New Hampshire Potential Study

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

Volume IV: Non-Residential Market Baseline Study

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New Hampshire Non-Residential Baseline Memo

This memo documents the underlying penetration and saturation metrics that the Dunsky-ERS team utilized to develop the market potential of energy efficiency and demand reductions in the State of New Hampshire. It also documents specific opportunities and trends for select segments of the industrial sector.

An accurate distribution of building types in New Hampshire underpins the potential model. The team used New Hampshire primary data to determine the distribution of buildings by type (i.e., office, retail), the average building size, and the average energy use. The distribution of buildings was determined via an analysis of a census of New Hampshire commercial and industrial (CI) electric and natural gas CI customers. The team assigned each billing customer a building type and square-footage based on a combination of PA-assigned NAICS coding, business name data processing, and manual cleaning. We derived the size of the building from matched tax record data sets. This process and its results are described in more detail in Section 1.3.

Since the scope of this study did not include comprehensive on-site data collection, the metrics (such as the mix of cooling systems) associated with each building type was initialized with secondary data from regional studies that were based on on-site inventories. Since the function of a building is consistent within a type, a medium-sized office building in New Hampshire serves the same function as one in Massachusetts. In addition, the other regional similarities (e.g., vintages, construction practices, weather, and regional markets) allow us to apply these metrics to the building distribution, which provides a reasonable profile of equipment in New Hampshire. The specific metrics and their sources are identified in the Dunsky Market Archetype metric spreadsheet.

The penetration of high efficiency LED lighting within a lighting system (such as liner fixtures serving general ambient lighting in an office or retail setting) is a driver of program potential. The team conducted additional primary research to determine if the Massachusetts-observed adoption of LEDs applies to New Hampshire. This calibration was based on the team's successful completion of 21 trade ally interviews serving both Massachusetts and New Hampshire. To bolster this finding, we added questions to the barrier surveys to allow a comparison of similar questions asked of Massachusetts customers. Taken together, the data indicated New Hampshire was about two years behind Massachusetts in the adoption of LEDs and we therefore adjusted the lighting metrics accordingly. The barrier survey analysis was based on a comparison of the responses only from small customers in Massachusetts and New Hampshire; the COVID-19 pandemic curtailed the surveys before the medium and large customer dialing had commenced. Interviews of HVAC trade allies were less conclusive and did not lead to any metric adjustments of the cooling equipment metrics.

Potential studies yield highly aggregated end-use potential (e.g., motors, process heating), with little industry specificity. Medium and large industrial customers consume a large fraction of energy use in New Hampshire and often have unique process needs and thus were targeted for additional segment research. The research intended to leverage past on-site audits of industrial facilities updated through walk-throughs and calls to customers to identify both remaining and saturated opportunities and trends by specific sub-sector. The COVID-19 pandemic resulted in rescoping to calls only, with outreach to the entire sample (237 sites) but completion of only 36 industrial sites of the 75 planned.

While the number of completes is disappointing, coverage was high for fabricated metal product manufacturing (NAICS code 332) and computer and electronic product manufacturing sites (NAICS code 334). The ski segment (0 sites) and plastics and rubber products manufacturing (326 sites) had the lowest coverage and would benefit from future additional data collection. The remaining segments had moderate coverage but could also benefit from recruitment of additional sites: chemical manufacturing sites (NAICS code 325), food manufacturing sites (NAICS code 311), machinery manufacturing sites (NAICS code 333), and electrical equipment, appliance, and component manufacturing sites (NAICS code 335). In addition to subsegment findings, results are also presented by common equipment type across all industries.

1 Sources of Metrics

The Dunsky Energy Efficiency Potential model utilizes over 200 individual metrics for equipment saturation, penetration, and efficiency applied across each of the business segments. The data sources vary by metric but generally fall into one of three categories:

- Value from a previous study in similar jurisdiction (Dunsky 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 these depending on the findings of the additional available primary data. This section provides background on the data sources used during initialization. In general, the team changed initial metrics only when there was a compelling case to do so based on direct data or market knowledge.

1.1 Dunsky Market Archetype

Dunsky provided an initial data set for the New Hampshire study based on a Market Archetype approach developed and adapted for the Northeast United States. This was predominantly based on the Massachusetts Potential study conducted in 2017 and the corresponding primary data collected from more than 800 site visits and recent Massachusetts on-site data collection incorporated into the lighting market model. In addition, the team leveraged information from other jurisdictions including Rhode Island, Long Island, Newfoundland, and New Brunswick where required and to facilitate benchmarking. Adjustments to the market archetype data set by segment were based on factors such as building square footage, heating fuel mix, and climate zone. Populations for each building segment were based on NH-specific customer billing data, and lighting data from MA studies were adjusted to reflect slower market adoption in NH.

1.2 Massachusetts – Linear Lighting Saturation and Market Model Study (MA19C14-E-LGHTMKT)

The primary data collection included CATI surveys with 511 small and medium C&I establishments and 104 on-site and three large sites collected in December 2019 and January 2020. The subsequent saturations and market model were finalized in February 2020.

1.3 Customer Data (Primary Data)

The team conducted a segmentation analysis of utility customers by size and industry. We merged utility billing data with tax data to develop average building square footages by segment. Additional details about segment mapping procedures, data challenges, and results can be found in the segmentation memo dated February 10, 2020. Key summary tables of the results are included in Appendix B of this document. The team also analyzed the customer data to quantify metrics involving fuel distribution and heating types.

1.4 Distributor Surveys – Lighting and HVAC (Primary Data)

The team refined technology-specific saturations through 28 interviews with market actors for technologies that have demonstrated rapid evolution in recent years, focused primarily on the saturation of lighting technologies. We coordinated with concurrent market actor studies led by Energy Solutions and DNV GL in MA by adding NH specific questions to their surveys.

1.5 Barrier Survey (Primary Data)

The team used the 148 completed barrier surveys primarily for lighting metrics. We included several penetration-specific questions and used them to further support adjustments to the LED penetration for lighting measures between NH and MA. Details of this process are provided in Section 3.1.

1.6 Industrial Data Collection (Primary Data)

The team conducted interviews with staff at 36 industrial facilities to understand the prevalence and distribution of equipment types, attitudes toward energy efficiency, and typical projects undertaken. This data was not used directly in the metrics development but provides insights at the granular subsegment level of the magnitude of opportunities within the sectors.

1.7 Professional Engineering Judgment

These metrics rely on engineering calculations or assumptions based on industry knowledge when other data sources are not available.

2 Initial Metrics Analysis by End Use

Table 1 provides the chief data source used to populate data for each equipment category, examples of the types of metrics within each, and the team's adjustment sources. The metric initialization, data collection, and adjustment processes are described in subsequent sections.

Table 1. Metric Categories, Sources, and Examples

Metric Category (End Use)	Source	Metric Examples	Adjustment Sources
Building distribution by type and size	Program administrator (PA) CI billing data, NH tax record data, manual mapping	• Number of buildings by type • Average square footage by type • Average consumption • Total population	• N/A, primary data analysis
Lighting	MA lighting market model Dunsky Market Archetype	• Fixtures with controls (percent) • Mean number of lamps • Mean fixture wattages • Fixture types (percent saturation) • Percent bulbs LED (LED penetration)	• Interviews of lighting distributors and manufacturer reps in MA and NH • NH customer surveys and comparison analysis with MA data MA lighting market model
Cooling	Dunsky Market Archetype	• System type (percent of businesses) • Mean system capacity • Percent cooling capacity by type • Percent cooling capacity by size • Benchmark cooling load	• Interviews of HVAC distributors and manufacturer reps in MA and NH for market context • Industrial segment insights provided from calls • Benchmark load adjustment
Heating	Dunsky Market Archetype	• Primary heating fuel type • Mean capacity of systems • Percent of load by system type • Percent of load by system size • Benchmark heating load	• Interviews of HVAC distributors and manufacturer reps in MA and NH for market context • Customer billing data • Industrial segment insights provided from calls • Benchmark load adjustment

Metric Category (End Use)	Source	Metric Examples	Adjustment Sources
Hot Water	Dunsky Market Archetype	• Primary heating fuel type • System type • Mean number of faucets • Percent of low flow equipment	• Customer billing data
Food Service	Dunsky Market Archetype	• Percent with electric/gas equipment	• Customer segmentation data
Compressed Air	Dunsky Market Archetype	• Mean number of compressors • Mean compressor size • Percent of systems with various energy savings measures applied	• Industrial segment insights provided from calls. No direct adjustments
Motors	Dunsky Market Archetype	• Percent with non-HVAC motors • Mean number • Percent with VSD • Mean horsepower of HVAC pumps/fans • Distribution by end use: pumping, conveyance, hydraulics, process	• Industrial segment insights provided from calls. No direct adjustments
Refrigeration	Dunsky Market Archetype	• Mean quantities (walk-ins, reach-ins, vending, coolers/freezers) • Percent with anti-sweater door heaters and EC motors	• Industrial segment insights provided from calls. No direct adjustments

3 Primary Data Collection and Metric Adjustments

The starting points for the metrics are the typical building findings (like benchmark heating load) from the jurisdictions noted in Table 1. These findings are customized for New Hampshire first, by accounting for the New Hampshire mix of building types, heating fuel type, and distribution by size. Annual energy use must reconcile with New Hampshire billing data. The team adjusted individual equipment metrics when the primary data supported an adjustment.

This section describes the primary data collection efforts and how they informed or revised metrics, including the following:

- Lighting distributor interviews
- Survey comparison between NH and MA
- HVAC trade ally interviews

- NH customer surveys
- Industrial sector audits and calls

3.1 Lighting

The Dunsky Market Model Archetypes requires the following key lighting metrics inputs:

- Lighting technology saturation – The percentage of lighting by technology type (i.e., linear, decorative) that serves each building type.
- Penetration – The percentage of LEDs serving standard and specialty screw-in bulbs and linear lamps. Most screw-in lamps must meet federal efficiency standards, helping to drive high rates of LED penetration. The penetration of linear lighting is more uncertain and has the most consequences for commercial programs.
- Lighting control saturation – The percentage of lighting with lighting controls by control technology type (i.e., occupancy controls, no controls, etc.).

The archetype lighting technology saturations metrics reference the saturation outputs of the Massachusetts market model. This model incorporates two rounds of recent on-site saturation inventories and models installed technologies by socket and building type as well as sales for the period of 2016 through 2026. The MA market model embodies an LED adoption curve evidencing increasing penetration of LEDs in each technology type in MA through the modeled period. The model has been trued-up multiple times with on-site observations, raising confidence in the model results.

This study sought to identify the baseline conditions at the time of the study (2019 baseline conditions), which coincides with primary data collection such as the trade ally interviews and barrier surveys. However, the potential study forecast starts in PY2021, two years into the future. Thus, the 2019 baseline observed through this study was advanced to 2021 for the purpose of inputs into the potential study model.

Commercial lighting technology types have evolved to serve distinct functions in buildings, for example linear lighting is ubiquitous in office settings. Since the distribution of functions is stable within a building type, it is reasonable to assume the technology type distribution is similar between NH and MA. MA technology saturations by technology were therefore adopted for the lighting technology saturation metrics.

However, MA has had aggressive energy efficiency programs in place for many years and, therefore, the penetration of energy efficient LED within a technology type may not be the same in NH. The research of this study focused on finding evidence for where NH is on the MA market model adoption curve – that is, what year of the MA market model best matches NH's 2019 LED adoption rate? The conclusion of this study is that NH is two years behind MA in adopting LEDs, as illustrated in Figure 1.

Figure 1. New Hampshire Adoption of LEDs

Summary of MA saturation study (Dec-19/Jan20) with RI (mid-2019)

2 years behind

				NH in PY2021 MA Market Study		
	PY2016	PY2017	PY2018	PY2019	PY2020	PY2021
Percentage of Standard bulbs that are LED (Indoor)	64%	79%	89%	95%	97%	96%
Percentage of Specialty bulbs that are LED (Indoor)	50%	71%	78%	83%	86%	87%
Percentage of linear lamps that are LED (Indoor)	16%	23%	33%	47%	63%	55%

	RI Market Study PY2019
Percentage of Standard bulbs that are LED (Indoor)	62%
Percentage of Specialty bulbs that are LED (Indoor)	36%
Percentage of linear lamps that are LED (Indoor)	22%

These conclusions are based on a triangulation of results from both NH and MA customer surveys, lighting trade ally interviews, and other research described in this section and summarized as follows:

- **NH customer barrier surveys** – The NH customers surveyed (in late 2019) reported an LED penetration rate for linear lighting of 28%, a value that best matches PY2017 in Figure 1. Further analysis tested this conclusion by comparing NH and MA responses to a variety of questions and by examining how well survey responses matched in-field observations. The findings of this work supported the conclusion that NH is two years behind MA in adopting LEDs.

  While the NH customers report lower LED penetration rates than MA, they also reported higher rates of program participation and more recent lighting projects. An interpretation of the higher reported activity rates is that NH is on a steeper and earlier part of the adoption curve, supporting the conclusion that NH is behind MA in LED adoption.
- **Lighting trade ally interviews** – The interviews of distributors and contractors yielded conflicting findings. In the structured part of the interview, interviewees responded that the NH and MA lighting market were similar. However, the NH-related questions were embedded in a survey sponsored by Massachusetts PAs as a courtesy to the NH community. The Massachusetts context of the interviews may have biased the structured responses, since half of the trade allies volunteered at the conclusion of the interview that the NH lighting market was less mature than MA.
- **Rhode Island on-site saturation results** – Rhode Island conducted an on-site equipment saturation study in 2019 that yielded a linear lighting penetration aligned with PY2017 in the MA market model (22% LED penetration of linear lighting). While the Rhode Island study left lingering concerns about some of the results, the finding suggests that the New England lighting market is not marching in lockstep and that state to state differences exist.

