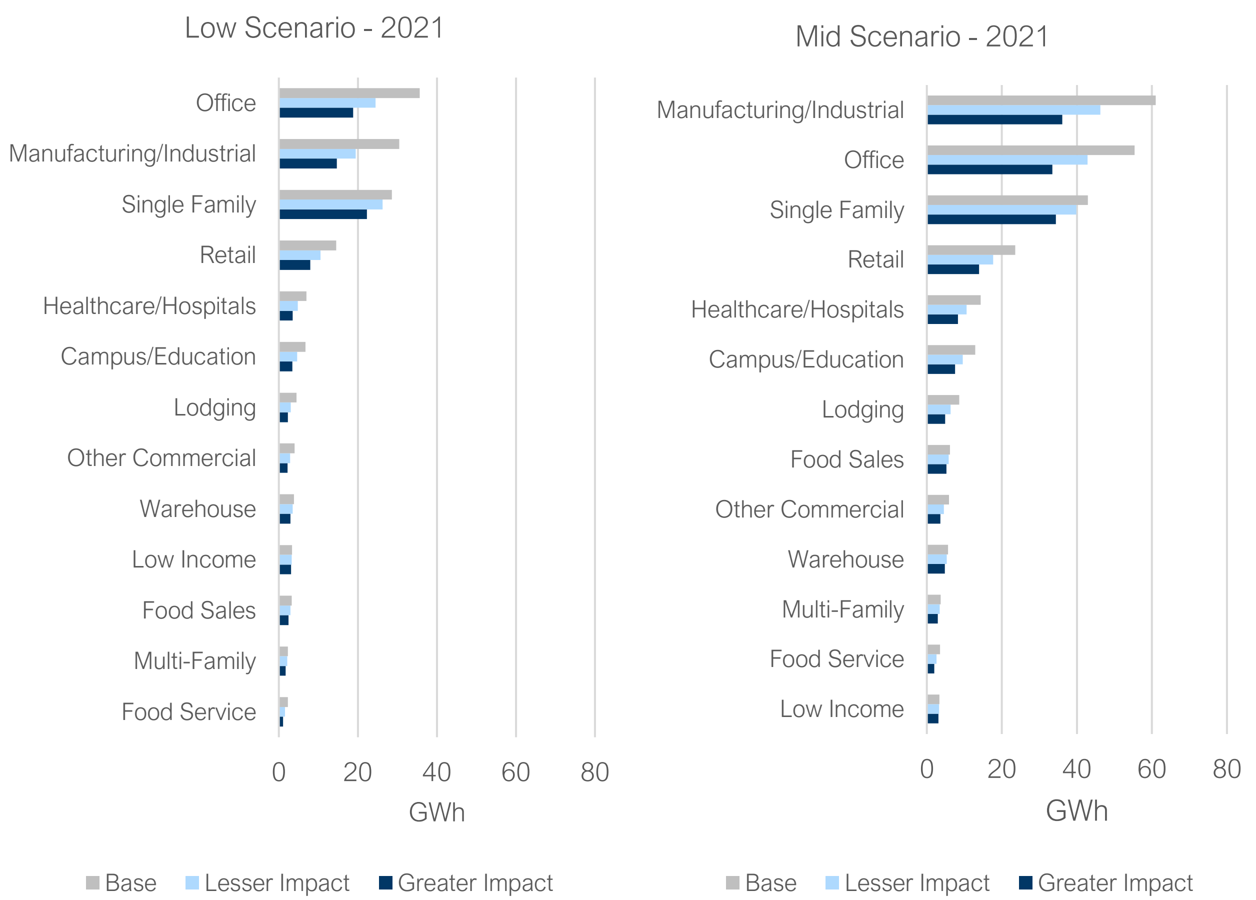



At the scenario settings outlined in Table 22, electric savings are forecasted to decrease from 20% to 41% in 2021 depending on the achievable potential and impact on savings scenario in question, and from 14% to 30% by 2023.

Relative decreases in savings are greater under the low scenario. The mid scenario is characterized by higher incentive levels, and consequently higher participant cost-effectiveness. As a result of the non-linear shape of the adoption curves used in the model[24], higher participant cost-effectiveness is associated with lessened impact from changing barriers, resulting in decreased sensitivity under the mid scenario. This points to programs designed more closely in alignment with mid scenario incentive levels and barrier reductions being more resilient with respect to the adoption of measures in the face of COVID-19 impacts.

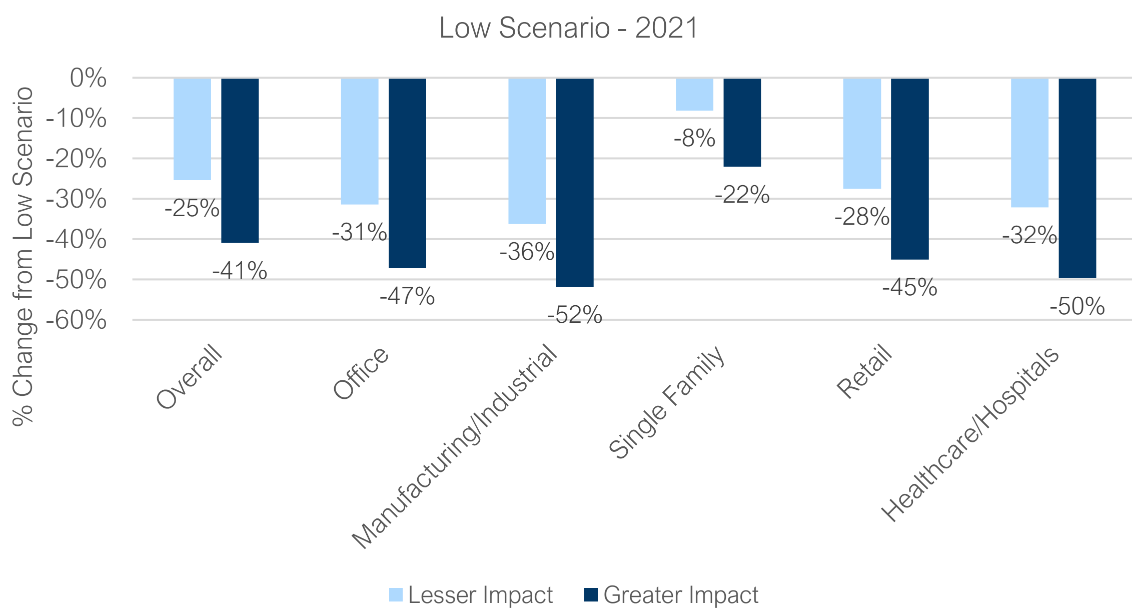
[24] For additional details on this, see call-out box 'DEEP's Adoption Methodology and Optimizing Program Savings' in Volume II of the study, Section A.3.3.

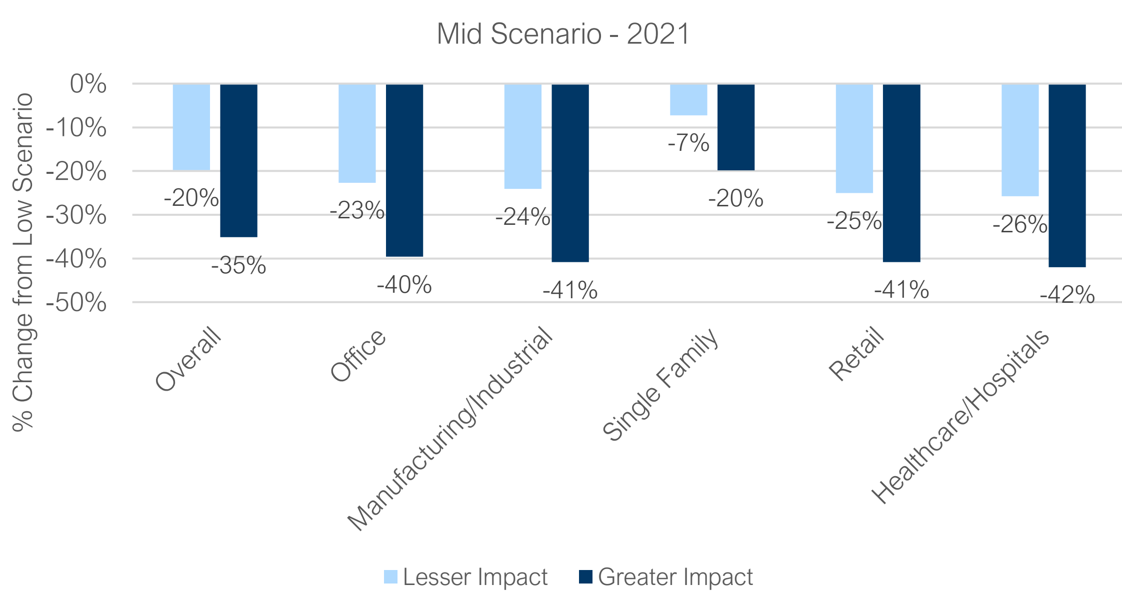
*Figure 36. Achievable Potential by Segment and Impact Scenario Compared to Base for Low and Mid achievable potential scenario*




Smaller relative impacts are noted for residential segments, as there are no 'closures' associated with this sector, unlike non-residential segments. The largest absolute decreases are noted in those segments associated with the most baseline achievable potential - Manufacturing/Industrial, Office, Retail, Single Family, and Healthcare/Hospitals. The relative change from baseline for each of these segments is in Figure 37 below.

*Figure 37. Relative Change from Baseline for Top Segments, 2021*




As previously noted in the end use section of the program savings chapters, savings by end use vary between segments. As a result, changes in savings will not be decreased uniformly among end uses – instead, those end uses which feature more prominently in the top saving segments will be most impacted. The manufacturing and industrial segment sees the largest relative change in savings and shows a relatively different breakdown of end use savings than the other segments, with greater opportunities in process savings, HVAC and HVAC motors, and compressed air than the non-residential sector overall. The office and retails segments depend more heavily on lighting savings than the sector overall, while healthcare and hospitals are associated with greater HVAC opportunities. Each of these end uses, and others with high potential in the most impacted segments, are expected to see larger savings reductions than would be expected based on the overall sector-level breakdown of opportunities.

