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2021 Focus on Energy Energy Efficiency Potential Study Report

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Acronyms

BBTU:	Billion British Thermal Units
CEE:	Consortium for Energy Efficiency
EISA:	Energy Independence and Security Act of 2007
GWh:	Gigawatt hours
kWh:	Kilowatt-hour
MTRC:	Modified Total Resource Cost
MMBTU	Million British Thermal Units
MW:	Megawatt
MWh:	Megawatt-hour
PSC:	Public Service Commission of Wisconsin
SCT:	Societal Cost Test
T&D:	Transmission and distribution
TLED:	Tubular LEDs
TRM:	Technical reference manual
UCT:	Utility Cost Test
VFD:	Variable frequency drive
WI UDC:	Wisconsin Uniform Dwelling Code

Executive Summary

The Public Service Commission of Wisconsin (PSC) contracted with Cadmus to complete an energy efficiency potential assessment, timed to provide information to the PSC and stakeholders in planning for the 2023-2026 quadrennium of Focus on Energy. Cadmus produced estimates of the conservation resources available to Focus on Energy over a 12-year period, from 2023 through 2034.

Study Objectives and Approach

There were two primary objectives for the 2021 potential study:

- Inform program planning by assessing future energy savings potential for energy efficiency measures offered through existing Focus on Energy programs and those that may be included in future program designs. While the potential study does not provide a target for program planning, the research was timed to provide input on quadrennial planning for Focus on Energy programs.
- Estimate the energy savings potential for various scenarios, including a current policy scenario, which assumes Focus on Energy funding of approximately $90 million per year for energy efficiency and alternate funding scenarios and illustrates the effects of changes in program, state, and federal policies.

The study provided energy efficiency estimates for these six sectors:

SINGLE-FAMILY	**COMMERCIAL**	**INDUSTRIAL**
MULTIFAMILY	**GOVERNMENT**	**AGRICULTURE**

Cadmus produced **four types of potential estimates** (shown below) using a **hybrid top-down/bottom-up approach**. The top-down aspect used the most current participating utility sales forecasts, adjusting for building codes, equipment efficiency standards, and market trends that the forecasts did not account for, and disaggregating this information into sectors, market segments, and end-use components. The bottom-up component considered the potential technical impacts of various energy conservation measures and practices on each end use. Cadmus then estimated impacts based on engineering calculations, accounting for fuel shares, current market saturations, technical feasibility, and costs.

TECHNICAL POTENTIAL represents the theoretical maximum commercially available savings opportunities. It assumes all technically feasible energy efficiency measures commercially available at the time of the study will be implemented, regardless of their costs or of any market barriers.

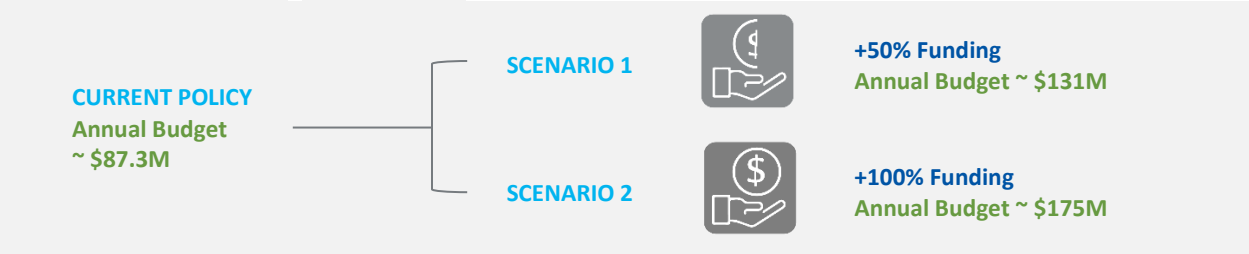
ECONOMIC POTENTIAL represents all theoretical savings opportunities that are also cost-effective to implement now. It represents a subset of technical potential and consists only of measures meeting the cost-effectiveness criteria, set by the Modified Total Resource Cost (MTRC), approved by the PSC for use as Focus on Energy's primary cost-effectiveness test.

OPTIMIZED POTENTIAL represents all theoretical cost-effective savings opportunities that could realistically be realized if program funding were not constrained. It represents the portion of economic potential that might be assumed reasonably attainable over the course of the planning horizon, given minimal implementation barriers to impede customer participation in Focus on Energy programs.

CURRENT POLICY POTENTIAL is a subset of optimized potential, constrained by the current annual Focus on Energy budget and in consideration of the equitable balance of current ratepayer program contributions, such as splits between fuels and customer sectors.

This study did not estimate program potential—the amount of potential savings Focus on Energy may realize through the energy efficiency programs it formally offers to Wisconsin customers and which accounts for program design, spending on specific energy efficiency programs, and program implementation barriers. Focus on Energy determines program-specific targets and budget estimates during quadrennial planning.

Cadmus conducted sensitivity analyses to determine the impacts of additional program funding on current policy potential. As illustrated below, Cadmus analyzed two funding scenarios.



Additionally, Cadmus conducted sensitivity analysis for a range of economic, financial, and technical variables, including costs of avoided transmission and distribution, cost of avoided carbon, discount rates, cost-effectiveness thresholds, and Energy Independence and Security Act (EISA) backstop timing. The results of these scenarios are further described in the *Economic Potential by Scenario* and *Current Policy and Increased Funding Scenarios* sections.

Stakeholder engagement was a key component to implementing the study. Cadmus engaged with PSC stakeholders, through a series of online webinars and meetings to gather feedback on the methodology and data collection approaches. Cadmus also engaged with technical market experts regarding the market adoption rates (ramp rates) for optimized potential.

For a more comprehensive discussion of Cadmus' methodology, refer to the section *Scope of Assessment* and the appendices in this report.

2021 Potential Study Results

Potential estimate results in tables and figures are organized by fuel type and color coded in this report. **Green represents electric** and **blue represents natural gas**.

2034 Forecast Sales (Final Year Baseline Sales)

	ELECTRIC ENERGY	**71,325 GWH IN 2034**
	NATURAL GAS ENERGY	**2,701,800 THOUSAND THERMS IN 2034**

Cumulative 12-Year Potential Savings Estimates by Fuel Type, 2023-2034

FUEL TYPE	TECHNICAL POTENTIAL	ECONOMIC POTENTIAL	OPTIMIZED POTENTIAL	CURRENT POLICY POTENTIAL
ELECTRIC ENERGY EFFICIENCY IN GWH (PERCENTAGE OF BASELINE SALES)	**19,380** (27%)	**15,010** (21%)	**11,859** (17%)	**9,408** (13%)
ELECTRIC ENERGY EFFICIENCY IN MW	**3,634**	**3,029**	**2,124**	**1,659**
NATURAL GAS ENERGY EFFICIENCY IN THOUSAND THERMS (PERCENTAGE OF BASELINE SALES)	**779,539** (29%)	**442,641** (16%)	**362,041** (13%)	**144,123** (5%)

Cumulative 12-Year Electric GWh Potential Savings Estimates by Sector, 2023-2034

ELECTRIC ENERGY EFFICIENCY BY SECTOR IN GWH	TECHNICAL POTENTIAL	ECONOMIC POTENTIAL	OPTIMIZED POTENTIAL	CURRENT POLICY POTENTIAL
SINGLE-FAMILY	7,666	5,456	3,758	2,425
MULTIFAMILY	1,100	561	431	275
COMMERCIAL	4,362	3,113	2,607	2,235
GOVERNMENT	781	485	406	406
INDUSTRIAL	5,199	5,125	4,420	3,830
AGRICULTURE	272	270	237	237

12-Year Electric MW Potential Savings Estimates by Sector, 2023-2034

ELECTRIC ENERGY EFFICIENCY BY SECTOR IN MW	TECHNICAL POTENTIAL	ECONOMIC POTENTIAL	OPTIMIZED POTENTIAL	CURRENT POLICY POTENTIAL
SINGLE-FAMILY	1,725	1,512	866	568
MULTIFAMILY	187	119	72	47
COMMERCIAL	806	574	478	412
GOVERNMENT	201	117	97	97
INDUSTRIAL	670	663	572	496

ELECTRIC ENERGY EFFICIENCY BY SECTOR IN MW	TECHNICAL POTENTIAL	ECONOMIC POTENTIAL	OPTIMIZED POTENTIAL	CURRENT POLICY POTENTIAL
AGRICULTURE	45	45	39	39

Cumulative 12-Year Natural Gas Potential Savings Estimates by Sector, 2023-2034

NATURAL GAS ENERGY EFFICIENCY BY SECTOR IN THOUSAND THERMS	TECHNICAL POTENTIAL	ECONOMIC POTENTIAL	OPTIMIZED POTENTIAL	CURRENT POLICY POTENTIAL
SINGLE-FAMILY	443,418	227,968	190,717	42,212
MULTIFAMILY	54,580	27,175	22,588	4,987
COMMERCIAL	188,403	108,136	82,419	50,751
GOVERNMENT	28,094	17,614	13,164	13,164
INDUSTRIAL	61,746	61,299	52,732	32,588
AGRICULTURE	3,299	448	420	420

Estimates from Income-Qualified Segment within Single-Family and Multifamily Sectors

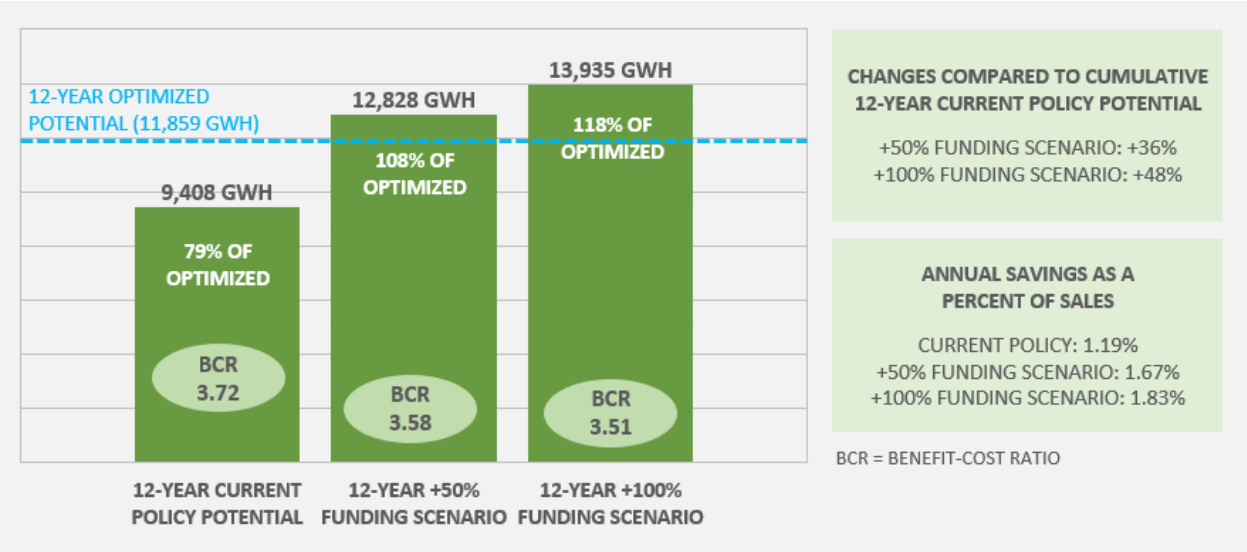
FUEL TYPE	2034 FORECAST SALES	TECHNICAL POTENTIAL	ECONOMIC POTENTIAL
ELECTRIC ENERGY EFFICIENCY IN GWH	**7,478**	**3,166**	**2,345**
NATURAL GAS ENERGY EFFICIENCY IN THOUSAND THERMS	**557,895**	**168,533**	**94,322**

Note: The PSC requested that 2021 Potential Study include an analysis of income-qualified potential and an investigation of barriers faced for delivering income-qualified customer-directed programming. Focus on Energy does not currently offer an income-qualified program, but offers special incentives for customers whose income is at or below 80% of Wisconsin median income. For this study, the income-qualified segment represents customers whose income is 80% or less of the Wisconsin median income. Eligibility for the Wisconsin Weatherization Assistance Program administered by the Department of Administration is for households at or below 60% of Wisconsin median income. This study does not seek to distinguish opportunities and barriers at the different income thresholds, but rather is more general in scope.

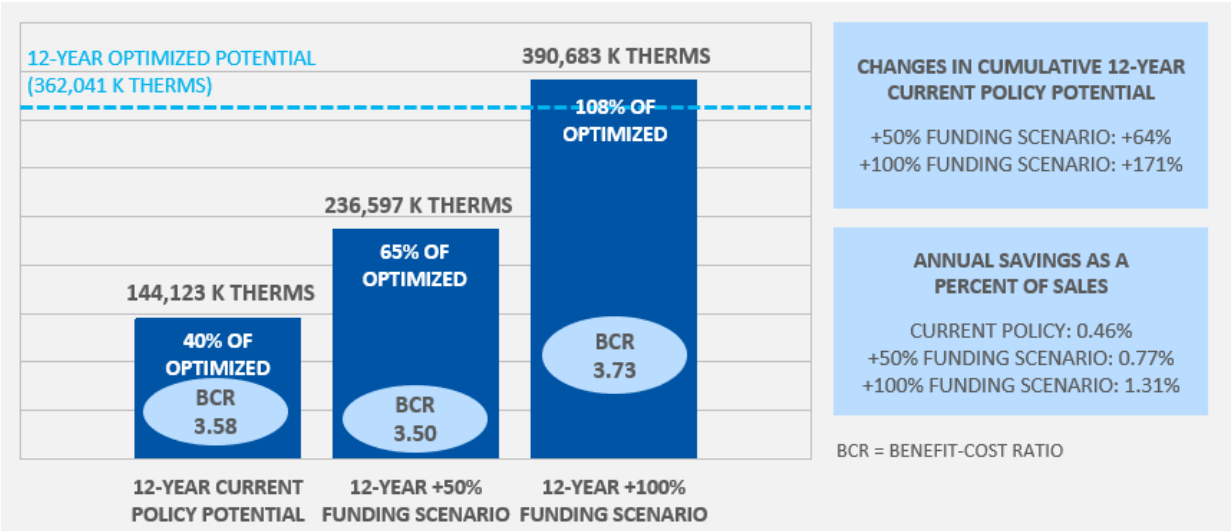
As noted above, Cadmus analyzed two funding scenarios beyond the current policy. In doing so, Cadmus removed the sector and fuel-type budgetary limitations for the +50% and +100% funding scenarios. Additionally, Cadmus used economic potential as the basis for the additional funding scenarios versus optimized potential, which was the basis of the current funding scenario. This differs from the current policy potential estimation, which is a subset of the optimized potential and assumes market constraints and associated market adoption ramp rates. The +50% and +100% funding scenarios are a subset of

economic potential and do not include the same barriers. For all funding scenarios, Cadmus used a minimum threshold of MTRC 1.0 at the measure level.

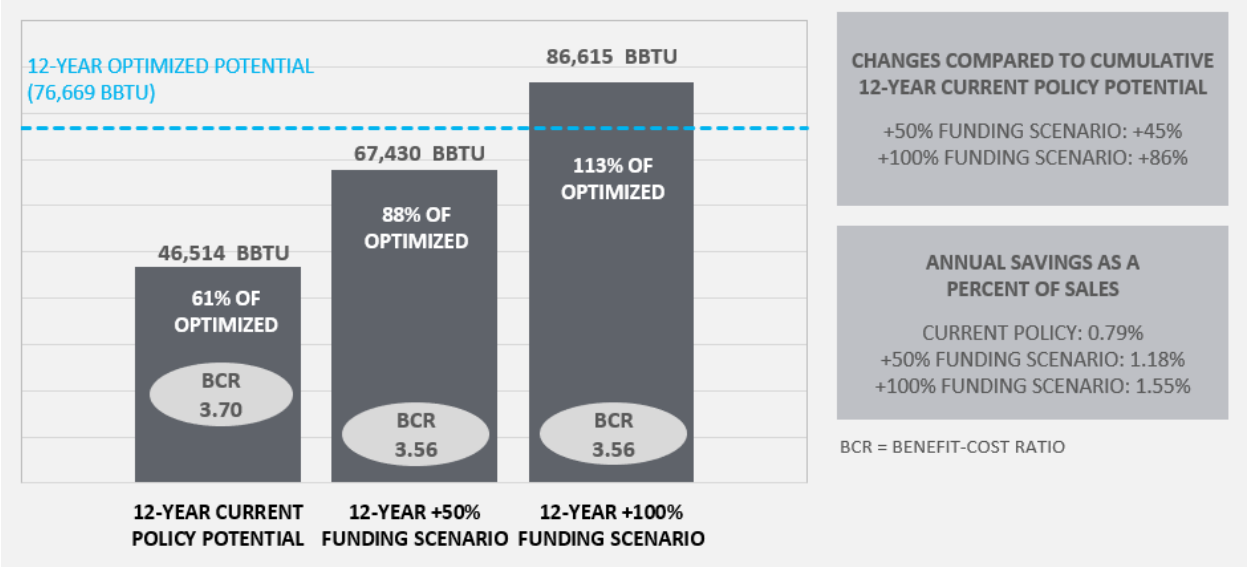
Electric Funding Scenarios



Natural Gas Funding Scenarios



BBTU Funding Scenarios



For electric potential funding scenarios, the increase in funding from +50% to +100% results in less additional savings potential compared to when the funding increases from current policy potential to the +50% funding scenario. Additionally, in the +100% funding scenario, the overall cost-effectiveness ratio trends downward as more funding is added. Both of these outcomes are expected and are caused by less cost-effective measures being included in the analysis. While these increased funding scenarios only included measures deemed cost-effective on their own, in practice the program is likely to include a mix of measures both above and below a 1.0 cost-effectiveness threshold, which would impact total portfolio potential and benefit-cost ratios. Determining which technologies and measures that are not cost-effective to include in the increased funding scenarios was beyond the scope of this study.

For the natural gas funding scenarios, the incremental increase in funding from +50% to +100% results in a proportionally similar increase in estimated savings potential compared to the funding increase from current policy to +50%. Additionally, the +100% funding scenario sees increased cost-effectiveness, because the majority of the incremental change in potential from the +50% funding to the +100% funding scenario comes from residential natural gas measures. Residential natural gas measures are generally more cost-effective than commercial natural gas measures, and as the model allows for more funding, more of these measures are included in the estimated potential. For example, at the sector level, the single-family natural gas benefit-cost ratio is 4.41 for the +100% funding scenario, but the commercial equivalent is 2.43. Therefore, the cost-effectiveness ratio in the +100% funding scenario is weighted more heavily toward measures with higher benefit-cost ratios. Some examples of these highly cost-effective residential measures include aerators and showerheads.

When considered from a BBTU perspective, where both the electric and gas measures considered in the individual fuel analyses are combined, the increase in the +100% funding scenario potential is approximately 86%, compared to 171% for gas measures and 48% for electric measures. While the portfolio benefit-cost ratio slightly decreases from the current policy scenario to the +50% funding

scenario, the ratio stays the same from when funding is increased from the +50% funding scenario to the +100% funding scenario.

Comparisons to 2017 Potential Study Results

Cadmus used the 2017 potential study as a benchmark to compare 2021 study results. Cadmus used similar methods to estimate technical and economic potential in both studies. However, the team used different methodologies to estimate optimized potential in 2021 and maximum achievable potential in 2017, making comparison at this level incongruent.

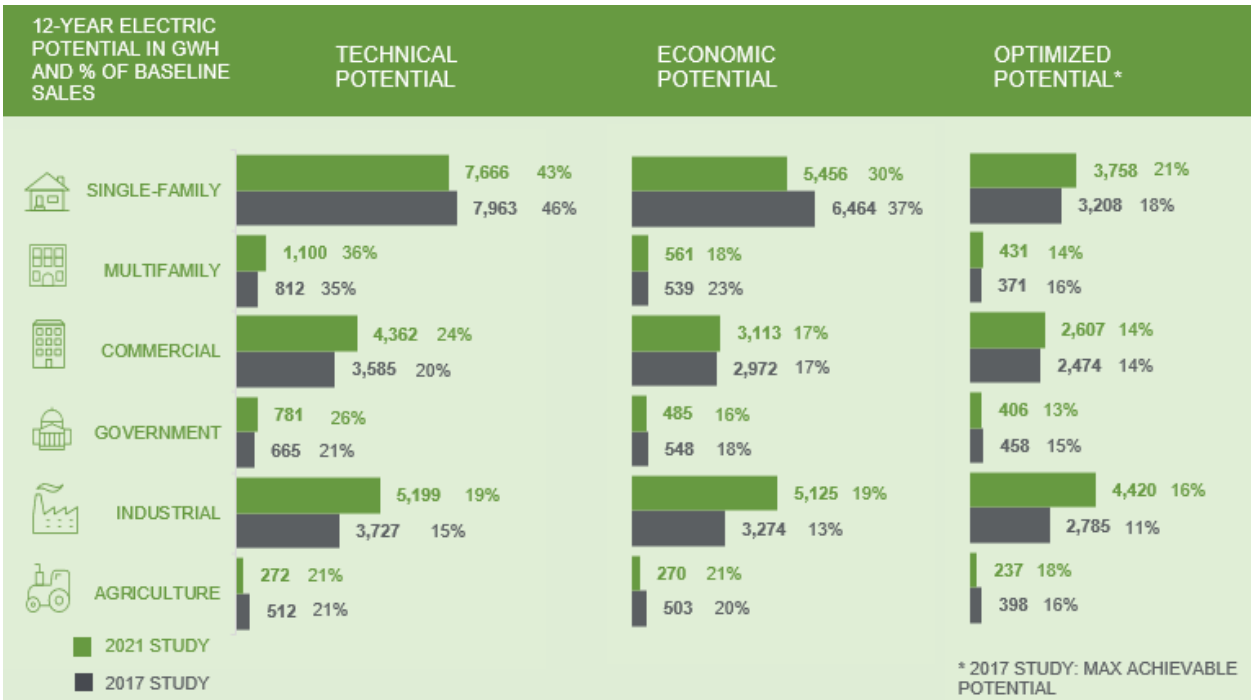
Overall, electric technical, economic, and optimized potential[1] increased in the 2021 study, while natural gas potential estimates decreased. There are numerous drivers for this trend:

- **An update to the most recent commercial survey data** showed significantly less natural gas heating in commercial buildings, which primarily impacted natural gas potential.
- **An update to the most recent industrial data sources** to determine end-use saturations from the 2018 Energy Information Administration's Manufacturing Energy Consumption Survey and new measure savings data added to the Industrial Assessment Center's project database between 2017 and 2020. The 2021 study additionally screened these updated sources to remove outlier data observations. Based on these updates, natural gas potential decreased.
- **Lower avoided energy costs** in the 2021 study led to fewer cost-effective measures.

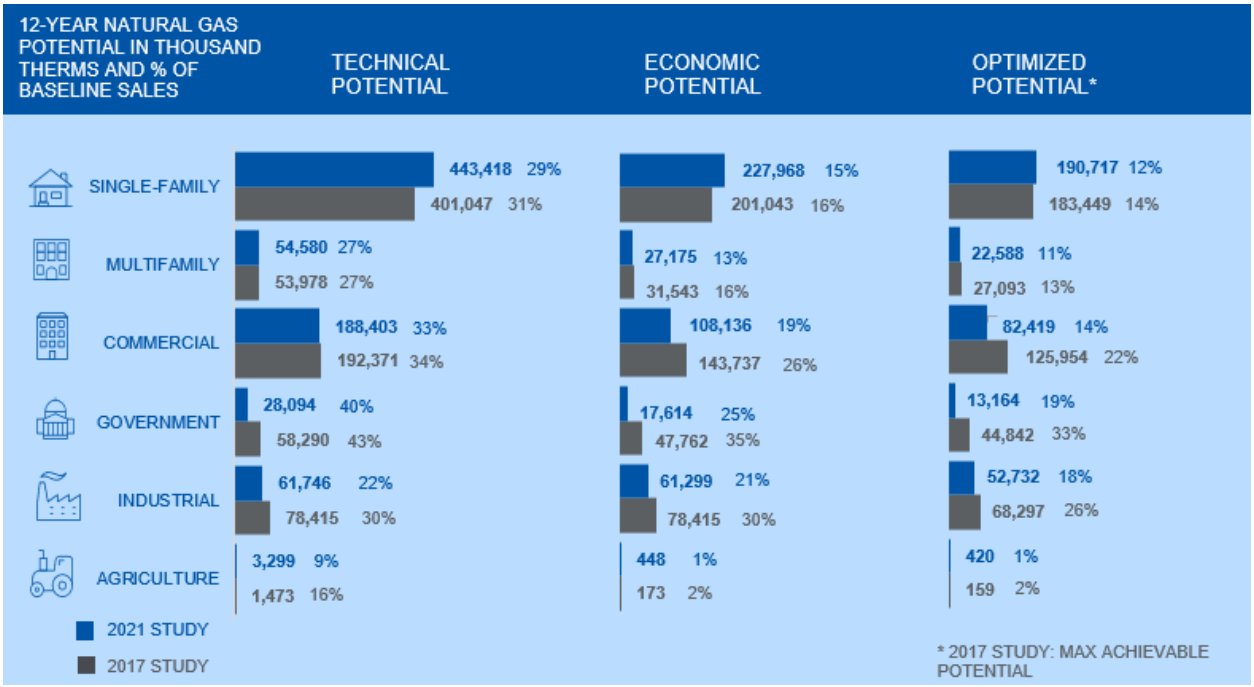
The figures below compare 2021 and 2017 technical, economic, and optimized/maximum achievable potential for electric (gigawatt hours) and natural gas (thousand therms) energy savings. The figures show each sector's estimated overall cumulative 12-year savings potential and its corresponding percentage of final year (2034) baseline sales.

[1] The *2017 Potential Study* did not include an estimate of optimized potential. The most analogous level of potential from that previous study is Maximum Achievable Potential. For more details about the difference in potential estimates, see the *Differences between 2021 and 2017 Potential Study* section.

Comparison of Electric Potential



Comparison of Natural Gas Potential



Conclusions

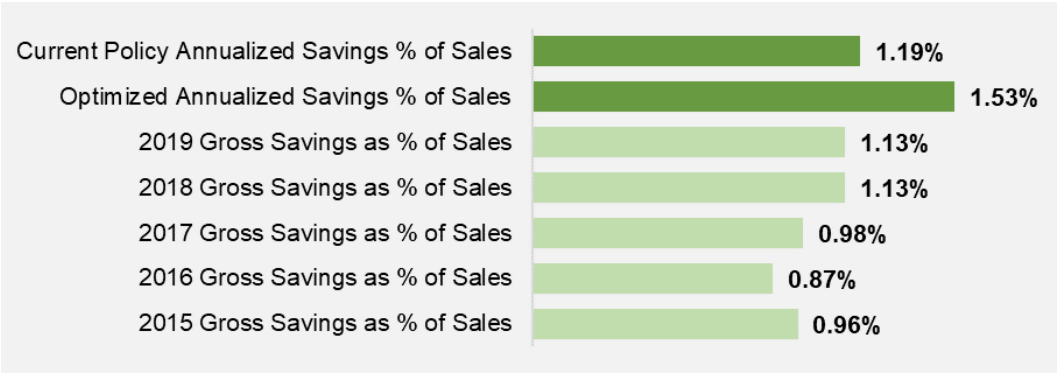
Focus on Energy's electric savings potential under current program funding levels and policies remains relatively comparable to Focus on Energy's recent savings achievements. During the first four years of the study period, 2023 through 2026, current policy potential represents electric potential savings of 3,183 GWh, compared to 2,864 GWh gross savings achieved from 2016 through 2019. On the other hand, natural gas potential registers lower than recent achievement: current policy potential from 2023 through 2026 is 49.4 million therms, compared to 96.9 million therms in gross program savings achieved from 2016 through 2019. The lower gas potential is not unexpected due to changes in fuel share data inputs and lower avoided natural gas costs.

Focus on Energy's electric savings potential under current program funding levels and policies remains relatively comparable to Focus on Energy's recent savings achievements. Changes to Focus on Energy policies could lead to additional savings achievements.

Under current Focus on Energy policies and funding levels, current policy potential amounts to 1.19% in electric savings and 0.46% in natural gas savings as a percentage of annual forecast sales (see figures below). Absent significant changes in Focus on Energy's policies, funding, or market conditions, these estimates can inform the program's savings goals for the 2023-2026 quadrennium. In determining these goals, the PSC should note that these estimates do not account for many of the program design constraints that need to be considered in establishing reasonable savings achievements. For example, under Wisconsin administrative code § PSC 137.05(12), Focus on Energy programs are required to pass a portfolio-level test of net cost-effectiveness. ***This potential study presents gross energy savings absent application of net-to-gross rates, which in all likelihood will lower the savings Focus on Energy can claim. Further adjustments to these estimates are appropriate to recognize such constraints and to set a goal that reflects program potential.***

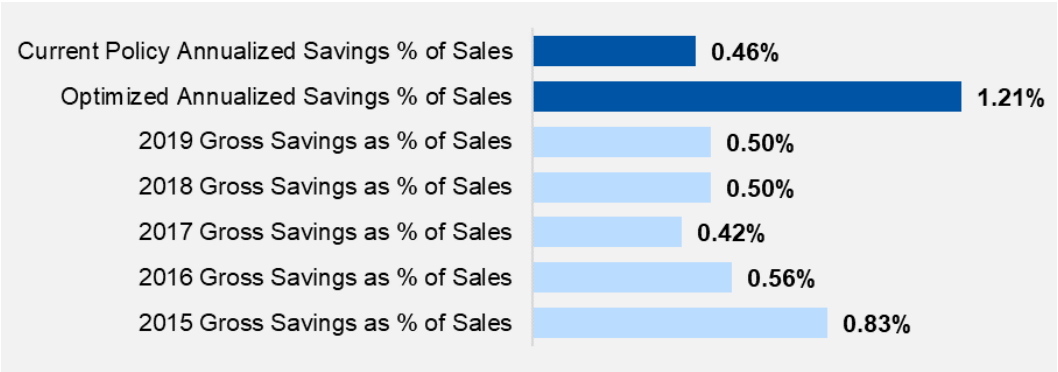
Another consideration is that because the standard for Focus on Energy is cost-effectiveness at the portfolio-level, this standard could be met with programs that, in addition to more cost-effective measures, include some measures that are not cost-effective. Economic, optimized, and policy funding potential is comprised only of measures that are cost-effective. However, measures not included in these potential estimates can be included in cost-effective Focus programs. This distinction should be recognized when making comparisons to historical program savings in the figures below.

Electric Optimized and Current Policy Potential Compared to Historical Gross Savings



Note: current and optimized potential do not account for many of the program design considerations required to create a cost-effective and equitable program.

Natural Gas Optimized and Current Policy Potential Compared to Historical Gross Savings



Note: current and optimized potential do not account for many of the program design considerations required to create a cost-effective and equitable program.

The full range of potential estimates generated in this study also indicates that total energy efficiency potential in the state can vary significantly under different circumstances. For example, total electric optimized potential increases to 1.53% of annual sales without funding constraints from 1.19% of annual sales with funding constraints.

Similar to the current policy potential scenario, these estimates do not account for all program design constraints. However, while total savings achievement would be generally reduced by several of those constraints, savings achievement in these scenarios could be increased by including measures not passing this study's measure-level cost-effectiveness screen.

Cost-effectiveness standards could be met with programs that, in addition to having more cost-effective measures, include some measures that are not cost-effective.

As mentioned above, portfolio cost-effectiveness standards could be met with programs that include some measures that are not cost-effective. Screening measures for economic potential using a MTRC

greater than or equal to 0.75 increases total economic electric and natural gas potential by 3.9% and 25%, respectively. Because this scenario, as modeled, still would likely meet Focus on Energy's requirement to maintain overall cost-effectiveness in its residential and nonresidential portfolios, it provides an estimate of the degree to which this factor could affect the difference between current policy potential presented here and program potential that could be realized by Focus on Energy.

Residential Sector

Cadmus' analysis identified significant numbers of residential electric and natural gas measures that offer considerable cost-effective savings potential. Additionally, Cadmus noted measures that experienced shifts in market saturations leading to changes in overall potential. The following highlights the conclusions about the potential found in the residential sector:

CONCLUSION 1	Residential measures that reduce electric water heating end-use loads comprise 34% of the sector's electric economic potential.
CONCLUSION 2	Residential lighting potential is substantially lower compared to the 2017 potential study.
CONCLUSION 3	Certain residential electric measures offer substantial, additional cost-effective savings opportunities compared to 2017 including advanced central air conditioners and ENERGY STAR 2020 efficient dehumidifiers.
CONCLUSION 4	Residential appliance recycling measures still offer substantial cost-effective savings opportunities.
CONCLUSION 5	Economic natural gas potential is led by savings from energy and water savings measures including low-flow showerheads and faucet aerators.
CONCLUSION 6	Premium efficiency gas furnaces offer substantial cost-effective residential natural gas efficiency savings.
CONCLUSION 7	Current program funding does not sufficiently capture a proportionate amount of cost-effective residential savings compared to nonresidential sectors.
CONCLUSION 8	Residential natural gas potential is particularly responsive to program funding, as demonstrated by the increase in potential for the +50% and +100% funding scenarios.

Nonresidential Sector

Cadmus' analysis identified total nonresidential electric economic potential equivalent to almost 9,000 GWh (60% of the electric total) and 188 million therms (42% of the natural gas total). The potential study identified several nonresidential electric and natural gas measure groups that offer significant cost-effective savings potential:

- Commercial and industrial lighting and lighting controls
- Commercial HVAC controls
- Commercial refrigeration
- Industrial sector process measures

The following highlights the conclusions about the potential found in the nonresidential sector:

CONCLUSION 1	Nonresidential screw-based lighting represents a significant source of economic potential savings, despite the increased prevalence of LED lighting technologies, due to a change in the treatment of screw-based lighting baseline technologies compared to the 2017 study. While there are economic savings from screw-based lighting at this time, the LED lighting market is rapidly changing and program planners should consider upcoming federal standards that could drastically reduce this savings opportunity in later years of the 12-year study.
CONCLUSION 2	Commercial refrigeration measures accounted for 15% of electric commercial economic potential, or approximately 525 GWh.
CONCLUSION 3	Commercial natural gas economic potential has declined substantially compared to the 2017 potential study, primarily due to the impact of lower avoided costs on several measures, such as retro-commissioning.
CONCLUSION 4	Industrial sector savings accounted for 34% and 14% of electric and natural gas economic potential, respectively, while accounting for 39% and 11% of total, 2034 electric and natural gas baseline sales.
CONCLUSION 5	Process measures accounted for largest share of electric and natural gas economic potential in the industrial sector, providing more than 2,390 GWh of cumulative 12-year electric potential and 32 million therms of natural gas potential.
CONCLUSION 6	Nonresidential natural gas economic potential is highly sensitive to changing cost-effectiveness assumptions.

Potential Study Approach

The Public Service Commission of Wisconsin (PSC) contracted with Cadmus to complete an energy efficiency potential assessment, designed to produce estimates of the conservation resources achievable by Focus on Energy over a 12-year period, from 2023 through 2034.

Study Objectives

While the potential study does not provide a target for program planning, the research was timed to provide input on quadrennial planning for Focus on Energy programs. Results from the study provide foundational information to the PSC and stakeholders in assessing the appropriate goals, priorities, and measurable targets for the 2023-2026 quadrennium of Focus on Energy. Study objectives included the following:

- Inform program planning by assessing future energy savings potential for energy-efficiency measures offered through existing Focus on Energy programs and those that may be included in future program designs.
- Estimate the energy savings potential for various scenarios, including a current policy scenario, which assumes Focus on Energy funding of approximately $90 million per year, and alternate scenarios that assume no funding limits and illustrate the effects of changes in program, state, and federal policies.

Scope of Assessment

This section provides an overview of Cadmus' scope of work and methodology.

Coverage

This study analyzed the six sectors and population segments shown in Figure 1.

Figure 1. Sectors and Segments Covered in 2021 Energy Efficiency Potential Study

	SINGLE-FAMILY	Single-family homes, manufactured homes, and income-qualified homes
	MULTIFAMILY	Multifamily apartment buildings (four or more units) and income-qualified apartment buildings
	COMMERCIAL	Commercial offices, grocery stores, healthcare facilities (hospitals and outpatient centers), lodging, private schools, restaurants, retail shops, warehouses, and miscellaneous commercial buildings
	GOVERNMENT	Government offices, public K-12 schools, and public universities (including technical colleges)
	INDUSTRIAL	Energy-intensive manufacturing, primarily process-driven customers, and water and wastewater management
	AGRICULTURAL	Dairy farms, crop farms, and other farms (livestock and greenhouses)

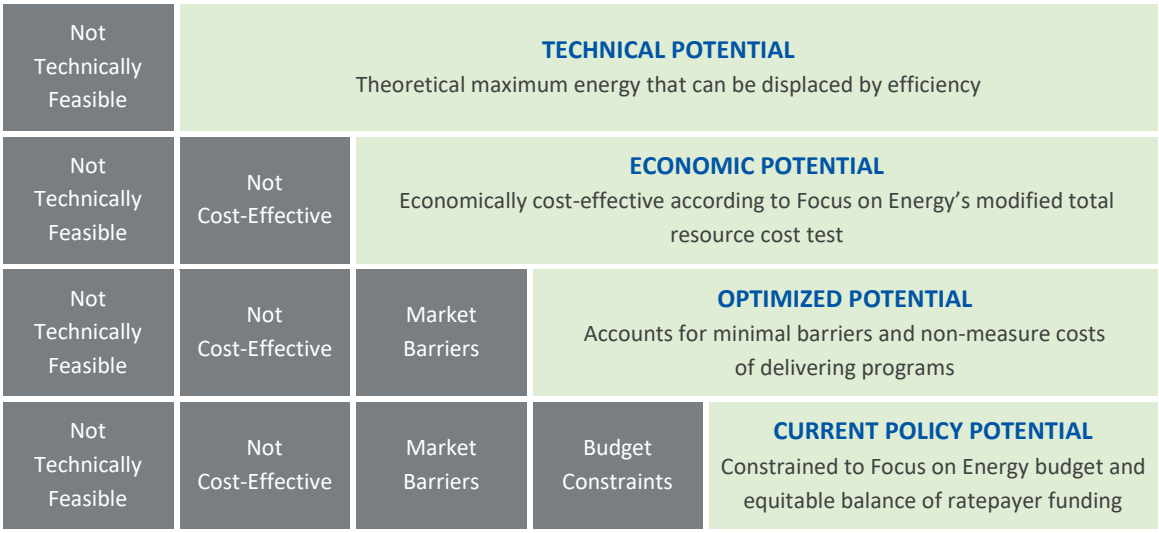
Within these sectors and population segments, Cadmus considered additional market segments, construction vintages (new and existing), and end uses. Cadmus also considered the income-qualified market segment within the single-family and multifamily sectors, conducting additional, targeted research for the segment. The income-qualified segment represents customers whose income is 80% or less of the Wisconsin median income, in line with Focus on Energy's qualification criteria for Tier 2 incentives. It should be noted that eligibility for the Wisconsin Weatherization Assistance Program administered by the Department of Administration is for households at or below 60% of Wisconsin median income.[2] This study does not seek to distinguish opportunities and barriers at the different income thresholds, but rather is more general in scope.

For each sector, Cadmus developed a baseline end-use load forecast that assumed no new future programmatic conservation savings from Focus on Energy. The baseline forecast largely captured savings from building energy codes, equipment standards, and other naturally occurring market forces. Cadmus calculated energy efficiency potential estimates by assessing the impact of each energy conservation measure on this baseline forecast. Therefore, conservation potential estimates presented in this report represent savings that energy efficiency programs could achieve *beyond* the naturally occurring savings resulting from the effects of codes, standards, and market forces.

Types of Potential Estimates

This section describes the four types of potential estimated in the 2021 study: technical, economic, optimized and current policy. Figure 2 provides an overview of each of the levels of potential estimates.

Figure 2. Types of Potential Estimated



[2] For more information please see http://homeenergyplus.wi.gov/section.asp?linkid=118&locid=25.

Technical Potential

Technical potential represents the theoretical maximum commercially available savings opportunities. To determine technical potential, Cadmus assumed all technically feasible energy efficiency measures commercially available at the time of the study were implemented, regardless of their costs or of any market barriers. Cadmus estimated this theoretical upper bound of available energy efficiency potential after accounting for technical constraints, such as the number of buildings and the percentage of buildings that can accommodate specific measures. For energy efficiency resources, Cadmus divided technical potential into three distinct classes:

- Retrofit opportunities in existing buildings
- Equipment replacements in existing buildings
- New construction

Customers can implement the first class, which exists in current building stock, at any point in the planning horizon. Examples of retrofit measures, which reduce the consumption of end-use equipment without modifying or replacing that equipment, include insulation, faucet aerators, and lighting controls. On the other hand, the potential model assumes that end-use equipment turnover rates and new construction rates dictate the timing of the other two classes. Furnaces and heat pumps are examples of measures in these categories.

Economic Potential

Economic potential represents all theoretical savings opportunities that are also cost-effective to implement now. It represents a subset of technical potential and consists only of measures that meet the cost-effectiveness criteria, set by the Modified Total Resource Cost (MTRC), approved by the PSC for use as Focus' primary cost-effectiveness test. For each energy efficiency measure, Cadmus structured the benefit-cost test as the ratio of net present values for the measure's benefits and costs, using the benefit and cost inputs approved by the PSC for the 2019-2022 quadrennial period. Only measures with a benefit-cost ratio of 1.0 or greater were deemed cost-effective. Cadmus also considered scenarios of lower measure-level cost-effectiveness thresholds in estimating economic potential. While Cadmus conducted cost-effectiveness testing at the measure-level, Focus on Energy is not required to maintain cost-effectiveness for each measure; rather, Focus on Energy must maintain cost-effectiveness at the portfolio level, and may include measures that are not cost-effective.

Optimized Potential

Optimized potential represents the portion of economic potential that might be assumed reasonably attainable over the course of the planning horizon, given minimal implementation barriers to impede customer participation in Focus on Energy programs. For this study, Cadmus did not consider Focus on Energy's funding constraints or current policy on program budget allocations to measure optimized potential. As a result, optimized potential is an estimate of the cost-effective energy efficiency savings potential that can be realized when funding amounts and distribution by sector is not a limiting factor.

Optimized potential does not consider program implementation barriers. Many programs require robust trade ally networks or must overcome barriers such as split incentives to succeed. This study does not account for such barriers.

To determine optimized potential, Cadmus applied an upper bound on the amount of long-term economic potential that consumers will ultimately adopt over the study period. This approach places an upper limit on the amount of economic potential that is achievable, based on historic program accomplishments and impacts of codes and standards on the adoption of energy efficiency measures. To reflect adoption of different technologies over time, Cadmus applied market adoption rates to energy efficiency measures. These rates of adoption, also known as ramp rates, reflect differing adoption patterns of technologies at different stages of market maturity. For example more mature technologies would experience a more rapid market adoption rate due to having fewer market barriers than less mature technologies.

Cadmus used an upper bound of 85% cumulative adoption for most measures. In other words, at its highest level of market adoption, most measures will be adopted by 85% of end-use consumers.[3] This upper limit is intended to capture the phenomenon that even when particular technologies have high levels of market maturity, some end users will still not adopt them due to a variety of factors which may include cost or personal tastes and preferences. For measures with minimum federal efficiency standards, Cadmus used an upper-bound of 95% cumulative adoption.

To assign ramp rates to the study's measures, Cadmus and the PSC engaged stakeholders in the industry including market experts. Stakeholders reviewed ramp rate assignments and provided feedback on the most appropriate ramp rates to use as inputs to model optimized potential.

Current Policy Potential

Current policy potential is a subset of optimized potential, constrained by the current annual Focus on Energy budget that considers equitable balance of ratepayer funding, such as splits between fuels and sectors. To estimate current policy potential, Cadmus applied measure incentives based on current amounts, expressed as a percentage of incremental cost. Cadmus used proxy incentives developed for non-program measures and emerging technologies. To scale optimized potential (see above) to current policy potential, Cadmus applied the current Focus on Energy budget as a modeling constraint. Total budget amounts included incentives and implementation and administrative costs, based on recent Focus on Energy experience.

Cadmus also considered additional scenarios of funding, where current policy funding was increased by 50% and 100%.

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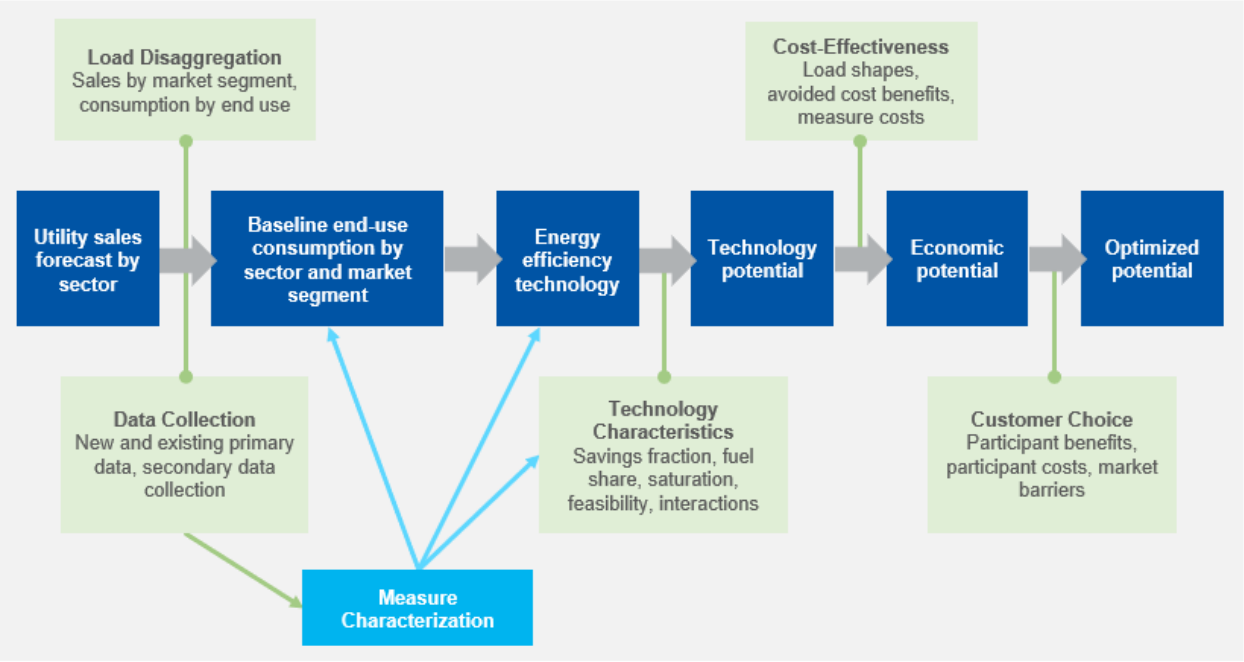
[3] Cadmus adopted this approach form the Northwest Power and Conservation Council. More information about this approach can be found here: https://www.nwcouncil.org/reports/2007/2007-13. The selection of ramp rates can further reduce overall adoption. See the *Ramp Rates* section below for additional details.

Methodology Overview

Cadmus used a combined top-down/bottom-up approach. The top-down component for the study began with the most current participating utility sales forecasts, which the team adjusted for building codes, equipment efficiency standards, and market trends that those forecasts did not account for, including baseline shifts to residential and commercial screw-based lighting during the study horizon. The team then disaggregated this information into sectors, market segments, and end-use components. The bottom-up component considered the potential technical impacts of various energy conservation measures and practices on each end use. Cadmus estimated impacts based on engineering calculations, accounting for fuel shares, current market saturations, technical feasibility, and costs. Cadmus uses the top-down approach to calibrate the bottom-up end-use consumptions to avoid over estimation of potential. Figure 3 provides a high-level overview of the steps Cadmus used to estimate potential.

Figure 3. General Methodology for Assessment of Energy Efficiency Potential



As a first step in the study, Cadmus developed a baseline forecast by determining 12-year future energy consumption by sector, market segment, and end use. Cadmus calibrated the base year (2023) to Focus on Energy participating utilities' forecasted sector loads. Baseline forecasts in this potential study include adjustments to utility forecasts and estimates of naturally occurring potential, such as energy savings due to building energy codes and federal equipment standards; therefore, conservation potential estimates presented in the report represent only additional savings achievable through energy efficiency programs.

As part of this study, Cadmus collected primary data across all sectors (residential and nonresidential building stock) within Focus on Energy service territory. Cadmus completed 74 virtual site visits and 604 telephone surveys in the commercial sector, 70 phone surveys in the agricultural sector, 600 email surveys in the residential sector, and 140 telephone surveys with income-qualified residential

customers. Additionally, Cadmus interviewed 11 industrial experts about industrial energy efficiency potential. These data collection activities provided Wisconsin-specific baseline data on building characteristics, demographics, energy-consuming end uses (e.g., fuel type, equipment type, estimate equipment age). *Appendix A* contains further details about the methodology.

Next, Cadmus developed a comprehensive measure database of technical and market data that applied to all end uses in various market segments and then estimated costs, savings, and applicability for a comprehensive set of energy efficiency measures, which was reviewed by study stakeholders. The listed measures included existing Focus on Energy program measures, measures from Focus on Energy's technical reference manual (TRM), additional measures identified by the potential study team and stakeholders, and various emerging technologies. *Appendix A* contains additional information about the data sources used as part of this study.

Differences between 2021 and 2017 Potential Study

In 2017, Cadmus published a Wisconsin energy efficiency potential study. Like the current study, the 2017 study was timed to align with quadrennial planning. While the general approach to the 2017 study is like the current study, there are several differences:

- **Revised methodology for estimating Optimized Potential:** For the 2017 study, Cadmus relied on willingness-to-pay surveys to calculate the level of achievable energy efficiency potential. These surveys estimated energy efficiency measure uptake given different measure incentive ranges. Following extensive consultations with stakeholders, the team adjusted this approach for the 2021 potential study. Rather than rely on willingness-to-pay surveys, Cadmus set a maximum adoption curve to the level of economic potential that the market would adopt and worked with stakeholders to apply appropriate ramp rates to measure for how quickly potential would be adopted over time, given know market barriers to full market adoption.

  In addition, and based on stakeholder feedback, Cadmus changed the nomenclature of "achievable potential" to "optimized potential" for the current study.
- **Scaled data collection:** In the 2017 study, Cadmus conducted extensive research at residential, commercial, and agricultural sites. In 2021, Cadmus scaled on-site research, given the extensive data collection effort undertaken four years earlier. Cadmus also focused on-site research on facilities and end uses where it expected the greatest change, which was primarily commercial lighting. For sites where Cadmus did not collect primary data on-site though virtual site visits, it leveraged 2017 and 2021 survey data.
- **Virtual Site Visits:** The COVID-19 pandemic made traditional site visits, such as those conducted for the 2017 potential study, impractical. For the current study, Cadmus conducted virtual site visits to directly gather on-site data about commercial lighting systems and key equipment data. Field engineers leveraged streaming video technology and the smart phone of a site contact to gain virtual access to a site, which allowed them to safely view facilities and interact with site contacts.
- **COVID-19-related data collection challenges:** Cadmus collected primary data for this potential study during a statewide surge of COVID-19 infections. As a result of this surge, many business

were closed, which made survey and virtual site visit recruitment more difficult than originally anticipated. As such, Cadmus did not meet all of its data collection targets, particularly regarding virtual site visits for schools. Additionally, Cadmus ceased conducting phone surveys with health institutions as hospitals became increasingly occupied with COVID-19 cases. In instances where Cadmus did not meet its data collection targets, we bridged the data gap with benchmarks, data from the previous study, or interpolated data from other segments where the team was able to reach more respondents.

Stakeholder Involvement

As part of this study, Cadmus engaged with PSC stakeholders through a series of virtual stakeholder meetings. The purpose of these meetings was to provide updates on progress and to get stakeholder feedback on key study areas, such as methodology and data collection approaches. Stakeholder attendees included PSC staff, the program administrator, program implementers, consumer advocate groups, local government and state agencies, participating utilities, technical experts from energy and evaluation firms, and other organizations with an interest in this study.

Key documents for stakeholder engagement, such as meeting recordings and slides, measure lists, draft reports, ramp rate assignment methods, and Frequently Asked Questions were posted to a study-specific website.[4] While the stakeholder meetings were key opportunities for engagement, Cadmus and PSC staff also answered questions from stakeholders directly. Stakeholders were able to provide feedback by email on key documents, such as the preliminary list of energy efficiency measures and the draft report. Additionally, Cadmus engaged with technical market experts regarding the ramp rates for optimized potential.

Stakeholder engagement was a key component to implementing the study. Stakeholders provided critical directional input on methodology, such as how to estimate optimized potential and which energy efficiency measures to include in the study. Additionally, stakeholders' feedback was critical to assign ramp rates to measure groups in order to estimate optimized potential. Table 1 describes key stakeholder engagement activities.

Table 1. Key Stakeholder Engagement Activities

Meeting	Key Discussion Items and Stakeholder Input
1st Stakeholder Meeting May 7, 2020	Cadmus and PSC staff introduced the potential study objectives, timeline, stakeholder engagement process, and overview of the methodology. Stakeholders provided feedback on the methodology, including on options to calculate and reframe achievable potential.
2nd Stakeholder Meeting June 24, 2020	Cadmus presented utility customer segmentation and energy and demand forecasts. Stakeholders provided feedback on how to estimate and frame achievable energy efficiency potential. Cadmus also presented its data collection plan, including the option for collecting data by virtual site visit due to the COVID-19 pandemic.