While none of the supporting research is conclusive, the preponderance of the evidence suggests that NH is behind MA in adopting LEDs in the order of two years. Based on this conclusion, the team populated the NH potential study model with values derived from PY2019

MA lighting saturations and penetrations results (i.e., the NH PY2021 model would reflect similar baseline conditions two years behind Massachusetts – in 2021, this would correspond to the MA PY2019).

The final lighting metric is for lighting controls. The Dunsky market model is populated with the Rhode Island saturation data. The Rhode Island and Massachusetts data both show low and similar lighting control findings.

3.1.1 Customer Surveys

Of the total 600 surveys targeted for the NH barrier surveys, only 148 were completed due to challenges in recruiting participants after the COVID-19 outbreak. The completes were unevenly distributed, with 73% completed for the small sector and 4% and 5% for the medium and large sectors, respectively. This lopsided distribution was still useful, however, since the purpose of the research was to test alignment between NH and MA, which could be done by comparing small sector NH with small sector MA findings. Table 2 presents the key NH barrier and MA study[1] CATI customer survey questions (paraphrased) that informed the analysis described below. The MA study was completed in conjunction with an on-site inventory of lighting equipment at a subset of 67 small business sites ("on-site study").

Table 2. NH Barrier and MA Study Survey Lighting Questions

Survey Description and Key Questions	NH Barrier	MA Study	Notes
Study description	CATI	CATI	
Survey period	Q1-20/Q2-20	Q4-19/Q1-20	
Responses included in analysis	119 small	346 small	
Do you have any LEDs installed at the facility today?	EU4a	Not asked	Measure of LED adoption.[2]
What percentage of the following fixture types would you estimate are LEDs?	EU4b, Q1a-d	Not asked	Measure of LED penetration.
Does your facility have any automatic lighting controls?	EU5.1	LC3	Measure of controls adoption.
Have you completed a lighting project in the last three years?	EU4.1, EU4.2, EU4.4	L1, L4a/b, L5A	Case comparison to test how well customers report field conditions.

Within the response to the EU4b and Q1a-d of the barrier survey, NH provided a reasonably robust measure of LED penetration. However, this value cannot be taken at face value since customers do not necessarily report field conditions accurately. To further test the validity of produced penetration values from the barrier survey and to further buttress the conclusions, the team conducted additional analysis as follows:

[1] This study is referred to in Massachusetts as MA19CL14-E-LGHTMKT.

[2] A site is an adopter if a facility has at least one of the technology units installed at the site.

How well do CATI-reported values reflect field observations?

The LED penetration series of questions requires customers to first distinguish between LED and non-LED technologies and between technology types and then to estimate the portion of the building that applies to each category. While error is to be expected, the team attempted to determine whether the results systematically understated or overstated LED penetration.

To test how well customers can estimate equipment quantities, the team conducted a case comparison of MA study CATI responses to the field observations captured in the on-site study. The comparison was done using the responses to LC3, which asked customers whether they had one or more lighting controls installed at the site. Almost half of the small customers (46%) said they had lighting controls (with 15% responding they did not know) compared to an on-site verified rate of 30%. This indicates customers might overstate the presence of a technology.

Two other studies were found with findings related to this topic

- P78: MA C&I Comprehensive Lighting Inventory – CATI and Onsite Survey Results Memorandum, published April 2019 with data collection in the 2018Q3/Q4 period.

  This study reported a comparison of adoption rates collected via CATI surveys and on-site observations. The comparisons showed that, on average, the CATI survey respondents understated the adoption of LEDs by about 16% (62% CATI vs. 78% for on-sites).

  However, in the same survey, customers were asked to identify the "primary lighting technology" and estimate what fraction of that technology was LED. CATI responders reported an average LED penetration rate of 48% for linear lighting, while the penetration rate in the field was about half, at 26%. In this case, customers overstated the presence of LEDs.
- P78 Final Report MA LED Spillover Analysis, Sept 24, 2015 – Data collection March 2014, Q3-2014. This study estimated free-ridership using CATI surveys but also included on-site findings from the P41 baseline work.

  The study concluded: "We found that there were no statistically significant differences between the findings of the telephone and on-site surveys with regard to the level of adoption of LED products supported by the PAs' programs."

The team concluded that any single study may find responses that understate, overstate, or reasonably represent field conditions and there is not a single reliable method or factor for truing up survey responses to match field conditions.

Are there other responses that could be used to model penetration?

In both the NH and MA CATI surveys, customers were asked about recent lighting projects, the portion of the building encompassed in the project, and whether LEDs were installed. The product of the portion of the building converted to LED provides a lower bound estimate of LED penetration that could be compared to field findings. Based on a case analysis of the 24 sites in the MA study with both CATI and on-site results and where a project was reported, the implied penetration of LEDS from the CATI responders was correlated with on-site observed penetration findings. The relationship was used to model a field-based linear lighting penetration for those customers who reported a recent project in NH. This analysis showed that there was little difference between the reported LED penetration and the modeled 'actual' penetration, providing additional substantiation for the NH customer-reported penetration rates.

The MA and NH small business customers reported rates of recent lighting activities whether through program participation or through recent projects. Table 3 summarizes a comparison of these responses.

Table 3. Comparison of Lighting Activity

	New Hampshire Barrier Survey	MA19CL14-E-LGHTMKT	
		CATI	On-Sites
Sample size	119 small	46 small	67 small
Linear lighting: LED penetration	28%	Did not ask	38%
Program participation	23% (DK: 7%)	17% based on tracking records	N/A
A lighting project was completed in the previous three years	48% (DK: 9%)	24% (DK: 32%)	N/A
Average LED project as % of building with projects	73%	80% from 67 responders with on-sites	N/A
LED penetration at sites with a project, linears	54%	Didn't ask	48%
LED penetration at sites with no project, linears	18%	Didn't ask	35%

DK = Don't know

The program participation rates are similar between the states, but NH shows double the number of recent reported projects compared to MA. NH responders, unsurprisingly, report higher rates of LED penetration after a project in the field, and LED penetration rates are higher in the field for those MA customers reporting a recent project.

Interestingly, a third of the MA customers did not know whether there had been a recent project at the site or not. This difference in recall may be an indicator that the NH projects were predominantly completed very recently and are still clearly in the responder's minds and could be an indicator that NH is earlier than MA in the adoption curve characterized by rapid advance.

3.1.2 Lighting Trade Ally Interviews

Following project kickoff, the sponsors informed the team of a lighting trade ally interview effort that would soon be conducted as part of a lighting market characterization study in Massachusetts. In the spirit of collaboration and mutual benefit, the MA and NH parties agreed to leverage this effort to expand the number of trade allies interviewed and to include questions comparing MA and NH. This allowed both efforts to achieve broader coverage while minimizing respondent fatigue.

ERS leveraged MA distributor interviews, supplemented with additional interviews conducted specifically for this effort. Program administrators (PAs) in Massachusetts contracted DNV GL to update their lighting inventory and market model study. As part of this study, DNV GL interviewed large lighting distributors and manufacturers about the C&I lighting market in MA. The DNV GL team agreed to include questions about the NH market and vendor sales activity so that the Dunsky/ERS team could utilize the findings for the NH Baseline Study. The Dunsky/ERS team interviewed lighting distributors serving the C&I market in both states who were not targeted by DNV GL's surveying efforts; we therefore modeled our interview guide after DNV GL's to ensure that results from the interviews could be blended.

Trade ally interviews were selected from two sample frames, described as follows:

- The sample frame developed for the MA study is comprised of 24 lighting distributors and 30 manufacturers who participated in Massachusetts' and Rhode Island's upstream lighting incentive program in 2018-2019. DNV GL completed 28 interviews.
- To develop our sample frame, we compared DNV GL's sample frame with lists of distributors who participated in New Hampshire's 2019 upstream sales lighting incentive program (provided by Eversource NH to Dunsky). We identified three distributors who were on the NHSaves lists but were not included in the DNV GL sample frame. Through an extensive web search, we identified two additional lighting distributor and manufacturer representatives for a total sample frame of five. We were able to recruit two of the five for participation in this study and completed those interviews.

Between the two sample frames described above, the trade ally survey effort has high coverage of the New Hampshire market.

Findings. The findings discussed in this section are based on the respondents from the DNV GL study who sold products in both MA and NH and had knowledge of both markets (n=19) as well as one of the Dunsky/ERS team respondents.[3]

Table 4. Trade Ally Markets and Interview Counts

Source	Completed Surveys	Sell in MA	Sell in NH	Used Interviews
DNV GL targeted	35	35	23	19
ERS team targeted	2	4	5	2

The team asked trade allies what percentage of their ambient linear, high and low bay, and exterior lighting product sales into the MA C&I sector in 2019 were LED versus non-LED. We then asked if those ratios differed from their 2019 LED versus non-LED product sales into the NH C&I sector. Salient findings are summarized here:

[3] ERS interviewed a lighting distributor and a manufacturer representative. Only the distributor does business in both Massachusetts and New Hampshire; the manufacturer representative does not do business in Massachusetts and thus their responses are not included in this section. Their responses are included in the section below titled "Additional Trade Ally Interviews."

- **High/low bay and exterior/outdoor fixtures.** All respondents who carry these lighting applications[4] said that they sold the same proportion of LED vs. non-LED products into the MA and NH markets in 2019. In both states, trade allies reported selling mostly LED products in these categories (87%–91% LEDs vs. 9%–13% non-LEDs).
- **Ambient linear lighting products.** Interviewed trade allies reported that, on average, their sales of ambient linear lighting products into MA in 2019 were 41% TLED, 49% integrated LED fixtures, and 10% non-LED products. When asked if these proportions differed significantly from their 2019 NH C&I sector sales, all respondents gave a "no" response; however, when providing further voluntary comment, two respondents reported that while they sell the same proportion of LEDs to non-LEDs into each state, their overall sales volume differs between states (i.e., they sell more into MA than NH).

The team's findings from the distributor surveys are summarized in Table 5. Note the first row(s) for each application show the LED percentage (i.e., the answer the respondent gave to the question: "In 2019, about what percentage of your sales of [lighting application] to the MA C&I sector were LED?"). The second (or last) row for each application shows the remainder (i.e., non-LED) such that each application will sum to 100%. Also note that we did not include NH ratios since most respondents indicated their ratios of LED vs. non-LEDs sold were the same, and those who indicated they were different did not provide NH sales percentage estimates.

Table 5. Summary of Lighting Responses: Trade Allies Serving MA and NH

<table>
<tr><th colspan="5">In 2019, about what percentage of your sales of [lighting application] to the Massachusetts C&I sector were LED?
What percentage were not LED? (n=17)</th><th rowspan="2">Would those proportions be significantly different for your 2019 NH [lighting product] sales?</th></tr>
<tr><th>Application</th><th>Type</th><th>Min</th><th>Max</th><th>Average</th></tr>
<tr><td rowspan="3">Ambient linear</td><td>TLED</td><td>0%</td><td>86%</td><td>40%</td><td rowspan="3">• Same ratios reported (n=16)
• More LEDs sold in MA, but could not give percentage estimate (n=3)
• Don't know (n=1)</td></tr>
<tr><td>LED fixture</td><td>14%</td><td>100%</td><td>49%</td></tr>
<tr><td>Non-LED</td><td>0%</td><td>55%</td><td>10%</td></tr>
<tr><td rowspan="2">High/low bay</td><td>LED</td><td>45%</td><td>100%</td><td>91%</td><td rowspan="2">• Same ratios reported (n=19)
• Does not sell high/low bay products (n=1)</td></tr>
<tr><td>Non-LED</td><td>0%</td><td>55%</td><td>9%</td></tr>
<tr><td rowspan="2">Exterior</td><td>LED</td><td>40%</td><td>100%</td><td>87%</td><td rowspan="2">• Same ratios reported (n=17)</td></tr>
<tr><td>Non-LED</td><td>0%</td><td>60%</td><td>13%</td></tr>
</table>

The respondents who reported selling more LED ambient linear lighting products in MA than in NH (n=3) said this was due to NH being behind in its rebate offerings and that the MA

[4] One respondent does not carry high/low bay lighting applications.

market was more mature. Supplementary comments made by just over half of the interviewed trade allies (n = 11)[5] echoed these sentiments:

- MA is a more mature market (n=5)
- Just recently started selling into NH or participating in the NH incentive program (n=3)
- Do not sell a lot into the NH market/only sell to a small portion of the state (n=5)
- Programs in NH are still in their infancy (n=3)

Note that these comments were not made in response to a specific question. Rather, trade allies gave their perspective of the NH market or additional details about their sales activity in NH voluntarily in the course of their discussion with the interviewer. Also note that of the 11 trade allies who made these comments, 9 reported having sold the same ratio of LEDs to non-LEDs in both MA and NH's C&I markets in 2019 during the structured part of the interview. While these comments do not directly contradict the sales information provided above, they do give a more nuanced perspective of the two markets.

In summary, these comments suggest that the NH C&I market for LEDs is smaller and distributors are far more familiar with operating in MA. However, the NHSaves upstream lighting incentive programs have helped mobilize the market over recent months, and distributors are starting to get used to conducting business in the NH market although they are still far more familiar with MA.