**COVID-19: Shifting Usage and Opportunities**

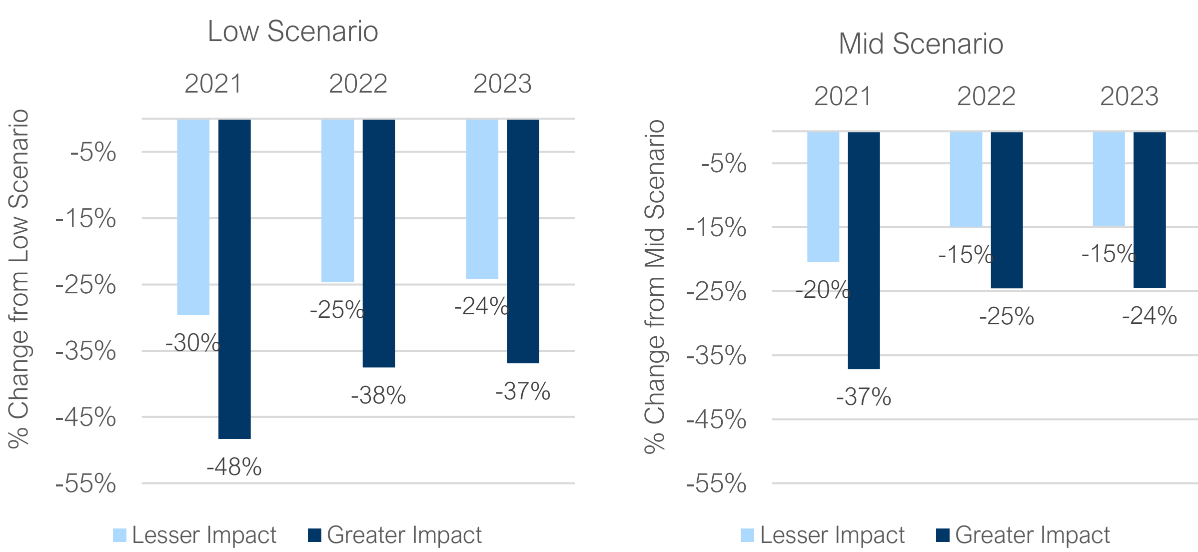
The COVID-19 pandemic has resulted in unprecedented changes in how and where we use energy. As more people work and attend school from their homes, occupancy in office buildings and schools remains low, for example. Program administrators and regulators are currently assessing how these changes will impact claimable savings, and the extent to which shifted usage characteristics should be considered in program evaluation.

These changes are also associated with potential opportunities for efficiency programs. Now may actually be a beneficial time for retrofits, given that there would be little-to-no disturbance to workers and students.

### 3.5.3.2 Natural Gas Savings

The relative change in annual incremental natural gas savings from baseline (low and mid achievable potential scenarios) are included in Figure 38 below.

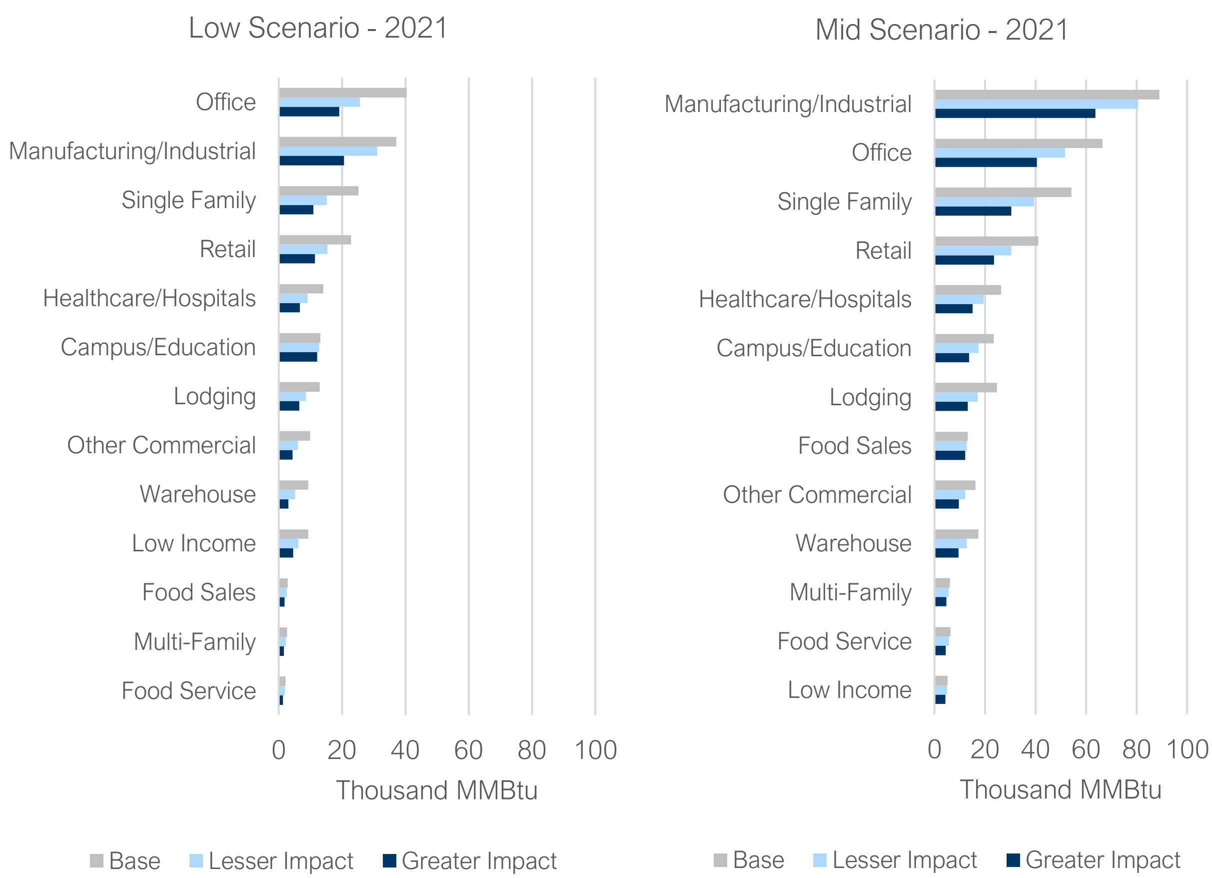
*Figure 38. Reduction in Savings from Low Achievable Potential Scenario (Left) and Mid Achievable Scenario (Right) by Year*




At the scenario settings outlined in Table 22, natural gas savings are forecasted to decrease from 20% to 48% in 2021 depending on the achievable potential and impact on savings scenarios, and from 15% to 37% by 2023.

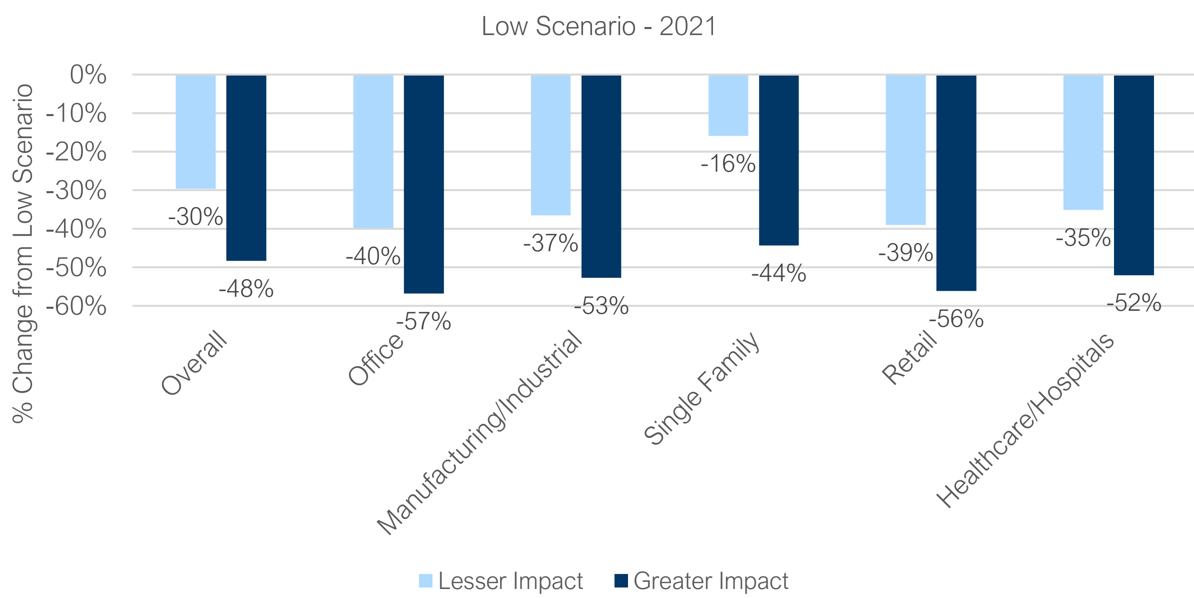
As with the electric savings potential, relative decreases in savings are greater under the low scenario in comparison to the mid scenario due to the non-linear relationship between cost-effectiveness and adoption in the adoption curves used in the model. This supports the conclusion that program design that is more in alignment with the mid scenario will see less impacts from increased barriers than programs at low scenario levels.

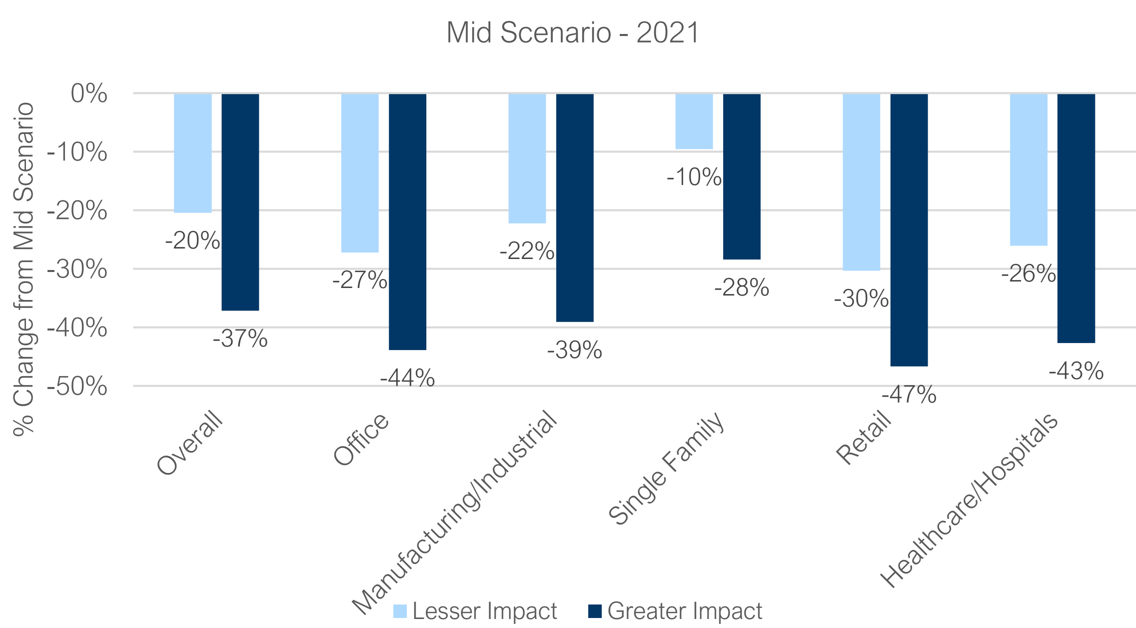
*Figure 39. Achievable Potential by Segment and Impact Scenario Compared to Base (Low Achievable Potential Scenario)*




Mirroring the electric results, the largest absolute decreases in savings are seen in the manufacturing/industrial, office, campus/education, single family, and healthcare/hospitals given high potential in these segments.

*Figure 40. Relative Change from Baseline for Top Segments, 2021*




As with electric savings, end uses with high potential in the most impacted segments are likely to see greater reductions in savings than would be expected based on the sector-level savings opportunity breakdown. Notably, larger than average impacts in the manufacturing/industrial and healthcare/hospital segments are expected to decrease process savings more than would be expected from the sector-level end use breakdown. HVAC savings also feature prominently among top saving segments and may be affected by COVID to a larger degree than would be expected from the sector-level breakdown.