[4] See the following website for key stakeholder documents: https://www.focusonenergy.com/about/2021-Potential-Study-Documents

Meeting	Key Discussion Items and Stakeholder Input
3rd Stakeholder Meeting September 17, 2020	Cadmus presented its revised approach to estimate optimized potential, provided an overview of measures to include in the potential study, and solicited stakeholder feedback on those measures.
4th Stakeholder Meeting November 18, 2020	Cadmus presented options for potential scenarios, provided information about the process for ramp rate review, provided an update on data collection activities, and summarized feedback Cadmus received regarding measures to include in the study.
Ramp Rates Review (Stakeholder Subgroup) February 24, 2021	A subgroup of stakeholders reviewed Cadmus assignments and provided feedback. On February 24, 2021, Cadmus had an initial meeting with the subgroups to explain the process. On March 15, 2021, stakeholders provided feedback. At this meeting stakeholders showed agreement with the scenarios presented in this study.
5th Stakeholder Meeting April 29, 2021	Cadmus presented draft study results and the outcome of the ramp rate review process. Stakeholders provided preliminary feedback on the study results.
6th Stakeholder Meeting Fall 2021	The final meeting will recap results, discuss the conclusions in detail, provide a discussion of stakeholder comments received, and next steps for Quadrennial Planning (this meeting had not occurred at time this report was published).

Study Limitations and Considerations

While this study provides insights about which measures Focus on Energy could offer in future programs, this information is meant to inform—not set—program targets. In addition to the descriptions of potential noted above, several other considerations regarding the design of the potential study may cause future program plans to differ from the study's results:

- **Potential study estimates account for interactions between cost-effective measures**. When installing two interactive measures (e.g., ceiling insulation and heating and cooling equipment), the combined interactive savings are lower than the sum of stand-alone savings for the two measures. Sometimes called *measure stacking*, such interactive effects can produce lower estimates than planned savings as program plans may not include all measures considered within the potential study.
- **The potential study uses broad assumptions about the adoption of energy efficiency measures**. Program design, however, requires a more detailed examination of historic participation and incentive levels on a measure-by-measure basis. The potential study can inform planning for measures that Focus on Energy has not historically offered.
- **The potential study only considers cost-effective energy efficiency measures.**[5] Focus on Energy does not require measures to be cost-effective on their own, but administrative code requires the statewide energy efficiency and renewable resource portfolio to pass a portfolio-level test of net cost-effectiveness. Programs can be designed so measures that are not cost-effective on their own can still be delivered through cost-effective programs, thereby increasing total available savings.
- **The potential study does not account for freeridership, spillover, or market transformation, which are used to determine net savings.** While all savings estimates included in the potential

[5] The potential study includes two scenarios where non-cost-effective measures were included in modeling.

study are gross savings, the PSC, evaluators, program implementers, and stakeholders also consider net savings. Net savings are determined through program evaluations.

- **The potential study does not consider program implementation barriers.** While it includes a robust, comprehensive set of efficiency measures, it does not examine whether these measures can be delivered through programs. Many programs require robust trade ally networks or must overcome barriers such as split incentives to succeed. This study does not account for such barriers.
- **The potential study cannot predict market changes over time, while programs have flexibility to address market changes**. While this study accounts for changes in codes and standards as they are enacted today, it cannot predict upcoming changes in policies, pending codes and standards, and which new technologies may become commercially available. For example, past potential studies may not have accurately predicted the speed and magnitude of recent LED technology adoption. Focus on Energy programs are not static and have the flexibility to address changes in the marketplace, whereas the potential study estimates potential using a set of information collected at a single point in time.
- **The potential study does not attempt to forecast or otherwise predict future changes in energy efficiency measure costs**. Although the study includes a thorough estimation of incremental energy efficiency measure costs, including equipment, labor, and operations and maintenance, it does not attempt to forecast changes to these costs during the course of the study and reflects current market conditions in 2021. As a result, incremental costs for some emerging technologies, which may decrease with increased adoption, could be overstated relative to actual costs later in the study period.
- **The potential study relies on specified measures, and it may not include highly customized measures provided by programs**. While this study includes a large variety of energy efficiency measures, it is difficult to characterize highly customized measures that may be designed specifically for a single project or customer facility. For example, while the study reviews a number of measures related to defined technologies used in industrial facilities, it does not capture all potential from industrial facility "custom process" measures specific to individual manufacturing processes or facility designs. Given that Focus on Energy has historically achieved substantial savings from industrial custom process projects, potential presented here may not fully reflect total program potential in that sector.
- **The potential study does not forecast net-to-gross ratios or make explicit out-of-model adjustments for net-to-gross.** This study develops gross estimates of potential. While the program administrator's goals are based on lifecycle verified gross savings, the PSC bases its goals on net lifecycle savings and Focus on Energy is required by code to pass a portfolio level test of net cost-effectiveness.[6] Therefore, net-to-gross ratios used as a part of the planning process must be established outside of this study.

[6] Further statutory details on Focus on Energy cost-effectiveness requirements can be found here: https://docs.legis.wisconsin.gov/code/admin_code/psc/137/05/12

- **The potential study does not account for fuel switching.** This study develops potential estimates by assuming that electric equipment can be upgraded with electric equipment and non-electric natural gas equipment can be upgraded with non-electric natural gas equipment. Natural gas equipment conversion to electric equipment would increase the electric system load as natural gas system load would decrease. Accounting of fuel switched loads was not in scope of this study. However, customers may naturally fuel switch in the process of upgrading space or water heating equipment, and the results of this behavior is not accounted for in this study.

Technical and Economic Potential Results

Cadmus developed technical and economic potential based on a comprehensive set of conservation measures. The list of measures includes measures from Focus on Energy's TRM and emerging technology measures that are not currently offered through any Focus on Energy programs. To begin, Cadmus assessed the technical potential for hundreds of unique energy efficiency measures, considering measure savings and costs separately for each measure permutation across applicable sector, segment, end use, and construction vintage. As shown in Table 2, the analysis included almost 16,000 energy efficiency measure permutations and 1,183 unique measures across all sectors and fuels.

Table 2. Measure Counts and Permutations

Sector	Unique Electric Measure Count	Electric Permutations	Unique Natural Gas Measure Count	Natural Gas Permutations
Single-Family	139	1,448	62	699
Multifamily	211	987	104	457
Commercial	199	4,901	81	2,397
Government	195	2,065	81	929
Industrial	62	1,560	19	471
Agriculture	30	48	-	12
Total	**836**	**11,009**	**347**	**4,965**

Throughout the report, the multifamily sector is inclusive of in-unit apartments and common area. Therefore, multifamily is based on commercial and residential customer account, sales, and measure characterization data.

Potential estimate results in tables and figures are organized by fuel type and color coded in this report. **Green represents electric** and **blue represents natural gas**.

Cross-Sector Overview of Results

Cadmus developed technical and economic energy efficiency potential based on energy sales forecasts for the Focus on Energy territory that assume no energy efficiency program savings. Therefore, the potential values estimated in this report are inclusive of—not in addition to—forecasted program savings.

Table 3 shows baseline sales and cumulative 12-year electric potential by sector. Study results indicated more than 19,379 GWh of technically feasible conservation (27% of baseline sales) by 2034, the end of the 12-year study horizon, with an estimated 15,010 GWh (21% of baseline sales) that are cost-effective and technically feasible (i.e., economic potential). In the first four years of the study, 46% of the technical potential is achieved and 43% of the economic potential is achieved. Seventy-seven percent of the technical potential was economically feasible.

Table 3. Electric Energy Efficiency Technical and Economic Potential by Sector

Sector	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Single-Family	18,022,489	7,665,986	43%	5,456,186	30%	71%
Multifamily	3,064,670	1,100,241	36%	560,524	18%	51%
Commercial	18,190,973	4,361,875	24%	3,112,928	17%	71%
Government	3,059,850	780,572	26%	484,583	16%	62%
Industrial	27,691,821	5,198,651	19%	5,124,906	19%	99%
Agriculture	1,295,590	272,194	21%	270,406	21%	99%
Total	**71,325,393**	**19,379,519**	**27%**	**15,009,533**	**21%**	**77%**

In addition to energy savings, Cadmus calculated the cumulative 12-year electric demand potential from energy efficiency by sector. Table 4 shows 3,634 MW of technically feasible conservation by 2034, with 83% of this potential determined to be economically feasible (3,029 MW).

Table 4. Electric Demand Technical and Economic Potential from Energy Efficiency by Sector

Sector	12-Year Technical Potential (MW)	12-Year Economic Potential (MW)	Economic as Percentage of Technical Potential
Single-Family	1,725	1,512	88%
Multifamily	187	119	64%
Commercial	806	574	71%
Government	201	117	58%
Industrial	670	663	99%
Agriculture	45	45	100%
Total	**3,634**	**3,029**	**83%**

As shown in Table 5, the cumulative 12-year natural gas technical potential for Focus on Energy territory is 779,539 thousand therms. Of that potential, 57%, or 442,641 thousand therms, is cost-effective under the MTRC test. Economic potential represented 16% of Focus on Energy participating utilities' forecasted 2034 sales. The single-family sector makes up 52% of the cumulative 12-year economic potential.

Table 5. Natural Gas Technical and Economic Energy Efficiency Potential by Sector

Sector	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Single-Family	1,530,824	443,418	29%	227,968	15%	51%
Multifamily	203,624	54,580	27%	27,175	13%	50%
Commercial	574,108	188,403	33%	108,136	19%	57%
Government	69,891	28,094	40%	17,614	25%	63%
Industrial	286,539	61,746	22%	61,299	21%	99%
Agriculture	36,814	3,299	9%	448	1%	14%
Total	**2,701,800**	**779,539**	**29%**	**442,641**	**16%**	**57%**

For the 2021 potential study, Cadmus updated several assumptions from the 2017 study that had an impact on the overall technical and economic potential estimates and how they relate to the baseline sales forecast. Cadmus also based potential estimates on updated sales forecasts provided by participating utilities. The following updates contributed to the changes in the sector-level potential:

- **An update to the most recent commercial survey data** showed significantly less natural gas heating in commercial buildings, which primarily impacted natural gas potential.
- **An update to the most recent industrial data sources** to determine end-use saturations and savings involved screening out outlier data observations.
- **Lower avoided energy costs** in the 2021 study led to fewer cost-effective measures (illustrated in Figure 4 and Figure 5).

Figure 4 shows the electric avoided energy and capacity costs from the 2017 potential study compared to the 2021 potential study. When levelized over 25 years, the avoided energy costs decreased from $0.083 per kWh in the 2017 study to $0.062 per kWh in the 2021 study. The electric avoided capacity cost changed from the stagnant value of $130.26 in 2017 to an increasing value of $135.46 per kW-year in the first year of the 2021 study and $208.65 per kW-year in the twenty-fifth year of the 2021 study.

Figure 4. Electric Avoided Energy and Capacity Cost Comparison

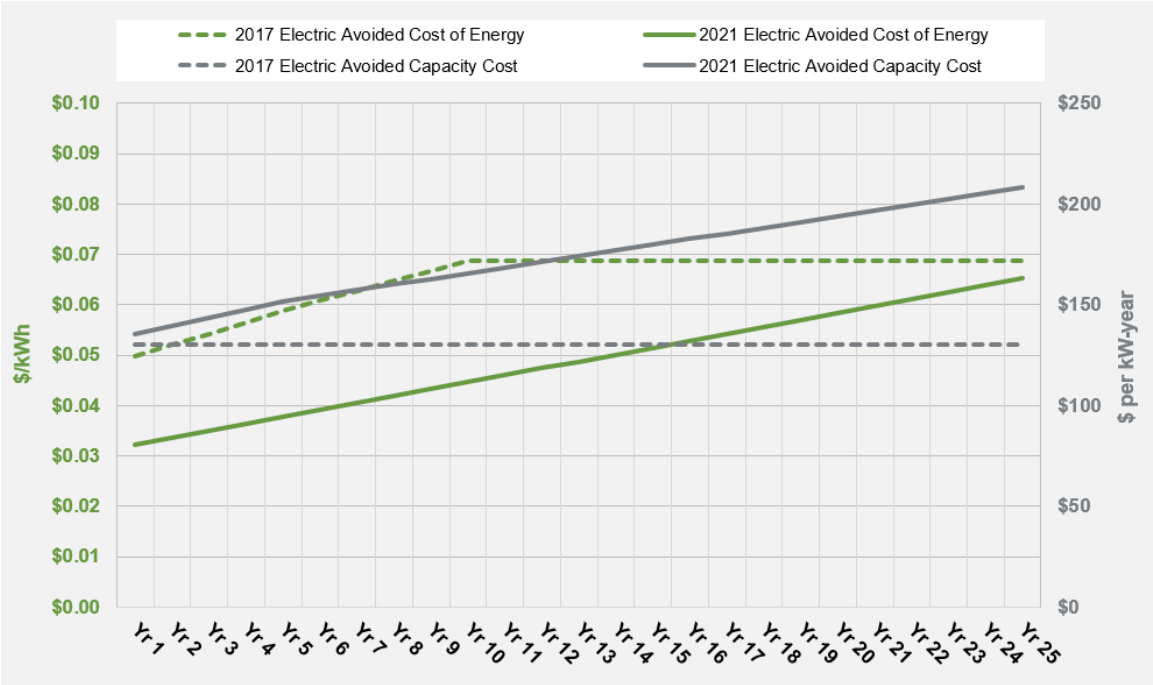


Figure 5 shows the avoided energy cost of natural gas from the 2017 potential study compared to the 2021 potential study. In the 2021 potential study, the natural gas avoided energy cost varied between residential and nonresidential customers. For residential customers, the 25-year levelized natural gas avoided cost of energy decreased from $1.322 per therm in the 2017 study to $0.922 per therm in the 2021 study. For nonresidential customers, the 25-year levelized cost of avoided energy is $0.854 per therm in the 2021 study, a 35% decrease from the 2017 study.

Figure 5. Natural Gas Avoided Energy Cost Comparison

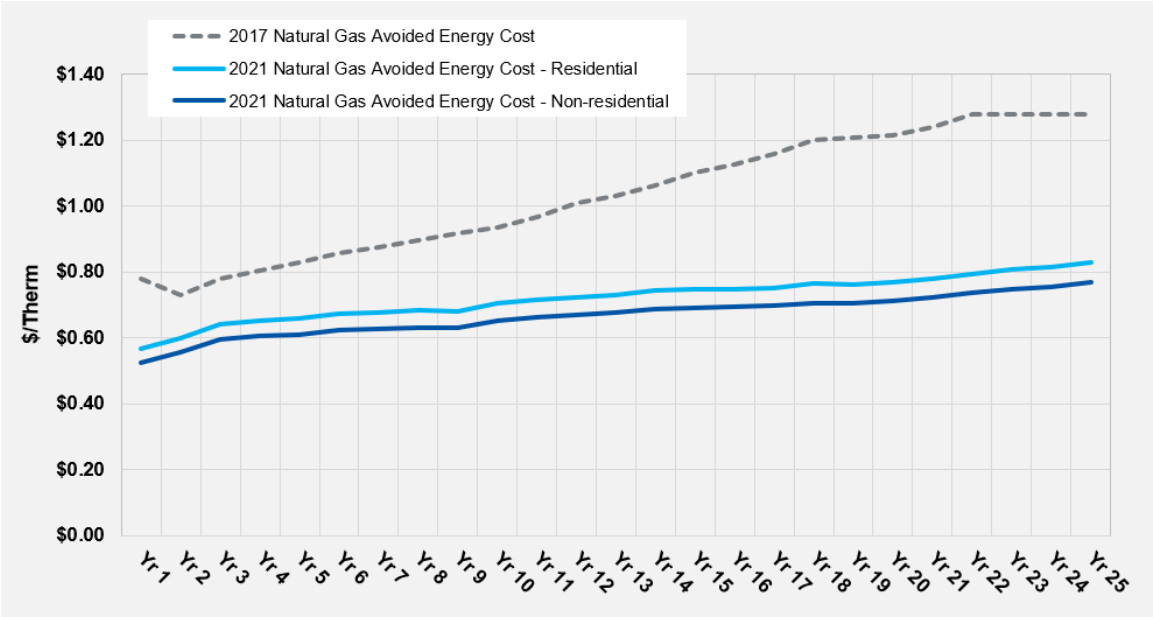


Figure 6 shows how these results compare to the cumulative 12-year potential estimates from the 2017 Focus on Energy potential assessment. Overall, technical potential increased by 12%, and economic potential increased by 5% compared to the 2017 study. At the sector level, economic potential has increased for multifamily, commercial, and industrial sectors, but decreased slightly for agriculture, government, and single-family sectors.

Figure 6. Electric Comparison to 2017 Focus on Energy Potential Study: Technical and Economic Energy Efficiency Potential by Sector

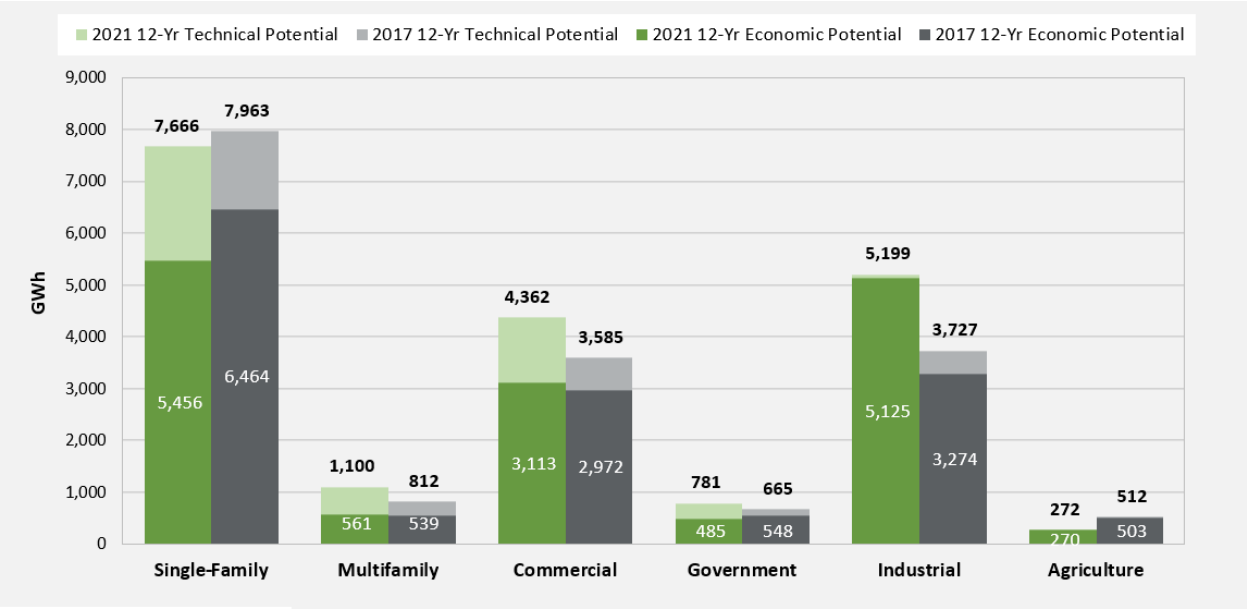


Table 6 shows the 2021 percentage of the baseline sales that the cumulative 12-year electric technical and economic potential make up compared to the 2017 study. The table shows that although the economic potential decreased in the agriculture sector in the 2021 study, the economic potential as a percentage of baseline sales is higher. Therefore, this decrease, as it compares to the 2017 potential study, is due to the updated baseline sales forecast. For the single-family and government sectors, the decrease in economic potential is largely the result of changes in avoided costs and measure-cost calculations. Additionally, the decrease in the residential sector is primarily because of the shift to an LED baseline as the technology has achieved a greater share of the residential lighting market compared to the prior study (single-family increased from roughly 14% LED saturation to over 50% LED saturation).

Table 6. Electric Comparison to 2017 Focus on Energy Study:
Technical and Economic Energy Efficiency Potential as a Percentage of Baseline Sales by Sector

Sector	12-Year Technical Potential Percentage of Final Year Sales		12-Year Economic Potential Percentage of Final Year Sales	
	2017 Study	2021 Study	2017 Study	2021 Study
Single-Family	46%	43%	37%	30%
Multifamily	35%	36%	23%	18%
Commercial	20%	24%	17%	17%
Government	21%	26%	18%	16%
Industrial	15%	19%	13%	19%
Agriculture	21%	21%	20%	21%
Total	**25%**	**27%**	**21%**	**21%**

Figure 7 shows the 2021 natural gas technical and economic potential compared to the 2017 study. In the nonresidential sector, technical potential decreased 15% and economic potential decreased 31% compared to the 2017 study. These changes resulted from changes in cost-year calculation methodologies and the most recent survey data for nonresidential customers that showed a decrease in natural gas heating. Additionally, industrial savings were impacted by updated end-use saturations from the 2018 Energy Information Administration's Manufacturing Energy Consumption Survey and new measure savings data added to the Industrial Assessment Center's project database between 2017 and 2020.

Figure 7. Natural Gas Comparison to 2017 Focus on Energy Potential Study: Technical and Economic Energy Efficiency Potential by Sector

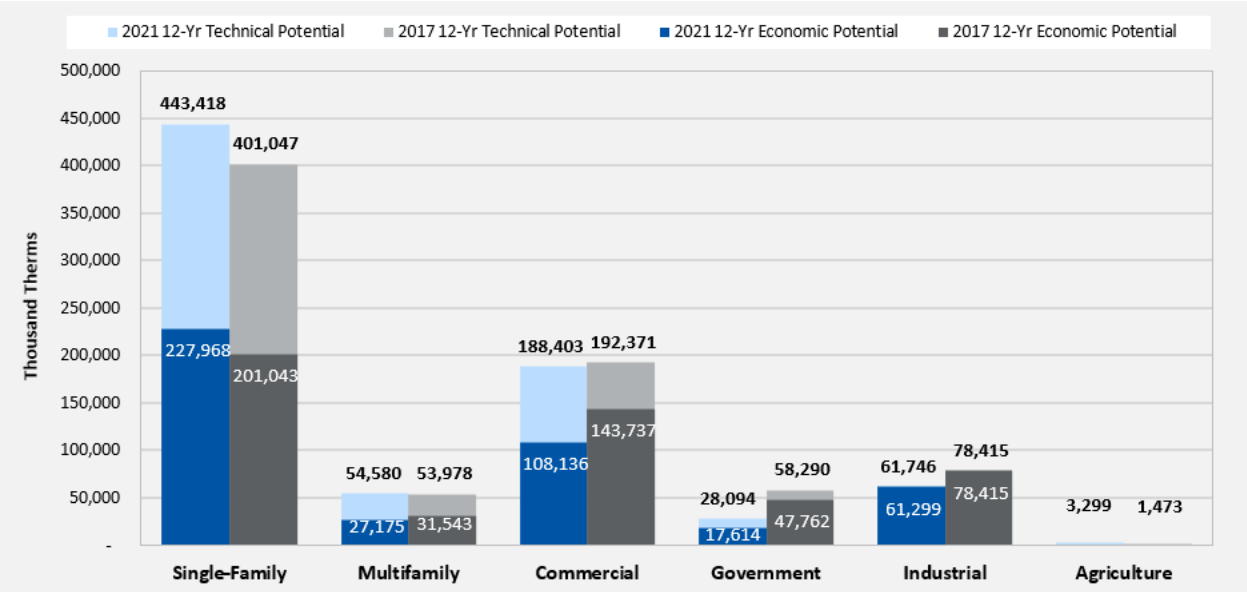


Table 7 shows 2021 natural gas technical and economic potential as a percentage of baseline sales by sector compared to the 2017 potential study. The technical potential is 29% of the baseline sales in the final year of the 2021 study but was 32% in the 2017 potential study. Economic potential also decreased, with 16% of the baseline sales as cost-effective energy efficiency potential in the 2021 study compared to 20% in the 2017 study. This is a result of the following factors:

- An update to the most recent commercial survey data showing less natural gas heating in commercial buildings.
- An update to the most recent industrial data sources to determine end-use saturations.
- Lower avoided energy costs in the 2021 study.

Table 7. Natural Gas Comparison to 2017 Focus on Energy Potential Study: Technical and Economic Energy Efficiency Potential as a Percentage of Baseline Sales by Sector

Sector	12-Year Technical Potential Percentage of Final Year Sales		12-Year Economic Potential Percentage of Final Year Sales	
	2017 Study	2021 Study	2017 Study	2021 Study
Single-Family	31%	29%	16%	15%
Multifamily	27%	27%	16%	13%
Commercial	34%	33%	26%	19%
Government	43%	40%	35%	25%
Industrial	30%	22%	30%	21%
Agriculture	16%	9%	2%	1%
Total	**32%**	**29%**	**20%**	**16%**

Residential Sector Results

The 2021 study shows that the residential sector will account for 30% of baseline electric sales in 2034 and 40% of total electric economic potential. The residential sector is composed of distinct segments as defined in this study: single-family, manufactured, and multifamily homes, as well as the income-qualified customer segment.

Table 8 shows the electric technical and economic potential by residential segment. The single-family and manufactured home segment has the greatest economic potential in total megawatt-hour savings. The PSC requested that Cadmus include specific results for the income-qualified segment, which includes all home types. The income-qualified segment has less overall potential savings, but the highest potential as a percentage of sales at 31%, with 74% of the technical potential being economically feasible.

Table 8. Residential Electric Technical and Economic Energy Efficiency Potential by Segment

Segment[1]	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Single-Family and Manufactured Homes	12,182,981	5,069,403	42%	3,380,113	28%	67%
Multifamily	1,426,539	531,316	37%	291,162	20%	55%
Income-Qualified	7,477,639	3,165,507	42%	2,345,435	31%	74%
Total	**21,087,159**	**8,766,226**	**42%**	**6,016,709**	**29%**	**69%**

[1] In this table income-qualified estimates are not included in the single-family and manufactured homes and multifamily segment results. Income-qualified results include customers in single-family, manufactured, and multifamily homes.

Within the residential sector, the single-family homes account for the bulk of the electric potential savings at 55%. Figure 8 also shows that the income-qualified segment also contributes a large percentage of the potential at 39%.

Figure 8. Residential Electric Economic Potential by Segment, 2034

	Single-Family 55%	Income-Qualified 39%	Multifamily 5%	Manufactured 1%

Table 9 shows the economic and technical potential for natural gas by segment. Single-family and manufactured homes have the most economic potential savings. Like the electric savings, the income-qualified segment has the highest savings as a percentage of sales at 17%, with 56% of the technical potential being economically feasible.

Table 9. Residential Natural Gas Technical and Economic Energy Efficiency Potential by Segment

Segment[1]	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Single-Family and Manufactured Homes	1,063,634	297,364	28%	143,834	14%	48%
Multifamily	112,918	32,101	28%	16,988	15%	53%
Income-Qualified	557,895	168,533	30%	94,322	17%	56%
Total	**1,734,447**	**497,998**	**29%**	**255,144**	**15%**	**51%**

[1] In this table income-qualified estimates are not included in the single-family and manufactured homes and multifamily segment results. Income-qualified results include single-family, manufactured, and multifamily homes.

As shown in Figure 9, the natural gas potential by segment is similar to the electric potential. Within the residential sector, single-family homes and the income-qualified segment represent the bulk of the potential savings, with a combined 93% of potential. The multifamily segment contributes slightly more natural gas potential savings than electric.

Figure 9. Residential Natural Gas Economic Potential by Segment, 2034

Single-Family 56%	Income-Qualified 37%	Multifamily 7%	Manufactured 1%

Note: Percentages may not sum up to 100% due to rounding.

Table 10 shows the electric end-use groups with the most economic potential across all residential segments. Water heat has the largest economic potential in megawatt-hours of all the end uses. Economic potential from water heat represent 56% of forecasted sales for that end use for 2034. Refrigerators have the second highest potential, with 99% of the technical potential being economically feasible. While plug load has the largest amount of forecasted sales, only 10% of that is economic. Notably, cooking and electric vehicles have a small percentage of technical potential, but none of it is economic.

Table 10. Residential Electric Technical and Economic Energy Efficiency Potential by End-Use Group

End-Use Group	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Water Heat	3,636,442	2,301,609	63%	2,027,565	56%	88%
Refrigerator	2,358,533	1,382,171	59%	1,362,228	58%	99%
Lighting	1,817,038	1,529,437	84%	1,118,152	62%	73%
Cooling	1,887,151	883,163	47%	677,660	36%	77%
Plug Load	5,038,707	891,144	18%	522,270	10%	59%
Heating	2,371,615	845,865	36%	298,774	13%	35%
Ventilation and Circulation	1,384,157	302,183	22%	3,655	0%	1%

End-Use Group	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Pool Pump	147,222	12,672	9%	4,861	3%	38%
Dryer	1,464,960	611,084	42%	1,544	0%	0%
Cooking	625,065	3,462	1%	0	0%	0%
Electric Vehicle	356,269	3,437	1%	0	0%	0%
Total	**21,087,159**	**8,766,226**	**42%**	**6,016,709**	**29%**	**69%**

Figure 10 shows the electric potential as a percentage of the total potential by end-use group. There is some reordering of potential once the economic screen is applied. Lighting has the second highest technical potential, but it drops behind refrigerator for economic potential. Other end uses, such as dryer, ventilation, and pool pumps, show significant technical potential, but have less than 1% of the total potential once the economic screen is applied.

Figure 10. Residential Electric Technical and Economic Energy Efficiency Potential by End-Use Group, 2034

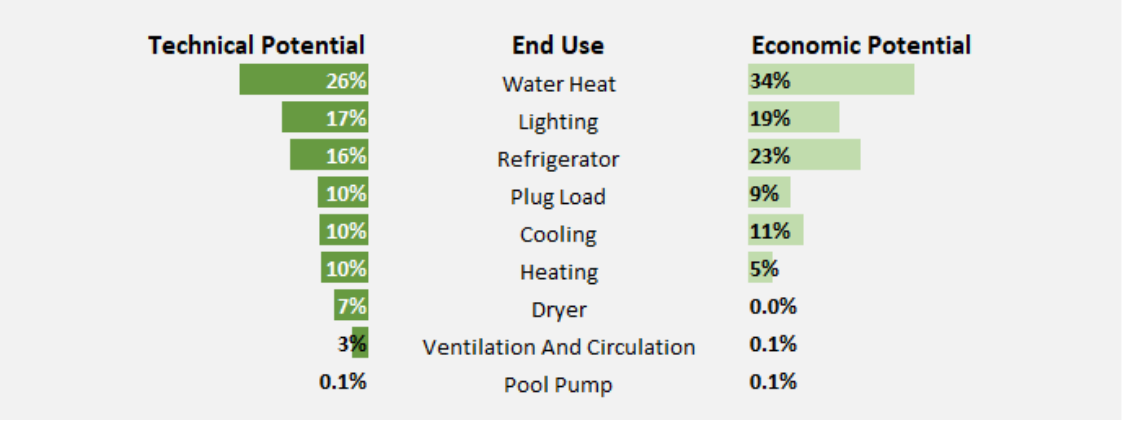


Table 11 shows natural gas potential by end-use group across all residential segments. Heat central gas furnace has the highest economic potential in thousand therms. While water heat has the highest percentage of technical and economic potential when compared with forecasted sales, at 76% and 45% respectively, the gross therms from water heat are far less than heat central gas furnace. The dryer and cooking end-use groups both show some level of technical potential, but none of it is economic.

Table 11. Residential Natural Gas Technical and Economic Energy Efficiency Potential by End-Use Group

End-Use Group	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Heat Central Gas Furnace	1,274,918	312,204	24%	130,049	10%	42%
Water Heat	210,380	123,051	58%	94,051	45%	76%
Heat Central Gas Boiler	212,828	58,029	27%	30,935	15%	53%
Pool Heat	5,795	588	10%	109	2%	19%
Dryer	12,789	1,851	14%	0	0%	0%
Cooking	17,738	2,275	13%	0	0%	0%
Total	**1,734,447**	**497,998**	**29%**	**255,144**	**15%**	**51%**

Figure 11 highlights the total natural gas potential across end-use groups. The figure shows the percentage of potential for each end use for technical and economic potential. For furnaces, more technical potential is screened out relative to water heaters, leading to a relative decrease in economic potential for furnaces and a relative increase in water heat potential. Pool heat does contribute some economic potential, as shown in Table 11, but it totals less than 0.1% of the total potential.

Figure 11. Residential Natural Gas Technical and Economic Energy Efficiency Potential by End-Use Group, 2034

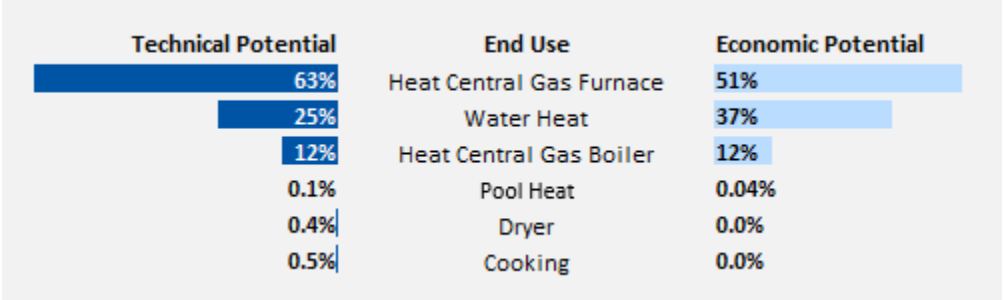


Table 12 shows the top 15 electric measures based on their economic savings potential. Removal of secondary refrigerators has the greatest economic potential for electric savings, contributing over 16% of the total economic potential. This top measure has nearly 400 MWh more cumulative economic savings compared to the next highest measure, low-flow showerheads. While the single measure with the most savings falls within the refrigerator end-use group, individual water heating measures together in the water heating end-use group contribute greater total savings.

Table 12. Top Electric Energy Efficiency Saving Residential Measures

Residential Energy Efficiency Measure	Cumulative 12-Year Economic Potential (MWh)	Percentage of Total Residential Economic Potential
Refrigerator - Removal of Secondary	982,666	16.33%
Low-Flow Showerhead	588,749	9.79%
Faucet Aerator Low Flow - Kitchen	550,059	9.14%
Lighting General Service Lamp - CEE Tier 2 LED	486,269	8.08%
Central Air Conditioner – Advanced [a]	312,137	5.19%
Freezer - Removal of Stand-Alone	290,463	4.83%
Lighting Specialty Lamp - CEE Tier 2 LED	282,328	4.69%
Faucet Aerator Low Flow – Bathroom	200,161	3.33%
Lighting Specialty Lamp - CEE Tier 2 LED	282,328	4.69%
Dehumidifier - ENERGY STAR® 2020 Most Efficient	170,496	2.83%
Wi-Fi Thermostat	167,198	2.78%
Heat Pump Water Heater - Advanced Efficiency [b]	157,107	2.61%
Heat Pump Water Heater - Enhanced Efficiency [b]	147,692	2.45%
Heat Pump Water Heater - ENERGY STAR [b]	140,722	2.34%
Clothes Washer (Top Loading) - CEE Tier 1	133,885	2.23%

[a] This measure represents a minimum efficiency of 24 SEER/18.5 EER.

[b] Heat pump water heater efficiencies for less than or equal to 55 gallons for ENERGY STAR, enhanced, and advanced are EF 2.0, EF 2.2, and EF 2.8, respectively. Heat pump water heater efficiencies for greater than 55 gallons for ENERGY STAR and advanced are EF 2.2 and EF 2.8, respectively. There is no heat pump water heater – enhanced efficiency for greater than 55 gallons (as this is covered by the ENERGY STAR iteration).

Table 13 shows the top 15 natural gas saving measures by their economic potential. Low-flow showerhead is the top measure, contributing 14.99% of the total residential potential. The top five natural gas measures have a closer distribution in terms of their economic potential percentages than the top five electric measures. Similar to the electric measures, the top measure is in the water heating end-use group, while the heat central gas furnace end-use group contributes the greatest overall savings.

Table 13. Top Natural Gas Energy Efficiency Saving Residential Measures

Residential Energy Efficiency Measure	Cumulative 12-Year Economic Potential (Thousand therms)	Percentage of Total Residential Economic Potential
Low-Flow Showerhead	38,239	14.99%
Faucet Aerator Low Flow – Kitchen	35,037	13.73%
Direct Energy Feedback Residential - HVAC Schedule Setback	32,686	12.81%
Furnace - Premium Efficiency (98% AFUE)	29,435	11.54%
Wall Insulation - Wisconsin Uniform Dwelling Code (WI UDC) Zone 1 Code	25,429	9.97%
Wi-Fi Thermostat	25,304	9.92%
Faucet Aerator Low Flow – Bathroom	12,783	5.01%
Wi-Fi Thermostat - Seasonal Savings	9,250	3.63%
Door - WI UDC Zone 1 and 2 Above Code	8,769	3.44%
Programmable Thermostat	7,537	2.95%

Residential Energy Efficiency Measure	Cumulative 12-Year Economic Potential (Thousand therms)	Percentage of Total Residential Economic Potential
Infiltration Control - Reduction of Existing Conditions	4,562	1.79%
Direct Digital Control System-Installation [a]	4,478	1.75%
Clothes Washer (Top Loading) - CEE Tier 1	3,776	1.48%
Pipe Insulation - Boiler – Code	2,839	1.11%
Indirect Energy Feedback Residential Tier 1 - Minutes per Shower Reduction	1,510	0.59%

[a] The installation of direct digital control systems – a commercial measure opportunity – in multifamily building common areas was included in the residential sector in this study

Income-Qualified Barriers and Opportunities

The PSC requested that Cadmus estimate energy efficiency potential for income-qualified customers and investigate barriers for implementing energy efficiency programming within this population. While Focus on Energy currently offers special incentives to customers whose income is 80% or less than the Wisconsin median income, it does not offer a targeted program for this population. Currently, energy efficiency programs in Wisconsin that are directed toward income-qualified customers are delivered through community action partner organizations. The income-qualified segment represents a large portion of the technical and economic potential within the residential sector. Understanding the barriers and opportunities of the income-qualified segment is therefore critical if Focus on Energy considers targeted programming in the future.

As part of the 2021 potential study, Cadmus conducted interviews with six community action partner stakeholders in Wisconsin who provide energy efficiency programs and services to the income-qualified segment. The objectives of the interviews were to identify the barriers to and opportunities for energy efficiency specific to the income-qualified segment. It should be noted that community action partner agencies typically engage with the Wisconsin Department of Administration's Weatherization Assistance Program which targets households at or below 60% of statewide median household income. Interviews were not designed to distinguish barriers and opportunities for customers at these different income eligibility levels. Rather, the interviews were performed to gain generalized insights based on the knowledge and experience of the agencies. The following subsections present key findings from these interviews. The viewpoints of the stakeholders reflect implementing specific income-qualified programs, usually focused on weatherization or whole-home retrofits, and may not necessarily reflect barriers of targeted income-qualified efforts that could be implemented through Focus on Energy.

Customer Barriers

Lack of money. Two agencies reported lack of money as a barrier. One of the agencies highlighted that income-qualified customers, especially people of color, often pay the most for utilities because they tend to live in older, leaky homes that were cheaply built. Another agency explained that rent in income-qualified buildings often has a cap that reduces the amount of cashflow available for property owners and managers to invest in large energy efficiency improvements.

Lack of awareness and knowledge. Three agencies reported this barrier. In particular, they emphasized that customers do not understand what energy-consuming products in their homes are costing them money and they do not know the benefits that energy efficiency programs and products can provide. Agencies also noted that customers do not have knowledge about HVAC systems and what options and alternatives are available to them. For property owners/managers, agencies said these individuals often do not know how to go about and move forward with an energy efficiency project.

Lack of time. Two agencies mentioned that income-qualified customers do not have time, as a result of having to work multiple jobs and long hours. Because energy-efficient upgrades require time, agencies noted that it becomes challenging to reach these customers and find a time to schedule a service for their home. These customers live minute by minute and cannot afford to take a day off to get their homes upgraded. Moreover, agencies have found it difficult to get customers to think long term; these customers tend to think in terms of "if something is not broken, then why bother to fix it."

Organizational and Market Barriers

Lack of qualified contractors. Three agencies said that contractors play an important role in delivering their energy efficiency programs and services to the income-qualified segment. These agencies noted that it is difficult to find contractors with the proper certification and training to work on energy-efficient projects. Contractors are also put off by the red tape (i.e., paperwork and procurement process) involved with energy efficiency projects, which may contribute to their disinterest in pursuing certification and training. As such, agencies said that they do not have enough qualified contractors to deliver energy efficiency programs and services to income-qualified customers.

Current program eligibility criteria. Two agencies reported this barrier. One of the agencies gave the example of program restrictions on mobile homes, which many income-qualified households live in. Another agency mentioned that trying to get customers referred to other programs was difficult because each program has different eligibility criteria and criteria constantly change; the constant change makes it difficult for agency staff to keep up and accurately inform customers.

Poor quality housing stock. One agency explained because the housing stock in rural areas is often of poor quality, these homes are viewed as not being worth the money and effort to invest in energy efficiency.

Interest Level and Products of Interest

Five of six agencies said that income-qualified households and property owners/managers are interested in energy efficiency and are generally open to any product that is offered to them. The interest in energy efficiency for households is primarily driven by cost savings and secondly by increasing comfort in the home. For property owners/managers, interest in energy efficiency is also primarily driven by cost savings and secondly by tenant retention.

Agencies said that the most popular products with income-qualified customers are mechanical, tangible products that can be seen. In particular, agencies reported that customers are interested in windows, air conditioning, furnaces, refrigerators, freezers, lighting and smart strips. Least popular with income-qualified customers are hidden measures, such as insulation and air sealing, or noisy products, such as

exhaust fans. Agencies have had to spend more time educating customers on the benefits of these hidden and noisy products to sway customers into adopting these products.

How to Overcome Barriers

As shown in Table 14, the community action partner agencies offered suggestions on ways to overcome the barriers to energy efficiency adoption among the income-qualified segment.

Table 14. Ways to Overcome Barriers to Energy Efficiency Adoption for Income-Qualified Segment

Customer Barriers	Ideas on Ways to Overcome Barriers
Lack of money	• Use geospatial analysis to identify and target customers with high utility bills and problematic properties • Offer more or higher incentives instead of financing
Lack of awareness and knowledge	• Increase the communication skills of staff, auditors, and contractors • Communicate the product purpose and benefits with simple language • Use a concierge-type model that will guide and coach the property owner/manager throughout the project process • Diversify outreach methods and make sure program language is up to date
Lack of time within the traditional 9 A.M. to 5 P.M. program hours	• Offer additional service times to accommodate income-qualified customers who often have multiple jobs
Organizational and Market Barriers	**Ideas on Ways to Overcome Barriers**
Lack of qualified contractors	• Increase contractor interest and awareness via information-sharing events and platforms • Offer the same products, procedures, and testing across energy efficiency programs • Develop a pool of qualified, program-dedicated contractors
Current program eligibility criteria	• Have the state review the rules and establish a working group to come up with solutions on how to include mobile homes and previously weatherized homes

Commercial and Government Sector Results

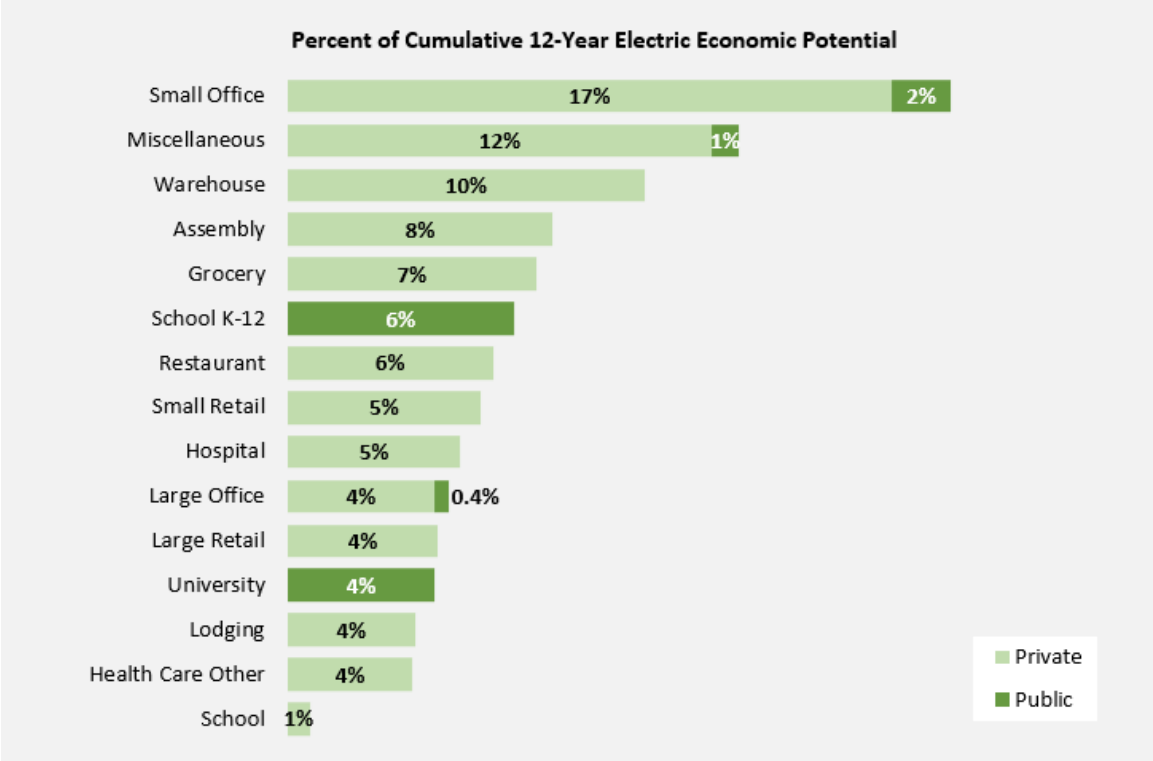
The 2021 potential study shows the commercial and government sector accounts for 30% of baseline sales in 2034 and 24% of total economic potential. The commercial and government sector is made up of 18 segments, listed in Table 15. The table shows electric 2034 forecast sales, cumulative 12-year technical and economic potential, and the potential as a percentage of baseline sales for each segment.

Table 15. Commercial and Government Electric Technical and Economic Energy Efficiency Potential by Segment

Segment	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Small Office – Private	3,757,073	902,622	24%	617,720	16%	68%
Miscellaneous – Private	2,437,703	590,626	24%	434,165	18%	74%
Warehouse	2,131,780	441,898	21%	365,204	17%	83%
Grocery	1,757,515	398,915	23%	254,406	14%	64%
School K-12 – Public	1,276,703	345,029	27%	231,493	18%	67%
Assembly	925,939	333,515	36%	271,399	29%	81%
Restaurant	1,400,699	287,917	21%	209,757	15%	73%
Small Retail	1,322,611	287,094	22%	197,556	15%	69%
University – Public	1,107,548	280,101	25%	150,896	14%	54%
Hospital	1,104,915	249,418	23%	177,046	16%	71%
Large Office - Private	931,601	244,851	26%	150,263	16%	61%
Large Retail	810,023	224,361	28%	154,128	19%	69%
Health Care Other	839,646	200,491	24%	128,029	15%	64%
Lodging	647,332	167,048	26%	130,234	20%	78%
Small Office - Public	406,232	91,741	23%	60,192	15%	66%
Miscellaneous - Public	167,771	38,013	23%	26,854	16%	71%
School – Private	124,135	33,119	27%	23,020	19%	70%
Large Office - Public	101,595	25,688	25%	15,148	15%	59%
Total	**21,250,823**	**5,142,447**	**24%**	**3,597,511**	**17%**	**70%**

Figure 12 shows the distribution of cumulative 12-year electric economic potential by each commercial and government segment. Small offices, miscellaneous (including a broad range of commercial businesses that either do not fit into another commercial building type or are generally unclassifiable), warehouses, and assemblies (including churches, theaters, gymnasiums, etc.) make up the largest proportion of the sector's economic potential at 49%.

Figure 12. Commercial and Government Electric Economic Potential by Segment, 2034



The commercial and government sector accounts for 24% of baseline natural gas sales in 2034 and 28% of total economic potential. Table 16 shows the natural gas 2034 forecast sales, the cumulative 12-year technical and economic potential, and the potential as a percentage of baseline sales for each segment.

Table 16. Commercial and Government Natural Gas Technical and Economic Energy Efficiency Potential by Segment

Segment	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Small Office - Private	107,468	32,990	31%	22,572	21%	68%
Miscellaneous - Private	73,141	26,478	36%	16,196	22%	61%
Assembly	61,901	23,657	38%	11,048	18%	47%
School K-12 - Public	44,316	18,536	42%	10,828	24%	58%
Restaurant	62,977	13,799	22%	10,668	17%	77%
Small Retail	43,740	13,291	30%	8,727	20%	66%
Large Retail	30,738	11,782	38%	8,057	26%	68%
Large Office - Private	39,170	15,333	39%	6,183	16%	40%
Health Care Other	30,551	9,413	31%	5,957	19%	63%
Grocery	20,824	6,893	33%	4,982	24%	72%
Warehouse	58,142	20,069	35%	4,770	8%	24%
Hospital	14,473	5,025	35%	4,310	30%	86%

Segment	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
University - Public	10,709	4,585	43%	4,035	38%	88%
Lodging	24,827	7,261	29%	3,044	12%	42%
Small Office - Public	9,486	2,930	31%	1,817	19%	62%
School - Private	6,155	2,412	39%	1,622	26%	67%
Large Office - Public	3,457	1,340	39%	504	15%	38%
Miscellaneous - Public	1,922	702	37%	429	22%	61%
Total	**643,999**	**216,497**	**34%**	**125,750**	**20%**	**58%**

Figure 13 shows the distribution of cumulative 12-year economic potential by segment, with public and private segments broken out within each segment group. Similar to the electric distribution, small offices, miscellaneous, and assemblies make up the largest proportion of economic potential in the sector. Combined, the top three segments account for 41% of the overall economic potential in the commercial and government sector.

Figure 13. Commercial and Government Natural Gas Economic Potential by Segment, 2034

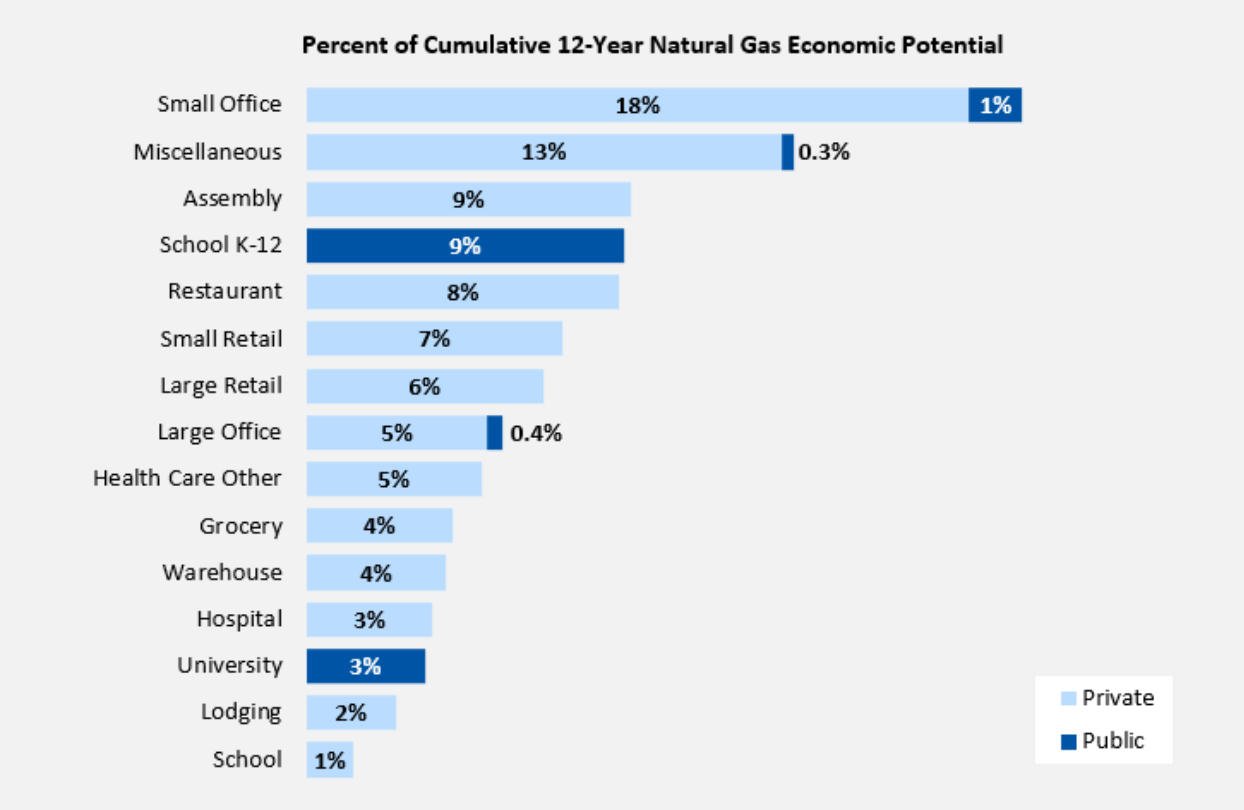


Table 17 shows the distribution of cumulative 12-year technical and economic potential by end use. Lighting makes up the greatest proportion of the potential in the commercial and government sector that is cost-effective. The lighting economic potential is 40% of the sector's 2034 baseline sales and 96% of the sector's total technical potential. This is the second most cost-effective end use, after cooking, where 99% of the technical potential is cost-effective.