3.1.3 Additional Trade Ally Interviews

The ERS/Dunsky team conducted two trade ally interviews: one with a lighting distributor who does business in Massachusetts, New Hampshire, Vermont, Maine, and New York; and the other with a lighting manufacturer representative who sells to distributors in New Hampshire, Vermont, and Maine. In addition to questions about 2019 sales data, the team asked each trade ally to estimate the ratio of LEDs to non-LEDs currently installed in NH's C&I sector. Salient findings include:

- The manufacturer representative estimated that half of the currently installed ambient linear technologies are LED, commenting that many buildings still have fluorescents in storage. (The manufacturer's representative did not comment on the other lighting products.) The distributor estimated that only 20% of NH's C&I ambient linear lighting was LED, and that integrated fixtures make up a majority of that (80% fixtures, 20% TLEDs).
- The distributor estimated that 10% of the currently installed high/low bay fixtures are LED, while 98% of the exterior/outdoor fixtures are LED. He said that he was not aware of one single exterior HID/metal halide-LED lighting swap that had taken place during the previous 12 months, suggesting that most replacements had already been made.

[5] A total of 11 trade allies volunteered these comments, but some made multiple comments. As such, the comment counts (as recorded in the bullets) sum to more than 11.

The team also asked the trade allies' professional perspective on where NH's C&I lighting market is in comparison to MA's market. Both reported that NH's market is behind that of MA because of how long MA's lighting incentive programs have been around.[6] Additional comments were as follows:

- There are more products/fixtures that are eligible for incentives in MA; the NH incentives are more limited.
- Customer demand is driving NH distributor and contractor awareness of the incentive programs.

3.1.4 Conclusion

Responses from 21 interviews provide a picture of the New Hampshire market with substantial LED activity, although likely behind the MA market in terms of absolute penetration. Exterior lighting is likely transformed in NH as it is the rest of the country.

A few respondents provided potentially contradictory information, stating the ratios of LED to non-LED sales were similar in both markets yet simultaneously that the NH market was behind that of MA. Since respondents were asked about their 2019 sales, this could be an indication that the NH market has been animated by the program but still has ground to make up from MA's long history of program support.

The MA data was shifted back two years to reflect conditions in NH as described in the sections above.

3.2 Heating and Cooling (HVAC)

The team initially populated the metrics from the Dunsky Market Archetype and then updated them with the sources described below.

3.2.1 Customer Surveys

The team intended to leverage the CATI customer barrier surveys for data regarding heating and cooling systems and fuel types. These surveys were designed to capture a representative distribution across the NH customer population by both business segment and size strata. However, challenges from COVID-19 resulted in a low number of responses such that the completed surveys were no longer representative of the population. Therefore, the team used alternative approaches to adapt critical metrics for NH.

3.2.2 Customer Billing Data

ERS used customer billing data in lieu of the survey data to develop several key metrics related to fuel use, heating, and hot water. The team estimated the prevalence of electric heating with a

[6] Though the manufacturer representative does not do business in Massachusetts, the respondent has been in the lighting industry in New England for over 20 years and, as such, was able to provide a professional opinion.

billing analysis of NH customer data, by identifying the portion of sites with increased winter electric loads. Natural gas coverage estimation used the natural gas billing data and account tax mapping during the segmentation analysis stage. The team used Energy Information Administration (EIA) data to determine the remaining share of fuel oil and propane coverage.

3.2.3 Distributor Surveys

Following project kickoff, the sponsors informed the team of an ongoing trade ally survey effort that would soon be conducted in Massachusetts. To achieve fuller market coverage while minimizing respondent fatigue of those trade allies serving regional markets, the team coordinated with the other study. As discussed below, much of the information collected through these surveys had to do with current equipment sales as opposed to existing penetration of LEDs in the field. This was to be expected, as that is the level at which distributors operate and have direct knowledge. The data collected was not meant to be a direct reflection of existing equipment penetration, but rather to inform where New Hampshire was on the adoption curve. Higher or lower LED sales in New Hampshire versus Massachusetts infers different points on the adoption curve.

The NHSaves PAs contracted the firm Energy Solutions to conduct market research on commercial HVAC, water heating, and foodservice equipment in NH. The research was designed to help the PAs understand the supply chain and estimate the market size for each technology type (both standard and high efficiency, defined as eligible for utility program incentives in MA) to determine impacts of a midstream incentive program model. Energy Solutions conducted research primarily through interviews with HVAC distributors, which focused on stocking and sales protocols and vendor perception of what incentives are needed to close the gap between sales of standard and high efficiency technologies. Energy Solutions also requested that, when able, the vendors share their 2019 sales data, or counts of standard vs. high efficiency units sold of various technologies that would soon be covered by upstream incentives. This included mini-splits, ground-source heat pumps, water-source heat pumps, water-cooled or evaporatively-cooled air conditioning units, variable refrigerant flows (VRFs), packaged and split rooftop units (RTUs), and electronically commutated (EC) motor pumps.

The team engaged Energy Solutions to combine survey efforts. Dunsky/ERS added questions to the Energy Solutions interview guide that would prompt vendors to provide information about their sales activity/data in NH in addition to MA. To better understand market shifts or changes, the team also added a question that asked if the ratio of high to standard efficiency products sold to customers in NH had shifted at all over the previous three years, and, if so, why. The technology list was also expanded to include commercial boilers and chillers.

Interviews were conducted jointly when possible (i.e., with members of both teams involved). The Energy Solutions team shared the data they collected with the team. Energy Solutions' sample frame was made up of 20 HVAC distributors who are participants in NHSaves' midstream incentive programs.

Findings. This report includes results from seven vendor interviews. Results are summarized below in Table 6.

- **Mini-splits.** Three of the seven trade allies interviewed sell mini-splits, and two reported selling more high efficiency splits into MA than into NH because of the availability of incentives in MA. The other distributor reported that in both states, 80% of the splits they sold were standard efficiency and 20% were high efficiency.
- **EC motors.** Three of the seven trade allies interviewed sell EC motors and circulator pumps. All three respondents sell more EC motors in MA than they do in NH because of the incentives available in MA (one reported having sold EC motors only in MA). Two respondents mentioned that the rebates in MA lower the cost of EC motors past those of standard efficiency circulator pumps. One reported that over the previous year, his company sold five EC motors for every standard efficiency circulator sold in MA. This trade ally also shared sales numbers from two NH branches. Over the previous year, the branch that serves northern NH sold approximately 170 standard efficiency units and 80 high efficiency units. The branch that serves southern NH and MA saw the sale of 150 standard efficiency units and 1,230 high efficiency units over the previous year; the respondent explained that the southern NH/MA branch serves a major contractor in MA, which was the reason it sold so many EC motors.
- **VRFs.** One of the seven trade allies interviewed sells VRFs. This trade ally reported that the MA market is a larger market; they complete approximately 120 VRF projects per year in MA and only 20–30 projects per year in NH. That said, the trade ally also said that almost all VRFs sold in both MA and NH are now high efficiency.
- **Ground-source heat pumps (GSHPs).** One of the seven trade allies interviewed (exclusively) sells GSHPs. This trade ally mainly carries high efficiency systems that meet Federal ENERGY STAR standards so that their customers can get the Federal Investment Tax Credit (ITC) for the project. As such, their policy is to sell the most efficient system possible in all the markets they serve (e.g., there is often little difference between what they sell in MA vs. NH).

Table 6. HVAC Trade Ally Survey Results Summary Table

Technology	Respondents Who Sell Equipment Type	Summary
Mini-splits	3 of 7	• More high efficiency units sold in MA due to availability of incentives (n=2).
EC motors	3 of 7	• More EC motors sold in MA due to availability of incentives (n=3). • Rebates in MA lower the cost of EC motors below those of standard efficiency circulator pumps (n=2).
VRFs	1 of 7	• VRFs sold in both MA and NH are almost all high efficiency.
GSHPs	1 of 7	• Sell only high efficiency systems so that customers can receive the federal ITC (n=1).

3.3 Food Service, Motors, Compressors, and Refrigeration

Due to the lack of completed customer barrier surveys, the team used the Dunsky Market Archetype utilizing nearby jurisdictions for these metrics. We collected additional data through ERS's industrial focused calls; results are provided in the following sections.

3.4 Building Characteristics

These metrics were updated through the segmentation study, which analyzed customer billing data. The team merged account data with tax parcel data to develop building square footage distributions. This process and the results are provided in Section 5 and the separately submitted Segmentation Memo.

4 Industrial Insights

This section provides insights about equipment and customer attitudes toward energy efficiency from primary data collection activities in within the industrial sector. Findings are reported out by industry type and equipment type.

We interviewed knowledgeable site staff at industrial facilities throughout the state with regards to their current equipment, previous energy efficiency projects, and planned projects. Due to COVID-19 site restrictions, only calls were conducted. Numerous businesses were closed impacting recruitment. Data collection focused on industries with the largest presence in the state based on business census and customer billing data.

We also mined our portfolio of energy audits that had been completed during the last six years to identify commonly recommended measures and follow-up if the recommended measures had been implemented. The common measures of the audit-participant sites informed the line of questioning for the non-audit participant sites. To reduce biases in sample selection, the team distributed the calls between previous participants in the audit program and non-audit participants, targeting half of the data collection for non-audit participant sites. To keep the data collection process manageable, the team focused on a subset of equipment expected to have the largest impact on energy use.

4.1 Targeted Segments

We selected eight of the largest industries for data collection. Table 7, below, provides the number of large firms for each segment as reported from United States Census Bureau's County Business Patterns: 2017, previous audits completed, and sample size for the sampled subsegments. Appendix A provides size and consumption metrics for all subsegments.

Table 7. Targeted Industrial Subsegments

Code	Meaning of 2012 NAICS Code	Large Firms	ERS Audits	Target Sample
334	Computer and electronic product manufacturing	45	7	8
332	Fabricated metal product manufacturing	50	8	10
333	Machinery manufacturing	27	23	10
326	Plastics and rubber products manufacturing	22	9	15
335	Electrical equipment, appliance, and component manufacturing	20	5	8
311	Food manufacturing	10	7	12
325	Chemical manufacturing	12	4	5
N/A	Ski industry	N.D.	N.D.	7
Total			**63**	**75**

4.2 Sample Disposition

ERS utilized the recruiting scripts approved by the NH utilities to recruit customers to participate in the study. The recruitment effort and interviews took place over a period of 7 weeks beginning June 8 and ending on July 24. Table 8 summarizes ERS's recruitment efforts by segment.

Table 8. Recruitment Effort Summary

Segment	311 - Food Manufacturing	325 - Chemical Manufacturing	326 - Plastics and Rubber Products Manufacturing	332 - Fabricated Metal Product Manufacturing	333 - Machinery Manufacturing	334 - Computer and Electronic Product Manufacturing	335 - Electrical Equipment Component Manufacturing	Ski	Total
Target	12	5	15	10	10	8	8	7	75
Complete	5	2	4	9	5	7	4	0	36
Attempts	33	76	46	169	67	77	83	41	592
Rejections	2	4	6	12	1	2	6	3	36
Target Completion	**42%**	**40%**	**27%**	**90%**	**50%**	**88%**	**50%**	**0%**	**48%**

Recruitment was challenging due to impacts of COVID-19; facilities were either closed, operating with reduced staff, or slowly ramping operations back to normal. As a result, ERS had difficulties contacting facility staff over the phone to recruit for the interview. When we were able to get in touch with a site on the phone, we achieved a 60% recruitment rate. ERS had no success in the ski segment, likely due to the season and COVID-19 impacts.

Table 9 shows a breakdown of the recruited sites by size, whether the facilities have been audited by ERS in the past, and number of shifts.

Table 9. Distribution of Recruited Sites

Metric	Size*		Previously Audited by ERS		Number of Shifts		
	Large	Medium	Yes	No	1	2	3
Count	15	21	16	20	10	14	12
Percentage	42%	58%	44%	56%	28%	39%	33%

*Medium facilities are those that have an annual electric consumption between 500,000 kWh and 4,500,000 kWh. Large facilities have an annual electric consumption that is greater than 4,500,000 kWh.

4.3 Equipment/Processes

The equipment outlined in this section are directly related to the facilities' processes; some, however, have dual functions (i.e., process cooling and space cooling).

Table 10 shows a high-level summary of the equipment the team surveyed.

Table 10. Summary of Equipment Surveyed

Equipment		Air Compressors	Cooling Equipment	Boilers	Fans/Pumps	IMM	CNC/Laser Cutter
Quantity		66	132	56	253	101	108
Size	Range	10–360 hp	2.5–950 tons	200–16,750 MBH	0.25–75 hp	N/A	N/A
	Average	64 hp	191 tons	2,258 MBH	12.5 hp	N/A	N/A
Operating Hours	Range	0–8,760	1,920–8,760	500–8,760	500–8,760	1,920–8,760	200–4,500
	Average	5,363	6,690	7,742	4,813	5,640	2,670
Age (Years)	Range	0–30	1–52	5–56	2–40	1–30	1–30
	Average	10	8	13	12	15	16

Based on the respective quantity of equipment studied as part of this project, one common factor across the board is the relatively large size of the equipment and the extended operating hours. Both of these indicate that any energy efficiency upgrades conducted in any one of the respective systems could result in substantial energy savings.

The following sections describe systems that are common across multiple segment types. Each section includes an Equipment and Summary table that summarizes the equipment inventoried at the sites surveyed and the average savings of recommended measures included in the reference audits. The team extrapolated these results statewide; however, the statewide estimates are based on small sample sizes and should be viewed as providing order of magnitude and relative ranking indicators.