## 3.6 Energy Efficiency Key Takeaways

**COVID-19 is expected to result in a reduction in the adoption of energy efficiency measures across programs, however recent survey efforts point to the effects as being more pronounced in some segments.** How this will translate to changes in claimable savings will depend on how program administrators and regulators assess the extent to which shifted usage characteristics should be considered in program evaluation.

**Claimable lighting savings decline over the study period due to an evolving lighting market but remain an important component of non-residential programs.** As natural adoption of LEDs increases over time, program savings contributions from lighting decrease. This decline is most pronounced in the residential sector given the rapid evolution of the standard A-lamp and speciality lighting market. Non-residential lighting measures (notably tubular LEDs) have not seen the same level of market transformation as A-lamps and specialty bulbs, and consequently lighting continues to play an important role in non-residential programs. In addition to bulbs and fixtures, considerable opportunities to reduce hours of use through lighting controls are noted.

**There is room to grow electric efficiency program savings through other end uses as lighting savings decline.** In the residential sector, heat pump, appliance, and advanced power strip measures show potential for increased electric savings as program spending increases to mid scenario levels. In the non-residential sector, claimable savings opportunities from increased equipment efficiency are diminishing rapidly as a result of improving equipment standards. Instead, electric savings opportunities transition to a focus on control and optimization of equipment and operational measures, including variable frequency drives, retro-commissioning, strategic energy management, and energy management systems.

**Reductions in space heating requirements – both from HVAC equipment and envelope measures - represent a key source of natural gas savings across all sectors.** The residential sector savings are focused on heating equipment, wi-fi thermostats, insulation and air sealing measures. As with electric savings, non-residential natural gas savings are increasingly found in controls measures, including energy management systems, building management systems, and ventilation controls. Hot water is also noted to have considerable residential and non-residential savings opportunities that have been largely been untapped by programs to date, although this potential should be verified in the non-residential sector through additional New Hampshire-specific primary data collection.

**Programs will need to adjust in the face of transforming A-lamp and specialty lighting markets, which will impact program costs.** Relative to 2019 NHSaves programs, the study estimates an increase in spending across all achievable potential scenarios. In addition to larger budgets, the average cost of savings also increases for both electric and natural gas measures as lighting savings decrease and investments in incentives and enabling strategies grow. Even though budgets and per unit cost of savings increase, programs are expected to provide considerable net benefits to the state of New Hampshire.

# 4 Active Demand Reduction Potential Results

The following chapter presents results for the active demand reduction module of the potential study. The active peak demand reduction potential is assessed by analyzing the ability for behavioral measures, equipment controls, and industrial and commercial curtailment to reduce the ISO North England (ISO-NE) system-wide annual peak demand[25].

## 4.1 Approach

The active demand reduction potential is assessed using Dunsky's Demand Response Optimized Potential (DROP) Model to determine potential impacts against New Hampshire's contribution to the ISO NE system annual peak demand. A standard peak day load curve is identified and adjusted to account for projected load growth and efficiency program impacts over the study period. Nine years of historical annual hourly load data are used to determine the timing, duration and magnitude of typical annual peaks.

**Technical potential** is estimated as the total possible coincident peak load reduction for each individual measure multiplied by the saturation of the measure or opportunity in each market segment.

**Economic potential** is the amount of coincident peak load reduction for each individual measure that passes the Granite State Test. Only those measures that pass the threshold (GST > 1.0) are included in the achievable potential scenarios.

**Achievable potential** is assessed under three program scenarios by applying mixes of all cost-effective measures, and accounting for the combined impact against the peak day load curve, when measure interactions are fully accounted for.

For each year, the active demand potential is assessed, accounting for existing programs from previous years as well as new measures or programs starting in that year. Unlike many efficiency measures, active demand peak savings only persist as long as the program is offered. For new and expanded programs, ramp-up factors were applied to account for the time required to recruit participants[26].

Because active demand measures interact via their effects on the statewide load curve, technical and economic active demand potentials are not considered to be additive and are therefore not presented in aggregate in this report. To ensure that the combined achievable potential results were truly additive in their ability to reduce annual peak loads, combinations of programs were assessed against the ISO-NE hourly load curve to capture inter-program interactions that could affect the net impact of each program. In each achievable scenario the most cost-effective new measures were given priority giving priority in the model. Further details of this approach are provided in Appendix B.

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[25] The system-wide annual peak demand refers to the hour in the year that exhibits the highest system peak demand in MW. It is assessed on a system-wide basis, not accounting for local constraints across the transmission and distribution system.

[26] A summary of active demand program assumptions, including ramp up rates, is included in Appendix C

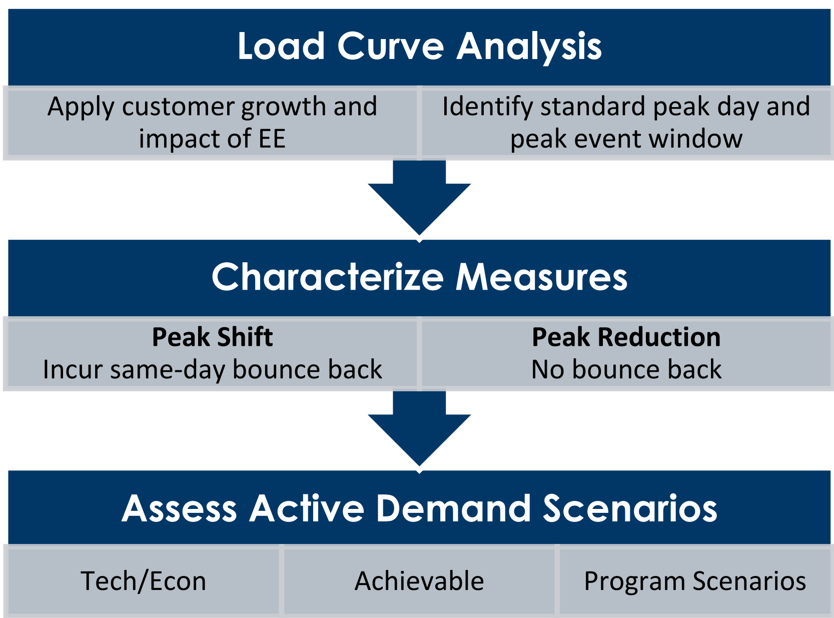
### 4.1.1 Modelling Approach

The active demand reduction potential was assessed through a series of analytical steps, centered around modeling using Dunsky's proprietary Demand Reduction Opportunity Potential (DROP) model. The DROP model dynamically models all measure interactions with the hourly load curve to determine the overall combined impact.

This assessment considered the statewide and ISO-NE system peak-day hourly load curves to identify a standard peak day for both the statewide demand and ISO-NE. Once this was established, the model then assessed each measure's interaction with the ISO-NE standard peak day, taking into account any measure bounce back or shift to an earlier or later hour.[27]

Figure 41 below presents an overview of the steps applied to assess the active demand potential in this study.

*Figure 41. Demand Response Potential Assessment Approach*




A more detailed description of the active demand reduction modeling approach applied in this study can be found in Appendix B.

### 4.1.2 Achievable Potential Scenarios

The achievable potential is assessed under three scenarios, corresponding to varied active demand program approaches and levels of investment, to determine the resulting peak demand reduction impacts

[27] Each individual measure characterization includes an active demand reduction peak-day load curve that accounts for any pre-charge or bounce-back effects. The model uses these to determine the overall impact of all active demand reduction measures when applied in aggregate, and to assess if these cause the system peak to shift to a new time. In this study, and in keeping with active demand reduction cost-effectiveness practice in NH, only the load reduction in the pre-determine peak hour is considered when expressing the active demand reduction potentials, regardless as to whether a new peak hour is predicted.

and benefits. Further details on the specific programs and their related inputs are presented in Appendix C.

*Figure 42. Active Demand Program Scenario Descriptions*

| | |
|---|---|
| Low | Current active demand programs and incentives[28], when applied to the full applicable market as projected using current incentive levels applied to the DROP model's propensity curves. |
| Mid | Expanded active demand reduction programs include new measures and increased incentives for existing measures that correspond to the mid-point between current incentives and the maximum scenario incentives, or – for new scenarios - benchmarked to other jurisdictions. |
| Max | Expanded DR programs, applying the maximum incentive level that still yield cost-effective measures as per a Granite State Test threshold of 1.0 |

## 4.2 Load Curve Analysis

The first step in the active demand potential analysis is to define the standard peak day (24-hour) load curve using historical ISO-NE hourly load data. The standard peak day load curve is then used to characterize measures and assess the measure-specific peak demand reduction potentials at the technical and economic levels. Achievable peak demand reduction potentials are further verified against ISO-NE annual historical hourly load data to assess measure deployment constraints and intra-day shifts in the ISO-NE annual peak.

The standard peak day load curve for the statewide electric system is defined by taking an average of the load shape from the top ten peak days in each of the nine years of historical hourly load data provided. The standard peak is then forecasted in the future, considering efficiency measures and load growth forecasts from NH utilities' projections. Since this is a relatively short term study covering just the years 2021-2023, the impact of load growth and efficiency programs on the peak day load curve is negligible.