Table 17. Commercial and Government Electric Technical and Economic Energy Efficiency Potential by End-Use Group

End-Use Group	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Lighting	4,916,223	2,044,090	42%	1,962,060	40%	96%
Ventilation	3,041,214	1,216,123	40%	424,144	14%	35%
Refrigeration	2,621,045	695,385	27%	525,860	20%	76%
Cooling	883,260	486,579	55%	220,686	25%	45%
Heating	1,105,983	282,771	26%	165,222	15%	58%
Water Heat	366,314	192,096	52%	138,918	38%	72%
Plug Load	6,980,885	132,764	2%	118,696	2%	89%
Compressed Air	735,685	48,820	7%	1,034	0%	2%
Cooking	542,096	35,085	6%	34,645	6%	99%
Dryer	53,697	8,121	15%	5,823	11%	72%
Pool Pump	4,421	615	14%	423	10%	69%
Total	**21,250,823**	**5,142,447**	**24%**	**3,597,511**	**17%**	**70%**

Electric technical and economic potential for the commercial and government sector is made up of 11 end-use groups. Figure 14 shows the distribution of the 2034 cumulative technical and economic potential for the commercial and government sector. The top three end uses make up 82% of this economic potential, with lighting making up 55% of the sector total.

Figure 14. Commercial and Government Electric Technical and Economic Energy Efficiency Potential by End-Use Group, 2034

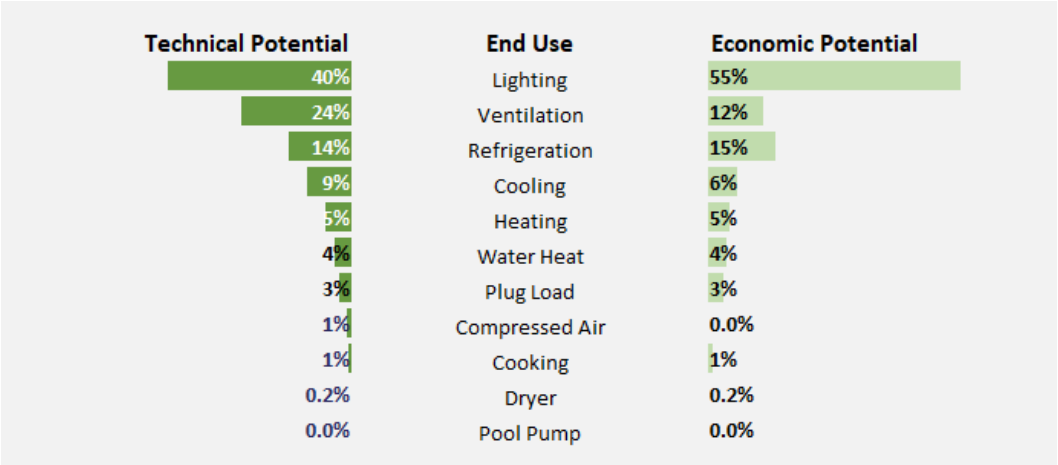


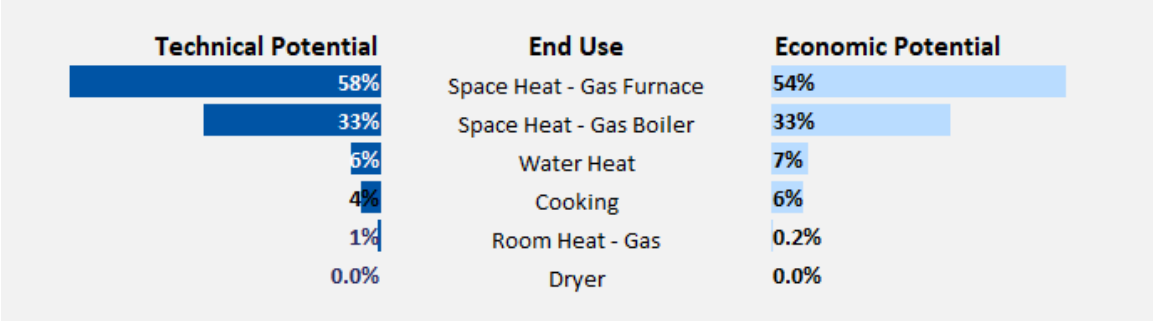
Table 18 shows the distribution of 12-year natural gas technical and economic potential by end use. Furnaces and boilers have the greatest amount of economic potential at 109,575 thousand therms. Like electric economic potential, cooking technical potential is the most cost-effective, with 96% of the technical potential being economically feasible.

Table 18. Commercial and Government Natural Gas Technical and Economic Energy Efficiency Potential by End-Use Group

End-Use Group	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Space Heat - Gas Furnace	374,629	124,499	33%	68,122	18%	55%
Space Heat - Gas Boiler	174,932	70,488	40%	41,453	24%	59%
Water Heat	38,908	12,253	31%	8,543	22%	70%
Cooking	45,847	7,720	17%	7,398	16%	96%
Room Heat – Gas	8,936	1,507	17%	234	3%	16%
Dryer	747	31	4%	0	0%	0%
Total	**643,999**	**216,497**	**34%**	**125,750**	**20%**	**58%**

Natural gas technical and economic potential for the commercial and government sector is made up of six end-use groups. Figure 15 shows the distribution of the 2034 cumulative natural gas technical and economic potential for the commercial and government sector. Space heating makes up 91% of the sector's total technical potential and 87% of the total economic potential.

Figure 15. Commercial and Government Natural Gas Technical and Economic Energy Efficiency Potential by End-Use Group, 2034



The top 15 electric, economic savings measures are made up of a variety of measures, listed in Table 19. The top measures, lighting interior screw base LEDs, panel LEDs and tubular LEDs (TLEDs), and occupancy sensor controls make up 43.7% of the commercial and government sector's 2034 cumulative economic potential. In total, the top 15 measures account for 71% of the sector's economic potential.

Table 19. Top Electric Energy Efficiency Saving Commercial and Government Measures

Commercial and Government Energy Efficiency Measure	Cumulative 12-Year Economic Potential (MWh)	Percentage of Total Commercial and Government Economic Potential
Lighting Interior - Screw Base LED - Above Standard - CEE Tier 2	582,071	16.18%
Lighting Interior - TLED/LED Panel - Above Standard - DLC Premium Qualified	553,459	15.38%
Occupancy Sensor Control	435,136	12.10%
Wi-Fi Thermostat - Seasonal Savings	147,888	4.11%
Fan System - HVAC - Variable Speed Control	112,351	3.12%
Walk-in Economizer	108,205	3.01%
Pump System - HVAC Heating Pump - Variable Speed Control	99,005	2.75%
Motor - Variable air volume Box High Efficiency (Electronically Commutated Motor)	89,749	2.49%
New Construction Lighting Package - Advanced Efficiency	84,323	2.34%
Bi-Level Control, Stairwell Lighting	76,532	2.13%
Water Heater LE 55 Gal - Heat Pump Water Heater - Advanced Efficiency	69,011	1.92%
Retro-commissioning	55,968	1.56%
Display Case Permanent Magnet Synchronous AC Fan Motor	52,297	1.45%
Direct Digital Control System-Installation	49,886	1.39%
Case Replacement Low Temp	47,387	1.32%

As shown in Table 20, the top 15 natural gas economic potential savings measures make up 92% of the total commercial and government sector potential. The table lists the cumulative economic potential by measure for each of these measures. Direct digital control system installation (e.g., building energy management systems) and Wi-Fi thermostats account for almost 37% of the total economic natural gas savings for the commercial and government sector.

Table 20. Top Natural Gas Energy Efficiency Saving Commercial and Government Measures

Commercial and Government Energy Efficiency Measure	Cumulative 12-Year Economic Potential (Thousand therms)	Percentage of Total Commercial and Government Economic Potential
Direct Digital Control System Installation	30,018	23.87%
Wi-Fi Thermostat - Seasonal Savings	16,270	12.94%
Duct Repair and Sealing	8,742	6.95%
Advanced Rooftop Unit Controller	8,036	6.39%
Furnace < 225 kBtuh - ENERGY STAR 2020 Most Efficient	7,714	6.13%
Boiler < 300 kBtuh - Advanced Efficiency	7,496	5.96%
Retro-commissioning	6,334	5.04%
Infiltration Reduction	5,861	4.66%
Boiler – Stack Economizer	4,011	3.19%
Integrated Space Heating and Water Heating	3,763	2.99%
Fryers – ENERGY STAR	3,269	2.60%
Furnace < 225 kBtuh - ENERGY STAR	3,175	2.52%
Boiler Controls - Reset Temperature Control	2,992	2.38%
Garage Door Hinges – Spring Loaded	2,461	1.96%
Low-Flow Showerheads	1,354	1.08%

Industrial Sector Results

Focus on Energy participating utilities' industrial sector accounted for 39% of baseline sales in 2034 and 34% of total economic potential. Cadmus assessed energy efficiency potential for 21 industrial segments in Focus on Energy's service territory, based on allocations from participating utilities' nonresidential customer databases and the North American Industry Classification System.[7] In addition to these industrial segments, this study considered wastewater treatment facilities (wastewater), water pumping and treatment facilities (water), and street lighting within the framework of the industrial sector. This was primarily because energy consumption in these segments was process-based and did not occur within a specific building type (as in the commercial and government sector).

As shown in Table 21, the assessment identified nearly 5,199 GWh of cumulative technical potential within the industrial sector, with 99% (5,125 GWh) of the technical potential determined to be economically feasible. Within the industrial sector overall, technical and economic potential accounted for approximately 19% of forecasted 2034 baseline sales.

Table 21. Industrial Electric Technical and Economic Energy Efficiency Potential by Segment

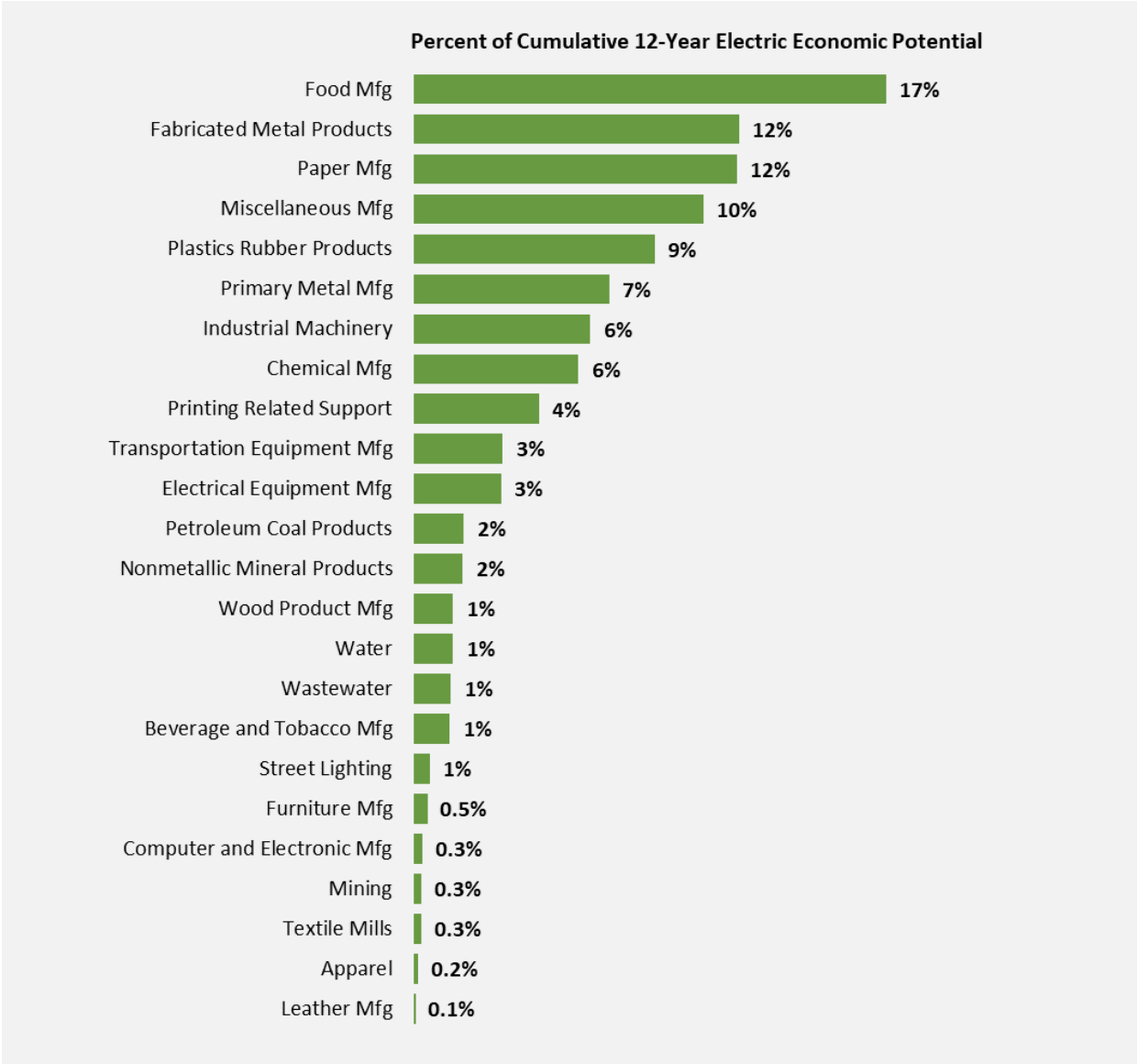
Segment	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Food Mfg	4,232,892	873,924	21%	862,634	20%	99%
Fabricated Metal Products	2,905,774	600,200	21%	595,182	20%	99%
Paper Mfg	4,499,163	601,266	13%	590,697	13%	98%
Miscellaneous Mfg	2,565,781	535,048	21%	529,097	21%	99%
Plastics Rubber Products	2,177,855	447,115	21%	439,978	20%	98%
Primary Metal Mfg	1,939,769	358,853	18%	357,439	18%	100%
Industrial Machinery	1,750,385	328,801	19%	322,710	18%	98%
Chemical Mfg	1,745,625	304,174	17%	300,368	17%	99%
Printing Related Support	1,226,249	231,599	19%	229,264	19%	99%
Transportation Equipment Mfg	748,960	164,338	22%	163,163	22%	99%
Electrical Equipment Mfg	717,073	160,781	22%	159,919	22%	99%
Petroleum Coal Products	598,556	91,925	15%	91,494	15%	100%
Nonmetallic Mineral Products	478,994	90,802	19%	90,374	19%	100%
Wood Product Mfg	428,038	73,368	17%	72,486	17%	99%
Water	304,581	71,945	24%	71,945	24%	100%
Wastewater	448,330	83,076	19%	68,397	15%	82%
Beverage and Tobacco Mfg	325,797	66,413	20%	65,688	20%	99%
Street Lighting	61,387	29,453	48%	29,453	48%	100%
Furniture Mfg	138,499	25,771	19%	25,486	18%	99%
Computer and Electronic Mfg	79,497	17,727	22%	17,470	22%	99%
Mining	172,428	14,683	9%	14,683	9%	100%
Textile Mills	80,243	14,653	18%	14,463	18%	99%
Apparel	45,110	8,803	20%	8,640	19%	98%

[7] For more information on the North American Industry Classification System: https://www.naics.com/

Segment	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Leather Mfg	20,836	3,935	19%	3,877	19%	99%
Total	**27,691,821**	**5,198,651**	**19%**	**5,124,906**	**19%**	**99%**

Figure 16 shows the distribution of cumulative 12-year electric economic potential by industrial segment. Food (17%), fabricated metal products (12%), paper (12%), miscellaneous manufacturing (10%), plastics and rubber products (9%), together accounted for the majority (60%) of electric industrial cumulative economic savings potential.

Figure 16. Industrial Electric Economic Potential by Segment, 2034



Focus on Energy participating utilities' industrial sector accounted for slightly less than 11% of baseline natural gas sales in 2034 and 14% of total economic potential. Table 22 shows the segment level natural gas sales forecast in 2034, the cumulative 2034 technical and economic potential, and the potential as a percentage of baseline sales. The assessment identified almost 62 million therms of technical natural gas potential within the industrial sector, with nearly all 61 million therms determined as economically feasible. Within the industrial sector overall, cumulative technical and economic potential both accounted for approximately 22% and 21% of forecasted 2034 baseline sales, respectively.

Table 22. Industrial Natural Gas Technical and Economic Energy Efficiency Potential by Segment

Segment	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Food Mfg	53,285	12,371	23%	12,260	23%	99%
Miscellaneous Mfg	45,717	9,317	20%	9,317	20%	100%
Fabricated Metal Products	37,845	8,318	22%	8,318	22%	100%
Industrial Machinery	35,387	6,715	19%	6,618	19%	99%
Chemical Mfg	16,390	3,254	20%	3,165	19%	97%
Nonmetallic Mineral Products	12,113	2,794	23%	2,785	23%	100%
Paper Mfg	11,210	2,795	25%	2,784	25%	100%
Plastics Rubber Products	11,927	2,647	22%	2,647	22%	100%
Primary Metal Mfg	10,297	2,316	22%	2,269	22%	98%
Wood Product Mfg	10,447	2,260	22%	2,211	21%	98%
Transportation Equipment Mfg	9,895	2,148	22%	2,124	21%	99%
Printing Related Support	9,196	1,858	20%	1,858	20%	100%
Electrical Equipment Mfg	8,007	1,725	22%	1,725	22%	100%
Beverage and Tobacco Mfg	3,804	843	22%	838	22%	99%
Furniture Mfg	3,576	703	20%	703	20%	100%
Petroleum Coal Products	2,976	684	23%	678	23%	99%
Textile Mills	3,297	742	22%	742	22%	100%
Apparel	898	205	23%	205	23%	100%
Computer and Electronic Mfg	273	51	19%	50	18%	99%
Total	**286,539**	**61,746**	**22%**	**61,299**	**21%**	**99%**

Food (20%), miscellaneous (15%), fabricated metal products (14%), and industrial machinery (11%) accounted for the majority (60%) of natural gas industrial cumulative economic savings potential, as shown in Figure 17.

Figure 17. Industrial Natural Gas Economic Potential by Segment, 2034

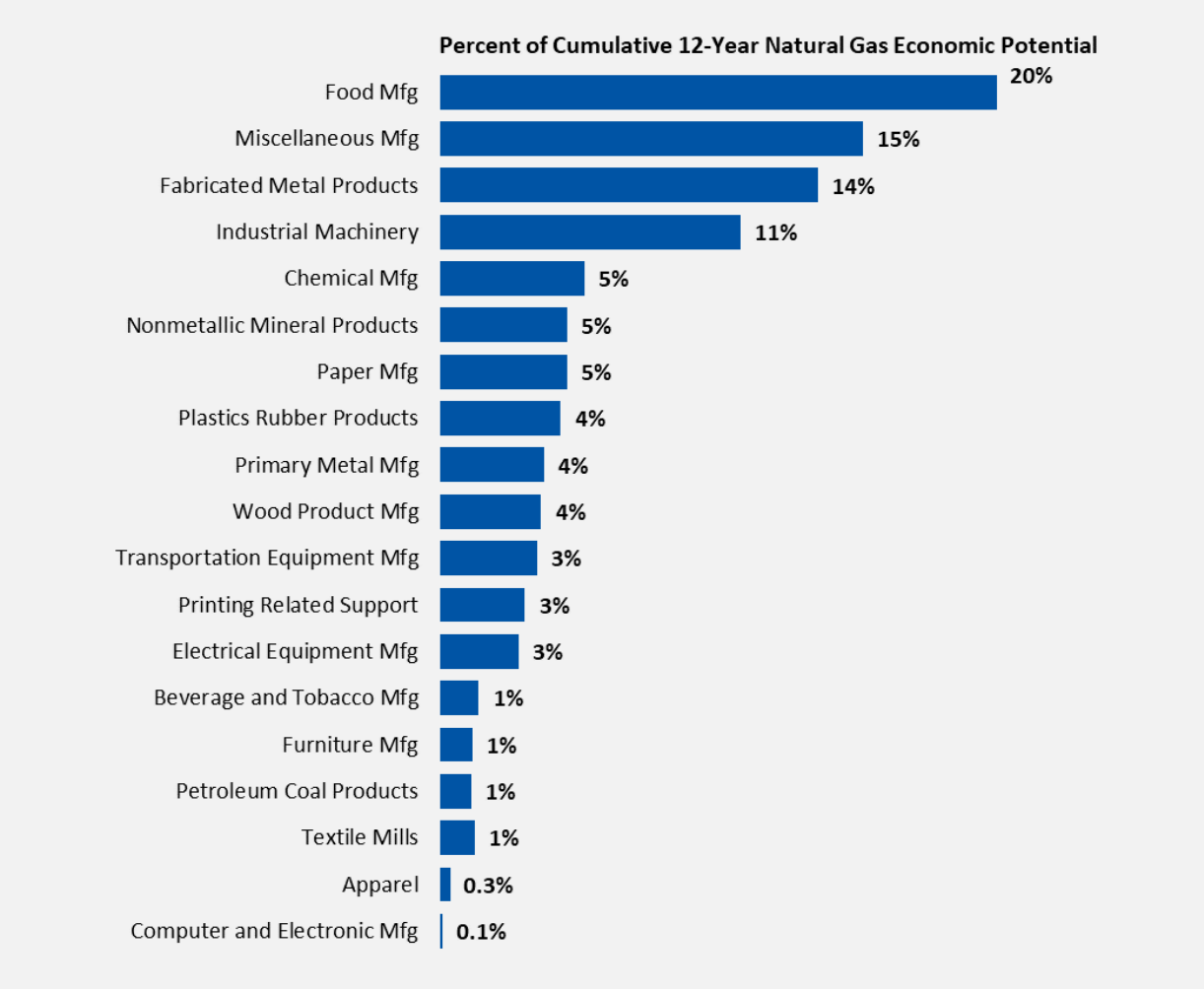


Table 23 shows the distribution of 12-year technical and economic potential by end use. The technical and economic industrial electric savings potential in the process end use each accounted for 25% of forecast electric sales. This study incorporated industrial process loads to better align with historical program accomplishments, industry expertise (from interviews conducted), and included additional process measures over the study horizon. While the process end-use economic potential accounts for the largest end-use category in terms of savings, process improvements are often specialized custom improvements, making it difficult to estimate across an entire industry.

Table 23. Industrial Electric Technical and Economic Energy Efficiency Potential by End-Use Group

End-Use Group	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Process	9,630,292	2,390,359	25%	2,390,359	25%	100%
HVAC	3,343,325	970,356	29%	963,220	29%	99%
Motors Other	5,750,653	502,964	9%	502,964	9%	100%
Lighting	1,865,362	435,190	23%	435,190	23%	100%
Pumps	3,354,159	363,156	11%	363,156	11%	100%
Fans	2,051,762	333,976	16%	329,058	16%	99%
Other	1,309,745	179,268	14%	140,959	11%	79%
Indirect Boiler	386,524	23,382	6%	0	0%	0%
Total	**27,691,821**	**5,198,651**	**19%**	**5,124,906**	**19%**	**99%**

Electric technical and economic potential for the industrial sector is made up of eight end-use groups. Figure 18 shows the distribution of the cumulative industrial technical and economic potential in 2034. The top three end uses make up 76% of the total cumulative 2034 industrial economic potential.

Figure 18. Industrial Electric Technical and Economic Energy Efficiency Potential by End-Use Group, 2034

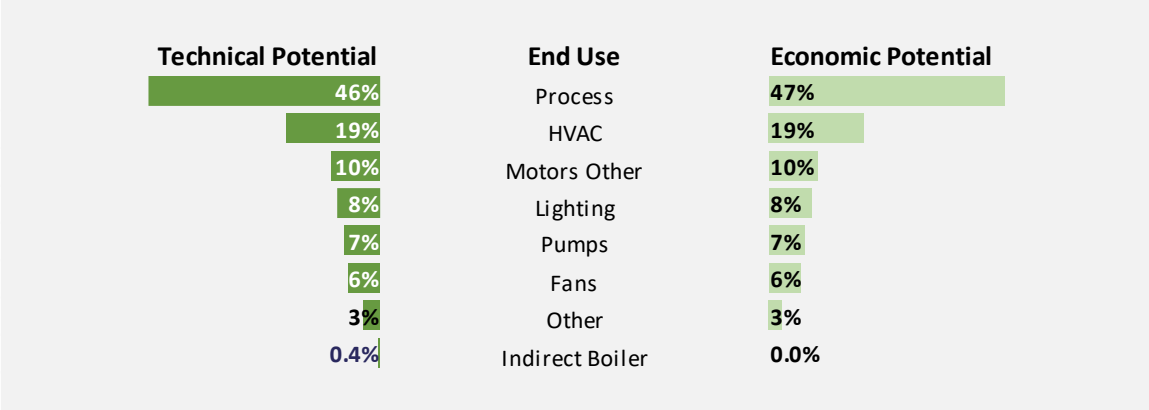


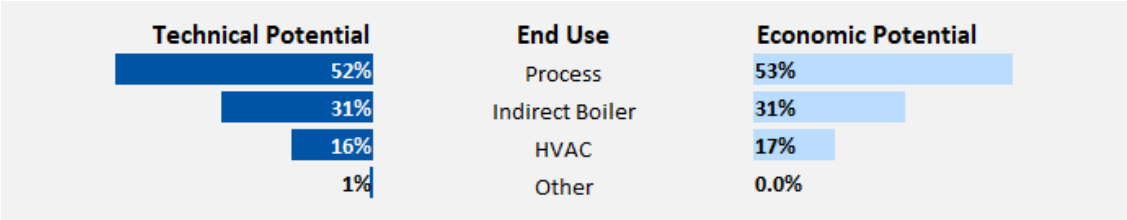
Table 24 shows the distribution of 12-year natural gas technical and economic potential by end use. The technical and economic industrial natural gas savings potential in the process end use each accounted for 25% of forecast gas sales, followed by indirect boiler (22% and 22%, respectively) and HVAC (15% and 15%, respectively). As mentioned above, not all program potential may be captured in the process end-use economic potential. However, this assessment did review prior program accomplishments and found most process improvements occurred within large facilities where the average project savings was larger than the average facility process load found within this study. This may indicate large process savings may be harder to achieve in the future and may require additional strategies by programs to capture the same levels of potential.

Table 24. Industrial Natural Gas Technical and Economic Energy Efficiency Potential by End-Use Group

End-Use Group	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Process	129,596	32,247	25%	32,247	25%	100%
Indirect Boiler	84,154	18,926	22%	18,926	22%	100%
HVAC	66,653	10,127	15%	10,127	15%	100%
Other	6,137	447	7%	0	0%	0%
Total	**286,539**	**61,746**	**22%**	**61,299**	**21%**	**99%**

Figure 19 shows the distribution of the 2034 cumulative natural gas technical and economic potential for the industrial sector by four end-use groups.

Figure 19. Industrial Natural Gas Technical and Economic Energy Efficiency Potential by End-Use Group, 2034



The top 15 electric energy-saving industrial measures, economic savings measures are shown in Table 25. The top 15 measures make up 56% of industrial electric 2034 cumulative economic potential with the top five measures representing 25% of the potential (process improvements [level 1], linear LEDs, motor optimization, cooling tower improvements, strategic energy management, and process improvements [level 2].[8]

Table 25. Top Electric Energy Efficiency Saving Industrial Measures

Industrial Energy Efficiency Measure	Cumulative 12-Year Economic Potential (MWh)	Percentage of Total Industrial Economic Potential
Process Improvements to Reduce Energy Requirements Level 1	439,125	8.57%
Lighting - Linear LED Packages	238,108	4.65%
Optimize Motor Systems with Right Sizing	227,655	4.44%
Cooling Tower Operation and Maintenance or Tune-Up	206,991	4.04%
Strategic Energy Management	184,663	3.60%
Process Improvements to Reduce Energy Requirements Level 2	178,383	3.48%
Equipment Upgrade - Replace Existing HVAC Unit with High-Efficiency Model	170,867	3.33%

[8] Level 2 process improvements are incremental to level 1 process improvements and can achieve more savings but at a higher cost.

Industrial Energy Efficiency Measure	Cumulative 12-Year Economic Potential (MWh)	Percentage of Total Industrial Economic Potential
Utilize an Evaporative Air Pre-Cooler or Other Heat Exchanger in AC System	170,559	3.33%
Install Outside Air Damper / Economizer on HVAC Unit	170,321	3.32%
Equipment Upgrade - Replace Existing Chiller with High-Efficiency Model	170,041	3.32%
Optimize Chiller and Refrigeration Systems	153,765	3.00%
Install Controls on Air Conditioning System	146,796	2.86%
Thermal Systems Recover Heat and Use for Preheating, Space Heating, Power Generation, Steam Generation, Transformers, Exhausts, Engines, Compressors, Dryers, Waste Process Heat, etc.	145,711	2.84%
Install Adjustable Frequency Drive to Replace Existing System - Motors Other	139,393	2.72%
Install Adjustable Frequency Drive to Replace Existing System – Fans	138,047	2.69%

The top 15 natural gas, economic savings measures comprise 95% of the total industrial sector potential. Table 26 lists the cumulative economic potential by measure for each of these measures. Process improvements (level 1), heat recovery for process loads, waste heat for preheating (indirect boiler end use), improved combustion air flow, and process improvements (level 2) account for almost 54% of the total economic natural gas savings for the industrial sector.

Table 26. Top Natural Gas Energy Efficiency Saving Industrial Measures

Industrial Energy Efficiency Measure	Cumulative 12-Year Economic Potential (Thousand therms)	Percentage of Total Industrial Economic Potential
Process Improvements to Reduce Energy Requirements Level 1	10,291	16.79%
Heat Recovery and Waste Heat for Process	6,658	10.86%
Waste Heat from Hot Flue Gases to Preheat	6,481	10.57%
Improve Combustion Control Capability and Air Flow	4,776	7.79%
Process Improvements to Reduce Energy Requirements Level 2	4,666	7.61%
Strategic Energy Management	4,151	6.77%
Equipment Upgrade - Replace Existing HVAC Unit with High-Efficiency Model	4,148	6.77%
Install or Repair Insulation on Condensate Lines and Optimize Condensate	3,912	6.38%
HVAC Equipment Scheduling Improvements - HVAC Controls, Timers or Thermostats	2,682	4.38%
Optimize Heating System to Improve Burner Efficiency, Reduce Energy Requirements and Heat Treatment Process	2,151	3.51%
Equipment Upgrade - Boiler Replacement	2,133	3.48%
Optimize Ventilation System	1,753	2.86%
Utilizes High-Efficiency Lime Kiln Improvements	1,632	2.66%
Analyze Flue Gas for Proper Air/Fuel Ratio	1,471	2.40%
Repair or Replace Steam Traps	1,457	2.38%

Agricultural Sector Results

Cadmus identified agricultural-specific measures for three segments (dairy, irrigation, and miscellaneous agriculture), but did not include all applicable commercial or government measures (e.g., HVAC measures) as part the agricultural sector assessment of potential. As a result, not all Focus on Energy program measures may be presented here and may show lower estimates of potential compared to programs serving agricultural customers.

Cadmus estimated potential of the three agricultural segments listed in Table 27, based on allocations from Focus on Energy participating utilities' nonresidential customer databases. The table also summarizes baseline 2034 forecast sales, cumulative technical and economic potential, and those potentials as a percentage of baseline 2034 forecast sales. Focus on Energy participating utilities' agricultural sector accounted for 2% of baseline sales in 2034 and 2% of total economic potential.

Table 27. Agricultural Electric Technical and Economic Energy Efficiency Potential by Segment

Segment	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Dairy	832,930	200,603	24%	199,510	24%	99%
Miscellaneous Ag	462,498	71,547	15%	70,863	15%	99%
Irrigation	162	44	27%	33	21%	76%
Total	**1,295,590**	**272,194**	**21%**	**270,406**	**21%**	**99%**

Overall, 99% of the agricultural electric technical potential was cost-effective. The dairy segment accounted for about three-quarters of the agricultural electric economic potential, followed by miscellaneous agriculture (26%) and irrigation (0.01%), as shown Figure 20.[9]

Figure 20. Agricultural Electric Economic Potential by Segment, 2034

Note: Percentages may not sum up to 100% due to rounding.

Table 28 shows the agricultural natural gas potential for the two segments, based on allocations from Focus on Energy participating utilities' nonresidential customer databases. The table also summarizes baseline 2034 forecast sales, cumulative technical and economic potential, and those potentials as a percentage of baseline 2034 forecast sales.

[9] The miscellaneous agriculture segment represents all non-dairy or irrigation farms, such as dry cows, hog, poultry, green houses, and other agriculture.

Table 28. Agricultural Natural Gas Technical and Economic Energy Efficiency Potential by Segment

Segment	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Miscellaneous Ag	27,975	2,328	8%	263	1%	11%
Dairy	8,838	971	11%	185	2%	19%
Total	**36,814**	**3,299**	**9%**	**448**	**1%**	**14%**

Figure 21 shows economic potential by segment, where miscellaneous agriculture represents 59% of the 2034 economic potential.

Figure 21. Agricultural Natural Gas Economic Potential by Segment, 2034

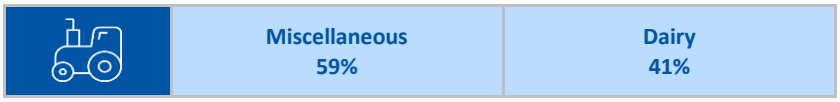


Table 29 shows cumulative 12-year potential by agricultural electric end use. Ventilation (37%), lighting (29%), and pumps (12%) together accounted for approximately 78% of the agricultural electric economic potential.

Table 29. Agricultural Electric Technical and Economic Energy Efficiency Potential by End-Use Group

End-Use Group	2034 Forecast Sales (MWh)	12-Year Technical Potential (MWh)	Technical Potential Percentage of Sales	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Ventilation	362,276	132,886	37%	132,886	37%	100%
Lighting	244,661	71,837	29%	71,638	29%	100%
Pumps	305,872	36,613	12%	36,603	12%	100%
Process	208,233	19,394	9%	18,789	9%	97%
Water Heat	48,236	6,208	13%	6,208	13%	100%
Other	126,312	5,256	4%	4,283	3%	81%
Total	**1,295,590**	**272,194**	**21%**	**270,406**	**21%**	**99%**

Figure 22 shows the distribution of agricultural electric technical and economic potential by end use.

Figure 22. Agricultural Electric Technical and Economic Energy Efficiency Potential by End-Use Group, 2034

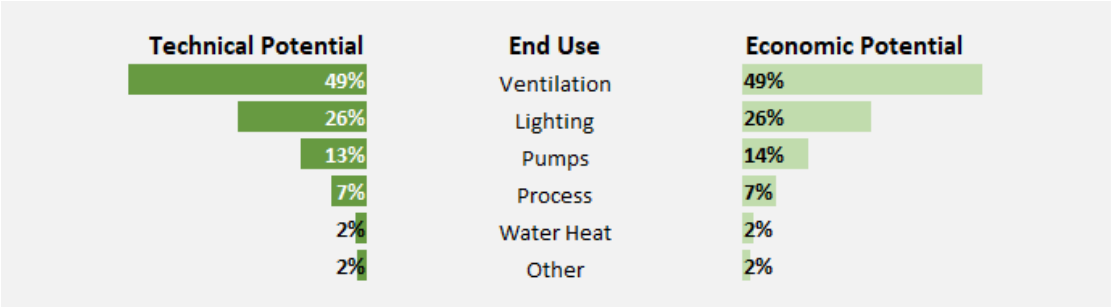


Table 30 shows cumulative 12-year potential by natural gas agriculture end use. Few agriculture buildings have natural gas connections (due to the rural locations of the buildings), with most of the sites represented as miscellaneous agriculture. As a result, Cadmus characterized the natural gas loads into one end-use group.

Table 30. Agricultural Natural Gas Technical and Economic Energy Efficiency Potential by End-Use Group

End-Use Group	2034 Forecast Sales (Thousand therms)	12-Year Technical Potential (Thousand therms)	Technical Potential Percentage of Sales	12-Year Economic Potential (Thousand therms)	Economic Potential Percentage of Sales	Economic Potential Percentage of Technical
Gas	36,814	3,299	9%	448	1%	14%
Total	**36,814**	**3,299**	**9%**	**448**	**1%**	**14%**

Table 31 shows the top energy-saving electric agricultural measures. Collectively, these 15 measures represented approximately 96% of the sector's total economic potential. Ventilation fan – level 2 (16%), variable frequency drive (VFD) installations on ventilation and circulation fans (13%), lighting controls (12%), and high-volume, low-speed fans (11%) are the top four saving electric agriculture measures, contributing 52% of the economic potential.

Table 31. Top Electric Energy Efficiency Saving Agricultural Measures

Agricultural Energy Efficiency Measure	Cumulative 12-Year Economic Potential (MWh)	Percentage of Total Agricultural Economic Potential
Ventilation Fan - Level 2	42,705	15.79%
VFD, Ventilation/Circulation Fan	36,152	13.37%
Lighting Controls - Occupancy Sensors, Daylighting, Photocell Controls, and Timers	31,374	11.60%
High-Volume Low-Speed Fan	30,799	11.39%
Variable Speed Control Vacuum Pump (Dairy Farm, Parlor, Milk House)	23,843	8.82%
Lighting - Linear LED Packages	17,128	6.33%
Ventilation Fan - Level 1	16,895	6.25%
Lighting - Lamp (Screw-base) LED	13,719	5.07%
Plate Heat Exchanger and Well Water Pre-Cooler (Dairy Farm, Parlor, Milk House)	10,316	3.82%

Agricultural Energy Efficiency Measure	Cumulative 12-Year Economic Potential (MWh)	Percentage of Total Agricultural Economic Potential
Lighting - High Bay LED Packages	9,417	3.48%
VFD, Agriculture Primary and Secondary Use Water System	9,331	3.45%
Scroll Compressor Replacement (Dairy Farm, Parlor, Milk House)	8,473	3.13%
Circulation Fan - Level 2	4,471	1.65%
Refrigeration Heat Recovery Unit	3,732	1.38%
Water Heater Electric Upgrade	2,476	0.92%

Table 32 shows the top energy-saving natural gas agricultural measures. Collectively, these five measures represented 100% of the economic natural gas savings.

Table 32. Top Natural Gas Energy Efficiency Saving Agricultural Measures

Agricultural Energy Efficiency Measure	Cumulative 12-Year Economic Potential (Thousand therms)	Percentage of Total Agricultural Economic Potential
Water Heater Gas Upgrade	393	87.67%
Grain Dryer Tune-Up	36	7.96%
Greenhouse Climate Controls	14	3.02%
Greenhouse Unit Heater (Natural Gas Only), >= 90% thermal efficiency, per input MBH, for retrofit	6	1.32%
Double Polyethylene Treated Film	<1	0.02%

Optimized and Current Policy Potential Results

For the 2021 Potential Study Assessment, Cadmus estimated two types of potential that represent a subset of economic potential: optimized and current policy potential.

Optimized potential represents all theoretical cost-effective savings opportunities that could realistically be achieved if program funding were not constrained by a total budget cap or fuel and sector allocations. Optimized potential represents minimal implementation barriers to impede customer participation in Focus on Energy programs.

Current policy potential is a subset of the optimized potential and accounts for Focus on Energy funding constraints. The level of Focus on Energy funding is established under Wisconsin Act 141. Cadmus employed several constraints for current policy potential (Figure 23):[10]

- **Total budget.** Cadmus applied a budget constraint so the average annual budget over the first four years and 12 years does not exceed the Focus on Energy annual program budget (~ $87.3M). This amount is based on recent annual Focus on Energy collections less general administrative costs (evaluation, compliance agent, fiscal agent, PSC staff, and data systems) and annual budget amounts for renewable energy programs.
- **Fuel-type budgets.** The cost of electric savings accounts for 80% of the annual Focus on Energy budget, and the cost of natural gas savings accounts for 20% of the annual budget. Under Act 141, the PSC is required to ensure each energy utility customer class has the opportunity to receive benefits under energy efficiency programs equal to the amount that is recovered from the customer class. Focus on Energy does not formally track program costs by electric and natural gas savings but has adopted a longstanding rule of reporting spending for electric and gas savings at 80% and 20% of the total delivery costs, respectively. These proportions generally align with fuel-specific utility revenues used to calculate utility contributions to Focus.
- **Sector budgets.** Act 141 requires that the local government and agriculture sectors make up at least 10% of the total budget. The commercial and industrial sector makes up approximately 50%, and the residential sector makes up the remaining 40%. These sector budget allocations align with historic and current PSC policy.

[10] Cadmus did not consider rural-urban budget allocations, which are also included in current funding requirements for Focus on Energy.

Figure 23. Current Policy Potential Funding Constraints

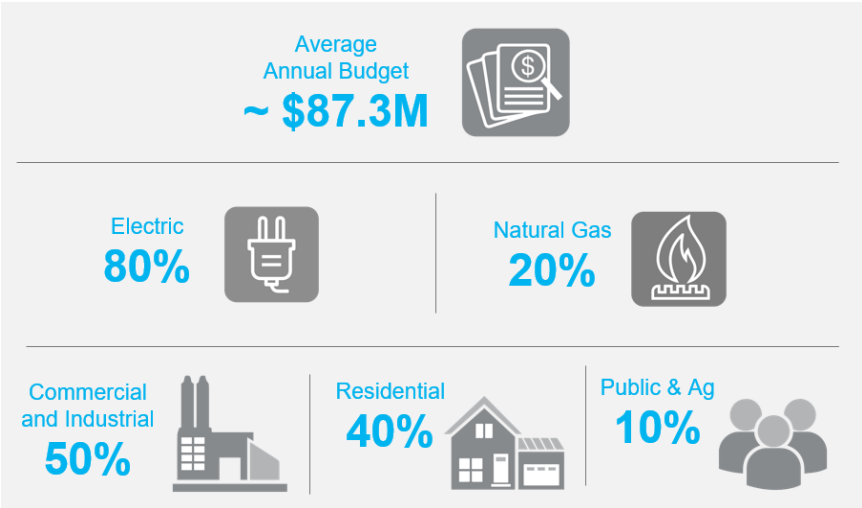


Table 33 shows how the different sectors contributed to overall electric optimized and current policy potential, as well as potential as a percentage of baseline sales. Overall, 12-year period optimized potential corresponds to 11,859 GWh of savings, or 1.53% of annual baseline sales. Current policy potential equates to 9,408 GWh, which is 1.19% of annual baseline sales. Demand reduction was 2,124 MW for 12-year optimized potential and 1,659 MW for 12-year current policy potential.

Table 33. Cumulative 12-Year Electric Optimized and Current Policy Potential by Sector

Sector	2034 Forecast Sales (MWh)	12-Year Optimized Potential (MWh)	Optimized Potential Percentage of Sales	12-Year Optimized Potential (MW)	12-Year Current Policy Potential (MWh)	Current Policy Potential Percentage of Optimized Potential	Current Policy Potential Percentage of Sales	12-Year Current Policy Potential (MW)
Single-Family	18,022,489	3,758,277	21%	866	2,424,469	65%	13%	568
Multifamily	3,064,670	431,281	14%	72	274,619	64%	9%	47
Commercial	18,190,973	2,606,647	14%	478	2,235,438	86%	12%	412
Government	3,059,850	406,277	13%	97	406,277	100%	13%	97
Industrial	27,691,821	4,419,782	16%	572	3,830,398	87%	14%	496
Agriculture	1,295,590	236,821	18%	39	236,821	100%	18%	39
Total	**71,325,393**	**11,859,085**	**17%**	**2,124**	**9,408,022**	**79%**	**13%**	**1,659**

Using the fuel-type funding assumptions shown in Figure 23, the overall electric optimized potential could be attained with approximately $90 million in annual funding. This compares to current policy funding levels for electric savings of approximately $69 million. By viewing the electric current policy potential at the sector level for certain sectors (i.e., government and agriculture), the current policy potential is equivalent to the optimized potential. This indicates that the current policy budget for those sectors is sufficient to cover the costs of the optimized potential in these sectors. On the other hand, for some sectors, current policy potential is much smaller than the optimized potential. For example, the

single-family sector current policy potential is only 65% of the optimized potential. This indicates that current policy budget for the single-family sector is not sufficient to cover the costs of the optimized potential in this sector. This is an example of how choices regarding the distribution of portfolio funding between sectors can impact the overall potential.

Table 34 shows the natural gas 12-year optimized and current policy potential. The current policy potential, which could be achieved with just over $17 million in funding annually, is 144,123 thousand therms and 40% of the optimized potential (362,041 thousand therms). The average annual funding associated with the natural gas optimized potential is $47 million (this is approximately $30 million more than what is currently allocated to program spending). On an annual basis, the optimized potential represents 1.21% of the natural gas baseline sales, and the current policy potential represents 0.46% of the natural gas baseline sales.

Table 34. Cumulative 12-Year Natural Gas Optimized and Current Policy Potential by Sector

Sector	2034 Forecast Sales (Thousand therms)	12-Year Optimized Potential (Thousand therms)	Optimized Potential Percentage of Sales	12-Year Current Policy Potential (Thousand therms)	Current Policy Potential Percentage of Optimized Potential	Current Policy Potential Percentage of Sales
Single-Family	1,530,824	190,717	12%	42,212	22%	3%
Multifamily	203,624	22,588	11%	4,987	22%	2%
Commercial	574,108	82,419	14%	50,751	62%	9%
Government	69,891	13,164	19%	13,164	100%	19%
Industrial	286,539	52,732	18%	32,588	62%	11%
Agriculture	36,814	420	1%	420	100%	1%
Total	**2,701,800**	**362,041**	**13%**	**144,123**	**40%**	**5%**

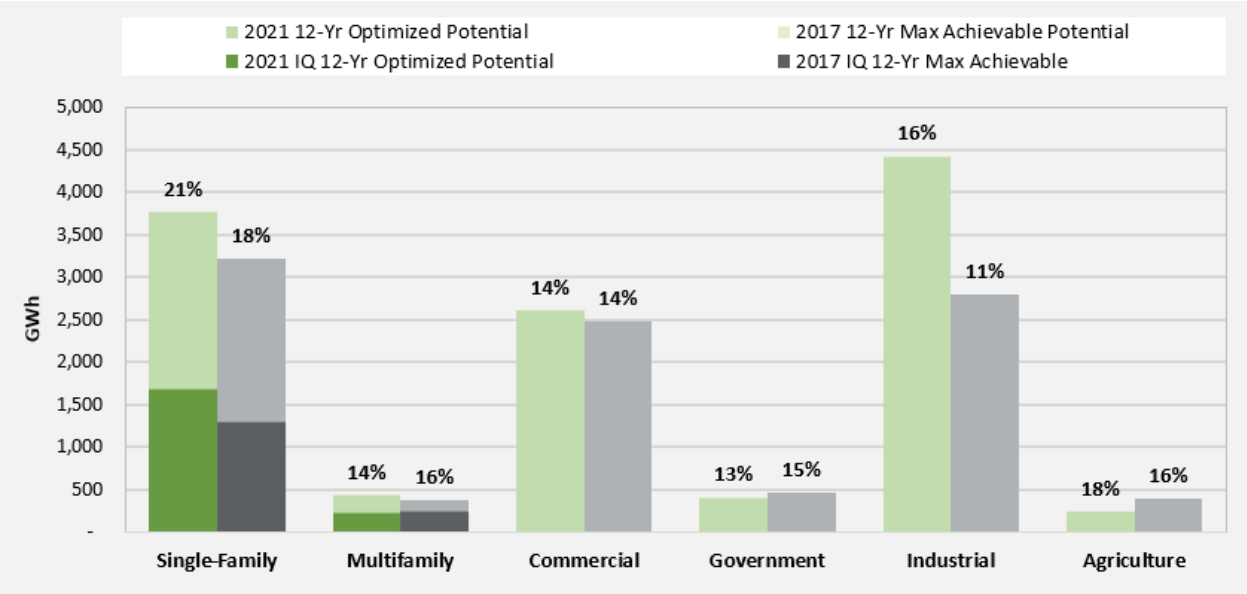
For the government and agricultural sectors, the current policy potential is equivalent to the optimized potential. This indicates that the current policy potential budget allocation is sufficient to cover the cost of the optimized potential. For other sectors, current policy potential is much smaller than the optimized potential. For example, the current policy potential for the single-family and multifamily sectors is only approximately 22% of the optimized potential. This indicates that current budget levels are not sufficient to cover the cost of the optimized potential for those sectors.

Cadmus compared the optimized potential to the maximum achievable potential scenario from the 2017 potential study assessment. Though the methods for producing each of these types of potential are not completely equivalent, Cadmus found that the maximum achievable scenario from 2017 is the most similar in terms of expected outcome. The optimized potential assumes no budget constraints and applies ramp rates to determine measure uptake over time to a determined market adoption cap. Maximum achievable potential sets a cap on economic potential determined through utility customer willingness-to-pay surveys, assuming that 100% of measure incremental costs would be covered through incentives, and applied ramp rates to determine uptake over time.

Overall, the 12-year electric, optimized potential is 22% greater than the maximum achievable potential. The overall increase in electric optimized potential came from single-family and industrial sectors. The

optimized potential is less than the maximum achievable potential for the government and agriculture sectors. Figure 24 compares 2021 optimized potential to 2017 maximum achievable potential. For the single-family and multifamily sectors, the figure also shows the portion of potential for income-qualified (IQ) households. The potential as a percentage of baseline sales is shown at the top of each bar in the figure.

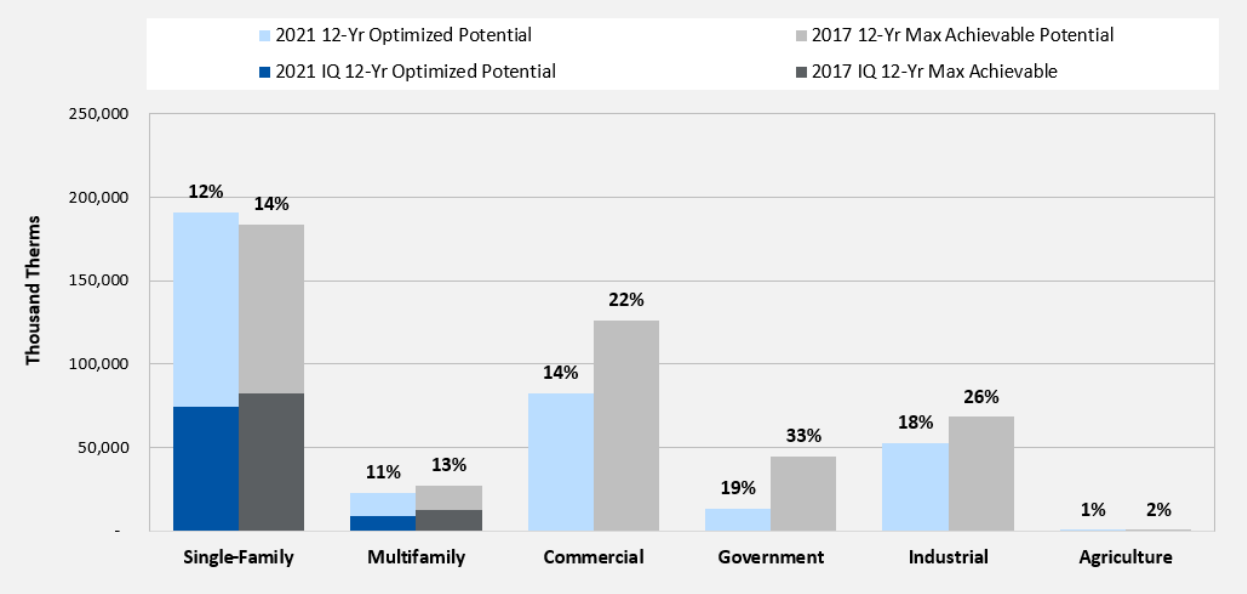
Figure 24. Comparison of 2017 and 2021 Electric Optimized (Maximum Achievable) Potential



For natural gas energy efficiency, the total estimated 2021 study 12-year optimized potential is 445,716 thousand therms, amounting to approximately 13% of baseline sales. By comparison, the 2017 12-year estimate was 545,011 GWh (18% of baseline sales).

As shown in Figure 25, the overall natural gas optimized potential is 18% less than the natural gas maximum achievable potential from the 2017 potential study. This is a result of the decrease in the economic potential, caused by lower avoided energy costs and nonresidential survey data indicating a decrease in natural gas usage.

Figure 25. Comparison of 2017 and 2021 Gas Optimized (Maximum Achievable) Potential



Maximum Adoption

Optimized, and subsequently current policy, potential calculations are dependent on two key input assumptions: the maximum adoption rate and ramp rate. The maximum adoption values represent the proportion of economic potential that can be reasonably achieved over the long run. Cadmus took a deterministic approach, in line with the Northwest Power and Conservation Council, to assign maximum adoption percentages.[11] Cadmus assigned these values at the measure group level. For measure groups with minimum federal efficiency standards, Cadmus assigned a maximum adoption rate of 95% and assigned a maximum adoption values of 85% to all other measures. These long-term maximum adoption rates reflect some customers' behavior to not adopt efficiency measures under any circumstances.

Ramp Rates

In addition to maximum adoption percentages, Cadmus worked with stakeholders to determine appropriate ramp rates for measure groups. Ramp rates determine the incremental, year-to-year optimized potential for an energy efficiency measure, provided that it is cost-effective. Ramp rates are not sector specific; rather, they are generalized s-curves that assume an initial saturation rate in the study's first year (2023) before progressing to 100% on either an incremental or cumulative basis, depending on the resource. In the case of this study, 100% saturation equates to the 95% and 85% maximum adoption values described in the section above.