In this section, the team assigned a project type to each measure that describes business decision-making often associated with the measure and that can contribute to the likelihood of adoption. The categories include the following:

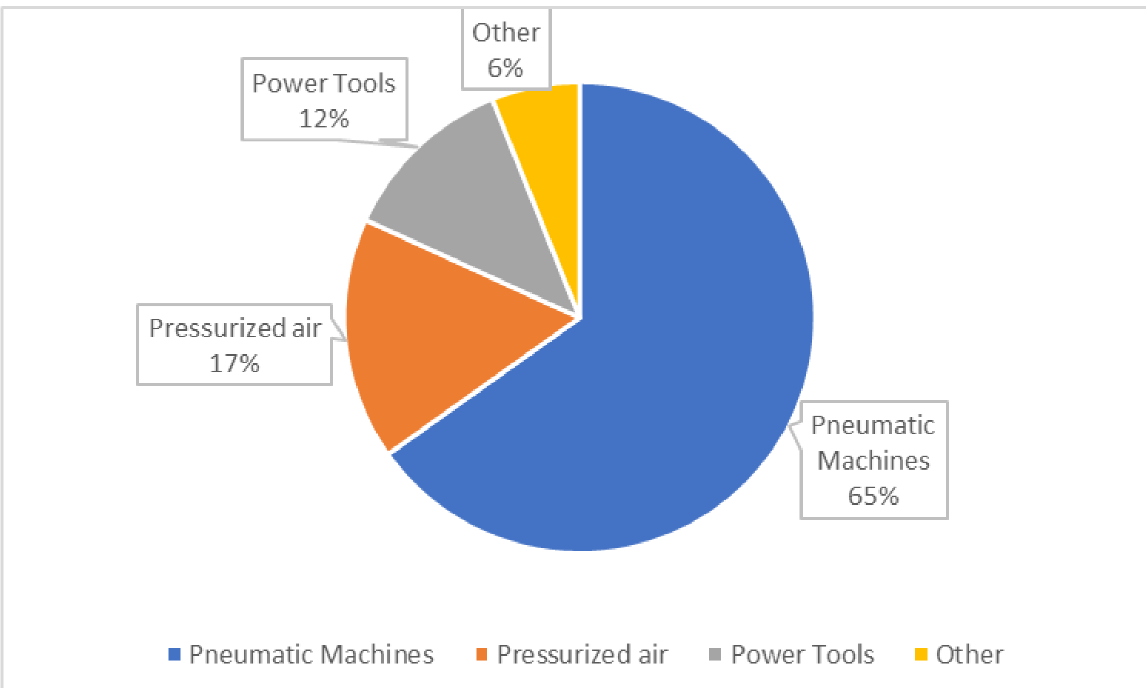
- **Capital** – Equipment is likely to meet company thresholds requiring justification in an annual budgeting process well in advance of the upgrade. Includes equipment such as boilers and chillers. Capital equipment is typically replaced at end of life or as part of a plant expansion.
- **Operating** – Lower cost equipment upgrades (controls, smaller motors) are relatively low cost and usually not subject to a capital budget review but instead are paid from an annual operating budget.
- **O&M** – Repair and parts. Continuous replacement required for optimum energy efficiency, like leak repairs and steam traps.

The reporting tables also estimate the number of customers who may be in a position to consider a measure in any year. This is a function of the number of customers in the segments, the expected measure life, and the current saturation of the measure.

4.3.1 Air Compressors

The team found air compressors at all seven segment types, specifically in 32 out of 36 interviewed sites. The most common end uses are outlined in Figure 2.

Figure 2. Air Compressors End Uses



Most compressed air is used to supply pneumatic machines for various processes throughout the facilities. In total, 59% of interviewed customers who have compressed air systems confirmed that they had sufficient compressed air storage, while 38% could not confirm that information and 3% did not have a need to store compressed air.

Table 11 summarizes the air compressor mode of control by whether the units were primary or secondary.

Table 11. Surveyed Air Compressor Controls

Control Type	Primary	Secondary/Backup	Total HP
Variable speed	33	1	2,260
Constant speed	10	8	950
Modulating	5	8	475
Load/unload	1	0	25
Total	**49**	**17**	**2,980**

The overall trend is that customers have been replacing their constant speed compressors with newer, more efficient variable speed drive compressors and leaving the former as backup. As can be seen in Table 10, farther above, the average age of the air compressors in our sample is around 10 years, which is on the cusp of the average end of useful life (EUL) of air compressors (12–15 years).

Table 12 presents measures recommended as part of the reference audits and their average normalized energy savings (kWh/hp). Each measure is classified by its project type and includes estimates of the number of customers who might be considering the measure in any year and the statewide estimated savings. The statewide values have been extrapolated from a small sample and should be viewed as providing order of magnitude and relative ranking indicators.

Table 12. Recommended Measures and Estimated Savings

Measure Type	Project Type	Notes	Cust/ Year	Audited Average kWh Saved/HP	NH-Wide Annual (MWh)
Air leakage repair	O&M	A handful of facilities perform leak tests as part of their routine maintenance.	93	1,604	513
High efficiency compressor	Capital	Half of existing fleet is VFD.	9	1,044	17
Pressure setpoint reset	Operating	Energy audits typically identify this measure and drive the customers to implement it.	37	831	53
Air saver nozzle	O&M	Few customers reported having air saving nozzles.	37	124	16
Storage	Capital	Customers report adequate storage.	9	N.D.	N.D.

N.D. = No data

Compressed air is a very common end use present at 90% of the industrial sites surveyed. Compressor replacement opportunities are typically considered toward the end of the life of the equipment or as part of a plant expansion; therefore, they will occur more rarely. The New Hampshire compressed air fleet is, on average, about halfway through its expected life span, but there is a steady stream of compressor upgrade opportunities. Lower cost add-on type measures, like controls and dryers, are cost-effective with opportunities remaining. Lead repair and nozzle replacements remain an ongoing opportunity, although program policy may impact the extent to which customers can be provided with assistance in this area.

4.3.2 Process Cooling and Refrigeration

Process cooling covers all equipment that supplies cooling, including process refrigeration, chillers, dry coolers, cooling towers, and direct expansion (DX) units that maintain temperature and relative humidity of a room to preserve a product. Process cooling/refrigeration is found in all seven segment types, specifically in 21 out of 36 interviewed sites. Some of this equipment is only used for process cooling and refrigeration (65%) where others are used for both space and process cooling (27%).

Similar to air compressors, there generally seems to be a high efficiency trend when it comes to process cooling. One site in particular replaced some of their old chillers in the past 3 years and is looking into upgrading their remaining dry coolers and chillers should a rebate be available.

Table 13 presents measures recommended as part of the reference audits and their average normalized energy savings (kWh/ton). Each measure is classified by its project type and includes an estimate of the number of customers who might be considering the measure in any year and the statewide estimated savings. The statewide values have been extrapolated from a small sample and should be viewed as providing order of magnitude and relative ranking indicators.

Table 13. Recommended Measures and Estimated Savings

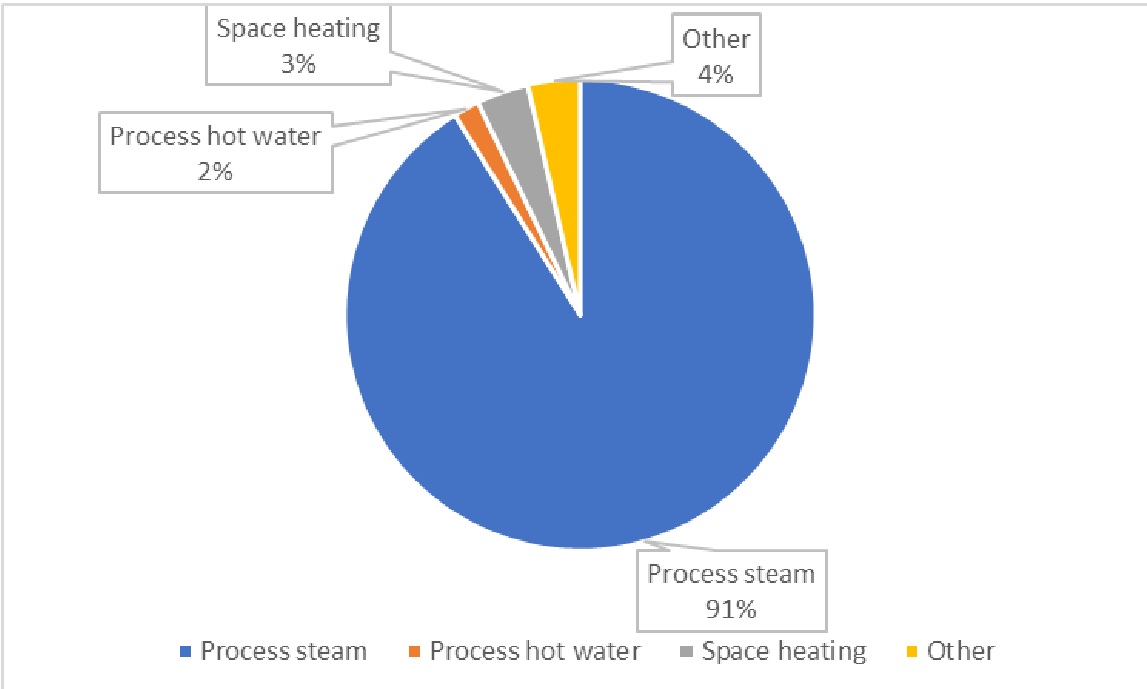
Measure Type	Project Type	Notes	Cust/ Year	Average kWh Saved/Ton	NH-Wide Annual (MWh)
Chiller plant optimization through controls	O&M	Typically identified after an audit and is mostly implemented.	26	1,641	2251
Upgrade to more efficient chiller	Capital	Usually installed at EUL of existing equipment.	13	1,187	814
Chilled water reset	Operating	Energy audits typically identify this measure and drive the customers to implement it.	51	N.D.	N.D.
VFD on CT fans	Capital	No customers have reported having this measure.	51	N.D.	N.D.
Water side economizing	Capital	Though measure is not commonly adopted, some customers have reported doing free cooling.	13	203	139

N.D. = No data

4.3.3 Boilers

Boilers were found at six out of the seven segment types, but only in 12 out of 36 interviewed sites. Even though 56 total boilers were surveyed, very little inferences can be drawn from the result since 39 out of the 56 make up boiler plants at a single facility. The most common end uses are outlined in Figure 3.

Figure 3. Boiler End Uses



The sampled boilers are 96% natural gas and only 4% propane. All sampled boilers are reported to be modulating. Table 14 shows a breakdown of the type of boilers surveyed.

Table 14. Boiler Types

Boiler Type	Quantity	Capacity MBH	Percentage
Steam boiler	53	59,621	95%
Condensing - hot water boiler	2	400	4%
Non-condensing - hot water boiler	1	200	2%
Total	**56**		**100%**

As shown in the table, 95% of the boilers are steam boilers. In addition, none of the sites stated that they have existing heat recovery from process heating equipment, which presents another opportunity.

Table 15 presents measures recommended as part of the reference audits and their average normalized energy savings (kWh/MBH). Each measure is classified by its project type and includes estimates of the number of customers who might be considering the measure in any year and the statewide estimated savings. The statewide values have been extrapolated from a small sample and should be viewed as providing order of magnitude and relative ranking indicators.

Table 15. Recommended Measures and Estimated Savings

Measure Type	Project Type	Notes	Cust/ Year	Ave Therms Saved/ MBH	NH-Wide Annual (Therms)
Boiler tuning	Operating	Energy audits typically identify this measure and drive the customers to implement it.	129	0.078	5,569
Upgrade to more efficient boiler	Capital	Usually installed at EUL of existing equipment.	10	1.561	8,911
Controls	Operating	Customers have reported having modulating boilers and lead lag boilers. No other controls beyond that.	26	0.781	11,139
Steam traps	Operating		43	0.312	14,852

Although steam trap repair measures were not recommended in the audits, this measure contributes to savings portfolios in New York and Massachusetts.

Finally, one of the sites informed the team that one of their departments only uses electric resistance process heat and mentioned that "it would be great if there was an incentive to move from electric resistance heat to natural gas."

4.3.4 Fans and Pumps

Fans and pumps are key equipment to any process and were found in abundance across all seven segment types, specifically in 22 out of 36 interviewed sites. The team surveyed a total of 122 fans and 131 pumps. The most common end uses based on the sites interviewed are found in Figures 4 and 5 for fans and pumps, respectively.