[28] Incentives were based on 2020 incentive levels from Eversource

*Figure 43. NH Standard Peak Day Based on Historical Data from ISO-NE*

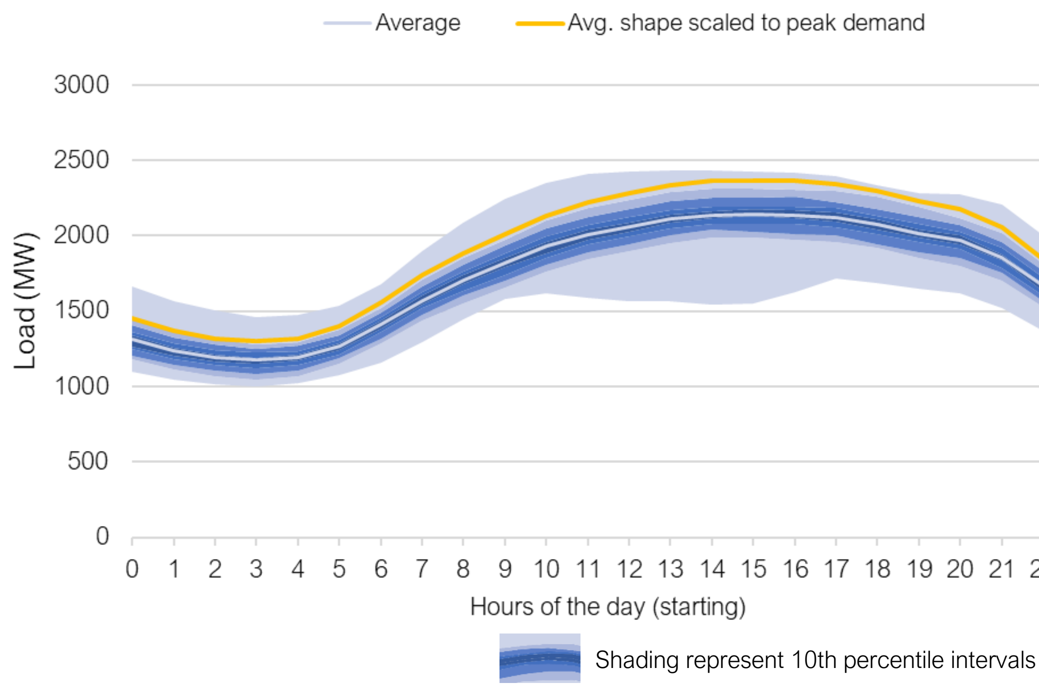
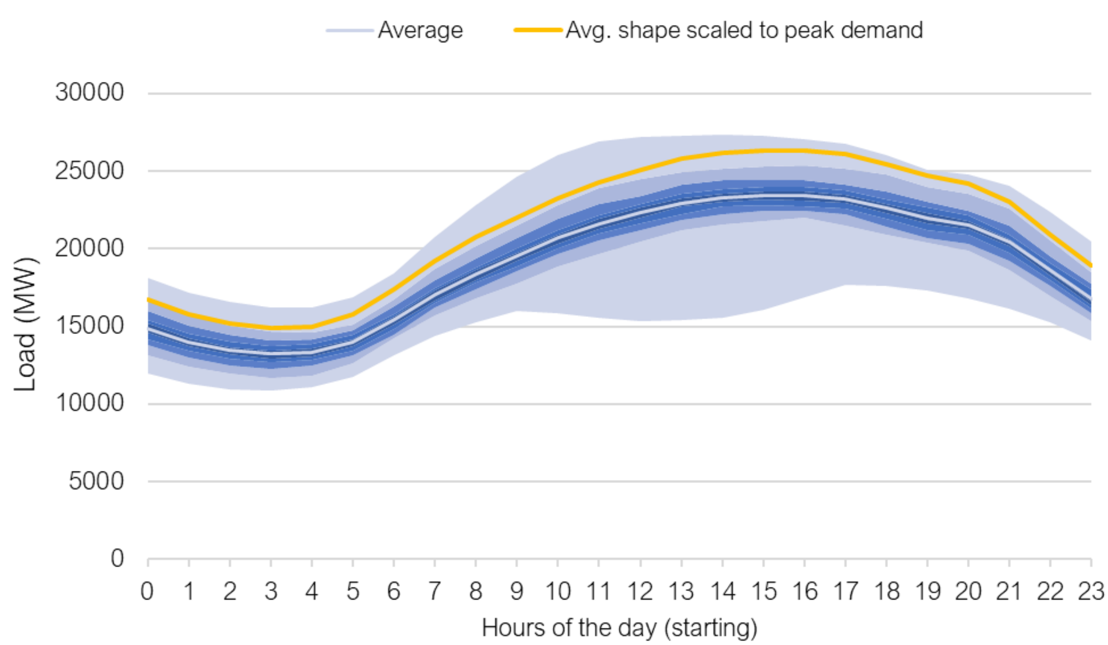



*Figure 44. ISO-NE Standard Peak Day Based on Historical Data*




This analysis finds that NH's statewide system has an extended late afternoon peak that occurs in the summer months (June-September), which is driven predominantly by residential and commercial space cooling. ISO-NE peak load has a similar shape compared to NH, allowing both systems to benefit from a similar DR window. NH peak demand is responsible for slightly under 10% of the ISO-NE peak demand. Therefore, fluctuations in New Hampshire's demand has little impact on the overall ISO-NE demand curve shape (based on this, it is assumed that active demand reduction programs in NH have negligible impacts to shift the time or duration of the ISO-NE peak period). Table 23 below provides key metrics to describe the peak day shape from an active demand reduction potential perspective.

*Table 23. Standard Peak Day Key Metrics*[29]

| Year | NH Peak Demand (MW) | Peak hour | ISO-NE Peak Demand (MW) | Peak hours |
|---|---|---|---|---|
| 2011 | 2,433 | 13:00 – 13:59 | 27,333 | 14:00 – 14:59 |
| 2012 | 2,292 | 17:00 – 17:59 | 25,553 | 16:00 – 16:59 |
| 2013 | 2,421 | 15:00 – 15:59 | 26,919 | 16:00 – 16:59 |
| 2014 | 2,288 | 13:00 – 13:59 | 24,089 | 14:00 – 14:59 |
| 2015 | 2,219 | 17:00 – 17:59 | 24,074 | 15:00 – 15:59 |
| 2016 | 2,367 | 16:00 – 16:59 | 25,192 | 14:00 – 14:59 |
| 2017 | 2,165 | 17:00 – 17:59 | 23,519 | 16:00 – 16:59 |
| 2018 | 2,379 | 16:00 – 16:59 | 25,612 | 16:00 – 16:59 |
| 2019 | 2,299 | 16:00 – 16:59 | 23,988 | 17:00 – 17:59 |
| 2021 | 2,370 | 15:00 – 15:59 | 26,351 | 16:00 – 16:59 |
| 2022 | 2,372 | 15:00 – 15:59 | 26,670 | 16:00 – 16:59 |
| 2023 | 2,385 | 15:00 – 15:59 | 26,988 | 16:00 – 16:59 |

Following this analysis, the reduction potential for all measures was assessed against the ISO-NE curve and based on a system peak hour occurring between 16:00 and 16:59 as presented in the table above. It is important to note that ISO-NE peak forecast shows that the peak hour could be shifting to 17:00 to 17:59 in the coming years. The impact of a one-hour peak shift later in the afternoon is not expected to alter the results of this study significantly, but it may increase potentials from residential measures and a somewhat lower potentials from the C&I sector.

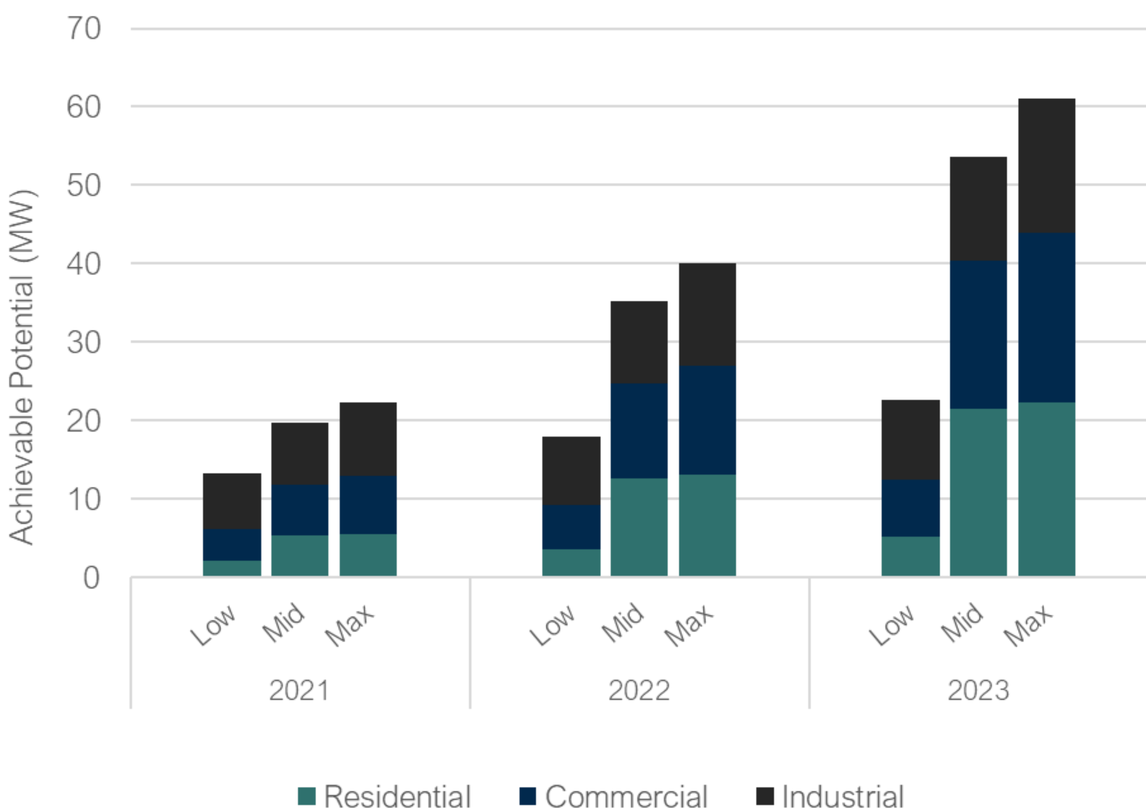
[29] Historical hourly load data for the years 2011-2019 (shaded rows) were extracted from ISO-NE's website. 2020 values were not available at the time this study was produced.

## 4.3 Achievable Potential Results

The overall achievable potential in each year for each scenario is presented below. These results represent the combined peak load reduction from all cost-effective programs assessed against the ISO-NE load curve, accounting for interactions among programs and ramp-up schedules for new measures and programs. A description of each measure and program along with the individual measure technical and economic potentials in each market segment are provided in Appendix C.

Under the low scenario, which focuses on New Hampshire's current programs[30] expanded across their applicable markets to the full extent, the potential is estimated to grow from 14 MW in 2021 to 23 MW in 2023, which represents 1.0% of New Hampshire's statewide peak demand in 2023. Program spending is projected to range between $1 to $2 million per year, which is within range of the $1.5 of planned spending by New Hampshire utilities in 2020. The mid and max scenarios introduce new measures along with increased incentive levels, which leads to significant increases in the achievable potential, reaching 54 MW and 61 MW in 2023 respectively, representing 2.2% and 2.6% of New Hampshire's statewide peak demand. Based on these results, the scenario analysis indicates that expanding the number and types offers significantly more peak reduction potential than simply expanding the current programs.