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[11] Northwest Power and Conservation Council. August 1, 2017. "Achievable Savings: A Retrospective Look at the Northwest Power and Conservation Council's Conservation Planning Assumptions." https://www.nwcouncil.org/reports/2007/2007-13/

To determine which ramp rate should be applied for a given measure, Cadmus engaged with stakeholders through the following course of steps:

1. Assigned initial measure-level ramp rates based on Focus on Energy program savings and the incremental cost of a measure.
2. Determined measure groups on a sector and fuel-type basis and used the most representative measures to determine measure group ramp rates from the individual measures.
3. Worked with stakeholders to identify market experts to review ramp rates, with assignments at the measure/technology group level.
4. Engaged market experts to review ramp rate assignments for a subset of measure groups and provide feedback to Cadmus and Focus on Energy.
5. Updated ramp rates based on the majority of market expert responses for a given measure group.

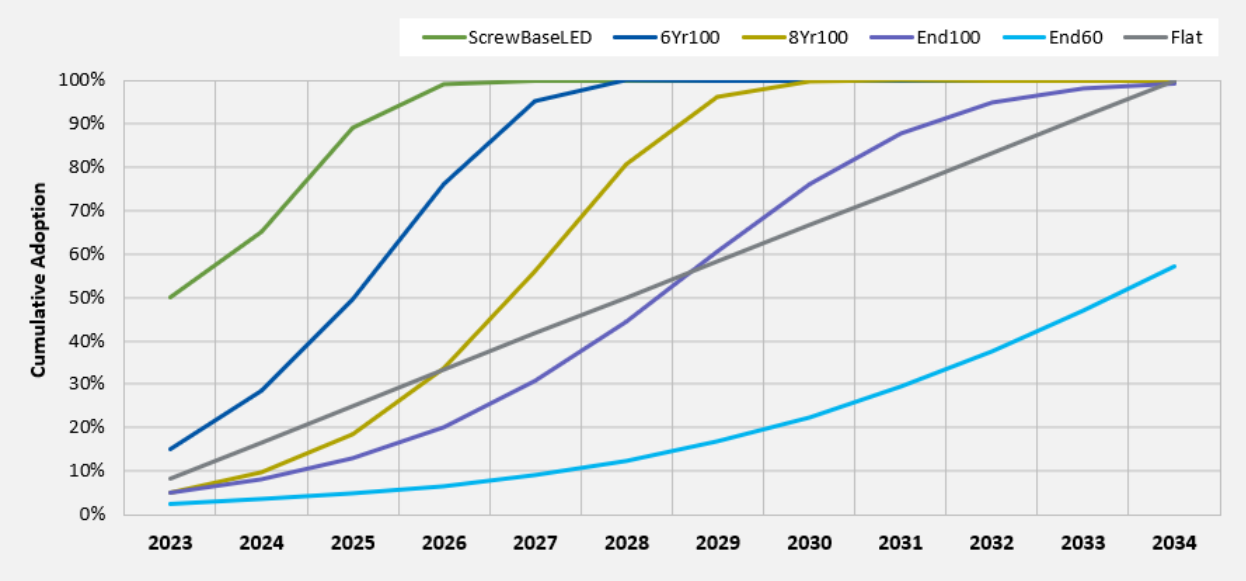
Table 35 provides the 12 ramp rate names applied to measures in the study to determine the optimized potential. For modeling purposes, Cadmus established separate ramp rates for retrofits and lost opportunities, but assigned those separate ramp rates similar names and meanings. The table lists ramp rate names in each category (i.e., discretionary and nondiscretionary), from most to least aggressive.

Table 35. Ramp Rate Names

Discretionary (Retrofit)	Nondiscretionary (Lost Opportunity)
Retro – ScrewBaseLED	ScrewBaseLED
Retro - 6Yr100	6Yr100
Retro - 8Yr100	8Yr100
Retro - End100	End100
Retro - End60	End60
Retro – Flat	Flat

Figure 26 depicts the ramp rates and shows the discretionary values on a cumulative basis. As these resources were available at the study's beginning and can be acquired at any time, the first-year values represent the percentage of total retrofits acquired in that year. A retrofit measure assigned the "6Yr100 – Retro" ramp rate will have reached 100% saturation in the study's sixth year, whereas a retrofit measure assigned the "End100" ramp rate will not reach 100% saturation until the last year of the study. Cadmus assigned screw-base LEDs a more aggressive ramp rate of their own for several reasons: (1) a relatively high rate of saturation, (2) recent program success with these products, (3) and their rapidly declining prices.

Figure 26. Potential Study Ramp Rates



For nondiscretionary measures, the percentage values in each year represent the percentage of economic units that are achievable for that year (rather than the study period total). For example, in 2027, the "6Yr100" ramp rate assumed that 95% of the economic units that are available that year are achievable, whereas the "8Yr100" and "End100" rates assumed 56% and 31%, respectively.

Economic Potential by Scenario

Cadmus evaluated the sensitivity of the economic potential to changes in various global, economic assumptions and lighting baselines as a part of the potential assessment. The economic inputs adjusted for the scenarios included discount rates, cost-effectiveness tests, MTRC cost-effectiveness thresholds, carbon costs, and transmission and distribution costs. Additionally, Cadmus analyzed the impact on residential and commercial potential that changes in screw-base and specialty lighting standards have. The following list defines the scenarios, their assumptions, and high-level economic potential impacts. Full details and results of these scenarios are in *Appendix E*.

- **Alternate global economic assumption scenarios:** The base scenario makes several assumptions about the economics surrounding potential estimation. This includes a discount rate of 2% and a $15 carbon per ton value. Additionally, Cadmus did not include avoided transmission and distribution costs as a benefit when evaluating cost-effectiveness. In the scenario analysis, Cadmus evaluated the sensitivity of the discount rate, the impact of using the social cost of carbon[12] (with a levelized cost of $69 per ton), and the impact on cost-effectiveness of including

[12] United States Environmental Protection Agency. (n.d.). The Social Cost of Carbon: Estimating the Benefits of Reducing Greenhouse Gas Emissions. Retrieved from https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html

transmission and distribution (T&D) benefits. The T&D benefits range from $67 to $70 per kilowatt-year and are based on the PSC recommendations for T&D benefits.[13]

- **Avoided T&D.** Total electric and natural gas economic potential increased by 1.6% and 15.6%, respectively, compared with the base economic potential.
- **Social cost of carbon.** Total electric and natural gas economic potential increased by 6.3% and 28.7%, respectively, compared with the base economic potential.
- **0% discount rate.** Total electric and natural gas economic potential increased by 2.3% and 21.3%, respectively, compared with the base economic potential.
- **5% discount rate.** Total electric and natural gas economic potential decreased by 4.1% and 6.7%, respectively, compared with the base economic potential.

- **Alternate cost test scenarios:** The base economic potential only includes measures that are cost-effective using Focus on Energy's MTRC. In this cost test scenario analysis, Cadmus assessed potential by screening measures using the Utility Cost Test (UCT) and Societal Cost Test (SCT).
  - **SCT.** Screening measures using the SCT slightly increased economic potential, because a 10% conservation adder was included as a part of the economic screen. Total electric and natural gas economic potential increased by 1.8% and 18%, respectively, compared with the base economic potential.
  - **UCT.** More measures became cost-effective under the UCT compared to the MTRC. This scenario led to a 18.6% increase in electric economic potential relative to the base scenario, the greatest increase in electric economic potential. The natural gas economic potential increased by 58% relative to the base scenario.
- **Minimum MTRC threshold scenarios:** In the base scenario, Cadmus uses a MTRC threshold of 1 to evaluate cost-effectiveness. These scenarios test the sensitivity of economic potential using two separate MTRC thresholds. Such models reflect that non-cost-effective measures may be included in Focus on Energy programs that meet the program requirement to maintain cost-effective residential and nonresidential portfolios.
  - **0.5 MTRC threshold.** Screening measures for economic potential using an MTRC greater than or equal to 0.5 increases total economic electric and natural gas potential by 9.3% and 36%, respectively.
  - **0.75 MTRC threshold.** Screening measures for economic potential using an MTRC greater than or equal to 0.75 increases total economic electric and natural gas potential by 3.9% and 25%, respectively.
- **Lighting scenarios:** In December of 2019 DOE issued a Final Determination in which they formalized full recension of the 2007 Energy Independence and Security Act (EISA) backstop requirement, which would have established a 45 lumen/watt baseline beginning in 2020. However, there are still pending legal challenges and with the change in presidential

[13] Public Service Commission of Wisconsin. January 20, 2021. Ref#: 403255: Quadrennial Planning Process III. https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=403255

administrations, uncertainty remains regarding if and how this standard will be reintroduced. For example, the Biden-Harris Administration, through the Department of Energy, has introduced a semi-annual Unified Agenda of Federal Regulatory and Deregulatory Actions that includes potential amendments to EISA. In addition, market adoption for LEDs continues to be rapid and has implications on the remaining potential. Considering this, this study looks at various lighting scenario and the timing of LED adoption. For the base scenario, Cadmus assumed screw-base LEDs would saturate the market for commercial and standard-income residential customers by 2027. This was informed by regional market trends and Focus on Energy's evaluation team. For specialty lamps, residential customer LED market saturation occurs in 2029. Income-qualified residential customer market LED saturation is assumed to be slower for both screw-base and specialty lamps and market saturation of LEDs for the income-qualified customer segment occurs in 2031. Cadmus evaluated two lighting scenarios:

- **Accelerated EISA compliance scenario 1.** Market saturation of LEDs for all bulb types and customer groups is shifted forward by two years. In this scenarios, commercial and residential electric 12-year economic potential decreased by 5% compared to the base scenario.
- **Accelerated EISA compliance scenario 2.** Market saturation of LEDs for residential standard-income customers and commercial screw-base and specialty bulbs occurs in 2024. For income-qualified residential customers, market saturation of LEDs occurs in 2027. In this alternate scenario, commercial and residential electric 12-year economic potential decreased by 10% compared to the base scenario.

Current Policy and Increased Funding Scenarios

In addition to the scenarios of the previous section, which have primary impacts on economic and optimized potential, Cadmus conducted sensitivity analyses to determine the impacts of additional program funding on current policy potential. Cadmus evaluated the impact for two different funding scenarios: (1) a 50% increase in energy efficiency program funding from current levels and (2) a 100% increase in energy efficiency program funding from current levels.

To estimate the potential for the two increased funding scenarios, Cadmus removed the sector and fuel funding allocation assumptions. Cadmus assumed that significant increases in funding would call for an evaluation and assessment of Focus on Energy priorities and program design, which may include how the Focus on Energy budget is distributed, to ensure that energy savings are achieved efficiently and equitably.

As opposed to current policy potential, where Cadmus used optimized potential as the base potential and applied sector and funding constraints, Cadmus used economic potential as the basis from which to estimate the increased funding scenarios. Cadmus chose economic potential, rather than optimized potential, in part because the additional funding, among other policy considerations, may lead to innovation and adaptations in program delivery in a manner such that ramp rates used in this study may not be appropriate (that is, with increased funding the program may be able to overcome existing barriers more rapidly).

Cadmus calculated increased scenario funding potential following four steps:

1. Determined the total program delivery cost associated with economic potential.
2. Estimated the economic potential (for three scenarios: optimized, and 50% and 100% increase funding scenarios) and program delivery budget in each funding bin (commercial and industrial, residential, and public and agriculture) for each fuel type.
3. When a funding bin achieved all the economic potential and did not use all the assigned funds, shifted those remaining funds to another funding bin where energy saving opportunity was still available. For example, reallocated $2 million left in electric agricultural and government bin after it reached maximum economic potential to under-budgeted funding bins.
4. Determined amount of budget for each funding bin and calculated scenario savings potential for each bin, completed by determining the ratio of economic budget to the scenario budgets and applying this ratio to the economic potential. For instance, in the +50% residential electric funding bin, 93% of economic budget was realized; therefore, the economic potential, multiplied by 0.93, is the overall scenario savings potential.

Table 36 shows the impact of the different funding levels on the 12-year, cumulative electric potential by sector. With current policy funding levels, 13% savings of the 2034 baseline sales are achievable. If funding levels are increased by 50%, the electric savings potential increases by 37% to represent 18% of the 2034 baseline sales. Finally, if the funding levels are increased by 100% (double the current policy values), potential increases by 48% relative to the current policy scenario. This represents 20% of the 2034 baseline sales.

Table 36. Cumulative 12-Year Electric Current Policy and Increased Funding Scenarios, by Sector - MWh

Sector	2034 Forecast Sales (MWh)	Cumulative 12-Year Current Policy Potential (MWh)	Current Policy as % of Baseline	Cumulative 12-Year +50% Funding Potential (MWh)	+50% Funding as % of Baseline	Cumulative 12-Year +100% Funding Potential (MWh)	+100% Funding as % of Baseline
Single-Family	18,022,489	2,424,469	13%	3,670,169	20%	4,479,836	25%
Multifamily	3,064,670	274,619	9%	379,573	12%	461,981	15%
Commercial	18,190,973	2,235,438	12%	3,007,039	17%	3,112,928	17%
Government	3,059,850	406,277	13%	484,583	16%	484,583	16%
Industrial	27,691,821	3,830,398	14%	5,016,017	18%	5,124,906	19%
Agriculture	1,295,590	236,821	18%	270,406	21%	270,406	21%
Total	**71,325,393**	**9,408,022**	**13%**	**12,827,786**	**18%**	**13,934,640**	**20%**

Figure 27 shows the potential for the different funding level scenarios relative to the optimized potential. Overall, 79% of the cumulative 12-year optimized potential is captured in the current policy potential. The cumulative 12-year potential represents 108% and 118% of the optimized potential when the program funding levels are increased by 50% and 100%, respectively.

Figure 27. Electric Cumulative 12-Year Current Policy Potential by Funding Level Scenario – MWh

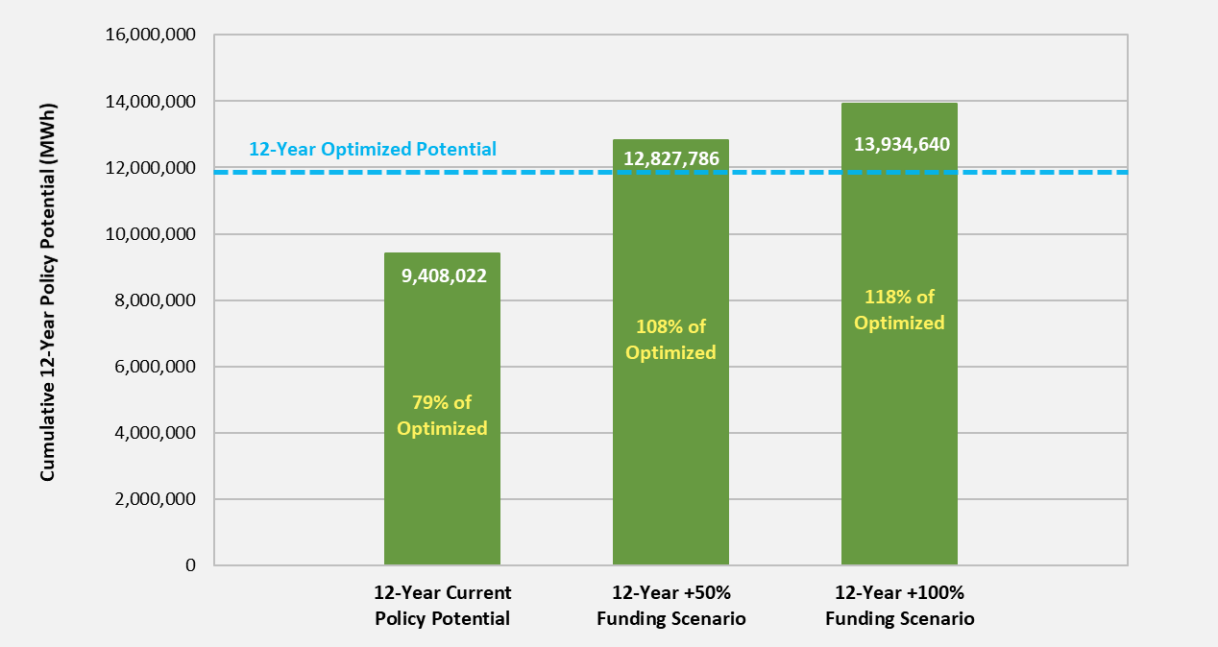


Table 37 shows the portfolio-level benefit-cost ratio for the respective scenario. As the figure shows, the benefit-cost ratio is greatest under the current policy potential scenario and is progressively less under higher funding scenarios. The MTRC declines because as funding levels increase, the model captures more savings from electric measures in the single-family sector. This is because there is more available potential for the residential sector than any other sector. Therefore, as more funding is included, more savings come from residential measures (which have a lower MTRC than the portfolio average of 3.72 in the current policy scenario), and the overall portfolio MTRC decreases for the increased funding scenarios.

Table 37. Funding Scenario Electric Portfolio Benefit-Cost Ratio

Benefit-Cost Ratio (MTRC)	12-Year Current Policy Potential	12-Year +50% Funding Potential	12-Year +100% Funding Potential
Portfolio	3.72	3.58	3.51

Table 38 shows the impact of the different funding levels on the cumulative 12-year natural gas potential. With current policy funding levels, savings amounting to 5% of the 2034 baseline sales are achievable. The commercial sector makes up the greatest proportion of the current policy potential at 35%. A 50% increase in the current policy funding levels for natural gas programs leads to a 64% increase in 12-year natural gas potential to 236,597 thousand therms. This is 9% of the natural gas baseline sales in 2034. From the current policy scenario, the cumulative 12-year natural gas potential with a 100% increase in funding increases by 171% to represent 14% of the natural gas baseline sales.

Table 38. Cumulative 12-Year Natural Gas Current and Increased Funding Scenarios, by Sector – Thousand therms

Sector	2034 Forecast Sales (Thousand therms)	Cumulative 12-Year Current Policy Potential (Thousand therms)	Current Policy as % of Baseline	Cumulative 12-Year +50% Funding Potential (Thousand therms)	+50% Funding as % of Baseline	Cumulative 12-Year +100% Funding Potential (Thousand therms)	+100% Funding as % of Baseline
Single-Family	1,530,824	42,212	3%	77,501	5%	183,301	12%
Multifamily	203,624	4,987	2%	9,236	5%	21,838	11%
Commercial	574,108	50,751	9%	83,836	15%	106,843	19%
Government	69,891	13,164	19%	17,614	25%	17,614	25%
Industrial	286,539	32,588	11%	47,963	17%	60,639	21%
Agriculture	36,814	420	1%	448	1%	448	1%
Total	**2,701,800**	**144,123**	**5%**	**236,597**	**9%**	**390,683**	**14%**

Figure 28 shows the policy potential for the different funding level scenarios relative to the optimized potential. Overall, 40% of the cumulative 12-year optimized potential is captured in the current policy potential. The captured amount of optimized potential increases to 65% and 108% when program funding levels are increased by 50% and 100%, respectively. As shown in Table 38, removal of the current policy fuel and sector funding constraints in the two increased funding scenarios substantially increases residential single-family natural gas savings.

Figure 28. Natural Gas Cumulative 12-Year Current Policy Potential by Funding Level Scenario – Thousand therms

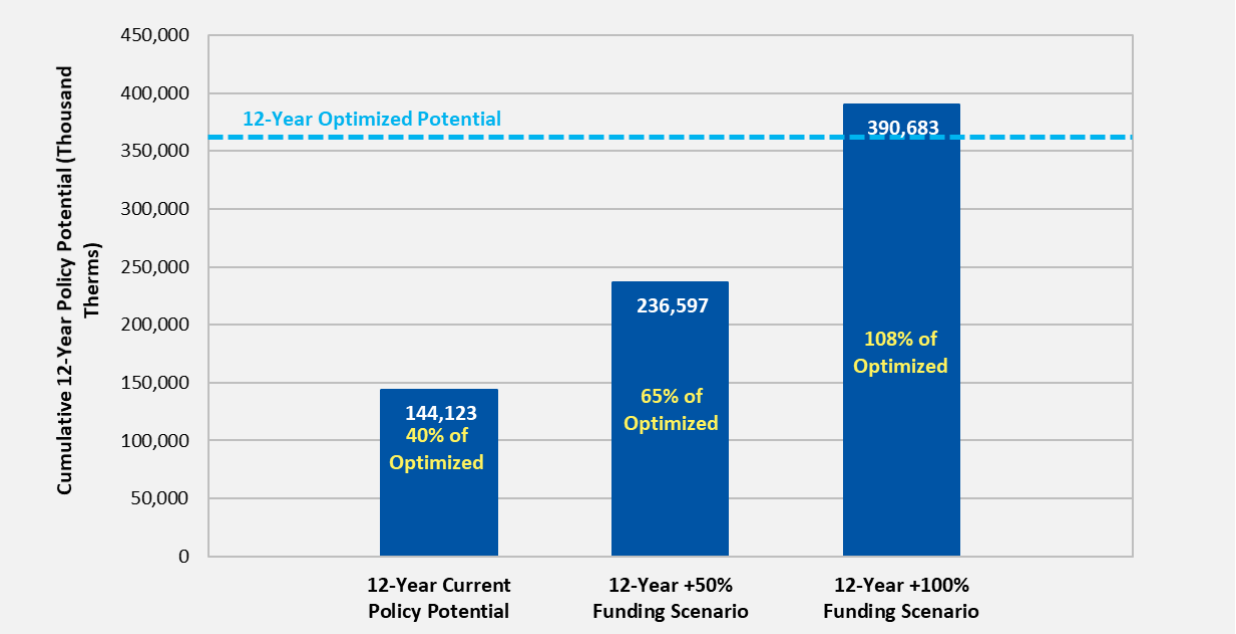


Table 39 shows the portfolio-level benefit-cost ratio for each of the respective scenarios. Unlike the electric benefit-cost ratios, which trend downward as funding increases, the natural gas benefit-cost ratios do not follow a consistent pattern. The benefit-cost ratio variation across funding scenarios is based on the incremental increase in potential from the measures that become affordable when funding is increased. For example, the decrease in the benefit-cost ratio from the current policy scenario to the +50% funding scenario is because there is a substantial increase in nonresidential potential, which tends to have more costly natural gas measures. However, the increase in potential from the +50% funding scenario to the +100% funding scenario is more heavily weighted toward residential measures. The residential natural gas measures tend to have higher benefit-cost ratios leading to a higher overall portfolio benefit-cost ratio when more savings from those measures can be attained. Since there are fewer natural gas end uses, savings and benefit-cost results for this fuel are more sensitive to modeling assumptions compared to assumptions impacting electric potential and benefit-cost results.

Table 39. Funding Scenario Natural Gas Portfolio Benefit-Cost Ratio

Benefit-Cost Ratio (MTRC)	12-Year Current Policy Potential	12-Year +50% Funding Potential	12-Year +100% Funding Potential
Portfolio	3.58	3.50	3.73

Table 40 shows the impact of the different funding levels on the cumulative 12-year combined electric and natural gas potential. With current policy funding levels, savings potential amounts to 9% of 2034 baseline sales. The industrial sector makes up the greatest proportion of the current policy potential at 35% of the total 12-year current policy potential. A 50% increase in funding levels allows for a 45% increase in 12-year potential. This is 13% of the combined fuel baseline sales in 2034. A 100% increase in funding increases potential by 86% to represent 17% of the combined fuel baseline sales

Table 40. Cumulative 12-Year Natural Gas Current and Increased Funding Scenarios, by Sector – BBTU

Sector	2034 Forecast Sales (BBTU)	Cumulative 12-Year Current Policy Potential (BBTU)	Current Policy as % of Baseline	Cumulative 12-Year +50% Funding Potential (BBTU)	+50% Funding as % of Baseline	Cumulative 12-Year +100% Funding Potential (BBTU)	+100% Funding as % of Baseline
Single-Family	214,578	12,494	6%	20,273	9%	33,616	16%
Multifamily	30,819	1,436	5%	2,219	7%	3,760	12%
Commercial	119,481	12,703	11%	18,644	16%	21,306	18%
Government	17,430	2,703	16%	3,415	20%	3,415	20%
Industrial	123,142	16,329	13%	21,912	18%	23,551	19%
Agriculture	8,102	850	10%	967	12%	967	12%
Total	**513,552**	**46,514**	**9%**	**67,430**	**13%**	**86,615**	**17%**

Figure 29 shows the policy potential for the different funding level scenarios relative to the optimized potential for combined electric and natural gas measures. Overall, 61% of the cumulative 12-year optimized potential is captured in the current policy potential. The captured amount of optimized potential increases to 88% and 113% when program funding levels are increased by 50% and 100%, respectively.

Figure 29. Electric and Natural Gas Cumulative 12-Year Current Policy Potential by Funding Level Scenario – BBTU

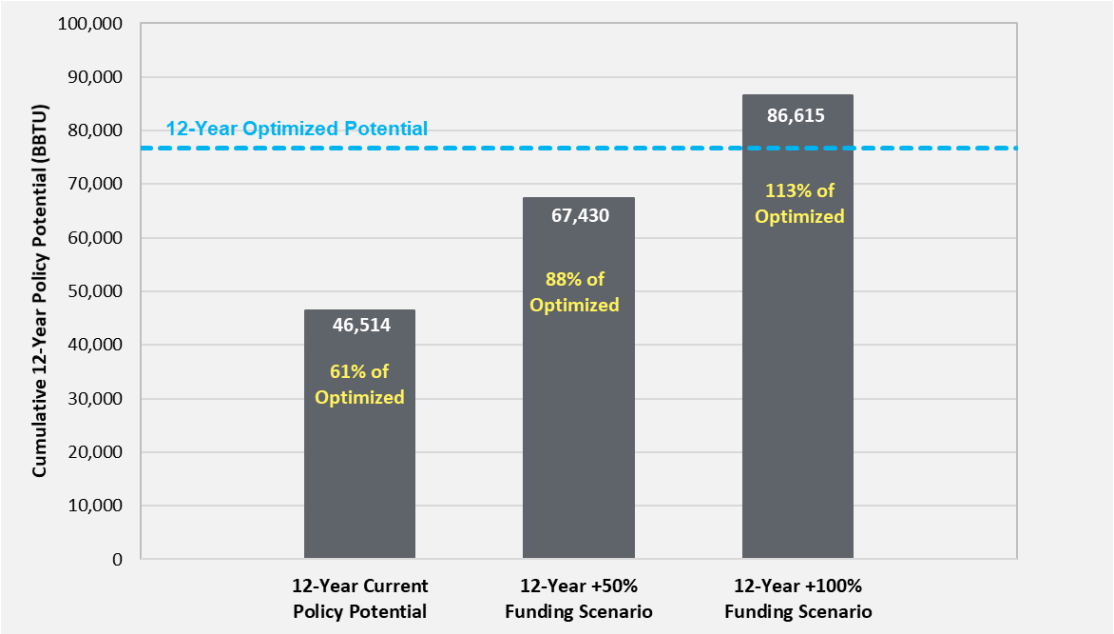


Table 41 shows the portfolio-level benefit-cost ratio for each of the respective scenarios. While portfolio cost-effectiveness trends downward initially, it stays the same when funding is increased from the +50% funding scenario.

Table 41. Funding Scenario BBTU Portfolio Benefit-Cost Ratio

Benefit-Cost Ratio (MTRC)	12-Year Current Policy Potential	12-Year +50% Funding Potential	12-Year +100% Funding Potential
Portfolio	3.70	3.56	3.56

Potential Benchmarking

Cadmus compared the results of the 2021 Focus on Energy potential study to other recent energy efficiency studies in the United States. To make results of the studies comparable, Cadmus focused on studies that provided technical and economic potential as a percentage of baseline electric and natural gas sales over the study horizon. Additionally, since methodologies for estimating other levels of potential vary, Cadmus did not provide a comparison to optimized potential. Table 42 shows the studies that Cadmus used to benchmark results from this potential study. The citations for these studies can be found in *Appendix G.*

Table 42. Energy Efficiency Studies Benchmarked

Study Beneficiary	Study Scope	Study Year	Study Horizon
Vermont Public Service	Statewide	2019	2021-2040
Commonwealth Edison (ComEd)	Utility Service Area (Illinois)	2020	2021-2030
Minnesota Department of Commerce	Statewide	2018	2020-2029
Ontario Independent Electric System Operator	Provincewide	2019	2019-2038
Ameren Missouri	Statewide	2020	2022-2040
Iowa Utilities Association	Statewide	2017	2018-2027

Benchmarking Results

Figure 30 shows how Focus on Energy technical and economic potential compare to six other recent electric potential studies (the Minnesota study did not provide technical potential as a percentage of baseline sales). As shown in the figure, Focus on Energy study's 12-year technical and economic period is comparable to other large potential studies. However, it is important to consider the many factors that affect the technical potential results, including (but not limited to) these:

- Variations in analytic methods between studies
- The inclusion (or absence) of emerging technologies
- The saturation of efficient measures and the degree to which input data capture these
- The mix of customer classes (e.g., residential, commercial, and industrial)
- End-use fuel shares for electricity and natural gas
- The length of the potential study horizon

In addition to the level of overall technical potential, which provides a theoretical upper limit on economic potential, the following factors also affect the level of economic potential:

- The economic cost test applied to screen for cost-effectiveness
- The vintage and level of various avoided energy costs
- The inclusion (or absence) of additional non-energy benefits, such as avoided carbon emissions
- The source data for incremental measure costs and program administration costs

Figure 30. Electric Benchmarking Results

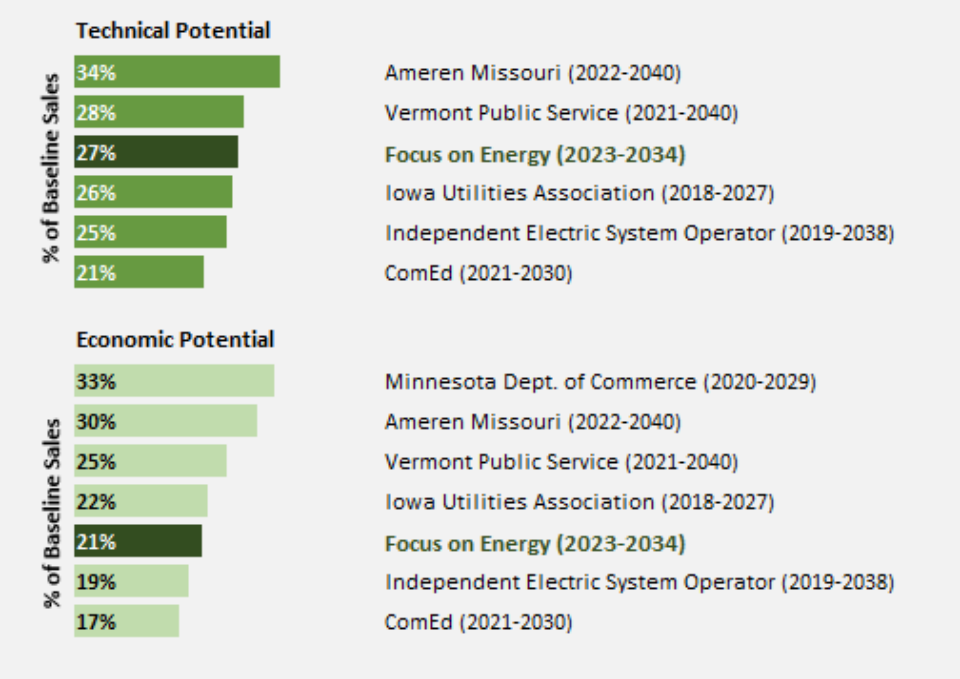
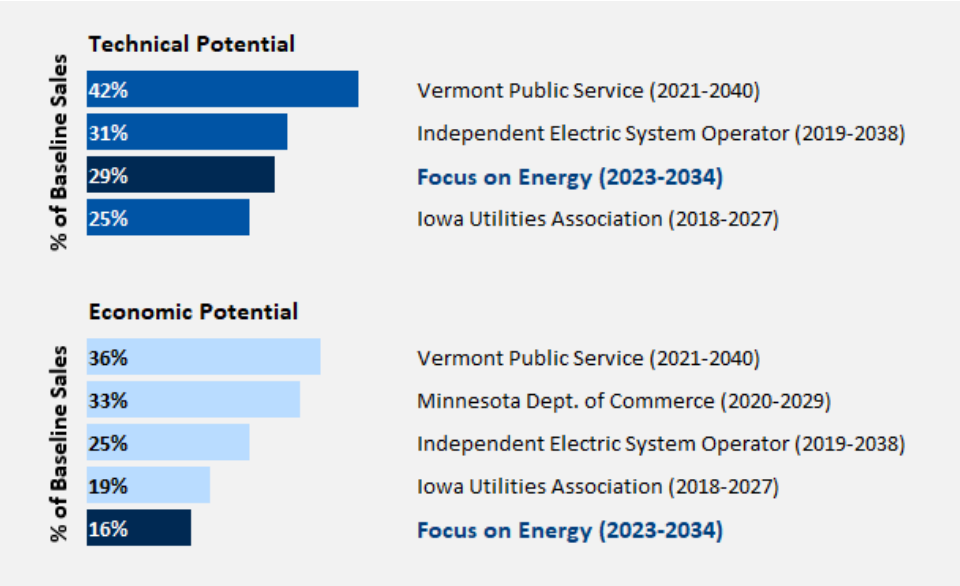


Figure 31 provides a comparison of Focus on Energy technical and economic potential to four recent natural gas state or provincewide potential studies (the Minnesota study did not provide technical potential as a percentage of baseline sales). The figure shows that the estimated technical and economic 12-year potential estimated for Focus on Energy is lower compared to other similar potential studies.

Figure 31. Natural Gas Benchmarking Results

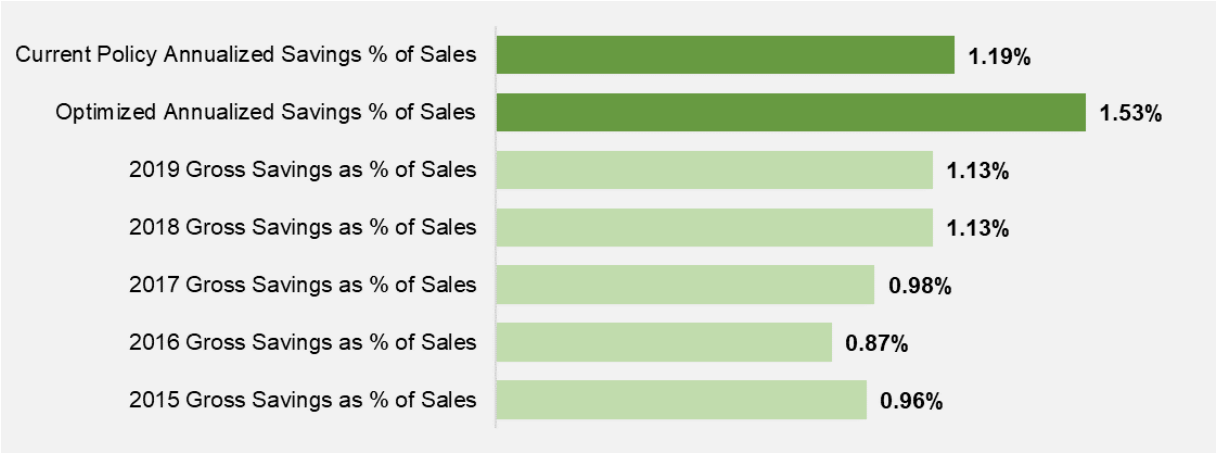


Conclusions

Focus on Energy's savings potential under current program funding levels and policies remains relatively comparable to Focus on Energy's recent savings achievements. During the first four years of the study period, 2023 through 2026, current policy potential represents electric potential savings of 3,183 GWh, compared to 2,864 GWh gross savings achieved from 2016 through 2019. Natural gas potential registers lower than recent achievement: current policy potential from 2023 through 2026 is 49.4 million therms, compared to 96.9 million therms in gross program savings achieved from 2016 through 2019. The lower natural gas potential is not unexpected due to changes in fuel shares and avoided costs.

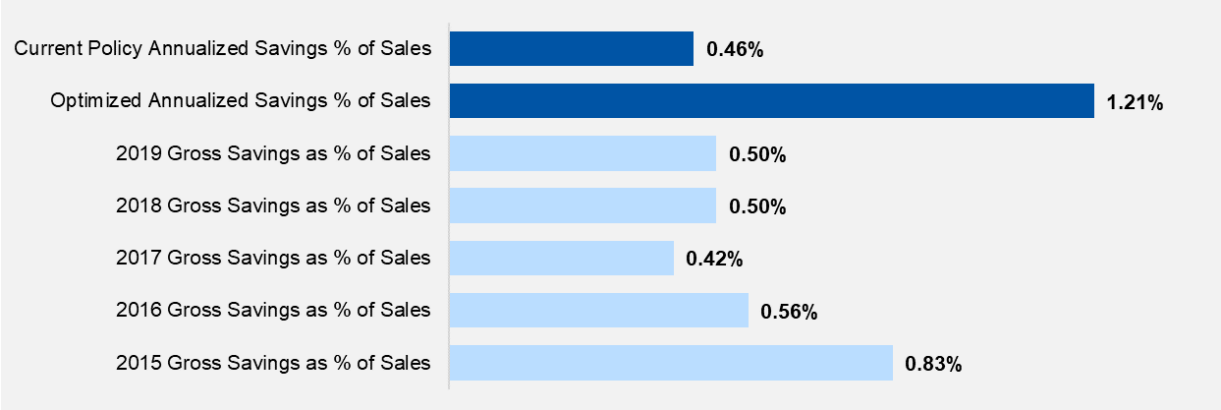
Under current Focus on Energy policies and funding levels, current policy potential amounts to 1.19% in electric savings (Figure 32) and 0.46% in natural gas savings as a percentage of annual forecast sales (Figure 33). Absent significant changes in Focus on Energy's policies, funding, or market conditions, these estimates can inform the program's savings goals for the 2023-2026 quadrennium. In determining these goals, the PSC should note that these estimates do not account for all program design constraints (e.g., net-to-gross rates), and further adjustments to these estimates likely will be appropriate to recognize such constraints and to set a goal that reflects program potential. Furthermore, comparisons of estimates of potential produced as part of this study to historical program performance should recognize that programs operating in practice account for various endogenous and exogenous factors impacting program performance that are beyond the scope of this study.

Figure 32. Electric Optimized and Current Policy Potential Compared to Historical Gross Savings



Note: current and optimized potential do not account for many of the program design considerations required to create a cost-effective and equitable program.

Figure 33. Natural Gas Optimized and Current Policy Potential Compared to Historical Gross Savings



Note: current and optimized potential do not account for many of the program design considerations required to create a cost-effective and equitable program.

The full range of potential estimates generated in this study also indicates that total energy efficiency potential in the state, independent of Focus on Energy's current funding levels, can vary significantly under different circumstances. For example, total electric optimized potential increases to 1.53% without funding constraints and current budget allocation policy, and total electric economic potential represents 21% of total forecasted 2034 sales—an amount greater than the 3.8% total forecasted 12-year load growth from 2023 through 2034.

Similar to the current policy potential scenario, these estimates do not account for all program design constraints. However, while total savings achievement would be generally reduced by several of those constraints, savings achievement in these scenarios could be increased by including measures not passing this study's measure-level cost-effectiveness screen.

The PSC requires Focus on Energy programs to pass a portfolio-level test of net cost-effectiveness, and such cost-effectiveness standards could be met with programs that, in addition to more cost-effective measures, include some measures that are not cost-effective. Screening measures for economic potential using a MTRC greater than or equal to 0.75 increases total economic electric and natural gas potential by 3.9% and 25%, respectively. Because this scenario, as modeled, still would likely meet Focus on Energy's requirement to maintain overall cost-effectiveness in its residential and nonresidential portfolios, it provides an estimate of the degree to which this factor could affect the difference between current policy potential presented here and program potential that could be realized by Focus on Energy.

Residential Sector

Cadmus' analysis identified significant numbers of residential electric and natural gas measures that offer considerable cost-effective savings potential. Additionally, Cadmus noted measures that experienced shifts in market saturations leading to changes in overall potential. In the following sections, we highlight the conclusions about the potential found in the residential sector.

Conclusion: Residential measures that reduce electric water heating end-use loads comprise 34% of the sector's electric economic potential.

Notably, Cadmus found an increase from 910 GWh of economic potential for electric water heating in 2017 to 2,028 GWh of potential in the 2021 potential study. This increase in potential results from two primary factors: heat pump water heaters becoming cost-effective in the 2021 study and updated residential survey data indicating a greater proportion of residential customers with electric water heat. Furthermore, retrofit measures saving both energy and water, such as low-flow showerheads and faucet aerators, make up 1,365 GWh or 22% of the overall economic potential.

Conclusion: Residential lighting potential is substantially lower compared to the 2017 potential study.

In the 2017 Potential Study, Cadmus found that lighting potential made up 32% or 2,260 GWh of residential economic potential. However, in 2021 economic lighting potential equates to only 19% of the total economic potential or 1,118 GWh. This is a result of the shift to an LED baseline, as the residential market becomes more saturated with LEDs.

Conclusion: Certain residential electric measures offer substantial, additional cost-effective savings opportunities compared to 2017 including advanced central air conditioners and ENERGY STAR 2020 efficient dehumidifiers.

Cadmus found over 300 GWh of economic potential for advanced central air conditioners and 170 GWh of cost-effective dehumidifier savings over the 12-year study horizon. These measures account for approximately 5% and 3% of the total residential electric economic savings potential, respectively.

Conclusion: Residential appliance recycling measures still offer substantial cost-effective savings opportunities.

Cadmus found 1,273 GWh of economic potential for residential appliance recycling. This constitutes more than 20% of the economic potential. It should be noted that the potential study did not consider implementation challenges specific to the Focus on Energy Appliance Recycling Program in its analysis. Those programmatic considerations are best suited as part of program design and delivery.

Conclusion: Economic natural gas potential is led by savings from energy and water savings measures including low-flow showerheads and faucet aerators.

Cadmus found these retrofit measures account for approximately 86 million therms of 12-year economic potential, which represents about 34% of the total residential natural gas potential.

Conclusion: Premium efficiency gas furnaces (97% to 98% AFUE) offer substantial cost-effective residential natural gas efficiency savings.
Cadmus found approximately 29 million therms of 12-year economic potential for residential gas furnaces, which account for about 12% of the total residential natural gas potential.

Conclusion: The residential sector benefits the greatest from increased program funding.
Based on current funding allocation policy set by the PSC, which require residential program expenditures to comprise approximately 40% of the overall budget, the residential sector experiences the largest decrease in current policy potential relative to the optimized potential. For example, residential electric and natural gas current policy potential makes up 64% and 22% of the electric and natural gas residential optimized potential, respectively. On the other hand, the commercial, government, industrial, and agriculture sectors' electric current policy potential each make up at least 80% of their corresponding optimized potential, and 61% for gas measures.

Under the current funding allocation policy, available budget is not sufficient to capture a proportionate amount of cost-effective residential savings compared to nonresidential sectors. Therefore, increases in funding lead to significant increases in the residential potential as more budget is available to attain cost-effective savings.

Conclusion: Residential natural gas potential is particularly responsive to program funding, as demonstrated by the increase in potential for the +50% and +100% funding scenarios.
The 2021 study found that, for the +50% and +100% funding scenarios, the total residential natural gas potential increases by 84% and 335%, respectively, relative to current policy potential. In the +100% funding scenario, fewer natural gas savings opportunities remain for the commercial, government, industrial, and agriculture sectors, thereby allowing for more of the additional program funding to be allocated to the residential sector.

Nonresidential Sector

Cadmus' analysis identified total nonresidential electric economic potential equivalent to almost 9,000 GWh (60% of the electric total) and 188 million therms (42% of the natural gas total). The potential study identified several nonresidential electric and natural gas measure groups that offer significant cost-effective savings potential:

- Commercial and industrial lighting and lighting controls
- Commercial HVAC controls
- Commercial refrigeration
- Industrial sector process measures

Conclusion: Nonresidential screw-based lighting represents a significant source of economic potential savings, despite the increased prevalence of LED lighting technologies. This is due to a change in the treatment of screw-based lighting baseline technologies.
The 2017 potential study assumed a baseline change for screw-based lighting to the EISA 2020 backstop; however, the 2021 potential study does not because the previous federal administration rescinded the

EISA 2020 backstop standard and it is no longer in effect. Across all lighting applications and lighting controls measures, screw-based lighting represents roughly 34% of the economic potential compared to the LED fixtures and lighting controls. The economic potential also falls substantially for screw-base lighting after 2026, thereby only impacting the early part of this study's time horizon.

Conclusion: Commercial refrigeration measures account for 15% of electric commercial economic potential, or approximately 525 GWh.
Walk-in economizers, grocery display case measures, anti-sweat controls, and other grocery measures provide a robust source of cost-effective savings for the refrigeration end use—the fourth largest commercial electric end-use group projected in 2034 forecast sales.

Conclusion: Commercial natural gas economic potential declined substantially in the 2021 study compared to the 2017 study. This is primarily due to the impact of lower avoided costs on several measures with substantial technical potential savings.
Cadmus determined several key commercial natural gas measures, including retro-commissioning and some direct digital control system applications, had MTRC benefit-cost ratios between 0.75 and 0.99. Non-economic retro-commissioning, a key economic measure from 2017, accounted for almost 10 million therms of technical potential.

Conclusion: Industrial sector savings account for 34% of electric and 14% of natural gas economic potential and for 39% of electric and 11% of natural gas total 2034 baseline sales.
In terms of optimized potential, 2021 industrial sector savings account for an even greater share of total electric (37%) and natural gas (15%) potential when compared to the economic potential. Due to the unique nature of the industrial sector, almost all of the industrial technical potential is economic. The set of measures that characterize the industrial sector are drawn from data sources based solely on measures installed in industrial facilities across the country. This result is not unusual or unexpected, especially considering that these facilities likely will not install measures unless payback periods are relatively short.

Conclusion: Process measures accounted for the largest share of electric and natural gas economic potential in the industrial sector, providing more than 2,390 GWh of cumulative 12-year electric potential and 32 million therms of natural gas potential.
The 2021 study incorporated updates to industrial end-use shares from the recently released 2018 Energy Information Administration's Manufacturing Energy Consumption Survey and new measure data added to the Industrial Assessment Center's project database between 2017 and 2020. The 2021 study also included new process improvement measures to better align with Focus on Energy programs.

Conclusion: Nonresidential natural gas economic potential is highly sensitive to changing cost-effectiveness assumptions.
Several high-saving nonresidential natural gas measures, including retro-commissioning, that were marginally cost-effective in the 2017 study have an MTRC less than 1.0 in the current study due to lower avoided natural gas costs. Nonresidential natural gas economic potential increases substantially in each of the economic potential scenarios (e.g., lower discount rates, higher carbon costs, inclusion of

deferred electric T&D, societal cost test, and utility cost test) compared with the primary MTRC. Seemingly relative minor changes can lead to substantial increases in nonresidential natural gas potential, particularly because there are fewer end uses and measures compared with electric and this smaller set of natural gas measures represent proportionally higher savings.

Appendix A. Analysis Methodology

This appendix documents the analysis methodology for the Wisconsin Focus on Energy 2021 potential study for the following topics:

- Developing baseline forecasts
- Measure characterization
- Compiling Energy Efficiency Technology Measure Database
- Estimating technical potential
- Estimating economic potential
- Primary data collection

Developing Baseline Forecasts

Creating a baseline forecast required multiple data inputs to accurately characterize energy consumption in Focus on Energy's service area. These key inputs included the following:

- Participating utility sales and customer forecasts
- Major customer segments (e.g., residential dwelling types, commercial business types)
- End-use saturations (percentage of an end use [e.g., air conditioner] present in a building)
- Equipment saturations (e.g., average number of units in a building)
- Fuel shares (proportion of units using electricity versus natural gas)
- Efficiency shares (the percentage of equipment below, at, and above standard)
- Annual end-use consumption estimates by efficiency levels

Collecting Baseline Data

Data specific to Focus on Energy's service territory not only provided the basis for baseline calibration but also supported estimation of technical potential. The study included a significant effort to collect the best available primary data. Table A-1 identifies the key data sources used for each of the inputs.

Table A-1. Baseline Forecast Data Sources

Data	Residential Single-Family and Multifamily	Commercial and Government	Industrial	Agricultural
Baseline Sales and Customers	Wisconsin utilities customer databases, actual	Wisconsin utilities customer databases, actual	Wisconsin utilities customer databases, actual	Wisconsin utilities customer databases, actual
Forecasted Sales and Customers	Wisconsin utilities forecasts	Wisconsin utilities forecasts	Wisconsin utilities forecasts	Wisconsin utilities forecasts
Percentage of Sales by Building Type	Wisconsin utilities customer databases	Wisconsin utilities customer databases	Wisconsin utilities customer databases	Wisconsin utilities customer databases
End-Use Energy Consumption	Wisconsin utilities load forecasts, primary research, EIA's Residential Energy Consumption Survey (RECS), ENERGY STAR, Wisconsin Focus on Energy 2020 TRM	Wisconsin utilities load forecasts, primary research, EIA's Commercial Building Energy Consumption Survey (CBECS), ENERGY STAR, Wisconsin Focus on Energy 2020 TRM	Wisconsin utilities load forecasts, primary research, EIA's Manufacturing Energy Consumption Survey (MECS), Wisconsin Focus on Energy 2020 TRM	Wisconsin utilities load forecasts, primary research, Cadmus research, Wisconsin Focus on Energy 2020 TRM
Saturations and Fuel Shares	Primary data collection survey, Wisconsin Focus on Energy program evaluations, EIA's RECS	Primary Data Collection Survey and Virtual Site Visits, Wisconsin Focus on Energy program evaluations, EIA's CBECS	Primary data collection expert interviews, Industrial Assessment Center, EIA's MECS, Cadmus research	Primary data collection survey, Cadmus research
Efficiency Shares	Primary data collection survey, EIA's RECS, ENERGY STAR unit shipment reports	Primary data collection survey and Virtual Site Visits, Wisconsin Focus on Energy program evaluations, EIA's CBECS	Primary data collection expert Interviews, Industrial Assessment Center, EIA's MECS, Cadmus research	Primary data collection survey, Cadmus research

Baseline Forecast of Sales and Customers

Cadmus requested customer counts, sales (consumption), and peak demand by sector and segment, where available, from Focus on Energy participating utilities. The initial data request included these additional details:

- Data should include number of customers and weather-normalized actual electric and natural gas sales for a historic period (i.e., 2019), which will serve as a base year and a forecast period.
- Forecast sales should be absent energy efficiency to avoid double-counting savings.
- These customer data should represent the number of buildings or dwellings but accounts and premises can be used as a proxy where available and necessary.
- Utility forecasts should reflect customers in Wisconsin only.

The following Focus on Energy participating utilities provided data on actual and forecasted sales and on customers by sector:

- Madison Gas and Electric
- WE Energies
- WPPI Energy
- Xcel Energy
- Manitowoc Public Utilities
- Wisconsin Power and Light
- Wisconsin Public Service

Once Cadmus received all the customer counts and sales from the base year, it compared the information to the U.S. Energy Information Administration (EIA) Form 861 and 176 data for reasonableness and adjusted the sales and customer forecasts for the remaining share of Focus on Energy participating utilities from which no data were received. Cadmus then calibrated each sector and fuel type model to match the segmented utility load and sales forecasts. Prior to estimating technical potential, Cadmus also adjusted the load and sales forecasts to account for future federal standards to avoid double-counting the savings from these end uses.

End-Use Energy Consumption

The per-unit end-use energy consumption—sometimes called unit energy consumption for a residential forecast and energy-use intensity for a commercial forecast—provides a crucial input for end-use forecasts. Industry studies have derived this consumption using a variety of methods, including statistical methods (e.g., conditional demand modeling), physics-based building simulation models (e.g., the U.S. Department of Energy's EnergyPlus model), and simple algorithms (e.g., ENERGY STAR calculators).

Cadmus drew from several resources to estimate the end-use energy consumption for each sector, segment, and fuel type combination in the study. It prioritized using data from primary research—either virtual site visits or surveys—before relying on secondary data sources. Using primary data from Wisconsin data sources allowed for better baseline energy use estimates and ensured that results are based upon local data sources, where possible. Using local data sources improves the potential savings estimates compared with relying on regional or national data for end-use energy consumption.

Saturations and Fuel Shares

To produce a bottom-up, end-use forecast, Cadmus first determined how many units of each end use would be found in a typical home. End-use saturations represent the average number of units in a home, and fuel shares represent the proportion of those units using electricity versus natural gas. For instance, on average, a typical home has 0.9 clothes dryers (the saturation), and 85% of these units are electric (the fuel share).[14]

End-use saturations represent the average number of units in a home.

Fuel shares represent the proportion of those units using electricity versus natural gas.

Efficiency Shares

Efficiency shares equal the current saturation of a specific type of equipment (of varying efficiency). Within an end use, these shares sum to 100%. For instance, the efficiency shares for a central air conditioning end use may be 50% SEER 13, 25% SEER 15, and 25% SEER 16.

End-Use Consumption Estimates

Prior to estimating the technical potential of electric and natural gas energy efficiency measures, Cadmus developed annual end-use consumption estimates for each fuel type, sector, and segment. This equation specified the forecast for each end use in the study:

$$EUSE_{ij} = \Sigma_{e} ACCTS_{i} * UPA_{i} * SAT_{ij} * FSH_{ij} * ESH_{ije} * EUI_{ije}$$

Where:

EUSEij	=	Total energy consumption for end use j in customer segment i
ACCTSi	=	The number of accounts/customers in segment i
UPAi	=	The units per account in customer segment i
SATij	=	The share of customers in customer segment I with end use j
FSHij	=	The share associated with electric or natural gas in end use j in customer segment i
ESHije	=	The market share of efficiency level e in the equipment for customer segment ij
EUIije	=	End-use intensity or unit energy consumption for the equipment configuration ije

Each end-use forecast was summed within each segment, sector, and fuel type combination to determine the overall sales forecast. *Appendix C* contains detailed base case forecasts for each end use, segment, sector, and fuel type combination in the study.