Figure 4. Fan End Uses

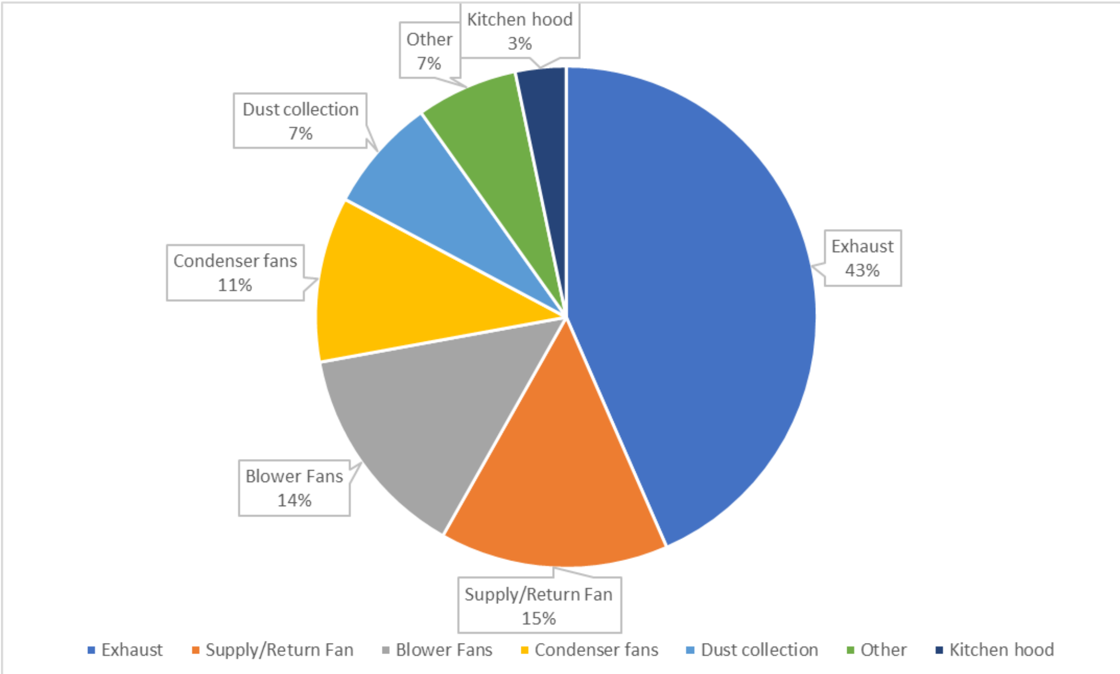
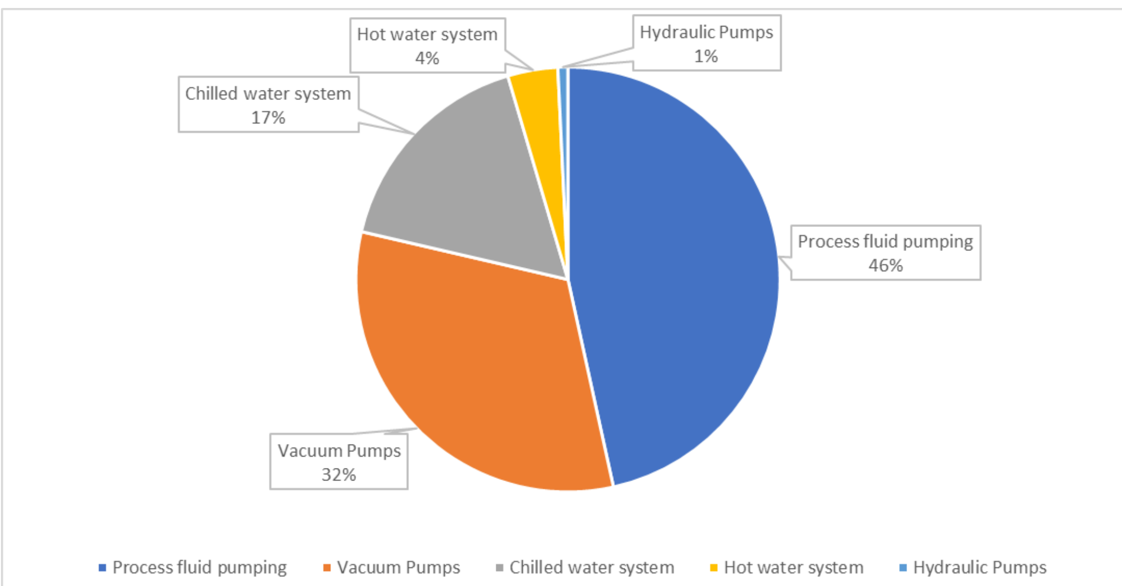


Figure 5. Pump End Uses



Fans are mostly used for exhaust and circulating conditioned air throughout the facilities. Most sites have certain requirements about the air quality, temperature, and relative humidity in the space either for process or human safety purposes. Regardless, the general practice according to the interviewees is that air is exhausted out of the facility during the entire duration of the operation, which results in great energy losses, both from fan operation and from expelling conditioned air. There is opportunity for heat recovery, especially in facilities were room air conditioning is also part of the process.

Pumps are mostly used to circulate process fluid as well as chilled and hot water throughout the facility. Vacuum pumps were also found to be prominent mostly in sites were material machining takes place or when controlled space conditions are important to the process.

Regardless of the end use, ERS found the potential for energy savings if the pumping speed is optimized to meet the load only and avoid full capacity operation.

VFD retrofits are a popular measure when it comes to flow rate control. The controls measure refers to proper scheduling of the equipment and avoiding run time when not necessary. With heat recovery, exhausted air/returning fluid exchanges heat with air/fluid supplied into the facility, minimizing energy losses. It is important to mention that some customers have showed concerns when it comes to exhaust air heat recovery; they stated, "We considered heat exchangers, but the exhausted material is highly corrosive and would damage standard heat exchange equipment" – therefore, heat exchangers have to be custom to a facility's operation in some instances.

Table 16 presents measures recommended as part of the reference audits and their average normalized energy savings (kWh/hp). Each measure is classified by its project type and includes estimates of the number of customers who might be considering the measure in any year and the statewide estimated savings. The statewide values have been extrapolated from a small sample and should be viewed as providing order of magnitude and relative ranking indicators.

Table 16. Recommended Measures and Estimated Savings

Measure Type	Project Type	Notes	Cust/ Year	Average kWh Saved/hp	NH-Wide Annual (MWh)
Install VFD drive	Operating	Common across sites though not widely adopted.	32	1,736	1,091
Controls and scheduling	Operating	This low-cost measure is identified after an energy audit and has a high adoption rate.	32	3,456	2,172
Heat recovery	Capital	No customers reported heat recovery measures. This presents a big potential but also has site-specific considerations.	26	1,204	605
Upgrade to higher efficiency model	Capital	Typically occurs at EUL of existing equipment.	51	2,666	2,680

4.3.5 Injection Molding Machines (IMM)

IMMs are found at only four of the seven segment types, specifically in 9 out of 36 interviewed sites. Table 17 shows the distribution of the type of machines surveyed.

Table 17. IMM Types

IMM Type	Quantity	Percentage	Average Age
Electric	52	51%	14
Hybrid	30	30%	10
Hydraulic	19	19%	23
Total	**101**	**100%**	

According to the sites surveyed, hydraulic IMMs are being phased out or kept as a backup when newer equipment is installed. Hydraulic IMMs are also the older of the three types, with most hydraulic machines aging anywhere between 20 and 30 years. Electric IMMs are the most prominent type of the three, but hybrid machines seem to be penetrating the market as they represent most of the newest installs.

Measures involving barrel insulation and equipment shut off during idle or no operation are found to be easy to implement yet highly efficient, and some facilities are following these measures as best practice. However, the team has not conducted any studies on IMMs in New Hampshire in recent years to determine the estimated energy savings from those measures.

Cooling is one area of potential for IMMs. Though customers were not always able to provide concrete data, one facility in particular mentioned that each one of their roughly 60 IMMs has its individual dryer cooler or chiller. The latter has potential in consolidating their cooling system. Another site mentioned that their IMM process cooling is served by constant-volume cooling towers and chillers – this presents an opportunity for cooling controls.

Finally, some interviewed customers cautioned against retrofitting hydraulic IMM pumps with VFDs. One interviewee stated “VFDs on IMMs with rapid changes to motor speeds do not work well" –and therefore often cause issues in production.

4.3.6 CNC/Laser Cutters

CNC/laser cutters were found at three of the seven segment types, specifically in 6 out of 36 interviewed sites. The team surveyed 66 total CO_2 laser cutters and 42 CNC machines. Site contacts have reported that the equipment is mostly in good condition and that newer cutters are purchased when the current equipment reaches EUL.

There are generally no major findings, as the sample of sites is small. Most energy efficiency best practices, however, usually revolve around the auxiliary equipment and include appropriate control and operation of dust collection equipment and vacuum pumps as well as general process cooling and compressed air measures.

4.3.7 Other Equipment

The team surveyed other key equipment found at the facility and labeled them under “Other” if they have limited potential, are not common across segments, or if customers had interest in upgrading to newer and more efficient equipment should an incentive be made available.

Ovens

Ovens the team surveyed were mostly found to be electric (90%) or natural gas (9%). Ovens are mostly found in fabricated metal and electric equipment manufacturing for material conditioning. Most ovens are 10 years or older, with newer efficient installs being reported. This equipment operates 2,000 hours per year on average. Customers reported that they are generally well insulated; however, with newer, higher efficiency equipment available, efficiency opportunities can be found.

Mixers and Agitators

Mixers and agitators surveyed are mostly found in food processing and chemical manufacturing for mixing various products or chemicals. Most equipment is 10 years or older and operates 2,000 hours per year on average. One opportunity here is to install VFDs on the motors.

Extruders

Extruders are found in both fabricated metal and plastic manufacturing. The equipment surveyed is 10 years or older and operated around 4,000 hours annually. Extruders are similar to IMMs, and there are generally energy savings potentials in insulating the barrel and shutting down the equipment when it's not operating.

4.4 Segments

Generally, the team found that all segments share an interest in energy efficiency; all facilities interviewed reported to have participated in a rebate program in the last five years. One customer indicated that they had done lighting and some HVAC upgrades through the program because it was a "no brainer." Another stated, "We recently acquired a VFD air compressor as part of a rebate program. […] We've converted our lights through a program as well."

The following section will outline segment-specific findings.

4.4.1 Segment 311 – Food Processing

Food processing includes all manufacturing that starts with raw materials (i.e., meats, vegetables) to make into a food product. Refrigerated warehouses and food and beverage storage are not included in this segment. Table 18 summarizes population, annual energy use, and survey statistics for this segment.

Table 18. Food Processing Statistics

Size	Population	Annual Energy Use (MWh)	Sites with Audits	Audited Sites Surveyed	Non-Audited Sites Surveyed
Large	5	98,409	4	4	0
Medium	12	23,797	0	0	1

Table 19 summarizes the equipment inventoried at the surveyed sites along with the findings extrapolated statewide. The statewide estimates are based on small sample sizes and should be viewed as providing order of magnitude and relative ranking indicators.

Table 19. Food Processing Equipment and Savings Summary

Systems	Surveyed			Statewide			
	Sites	# Units	Capacity	Sites	Capacity	Savings (MWh)	Savings (Therms)
Compressed air	3	10	640 hp	10	2,144 hp	599	N/A
Process cooling	5	37	7,067 tons	17	26,673 tons	1,383	N/A
Boilers	4	44	99,352 MBH	13	332,810 MBH	N/A	23,601
Fans and pumps	5	42	525 hp	17	1,759 hp	573	N/A
IMM	0	0	N/A	0	N/A	N/A	N/A
CNC/Laser	0	0	N/A	0	N/A	N/A	N/A

The team found refrigeration equipment (compressors and condensers) to be primary equipment for the food processing segment. Large facilities tend to have central plants that utilize ammonia as refrigerant, and process cooling (i.e., blast freezers) represents the majority of the refrigeration load. Large systems focus on optimization – most efficient sequencing, condensing temperature reset, etc. Smaller facilities tend to have distributed units that utilize R22, R134, or other conventional refrigerants and storage (warehousing, walk-in coolers and freezers), which represent the majority of the refrigeration load. Small systems focus on end uses – evaporator VFD, efficient fans, etc.

The team found that boilers are also primary equipment, predominantly used for process steam and hot water. Combustion controls and higher efficiency boilers are potential energy saving measures.

As mentioned before, refrigeration is by far the largest energy user and also appears to be where the capital funding is allocated to. Refrigeration is most critical as viewed by facility owners.

All customers interviewed in this segment have participated in prior rebate programs (the most common include lighting and refrigeration), and there was a general willingness and interest in energy efficiency. All sites have completed upgrades within the last 5 years and did not express any project delays due to COVID-19. This segment is considered essential and experienced stronger-than-usual demand due to COVID-19, though sites indicated that product demand is trending back to normal.

4.4.2 Segment 325 – Chemical Manufacturing

Chemical manufacturing includes all manufacturing that covers the transformation of organic and inorganic raw materials to form products. Table 20 summarizes the population, annual energy use, and survey statistics for this segment.

Table 20. Chemical Manufacturing Statistics

Size	Population	Annual Energy Use (MWh)	Sites with Audits	Audited Sites Surveyed	Non-Audited Sites Surveyed
Large	7	97,071	3	0	0
Medium	20	30,230	5	2	0

Table 21 summarizes the equipment inventoried at the surveyed sites along with the findings extrapolated statewide. The statewide estimates are based on small sample sizes and should be viewed as providing order of magnitude and relative ranking indicators.

Table 21. Chemical Manufacturing Equipment and Savings Summary

Systems	Surveyed			Statewide			
	Sites	# Units	Capacity	Sites	Capacity	Savings (MWh)	Savings (Therms)
Compressed air	2	2	128 hp	27	1,728 hp	468	N/A
Process cooling	1	1	191 tons	14	2,579 tons	101	N/A
Boilers	1	1	2,258 MBH	14	30,482 MBH	N/A	2,162
Fans and pumps	1	5	62.5 hp	14	844 hp	122	N/A
IMM	1	4	N.D.	14	N.D.	N.D.	N.D.
CNC/Laser	0	0	N/A	0	N/A	N/A	N/A

N.D. = No data

The team found boilers to be a primary equipment at chemical manufacturing facilities interviewed. Though boilers are generally well maintained, most were non-condensing. Boilers were used for both process steam and facility heating where needed. Interviewed sites indicated having thermal jacket insulation on steam distribution piping and fittings. The team found that boiler controls and upgrading to condensing boilers are two potential measures at these facilities.

Chillers were also found to be primary equipment at these facilities and tend to have high annual hours. Therefore, chiller and chilled water distribution controls are candidates for energy saving measures.

Air compressors are also found to be primary, though the facilities interviewed showed no interest in replacing their old vintage air compressors.

Humidifiers, though not commonly found in other segments, were found to be a secondary equipment for chemical manufacturing. Humidifiers are used for climate-controlled sections within facilities. They generate water vapor electrically (ultrasonic or misting pumps) and do not use steam from the boiler. Since relative humidity is a process-specific requirement, humidifiers were classified as a secondary equipment even though, when required, they operate continuously.

Since few sites were recruited, no major inferences were made on customer participation in energy efficiency rebate programs. However, one of the two sites performed humidifier and chiller upgrades prior to the COVID-19 pandemic.

4.4.3 Segment 326 – Plastics and Rubber Products Manufacturing

Plastics and rubber products manufacturing includes processing of plastics materials and raw rubber to make goods. Table 22 summarizes the population, annual energy use, and survey statistics for this segment.