*Figure 45. Achievable Potential by Sector, Scenario, and Year*

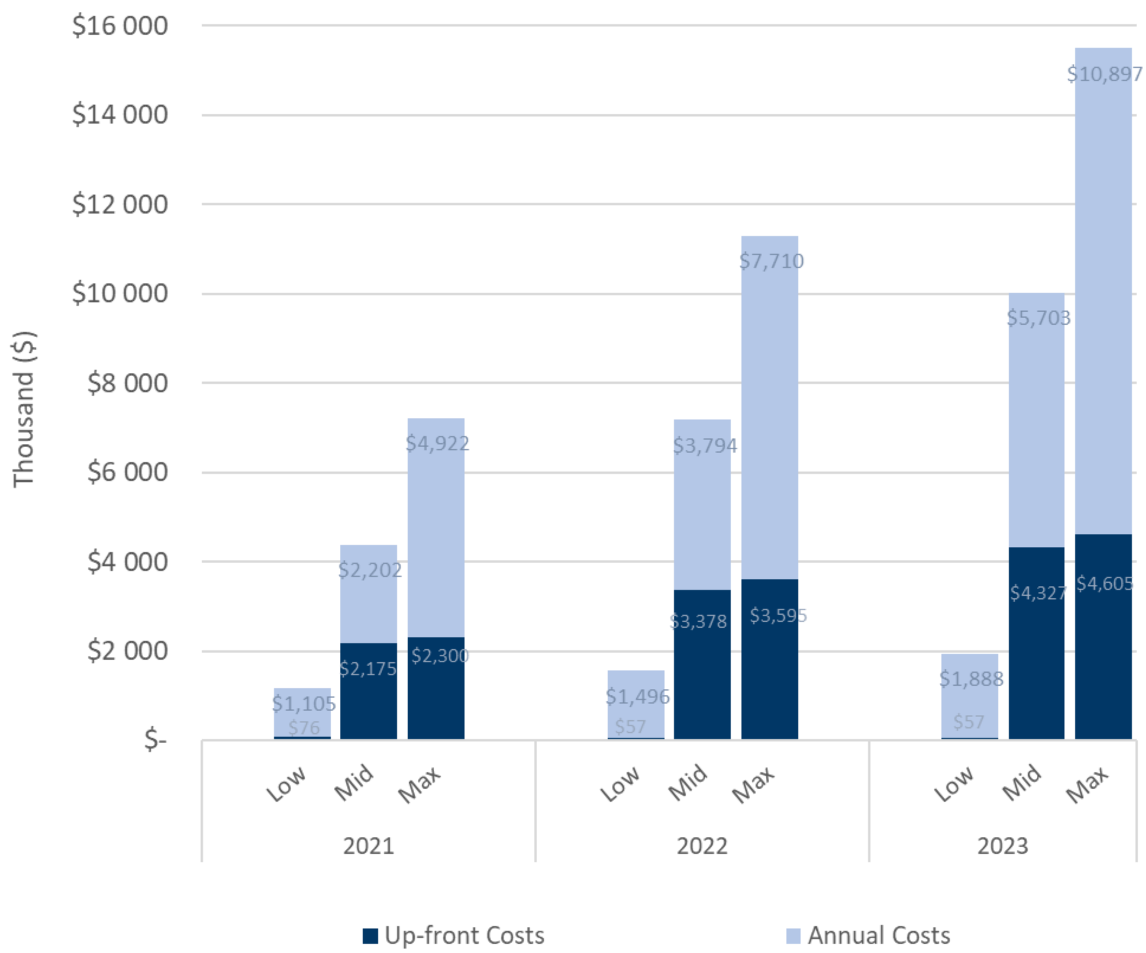



[30] Based on the Utilities' 2019 active demand programs

Figure 46 below provides the program costs for each scenario, broken down between upfront costs and annual running costs.[31] In the mid and max scenarios, the results show high up-front costs in the initial years as new programs are developed, new customers are enrolled in the programs, and new controls systems are put in place.

While it is not evident in the short-term results presented in the figure below, in years following 2023 the upfront program costs for the mid and max scenarios would likely be lower than in the 2021-2023 period. This is because both scenarios require significant upfront costs for program set-up and equipment purchase during the study period. These investments can be leveraged for years to come by maintaining program participation incentives.

*Figure 46. Demand Response Program Costs*




The Granite State Test was applied to assess the cost-effectiveness of the active demand reduction programs using a benefit-cost ratio threshold 1.0 and assuming a 9-year measure/program life with a 3-year contract cycle (to account for participant attrition and new recruitment costs).[32] Table 24 below

[31] Upfront costs include customer enrollment incentives, as well as controls and equipment installation costs. Annual costs include annual participation incentives and recurring program administration costs.

[32] It is assumed that after each contract cycle, some participants will drop out of the program (5% for C&I customers, 15% for BYOD programs and 10% for DLC programs)

provides the cost-effectiveness results for scenario, accounting for the costs and benefits for both existing and newly added active demand reduction program capacity in each year.

*Table 24. Active Demand Reduction Program Granite State Test Results by Year*

| Scenario | 2021 | 2022 | 2023 |
|---|---|---|---|
| Low | 2.4 | 2.4 | 2.4 |
| Mid | 1.0 | 1.0 | 1.1 |
| Max | 0.7 | 0.7 | 0.8 |

The Granite State Test results show that while the max scenario provides the most peak reduction potential, the mid and low scenarios are more cost-effective. A few key observations to note are:

- **The low scenario is cost-effective throughout the study period.** The Granite State Test values increase in later years as more participants enroll in the program, and as enrollment costs diminish.
- **The mid scenario is marginally cost-effective, but trends toward increased cost-effectiveness as the study period progresses.** Expanded programs benefit from the upfront cost investments made in the initial years and simply require customer incentives to maintain participation after that.
- **The max scenario does not prove cost-effective over the program lifetime.** More substantial upfront costs and higher annual incentives result in a portfolio does not pass the GST threshold for cost-effectiveness under New Hampshire's current framework. However, the GST results are trending higher, and our analysis indicated that when the investments made under the max scenario are considered over the full life of equipment life (10 year EUL) the max scenario would yield a GST of 1.0 by 2023.[33]

Overall, these results show that there is remains a significant amount of cost-effective active demand reduction potential in New Hampshire - up to 61 MW of annual peak reduction by 2023, which is a 54 MW increase from the 2019 achieved reduction through current active demand reduction programs.

### 4.3.1 Low Scenario

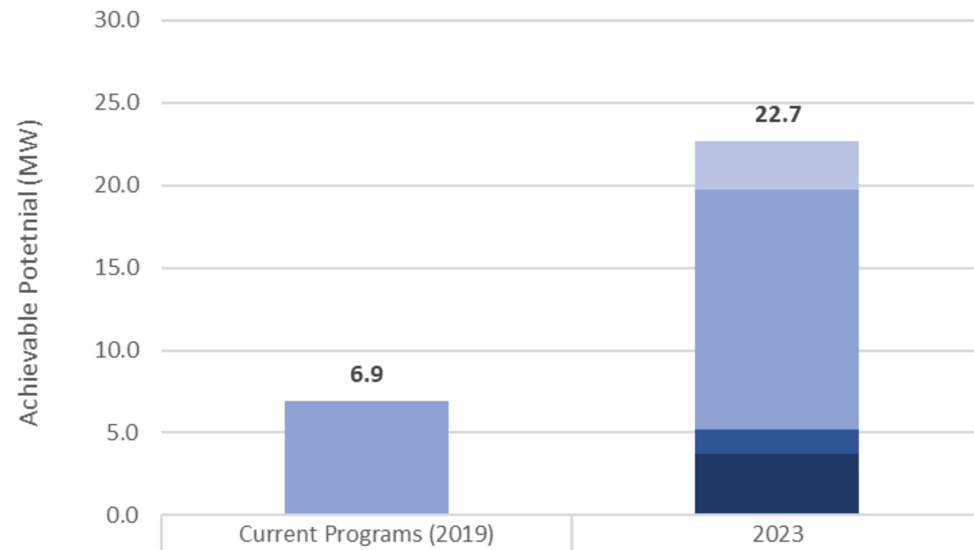
The low scenario captures the potential from expanding existing active demand reduction programs to their fullest extent under the current incentive levels and delivery approach, thereby assessing the uncaptured potential still available to these programs. The BYOD residential program was included in the existing programs as it was launched in 2020 and is expected to achieve 0.9 MW of potential in 2020.

Figure 47 shows that the NH utilities can collectively achieve three times the 2019 peak demand reductions by 2023 by expanding their existing programs. This comes primarily from growing participation

[33] The current framework for assessing active demand reduction programs in New Hampshire only counts a single year of benefits against all costs. However considering that the max scenario includes investments in customer sited equipment (controls, thermostats and energy storage) that have EULs of 10 years or more, measures were selected that could prove cost-effective when the full stream of benefits over their lifetime was considered (i.e. over a 10 year period).

in the commercial and industrial curtailment programs from 6.9 MW to 22.7 MW in 2023, along with an expanded deployment of the BYOD residential program.

*Figure 47. Low Scenario Achievable Potential – Breakdown by Program*




| | Current Programs (2019) | 2023 |
|---|---|---|
| Total | 6.9 | 22.7 |
| C&I Energy Storage | 0.0 | 2.9 |
| Medium & Large C&I Curtailment | 6.9 | 14.6 |
| Residential Energy Storage | 0.0 | 1.4 |
| Residential BYOD | 0.0 | 3.7 |

Table 25 below provides the measure-level savings for the current NH active demand reduction programs, presented alongside the assessed potential in 2023. Commercial and industrial curtailment show significant potential for growth from their current levels. These programs tend to be very cost-effective, and the cost of expanding these existing programs is much less than the costs of expanding to new measures and programs under the mid and max scenarios, as demonstrated by the higher Granite State Test results under the low scenario.

The Residential BYOD program also shows potential, specifically by increasing the enrollment of customers with WiFi thermostats paired with central AC units (although this potential is limited due to the limited penetration of central AC units in New Hampshire homes). At the program level, residential WiFi thermostats only reach a cost-effectiveness of 1.0 in the first year, but by 2023 it increases up to 1.4 as there are more participants and benefits to justify program administration costs.

The reader should note one limitation in the treatment WiFi thermostats potentials throughout this report. The growth in BYOD program potential associated with the increased adoption of WiFi thermostats via the efficiency program incentives was accounted for in this study. However, a more detailed assessment of the likely adoption of thermostats by customers who would consider both the efficiency and active demand reduction incentives was not conducted. It is worth noting that an integrated offer of a purchase incentive combined with an annual active demand reduction program incentive could lead to increased adoption of WiFi thermostats in both programs.

*Table 25. Low Scenario - Top Measures*

| Measures | 2019 Enrolment (MW) | Achievable Potential 2023 (MW) |
|---|---|---|
| Large Commercial Curtailment | 6.9 | 3.8 |
| Large Industrial Curtailment | | 5.1 |
| Medium Commercial Curtailment | 0 | 2.5 |
| Medium Industrial Curtailment | 0 | 3.2 |
| C&I Battery Storage | 0 | 3.0 |
| Residential WiFi Thermostats - BYOD | 0 | 3.8 |
| Residential Battery Energy Storage - BYOD | 0 | 1.4 |
| Total | **6.9** | **22.7** |

Table 26 provides the cost-effectiveness results by program in each study year. Under the low scenario, almost all programs pass the GST threshold of 1.0 in all years with the exception of the Residential Battery Energy Storage program. As noted earlier, this scenario focuses primarily on expanding participation in existing programs via utility outreach using the current incentive levels, and thus the programs are expected to pass the GST threshold.