Measure Characterization

Cadmus developed a comprehensive measure database of technical and market data that applied to all end uses in various market segments, and estimated costs, savings, and applicability for a comprehensive set of energy efficiency measures. Through this process, measure savings are calculated as unit energy savings or measure percentage savings to estimate the end-use present savings. These

[14] Saturations are less than 1.0 when some homes do not have the end use.

measure end-use percentage savings, when applied to the baseline end-use forecast, produced estimates of energy efficiency potential. First, Cadmus developed an initial list of measures for a database from the following:

- Measures included in the Wisconsin Focus on Energy's 2020 Technical Reference Manual (TRM)
- Measures currently included in the Focus on Energy's prescriptive programs and selective SPECTRUM custom measures
- Efficiency tiers from the Consortium for Energy Efficiency and ENERGY STAR
- Measures from Cadmus' extensive database, including measures in regional or national databases (e.g., California Database for Energy Efficient Resources [DEER][15]) and TRMs
- Selected emerging technologies and behavioral measures

Residential emerging technologies examined in this study included the following:

- Cold climate heat pumps
- CO_2 heat pump water heaters
- Heat pump dryers
- Smart Wi-Fi water heater controller
- Specialty framing (insulating concrete forms/structural insulated panels)

Nonresidential emerging technologies included the following:

- Active chilled beam cooling with dedicated outdoor air system
- Advanced lighting and controls design
- Boiler oxygen trim controls
- Cold climate heat pumps
- Continuous commissioning
- CO_2 heat pump water heaters
- Natural ventilation design for new construction
- Spring-loaded garage door hinges
- Ultra-low temperature freezers with sterling engine

Cadmus focused on emerging technologies approaching commercialization or that may become cost-effective within the next five years. Cadmus conducted a qualitative screen to evaluate the applicability of measures to Wisconsin, which involved reviewing and excluding measures from analysis if they met the following conditions:

- Not commercially available
- Did not benefit participating utilities' systems
- Unrealistically expensive to install
- Fell below prevailing code or standard practices

Though current research could not justify including these technologies in this study, Focus on Energy programs may want to consider reevaluating these technologies in future studies and assessing whether their market viability or supporting data has improved.

Upon identifying measures, Cadmus compiled all inputs required to estimate potential. Table A-2 shows key inputs and possible data sources. Virtual site visits and surveys were designed to collect information on key measures, and data were supplemented for other measures by the other sources.

[15] California Energy Commission Database for Energy Efficient Resources. http://www.deeresources.com/

Table A-2. Key Measure Data Sources

Input	Residential Single-Family and Multifamily	Commercial and Government	Industrial	Agricultural
Energy Savings	Primary data collection survey, Wisconsin Focus on Energy program evaluations, Wisconsin Focus on Energy 2020 TRM, ENERGY STAR, U.S. Department of Energy (DOE)/EERE,[1] Regional Technical Forum, Cadmus research	Primary data collection survey and virtual site visits, Wisconsin Focus on Energy program evaluations, Wisconsin Focus on Energy 2020 TRM, CBECs 2012 Microdata, ENERGY STAR, DEER, DOE/EERE, Regional Technical Forum, Cadmus research	Primary data collection expert interviews, Wisconsin Focus on Energy program evaluations, Wisconsin Focus on Energy 2020 TRM, DOE's Industrial Assessment Center Database, Industrial Savings Potential Project (ISPP), Northwest Power and Conservation Council (NWPCC) industrial data, Cadmus research	Primary data collection survey, Wisconsin Focus on Energy program evaluations, Wisconsin Focus on Energy 2020 TRM, Regional Technical Forum, Cadmus research
Equipment and Labor Costs	Wisconsin Focus on Energy 2020 TRM, Wisconsin Focus on Energy program evaluations, National Residential Efficiency Measures Database,[2] RSMeans,[3] ENERGY STAR, DOE/ Energy Office of Energy Efficiency (EERE), DEER, Regional Technical Forum, incremental cost studies, online retailers, Cadmus research, SPECTRUM cost data	Wisconsin Focus on Energy 2020 TRM, Wisconsin Focus on Energy Program Evaluations, RSMeans, ENERGY STAR, DOE/EERE, DEER, Regional Technical Forum, Incremental Cost Studies, online retailers, Cadmus research, SPECTRUM cost data	Wisconsin Focus on Energy 2020 TRM, Wisconsin Focus on Energy program evaluations, DOE's IAC Database, ISPP, NWPCC industrial data, Cadmus research, SPECTRUM cost data	Wisconsin Focus on Energy 2020 TRM, Wisconsin Focus on Energy program evaluations, RSMeans, ENERGY STAR, DOE/EERE, DEER, Regional Technical Forum, incremental cost studies, online retailers, Cadmus research, SPECTRUM cost data
Measure Life	Wisconsin Focus on Energy 2020 TRM, Wisconsin Focus on Energy program evaluations, ENERGY STAR, DEER, Cadmus research	Wisconsin Focus on Energy 2020 TRM, Wisconsin Focus on Energy program evaluations, ENERGY STAR, DEER, Cadmus research	Wisconsin Focus on Energy 2020 TRM, Wisconsin Focus on Energy program evaluations, DOE's Industrial Technologies Program, DEER, NWPCC industrial data, Cadmus research	Wisconsin Focus on Energy 2020 TRM, Wisconsin Focus on Energy program evaluations, ENERGY STAR, DEER, Cadmus research
Technical Feasibility	Primary data collection survey, Cadmus research	Primary data collection survey and virtual site visits, Cadmus research	Primary data collection expert interviews, Wisconsin Focus on Energy program evaluations, NWPCC industrial data, Cadmus research	Primary data collection survey, Cadmus research
Percentage Incomplete	Primary data collection survey, Wisconsin Focus on Energy program accomplishments, RECS, Cadmus research	Primary data collection survey and virtual site visits, Wisconsin Focus on Energy program accomplishments, Cadmus research	Primary data collection expert interviews, Wisconsin Focus on Energy Program accomplishments, Cadmus research	Primary data collection survey, Wisconsin Focus on Energy program accomplishments, Cadmus research

[1] Department of Energy Office of Energy Efficiency and Renewable Technology (EERE). http://energy.gov/eere/office-energy-efficiency-renewable-energy

[2] National Renewable Energy Laboratory National Residential Efficiency Measures Database. https://remdb.nrel.gov/

[3] RSMeans Cost Data. https://www.rsmeans.com/products/online

Energy Savings and Measure Interactions

For each energy efficiency measure, Cadmus had to estimate energy savings, both as savings per unit (kWh or therm) and as savings as a percentage of end-use consumption. These estimates also had to account for savings interactions and results across end uses (e.g., upon installing efficient lighting, cooling loads decrease due to the reduction of waste heat). Cadmus relied on a number of sources to develop savings estimates:

- **Survey and virtual site visits.** Primary data collection involved virtual site visits and surveys in the commercial sector and surveys in the residential and agriculture sectors. For the industrial sector, expert interviews were conducted rather than surveys or virtual site visits. Primary data provided comprehensive information on building characteristics, energy-consuming end uses, and equipment efficiencies.
- **Wisconsin Focus on Energy's most recent program evaluations and program data.** Program evaluations can inform estimates of energy savings, and many program evaluations use engineering algorithms (such as those found in TRMs), metering data, billing analyses, or building simulations to estimate savings for energy efficiency measures. Also included were any program data from implementation contractors (e.g., reports, work papers, impact calculations).
- **Wisconsin Focus on Energy 2020 TRM.** The TRM was used as the primary method to calculate the estimate per-unit energy savings for a variety of measures. Cadmus supplemented default TRM values with primary data where possible.
- **Other utility program evaluations.** Cadmus relied on other utilities' program evaluations when characterizing measures that Wisconsin Focus on Energy did not offer through its existing prescriptive programs. For some measures, Cadmus used an average value derived from multiple program evaluations. For example, Cadmus typically assumed that home energy reports saved approximately 1.5% of a home's annual energy use, which Cadmus derived from a meta-analysis of home energy report impact evaluations.
- **The U.S. Department of Energy (DOE) Uniform Methods Project or other standard evaluation protocols.** The Uniform Methods Project defined standard calculations used to estimate energy savings for a number of measures. Cadmus' savings calculations were consistent with such industry standards.
- **ENERGY STAR Calculators.** U.S. Environmental Protection Agency (EPA) ENERGY STAR calculators provided estimates of per-unit savings for a number of measures, including efficient appliances (e.g., refrigerators, freezers, clothes washers) and efficient home electronics (e.g., televisions, computers, monitors).
- **DOE/Office of Energy Efficiency and Renewable Energy (EERE) technical support documents.** DOE included estimates of equipment energy consumption in its technical support documents for a number of different types of energy-efficient equipment.

Equipment and Labor Costs

Cadmus estimated equipment and labor costs for each energy efficiency measure and used these costs to calculate benefit-cost ratios and to estimate potential program expenditures. Cadmus relied on a number of sources in developing cost estimates:

- **Wisconsin Focus on Energy 2020 TRM.** The TRM provided estimates of per-unit costs for a variety of measures as part of the incremental cost database. Where possible, Cadmus supplemented default TRM values with primary data. In some cases, secondary data were used due to differences in measure definitions between the TRM and the potential study.
- **Wisconsin Focus on Energy's most recent program evaluations and program data.** Where applicable, Cadmus used Focus on Energy equipment cost data from program data.
- **National Renewable Energy Laboratory (NREL) National Residential Efficiency Measures Database.** NREL maintains a detailed, up-to-date dataset of measure costs for a number of energy efficiency measures.
- **RSMeans.** RSMeans provided construction cost data, including costs for a number of home retrofits (e.g., weatherization, windows, other shell upgrades). Cadmus used data from RSMeans Online, the most recent version.
- **ENERGY STAR.** EPA provided current equipment costs for a number of ENERGY STAR-rated units.
- **DOE/EERE technical support documents.** DOE included estimates of equipment and labor costs in its technical support documents for a number of different types of energy-efficient equipment.
- **Incremental cost studies.** TRMs often require incremental cost studies that show baseline and efficiency measure costs (e.g., labor, equipment, O&M) and states often frequently update these studies to incorporate the most recent cost data. These studies included the measures most commonly offered through utility-sponsored energy efficiency programs.
- **Online retailers.** Cadmus staff continuously reviewed prices listed on manufacturer or retailer websites. Though online retailers may not provide estimates of installation (labor) or annual O&M costs, they provide reliable equipment costs.
- **Focus on Energy SPECTRUM cost data.** The database contained project costs, mainly for custom projects and measures. Most data represented full costs in the database and could be used only for certain measures.

Measure Life

Cadmus used estimates of each measure's effective useful life (EUL) to calculate the lifetime net present value (NPV) benefits and costs for each energy efficiency measure. Many data sources for measure savings and costs (described above) also provided estimates for measure lifetimes.

Cadmus relied on a number of sources to develop measure life estimates:

- Wisconsin Focus on Energy 2020 TRM, which includes the results of a comprehensive review conducted by Cadmus in 2017 of measure lifetimes for all active Focus measures
- NREL's National Residential Efficiency Measures Database

- Effective useful life (EUL) studies, including the Northeast Energy Efficiency Partnership's 2007 EUL study or EULs derived by the Association of Home Appliance Manufacturers[16]
- ENERGY STAR
- DOE/EERE technical support documents
- Regional TRMs

Technical Feasibility

Technical feasibility factors represented the percentage of homes or buildings that could feasibly install an energy efficiency measure. Technical limitations included equipment capability or space limitations. For example, solar water heaters could not be feasibly installed in all buildings, given some buildings did not have the required roof orientation and pitch. Cadmus relied on a number of sources to develop feasibility estimates:

- **Surveys and virtual site visit.** These surveys and virtual site visits collected data about building characteristics that could inform estimates of technical feasibility. For instance, some water heaters located in small spaces reduced the feasibility of installing a heat pump water heater, which would require airflow above that of a standard water heater.
- **Stock assessments and surveys (e.g., EIA's RECS and CBECS).** These assessments included building characteristics that could inform estimates of technical feasibility. For instance, some floor insulation measures required a basement or a crawlspace; using EIA's RECS, Cadmus could determine the proportion of homes with a basement or crawlspace and that could, therefore, feasibly install this measure.
- **Energy efficiency program evaluations.** Some energy efficiency program evaluations included research to identify technical barriers to installing energy efficiency measures.
- **Power plans and other potential studies.** Regional potential studies, such as the Northwest Power and Conservation Council's Seventh Power Plan,[17] provided estimates of the technical feasibility for common energy efficiency measures.
- **Cadmus research, third-party research (including the Federal Energy Management Program, DOE, or Toolbase.org).** Various third-party measure characterization reports identified technical limitations for energy efficiency measures. Cadmus used these assessments to estimate the proportion of homes or businesses that could feasibly install each measure. In some instances, Cadmus' engineering judgment was used to proximate technical constraints.

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16 Northwest Energy Efficiency Partnerships. "NEEP Load Shape Research and Data." Accessed July 2021: https://neep.org/loadshape-report-and-catalogue

17 Northwest Power Planning Council. "Power Planning." Accessed July 2021: https://www.nwcouncil.org/energy/7th-northwest-power-plan/about-seventh-power-plan

Percentage Incomplete

Percentage incomplete factors represent the percentage of remaining homes or businesses yet to install an energy efficiency measure. This equals one minus the current saturation of energy efficiency measures. The study had to account for Wisconsin Focus on Energy's program accomplishments, building energy codes and standards, and the natural adoption of efficiency measures, so Cadmus relied on a number of sources to develop percentage incomplete estimates:

- Surveys and virtual site visits for key measures
- Wisconsin Focus on Energy's most recent program evaluations and program data
- Recent stock assessments and surveys (e.g., U.S. EIA's RECS and CBECS)
- ENERGY STAR reports
- DOE/EERE technical support documents

Compiling Energy Efficiency Technology Measure Database

After creating a list of electric and gas energy efficiency measures applicable to Focus on Energy's service territory, Cadmus classified energy efficiency measures into these two categories:

- **High-efficiency equipment measures.** These measures directly affected end-use equipment (e.g., high-efficiency central air conditioners) that followed normal replacement patterns and were based on EULs.
- **Non-equipment measures (retrofit).** These measures affected end-use consumption without replacing end-use equipment (e.g., insulation). Such measures did not include timing constraints from equipment turnover (except for new construction) and therefore should be considered discretionary (i.e., savings could be acquired at any point over the planning horizon).

This study assumed that all high-efficiency equipment measures would be installed at the end of the existing equipment's remaining useful life; therefore, Cadmus did not assess energy efficiency potential for early replacement.

Most measures naturally turn over within the study horizon, and long-run technical potential from early replacement measures equals savings from replace-on-burnout measures. However, early replacement measure costs are much higher than replace-on-burnout measure costs because the former reflect the full measure cost, not incremental costs. The economic potential, therefore, depends on the allocation of early replacement and replace-on-burnout measures. Including these early replacement measures would contribute to estimates of technical and economic potential inconsistent with their definitions.[18]

Early replacement, however, could be considered in estimating program potential. Short-run savings from early replacement measures could exceed savings from replace-on-burnout iterations as early

[18] Cadmus considered refrigerator, freezer, and room air conditioner recycling to estimate savings associated with the removal of below-standard secondary units. These measures, however, could not be considered "early replacement" as they did not assume secondary units would be replaced with efficient units.

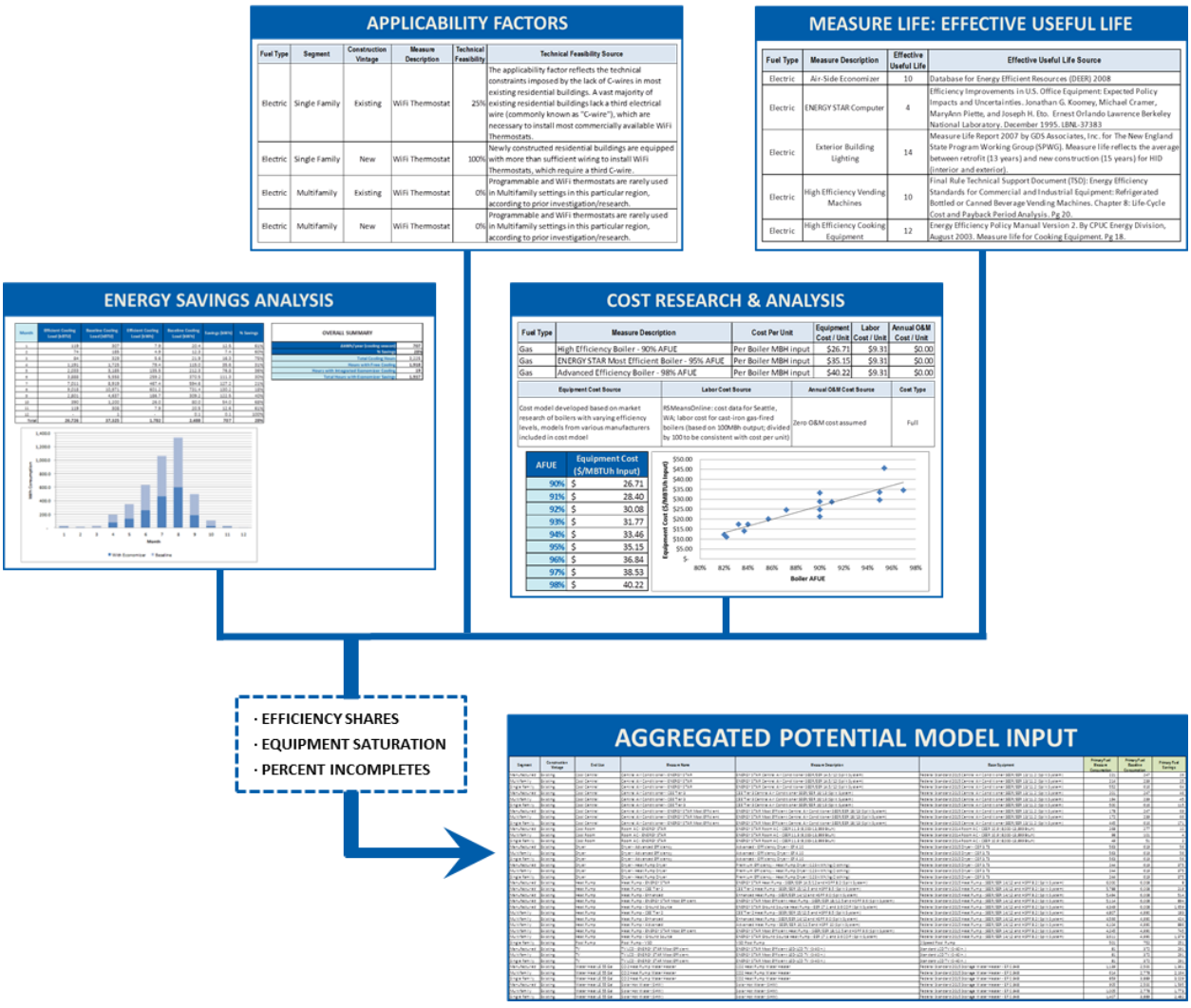
replacement savings would be calculated using a below-standard baseline. Because this study did not include program potential, Cadmus excluded early replacement measures from the analysis.

The following lists relevant inputs for each measure type:

- Equipment and non-equipment measures:
  - Technical feasibility—the percentage of buildings where customers could install this measure, accounting for physical constraints
  - Energy savings—average annual savings attributable to installing the measure, in absolute and/or percentage terms
  - Equipment cost—full or incremental, depending on the nature of the measure and the application
  - Labor cost—the expense of installing the measure, accounting for differences in labor rates by region, urban versus rural areas, and other variables
  - Measure life—the expected life of the measure's equipment
- Non-equipment measures only:
  - Percentage incomplete—the percentage of buildings in which customers had not installed the measure, but where, technically, it could be feasibly installed
  - Measure competition—for mutually exclusive measures, accounting for the percentage of each measure likely installed to avoid double-counting savings (e.g., 1.5 GPM and 2.0 GPM showerheads cannot both be installed in the same showerhead socket; therefore, only one permutation could possibly be installed depending on technical feasibility for technical potential and technical feasibility and cost-effectiveness for economic potential)

Underlying measure assumptions and analysis were characterized in Excel workbooks (by measure), as shown in Figure A-1. The measure workbooks contained detailed saving calculations, cost research, EUL data, applicability factor values, and measure assumptions as well as well-documented source descriptions. Cadmus aggregated all measure data into a final master input file for use in the potential model.

Figure A-1. Example of Measure Technical Workbooks



Incorporating Codes and Standards

Cadmus' assessment accounted for changes in codes and standards over the planning horizon. These changes affected customers' energy-consumption patterns and behaviors and determined which energy efficiency measures would continue to produce energy savings over minimum requirements. Cadmus captured current efficiency requirements, including those enacted but not yet in effect. For the residential state energy code, this study used Wisconsin's Uniform Dwelling Code SPS 320-325. For the commercial and government energy code, this study used the International Energy Conservation Code, 2015 edition, with amendments found in SPS 361.05.

Cadmus did not attempt to predict how federal standards might change in the future. Rather, the study factored in only the legislation already enacted, except for lighting standards.

In December of 2019, the DOE issued a Final Determination in which it formalized full rescission of the 2007 Energy Independence and Security Act (EISA) backstop requirement, which would have established a

45 lumen/watt baseline beginning in 2020. However, there are still pending legal challenges and, with the change in presidential administrations, uncertainty remains regarding if and how this standard will be reintroduced. In addition, market adoption for LEDs continues to be rapid and has implications on the remaining potential. Cadmus developed two EISA compliance scenarios for a base case scenario to help determine the overall impact to economic potential. These scenarios are discussed in detail in *Appendix D*.

Cadmus explicitly accounted for several other pending federal standards. Table A-3 and Table A-4 list recent enacted or pending equipment standards that are accounted for in this study's commercial and residential sectors for electric and gas end uses. For measures where a future standard would have a higher efficiency than a current standard market practice baseline, Cadmus adjusted the baseline to the new federal standard.

Table A-3. Current and Pending Electric Standards by End Use

Equipment Electric Type	Existing (Baseline) Standard	New Standard	Sectors Impacted	Study Effective Year
Appliances				
Vending machines	Federal standard 2012	Federal standard 2019	Nonresidential	2020[1]
HVAC				
Residential heat pump (air source)	Federal standard 2017	Federal standard 2023	Residential	2023
Residential central air conditioner	Federal standard 2017	Federal standard 2023	Residential	2023
Residential furnace fans	Existing conditions (no prior federal standard)	Federal standard 2019	Residential	2020[1]
Small, large, and very large commercial air conditioners and heat pumps	Federal standard 2018	Federal standard 2023	Nonresidential	2023
Lighting				
Lighting General Service and Specialty Lamp (EISA Backstop Provision)	Existing conditions (no federal standard prior to EISA 2007)	Federal standard 2020	Nonresidential/ Residential	2020
Other				
Residential Pool Pump	Federal standard 2017	Federal standard 2021	Residential	2021
Water Heat				
Pre-rinse Spray Valves	Federal standard 2006	Federal standard 2019	Nonresidential	2020[1]

[1]To estimate potential, Cadmus assumed standards taking effect mid-year would start January 1 of the following year.

Table A-4. Current and Pending Gas Standards by End Use

Equipment Gas Type	Existing (Baseline) Standard	New Standard	Sectors Impacted	Study Effective Year
HVAC				
Boiler	Federal standard 2012	Federal standard 2021	Residential	2022[1, 2]
Boiler	Federal standard 2012	Federal standard 2021	Nonresidential	2023

[1]To estimate the potential, Cadmus assumed standards taking effect midyear will start on January 1 of the following year.
[2] The Wisconsin residential Uniform Dwelling Code (UDC) requires a minimum boiler and furnace efficiency of 90% AFUE, which exceeds the boiler federal standard 2021 requirements of 84% AFUE and the furnace federal standard 2016 requirements of 80% AFUE. The Wisconsin residential UDC requirement of 90% AFUE was used in place of these federal standard at the start of the study.

Cadmus also incorporated other standards that, prior to 2019, have become effective for equipment:

- Commercial clothes washers (2018)
- Commercial ice maker (2018)
- Commercial package terminal air conditioners (2017)
- Commercial package terminal heat pumps (2013)
- Commercial refrigeration equipment (2017)
- Commercial single package three phase air conditioners and heat pumps (2017)
- Cooking ovens and ranges (2012)
- Dehumidifiers (2019)
- Faucet aerators (1994)
- General service fluorescent lamps (2018)
- Metal halide lamp fixtures (2017)
- Microwaves (2016)
- Motors (2019)
- Pool heaters (2014)
- Residential clothes dryers (2016)
- Residential clothes washer (2018)
- Residential dishwashers (2014)
- Residential furnaces (2016) [19]
- Residential refrigerators and freezers (2015)
- Room air conditioners (2015)
- Showerheads (1994)
- Walk-in cooler and freezer (2017)
- Water heaters (2015)

Naturally Occurring Conservation

Cadmus' baseline forecast included naturally occurring conservation, which refers to reductions in energy use that occur due to normal market forces (e.g., technological change and changes in energy prices) and improved energy codes and standards. These impacts resulted in changed baseline sales, from which Cadmus could estimate technical and achievable technical potential.

[19] The Wisconsin residential Uniform Dwelling Code (UDC) requires a minimum boiler and furnace efficiency of 90% AFUE which exceeds the boiler federal standard 2021 requirements of 84% AFUE and the furnace federal standard 2016 requirements of 80% AFUE. The Wisconsin residential UDC requirement of 90% AFUE was used in place of these federal standard at the start of the study.

This analysis accounted for naturally occurring conservation in three ways:

- The potential associated with certain energy-efficient measures assumed a natural adoption rate, net of current saturation. For example, total potential savings associated with ENERGY STAR appliances account for current trends in customer adoption. As such, the baseline energy forecast reflected the total technical savings potential from ENERGY STAR appliances.
- The assessment accounted for gradual increases in efficiency due to retirement of older equipment in existing buildings, followed by replacement with units meeting or exceeding minimum standards at the time of replacement.
- The assessment accounted for pending improvements to equipment efficiency standards that will take effect during the planning horizon, as discussed above. The assessment did not, however, forecast changes to standards yet to be passed.

Estimating Technical Potential

Once Cadmus fully populated the measure database, it used measure-level inputs to estimate technical potential over the planning horizon. To begin this process, Cadmus estimated savings from all measures included in the analysis, then aggregated the results to the end use, market segment, and sector levels.

Cadmus characterized individual measure savings, first in terms of the percentage of end-use consumption. For each non-equipment measure, the study estimated absolute savings using the following equation:

$$SAVE_{ijm} = EUI_{ije} * PCTSAV_{ijem} * APP_{ijem}$$

Where:

$SAVE_{ijm}$	=	Annual energy savings for measure, *m*, for end use, *j*, in customer segment, *I*
EUI_{ije}	=	Calibrated annual end-use energy consumption for equipment, *e*, for end use, *j,* and customer segment, *I*
$PCTSAV_{ijem}$	=	The percentage savings of measure, *m,* relative to the base use for the equipment configuration, *ije*, accounting for interactions among measures (such as lighting and HVAC), calibrated to annual end-use energy consumption
APP_{ijem}	=	Measure applicability: a fraction representing combined technical feasibility, existing measure saturation, end-use interaction, and any adjustments used to account for competing measures

For example, for wall insulation that saved 10% of space heating consumption, the final percentage of the end use saved would be 5%, assuming an overall applicability of 50%. This value represented the percentage of baseline consumption that the measure saved in an average home.

Capturing all applicable measures, however, would require examining many instances in which multiple measures affected a single end use. To avoid overestimating total savings, Cadmus assessed cumulative impacts and accounted for interactions among various measures—a treatment called “measure stacking.”

The primary method used to account for stacking effects establishes a rolling, reduced baseline, applied sequentially upon assessment of measures in the stack. The following equations illustrate this technique, applying measures 1, 2, and 3 to the same end use:

$$SAVE_{ij1} = EUI_{ije} * PCTSAV_{ije1} * APP_{ije1}$$

$$SAVE_{ij2} = (EUI_{ije} - SAVE_{ij1}) * PCTSAV_{ije2} * APP_{ije2}$$

$$SAVE_{ij3} = (EUI_{ije} - SAVE_{ij1} - SAVE_{ij2}) * PCTSAV_{ije3} * APP_{ije3}$$

After iterating all measures in a bundle, the final percentage of the reduced end-use consumption provided the sum of each individual measure's stacked savings, which Cadmus divided by the original baseline consumption. The order of the stacked, retrofit measures in a bundle is ranked from the highest- to lowest-saving measures, in terms of the percentage energy savings for that end use.

About Net-To-Gross

Cadmus' baseline forecast includes naturally occurring efficiency; that is, the forecast assumes that some customers would install efficiency measures even without an intervention from Focus on Energy. Cadmus adopted this assumption when calibrating baseline load forecasts to Focus on Energy participating utilities' forecasts. These sales histories (from which the utilities derive their forecasts) exhibited some level of naturally occurring savings. Failure to account for such savings in Cadmus' forecasts would have led to baseline forecasts that exceeded Focus on Energy participating utilities' forecasts or overestimated energy efficiency potential.

Cadmus' estimates of energy efficiency potential did not consider the impacts on future program savings attribution by estimating or forecasting net-to-gross ratios, making explicit out-of-model adjustments for net-to-gross, or otherwise considering the possible effects of freeridership or spillover. Because this study estimated optimized—not program—potential, program planners should consider the possible impacts to net savings when determining program budgets and targets during the next quadrennium planning process. Program planners should consider the following indicators for measures for which lower net-to-gross ratios are possible:

- Measures with low or no incremental cost
- Measures with low percentage incomplete values
- Measures with fast ramp rates
- Measures whose efficiency level distributions are relatively high

Estimating Economic Potential

Economic potential represents a subset of technical potential, consisting only of measures meeting cost-effectiveness criteria, based on to Focus on Energy participating utilities' avoided supply costs for delivering electricity. Cadmus used the modified total resource cost (MTRC) to identify cost-effective measures in a manner consistent with Focus on Energy's program evaluation. Table A-5 lists the benefits and costs considered in calculating MTRC benefit-cost ratios to develop the economic potential that served as the basis of the optimized potential. *Appendix D* provides additional economic scenarios that considered alternate cost tests, additional variables, and varying assumptions for discount rate and carbon value.

Table A-5. Summary of Costs and Benefit Components

Type	Component
Costs	Incremental measure equipment and labor cost
	Administrative adder
Benefits	PV avoided energy supply benefits
	Non-energy benefits
	Secondary energy benefits

Details follow of components shown in Table A-5.

- **Incremental measure equipment and labor cost.** This study considered equipment and labor costs required to purchase a measure and sustain savings over each measure's EUL.
- **Administrative adder.** Cadmus assumed these costs were equal to 21% of incremental costs for residential measures and 18% for nonresidential measures, informed by Focus on Energy's historical delivery and administration charges from the Focus on Energy 2019 annual report.
- **PV avoided energy supply benefits.** Cadmus estimated avoided energy and deferred generation capacity benefits based on energy and transmission and distribution cost forecasts provided by Focus on Energy.
- **Non-energy benefits.** This study accounted for benefits from reduced emissions and indirect energy savings from reduced water consumption (for measures such as low flow showerheads). Reduced emissions reflect the economic value of avoided greenhouse gas emissions, including carbon dioxide, nitrous oxides, and sulfur oxides. The study valued avoided carbon at $15 per ton.
- **Secondary energy benefits.** Cadmus considered secondary energy benefits for measures that saved energy on secondary fuels. Cadmus's end-use approach to estimating technical potential necessitated this treatment. For example, consider the cost of R-60 ceiling insulation for a home with a gas furnace and an electric cooling system. For the gas furnace end use, Cadmus classified energy savings that R-60 insulation produced for electric cooling systems, conditioned on the presence of a gas furnace, as a secondary benefit.

In addition to each benefit and cost detailed above, Focus on Energy provided standard line loss factors and discount rates for this study. The discount rate applied was two percent.

Economic potential can exceed technical potential when a second measure, interacting with a given measure, fails a benefit-cost screen. For instance, suppose a homeowner installs an efficient air conditioner that reduces baseline cooling consumption from 1,000 kWh to 900 kWh then installs a weatherization measure that saves 10% off the baseline cooling consumption. Consequently, the technical potential for this weatherization measure would equal 90 kWh (900*10%). If the efficient air conditioner measure did not prove cost-effective, the homeowner's baseline consumption would remain at 1,000 kWh. If the weatherization measure did prove cost-effective, the 10% savings would yield economic potential equal to 100 kWh (1,000*10%). In this case, economic potential for the weatherization measure would exceed the technical potential.

Avoided Energy Costs

Cadmus employed the same electric and natural gas avoided energy and capacity cost forecasts used by Focus on Energy to evaluate program and measure cost-effectiveness. Figure A-2 and Figure A-3 provide the avoided energy and cost forecasts for electricity and natural gas, respectively. Figure A-2 also includes the electric avoided capacity forecast. Avoided natural gas energy forecasts vary between the nonresidential and the residential sector, while the electric energy forecasts are consistent across customer types.

Figure A-2. Avoided Electric Energy and Capacity Cost Forecast

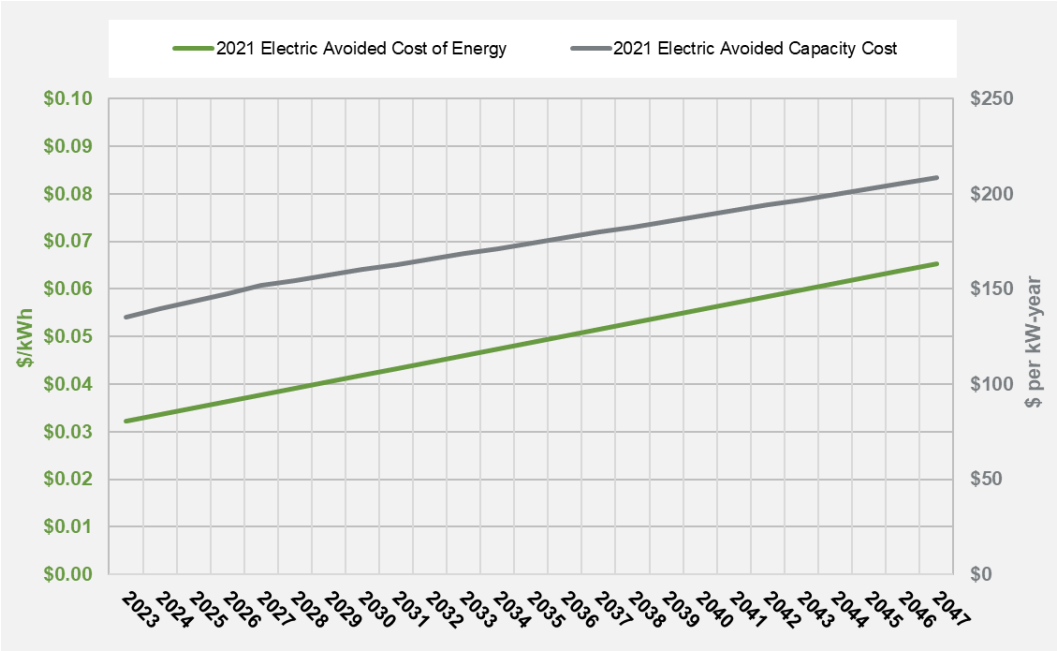
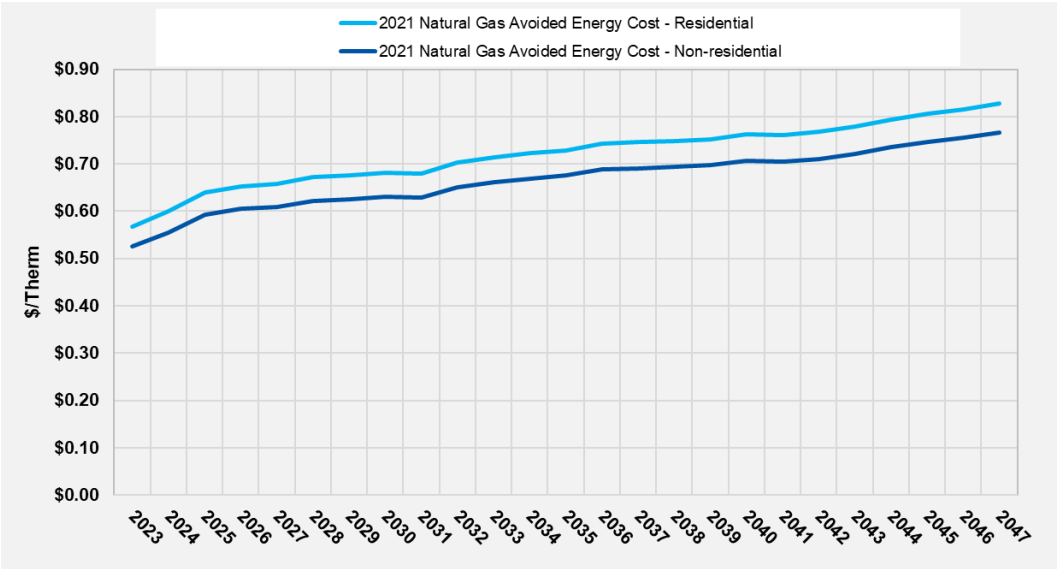


Figure A-3. Avoided Natural Gas Energy Cost Forecast



Primary Data Collection

A large part of this study involved collecting comprehensive primary data through these three activities:

- **Virtual site visit.** Due to COVID-19 travel restrictions and safety protocols, virtual site assessments were conducted to collect comprehensive information on building characteristics, high impact energy-consuming end uses (e.g., lighting, HVAC, and water heating equipment), and equipment efficiencies. This methodology provided a high level of detail to inform the study. The *Commercial Virtual Site Visits* section in this appendix contains more detail.
- **Detailed survey.** A phone or online survey collected information on building characteristics, demographics, general information on energy-consuming end uses (e.g., fuel type, equipment type, estimate equipment age), and equipment saturations. Online surveys were delivered to standard-income residential customers and phone surveys were delivered to income-qualified customers.
- **Expert interview.** Cadmus conducted phone interviews with industrial subject matter experts (specifically, industry experts) to assess general baseline data. These industry experts had backgrounds in pulp and paper, ethanol, metal manufacturing, general process manufacturing, food manufacturing, and refrigeration.

Cadmus defined the stratified sampling plan for the surveys and virtual site visits. The allocated budget for this study could not support virtual site visits for all segments. Therefore, the study prioritized commercial building types that account for the majority of consumption representing high-impact and high-value segments (e.g., offices, schools, and retail). The virtual site visits focused on conducting a lighting inventory, considering LED saturation were predicted to have changed significantly since the prior study.

Cadmus conducted a detailed online survey for the residential standard-income customers. For residential income-qualified households and commercial segments, Cadmus conducted telephone phone surveys. These surveys gathered data to supplement existing saturation data and collected information on building characteristics and demographics.

For the industrial sector, gathering data can be challenging, especially at very large industrial facilities. Large facilities have unique site-specific characteristics that make conducting successful and meaningful site visits or surveys difficult. Therefore, Cadmus interviewed industry experts (subject matter experts) with historical and institutional knowledge of Wisconsin industrial sites to provide a broader perspective rather than conducting a few dozen virtual site visits across all industries. The results of these interviews are presented in *Appendix F*. Results from surveys and site visits can be found in *Appendix H*.

Overview of Sampling Methodology

Cadmus used stratified random sampling in each sector and information available from current utility tracking data to determine an appropriate stratification scheme. Table A-6 shows this study's segment strata for the virtual site visits, including targets and achieved samples. COVID-19 pandemic limited the ability to successfully achieve the targets. Schools especially were impacted as remote learning

continued throughout 2020, and it was therefore very challenging to schedule virtual site visits with facility staff.

Table A-6. Virtual Site Visit Size Sample Targets

Segment/Strata	Target	Achieved
School	68	8
Office	68	45
Retail	68	41
Total	**204**	**94**

Cadmus also conducted phone and online surveys with 1,418 Wisconsin residents across all segments, as shown in Table A-7. By switching to an online survey format for the residential survey, Cadmus could expand the number of completed responses (due to the lower cost per complete) within the program budget.

The commercial and agricultural survey was conducted via phone. On October 12, 2020, calls to healthcare facilities were immediately halted, as Wisconsin was experiencing a high number of COVID-19 cases and healthcare facilities were overwhelmed. Response rates for other commercial sectors varied by the available sample size. Another complication was the lead-up to the 2020 national election and Wisconsin being a battleground state. This caused many in the residential and commercial sectors to screen calls, which contributed to a lower success rate in recruitment.

Table A-7. Phone Survey Size Sample Targets

Sector	Segment/Strata	Survey Type	Target	Achieved
Residential	Single-family and manufactured	Online survey	70 (minimum)	326
	Multifamily	Online survey	70 (minimum)	91
Residential Income-Qualified	Single-family	Phone survey	70	274
	Multifamily	Phone survey	70	70
Commercial and School/Government	Schools	Phone survey	70	75
	Commercial offices	Phone survey	70	76
	Restaurant	Phone survey	70	77
	Retail	Phone survey	70	55
	Health care (hospitals/out-patient)	Phone survey	70	23
	Lodging	Phone survey	70	51
	Grocery	Phone survey	70	103
	Warehouse	Phone survey	70	69
	Commercial miscellaneous	Phone survey	70	58
Agricultural	Agriculture dairy	Phone survey	35	35
	Agriculture non-dairy	Phone survey	35	35
Total			**980**	**1,418**

Residential Online Surveys

Cadmus completed an online survey of 471 residential standard-income customers (321 single-family and manufactured homes and 91 multifamily homes) and 344 residential income-qualified customers (274 single-family and manufactured homes and 70 multifamily homes). Cadmus collaborated with Qualtrics, an online survey firm to engage the public regarding these energy efficiency potential study topics:[20]

- Efficient product awareness and perceptions
- Customers' willingness to adopt and pay for energy efficiency measures
- Demographic information and housing characteristics

As Cadmus was unable to obtain a list of residential customers from all Focus on Energy utilities, it purchased a panel from Qualtrics, using the list of zip codes of residential customers in each utility service territories. Quota sizes within each utility region were determined based on utility size to ensure the responses would accurately represent the distribution of Focus on Energy-eligible customers. Qualtrics was also provided quotas based on educational level and ethnicity to ensure appropriate representation compared to state overall demographics.

Residential Income-Qualified Survey

Cadmus subcontracted with Ironwood Insights Group to complete a phone survey of 140 income-qualified residential customers (70 from single-family and 70 from multifamily homes). The subcontractor used a screening battery to identify customers who earn 80% or less of state monthly median income based on estimated income and number of residents in the home. Income-qualified respondents were asked to provide feedback on the following:

- Energy-using equipment saturations in the home
- Demographic information and housing characteristics

Cadmus provided a sample to the survey firm with customer contact information, which was created from utility customer data. These data included the customer's utility and an estimate of if the home was single-family or multifamily based on the address provided (if an apartment or unit number was included), which was verified in the survey screening. After a review of the demographic responses provided in the online residential survey, results for 204 respondents were moved from the residential survey analysis to the residential income-qualified analysis.

Commercial Virtual Site Visits

Cadmus and Nexant (Nexant was a subcontractor for the study) conducted 94 virtual commercial site assessments between August and December of 2020. Cadmus initially planned to include schools, offices, and retail establishments in the study, but the COVID-19 pandemic made it challenging to schedule. Many facilities were either closed or understaffed and therefore could not accommodate virtual site visits. At the time of the study, most schools were closed, which made scheduling of this

[20] Sample sizes for individual survey questions vary due to nonresponses.

market segment extremely challenging, so sites were dropped from the study in favor of commercial office and retail buildings.

The peak recruitment period of the study also coincided with the lead-up to the 2020 national election. The recruitment team said Wisconsin, as a battleground state, was highly focused on this election and this contributed to a lower success rate in recruitment.

Cadmus used the STREEM videoconferencing software platform to conduct the virtual site visits with the site contacts. Cadmus engineers could view the site through the site contact's smartphone, record video, and capture still photographs of the building, equipment, and nameplates.

Engineers input data into a data collection software tool developed by Cadmus. This tool systematically collects data and incorporates automatic quality control (QC) checks to flag any inappropriate or out-of-expected-range values. A trained senior Cadmus engineer performed a second, manual QC check on each site assessment's data, which included a review of the site videos, photos, and all data inputs.

Cadmus collected the following data:

- General building information
- Window type and percentage of wall area
- Space types and sizes
- Lighting type and quantities
- HVAC equipment type and quantities
- Domestic water heating
- Miscellaneous equipment (laundry, food service, air compressor, elevator, pool, refrigeration)

Other Focus on Energy-Specific Data

In addition to surveys and virtual site visits, Cadmus received various data from stakeholders and evaluation-related data; these included the following:

- Focus on Energy's energy best practices guidebooks, covering various industrial segments (e.g., pulp and paper, waste water treatment, metal casting)
- Focus on Energy's SPECTRUM database
- Residential HVAC Wisconsin region sales data
- Residential lighting Wisconsin region sales data

Appendix B. Survey and Site Visit Findings

This appendix contains findings from Cadmus' 2021 survey and site visit data.

Primary Data Findings Comparison 2017 to 2021

Cadmus collected primary data for both this study and the 2017 statewide potential study. This section highlights notable comparisons between the primary data results for these two studies.

Nonresidential Site Visits and Survey

This section focuses on the comparison of the nonresidential data between the 2017 and 2021 potential studies. The analysis combines nonresidential virtual site and survey data as appropriate. We used virtual site data for the office and retail building types and used survey data for all other building types shown.

Lighting Saturations

Figure B-1 shows the nonresidential lighting saturations by technology type and by LED versus non-LED. There have been significant shifts from non-LED to LED and from socket fixtures to linear fixtures between the 2017 and 2021 study.

Figure B-1. 2017 vs. 2021 Lighting Saturations by Type and LED Type

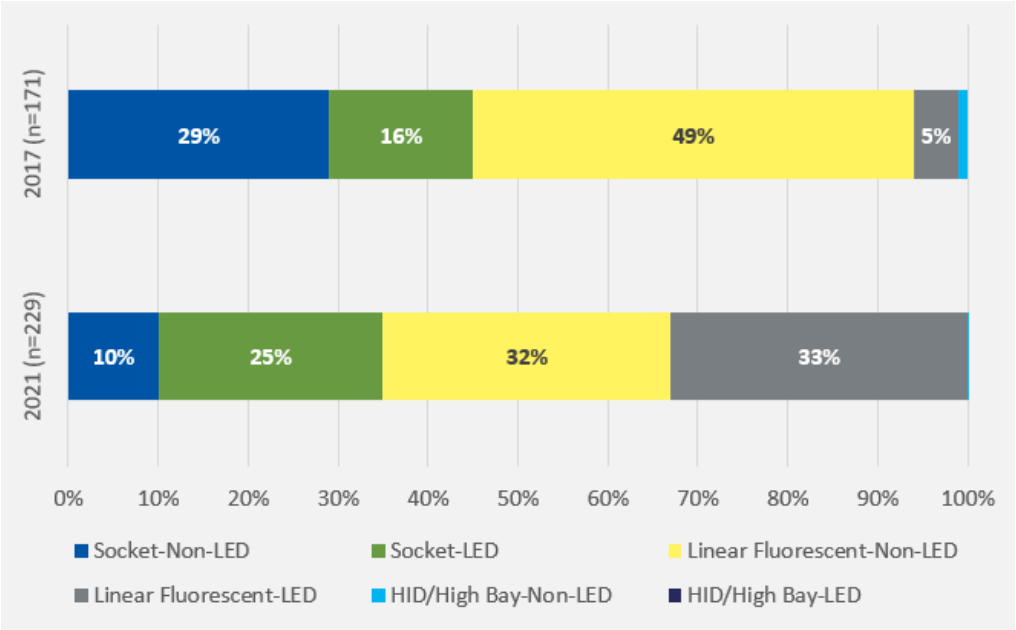


Figure B-2 and Figure B-3 show lighting saturations and trends by building type for 2017 and 2021, respectively.

Figure B-2. 2017 Lighting Saturations by Building Type

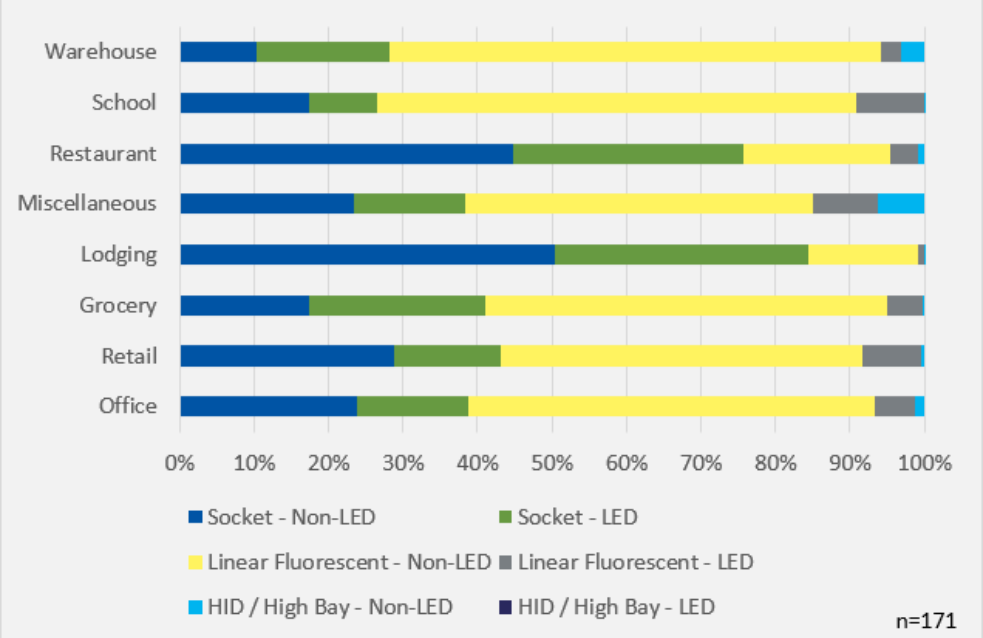
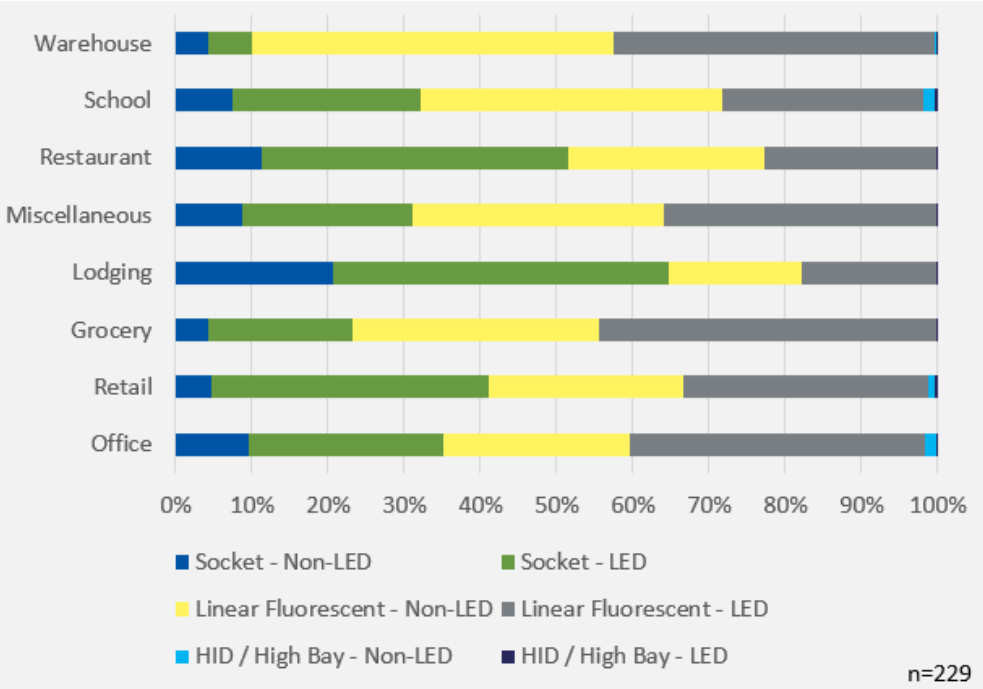


Figure B-3. 2021 Lighting Saturations by Building Type



Lighting Controls

Figure B-4 and Figure B-5 show the distribution of lighting controls for the office, retail, school, and restaurant building types for 2017 and 2021, respectively. There are no significant trends from comparing the 2017 results to the 2021 results for lighting controls. Most lights are still controlled manually, with 10% to 30% of lights controlled in an automated manner.