Table 22. Plastics and Rubber Products Manufacturing Statistics

Size	Population	Annual Energy Use (MWh)	Sites with Audits	Audited Sites Surveyed	Non-Audited Sites Surveyed
Large	6	59,029	5	0	1
Medium	17	29,852	3	1	2

Table 23 summarizes the equipment inventoried at the surveyed sites along with the findings extrapolated statewide. The statewide estimates are based on small sample sizes and should be viewed as providing order of magnitude and relative rankings indicators.

Table 23. Plastics and Rubber Products Manufacturing Equipment and Savings Summary

	Surveyed			Statewide			
Systems	Sites	# Units	Capacity	Sites	Capacity	Savings (MWh)	Savings (Therms)
Compressed air	2	8	128 hp	27	1,728 hp	468	N/A
Process cooling	1	5	191 tons	14	2,579 tons	176	N/A
Boilers	1	0	2,258 MBH	14	30,483 MBH	N/A	1,864
Fans and pumps	1	108	62.5 hp	14	844 hp	275	N/A
IMM	1	26	N.D.	14	N.D.	N.D.	N.D.
CNC/Laser	1	2	N.D.	0	N.D.	N.D.	N.D.

N.D. = No data

The team found that extruders and IMMs are primary equipment for this segment. Though there were not enough complete sites to draw this conclusion, conversations with facility staff indicated that this equipment contributes to the largest part of production. Conversations also indicated that the machines are generally well insulated.

Air compressors were also found to be a primary equipment at these facilities. There was a balanced mixture of old and new air compressors, with new compressors mostly variable speed and taking most of the load as the primary compressors. The old compressors are mostly constant speed serving as secondary or backup. The site contact also indicated that there is generally sufficient compressed air storage at the facility, avoiding any short cycling of the equipment.

The process machines (e.g., extruders) consume the majority of the electric energy, with support equipment (air compressors, fans, and pumps) being quite insignificant in comparison. Boilers are also insignificant and do not contribute to the processing, since most of the heating is done within the extruders and IMMs.

Traditionally, this segment is open to energy audits sponsored by utilities, but history of implementation has been poor due to aversion of potential equipment shutdowns during measure installation and lack of funding.

4.4.4 Segment 332 – Fabricated Metal Product Manufacturing

Fabricated metal product manufacturing includes processes that transform metal into intermediate or end products (other than machinery, computers and electronics, and metal furniture) or that treat metals and fabricated metal-formed products. Table 24 summarizes population, annual energy use, and survey statistics for this segment.

Table 24. Fabricated Metal Product Manufacturing Statistics

Size	Population	Annual Energy Use (MWh)	Sites with Audits	Audited Sites Surveyed	Non-Audited Sites Surveyed
Large	22	277,208	5	2	0
Medium	71	100,991	1	0	7

Table 25 summarizes the equipment inventoried at the surveyed sites along with the findings extrapolated statewide. The statewide estimates are based on small sample sizes and should be viewed as providing order of magnitude and relative ranking indicators.

Table 25. Fabricated Metal Product Manufacturing Equipment and Savings Summary

	Surveyed			Statewide			
Systems	Sites	# Units	Capacity	Sites	Capacity	Savings (MWh)	Savings (Therms)
Compressed air	9	15	960 hp	97	10,340 hp	2,798	N/A
Process cooling	3	7	1,337 tons	32	14,401 tons	604	N/A
Boilers	2	2	4,516 MBH	22	48,642 MBH	N/A	3,449
Fans and pumps	4	22	275 hp	43	2,962 hp	965	N/A
IMM	3	11	N.D.	17	N.D.	N.D.	N.D.
CNC/Laser	3	75	N.D.	17	N.D.	N.D.	N.D.

N.D. = No data

The team found that extruders, IMMs, and CNC/laser cutters are primary equipment, since the major process within this segment involves transforming, reshaping, and machining of metal products.

None of the sites interviewed have existing heat recovery from any of their process heating equipment, and therefore there is great energy efficiency potential in recovering some of that heat to preheat the metals or for space heating.

CNC milling machines oftentimes appear to have constant-volume process cooling equipment. General cooling measures can also optimize facilities' operations. Ovens are also a primary equipment used to condition products before or after processing. Ovens with electrical resistance heating elements are of old vintage that could deploy more efficient technologies.

Facilities have shown to have participated in prior energy rebate programs. Most recent programs include LED lighting upgrades, VFD air compressor upgrades, and pump/fan VFDs. Customers have shown interest in updating their IMM and ovens and some were in the process of doing so but elected to hold off due to the COVID-19 pandemic.

Some facilities have scaled back their operation and are operating fewer shifts due to COVID-19. At the time of the interview, some saw the reductions lasting throughout the year, while others see their operations impacted for longer.

4.4.5 Segment 333 – Machinery Manufacturing

Machinery manufacturing includes facilities that primarily engage in manufacturing industrial and commercial machinery. Table 26 summarizes the population, annual energy use, and survey statistics for this segment.

Table 26. Machinery Manufacturing Statistics

Size	Population	Annual Energy Use (MWh)	Sites with Audits	Audited Sites Surveyed	Non-Audited Sites Surveyed
Large	11	143,923	7	2	0
Medium	16	27,529	6	2	1

Table 27 summarizes the equipment inventoried at the surveyed sites along with the findings extrapolated statewide. The statewide estimates are based on small sample sizes and should be viewed as providing order of magnitude and relative ranking indicators.

Table 27. Machinery Manufacturing Equipment and Savings Summary

	Surveyed			Statewide			
Systems	Sites	# Units	Capacity	Sites	Capacity	Savings (MWh)	Savings (Therms)
Compressed air	4	9	576 hp	27	3,888 hp	3,153	N/A
Process cooling	2	3	573 tons	14	3,868 tons	3,136	N/A
Boilers	2	3	6,774 MBH	14	45,725 MBH	N/A	2,629
Fans and pumps	5	45	562.5 hp	34	3,797 hp	1,003	N/A
IMM	0	0	N/A	0	N/A	N/A	N/A
CNC/Laser	0	0	N/A	0	N/A	N/A	N/A

The team found that fans are a primary equipment; the industry is heavy on ventilation, exhaust, and dust collection. As a result, long run times are to be expected. Measures such as VFDs, controls, and schedule/run-time optimization can have a great impact on energy savings.

Chillers and air compressor are also found to be primary equipment. There is no unique aspect of their operation within this segment, however, and most potential measures in other segments apply here as well.

These facilities employ product-specific process machines such as power tools, welders, and cutters, which cannot be generalized.

4.4.6 Segment 334 – Computer and Electronic Product Manufacturing

Computer and electronic product manufacturing facilities primarily manufacture computers, computer peripheral equipment, communications equipment, and similar electronic products, as well as components for such products. Table 28 summarizes the population, annual energy use, and survey statistics for this segment.

Table 28. Computer and Electronic Products Manufacturing Statistics

Size	Population	Annual Energy Use (MWh)	Sites with Audits	Audited Sites Surveyed	Non-Audited Sites Surveyed
Large	9	86,279	2	2	4
Medium	26	40,859	1	0	1

Table 29 summarizes the equipment inventoried at the surveyed sites along with the findings extrapolated statewide. The statewide estimates are based on small sample sizes and should be viewed as providing order of magnitude and relative ranking indicators.

Table 29. Computer and Electronic Product Manufacturing Equipment and Savings Summary

Systems	Surveyed			Statewide			
	Sites	# Units	Capacity	Sites	Capacity	Savings (MWh)	Savings (Therms)
Compressed air	7	14	896 hp	45	8,399 hp	2,273	N/A
Process cooling	7	77	14,707 tons	45	137,859 tons	491	N/A
Boilers	2	1	2,258 MBH	13	21,166 MBH	N/A	1,501
Fans and pumps	3	11	137.5 hp	19	1,289 hp	420	N/A
IMM	4	60	N/A	26	N/A	N/A	N/A
CNC/Laser	0	0	N/A	0	N/A	N/A	N/A

IMMs were found to be a primary equipment, though nothing unique is inferred.

Process cooling is also a primary equipment since those were mostly found to supply the IMMs. One of the surveyed sites informed the team that each IMM has its own cooling equipment.

Efficiency opportunities can be obtained from proper control and centralization of the process cooling.

Air compressors are also a primary equipment and are heavily used for pneumatics machines and tool shops.

One of the facilities employs 11 RTUs to air condition their clean rooms that need to be maintained at a certain temperature and relative humidity 24/7, 365 days a year. The process is crucial to their operations, during which 100% of the return air is exhausted. The team found great potential in recovering heat from the exhaust air, as this could lead to significant energy savings.

Similar to other segments, there seems to be a general interest in energy efficiency and rebate programs. Some facilities are in the process of upgrading the process cooling chillers and dry coolers, while others have participated in lighting and compressed air energy programs over the last 5 years.

4.4.7 Segment 335 – Electrical Equipment, Appliance, and Component Manufacturing

Electrical equipment, appliance, and component manufacturing facilities primarily manufacture products that generate, distribute, and use electrical power. Table 30 summarizes the population, annual energy use, and survey statistics for this segment.

Table 30. Electrical Equipment, Appliance, and Component Manufacturing Statistics

Size	Population	Annual Energy Use (MWh)	Sites with Audits	Audited Sites Surveyed	Non-Audited Sites Surveyed
Large	9	81,116	3	0	1
Medium	26	33,055	1	1	2

Table 31 summarizes the equipment inventoried at the surveyed sites along with the findings extrapolated statewide. The statewide estimates are based on small sample sizes and should be viewed as providing order of magnitude and relative rankings indicators.

Table 31. Electrical Equipment, Appliance, and Component Manufacturing Equipment and Savings Summary

Systems	Surveyed			Statewide			
	Sites	# Units	Capacity	Sites	Capacity	Savings (MWh)	Savings (Therms)
Compressed air	7	8	512 hp	35	4,559 hp	1,234	N/A
Process cooling	1	2	382 tons	5	3,401 tons	226	N/A
Boilers	1	5	11,290 MBH	5	100,520 MBH	N/A	7,128
Fans and pumps	2	20	250 hp	10	2,226 hp	725	N/A
IMM	0	0	N/A	0	N/A	N/A	N/A
CNC/Laser	2	31	N.D.	10	N.D.	N.D.	N.D.

N.D. = No data

Boilers were found to be a primary equipment at facilities interviewed. Non-condensing boilers were mostly kept as backup, while facilities tend to have newer, more efficient condensing boilers running as primary. Most boilers were used for process steam only. Process heat recovery as well as condensate recovery are potential measures to be considered. Upgrading to a newer, more efficient boiler can also show potential, though most facilities were found to already be replacing their primary boilers.

CNC machines were also found to be a primary equipment at these facilities. The majority of machines were found to be of old vintage (>25 years). Therefore, there is potential to upgrade to newer, more efficient machines and centralize cooling and vacuum pump systems with adequate controls.

Air compressors were also found to be a primary equipment at these facilities. There was a balanced mixture of old and new air compressors. Most old air compressors are constant speed and are used as backup. Newer units tend to be variable speed and are primaries.

The team found 335 facilities to mostly have industry-specific equipment that cannot be generalized.

All customers interviewed in this segment have participated in prior rebate programs including lighting and air compressors. There was a general willingness and interest in energy efficiency. The majority of sites have completed upgrades within the last 5 years. A few had projects planned before COVID-19 interruptions.

Almost all facilities have had some level of scaling back because of COVID-19 but are seeing a slow but steady recovery path.

4.4.8 Ski Segment

Out of the 41 attempts, very few facilities answered or returned our recruiting calls. Seeing that ski resorts are in the entertainment industry, ERS concluded that the facilities are likely not operational due to shut-downs caused by COVID-19. As a result, ERS leveraged studies conducted at ski resorts in Maine and Vermont. Although the findings will not give insight on measure penetration in New Hampshire, they still can inform which potential measures can be applied and what savings to expect.

Table 32 summarizes the population, annual energy use, and survey statistics for this segment.

Table 32. Ski Resort Statistics

Size	Population	Annual Energy Use (MWh)	Sites with Audits	Audited Sites Surveyed	Non-Audited Sites Surveyed
Large	7	58,051	0	0	0
Medium	8	11,122	0	0	0

The biggest energy users at ski resorts, excluding lodging and hotels, is the snowmaking process, which involves a snow gun/air compressor combination and lift operation.

One of the lowest hanging fruits is the ski lift heating controls measure. ERS found multiple resorts throughout Maine and Vermont where ski lift heaters were left on throughout the entirety of the ski season. Installing a simple time switch to turn the heaters on a few hours prior to operation can have drastic energy savings. The measure also has very small capital investment associated with it. The savings at two evaluated resort were 453,000 kWh/year and 490,000 kWh/year. Since the project was part of a technical review, not enough information was provided to normalize energy usage. It can be inferred, however, that the measures scale with the size of the resort.

Snow gun replacements can also present potential energy savings. Newer, more efficient snow gun nozzles utilize less compressed air (14% less) to make snow, which subsequently saves energy (0.12kW/CFM).

Fan snowmakers are an alternative method of snow making that do not require compressed air. In addition to energy savings, fan snowmakers offer a simpler, more flexible layout as the equipment does not need an air compressor or compressed air distribution. Though substantial energy savings can be achieved, some customers have complained about the quality of snow produced.

The water distribution system for the snowmaking process can also be more efficient by properly sizing the pumps and installing VFDs on the water pumps.

All measures that apply to air compressors (heat recovery, VFD air compressors, leak tests, etc.) are also relevant in the ski segment; however, this section focused on segment-specific measures.