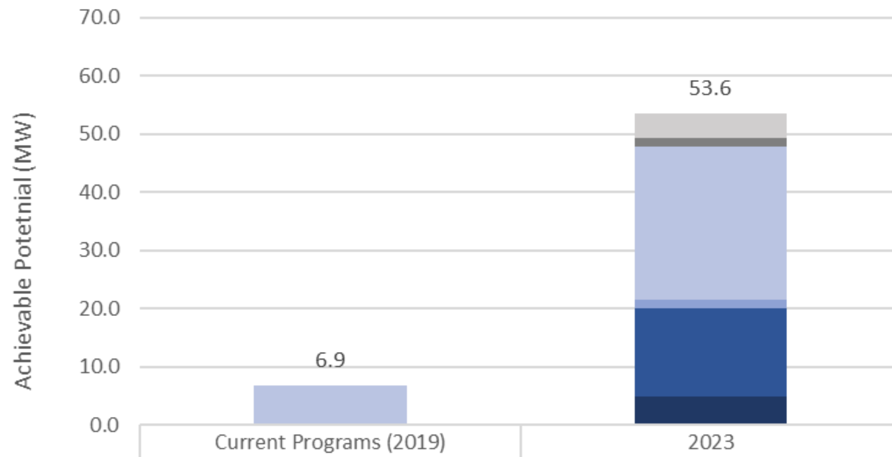
*Table 26. Annual Active Demand Reduction Program Granite State Test Results per Program by Year*

| Scenario | 2021 | 2022 | 2023 |
|---|---|---|---|
| Residential BYOD | 1.0 | 1.3 | 1.4 |
| Residential Energy Storage | 0.9 | 0.9 | 0.9 |
| Medium & Large C&I Curtailment | 4.0 | 4.3 | 4.5 |
| C&I Energy Storage | 1.1 | 1.4 | 1.6 |
| Portfolio | **2.4** | **2.4** | **2.4** |

### 4.3.2 Mid Scenario

As detailed in below in Figure 48, achievable potential increases under the mid scenario the in nearly all sectors as new programs are added and incentives are increased for existing programs. In particular the medium and large C&I curtailment program and the residential DLC program lead the way in offering significant amounts of new active demand reduction. The curtailment program benefits from increased incentives, while the Residential DLC program is a new initiative, which captures the potential from utility control over AC units and pool pumps. Further details on the program settings are provided in Appendix C.

*Figure 48. Mid Scenario Achievable Potential - Breakdown by Program*




| | Current Programs (2019) | 2023 |
|---|---|---|
| Total | 6.9 | 53.6 |
| C&I Energy Storage | 0.0 | 4.3 |
| Small Commercial BYOD/DLC | 0.0 | 1.4 |
| Medium & Large C&I Curtailment | 6.9 | 26.4 |
| Residential Energy Storage | 0.0 | 1.4 |
| Residential DLC | 0.0 | 15.2 |
| Residential BYOD | 0.0 | 4.9 |

The achievable potential from each of the top measures under the mid scenario are provided in the table below. The added programs and measures in the mid scenario generate additional potential, with a few measures offering notable opportunities such as:

- **Residential Pool Pumps and WiFi Thermostats**, which generate most of the new savings - 5.8 MW (pool pumps) and 12.9 MW (WiFi thermostats). These two measures represent 87% of the total residential potential, with most of this potential (77%) coming from a DLC program offering.[34] Overall it is noted that the residential program potentials approach the C&I potentials in magnitude, which is attributed to New Hampshire having a relatively small pool of C&I customers when compared to other north east jurisdictions, where C&I demand reduction potentials far exceed residential potentials.

- **Energy Storage** in commercial buildings yields an additional 1.4 MW of new achievable potential by 2023 compared to the low scenario, which comes from small business thermal energy storage. This measure includes an initial incentive to help finance the system (up to 50%) and an annual performance incentive.

- **Medium and Large Commercial Curtailment** offers increased potential by raising incentive levels to attract more participation, resulting in an overall increase of 6 MW compared to the low scenario.

[34] While all thermostats enrolled in the active demand reduction program would be controlled by the utility when events are called, the distinction made in this study is that the BYOD program applies to customers who already have a thermostat, while the DLC program requires the utility to provide the device free of charge to the customer.

- **Gas-Fired Emergency Generators** in the medium and large C&I program (6 MW in 2023) offer a notable opportunity to reduce annual peak loads by establishing the controls systems needed to run these units during system peak events. This measure includes an annual performance incentive as well as an up-front incentive to cover costs for achieving emissions compliance for non-emergency applications.

*Table 27. Mid Scenario – Top Measures*

| Measures | 2019 Enrollment (MW) | Achievable Potential 2023 (MW) |
|---|---|---|
| Large Commercial Curtailment | 6.9 | 7.6 |
| Large Industrial Curtailment | | 6.6 |
| Medium Commercial Curtailment | 0.0 | 2.9 |
| Medium Industrial Curtailment | 0.0 | 3.3 |
| C&I Battery Storage | 0.0 | 3.0 |
| Gas-Fired Emergency Generator (New) | 0.0 | 6.0 |
| Small Business Thermal Energy Storage (New) | 0.0 | 1.3 |
| Residential WiFi Thermostats (Expanded to DLC) | 0.0 | 12.9 |
| Residential Pool Pumps (New) | 0.0 | 5.8 |
| Residential Battery Energy Storage - BYOD | 0.0 | 1.4 |
| Small Business Water Heater (New) | 0.0 | 1.1 |

Table 28 provides the cost-effectiveness results by program in each study year. Under the mid scenario, a number of programs do not appear to pass the GST screening threshold. This is likely attributable to the expansion of measures under the mid Scenario, that carry significant program set-up and equipment costs, and also due to the ramping up of enrollment in the new programs.

*Table 28. Annual Active Demand Reduction Program Granite State Test Results per Program by Year*

| Scenario | 2021 | 2022 | 2023 |
|---|---|---|---|
| Residential DLC | 0.4 | 0.6 | 0.7 |
| Residential BYOD | 0.6 | 0.7 | 0.7 |
| Small Commercial BYOD/DLC | 0.2 | 0.5 | 0.7 |
| Residential Energy Storage | 0.6 | 0.7 | 0.7 |
| Medium & Large C&I Curtailment | 2.6 | 2.7 | 2.8 |
| C&I Energy Storage | 0.5 | 0.7 | 0.8 |
| Portfolio | 0.9 | 1.0 | 1.1 |

Table 29 is provided below to demonstrate the impact of these costs on the GST results, but showing the GST results for new capacity added in each year to each program. It can be seen that in many cases the new added capacity does prove cost effective when the value of the investments in new capacity are considered over an assumed 10 year usable life span. While this approach does not strictly adhere to New

Hampshire's current framework for assessing active demand program cost-effectiveness, it is useful to demonstrate the value of investments in new programs and equipment.

*Table 29. Active Demand Reduction Program Granite State Test Results per program by Year (new capacity only)*

| Scenario | 2021 | 2022 | 2023 |
|---|---|---|---|
| Residential DLC | 1.0 | 1.1 | 1.1 |
| Residential BYOD | 1.1 | 1.1 | 1.2 |
| Small Commercial BYOD/DLC | 0.5 | 0.9 | 1.1 |
| Residential Energy Storage[35] | 0.5 | 0.6 | 0.7 |
| Medium & Large C&I Curtailment | 2.2 | 2.6 | 2.7 |
| C&I Energy Storage | 1.0 | 1.1 | 1.2 |
| Portfolio | 1.2 | 1.4 | 1.5 |

Comparison of results in the above tables, and consideration of the year by year trends in GST results indicates that some of the new programs in the mid scenario appear to be trending toward cost-effectiveness as enrollment grows and new capacity is added to support the program set-up and administration investments. Most notable among these are the Residential and Small Commercial BYOD and DLC programs, and the C&I Energy Storage program. Further study may reveal that these offer cost-effective potential when considered over the longer term, that may justify investments over the study period.

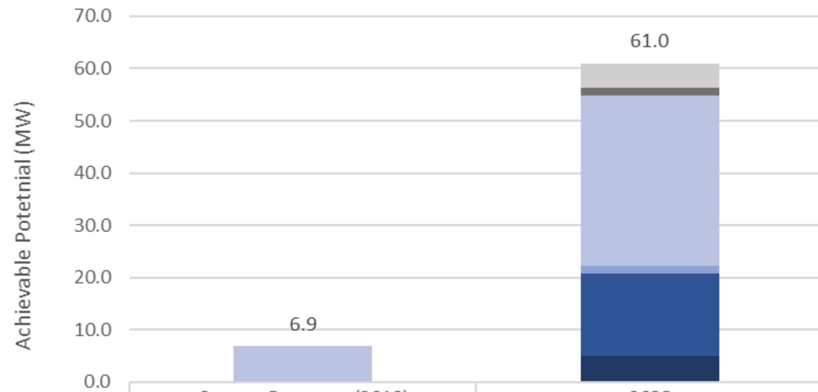
### 4.3.3 Max Scenario

In the max scenario incentives were increased further while maintaining individual measure Granite State Test values of at least 1.0[36], and portfolio-wide Granite State Test values over 1.0 on a lifetime basis. This leads to more savings in all programs, as shown in Figure 49 below.

When compared to the mid scenario, the max scenario offers an additional 7.3 MW of potential by 2023. Most of the gains come from the medium and large commercial curtailment programs (5.7 MW of additional potential), which benefit from higher incentives to attract more enrollment. However, as was noted earlier, this increase in potential comes with significantly higher incentive costs, which increase the costs of the existing potential as well as the newly enrolled potential. This leads to a significant reduction in the program cost-effectiveness under the max scenario relative to other scenarios.

[35] Residential Energy Storage does not pass cost-effectiveness under the current New Hampshire programs as incentives are set high by the utilities to encourage customers to buy new batteries.
[36] Measure screening considers all measure costs but excludes program set up and administration costs.

*Figure 49. Max Scenario Achievable Potential - Breakdown by Program*




| | Current Programs (2019) | 2023 |
|---|---|---|
| Total | 6.9 | 61.0 |
| C&I Energy Storage | 0.0 | 4.8 |
| Small Commercial BYOD/DLC | 0.0 | 1.5 |
| Medium & Large C&I Curtailment | 6.9 | 32.5 |
| Residential Energy Storage | 0.0 | 1.4 |
| Residential DLC | 0.0 | 15.8 |
| Residential BYOD | 0.0 | 5.0 |

The resulting top measure mix under the max scenario, as presented in Table 30, is similar to the mid scenario. However, all measures now have increased potential from increased adoption resulting from the attractiveness of higher customer incentives. Since industrial and large commercial measures are the most cost-effective, there is more room to increase incentives compared to the other measures. Thus industrial measures show the largest increase in potential over the mid scenario results. On the residential side, the potential increase was limited by because the overall residential program cost-effectiveness was already close to a Granite State Test of 1.0. Therefore, there was little room to increase incentives over the levels in the mid scenario, and as a result the potentials are similar between the two scenarios.

*Table 30. Max Scenario - Top 10 Measures*

| Measures | 2019 Enrolment (MW) | Achievable Potential 2023 (MW) |
|---|---|---|
| Large Commercial Curtailment | 6.9 | 10.0 |
| Large Industrial Curtailment | | 9.9 |
| Medium Commercial Curtailment | 0.0 | 2.6 |
| Medium Industrial Curtailment | 0.0 | 3.5 |
| C&I Battery Storage | 0.0 | 3.3 |
| Gas Emergency Generator (New) | 0.0 | 6.4 |
| Small Business Thermal Energy Storage (New) | 0.0 | 1.5 |
| Residential WiFi Thermostats (Expanded to DLC) | 0.0 | 13.4 |
| Residential Pool Pumps (New) | 0.0 | 6.5 |
| Residential Battery Energy Storage - BYOD | 0.0 | 1.4 |
| Small Business Water Heater (New) | 0.0 | 1.1 |

Table 31 provides the cost-effectiveness results by program in each study year. Under the max scenario, almost all programs fail to pass the GST threshold of 1.0 in all years, with the exception of the Medium and Large C&I Curtailment program. This is attributed to the impact of program administration and set-up costs, combined with the ramp-up of program expansion, which hinders overall program cost-effectiveness when the individual measure incentives are set near their maximum levels (i.e. the incentives approach the avoided capacity benefits attributable to each measure). Given that there is little additional achievable potential between the mid and max scenarios, these poor cost-effectiveness results indicate that there is little or not benefit of attempting to expand programs beyond the mid scenario levels.