Figure B-4. 2017 Lighting Controls

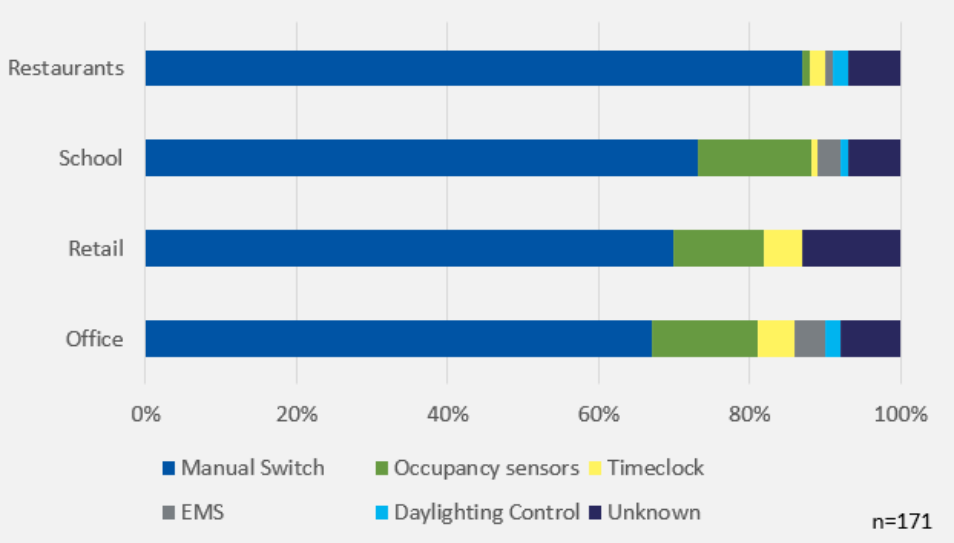
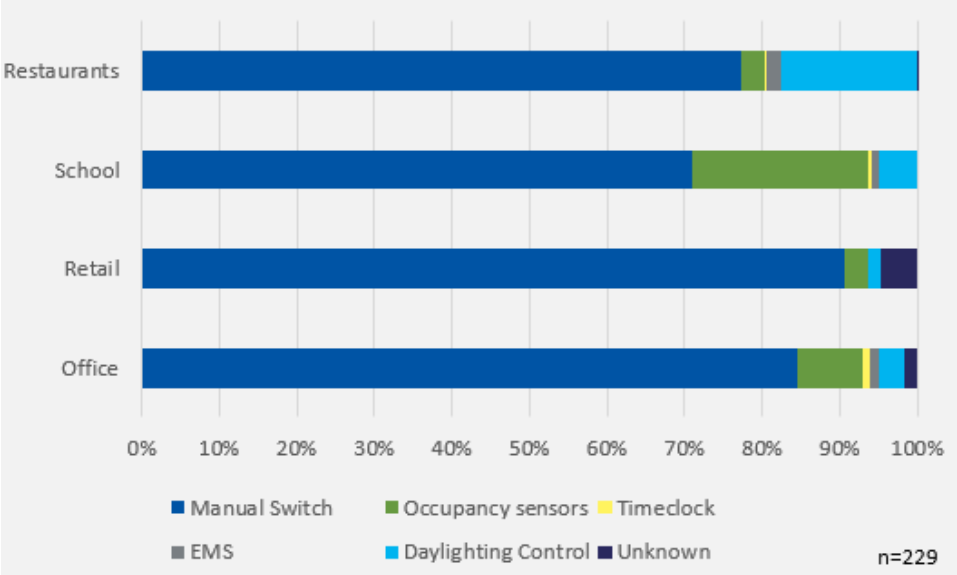


Figure B-5. 2021 Lighting Controls



Heating Equipment Saturations

Figure B-6 and Figure B-7 show heating equipment saturations by nonresidential building type for 2017 and 2021, respectively. While most buildings are heated by stand-alone furnaces, rooftop units, or boilers, there are some building types with noteworthy shifts between heating equipment from 2017 compared to 2021. Schools saw a large shift from boilers to furnaces or rooftop units. Restaurants saw a more modest shift from boilers to furnaces or rooftop units. Offices and retail saw moderate shifts in the opposite direction – from furnaces or rooftop units to boilers.

Figure B-6. 2017 Heating Equipment Saturation

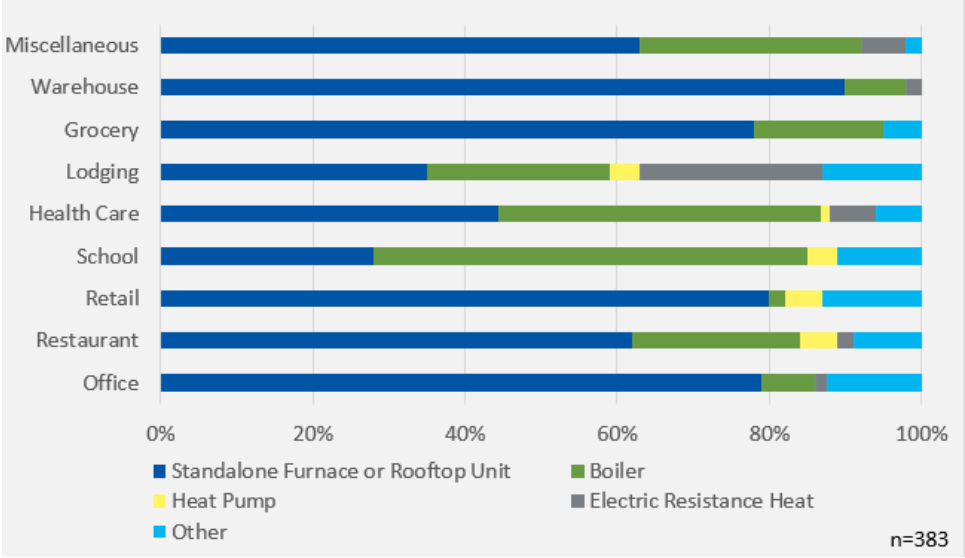
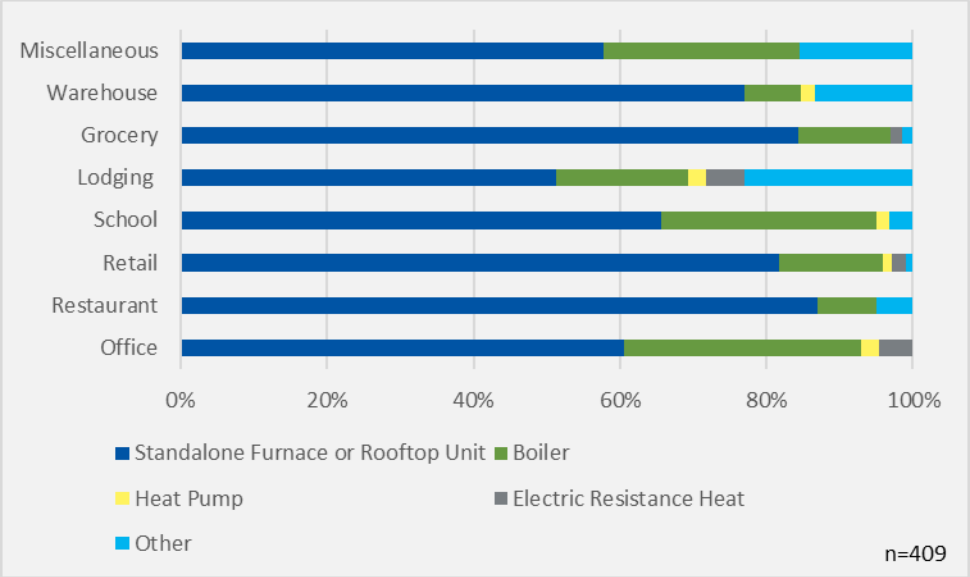


Figure B-7. 2021 Heating Equipment Saturation



Cooling Equipment Saturations

Figure B-8 and Figure B-9 show cooling equipment saturations by nonresidential building type for 2017 and 2021, respectively. There are no significant trends from comparing the 2017 results to the 2021 results for cooling equipment saturations for most building types. However, a few building types have notable differences between the 2017 and 2021. The lodging building type has lower saturation of wall or window in-room units and higher saturation of rooftop units, chillers, heat pumps, and no cooling in the 2021 results compared to 2017. Additionally, the restaurant building type has a much more diverse mix of cooling equipment in the 2021 results compared to 2017 results, including significant shares of wall or window in-room units and chillers.

Figure B-8. 2017 Cooling Equipment Saturation

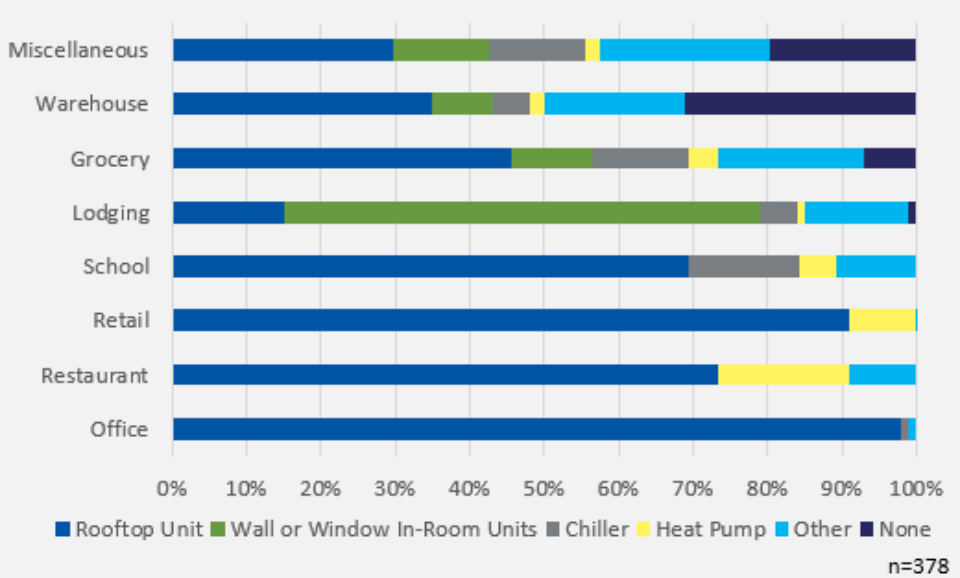
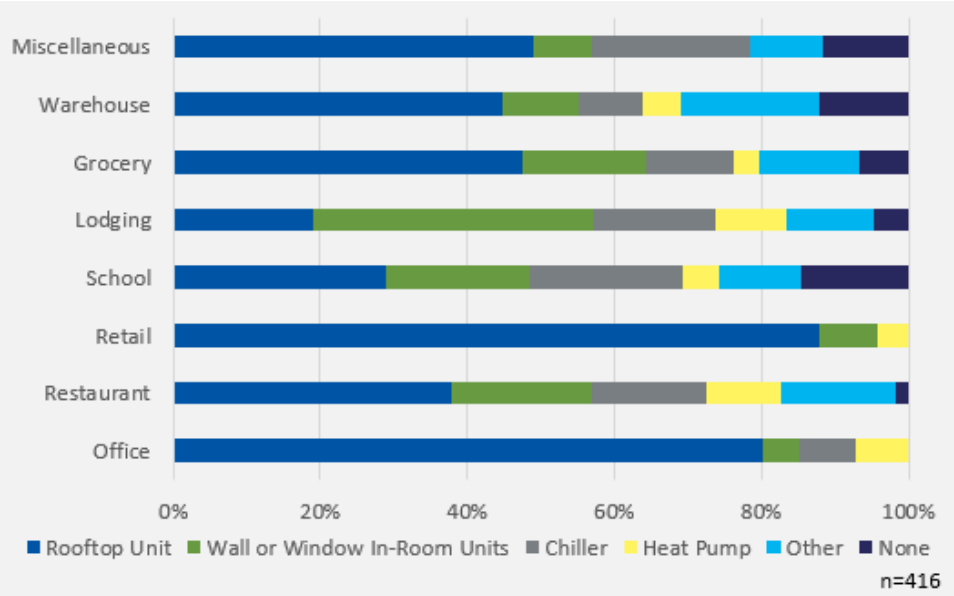


Figure B-9. 2021 Cooling Equipment Saturation



Residential Survey

This subsection focuses on the comparison of residential data between the 2017 and 2021 potential studies, first for single-family, then for multifamily. There are a few important differences in approach between the 2017 and 2021 residential surveys. The 2017 sample was significantly smaller than the 2021 sample (as shown in subsequent charts). Second, the 2017 sample was selected from participants of the longitudinal lighting study while the 2021 sample was selected from statewide customers. It is possible that the 2017 sample was biased due to the population it was selected from (namely, those that participated in a long-term efficiency study). Finally, the 2017 survey was administered via phone

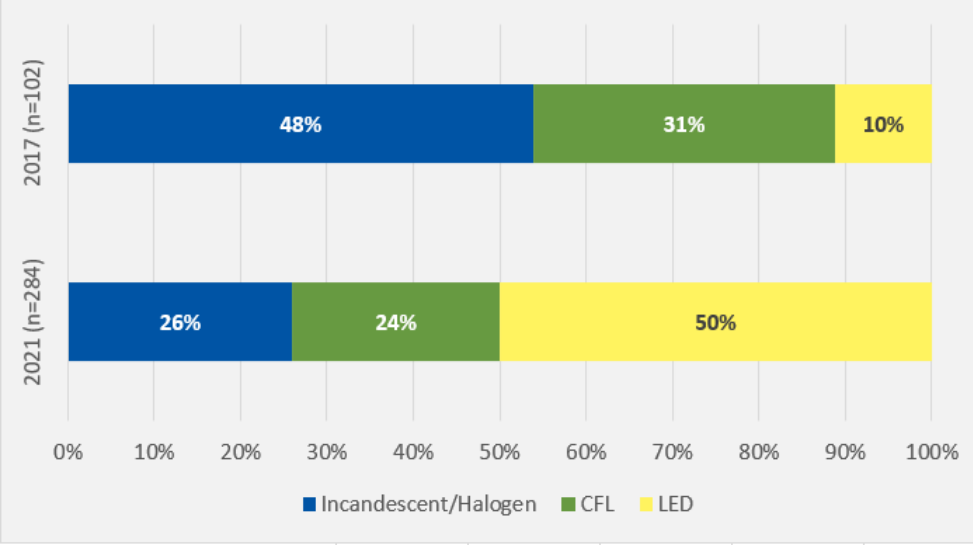
calls whereas the 2021 survey for standard income was conducted via online surveys. These are important considerations when comparing results between the 2017 and 2021 residential surveys.

Single-Family

Lighting Saturations

Figure B-10 shows lighting saturations in single-family homes for 2017 and 2021. As expected, there has been a significant shift from incandescent, halogen, and CFL bulbs to LED bulbs. This trend is likely to continue as market adoption of LEDs continues to be rapid.

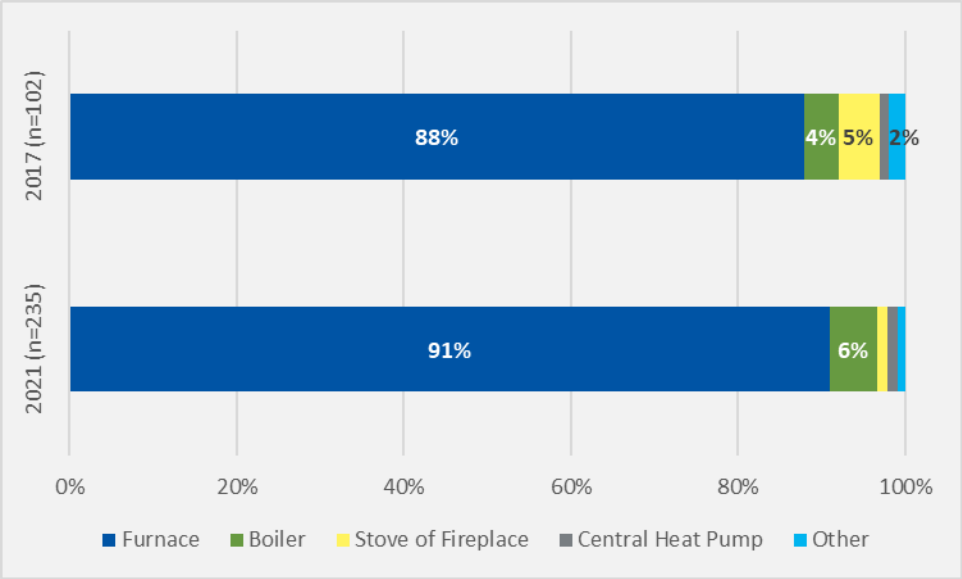
Figure B-10. 2017 vs. 2021 Residential Survey – Single-Family Screw-Base Lighting Saturations



Heating Equipment Saturations

Figure B-11 shows heating equipment saturations in single-family homes for 2017 and 2021. Fewer homes used stoves or fireplaces as their primary heating source in 2021 compared to 2017. Otherwise, the results are similar between the two years.

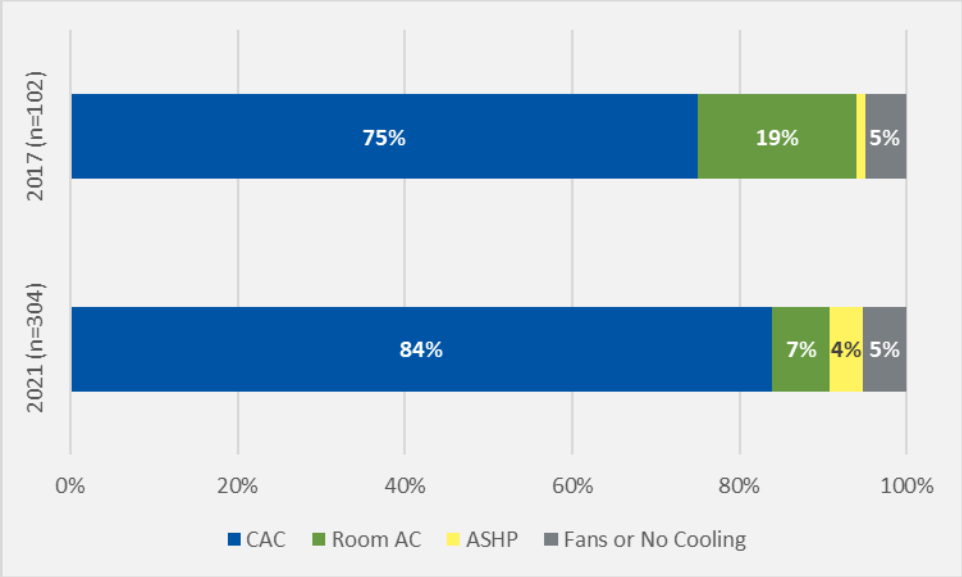
Figure B-11. 2017 vs. 2021 Residential Survey – Single-Family Heating Equipment Saturations



Cooling Equipment Saturations

Figure B-12 shows cooling equipment saturations in single-family homes for 2017 and 2021. The 2021 data collection effort found less homes using room air conditioners and more homes using central air conditioners and air source heat pumps as their primary cooling source compared to the 2017 efforts.

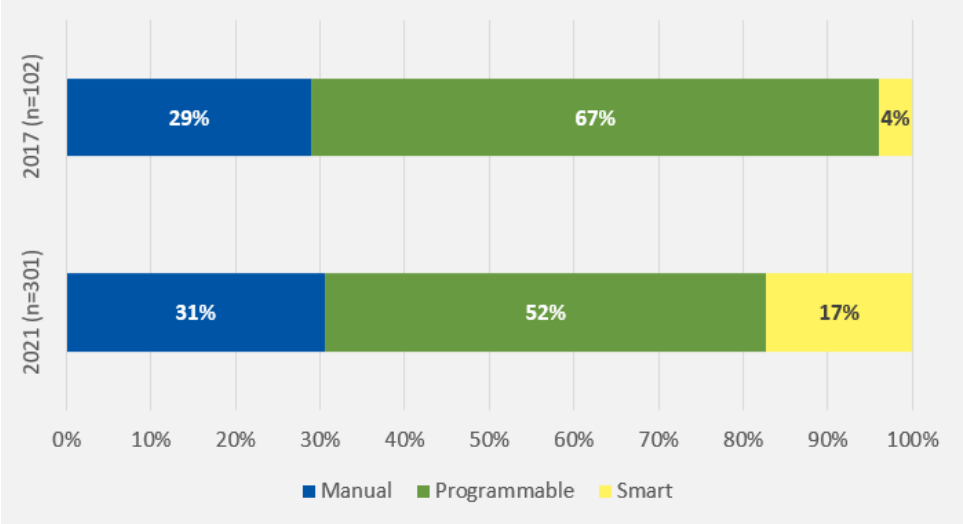
Figure B-12. 2017 vs. 2021 Residential Survey – Single-Family Cooling Equipment Saturations



HVAC Controls

Figure B-13 shows the distribution of HVAC controls in single-family homes for 2017 and 2021. The proportion of home HVAC systems controlled by manual thermostats has not changed significantly, but there has been a modest shift from programmable thermostats to smart thermostats in single-family homes.

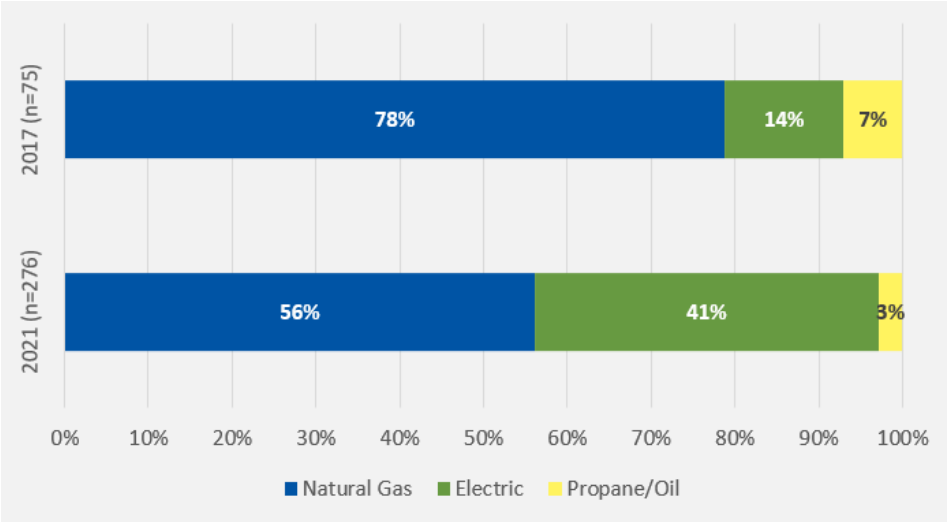
Figure B-13. 2017 vs. 2021 Residential Survey – Single-Family HVAC Controls



Water Heating

Figure B-14 shows the water heating fuel type in single-family homes for 2017 and 2021. Significantly more homes were found to use electricity as their primary water heating fuel in 2021 compared to 2017. It is possible that the 2017 sample was biased toward natural gas homes, as the sample was based on participants in the longitudinal lighting study.

Figure B-14. 2017 vs. 2021 Residential Survey – Single-Family Water Heating Fuel Type

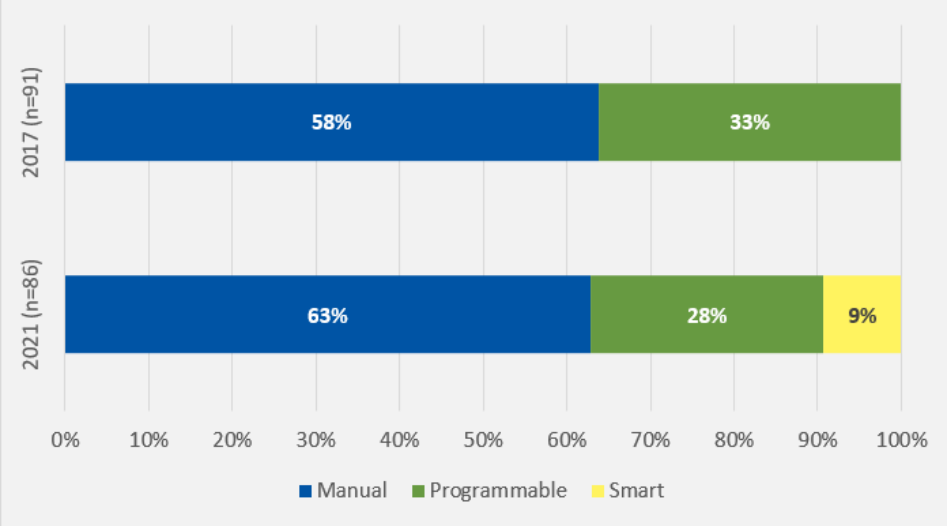


Multifamily

HVAC Controls

Figure B-15 shows the distribution of HVAC controls in multifamily homes for 2017 and 2021. There has been a modest shift from programmable thermostats to smart thermostats in multifamily homes.

Figure B-15. 2017 vs. 2021 Residential Survey – Multifamily HVAC Controls



Nonresidential Survey and Site Visit Findings

This section contains findings from Cadmus' data collection for nonresidential buildings.

Virtual Site Visits

Cadmus conducted virtual site visits for office, retail, and school buildings. However, the team virtually visited only eight schools. Therefore, due to the small sample of school buildings, the team used 2021 survey results or inputs from the 2017 data for measure characterization and is not reporting findings from the school site visits.

This section shows the virtual site visit findings for office and retail in tabular and graphical form. Note that the x-axis scales for the Lighting Controls (Figure B-17) and Heating Fuel Shares (Figure B-18) graphs are adjusted to better display results for technologies representing smaller proportions of the overall distribution.

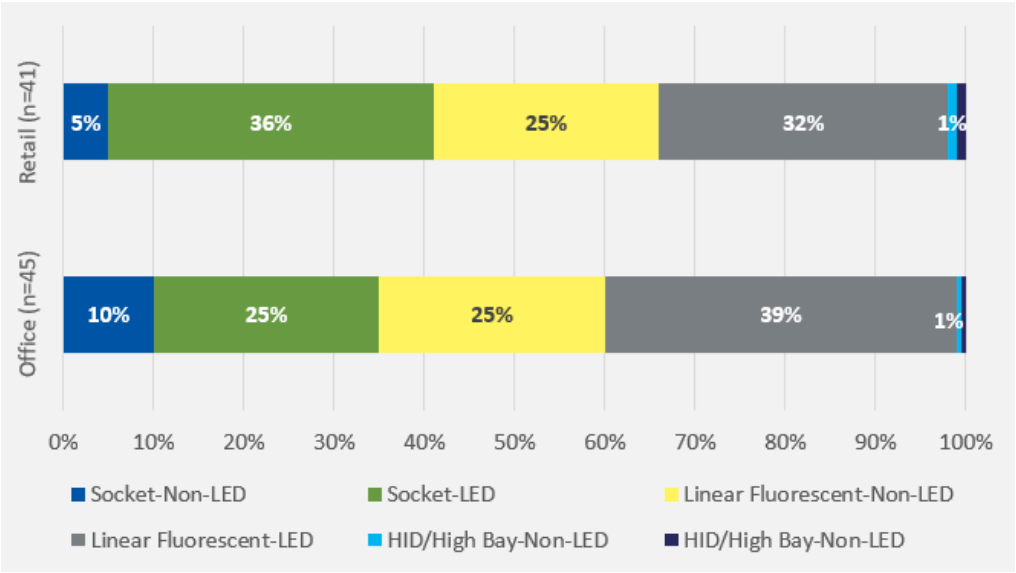
Building Characteristics

Table B-1. Nonresidential Virtual Site Visits – Building Characteristics

Building Type	Sites	Building Square Footage	Floors Above Grade	Floors Below Grade	Parking Spots
Office	45	27,658	1.7	0.4	68
Retail	41	8,172	1.3	0.4	26

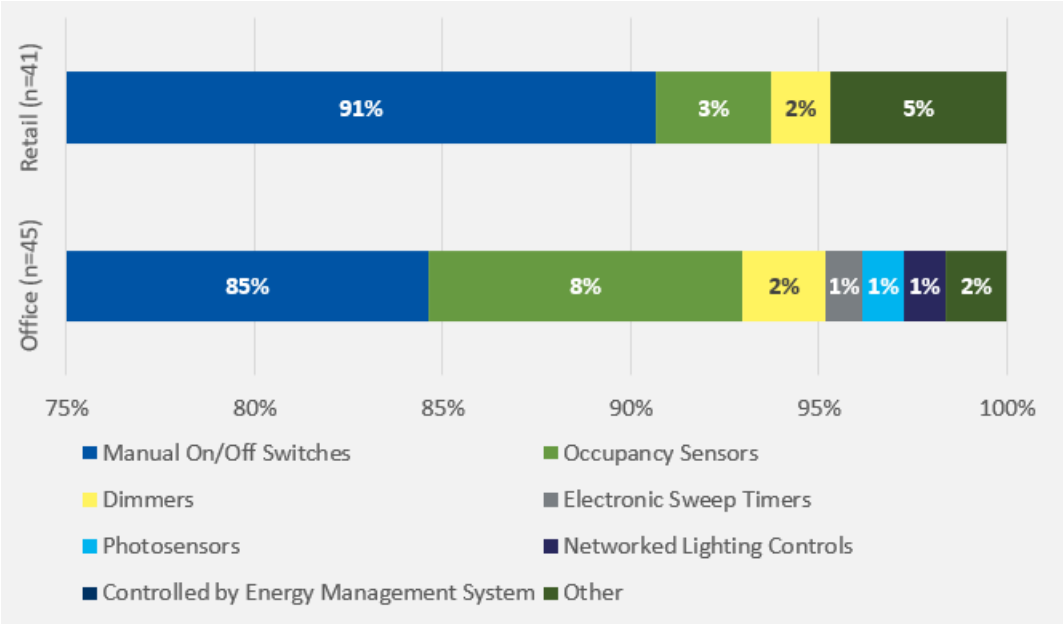
Lighting Saturations

Figure B-16. Nonresidential Virtual Site Visits – Lighting Fixture Distribution by Type and LED Type



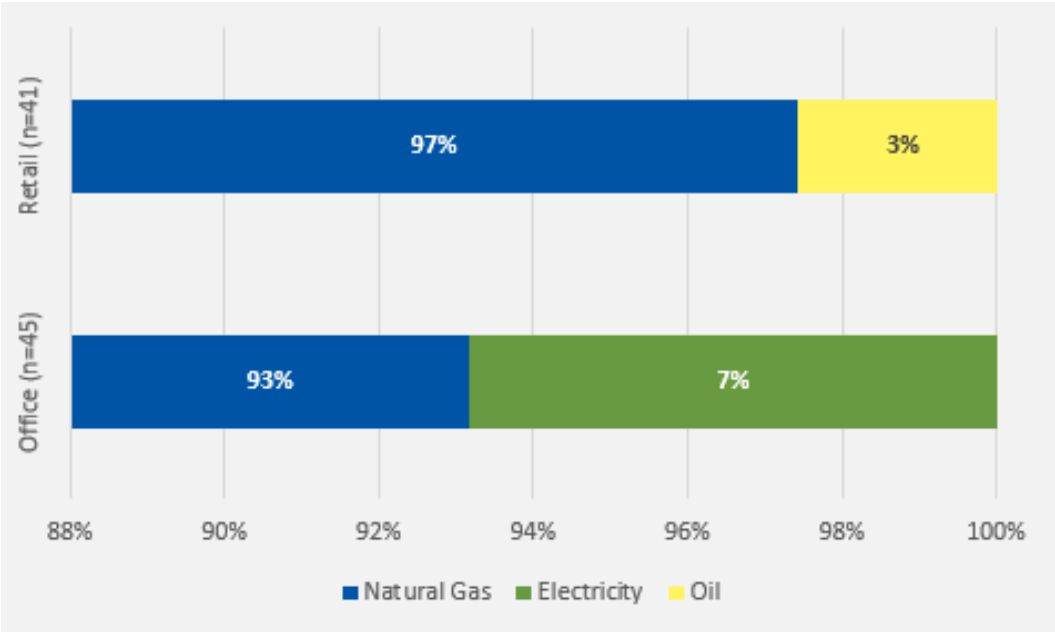
Lighting Controls

Figure B-17. Nonresidential Virtual Site Visits – Distribution of Lighting Controls (% of Controlled Wattage)



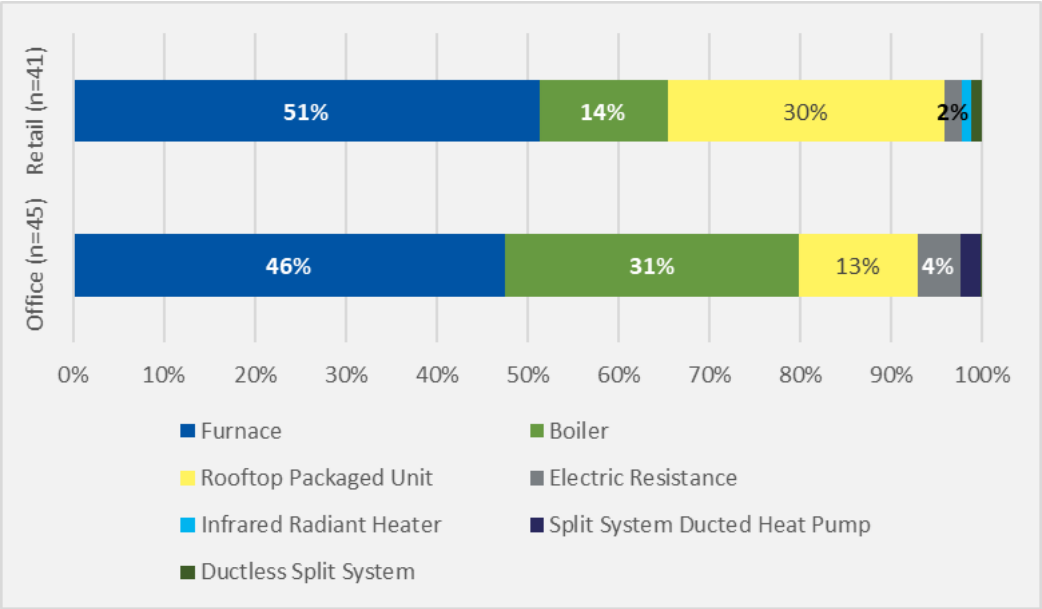
Heating Fuel Shares

Figure B-18. Nonresidential Virtual Site Visits – Heating Fuel Shares



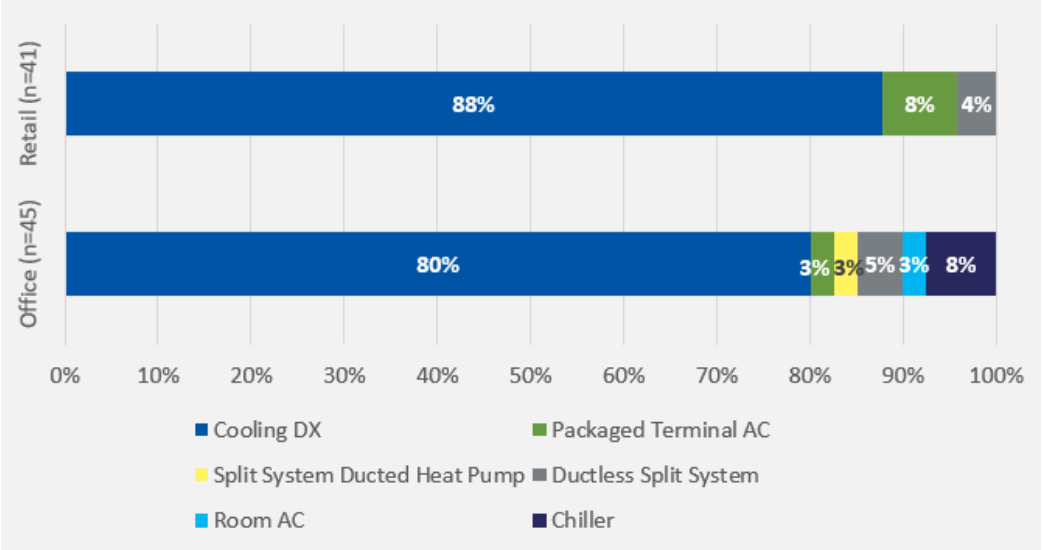
Heating Equipment Saturations

Figure B-19. Nonresidential Virtual Site Visits – HVAC Saturations



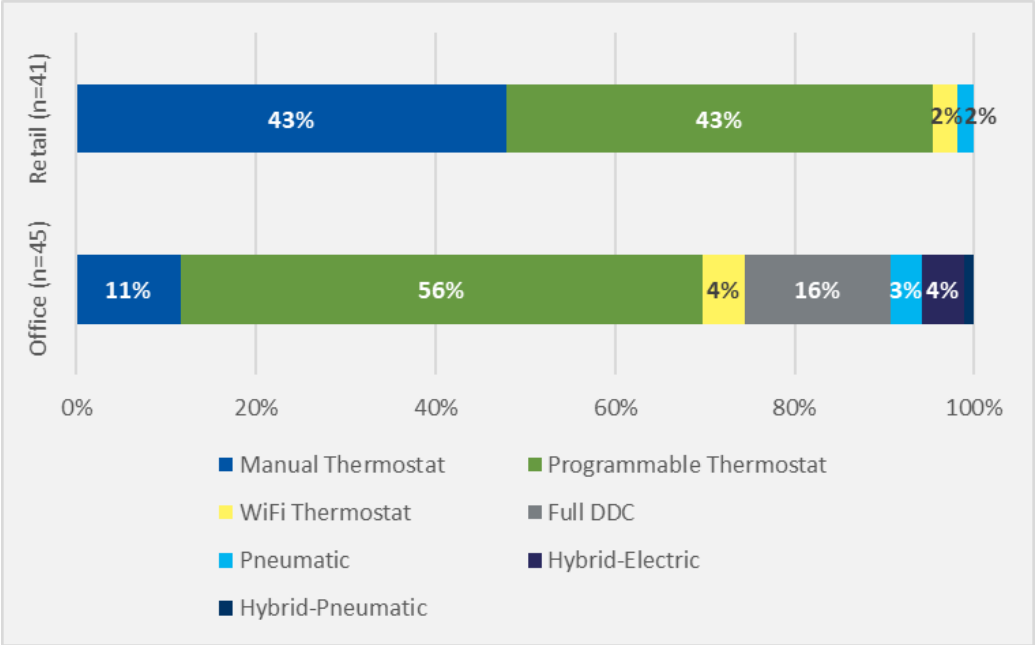
Cooling Equipment Saturations

Figure B-20. Nonresidential Virtual Site Visits – Cooling Saturations



HVAC Controls

Figure B-21. Nonresidential Virtual Site Visits – HVAC Controls



Surveys

Cadmus conducted phone surveys for grocery, lodging, restaurant, school, warehouse, office, retail, healthcare, and miscellaneous buildings. However, only 23 healthcare buildings were surveyed due to the COVID-19 pandemic. Due to the low sample, the team used inputs from the 2017 data and is not reporting the healthcare survey findings.

This section shows the survey findings for select nonresidential building types in tabular and graphical form. Cadmus used site visits as the highest level of data input for office and retail buildings, so this section does not include survey findings for these buildings nor for healthcare buildings.

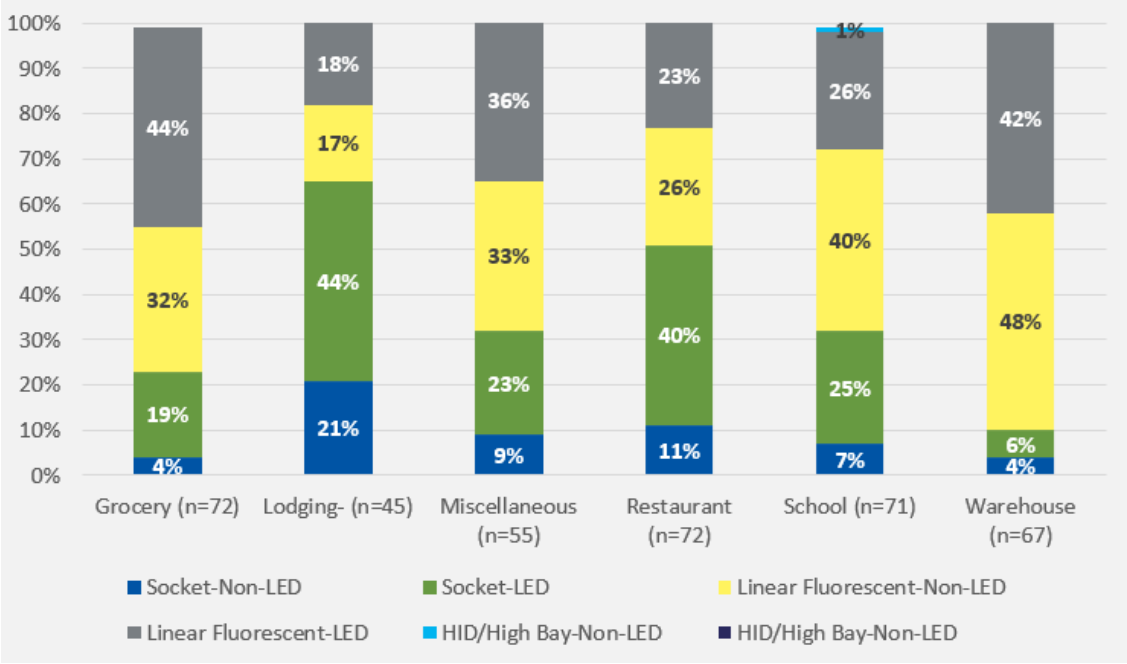
Building Characteristics

Table B-2. Nonresidential Survey – Building Characteristics

Building Type	Average Building Square Footage	Average Stories	Average Percentage of Space Heated or Cooled	Average Employees
Grocery	12,444	2	91%	20
Lodging	87,899	2	96%	85
Miscellaneous	112,637	2	88%	109
Restaurant	8,698	2	94%	23
School	252,799	2	96%	51
Warehouse	169,900	1	78%	47

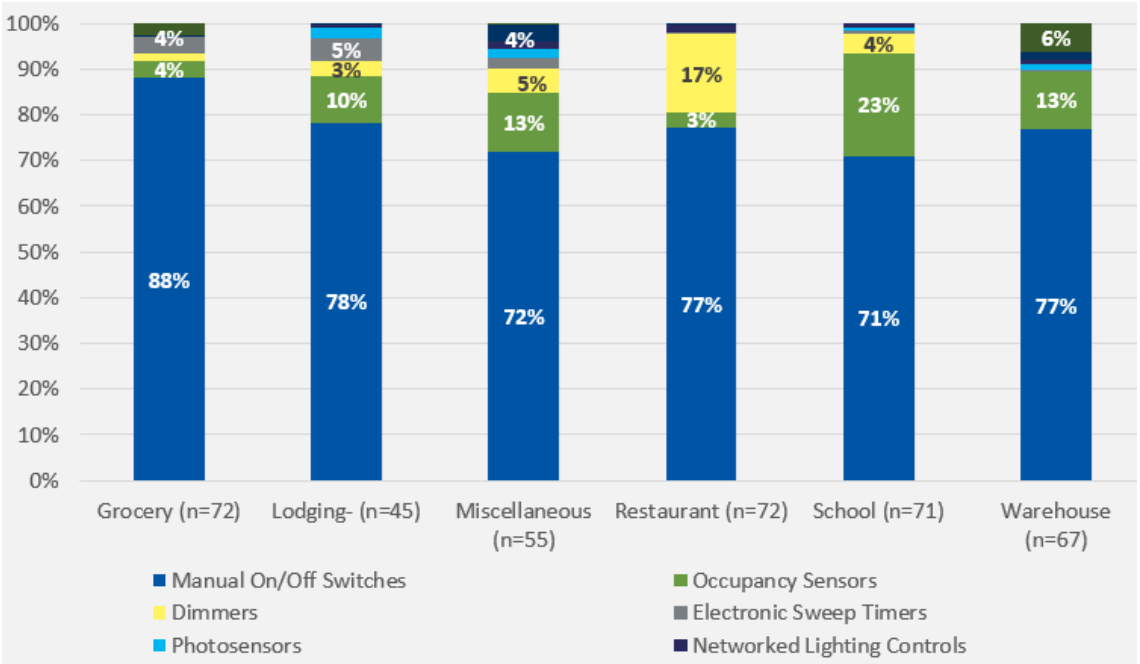
Lighting Saturations

Figure B-22. Nonresidential Survey – Lighting Fixture Distribution by Type and LED Type



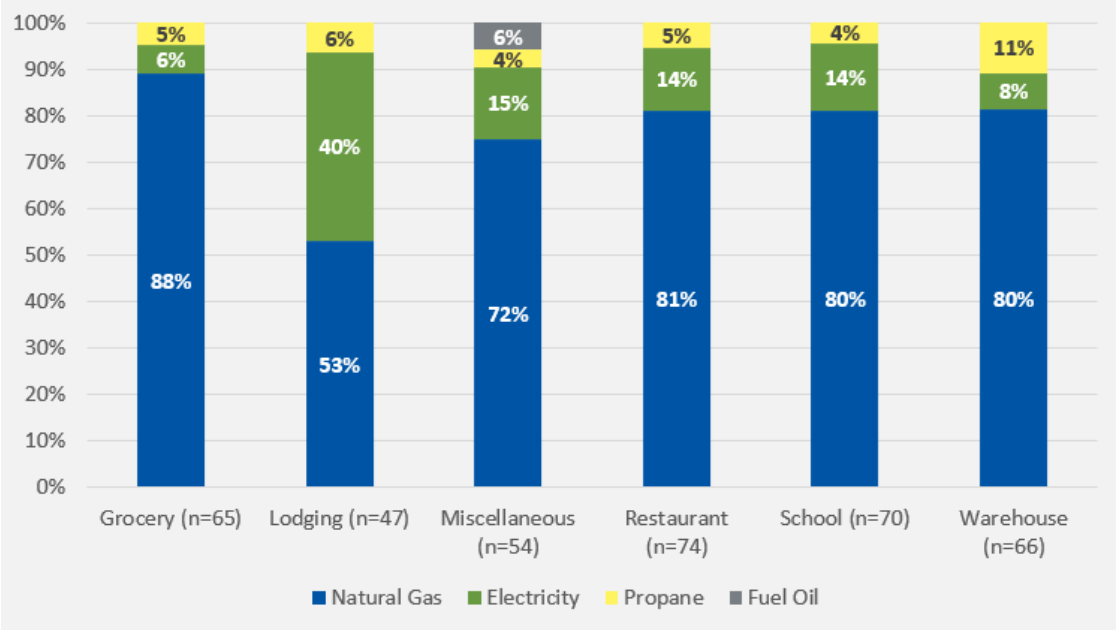
Lighting Controls

Figure B-23. Nonresidential Survey – Distribution of Lighting Controls (% of Controlled Wattage)



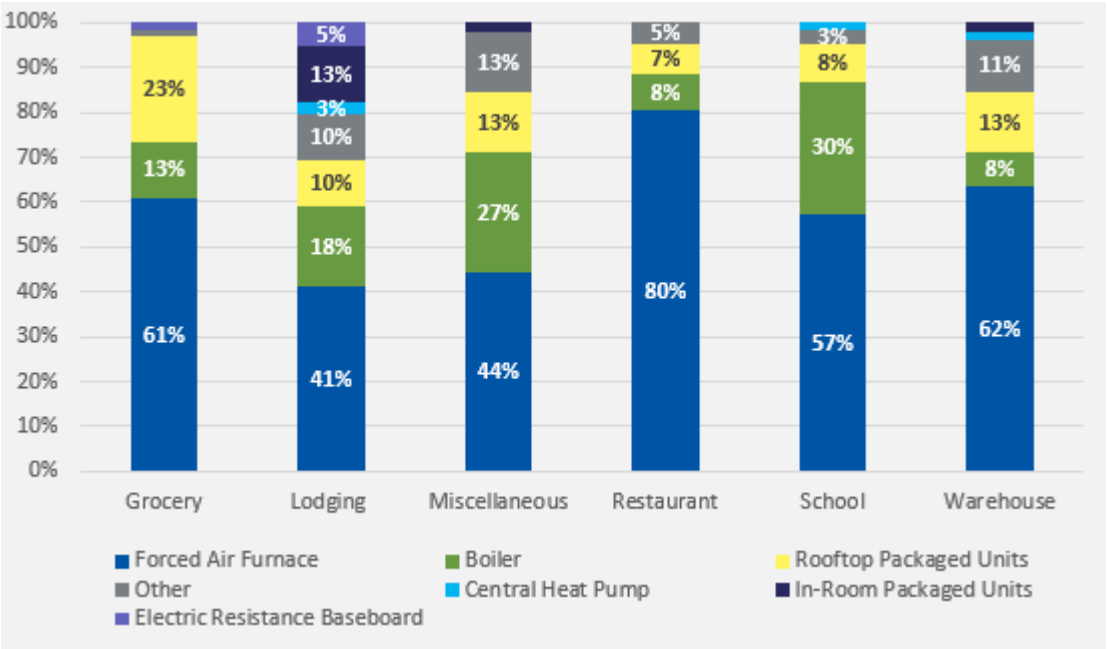
Heating Fuel Shares

Figure B-24. Nonresidential Survey – Heating Fuel Shares



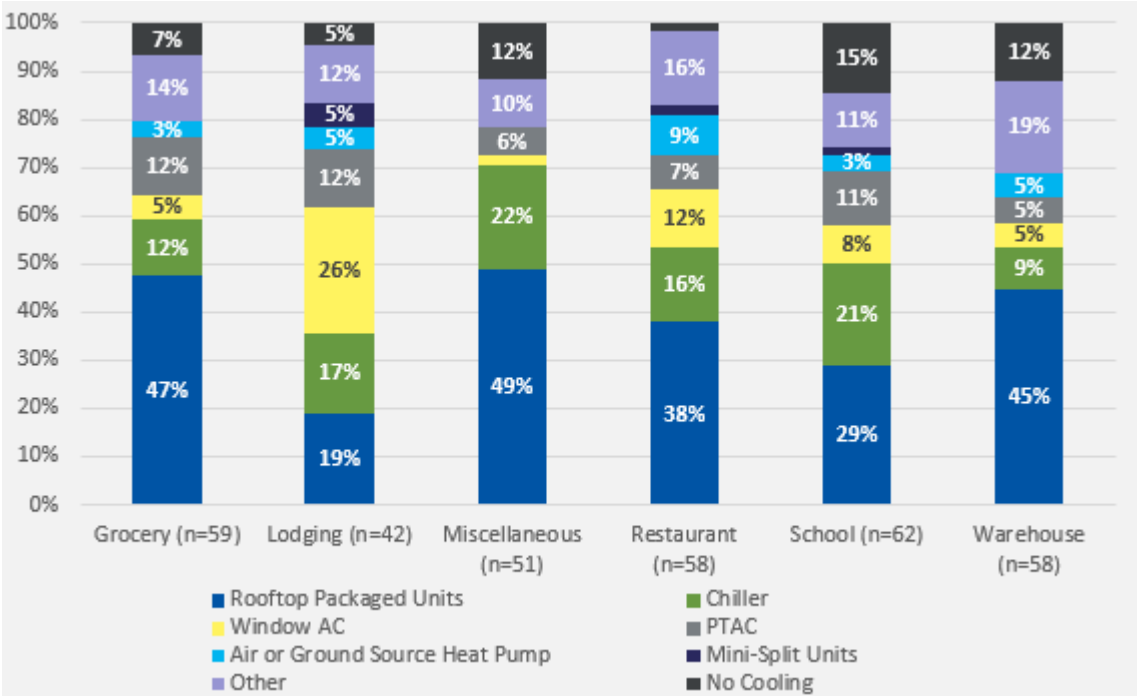
Heating Equipment Saturations

Figure B-25. Nonresidential Survey – Heating Equipment Saturations



Cooling Equipment Saturations

Figure B-26. Nonresidential Survey – Cooling Equipment Saturations



Residential Survey Findings

Cadmus surveyed single-family homes and multifamily residents for the 2021 statewide potential study. This section shows the findings of these residential surveys for standard and income-qualified customers.