4.5 Non-Equipment Findings

The sample targeted both participant and non-participants – participants are defined as those who participated in an audit or custom program in PY2014-2019. Non-participants were identified through the billing data provided by the PAs. All interviewees reported that they participated in a NHSaves or New Hampshire utility rebate program in the last 5 years, even if they had not received an audit. This finding is not surprising, since the largest customers were targeted. The measures implemented were mostly LED lighting upgrades but also included a few air compressors, dry coolers, and chillers.

Overall, facility contacts seem to be interested in energy efficiency programs and are keen on keeping their equipment and processes efficient whenever possible. The majority have made energy efficiency upgrades in the past and will be interested in upgrading other processes should assistance be available. However, the majority of the facilities claimed that any upgrades they had planned have been put on hold and will not resume until there is more certainty around COVID-19.

Finally, ERS asked customers about the effect of COVID-19 on their operations. The responses were mixed, and there was no trend across the answers. A handful of the facilities shut down their operations for a short period of time to reassess their safety plans. Others did not fully shut down but had a decrease in number of staff on the premises and reduced shifts. A customer at a fabricated metals facility stated: “We typically operate 3-shift; however, we’re now running only 2-shift due to COVID-19.”

Every respondent acknowledged that COVID-19 did have a great economic and operational impact that will take time to recover from. A customer from an electrical equipment manufacturing facility stated: “We had an energy audit [recently] and planned for energy efficiency measures, but that was halted by COVID-19. We anticipate going back to normal production by 2021 and implementing measures then.” Others echoed the sentiment and said: “No new purchases until sales recover from COVID-19” and “COVID-19 made funding more competitive internally between departments.”

Though the global health situation is still uncertain, at the time of the interview, most facilities reported that there were some positive signs of going back to normal as their operations ramp up again, especially in the medical equipment and food industry. A medical equipment manufacturer rushed to purchase more process equipment because of increased orders due to COVID-19, and a respondent from a food processing plant stated, “Our production just returned to normal from a rush caused by COVID-19, because the demand for prepared foods went up.” The former also indicated that, due to the rush, the facility could not wait to submit a rebate application. It should be noted, however, that the interview results only account for those sites that could be reached. Sites that were more drastically affected or remain shut down and could not be reached were not interviewed.

Appendix A: Population Analysis

As part of the baseline study, the team segmented NH customer billing data by size and industry. We mapped accounts back to buildings utilizing tax data to develop average square footages by segment. Additional details about segment mapping, data challenges, and implications can be found in the segmentation memo dated February 10, 2020. Table A-1 summarizes the segmentation data results.

Table A-1. Customer Segmentation by Consumption

Segment	Size	Count	Annual kWh	Percent of Use	Count	Annual Therms	Percent of Use
Campus/ Education	**All**	1,474	**410,133,914**	**7.2%**	598	**14,362,212**	**8.9%**
	Large	10	167,196,374	3.0%	25	6,494,578	4.0%
	Medium	138	158,645,141	2.8%	282	6,924,962	4.3%
	Small	1,326	84,292,399	1.5%	291	942,672	0.6%
Food Sales	**All**	1,163	**355,212,807**	**6.3%**	257	**2,837,748**	**1.8%**
	Large	3	19,850,000	0.4%	5	413,225	0.3%
	Medium	107	255,552,679	4.5%	56	1,889,270	1.2%
	Small	1,053	79,810,128	1.4%	196	535,254	0.3%
Food Service	**All**	1,014	**113,732,983**	**2.0%**	903	**7,570,816**	**4.7%**
	Large	0	0	0.0%	0	0	0.0%
	Medium	33	25,246,955	0.4%	361	5,493,558	3.4%
	Small	981	88,486,028	1.6%	542	2,077,258	1.3%
Healthcare/ Hospitals	**All**	1,749	**507,113,868**	**8.9%**	482	**12,710,800**	**7.9%**
	Large	20	280,420,262	4.9%	25	8,615,442	5.4%
	Medium	120	163,030,661	2.9%	124	3,213,293	2.0%
	Small	1,609	63,662,946	1.1%	333	882,066	0.5%
Lodging	**All**	1,889	**213,148,645**	**3.8%**	559	**4,470,963**	**2.8%**
	Large	25	38,370,841	0.7%	6	695,453	0.4%
	Medium	236	117,742,022	2.1%	129	2,468,657	1.5%
	Small	1,628	57,035,782	1.0%	424	1,306,853	0.8%
Manufacturing/ Industrial	**All**	2,787	**1,880,063,263**	**33.2%**	667	**45,495,857**	**28.3%**
	Large	103	1,118,715,387	19.7%	87	40,074,694	25.0%
	Medium	427	626,709,261	11.1%	177	4,185,757	2.6%
	Small	2,257	134,638,616	2.4%	403	1,235,405	0.8%
Office	**All**	15,457	**1,020,188,821**	**18.0%**	3,429	**25,065,878**	**15.6%**
	Large	21	277,360,365	4.9%	22	4,252,757	2.6%
	Medium	269	347,239,423	6.1%	775	12,536,042	7.8%
	Small	15,167	395,589,032	7.0%	2,632	8,277,079	5.2%
Retail	**All**	5,417	**487,311,364**	**8.6%**	1,531	**10,165,002**	**6.3%**
	Large	4	22,708,300	0.4%	13	1,910,758	1.2%
	Medium	168	253,221,310	4.5%	247	4,755,623	3.0%
	Small	5,245	211,381,754	3.7%	1,271	3,498,620	2.2%

Segment	Size	Count	Annual kWh	Percent of Use	Count	Annual Therms	Percent of Use
Warehouse	**All**	1,306	**81,890,014**	**1.4%**	404	**4,489,084**	**2.8%**
	Large	1	4,734,600	0.1%	11	2,025,279	1.3%
	Medium	24	30,663,578	0.5%	79	1,523,746	0.9%
	Small	1,281	46,491,836	0.8%	314	940,059	0.6%
Agriculture	**All**	31	**11,672,679**	**0.2%**	0	**0**	**0.0%**
	Large	0	0	0.0%	0	0	0.0%
	Medium	5	8,700,612	0.2%	0	0	0.0%
	Small	26	2,972,067	0.1%	0	0	0.0%
Other	**All**	2,377	**83,999,823**	**1.5%**	514	**4,225,826**	**2.6%**
	Large	2	10,777,200	0.2%	8	895,886	0.6%
	Medium	6	7,992,805	0.1%	113	2,162,372	1.3%
	Small	2,369	65,229,818	1.2%	393	1,167,568	0.7%
Total	**All**	**34,664**	**5,164,468,181**	**91%**	**9,344**	**131,394,187**	**82%**
Unclassified	**All**	**19,778**	**501,910,827**	**9%**	**4,083**	**29,128,300**	**18%**

The team used the underlying segmentation and square footage data to update the building characteristics metrics for the potential study. The team divided the customers into square footage bins to develop a distribution of buildings across each segment. The following table provides the weighted average square footage per segment and a distribution of the population across the size bins.

Table A-2. Business Segment Square Footage Distribution

Segment	Square Footage										
	Average	0 to 2,499	2,500 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 to 49,999	50,000 to 74,999	75,000 to 99,999	100,000 to 199,999	200,000 to 499,999	More than 500,000
Overall	9,886	33.6%	27.8%	18.4%	12.3%	4.5%	1.6%	0.7%	0.9%	0.2%	0.0%
Office	7,924	33.6%	28.0%	20.1%	12.9%	3.4%	1.0%	0.3%	0.5%	0.1%	0.0%
Retail	7,843	35.2%	32.7%	17.1%	9.9%	3.0%	0.8%	0.3%	0.8%	0.2%	0.0%
Food Service	3,958	46.2%	30.1%	18.1%	5.1%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%
Healthcare/ Hospitals	13,404	38.0%	23.9%	14.2%	11.0%	7.3%	2.7%	0.9%	1.4%	0.4%	0.2%
Campus/ Education	24,018	21.7%	19.7%	13.4%	19.0%	10.5%	6.5%	3.7%	4.7%	0.8%	0.0%
Warehouse	12,445	23.6%	25.8%	22.0%	17.4%	7.2%	1.7%	0.9%	0.8%	0.5%	0.0%
Lodging	12,902	33.9%	23.9%	17.2%	11.1%	6.8%	3.9%	1.8%	1.0%	0.3%	0.0%
Food Sales	5,712	45.2%	29.8%	13.4%	7.0%	3.0%	1.3%	0.0%	0.2%	0.0%	0.0%
Other Commercial	5,635	40.4%	31.2%	17.7%	7.7%	1.9%	0.5%	0.2%	0.2%	0.0%	0.0%
Manufacturing/ Industrial	20,401	22.7%	21.6%	18.0%	18.8%	10.3%	3.1%	1.8%	2.4%	1.1%	0.2%

Industrial Sub-Segments

Industrial sites are the single largest usage segment by both electric and natural gas consumption in NH. A large proportion of the opportunity for energy efficiency improvements lie within industry-specific process equipment or large energy-consuming systems. However, information on these systems is not collected through the other data sources in this study. Table A-3 provides a breakdown of the large and medium customers in the state as well as the proportion of total energy consumption they represent. Industrial sites consume almost as much energy as the next four segments combined.

Table A-3. Consumption by Business Segment

Electric			Natural Gas		
Segment	**Consumption**	**Count**	**Segment**	**Consumption**	**Count**
Manufacturing/ Industrial	31%	529	Manufacturing/ Industrial	28%	257
Office	11%	289	Office	10%	796
Healthcare/Hospitals	8%	140	Campus/Education	8%	307
Campus/Education	6%	147	Healthcare/Hospitals	7%	149
Retail	5%	172	Retail	4%	260
Food Sales	5%	111	Food Service	3%	361
Lodging	3%	263	Warehouse	2%	90
Warehouse	1%	24	Lodging	2%	135
Food Service	0%	33	Other	2%	121
Other	0%	9	Food Sales	1%	61
Agriculture	0%	5	Agriculture	0%	0
Total	**69%**	**1,722**	**Total**	**69%**	**2,537**

Key Industries in New Hampshire

To understand the largest energy-consuming industries in NH, we analyzed data collected from the United States Census Bureau's County Business Patterns: 2017. This data set provides county-level data of businesses for each industry type (denoted by NAICS code) including the number of businesses, number of employees, and annual revenues. Although the data does not directly contain energy consumption, we used employee count and revenues as a proxy for energy consumption. We found that both metrics of size agreed for the largest industries. Table A-4, below, shows the industries ranked by employee count.

To further understand the top energy-consuming industries in NH, the team used the completed segmentation analysis to manually map the large users (>4,500,000 kWh consumed annually) to NAICS codes. In general, the larger segments by employees and revenue corresponded with the larger energy-using segments and ERS's audit distribution. The ski industry is not directly tracked under the industrial NAICS codes but was included here due to its energy consumption in the state. Bolded segments were targeted segments for additional data collection.

Table A-4. Industrial Segmentation Analysis

Code	Meaning of 2012 NAICS Code	Large Firms	Employees	Revenue ($1,000s)	Annual kWh	
Data Source		Census Business Patterns			Customer Billing Data	ERS Audits
334	**Computer and electronic product manufacturing**	**45**	**15,024**	**1,383,710**	**70,395,416**	**7**
332	**Fabricated metal product manufacturing**	**50**	**12,184**	**717,716**	**296,064,194**	**8**
333	**Machinery manufacturing**	**27**	**7,634**	**514,963**	**137,580,092**	**23**
326	**Plastics and rubber products manufacturing**	**22**	**4,746**	**264,626**	**50,648,117**	**9**
339	Miscellaneous manufacturing	21	4,342	241,709	36,766,257	5
335	**Electrical equipment, appliance, and component manufacturing**	**20**	**4,042**	**248,399**	**69,492,733**	**5**
336	Transportation equipment manufacturing	12	3,132	176,696	-	1
311	**Food manufacturing**	**10**	**2,969**	**148,022**	**58,384,203**	**7**
325	**Chemical manufacturing**	**12**	**2,188**	**135,741**	**75,099,660**	**4**
323	Printing and related support activities	8	1,950	90,868	5,415,055	5
331	Primary metal manufacturing	9	1,785	90,583	-	0
321	Wood product manufacturing	10	1,783	79,615	42,906,451	2
313	Textile mills	7	1,698	92,991	17,688,771	0
327	Nonmetallic mineral product manufacturing	9	1,591	104,662	36,027,811	0
337	Furniture and related product manufacturing	3	1,000	48,466	-	1
312	Beverage and tobacco product manufacturing	4	902	50,978	47,753,787	0
322	Paper manufacturing	5	836	53,157	23,717,626	3
316	Leather and allied product manufacturing	3	341	12,861	-	0

Code	Meaning of 2012 NAICS Code	Large Firms	Employees	Revenue ($1,000s)	Annual kWh	
Data Source		Census Business Patterns			Customer Billing Data	ERS Audits
314	Textile product mills	0	284	9,082	13,024,432	0
315	Apparel manufacturing	0	113	2,830	-	3
324	Petroleum and coal products manufacturing	0	101	8,650	-	0
N/A	**Ski industry**	**N.D.**	**N.D.**	**N.D.**	**52,117,383**	**0**
Total		**277**	**68,645**	**4,476,325**	**1,033,081,986**	**83**

Bolded segments are targeted segments for additional data collection.

N.D. = No data reported

APPENDIX B: COMMERCIAL SEGMENTATION ANALYSIS

This memo presents the methodologies and findings of the segmentation analysis of Commercial and Industrial Customers in New Hampshire to support the NHSaves Commercial Baseline Study. The objective was two-fold:

1. To classify customers by their business segment and size (defined by annual energy consumption)
2. To develop an average business size (square footage) by business segment

The team will utilize these metrics in future portions of the study for scaling market segment potential and creating archetypal New Hampshire buildings by segment.