*Table 31. Annual Active Demand Reduction Program Granite State Test Results per Program by Year*

| Scenario | 2021 | 2022 | 2023 |
|---|---|---|---|
| Residential DLC | 0.4 | 0.5 | 0.7 |
| Residential BYOD | 0.6 | 0.6 | 0.6 |
| Small Commercial BYOD/DLC | 0.2 | 0.5 | 0.7 |
| Residential Energy Storage | 0.6 | 0.7 | 0.7 |
| Medium & Large C&I Curtailment | 0.9 | 1.0 | 1.1 |
| C&I Energy Storage | 0.4 | 0.5 | 0.6 |
| Portfolio | 0.8 | 0.9 | 0.9 |

# 4.4 Monthly Peak Analysis

The results presented to this point in the active demand reduction potential assessment have focused on reducing the annual peak. Because the NH utilities are also subject to monthly demand charges, there is value in understanding the degree to which the active demand reduction programs can also delivery monthly peak reductions over the calendar year.

This was accomplished using a high-level top-down approach wherein the annual peak potentials were adjusted for each month to account for changes in the statewide system load curve over the calendar year. The end results, described in the following section, provide an assessment of the ability for active demand programs to reduce the monthly peaks in each season, along with some guidance towards which measures would provide the most benefits.

## 4.4.1 Approach

For each measure included in the annual peak reduction potential assessment, the monthly peak reduction is estimated by prorating the annual peak impacts based on the monthly peak end use breakdown analysis. For example, as cooling demand exerts a decreasing contribution to the monthly peak load during the autumn months relative to the summer months, the potential for DLC control of AC units is similarly scaled down. Furthermore, additional measures that can reduce heating season monthly peaks but were not included in the annual peak reduction potential assessment are identified based on studies in jurisdictions with annual winter peaks.

Therefore, two key analytical steps were undertaken to assess the monthly peak reduction potential:

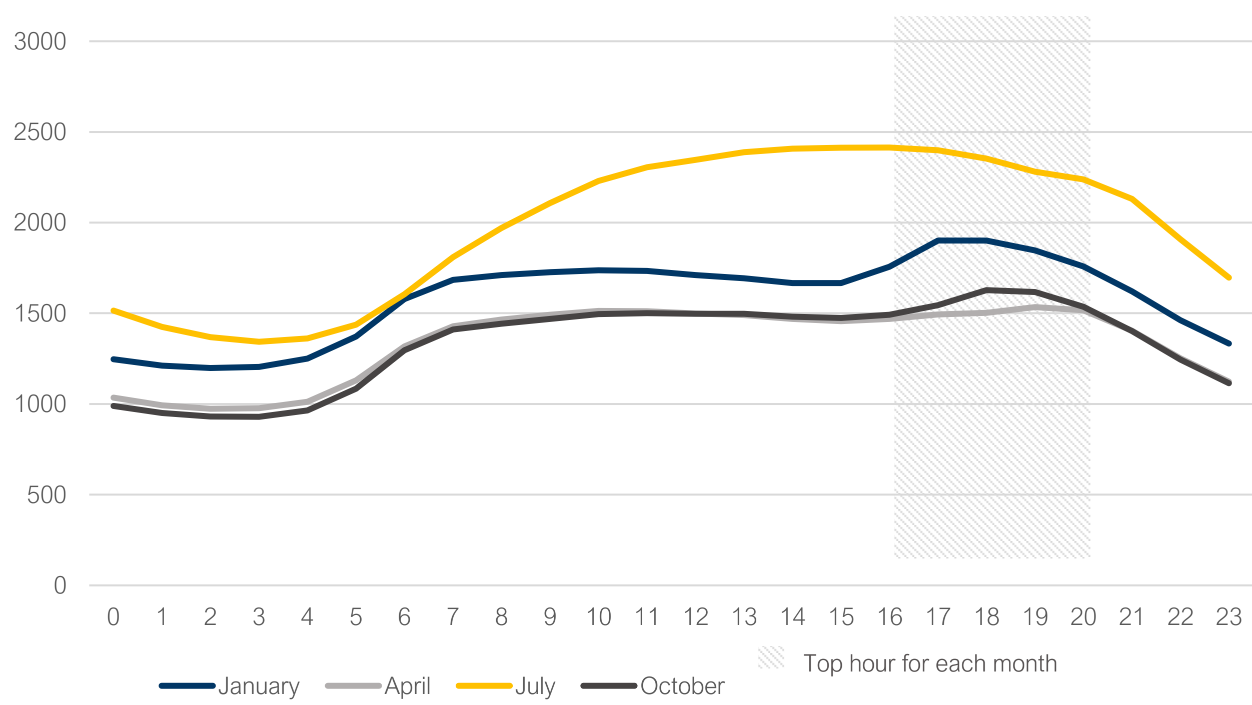
1. **Monthly Peak Load Curve Analysis:** A standard day peak load shape for each month of the year was developed using the historical hourly load data for the ISO-NE system, and the contribution from each electrical end use was determined.

2. **Monthly Active Demand Reduction Potential Assessment:** Using the monthly load curves, it is assumed that the modeled measures can exert a proportional impact on the monthly peak as they do on the summer peak. Depending on the measure, this can be either as an equivalent portion of the segment's contribution to the overall peak or as an equivalent portion of the end use contribution to the monthly peak.

### 4.4.2 Load Curve Analysis

The standard peak day load curve for the statewide electric system is defined by taking an average of the load shape from each of the top ten peak days in each of nine years of historical hourly load data provided. Figure 50 displays the peak day load shape for four key months of the year (i.e. one that is representative for each season). It shows that for all seasons, the peak demand hour occurs in the late afternoon, starting somewhere between 16:00 (in summer) and 19:00 (in the shoulder seasons). Moreover, the spring (April) and summer (July) seasons exhibit more prolonged peaks than the fall and winter months. Overall, this supports prorating the annual measure-level potentials (from summer) to the other seasons, because the measure-level load curves used in the characterizations would apply similar timing for peak load events in all months.

*Figure 50. Monthly NH Standard Peak Day Based on Historical Data*

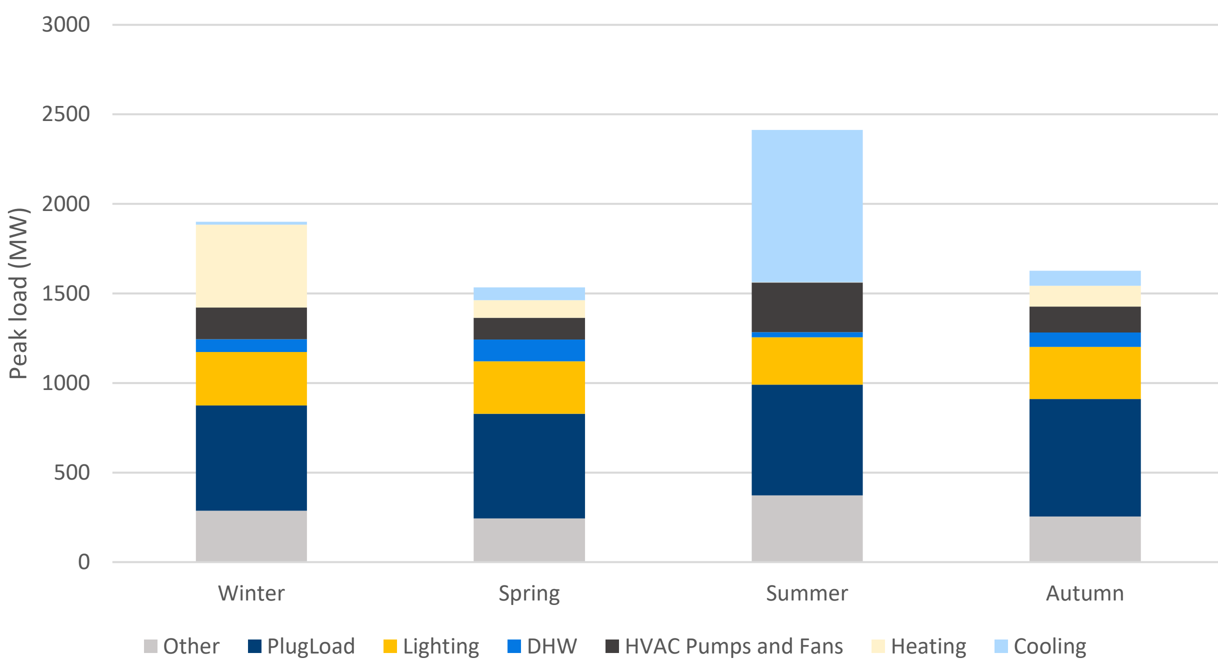



The end use contribution to each season's monthly peaks is presented in Figure 51 below. The analysis reveals that a large portion of the total load does not vary seasonally (1,235MW). The most notable consistent peak load contributions come from the lighting, plug load and 'other' end uses. As a result, the monthly peak reduction potential from active demand reduction measures applied to these end uses are assumed to be largely constant throughout the year.

Conversely, the cooling end use represents up to 35% of the summer season peak load, and up to 47% when other associated HVAC loads such as pumps and ventilation are considered. This is unique to the summer season, and thus cooling related active demand reduction measure potentials are significantly reduced in the other seasons.

Finally, it is noted that the heating end use makes a significant contribution to the winter season monthly peaks (up to 34%), and that measures connected to heating systems may offer important winter month peak reduction potentials. This may be via expanding the use of existing WiFi thermostats that are already connected to heat pumps or electric furnaces, or by installing new controls for electric heating equipment.

*Figure 51. Peak Load Hour by End Use*




### 4.4.3 Monthly Active Demand Reduction Potential

The overall achievable potential that could be used to reduce the load during ISO-NE monthly peak hours is presented in Figure 52 below[37]. It is important to note that the results presented do not include the impact of active demand reduction measures that specifically address the winter peak, as a quantification of measures that do not offer summer peak reduction potentials was beyond the of scope of this study.