Single-Family Households

Building/Home Characteristics

Figure B-27. Residential Survey – Single-Family Standard Income and Single-Family Income-Qualified Home Type

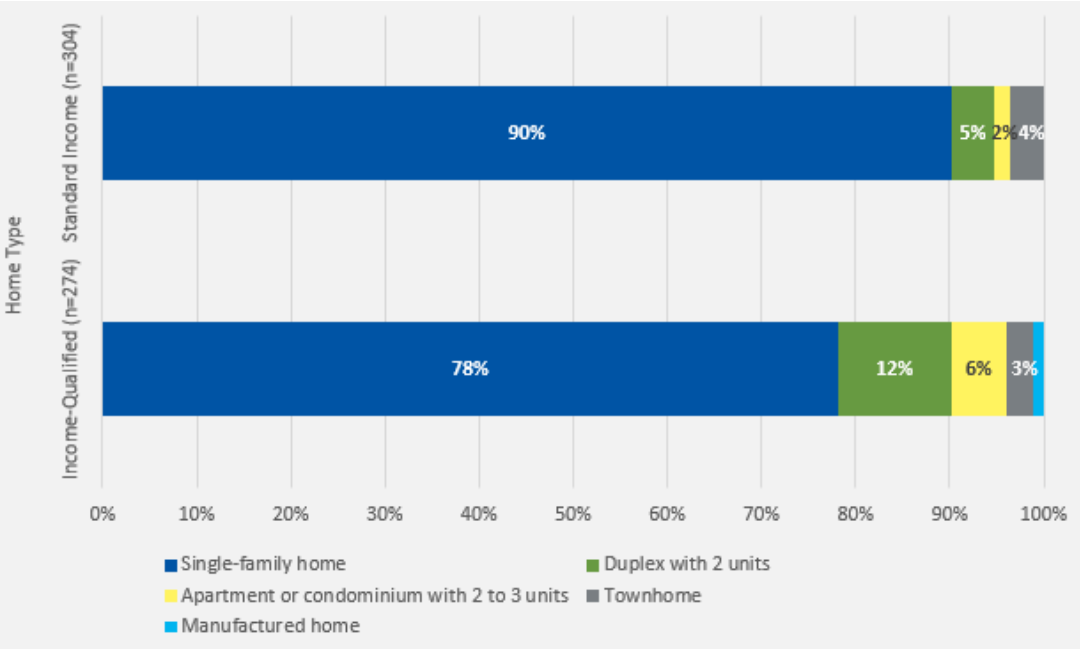


Figure B-28. Residential Survey – Single-Family Standard Income and Single-Family Income-Qualified Home Ownership

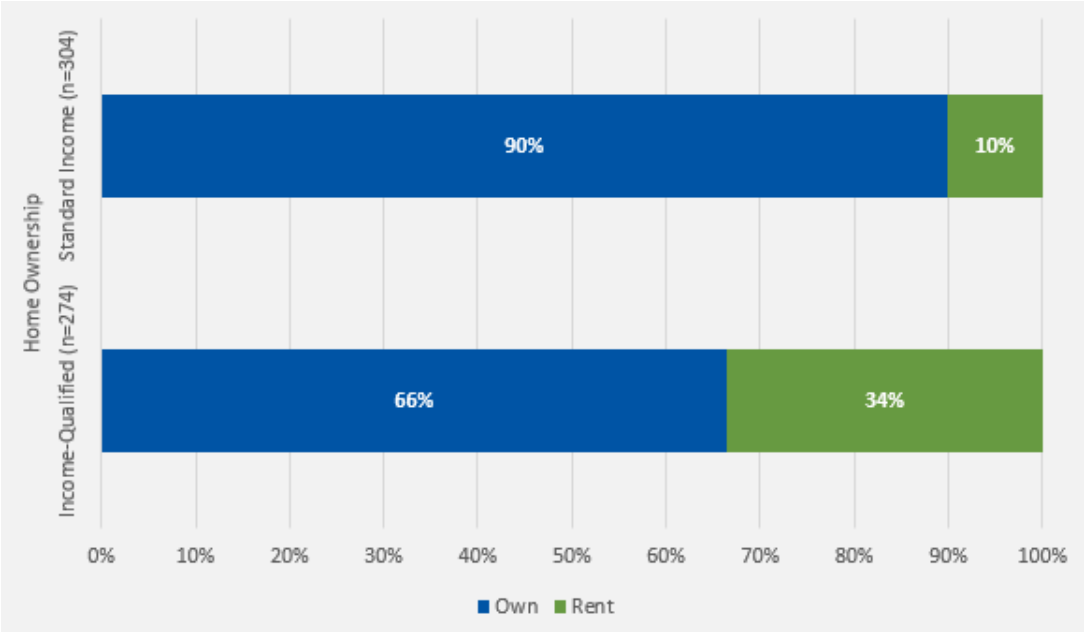
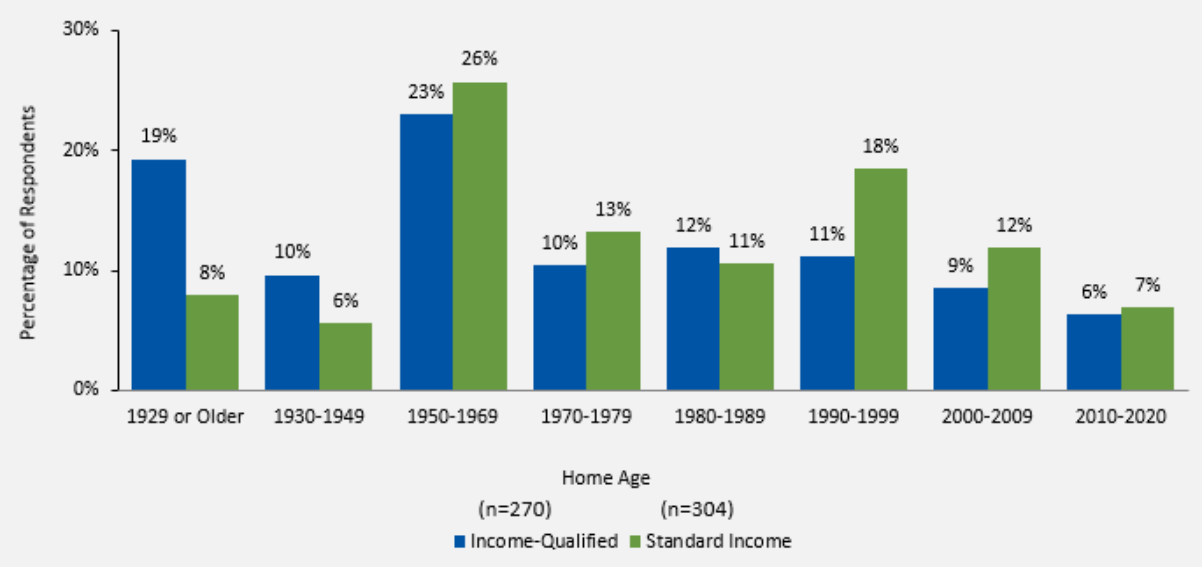
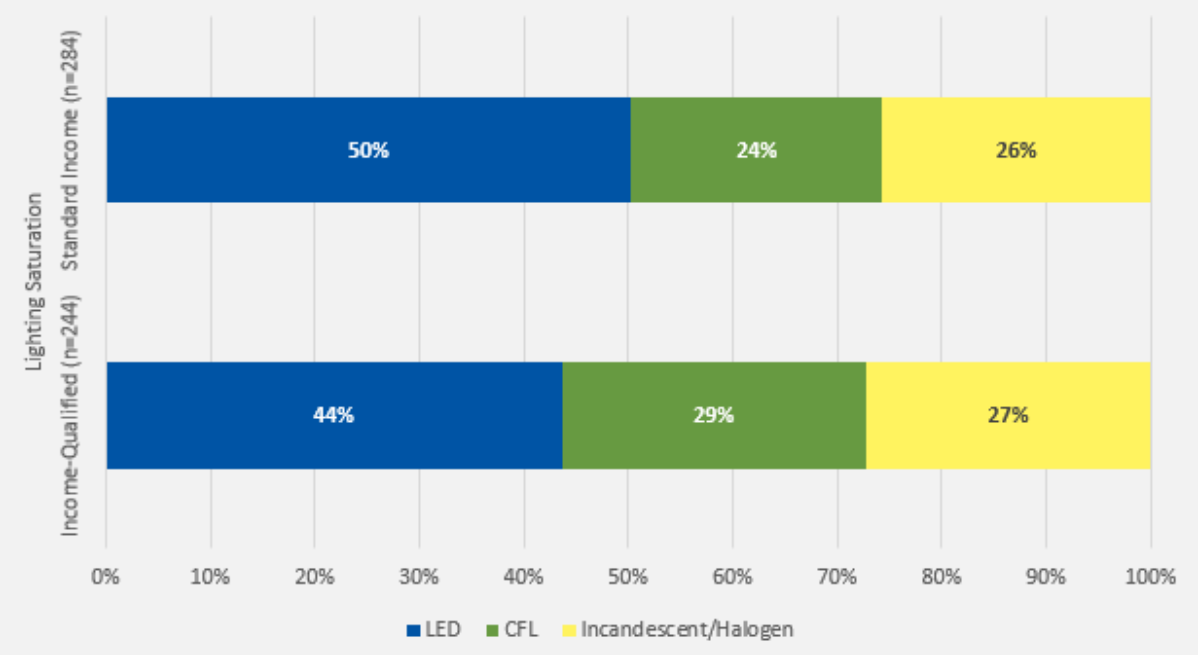


Figure B-29. Residential Survey – Single-Family Standard Income and Income-Qualified Home Age



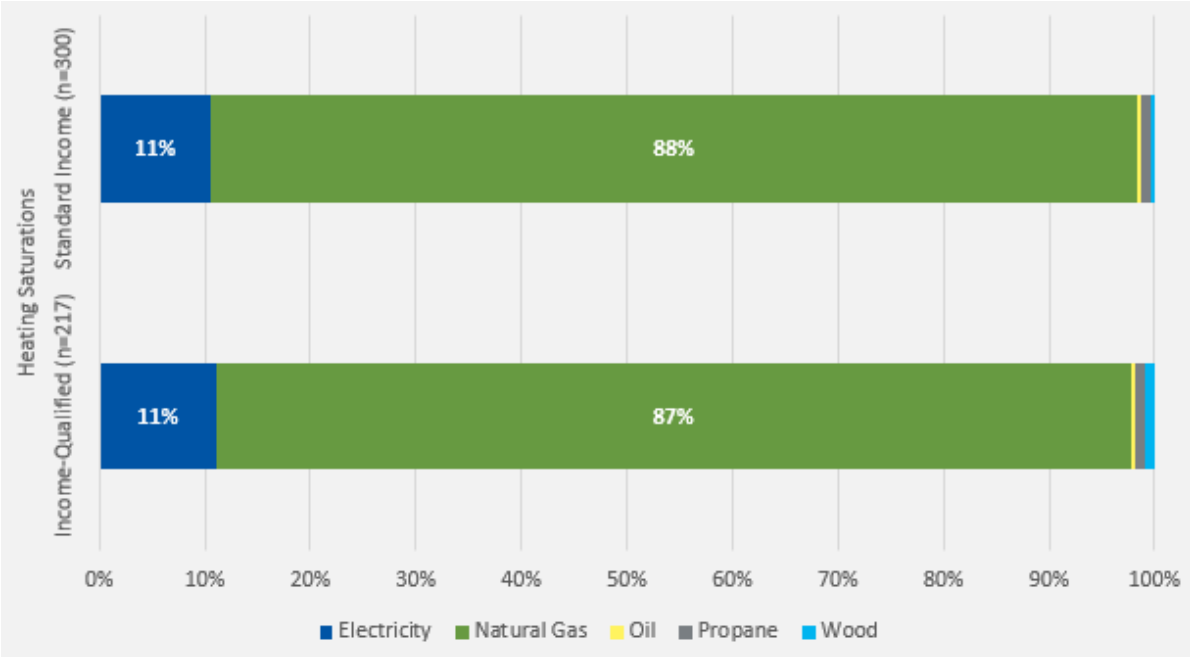
Lighting Saturations

Figure B-30. Residential Survey – Single-Family Standard Income and Single-Family Income-Qualified Lighting Saturations



Heating Fuel Shares

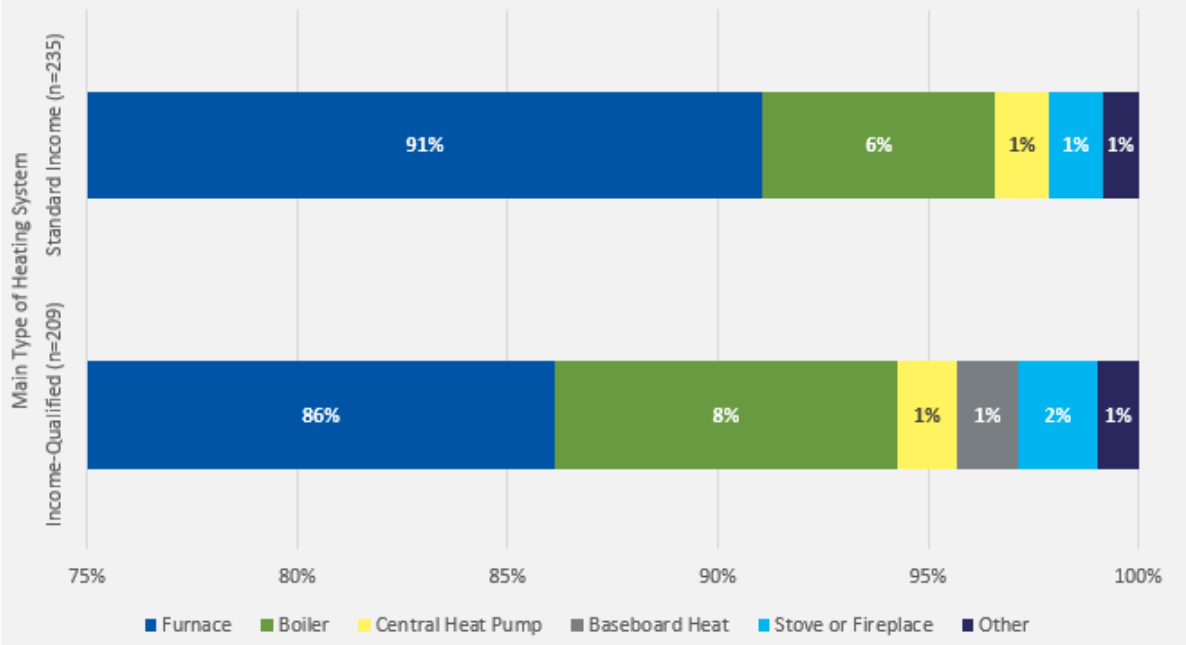
Figure B-31. Residential Survey – Single-Family Standard Income and Single-Family Income-Qualified Home Heating Fuel Type



Note: Standard Income: Oil – 0.4%, Propane – 0.8%, Wood – 0.4%. Income-Qualified: Oil – 0.5%, Propane – 0.9%, Wood – 0.9%.

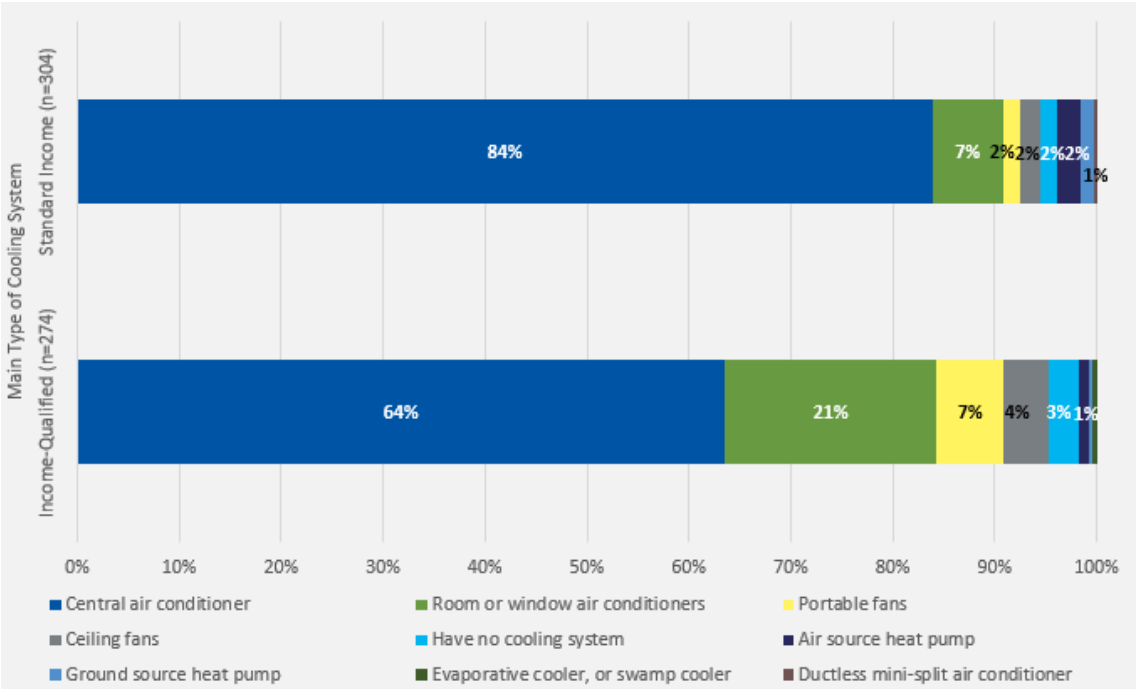
Heating Equipment Saturations

Figure B-32. Residential Survey – Single-Family Standard Income and Single-Family Income-Qualified Heating Equipment Saturations



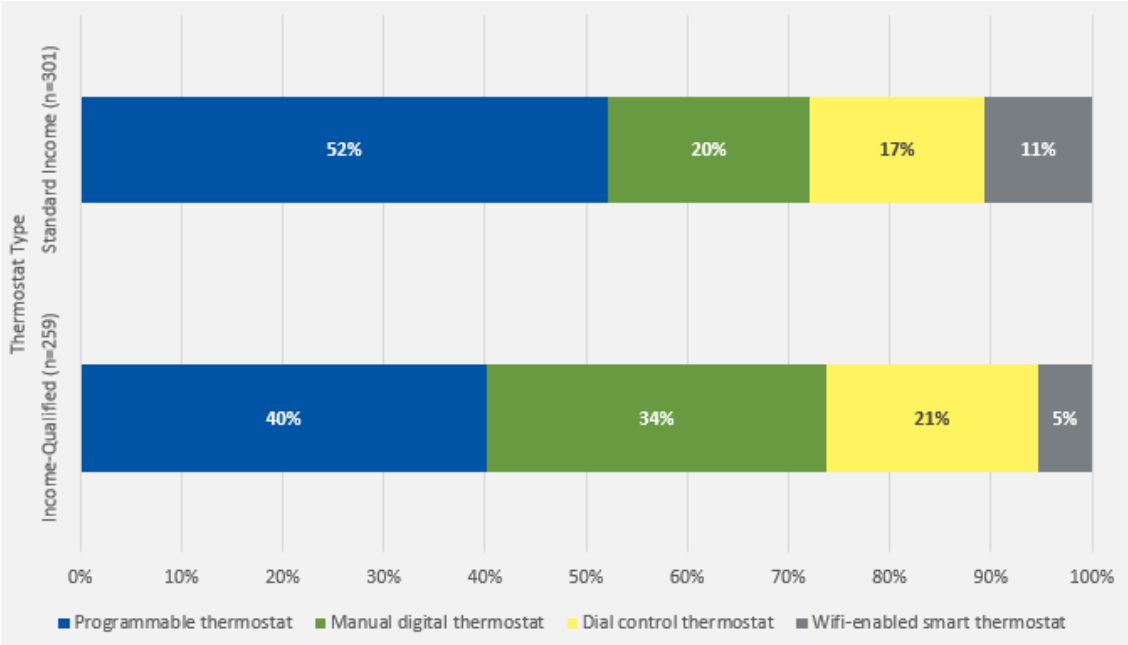
Cooling Saturations

Figure B-33. Residential Survey – Single-Family Standard Income Cooling Equipment Saturations



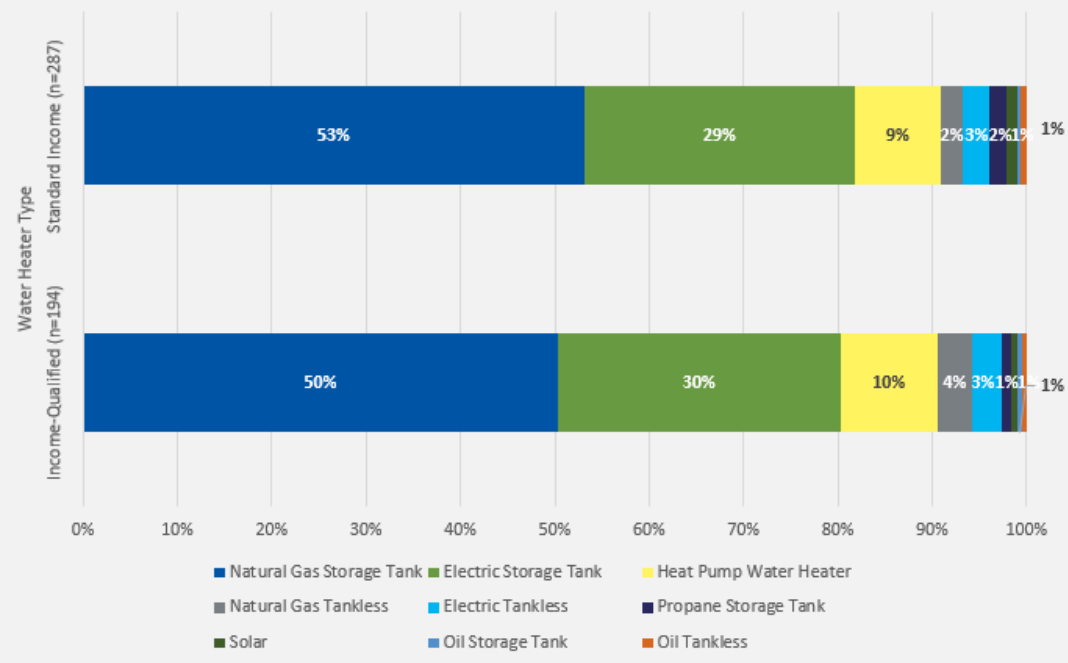
HVAC Controls

Figure B-34. Residential Survey – Single-Family Standard Income and Single-Family Income-Qualified HVAC Controls



Water Heating Equipment Saturations and Fuel Shares

Figure B-35. Residential Survey – Single-Family Standard Income and Single-Family Income-Qualified Water Heating Equipment Saturations



Multifamily Households

Building/Home Characteristics

Figure B-36. Residential Survey – Multifamily Standard Income and Multifamily Income-Qualified Home Type

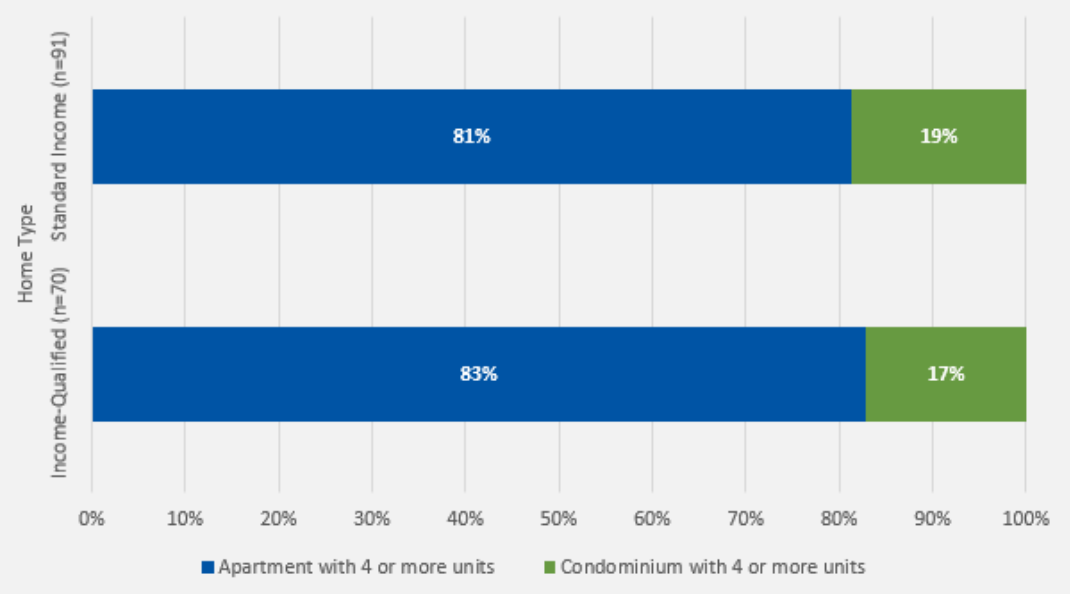
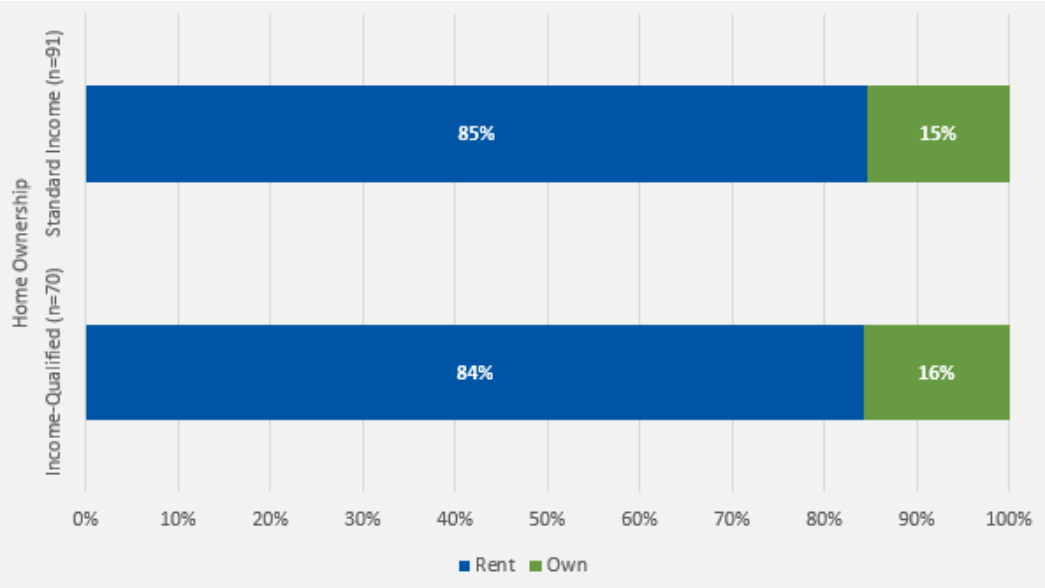
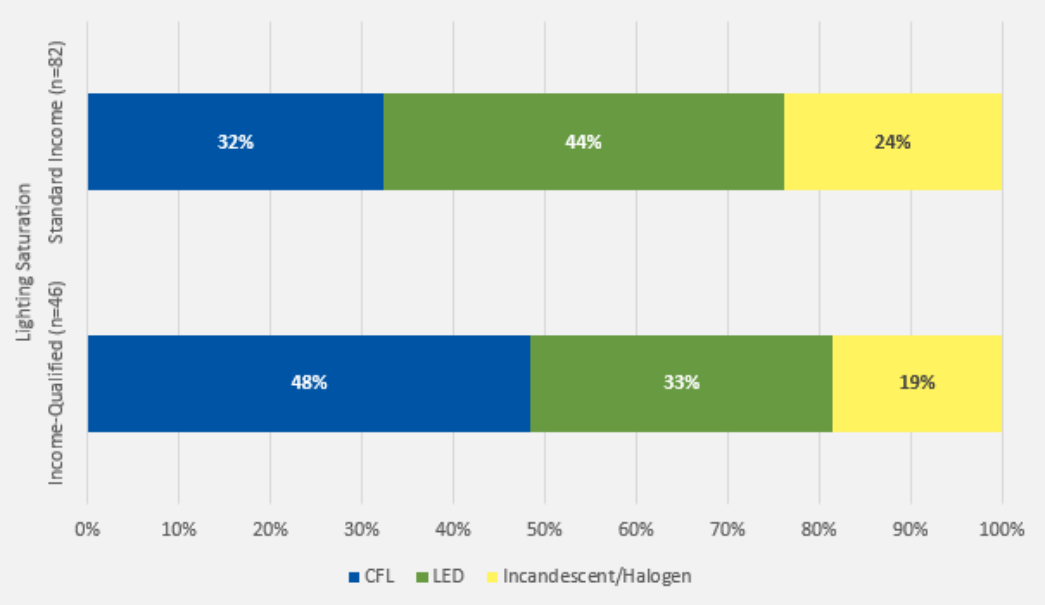


Figure B-37. Residential Survey – Multifamily Standard Income and Multifamily Income-Qualified Home Ownership



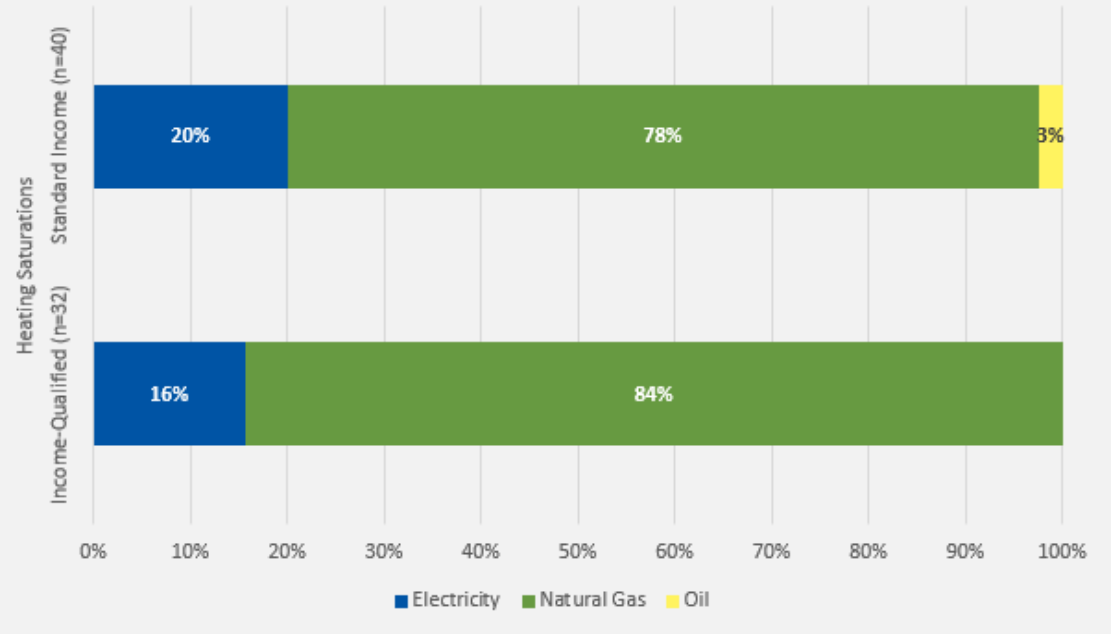
Lighting Saturations

Figure B-38. Residential Survey – Multifamily Standard Income and Multifamily Income-Qualified Lighting Saturations



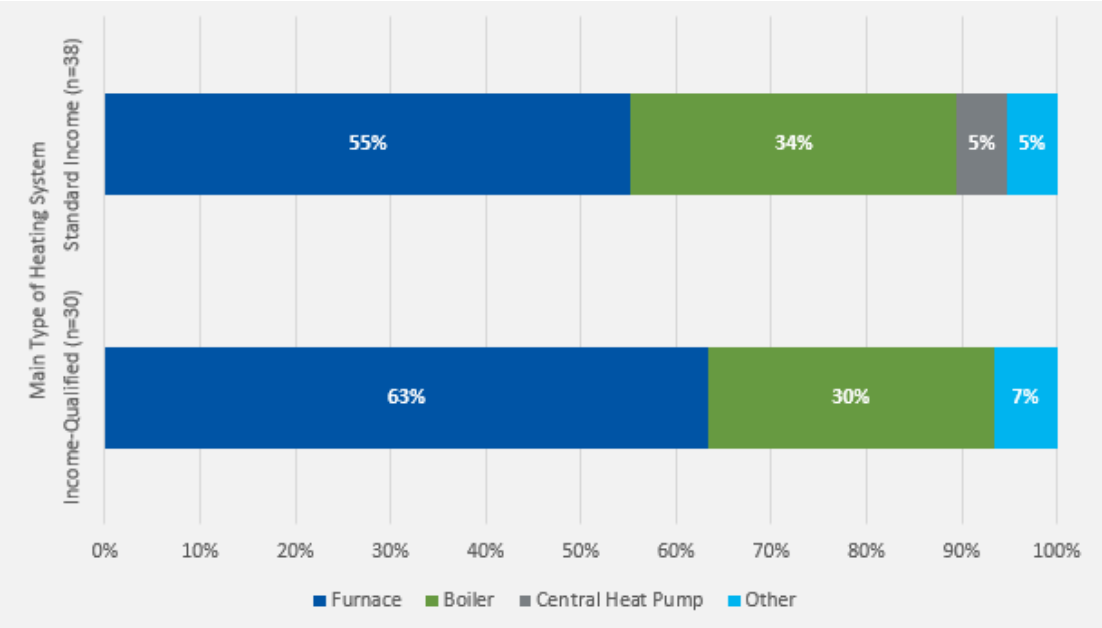
Heating Fuel Shares

Figure B-39. Residential Survey – Multifamily Standard Income and Multifamily Income-Qualified Home Heating Fuel Type



Heating Equipment Saturations

Figure B-40. Residential Survey – Multifamily Standard Income and Multifamily Income-Qualified Heating Equipment Saturations



Appendix C. Baseline Detail

Figure C-1. Residential Baseline Forecast by Segment - Electric

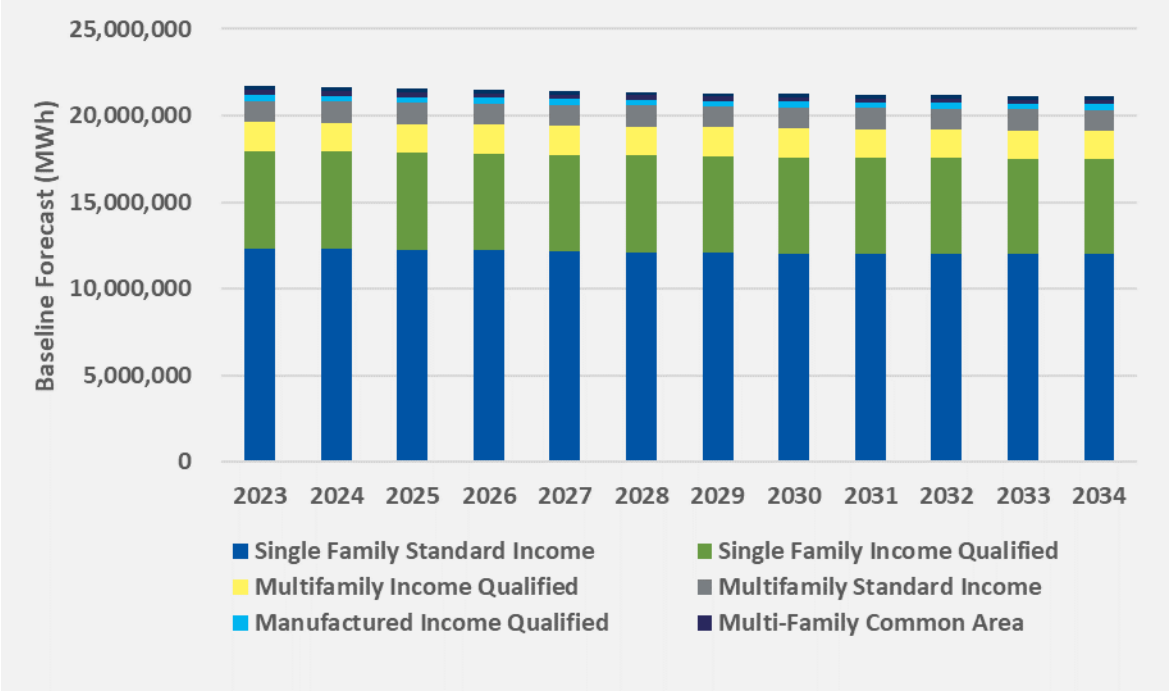


Figure C-2. Residential Baseline Forecast by End Use Group - Electric

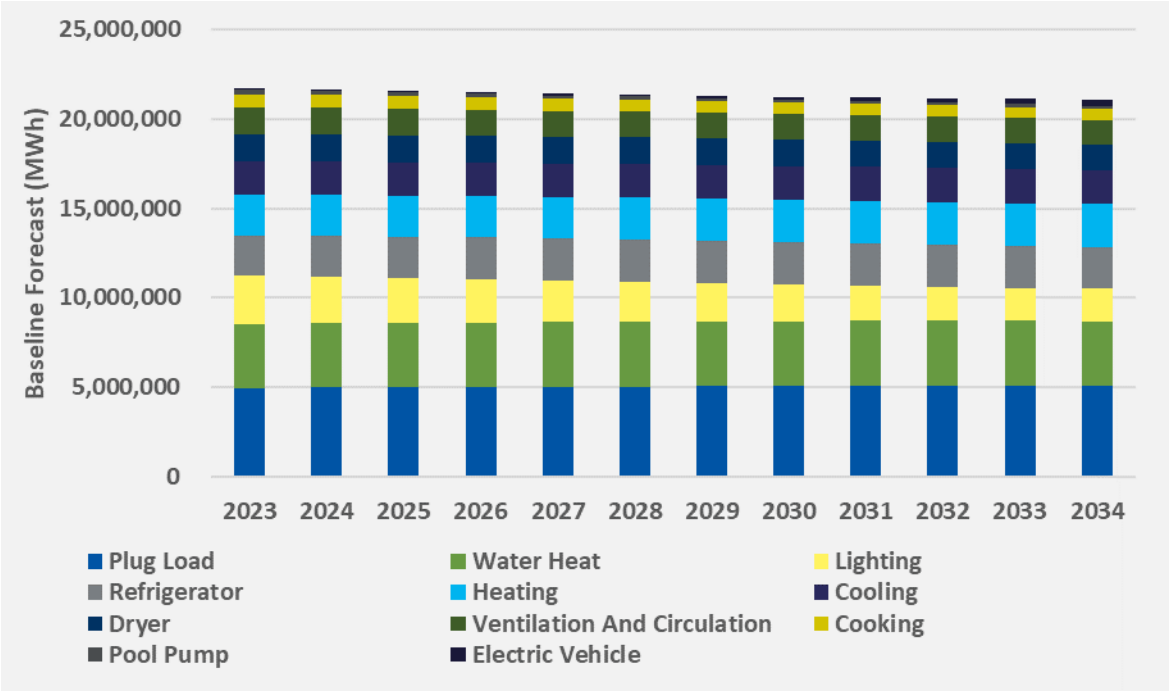


Table C-1. Residential Baseline Assumptions - Electric

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Manufactured Income Qualified	Air Purifier	Existing	32%	100%
Manufactured Income Qualified	Computer	Existing	155%	100%
Manufactured Income Qualified	Cooking Oven	Existing	105%	27%
Manufactured Income Qualified	Cooking Range	Existing	105%	23%
Manufactured Income Qualified	Cool Central	Existing	55%	100%
Manufactured Income Qualified	Cool Room	Existing	36%	100%
Manufactured Income Qualified	Copier	Existing	11%	100%
Manufactured Income Qualified	Dehumidifier	Existing	5%	100%
Manufactured Income Qualified	Dryer	Existing	82%	83%
Manufactured Income Qualified	DVD/Blu-Ray	Existing	66%	100%
Manufactured Income Qualified	Electric Vehicle	Existing	1%	100%
Manufactured Income Qualified	Freezer	Existing	68%	100%
Manufactured Income Qualified	Heat Central Electric Furnace	Existing	0%	100%
Manufactured Income Qualified	Heat Pump	Existing	0%	100%
Manufactured Income Qualified	Heat Room Electric	Existing	0%	100%
Manufactured Income Qualified	Home Audio System	Existing	32%	100%
Manufactured Income Qualified	Lighting Linear Fluorescent	Existing	801%	100%
Manufactured Income Qualified	Lighting Specialty	Existing	2638%	100%
Manufactured Income Qualified	Lighting Standard	Existing	3658%	100%
Manufactured Income Qualified	Microwave	Existing	95%	100%
Manufactured Income Qualified	Monitor	Existing	32%	100%
Manufactured Income Qualified	Multifunction Device	Existing	31%	100%
Manufactured Income Qualified	Other	Existing	100%	100%
Manufactured Income Qualified	Plug Load Other	Existing	100%	100%
Manufactured Income Qualified	Printer	Existing	31%	100%
Manufactured Income Qualified	Refrigerator	Existing	105%	100%
Manufactured Income Qualified	Set Top Box	Existing	77%	100%
Manufactured Income Qualified	Soundbar	Existing	32%	100%
Manufactured Income Qualified	Tv	Existing	209%	100%
Manufactured Income Qualified	Ventilation And Circulation	Existing	98%	100%
Manufactured Income Qualified	Water Heat GT 55 Gal	Existing	3%	52%
Manufactured Income Qualified	Water Heat LE 55 Gal	Existing	100%	52%
Manufactured Standard Income	Air Purifier	Existing	32%	100%
Manufactured Standard Income	Computer	Existing	155%	100%
Manufactured Standard Income	Cooking Oven	Existing	105%	27%
Manufactured Standard Income	Cooking Range	Existing	105%	23%
Manufactured Standard Income	Cool Central	Existing	55%	100%
Manufactured Standard Income	Cool Room	Existing	36%	100%
Manufactured Standard Income	Copier	Existing	11%	100%
Manufactured Standard Income	Dehumidifier	Existing	5%	100%
Manufactured Standard Income	Dryer	Existing	82%	83%
Manufactured Standard Income	DVD/Blu-Ray	Existing	66%	100%
Manufactured Standard Income	Electric Vehicle	Existing	1%	100%
Manufactured Standard Income	Freezer	Existing	68%	100%
Manufactured Standard Income	Heat Central Electric Furnace	Existing	0%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Manufactured Standard Income	Heat Pump	Existing	0%	100%
Manufactured Standard Income	Heat Room Electric	Existing	0%	100%
Manufactured Standard Income	Home Audio System	Existing	32%	100%
Manufactured Standard Income	Lighting Linear Fluorescent	Existing	801%	100%
Manufactured Standard Income	Lighting Specialty	Existing	2638%	100%
Manufactured Standard Income	Lighting Standard	Existing	3658%	100%
Manufactured Standard Income	Microwave	Existing	95%	100%
Manufactured Standard Income	Monitor	Existing	32%	100%
Manufactured Standard Income	Multifunction Device	Existing	31%	100%
Manufactured Standard Income	Other	Existing	100%	100%
Manufactured Standard Income	Plug Load Other	Existing	100%	100%
Manufactured Standard Income	Printer	Existing	31%	100%
Manufactured Standard Income	Refrigerator	Existing	105%	100%
Manufactured Standard Income	Set Top Box	Existing	77%	100%
Manufactured Standard Income	Soundbar	Existing	32%	100%
Manufactured Standard Income	Tv	Existing	209%	100%
Manufactured Standard Income	Ventilation And Circulation	Existing	98%	100%
Manufactured Standard Income	Water Heat GT 55 Gal	Existing	3%	52%
Manufactured Standard Income	Water Heat LE 55 Gal	Existing	100%	52%
Multifamily Income Qualified	Air Purifier	Existing	43%	100%
Multifamily Income Qualified	Computer	Existing	145%	100%
Multifamily Income Qualified	Cooking Oven	Existing	95%	88%
Multifamily Income Qualified	Cooking Range	Existing	99%	90%
Multifamily Income Qualified	Cool Central	Existing	50%	100%
Multifamily Income Qualified	Cool Room	Existing	41%	100%
Multifamily Income Qualified	Copier	Existing	12%	100%
Multifamily Income Qualified	Dehumidifier	Existing	41%	100%
Multifamily Income Qualified	Dryer	Existing	65%	91%
Multifamily Income Qualified	DVD/Blu-Ray	Existing	56%	100%
Multifamily Income Qualified	Freezer	Existing	7%	100%
Multifamily Income Qualified	Heat Central Electric Furnace	Existing	5%	100%
Multifamily Income Qualified	Heat Pump	Existing	9%	100%
Multifamily Income Qualified	Heat Room Electric	Existing	18%	100%
Multifamily Income Qualified	Home Audio System	Existing	54%	100%
Multifamily Income Qualified	Lighting Linear Fluorescent	Existing	103%	100%
Multifamily Income Qualified	Lighting Specialty	Existing	159%	100%
Multifamily Income Qualified	Lighting Standard	Existing	1726%	100%
Multifamily Income Qualified	Microwave	Existing	96%	100%
Multifamily Income Qualified	Monitor	Existing	36%	100%
Multifamily Income Qualified	Multifunction Device	Existing	6%	100%
Multifamily Income Qualified	Other	Existing	100%	100%
Multifamily Income Qualified	Plug Load Other	Existing	100%	100%
Multifamily Income Qualified	Printer	Existing	6%	100%
Multifamily Income Qualified	Refrigerator	Existing	113%	100%
Multifamily Income Qualified	Set Top Box	Existing	128%	100%
Multifamily Income Qualified	Soundbar	Existing	28%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Multifamily Income Qualified	Tv	Existing	169%	100%
Multifamily Income Qualified	Ventilation And Circulation	Existing	8%	100%
Multifamily Income Qualified	Water Heat GT 55 Gal	Existing	50%	53%
Multifamily Income Qualified	Water Heat LE 55 Gal	Existing	50%	53%
Multifamily Standard Income	Air Purifier	Existing	43%	100%
Multifamily Standard Income	Computer	Existing	202%	100%
Multifamily Standard Income	Cooking Oven	Existing	95%	76%
Multifamily Standard Income	Cooking Range	Existing	99%	78%
Multifamily Standard Income	Cool Central	Existing	43%	100%
Multifamily Standard Income	Cool Room	Existing	44%	100%
Multifamily Standard Income	Copier	Existing	12%	100%
Multifamily Standard Income	Dehumidifier	Existing	42%	100%
Multifamily Standard Income	Dryer	Existing	67%	81%
Multifamily Standard Income	DVD/Blu-Ray	Existing	69%	100%
Multifamily Standard Income	Freezer	Existing	7%	100%
Multifamily Standard Income	Heat Central Electric Furnace	Existing	7%	100%
Multifamily Standard Income	Heat Pump	Existing	5%	100%
Multifamily Standard Income	Heat Room Electric	Existing	28%	100%
Multifamily Standard Income	Home Audio System	Existing	81%	100%
Multifamily Standard Income	Lighting Linear Fluorescent	Existing	103%	100%
Multifamily Standard Income	Lighting Specialty	Existing	159%	100%
Multifamily Standard Income	Lighting Standard	Existing	1726%	100%
Multifamily Standard Income	Microwave	Existing	96%	100%
Multifamily Standard Income	Monitor	Existing	70%	100%
Multifamily Standard Income	Multifunction Device	Existing	6%	100%
Multifamily Standard Income	Other	Existing	100%	100%
Multifamily Standard Income	Plug Load Other	Existing	100%	100%
Multifamily Standard Income	Printer	Existing	6%	100%
Multifamily Standard Income	Refrigerator	Existing	115%	100%
Multifamily Standard Income	Set Top Box	Existing	76%	100%
Multifamily Standard Income	Soundbar	Existing	86%	100%
Multifamily Standard Income	Tv	Existing	210%	100%
Multifamily Standard Income	Ventilation And Circulation	Existing	8%	100%
Multifamily Standard Income	Water Heat GT 55 Gal	Existing	50%	67%
Multifamily Standard Income	Water Heat LE 55 Gal	Existing	50%	67%
Single-family Income Qualified	Air Purifier	Existing	37%	100%
Single-family Income Qualified	Computer	Existing	197%	100%
Single-family Income Qualified	Cooking Oven	Existing	105%	57%
Single-family Income Qualified	Cooking Range	Existing	105%	56%
Single-family Income Qualified	Cool Central	Existing	64%	100%
Single-family Income Qualified	Cool Room	Existing	21%	100%
Single-family Income Qualified	Copier	Existing	11%	100%
Single-family Income Qualified	Dehumidifier	Existing	64%	100%
Single-family Income Qualified	Dryer	Existing	90%	78%
Single-family Income Qualified	DVD/Blu-Ray	Existing	94%	100%
Single-family Income Qualified	Electric Vehicle	Existing	1%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Single-family Income Qualified	Freezer	Existing	79%	100%
Single-family Income Qualified	Heat Central Electric Furnace	Existing	2%	100%
Single-family Income Qualified	Heat Pump	Existing	1%	100%
Single-family Income Qualified	Heat Room Electric	Existing	5%	100%
Single-family Income Qualified	Home Audio System	Existing	69%	100%
Single-family Income Qualified	Lighting Linear Fluorescent	Existing	801%	100%
Single-family Income Qualified	Lighting Specialty	Existing	2638%	100%
Single-family Income Qualified	Lighting Standard	Existing	3658%	100%
Single-family Income Qualified	Microwave	Existing	107%	100%
Single-family Income Qualified	Monitor	Existing	68%	100%
Single-family Income Qualified	Multifunction Device	Existing	31%	100%
Single-family Income Qualified	Other	Existing	100%	100%
Single-family Income Qualified	Plug Load Other	Existing	100%	100%
Single-family Income Qualified	Pool Pump	Existing	3%	100%
Single-family Income Qualified	Printer	Existing	31%	100%
Single-family Income Qualified	Refrigerator	Existing	137%	100%
Single-family Income Qualified	Set Top Box	Existing	110%	100%
Single-family Income Qualified	Soundbar	Existing	58%	100%
Single-family Income Qualified	Tv	Existing	286%	100%
Single-family Income Qualified	Ventilation And Circulation	Existing	98%	100%
Single-family Income Qualified	Water Heat GT 55 Gal	Existing	3%	40%
Single-family Income Qualified	Water Heat LE 55 Gal	Existing	100%	40%
Single-family Standard Income	Air Purifier	Existing	50%	100%
Single-family Standard Income	Computer	Existing	240%	100%
Single-family Standard Income	Cooking Oven	Existing	105%	66%
Single-family Standard Income	Cooking Range	Existing	105%	65%
Single-family Standard Income	Cool Central	Existing	84%	100%
Single-family Standard Income	Cool Room	Existing	7%	100%
Single-family Standard Income	Copier	Existing	11%	100%
Single-family Standard Income	Dehumidifier	Existing	89%	100%
Single-family Standard Income	Dryer	Existing	99%	76%
Single-family Standard Income	DVD/Blu-Ray	Existing	102%	100%
Single-family Standard Income	Electric Vehicle	Existing	1%	100%
Single-family Standard Income	Freezer	Existing	81%	100%
Single-family Standard Income	Heat Central Electric Furnace	Existing	5%	100%
Single-family Standard Income	Heat Pump	Existing	3%	100%
Single-family Standard Income	Heat Room Electric	Existing	2%	100%
Single-family Standard Income	Home Audio System	Existing	85%	100%
Single-family Standard Income	Lighting Linear Fluorescent	Existing	801%	100%
Single-family Standard Income	Lighting Specialty	Existing	2638%	100%
Single-family Standard Income	Lighting Standard	Existing	3658%	100%
Single-family Standard Income	Microwave	Existing	110%	100%
Single-family Standard Income	Monitor	Existing	93%	100%
Single-family Standard Income	Multifunction Device	Existing	31%	100%
Single-family Standard Income	Other	Existing	100%	100%
Single-family Standard Income	Plug Load Other	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Single-family Standard Income	Pool Pump	Existing	7%	100%
Single-family Standard Income	Printer	Existing	31%	100%
Single-family Standard Income	Refrigerator	Existing	146%	100%
Single-family Standard Income	Set Top Box	Existing	135%	100%
Single-family Standard Income	Soundbar	Existing	75%	100%
Single-family Standard Income	Tv	Existing	310%	100%
Single-family Standard Income	Ventilation And Circulation	Existing	98%	100%
Single-family Standard Income	Water Heat GT 55 Gal	Existing	3%	36%
Single-family Standard Income	Water Heat LE 55 Gal	Existing	100%	36%
Manufactured Income Qualified	Air Purifier	New	32%	100%
Manufactured Income Qualified	Computer	New	155%	100%
Manufactured Income Qualified	Cooking Oven	New	105%	27%
Manufactured Income Qualified	Cooking Range	New	105%	23%
Manufactured Income Qualified	Cool Central	New	55%	100%
Manufactured Income Qualified	Cool Room	New	36%	100%
Manufactured Income Qualified	Copier	New	11%	100%
Manufactured Income Qualified	Dehumidifier	New	5%	100%
Manufactured Income Qualified	Dryer	New	82%	83%
Manufactured Income Qualified	DVD/Blu-Ray	New	66%	100%
Manufactured Income Qualified	Electric Vehicle	New	1%	100%
Manufactured Income Qualified	Freezer	New	68%	100%
Manufactured Income Qualified	Heat Central Electric Furnace	New	0%	100%
Manufactured Income Qualified	Heat Pump	New	0%	100%
Manufactured Income Qualified	Heat Room Electric	New	0%	100%
Manufactured Income Qualified	Home Audio System	New	32%	100%
Manufactured Income Qualified	Lighting Linear Fluorescent	New	801%	100%
Manufactured Income Qualified	Lighting Specialty	New	2638%	100%
Manufactured Income Qualified	Lighting Standard	New	3658%	100%
Manufactured Income Qualified	Microwave	New	95%	100%
Manufactured Income Qualified	Monitor	New	32%	100%
Manufactured Income Qualified	Multifunction Device	New	31%	100%
Manufactured Income Qualified	Other	New	100%	100%
Manufactured Income Qualified	Plug Load Other	New	100%	100%
Manufactured Income Qualified	Printer	New	31%	100%
Manufactured Income Qualified	Refrigerator	New	105%	100%
Manufactured Income Qualified	Set Top Box	New	77%	100%
Manufactured Income Qualified	Soundbar	New	32%	100%
Manufactured Income Qualified	Tv	New	209%	100%
Manufactured Income Qualified	Ventilation And Circulation	New	98%	100%
Manufactured Income Qualified	Water Heat GT 55 Gal	New	3%	52%
Manufactured Income Qualified	Water Heat LE 55 Gal	New	100%	52%
Manufactured Standard Income	Air Purifier	New	32%	100%
Manufactured Standard Income	Computer	New	155%	100%
Manufactured Standard Income	Cooking Oven	New	105%	27%
Manufactured Standard Income	Cooking Range	New	105%	23%
Manufactured Standard Income	Cool Central	New	55%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Manufactured Standard Income	Cool Room	New	36%	100%
Manufactured Standard Income	Copier	New	11%	100%
Manufactured Standard Income	Dehumidifier	New	5%	100%
Manufactured Standard Income	Dryer	New	82%	83%
Manufactured Standard Income	DVD/Blu-Ray	New	66%	100%
Manufactured Standard Income	Electric Vehicle	New	1%	100%
Manufactured Standard Income	Freezer	New	68%	100%
Manufactured Standard Income	Heat Central Electric Furnace	New	0%	100%
Manufactured Standard Income	Heat Pump	New	0%	100%
Manufactured Standard Income	Heat Room Electric	New	0%	100%
Manufactured Standard Income	Home Audio System	New	32%	100%
Manufactured Standard Income	Lighting Linear Fluorescent	New	801%	100%
Manufactured Standard Income	Lighting Specialty	New	2638%	100%
Manufactured Standard Income	Lighting Standard	New	3658%	100%
Manufactured Standard Income	Microwave	New	95%	100%
Manufactured Standard Income	Monitor	New	32%	100%
Manufactured Standard Income	Multifunction Device	New	31%	100%
Manufactured Standard Income	Other	New	100%	100%
Manufactured Standard Income	Plug Load Other	New	100%	100%
Manufactured Standard Income	Printer	New	31%	100%
Manufactured Standard Income	Refrigerator	New	105%	100%
Manufactured Standard Income	Set Top Box	New	77%	100%
Manufactured Standard Income	Soundbar	New	32%	100%
Manufactured Standard Income	Tv	New	209%	100%
Manufactured Standard Income	Ventilation And Circulation	New	98%	100%
Manufactured Standard Income	Water Heat GT 55 Gal	New	3%	52%
Manufactured Standard Income	Water Heat LE 55 Gal	New	100%	52%
Multifamily Income Qualified	Air Purifier	New	43%	100%
Multifamily Income Qualified	Computer	New	145%	100%
Multifamily Income Qualified	Cooking Oven	New	95%	88%
Multifamily Income Qualified	Cooking Range	New	99%	90%
Multifamily Income Qualified	Cool Central	New	50%	100%
Multifamily Income Qualified	Cool Room	New	41%	100%
Multifamily Income Qualified	Copier	New	12%	100%
Multifamily Income Qualified	Dehumidifier	New	41%	100%
Multifamily Income Qualified	Dryer	New	65%	91%
Multifamily Income Qualified	DVD/Blu-Ray	New	56%	100%
Multifamily Income Qualified	Freezer	New	7%	100%
Multifamily Income Qualified	Heat Central Electric Furnace	New	5%	100%
Multifamily Income Qualified	Heat Pump	New	9%	100%
Multifamily Income Qualified	Heat Room Electric	New	18%	100%
Multifamily Income Qualified	Home Audio System	New	54%	100%
Multifamily Income Qualified	Lighting Linear Fluorescent	New	103%	100%
Multifamily Income Qualified	Lighting Specialty	New	159%	100%
Multifamily Income Qualified	Lighting Standard	New	1726%	100%
Multifamily Income Qualified	Microwave	New	96%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Multifamily Income Qualified	Monitor	New	36%	100%
Multifamily Income Qualified	Multifunction Device	New	6%	100%
Multifamily Income Qualified	Other	New	100%	100%
Multifamily Income Qualified	Plug Load Other	New	100%	100%
Multifamily Income Qualified	Printer	New	6%	100%
Multifamily Income Qualified	Refrigerator	New	113%	100%
Multifamily Income Qualified	Set Top Box	New	128%	100%
Multifamily Income Qualified	Soundbar	New	28%	100%
Multifamily Income Qualified	Tv	New	169%	100%
Multifamily Income Qualified	Ventilation And Circulation	New	8%	100%
Multifamily Income Qualified	Water Heat GT 55 Gal	New	50%	53%
Multifamily Income Qualified	Water Heat LE 55 Gal	New	50%	53%
Multifamily Standard Income	Air Purifier	New	43%	100%
Multifamily Standard Income	Computer	New	202%	100%
Multifamily Standard Income	Cooking Oven	New	95%	76%
Multifamily Standard Income	Cooking Range	New	99%	78%
Multifamily Standard Income	Cool Central	New	43%	100%
Multifamily Standard Income	Cool Room	New	44%	100%
Multifamily Standard Income	Copier	New	12%	100%
Multifamily Standard Income	Dehumidifier	New	42%	100%
Multifamily Standard Income	Dryer	New	67%	81%
Multifamily Standard Income	DVD/Blu-Ray	New	69%	100%
Multifamily Standard Income	Freezer	New	7%	100%
Multifamily Standard Income	Heat Central Electric Furnace	New	7%	100%
Multifamily Standard Income	Heat Pump	New	5%	100%
Multifamily Standard Income	Heat Room Electric	New	28%	100%
Multifamily Standard Income	Home Audio System	New	81%	100%
Multifamily Standard Income	Lighting Linear Fluorescent	New	103%	100%
Multifamily Standard Income	Lighting Specialty	New	159%	100%
Multifamily Standard Income	Lighting Standard	New	1726%	100%
Multifamily Standard Income	Microwave	New	96%	100%
Multifamily Standard Income	Monitor	New	70%	100%
Multifamily Standard Income	Multifunction Device	New	6%	100%
Multifamily Standard Income	Other	New	100%	100%
Multifamily Standard Income	Plug Load Other	New	100%	100%
Multifamily Standard Income	Printer	New	6%	100%
Multifamily Standard Income	Refrigerator	New	115%	100%
Multifamily Standard Income	Set Top Box	New	76%	100%
Multifamily Standard Income	Soundbar	New	86%	100%
Multifamily Standard Income	Tv	New	210%	100%
Multifamily Standard Income	Ventilation And Circulation	New	8%	100%
Multifamily Standard Income	Water Heat GT 55 Gal	New	50%	67%
Multifamily Standard Income	Water Heat LE 55 Gal	New	50%	67%
Single-family Income Qualified	Air Purifier	New	37%	100%
Single-family Income Qualified	Computer	New	197%	100%
Single-family Income Qualified	Cooking Oven	New	105%	57%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Single-family Income Qualified	Cooking Range	New	105%	56%
Single-family Income Qualified	Cool Central	New	64%	100%
Single-family Income Qualified	Cool Room	New	21%	100%
Single-family Income Qualified	Copier	New	11%	100%
Single-family Income Qualified	Dehumidifier	New	64%	100%
Single-family Income Qualified	Dryer	New	90%	78%
Single-family Income Qualified	DVD/Blu-Ray	New	94%	100%
Single-family Income Qualified	Electric Vehicle	New	1%	100%
Single-family Income Qualified	Freezer	New	79%	100%
Single-family Income Qualified	Heat Central Electric Furnace	New	2%	100%
Single-family Income Qualified	Heat Pump	New	1%	100%
Single-family Income Qualified	Heat Room Electric	New	5%	100%
Single-family Income Qualified	Home Audio System	New	69%	100%
Single-family Income Qualified	Lighting Linear Fluorescent	New	801%	100%
Single-family Income Qualified	Lighting Specialty	New	2638%	100%
Single-family Income Qualified	Lighting Standard	New	3658%	100%
Single-family Income Qualified	Microwave	New	107%	100%
Single-family Income Qualified	Monitor	New	68%	100%
Single-family Income Qualified	Multifunction Device	New	31%	100%
Single-family Income Qualified	Other	New	100%	100%
Single-family Income Qualified	Plug Load Other	New	100%	100%
Single-family Income Qualified	Pool Pump	New	3%	100%
Single-family Income Qualified	Printer	New	31%	100%
Single-family Income Qualified	Refrigerator	New	134%	100%
Single-family Income Qualified	Set Top Box	New	110%	100%
Single-family Income Qualified	Soundbar	New	58%	100%
Single-family Income Qualified	Tv	New	286%	100%
Single-family Income Qualified	Ventilation And Circulation	New	98%	100%
Single-family Income Qualified	Water Heat GT 55 Gal	New	3%	40%
Single-family Income Qualified	Water Heat LE 55 Gal	New	100%	40%
Single-family Standard Income	Air Purifier	New	50%	100%
Single-family Standard Income	Computer	New	240%	100%
Single-family Standard Income	Cooking Oven	New	105%	66%
Single-family Standard Income	Cooking Range	New	105%	65%
Single-family Standard Income	Cool Central	New	84%	100%
Single-family Standard Income	Cool Room	New	7%	100%
Single-family Standard Income	Copier	New	11%	100%
Single-family Standard Income	Dehumidifier	New	89%	100%
Single-family Standard Income	Dryer	New	99%	76%
Single-family Standard Income	DVD/Blu-Ray	New	102%	100%
Single-family Standard Income	Electric Vehicle	New	1%	100%
Single-family Standard Income	Freezer	New	81%	100%
Single-family Standard Income	Heat Central Electric Furnace	New	5%	100%
Single-family Standard Income	Heat Pump	New	3%	100%
Single-family Standard Income	Heat Room Electric	New	2%	100%
Single-family Standard Income	Home Audio System	New	85%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Single-family Standard Income	Lighting Linear Fluorescent	New	801%	100%
Single-family Standard Income	Lighting Specialty	New	2638%	100%
Single-family Standard Income	Lighting Standard	New	3658%	100%
Single-family Standard Income	Microwave	New	110%	100%
Single-family Standard Income	Monitor	New	93%	100%
Single-family Standard Income	Multifunction Device	New	31%	100%
Single-family Standard Income	Other	New	100%	100%
Single-family Standard Income	Plug Load Other	New	100%	100%
Single-family Standard Income	Pool Pump	New	7%	100%
Single-family Standard Income	Printer	New	31%	100%
Single-family Standard Income	Refrigerator	New	134%	100%
Single-family Standard Income	Set Top Box	New	135%	100%
Single-family Standard Income	Soundbar	New	75%	100%
Single-family Standard Income	Tv	New	310%	100%
Single-family Standard Income	Ventilation And Circulation	New	98%	100%
Single-family Standard Income	Water Heat GT 55 Gal	New	3%	36%
Single-family Standard Income	Water Heat LE 55 Gal	New	100%	36%