Data Sources and Data Review

The underlying data sources for this analysis were customer consumption data provided by the utilities and tax record data obtained from the New Hampshire Department of Revenue Administration (DRA).

Each of the four New Hampshire utilities provided extracts of their customer databases in spreadsheet format (Excel or CSV). Each format was unique to the utility and required separate processing scripts.

A brief summary of the data structures is provided for reference:

- **Eversource**: Data was provided in two formats; 20 Excel files provided data for the residential and small commercial customers, and a separate file structure was provided from their Large Power Billing (LPB) database used for their largest customers. Data structures between the two files were different and required separate processing.
- **Unitil**: Data was provided in two spreadsheets with multiple worksheets (tabs) for each segment (residential, municipal, C&I). The initial data sets included consumption for calendar year 2019, and thus did not have a full year of data. The municipal and C&I data tabs were missing for natural gas accounts. Unitil was able to send a new set of data to address these gaps. The revised data combined all account types (natural gas, electric, residential, municipal, and C&I) into one worksheet. Unitil provided the data in two spreadsheets due to size (Jan – Jun 2018 and Jul – Dec 2018). Due to database extraction issues, Unitil was unable to provide a full year of complete monthly reading data. Quarter 1 of 2018 appeared to have complete data and corresponded to the roughly 50 million monthly kWh sales from the utility. Therefore, we scaled the Q1 data to full year data. The scaling factor was developed using EIA reported sales data for C&I customers in NH, comparing the fraction of use in the first quarter to the full year use.
- **Liberty**: Data was initially provided as a single CSV file containing all account types. However, customer-identifying information (names, addresses, etc.) was not provided. This information is required to map customers to tax parcels and segment business types.

Liberty provided a new data set containing two Excel files (one for electric and one for natural gas), which included customer identifiers and annual consumption data.

- **New Hampshire Electric Cooperative (NHEC):** Data was provided for all customers in a single spreadsheet format; however, customer addresses appeared to be billing addresses given the numerous P.O. boxes and out-of-state addresses. This prevented mapping to the tax parcel data.

Comprehensive data dictionaries were not provided; however, the critical information columns such as consumption, customer name, and address were generally identifiable. ERS developed data dictionaries for each of the data sets based on best estimates of the header names and data values. ERS will provided these data dictionaries along with this memo to support this study and future data processing efforts.

Table 1 provides a summary of the commercial customer counts and consumption from the utility data files.

Table 1a. Summary of C&I Customers by Utility (Electric)

Metric	Eversource	Liberty	Unitil	NHEC	Total
Accounts	71,584	7,393	18,148	11,112	108,237
Consumption (Annual kWh)	3,799,423,907	892,407,062	637,818,750	379,620,579	5,709,270,298

Table 1b. Summary of C&I Customers by Utility (Natural Gas)

Metric	Liberty	Unitil	Total
Accounts	12,197	7,681	19,878
Consumption (Annual therms)	101,940,376	60,791,726	162,732,102

Consumption data was generally in a monthly format, with the exception of Liberty, which included annual totals. We averaged monthly consumption values by month when more than one year of data was present. Numerous accounts had no or very low annual usage; we removed the smallest accounts (less than 3,000 kWh annually for electricity and less than 800 therms annually for natural gas) totaling approximately 1% of total consumption. Table 2 provides the number of accounts and total consumption after these low users were removed.

Table 2a. Summary of C&I Customers Excluding Lowest Users (Electric)

Metric	Eversource	Liberty	Unitil	NHEC	Total
Accounts	35,405	4,868	7,653	6,537	54,463
Consumption (Annual kWh)	3,769,946,244	890,433,795	630,537,075	375,485,218	5,666,402,332

Table 2b. Summary of C&I Customers Excluding Lowest Users (Natural Gas)

Metric	Liberty	Unitil	Total
Accounts	8,436	4,991	13,427
Consumption (Annual therms)	100,630,231	59,892,255	160,522,486

ERS requested tax parcel data from the NH DRA and was provided with the state's Mosaic Parcel Map (MPM) shapefile. We extracted the computer assisted mass appraisal (CAMA) data and for approximately 700,000 parcels in the state. While the data set contains an array of information about the parcel, the attributes used for this analysis were the address (to map to the utility accounts) and the parcel's building square footage.

Data Set Aggregation

We parsed the addresses to create a street number, street name, city data string for both the tax parcel and utility data sets. Only addresses with a complete (100%) match were joined for these results.

Street suffixes were normalized to increase matching and account for various in data entry (i.e. "St." was expanded to "Street").

Multiple utility accounts are allowed to be mapped to a single address. This allows for:

1. Customers with multiple accounts at one location
2. Facilities with multiple customers (e.g., malls)

Customer Classification

We segmented customers using two criteria, business classification and annual energy consumption.

Business Segmentation

Since the approach of this study does not include extensive site-level primary research, the approach is bounded by the secondary data sources that will be utilized. Thus, the classification segments and size thresholds were informed by the data format of the neighboring jurisdictions studies being leveraged and, as such, our approach is built around similar segments:

- Campus / Education
- Food Sales
- Food Service
- Healthcare / Hospitals
- Lodging
- Manufacturing / Industrial
- Office
- Retail
- Warehouse
- Agriculture

- Other

ERS applied multiple levels of logic to assign customers a business type. When existing classification was available through a NAICS code provided in the utility data sets, the code was assigned the relevant sector utilizing a mapping table provided by Dunsky.

For sites without a NAICS code, ERS staffers manually reviewed several hundred of each utility's largest customers' names (ranked by energy consumption) to classify them.

For the remaining sites, ERS then used keyword mapping. We parsed a customer's name into each word to be analyzed; e.g., "Fresh Grocer Inc." would be parsed into "Fresh"; "Grocer"; and "Inc.".

ERS parsed each account and tallied the count of each word, ranked from most to least common. The team reviewed the 3,000 most common keywords and assigned them to a segment category when the segment was clear or "skip" to exclude words without enough clarity or with multiple contexts. In the above example, Fresh = Skip; Grocer = Food Sales; Inc. = Skip.

Each account customer name was then screened across the mapped keywords. If there was a match, it was assigned to the matched category. In the "Fresh Grocer Inc." example, the customer would thus be classified as "Food Sales."

Consumption Classification

The available studies also include information by annual energy consumption categories (small, medium, and large) although only at the total population level, not at the segment level. The categories are defined as follows:

- Small: <500,000 kWh electric; <8,000 therms natural gas
- Medium: 500,000 – 4,500,000 kWh electric; 8,000 – 80,000 therms natural gas
- Large: >4,500,000 kWh electric; >80,000 therms natural gas

The same consumption buckets were used for classifying customers as small, medium, or large.

Results

Table 3 provides the coverage, by accounts and energy consumption, for the segmentation analysis by utility. Unitil and NHEC data did not have NAICS coverage and therefore relied solely on ERS customer name and keyword mapping which resulted in the lower coverage rates.

Table 3a. Segmentation Coverage by Utility (Electric)

Metric	Eversource	Liberty	Unitil	NHEC	Total
Accounts	74.7%	81.2%	31.3%	28.0%	63.6%
Consumption (Annual kWh)	**94.8%**	**96.6%**	**71.6%**	**73.9%**	**91.1%**

Table 3b. Segmentation Coverage by Utility (Natural Gas)

Metric	Liberty	Unitil	Total
Accounts	89.9%	35.0%	69.5%
Consumption (Annual therms)	**90.8%**	**66.9%**	**81.9%**

Table 4 provides a summary of the size segmentation. Table 5 provides the annual consumption by business segment and size segment.

Table 4. Customer Size Segmentation

Segment Size	Annual kWh	Accounts	Annual therms	Accounts
Large	1,940,133,328	189	65,378,072	194
Medium	1,994,744,447	1,533	45,153,279	2,343
Small	1,229,590,406	32,922	20,862,835	6,799
Total	**5,164,468,181**	**34,644**	**131,394,187**	**9,336**

Table 5. Customer Segmentation by Consumption

Segment	Size	Annual kWh	Percent of Use	Annual therms	Percent of Use
Campus / Education	**All**	**410,133,914**	**7.2%**	**14,362,212**	**8.9%**
	Large	167,196,374	3.0%	6,494,578	4.0%
	Medium	158,645,141	2.8%	6,924,962	4.3%
	Small	84,292,399	1.5%	942,672	0.6%
Food Sales	**All**	**355,212,807**	**6.3%**	**2,837,748**	**1.8%**
	Large	19,850,000	0.4%	413,225	0.3%
	Medium	255,552,679	4.5%	1,889,270	1.2%
	Small	79,810,128	1.4%	535,254	0.3%
Food Service	**All**	**113,732,983**	**2.0%**	**7,570,816**	**4.7%**
	Large	0	0.0%	0	0.0%
	Medium	25,246,955	0.4%	5,493,558	3.4%
	Small	88,486,028	1.6%	2,077,258	1.3%
Healthcare / Hospitals	**All**	**507,113,868**	**8.9%**	**12,710,800**	**7.9%**
	Large	280,420,262	4.9%	8,615,442	5.4%
	Medium	163,030,661	2.9%	3,213,293	2.0%
	Small	63,662,946	1.1%	882,066	0.5%
Lodging	**All**	**213,148,645**	**3.8%**	**4,470,963**	**2.8%**
	Large	38,370,841	0.7%	695,453	0.4%
	Medium	117,742,022	2.1%	2,468,657	1.5%
	Small	57,035,782	1.0%	1,306,853	0.8%
Manufacturing / Industrial	**All**	**1,880,063,263**	**33.2%**	**45,495,857**	**28.3%**
	Large	1,118,715,387	19.7%	40,074,694	25.0%
	Medium	626,709,261	11.1%	4,185,757	2.6%
	Small	134,638,616	2.4%	1,235,405	0.8%

Segment	Size	Annual kWh	Percent of Use	Annual therms	Percent of Use
Office	**All**	**1,020,188,821**	**18.0%**	**25,065,878**	**15.6%**
	Large	277,360,365	4.9%	4,252,757	2.6%
	Medium	347,239,423	6.1%	12,536,042	7.8%
	Small	395,589,032	7.0%	8,277,079	5.2%
Retail	**All**	**487,311,364**	**8.6%**	**10,165,002**	**6.3%**
	Large	22,708,300	0.4%	1,910,758	1.2%
	Medium	253,221,310	4.5%	4,755,623	3.0%
	Small	211,381,754	3.7%	3,498,620	2.2%
Warehouse	**All**	**81,890,014**	**1.4%**	**4,489,084**	**2.8%**
	Large	4,734,600	0.1%	2,025,279	1.3%
	Medium	30,663,578	0.5%	1,523,746	0.9%
	Small	46,491,836	0.8%	940,059	0.6%
Agriculture	**All**	**11,672,679**	**0.2%**	**0**	**0.0%**
	Large	0	0.0%	0	0.0%
	Medium	8,700,612	0.2%	0	0.0%
	Small	2,972,067	0.1%	0	0.0%
Other	**All**	**83,999,823**	**1.5%**	**4,225,826**	**2.6%**
	Large	10,777,200	0.2%	895,886	0.6%
	Medium	7,992,805	0.1%	2,162,372	1.3%
	Small	65,229,818	1.2%	1,167,568	0.7%
Total	**All**	**5,164,468,181**	**91%**	**131,394,187**	**82%**
Unclassified	**All**	**501,910,827**	**9%**	**29,128,300**	**18%**

Table 5 provides the average building square footage at the business segment level. Values are weighted to reflect the utility segmentation business counts since that dataset has a greater coverage percentage. The coverage of this analysis is less than the utility segmentation due to customer addresses that could not be mapped to tax parcels, or due to tax parcels with missing square footage. Additionally, without the service addresses of NHEC customers, we could not confidently map these accounts due to concerns of significantly increasing false matches. For example, a corporate customer may have all of their locations billed to the same corporate address, greatly inflating the amount of energy use at that address, when in reality that energy use is spread across their portfolio. This leaves a total population of potential accounts to map to the tax data of 34,644 of which we were able to map 59% of accounts and 60% of energy use to a square footage. ERS manually reviewed the approximately 100 large unmapped accounts to provide additional coverage in this size segment.

Table 6. Customer Count and Average Square Footage by Segment

Segment	Size	Count	Avg Square Feet
Campus / Education	**All**	**644**	**26,327**
	Large	**3**	
	Medium	**43**	
	Small	**598**	
Food Sales	**All**	**581**	**6,952**
	Large	**-**	
	Medium	**37**	
	Small	**544**	
Food Service	**All**	**693**	**4,009**
	Large	-	
	Medium	**12**	
	Small	**681**	
Healthcare / Hospitals	**All**	**758**	**16,242**
	Large	**13**	
	Medium	**55**	
	Small	**690**	
Lodging	**All**	**1,439**	**17,712**
	Large	-	
	Medium	**44**	
	Small	**1,395**	
Manufacturing / Industrial	**All**	**1,728**	**24,806**
	Large	**80**	
	Medium	**198**	
	Small	**1,450**	
Office	**All**	**7,242**	**8,346**
	Large	**17**	
	Medium	**119**	
	Small	**7,106**	
Retail	**All**	**4,376**	**8,764**
	Large	**1**	
	Medium	**68**	
	Small	**4,307**	
Warehouse	**All**	**1,080**	**13,341**
	Large	**1**	
	Medium	**14**	
	Small	**1,065**	
Agriculture	**All**	**383**	**9,058**
	Large	-	
	Medium	1	
	Small	382	

Segment	Size	Count	Avg Square Feet
Other	**All**	**1,475**	**5,688**
	Large	**2**	
	Medium	**8**	
	Small	**1,465**	
Total	**All**	**20,399**	
Coverage by:	**Accounts**	**59%**	
	kWh use	**60%**	