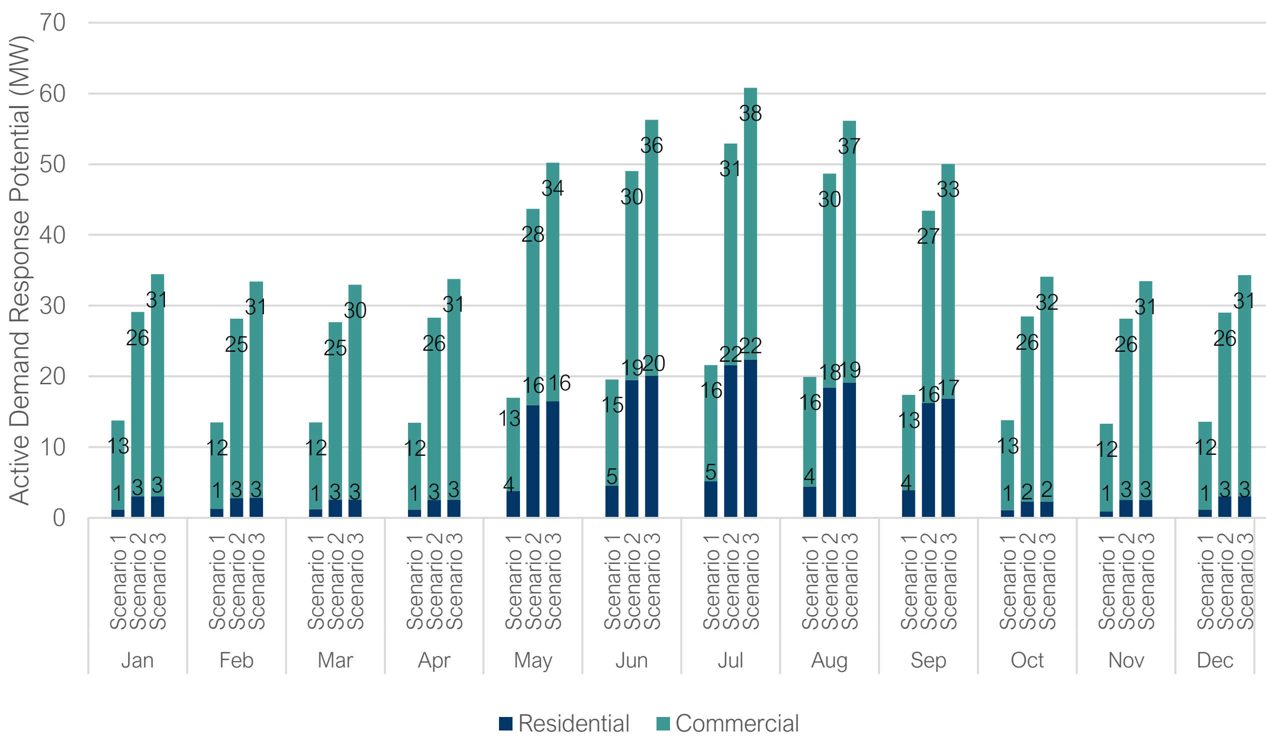
The results indicate that a little over half of the annual peak potential can be realized on a monthly basis over the winter and shoulder seasons. Furthermore, from May though September, the monthly peak

[37] The goal of the assessment is to identify measures that can be leveraged for a monthly use; however, the impact on the opt-out rates related to the number of DR calls is not evaluated. To apply the measure all year-long, a specific DR program will have to be developed.

approaches the annual peak as these months typically exhibit summer season peak day load curves, with substantial late afternoon cooling demands.

Under the low scenario, a minimum of13 MW of the 23 MW is achievable monthly by 2023. Under the mid and max scenarios, the monthly achievable potential respectively provides at least 28 MW of the 54 MW and 33 MW of the 61 MW achievable by 2023.

*Figure 52. Monthly Achievable Potential (MW) by Scenario in 2023*




An important portion of the active demand reduction potential can be maintained on a monthly basis. A few measures are offer notable year-long opportunities, while others are not transferable. A few key observations to note are:

- For the **low scenario**, 50% of the potential comes from controlling loads that are not seasonally impacted, mainly provided from energy storage or C&I loads such as process and lighting.
- For the **mid and max scenarios**, 27% stems from energy storage systems and 17% from C&I curtailable loads, both of which do not vary significantly on a month to month basis.
- The **residential potential** is the most impacted by seasonal variations. Most of the residential achievable potential targets summer loads (cooling, pool pump), and is therefore not applicable in other seasons.

In summary, current and expanded C&I curtailment and storage programs are best suited to capture monthly peak reduction potentials, while energy storage programs offer greater flexibility and the advantage to be less disruptive for customers.

### 4.4.4 Additional Winter Peak Reduction Opportunities

The monthly peak analysis indicates that further measures may be needed to address winter loads if the NH Utilities are to achieve a consistent level of active demand reduction throughout the calendar year. While our assessment does not quantify the potential for heating load reduction measures, an overview of potential solutions that have been successfully implemented in other jurisdictions are presented below.

**WiFi Thermostat Program:** WiFi thermostats represent a key measure to reduce space heating loads through control of the temperature setpoint. When winter peaks are targeted, the WiFi thermostat needs to be connected to a central electric heating system, such as a heat pump. Some jurisdictions also target electric baseboards, although this measure is not often cost-effective in DLC programs. While this program would target a different segment of the population, some customers enrolled under the BYOD summer program might have a WiFi thermostat connected to both their electric cooling and heating systems. In those cases, the program could benefit from targeting both the summer and winter peaks. Moreover, further potential could be leveraged for both the summer and winter peak BYOD potentials by offering an integrated active demand response program that combines the efficiency program thermostat purchase incentive with a generous active demand reduction annual incentive for customers with heat pumps operating year-round.

Peak loads savings usually range between 0.5 kW to 2 kW reduction per home in winter applications.

**Electric Water Heaters & Other Appliances:** The annual peak load potential assessment excludes most smart appliances (or smart switches), as they do not typically pass the cost-effectiveness screening. While these measures were not cost-effective when solely considering the annual peak reduction potential, leveraging these devices or appliances for monthly peak load reduction benefits could increase their cost-effectiveness, especially for appliances that are used more intensely in winter, such as clothes dryers.

Residential water heater programs are common in winter peaking jurisdiction and can offer great benefits if their use is coincident with the peak hour. For example, Burlington Electric Department has piloted ten devices that control electric domestic hot water heaters, and it was designed to provide both capacity and regulation service to the New England System Operator. The controls are based on the temperature of the tank so that the lowest-temperature tanks stay on, at least partially, during the event. This maximizes customer satisfaction and convenience by eliminating the possibility of a cold-water draw.

Peak savings for electric water heaters in winter is approximately 0.3kW per home.

**Dual fuel heating systems:** A dual fuel heating programs could be explored heating to further reduce peak load contributions from homes and businesses that currently use electric heating. In Quebec, the program provides a lower electricity rate that encourages the use of electric space heat during non-peak times, and a high rate that discourages the use of electricity during peak times. This is different from time-of-use rates, which encourage the shifting of electricity use to off-peak periods, because the intent is to shift to a combustible fuel heating, which avoids potential rebound effects of simply shifting the load to a different time. The ratio of non-peak rates to peak rates in the dual-fuel heating programs is a factor of four or five, which has been shown empirically to be sufficient to change customer behavior.

## 4.5 Key Takeaways

Based on the results of the active demand reduction potential assessment, there is an apparent 61 MW (max scenario) of achievable potential in 2023, representing about 2.6% of the statewide system peak load. 6.9 MW of this potential is being captured by current active demand reduction program enrollment, which indicates that a further 54 MW of potential could be achievable by expanding the program offer and increasing incentives.

The max scenario however did not pass the GST cost-effectiveness screen in any of the study years under the current framework for assessing active demand reduction programs in New Hampshire, and thus the mid scenario which yielded 54 MW of potential may offer a more appropriate target. As shown in Table 32below, the mid scenario yields an average GST of 1.0 portfolio wide across the entire study period.

Finally, the low scenario potential is estimated to grow from 14 MW in 2021 to 23 MW in 2023, which represents 1.0% of New Hampshire's statewide peak demand in 2023. This scenario focuses on New Hampshire's current programs[38] and uses the DROP model's propensity curves to determine the maximum equilibrium participation that they could achieve through ongoing marketing and outreach, but without altering incentives or measures offered. Program spending under this scenario is projected to range between $1 to $2 million per year, which is within range of the $1.5 of planned spending by New Hampshire utilities in 2020.

Overall, the scenario analysis indicates that expanding the number and type of programs (mid scenario) offers significantly more peak reduction potential than simply expanding the current programs (low scenario).

*Table 32. Active Demand Potential, by Scenario (by 2023)*

| Scenarios | Low Scenario | Mid Scenario | Max Scenario |
|---|---|---|---|
| Achievable Potential | 23 MW | 54 MW | 61 MW |
| Average Portfolio GST (2021-2023) | 2.3 | 1.0 | 0.8 |

Table 33 below provides relevant benchmarks for the achievable active demand reduction potential from the mid and max scenarios to demand response potential study findings in other relevant jurisdictions. Overall, these benchmarks show that the New Hampshire active demand reduction potential is similar results from other summer peaking jurisdictions where the avoided costs of capacity are similar to New Hampshire.

[38] Based on the Utilities' 2019 active demand reduction programs

*Table 33. Benchmarking of the Achievable Active Demand Potential (Mid-Max Scenarios) to Other Summer Peaking Jurisdictions*

| | New Hampshire (2020) | Massachusetts (2018) | Rhode Island (2020) | Michigan (2017) |
|---|---|---|---|---|
| Portion of Peak Load | 2.0% - 2.6% (by 2023) | 3.5% - 4.0% (10-year outlook) | 1.7%-4.5% (6-year outlook) | 2.3%-5.3% (3-year outlook) |
| Avoided Costs | $205 / kW | $290 / kW | $200 / kW | $140 / kW |

Based on the findings in this report, three key takeaways emerge:

- **Expanding industrial and commercial curtailment offers the most active demand reduction potential.** The C&I sector offers the most potential, and is the most cost-effective option to obtain further active demand reduction. Expanding the offer within the sector is a low-hanging fruit, that can be realized via increased incentives ($/MW) and offering incentives to enable gas-fired backup generators to be engaged during peak events.

- **There is significant room for growth in the residential sector.** WiFi thermostats remain an important contributor to the residential achievable potential. This potential can be realized by leveraging customer-owned thermostats through a BYOD program and by reaching out to customers that have not adopted advanced thermostat technology to provide them with fully subsidized devices under a multi-year DLC program contract. Integrating efficiency and annual active demand reduction program participation incentives could also serve to increase enrollment in the BYOD program even further. Residential pool pump DLC also contributes significantly to active demand reduction potential in the residential market (with smart pool pump, simple timer, and smart switch models).

- **An important part of the active demand reduction potential can be achieved on a monthly basis with an appropriate program design.** The results indicate that a little over half of the annual peak potential can be maintained on a monthly basis over the winter and shoulder seasons. Furthermore, from May though September, the monthly peak approaches the annual peak as these months typically exhibit summer season peak day load curves, with substantial late afternoon cooling demands.

- **Measures that can persist later in the afternoon should be prioritized.** With the advent of new loads such as electric vehicles or solar PV, the New Hampshire and ISO-NE peak hour appears to be shifting towards a later peak time (i.e. from 4pm to 5pm). When developing new programs and measures, close attention should be paid to ensure that they are able to deliver savings under the shifted peak timing.

Overall, these finding indicate that both expanding to new programs and increasing incentives have an important role in increasing active demand potential in New Hampshire.

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