Figure C-3. Residential Baseline Forecast by Segment – Natural Gas

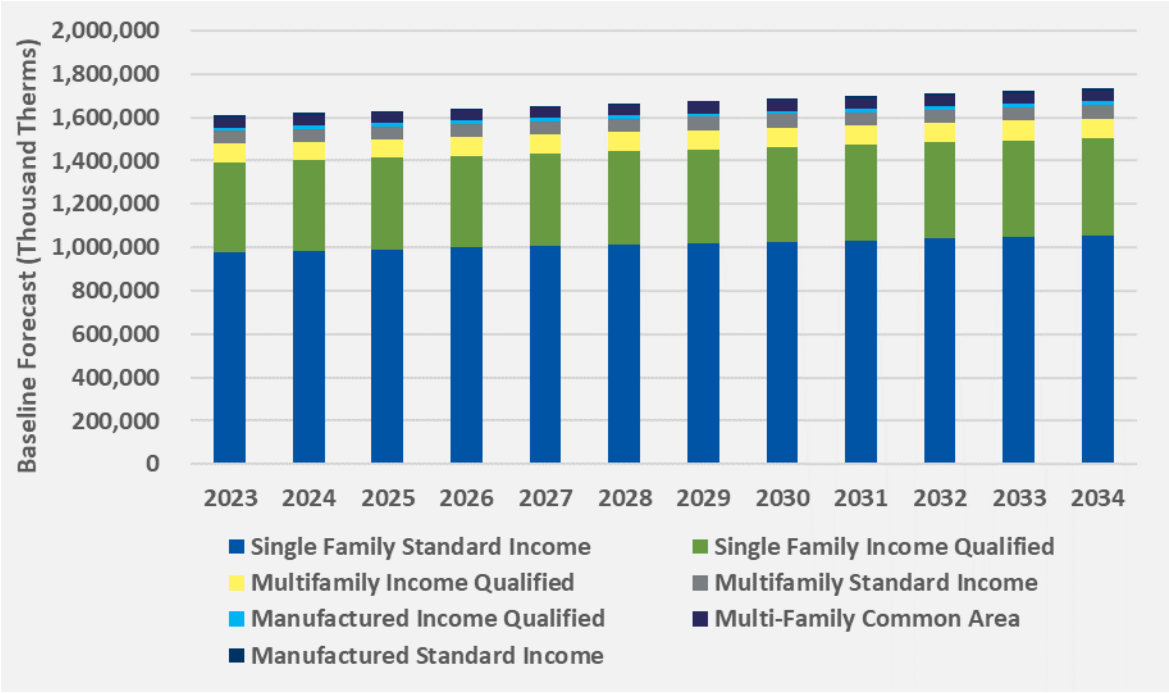


Figure C-4. Residential Baseline Forecast by End Use Group – Natural Gas

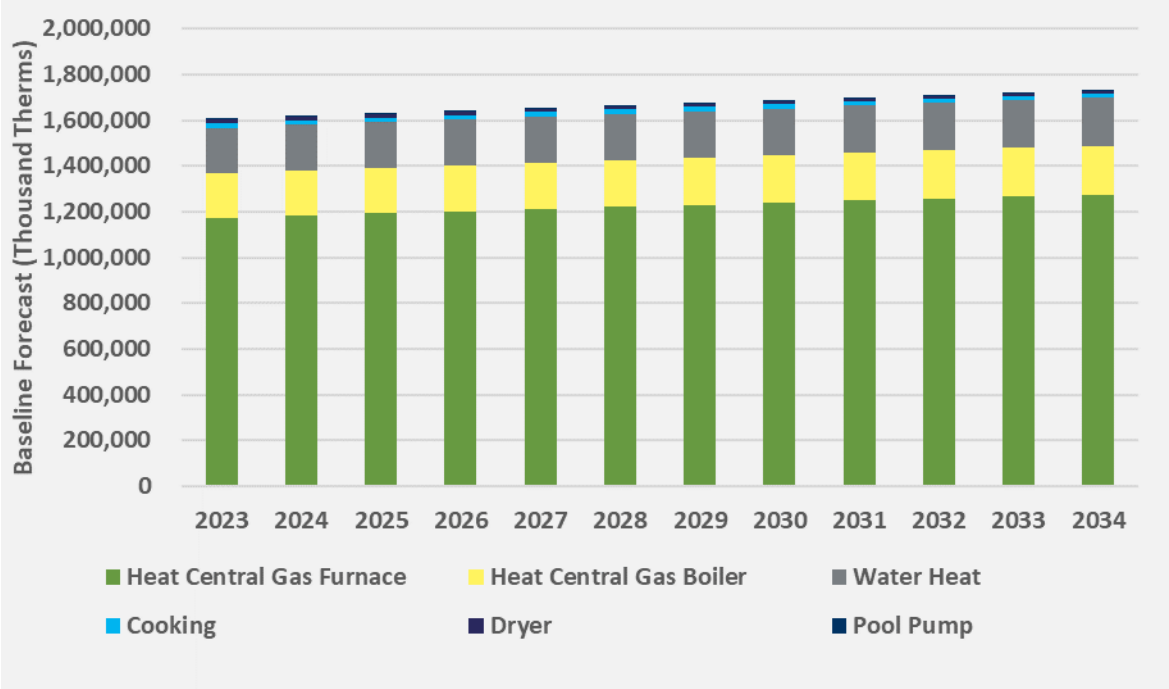


Table C-2. Residential Baseline Assumptions – Natural Gas

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Manufactured Income Qualified	Cooking Oven	Existing	105%	81%
Manufactured Income Qualified	Cooking Range	Existing	105%	81%
Manufactured Income Qualified	Dryer	Existing	88%	21%
Manufactured Income Qualified	Heat Central Gas Boiler	Existing	6%	100%
Manufactured Income Qualified	Heat Central Gas Furnace	Existing	94%	100%
Manufactured Income Qualified	Other	Existing	100%	100%
Manufactured Income Qualified	Water Heat GT 55 Gal	Existing	3%	47%
Manufactured Income Qualified	Water Heat LE 55 Gal	Existing	100%	47%
Manufactured Standard Income	Cooking Oven	Existing	105%	81%
Manufactured Standard Income	Cooking Range	Existing	105%	81%
Manufactured Standard Income	Dryer	Existing	88%	21%
Manufactured Standard Income	Heat Central Gas Boiler	Existing	6%	100%
Manufactured Standard Income	Heat Central Gas Furnace	Existing	94%	100%
Manufactured Standard Income	Other	Existing	100%	100%
Manufactured Standard Income	Water Heat GT 55 Gal	Existing	3%	47%
Manufactured Standard Income	Water Heat LE 55 Gal	Existing	100%	47%
Multifamily Income Qualified	Cooking Oven	Existing	95%	25%
Multifamily Income Qualified	Cooking Range	Existing	99%	22%
Multifamily Income Qualified	Dryer	Existing	71%	19%
Multifamily Income Qualified	Heat Central Gas Boiler	Existing	28%	100%
Multifamily Income Qualified	Heat Central Gas Furnace	Existing	62%	100%
Multifamily Income Qualified	Other	Existing	100%	100%
Multifamily Income Qualified	Water Heat GT 55 Gal	Existing	50%	70%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Multifamily Income Qualified	Water Heat LE 55 Gal	Existing	50%	70%
Multifamily Standard Income	Cooking Oven	Existing	95%	55%
Multifamily Standard Income	Cooking Range	Existing	99%	50%
Multifamily Standard Income	Dryer	Existing	85%	33%
Multifamily Standard Income	Heat Central Gas Boiler	Existing	35%	100%
Multifamily Standard Income	Heat Central Gas Furnace	Existing	54%	100%
Multifamily Standard Income	Other	Existing	100%	100%
Multifamily Standard Income	Water Heat GT 55 Gal	Existing	50%	64%
Multifamily Standard Income	Water Heat LE 55 Gal	Existing	50%	64%
Single-family Income Qualified	Cooking Oven	Existing	105%	53%
Single-family Income Qualified	Cooking Range	Existing	105%	54%
Single-family Income Qualified	Dryer	Existing	91%	26%
Single-family Income Qualified	Heat Central Gas Boiler	Existing	8%	100%
Single-family Income Qualified	Heat Central Gas Furnace	Existing	85%	100%
Single-family Income Qualified	Other	Existing	100%	100%
Single-family Income Qualified	Pool Heat	Existing	2%	57%
Single-family Income Qualified	Water Heat GT 55 Gal	Existing	3%	71%
Single-family Income Qualified	Water Heat LE 55 Gal	Existing	100%	71%
Single-family Standard Income	Cooking Oven	Existing	105%	42%
Single-family Standard Income	Cooking Range	Existing	105%	43%
Single-family Standard Income	Dryer	Existing	100%	29%
Single-family Standard Income	Heat Central Gas Boiler	Existing	5%	100%
Single-family Standard Income	Heat Central Gas Furnace	Existing	90%	100%
Single-family Standard Income	Other	Existing	100%	100%
Single-family Standard Income	Pool Heat	Existing	2%	57%
Single-family Standard Income	Water Heat GT 55 Gal	Existing	3%	75%
Single-family Standard Income	Water Heat LE 55 Gal	Existing	100%	75%
Manufactured Income Qualified	Cooking Oven	New	105%	81%
Manufactured Income Qualified	Cooking Range	New	105%	81%
Manufactured Income Qualified	Dryer	New	88%	21%
Manufactured Income Qualified	Heat Central Gas Boiler	New	6%	100%
Manufactured Income Qualified	Heat Central Gas Furnace	New	94%	100%
Manufactured Income Qualified	Other	New	100%	100%
Manufactured Income Qualified	Water Heat GT 55 Gal	New	3%	47%
Manufactured Income Qualified	Water Heat LE 55 Gal	New	100%	47%
Manufactured Standard Income	Cooking Oven	New	105%	81%
Manufactured Standard Income	Cooking Range	New	105%	81%
Manufactured Standard Income	Dryer	New	88%	21%
Manufactured Standard Income	Heat Central Gas Boiler	New	6%	100%
Manufactured Standard Income	Heat Central Gas Furnace	New	94%	100%
Manufactured Standard Income	Other	New	100%	100%
Manufactured Standard Income	Water Heat GT 55 Gal	New	3%	47%
Manufactured Standard Income	Water Heat LE 55 Gal	New	100%	47%
Multifamily Income Qualified	Cooking Oven	New	95%	25%
Multifamily Income Qualified	Cooking Range	New	99%	22%
Multifamily Income Qualified	Dryer	New	71%	19%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Multifamily Income Qualified	Heat Central Gas Boiler	New	28%	100%
Multifamily Income Qualified	Heat Central Gas Furnace	New	62%	100%
Multifamily Income Qualified	Other	New	100%	100%
Multifamily Income Qualified	Water Heat GT 55 Gal	New	50%	70%
Multifamily Income Qualified	Water Heat LE 55 Gal	New	50%	70%
Multifamily Standard Income	Cooking Oven	New	95%	55%
Multifamily Standard Income	Cooking Range	New	99%	50%
Multifamily Standard Income	Dryer	New	85%	33%
Multifamily Standard Income	Heat Central Gas Boiler	New	35%	100%
Multifamily Standard Income	Heat Central Gas Furnace	New	54%	100%
Multifamily Standard Income	Other	New	100%	100%
Multifamily Standard Income	Water Heat GT 55 Gal	New	50%	64%
Multifamily Standard Income	Water Heat LE 55 Gal	New	50%	64%
Single-family Income Qualified	Cooking Oven	New	105%	78%
Single-family Income Qualified	Cooking Range	New	105%	78%
Single-family Income Qualified	Dryer	New	91%	58%
Single-family Income Qualified	Heat Central Gas Boiler	New	8%	100%
Single-family Income Qualified	Heat Central Gas Furnace	New	85%	100%
Single-family Income Qualified	Other	New	100%	100%
Single-family Income Qualified	Pool Heat	New	2%	57%
Single-family Income Qualified	Water Heat GT 55 Gal	New	3%	86%
Single-family Income Qualified	Water Heat LE 55 Gal	New	100%	86%
Single-family Standard Income	Cooking Oven	New	105%	78%
Single-family Standard Income	Cooking Range	New	105%	78%
Single-family Standard Income	Dryer	New	100%	58%
Single-family Standard Income	Heat Central Gas Boiler	New	5%	100%
Single-family Standard Income	Heat Central Gas Furnace	New	90%	100%
Single-family Standard Income	Other	New	100%	100%
Single-family Standard Income	Pool Heat	New	2%	57%
Single-family Standard Income	Water Heat GT 55 Gal	New	3%	86%
Single-family Standard Income	Water Heat LE 55 Gal	New	100%	86%

Figure C-5. Commercial Baseline Forecast by Segment – Electric

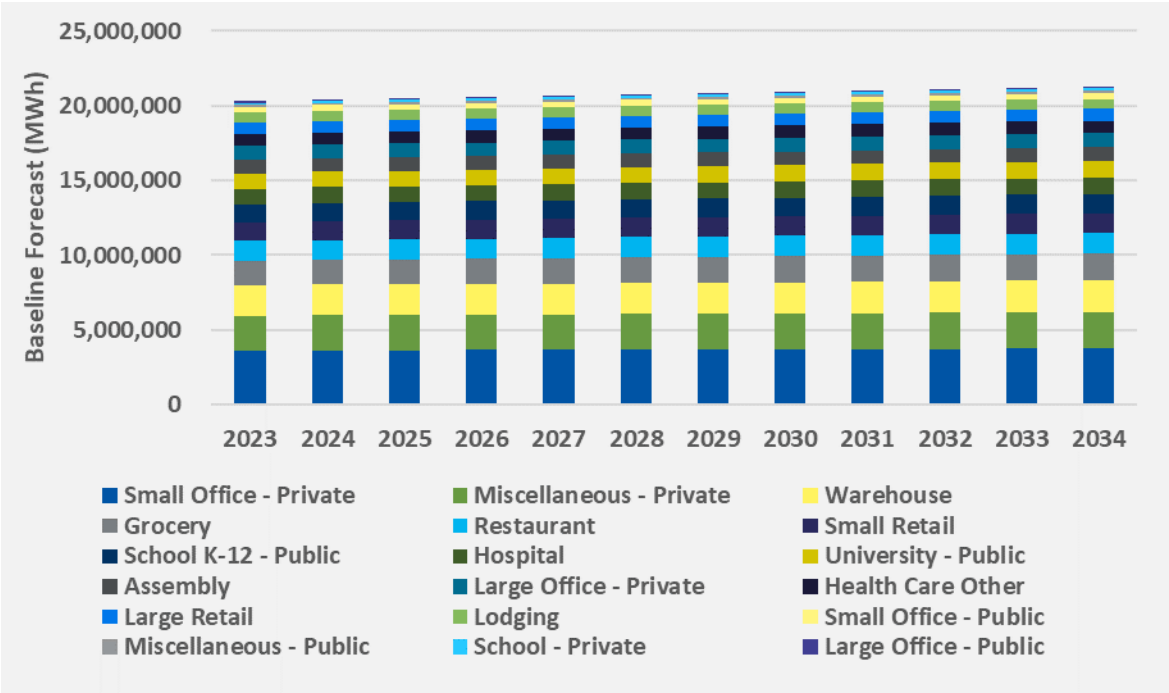


Figure C-6. Commercial Baseline Forecast by End Use Group – Electric

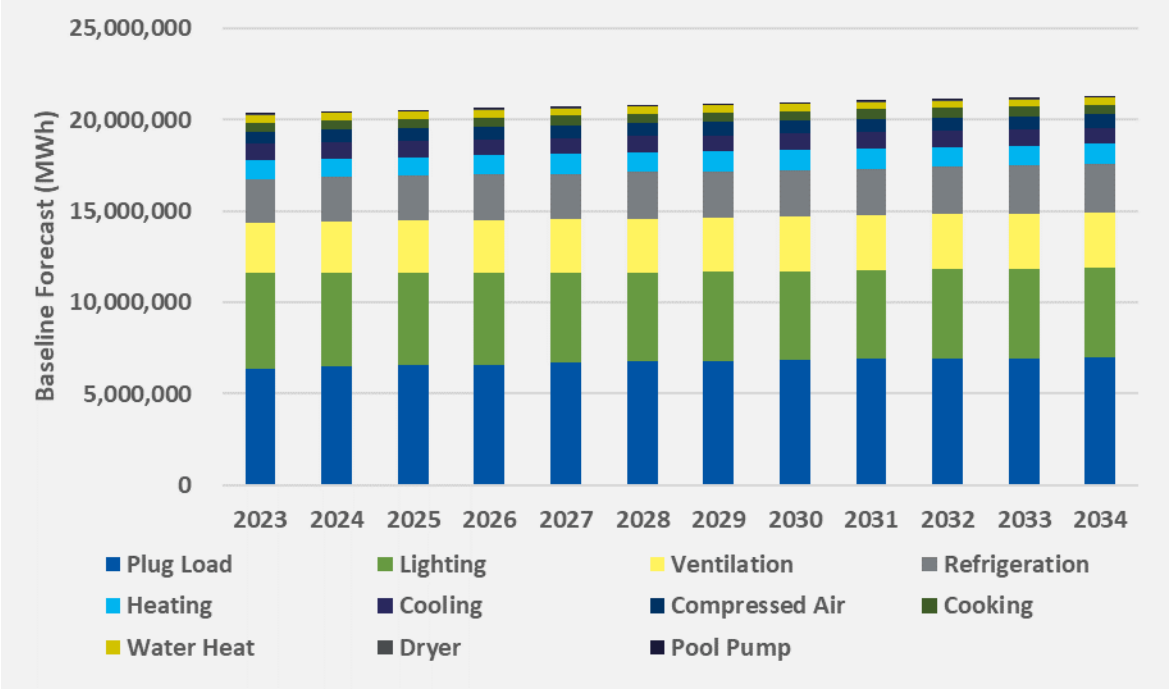


Table C-3. Commercial Baseline Assumptions – Electric

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Assembly	Computers	Existing	100%	100%
Assembly	Cooking	Existing	100%	20%
Assembly	Cooling Chillers	Existing	15%	100%
Assembly	Cooling Dx Evap	Existing	75%	100%
Assembly	Fax	Existing	100%	100%
Assembly	Flat Screen Monitors	Existing	100%	100%
Assembly	Freezers	Existing	100%	100%
Assembly	Heat Pump	Existing	0%	100%
Assembly	Lighting Exterior	Existing	100%	100%
Assembly	Lighting Interior Fluorescent	Existing	100%	100%
Assembly	Lighting Interior HID	Existing	100%	100%
Assembly	Lighting Interior Other	Existing	100%	100%
Assembly	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Assembly	Lighting Interior Screw Base - Standard	Existing	100%	100%
Assembly	Other	Existing	100%	100%
Assembly	Other Plug Load	Existing	100%	100%
Assembly	Photo Copiers	Existing	100%	100%
Assembly	Printers	Existing	100%	100%
Assembly	Refrigeration	Existing	100%	100%
Assembly	Refrigerators	Existing	100%	100%
Assembly	Room Cool	Existing	3%	100%
Assembly	Room Heat - Electric	Existing	0%	100%
Assembly	Servers	Existing	100%	100%
Assembly	Space Heat - Electric	Existing	12%	100%
Assembly	Vending Machines	Existing	100%	100%
Assembly	Ventilation And Circulation	Existing	100%	100%
Assembly	Water Heat GT 55 Gal	Existing	12%	100%
Assembly	Water Heat LE 55 Gal	Existing	23%	100%
Grocery	Computers	Existing	100%	100%
Grocery	Cooking	Existing	100%	55%
Grocery	Cooling Chillers	Existing	0%	100%
Grocery	Cooling Dx Evap	Existing	79%	100%
Grocery	Fax	Existing	100%	100%
Grocery	Flat Screen Monitors	Existing	100%	100%
Grocery	Freezers	Existing	100%	100%
Grocery	Heat Pump	Existing	0%	100%
Grocery	Lighting Exterior	Existing	100%	100%
Grocery	Lighting Interior Fluorescent	Existing	100%	100%
Grocery	Lighting Interior HID	Existing	100%	100%
Grocery	Lighting Interior Other	Existing	100%	100%
Grocery	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Grocery	Lighting Interior Screw Base - Standard	Existing	100%	100%
Grocery	Other	Existing	100%	100%
Grocery	Other Plug Load	Existing	100%	100%
Grocery	Photo Copiers	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Grocery	Printers	Existing	100%	100%
Grocery	Refrigeration	Existing	100%	100%
Grocery	Refrigerators	Existing	100%	100%
Grocery	Room Cool	Existing	21%	100%
Grocery	Room Heat - Electric	Existing	2%	100%
Grocery	Servers	Existing	100%	100%
Grocery	Space Heat - Electric	Existing	5%	100%
Grocery	Vending Machines	Existing	100%	100%
Grocery	Ventilation And Circulation	Existing	100%	100%
Grocery	Water Heat GT 55 Gal	Existing	17%	100%
Grocery	Water Heat LE 55 Gal	Existing	28%	100%
Health Care Other	Computers	Existing	100%	100%
Health Care Other	Cooking	Existing	100%	42%
Health Care Other	Cooling Chillers	Existing	15%	99%
Health Care Other	Cooling Dx Evap	Existing	48%	99%
Health Care Other	Fax	Existing	100%	100%
Health Care Other	Flat Screen Monitors	Existing	100%	100%
Health Care Other	Freezers	Existing	100%	100%
Health Care Other	Heat Pump	Existing	5%	100%
Health Care Other	Lighting Exterior	Existing	100%	100%
Health Care Other	Lighting Interior Fluorescent	Existing	100%	100%
Health Care Other	Lighting Interior HID	Existing	100%	100%
Health Care Other	Lighting Interior Other	Existing	100%	100%
Health Care Other	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Health Care Other	Lighting Interior Screw Base - Standard	Existing	100%	100%
Health Care Other	Other	Existing	100%	100%
Health Care Other	Other Plug Load	Existing	100%	100%
Health Care Other	Photo Copiers	Existing	100%	100%
Health Care Other	Printers	Existing	100%	100%
Health Care Other	Refrigeration	Existing	100%	100%
Health Care Other	Refrigerators	Existing	100%	100%
Health Care Other	Room Cool	Existing	28%	100%
Health Care Other	Room Heat - Electric	Existing	8%	80%
Health Care Other	Servers	Existing	100%	100%
Health Care Other	Space Heat - Electric	Existing	45%	7%
Health Care Other	Vending Machines	Existing	100%	100%
Health Care Other	Ventilation And Circulation	Existing	100%	100%
Health Care Other	Water Heat GT 55 Gal	Existing	17%	100%
Health Care Other	Water Heat LE 55 Gal	Existing	9%	100%
Hospital	Computers	Existing	100%	100%
Hospital	Cooking	Existing	100%	31%
Hospital	Cooling Chillers	Existing	75%	92%
Hospital	Cooling Dx Evap	Existing	25%	92%
Hospital	Dryer	Existing	100%	100%
Hospital	Fax	Existing	100%	100%
Hospital	Flat Screen Monitors	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Hospital	Freezers	Existing	100%	100%
Hospital	Heat Pump	Existing	0%	100%
Hospital	Lighting Exterior	Existing	100%	100%
Hospital	Lighting Interior Fluorescent	Existing	100%	100%
Hospital	Lighting Interior HID	Existing	100%	100%
Hospital	Lighting Interior Other	Existing	100%	100%
Hospital	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Hospital	Lighting Interior Screw Base - Standard	Existing	100%	100%
Hospital	Other	Existing	100%	100%
Hospital	Other Plug Load	Existing	100%	100%
Hospital	Photo Copiers	Existing	100%	100%
Hospital	Printers	Existing	100%	100%
Hospital	Refrigeration	Existing	100%	100%
Hospital	Refrigerators	Existing	100%	100%
Hospital	Room Cool	Existing	0%	100%
Hospital	Room Heat - Electric	Existing	4%	13%
Hospital	Servers	Existing	100%	100%
Hospital	Space Heat - Electric	Existing	14%	13%
Hospital	Vending Machines	Existing	100%	100%
Hospital	Ventilation And Circulation	Existing	100%	100%
Hospital	Water Heat GT 55 Gal	Existing	0%	100%
Hospital	Water Heat LE 55 Gal	Existing	8%	100%
Large Office - Private	Compressed Air	Existing	100%	100%
Large Office - Private	Computers	Existing	100%	100%
Large Office - Private	Cooling Chillers	Existing	8%	100%
Large Office - Private	Cooling Dx Evap	Existing	82%	100%
Large Office - Private	Fax	Existing	100%	100%
Large Office - Private	Flat Screen Monitors	Existing	100%	100%
Large Office - Private	Freezers	Existing	100%	100%
Large Office - Private	Heat Pump	Existing	2%	100%
Large Office - Private	Lighting Exterior	Existing	100%	100%
Large Office - Private	Lighting Interior Fluorescent	Existing	100%	100%
Large Office - Private	Lighting Interior HID	Existing	100%	100%
Large Office - Private	Lighting Interior Other	Existing	100%	100%
Large Office - Private	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Large Office - Private	Lighting Interior Screw Base - Standard	Existing	100%	100%
Large Office - Private	Other	Existing	100%	100%
Large Office - Private	Other Plug Load	Existing	100%	100%
Large Office - Private	Photo Copiers	Existing	100%	100%
Large Office - Private	Printers	Existing	100%	100%
Large Office - Private	Refrigerators	Existing	100%	100%
Large Office - Private	Room Cool	Existing	10%	100%
Large Office - Private	Room Heat - Electric	Existing	5%	100%
Large Office - Private	Servers	Existing	100%	100%
Large Office - Private	Space Heat - Electric	Existing	2%	100%
Large Office - Private	Vending Machines	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Large Office - Private	Ventilation And Circulation	Existing	100%	100%
Large Office - Private	Water Heat GT 55 Gal	Existing	4%	100%
Large Office - Private	Water Heat LE 55 Gal	Existing	49%	100%
Large Office - Public	Compressed Air	Existing	100%	100%
Large Office - Public	Computers	Existing	100%	100%
Large Office - Public	Cooling Chillers	Existing	8%	100%
Large Office - Public	Cooling Dx Evap	Existing	82%	100%
Large Office - Public	Fax	Existing	100%	100%
Large Office - Public	Flat Screen Monitors	Existing	100%	100%
Large Office - Public	Freezers	Existing	100%	100%
Large Office - Public	Heat Pump	Existing	2%	100%
Large Office - Public	Lighting Exterior	Existing	100%	100%
Large Office - Public	Lighting Interior Fluorescent	Existing	100%	100%
Large Office - Public	Lighting Interior HID	Existing	100%	100%
Large Office - Public	Lighting Interior Other	Existing	100%	100%
Large Office - Public	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Large Office - Public	Lighting Interior Screw Base - Standard	Existing	100%	100%
Large Office - Public	Other	Existing	100%	100%
Large Office - Public	Other Plug Load	Existing	100%	100%
Large Office - Public	Photo Copiers	Existing	100%	100%
Large Office - Public	Printers	Existing	100%	100%
Large Office - Public	Refrigerators	Existing	100%	100%
Large Office - Public	Room Cool	Existing	10%	100%
Large Office - Public	Room Heat - Electric	Existing	5%	100%
Large Office - Public	Servers	Existing	100%	100%
Large Office - Public	Space Heat - Electric	Existing	2%	100%
Large Office - Public	Vending Machines	Existing	100%	100%
Large Office - Public	Ventilation And Circulation	Existing	100%	100%
Large Office - Public	Water Heat GT 55 Gal	Existing	4%	100%
Large Office - Public	Water Heat LE 55 Gal	Existing	49%	100%
Large Retail	Compressed Air	Existing	100%	100%
Large Retail	Computers	Existing	100%	100%
Large Retail	Cooking	Existing	100%	28%
Large Retail	Cooling Chillers	Existing	0%	100%
Large Retail	Cooling Dx Evap	Existing	88%	100%
Large Retail	Fax	Existing	100%	100%
Large Retail	Flat Screen Monitors	Existing	100%	100%
Large Retail	Freezers	Existing	100%	100%
Large Retail	Heat Pump	Existing	0%	100%
Large Retail	Lighting Exterior	Existing	100%	100%
Large Retail	Lighting Interior Fluorescent	Existing	100%	100%
Large Retail	Lighting Interior HID	Existing	100%	100%
Large Retail	Lighting Interior Other	Existing	100%	100%
Large Retail	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Large Retail	Lighting Interior Screw Base - Standard	Existing	100%	100%
Large Retail	Other	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Large Retail	Other Plug Load	Existing	100%	100%
Large Retail	Photo Copiers	Existing	100%	100%
Large Retail	Printers	Existing	100%	100%
Large Retail	Refrigeration	Existing	100%	100%
Large Retail	Refrigerators	Existing	100%	100%
Large Retail	Room Cool	Existing	12%	100%
Large Retail	Room Heat - Electric	Existing	3%	100%
Large Retail	Servers	Existing	100%	100%
Large Retail	Space Heat - Electric	Existing	0%	100%
Large Retail	Vending Machines	Existing	100%	100%
Large Retail	Ventilation And Circulation	Existing	100%	100%
Large Retail	Water Heat GT 55 Gal	Existing	0%	100%
Large Retail	Water Heat LE 55 Gal	Existing	80%	100%
Lodging	Computers	Existing	100%	100%
Lodging	Cooking	Existing	100%	43%
Lodging	Cooling Chillers	Existing	9%	100%
Lodging	Cooling Dx Evap	Existing	46%	100%
Lodging	Dryer	Existing	100%	100%
Lodging	Fax	Existing	100%	100%
Lodging	Flat Screen Monitors	Existing	100%	100%
Lodging	Freezers	Existing	100%	100%
Lodging	Heat Pump	Existing	3%	100%
Lodging	Lighting Exterior	Existing	100%	100%
Lodging	Lighting Interior Fluorescent	Existing	100%	100%
Lodging	Lighting Interior HID	Existing	100%	100%
Lodging	Lighting Interior Other	Existing	100%	100%
Lodging	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Lodging	Lighting Interior Screw Base - Standard	Existing	100%	100%
Lodging	Other	Existing	100%	100%
Lodging	Other Plug Load	Existing	100%	100%
Lodging	Package Terminal Ac	Existing	14%	100%
Lodging	Package Terminal HP	Existing	14%	100%
Lodging	Photo Copiers	Existing	100%	100%
Lodging	Pool Pump	Existing	100%	100%
Lodging	Printers	Existing	100%	100%
Lodging	Refrigeration	Existing	100%	100%
Lodging	Refrigerators	Existing	100%	100%
Lodging	Room Cool	Existing	31%	100%
Lodging	Room Heat - Electric	Existing	6%	100%
Lodging	Servers	Existing	100%	100%
Lodging	Space Heat - Electric	Existing	14%	100%
Lodging	Vending Machines	Existing	100%	100%
Lodging	Ventilation And Circulation	Existing	100%	100%
Lodging	Water Heat GT 55 Gal	Existing	18%	100%
Lodging	Water Heat LE 55 Gal	Existing	15%	100%
Miscellaneous - Private	Compressed Air	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Miscellaneous - Private	Computers	Existing	100%	100%
Miscellaneous - Private	Cooking	Existing	100%	63%
Miscellaneous - Private	Cooling Chillers	Existing	15%	100%
Miscellaneous - Private	Cooling Dx Evap	Existing	75%	100%
Miscellaneous - Private	Dryer	Existing	100%	100%
Miscellaneous - Private	Fax	Existing	100%	100%
Miscellaneous - Private	Flat Screen Monitors	Existing	100%	100%
Miscellaneous - Private	Freezers	Existing	100%	100%
Miscellaneous - Private	Heat Pump	Existing	0%	100%
Miscellaneous - Private	Lighting Exterior	Existing	100%	100%
Miscellaneous - Private	Lighting Interior Fluorescent	Existing	100%	100%
Miscellaneous - Private	Lighting Interior HID	Existing	100%	100%
Miscellaneous - Private	Lighting Interior Other	Existing	100%	100%
Miscellaneous - Private	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Miscellaneous - Private	Lighting Interior Screw Base - Standard	Existing	100%	100%
Miscellaneous - Private	Other	Existing	100%	100%
Miscellaneous - Private	Other Plug Load	Existing	100%	100%
Miscellaneous - Private	Package Terminal Ac	Existing	8%	100%
Miscellaneous - Private	Package Terminal HP	Existing	0%	100%
Miscellaneous - Private	Photo Copiers	Existing	100%	100%
Miscellaneous - Private	Pool Pump	Existing	100%	100%
Miscellaneous - Private	Printers	Existing	100%	100%
Miscellaneous - Private	Refrigeration	Existing	100%	100%
Miscellaneous - Private	Refrigerators	Existing	100%	100%
Miscellaneous - Private	Room Cool	Existing	3%	100%
Miscellaneous - Private	Room Heat - Electric	Existing	0%	100%
Miscellaneous - Private	Servers	Existing	100%	100%
Miscellaneous - Private	Space Heat - Electric	Existing	12%	100%
Miscellaneous - Private	Vending Machines	Existing	100%	100%
Miscellaneous - Private	Ventilation And Circulation	Existing	100%	100%
Miscellaneous - Private	Water Heat GT 55 Gal	Existing	12%	100%
Miscellaneous - Private	Water Heat LE 55 Gal	Existing	23%	100%
Miscellaneous - Public	Compressed Air	Existing	100%	100%
Miscellaneous - Public	Computers	Existing	100%	100%
Miscellaneous - Public	Cooking	Existing	100%	63%
Miscellaneous - Public	Cooling Chillers	Existing	15%	100%
Miscellaneous - Public	Cooling Dx Evap	Existing	75%	100%
Miscellaneous - Public	Dryer	Existing	100%	100%
Miscellaneous - Public	Fax	Existing	100%	100%
Miscellaneous - Public	Flat Screen Monitors	Existing	100%	100%
Miscellaneous - Public	Freezers	Existing	100%	100%
Miscellaneous - Public	Heat Pump	Existing	0%	100%
Miscellaneous - Public	Lighting Exterior	Existing	100%	100%
Miscellaneous - Public	Lighting Interior Fluorescent	Existing	100%	100%
Miscellaneous - Public	Lighting Interior HID	Existing	100%	100%
Miscellaneous - Public	Lighting Interior Other	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Miscellaneous - Public	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Miscellaneous - Public	Lighting Interior Screw Base - Standard	Existing	100%	100%
Miscellaneous - Public	Other	Existing	100%	100%
Miscellaneous - Public	Other Plug Load	Existing	100%	100%
Miscellaneous - Public	Package Terminal Ac	Existing	8%	100%
Miscellaneous - Public	Package Terminal HP	Existing	0%	100%
Miscellaneous - Public	Photo Copiers	Existing	100%	100%
Miscellaneous - Public	Pool Pump	Existing	100%	100%
Miscellaneous - Public	Printers	Existing	100%	100%
Miscellaneous - Public	Refrigeration	Existing	100%	100%
Miscellaneous - Public	Refrigerators	Existing	100%	100%
Miscellaneous - Public	Room Cool	Existing	3%	100%
Miscellaneous - Public	Room Heat - Electric	Existing	0%	100%
Miscellaneous - Public	Servers	Existing	100%	100%
Miscellaneous - Public	Space Heat - Electric	Existing	12%	100%
Miscellaneous - Public	Vending Machines	Existing	100%	100%
Miscellaneous - Public	Ventilation And Circulation	Existing	100%	100%
Miscellaneous - Public	Water Heat GT 55 Gal	Existing	12%	100%
Miscellaneous - Public	Water Heat LE 55 Gal	Existing	23%	100%
Multi-Family Common Area	Cooling Chillers	Existing	0%	100%
Multi-Family Common Area	Cooling Dx Evap	Existing	20%	100%
Multi-Family Common Area	Dryer	Existing	100%	100%
Multi-Family Common Area	Heat Pump	Existing	0%	100%
Multi-Family Common Area	Lighting Exterior	Existing	100%	100%
Multi-Family Common Area	Lighting Interior Fluorescent	Existing	100%	100%
Multi-Family Common Area	Lighting Interior HID	Existing	100%	100%
Multi-Family Common Area	Lighting Interior Other	Existing	100%	100%
Multi-Family Common Area	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Multi-Family Common Area	Lighting Interior Screw Base - Standard	Existing	100%	100%
Multi-Family Common Area	Other	Existing	100%	100%
Multi-Family Common Area	Other Plug Load	Existing	100%	100%
Multi-Family Common Area	Pool Pump	Existing	100%	100%
Multi-Family Common Area	Space Heat - Electric	Existing	0%	100%
Multi-Family Common Area	Vending Machines	Existing	6%	100%
Multi-Family Common Area	Ventilation And Circulation	Existing	100%	100%
Multi-Family Common Area	Water Heat GT 55 Gal	Existing	30%	6%
Multi-Family Common Area	Water Heat LE 55 Gal	Existing	70%	43%
Restaurant	Computers	Existing	100%	100%
Restaurant	Cooking	Existing	100%	29%
Restaurant	Cooling Chillers	Existing	2%	100%
Restaurant	Cooling Dx Evap	Existing	75%	100%
Restaurant	Fax	Existing	100%	100%
Restaurant	Flat Screen Monitors	Existing	100%	100%
Restaurant	Freezers	Existing	100%	100%
Restaurant	Heat Pump	Existing	0%	100%
Restaurant	Lighting Exterior	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Restaurant	Lighting Interior Fluorescent	Existing	100%	100%
Restaurant	Lighting Interior HID	Existing	100%	100%
Restaurant	Lighting Interior Other	Existing	100%	100%
Restaurant	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Restaurant	Lighting Interior Screw Base - Standard	Existing	100%	100%
Restaurant	Other	Existing	100%	100%
Restaurant	Other Plug Load	Existing	100%	100%
Restaurant	Photo Copiers	Existing	100%	100%
Restaurant	Printers	Existing	100%	100%
Restaurant	Refrigeration	Existing	100%	100%
Restaurant	Refrigerators	Existing	100%	100%
Restaurant	Room Cool	Existing	23%	100%
Restaurant	Room Heat - Electric	Existing	0%	100%
Restaurant	Servers	Existing	100%	100%
Restaurant	Space Heat - Electric	Existing	7%	100%
Restaurant	Vending Machines	Existing	100%	100%
Restaurant	Ventilation And Circulation	Existing	100%	100%
Restaurant	Water Heat GT 55 Gal	Existing	15%	100%
Restaurant	Water Heat LE 55 Gal	Existing	22%	100%
School - Private	Compressed Air	Existing	100%	100%
School - Private	Computers	Existing	100%	100%
School - Private	Cooking	Existing	100%	42%
School - Private	Cooling Chillers	Existing	15%	100%
School - Private	Cooling Dx Evap	Existing	81%	100%
School - Private	Fax	Existing	100%	100%
School - Private	Flat Screen Monitors	Existing	100%	100%
School - Private	Freezers	Existing	100%	100%
School - Private	Heat Pump	Existing	0%	100%
School - Private	Lighting Exterior	Existing	100%	100%
School - Private	Lighting Interior Fluorescent	Existing	100%	100%
School - Private	Lighting Interior HID	Existing	100%	100%
School - Private	Lighting Interior Other	Existing	100%	100%
School - Private	Lighting Interior Screw Base - Specialty	Existing	100%	100%
School - Private	Lighting Interior Screw Base - Standard	Existing	100%	100%
School - Private	Other	Existing	100%	100%
School - Private	Other Plug Load	Existing	100%	100%
School - Private	Photo Copiers	Existing	100%	100%
School - Private	Pool Pump	Existing	100%	100%
School - Private	Printers	Existing	100%	100%
School - Private	Refrigeration	Existing	100%	100%
School - Private	Refrigerators	Existing	100%	100%
School - Private	Room Cool	Existing	1%	100%
School - Private	Room Heat - Electric	Existing	1%	36%
School - Private	Servers	Existing	100%	100%
School - Private	Space Heat - Electric	Existing	49%	5%
School - Private	Vending Machines	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
School - Private	Ventilation And Circulation	Existing	100%	100%
School - Private	Water Heat GT 55 Gal	Existing	3%	17%
School - Private	Water Heat LE 55 Gal	Existing	97%	17%
School K-12 - Public	Compressed Air	Existing	100%	100%
School K-12 - Public	Computers	Existing	100%	100%
School K-12 - Public	Cooking	Existing	100%	42%
School K-12 - Public	Cooling Chillers	Existing	15%	100%
School K-12 - Public	Cooling Dx Evap	Existing	81%	100%
School K-12 - Public	Fax	Existing	100%	100%
School K-12 - Public	Flat Screen Monitors	Existing	100%	100%
School K-12 - Public	Freezers	Existing	100%	100%
School K-12 - Public	Heat Pump	Existing	0%	100%
School K-12 - Public	Lighting Exterior	Existing	100%	100%
School K-12 - Public	Lighting Interior Fluorescent	Existing	100%	100%
School K-12 - Public	Lighting Interior HID	Existing	100%	100%
School K-12 - Public	Lighting Interior Other	Existing	100%	100%
School K-12 - Public	Lighting Interior Screw Base - Specialty	Existing	100%	100%
School K-12 - Public	Lighting Interior Screw Base - Standard	Existing	100%	100%
School K-12 - Public	Other	Existing	100%	100%
School K-12 - Public	Other Plug Load	Existing	100%	100%
School K-12 - Public	Photo Copiers	Existing	100%	100%
School K-12 - Public	Pool Pump	Existing	100%	100%
School K-12 - Public	Printers	Existing	100%	100%
School K-12 - Public	Refrigeration	Existing	100%	100%
School K-12 - Public	Refrigerators	Existing	100%	100%
School K-12 - Public	Room Cool	Existing	1%	100%
School K-12 - Public	Room Heat - Electric	Existing	1%	36%
School K-12 - Public	Servers	Existing	100%	100%
School K-12 - Public	Space Heat - Electric	Existing	49%	5%
School K-12 - Public	Vending Machines	Existing	100%	100%
School K-12 - Public	Ventilation And Circulation	Existing	100%	100%
School K-12 - Public	Water Heat GT 55 Gal	Existing	3%	17%
School K-12 - Public	Water Heat LE 55 Gal	Existing	97%	17%
Small Office - Private	Computers	Existing	100%	100%
Small Office - Private	Cooling Chillers	Existing	8%	100%
Small Office - Private	Cooling Dx Evap	Existing	82%	100%
Small Office - Private	Fax	Existing	100%	100%
Small Office - Private	Flat Screen Monitors	Existing	100%	100%
Small Office - Private	Freezers	Existing	100%	100%
Small Office - Private	Heat Pump	Existing	2%	100%
Small Office - Private	Lighting Exterior	Existing	100%	100%
Small Office - Private	Lighting Interior Fluorescent	Existing	100%	100%
Small Office - Private	Lighting Interior HID	Existing	100%	100%
Small Office - Private	Lighting Interior Other	Existing	100%	100%
Small Office - Private	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Small Office - Private	Lighting Interior Screw Base - Standard	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Small Office - Private	Other	Existing	100%	100%
Small Office - Private	Other Plug Load	Existing	100%	100%
Small Office - Private	Photo Copiers	Existing	100%	100%
Small Office - Private	Printers	Existing	100%	100%
Small Office - Private	Refrigerators	Existing	100%	100%
Small Office - Private	Room Cool	Existing	10%	100%
Small Office - Private	Room Heat - Electric	Existing	5%	100%
Small Office - Private	Servers	Existing	100%	100%
Small Office - Private	Space Heat - Electric	Existing	2%	100%
Small Office - Private	Vending Machines	Existing	100%	100%
Small Office - Private	Ventilation And Circulation	Existing	100%	100%
Small Office - Private	Water Heat GT 55 Gal	Existing	4%	100%
Small Office - Private	Water Heat LE 55 Gal	Existing	49%	100%
Small Office - Public	Computers	Existing	100%	100%
Small Office - Public	Cooling Chillers	Existing	8%	100%
Small Office - Public	Cooling Dx Evap	Existing	82%	100%
Small Office - Public	Fax	Existing	100%	100%
Small Office - Public	Flat Screen Monitors	Existing	100%	100%
Small Office - Public	Freezers	Existing	100%	100%
Small Office - Public	Heat Pump	Existing	2%	100%
Small Office - Public	Lighting Exterior	Existing	100%	100%
Small Office - Public	Lighting Interior Fluorescent	Existing	100%	100%
Small Office - Public	Lighting Interior HID	Existing	100%	100%
Small Office - Public	Lighting Interior Other	Existing	100%	100%
Small Office - Public	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Small Office - Public	Lighting Interior Screw Base - Standard	Existing	100%	100%
Small Office - Public	Other	Existing	100%	100%
Small Office - Public	Other Plug Load	Existing	100%	100%
Small Office - Public	Photo Copiers	Existing	100%	100%
Small Office - Public	Printers	Existing	100%	100%
Small Office - Public	Refrigerators	Existing	100%	100%
Small Office - Public	Room Cool	Existing	10%	100%
Small Office - Public	Room Heat - Electric	Existing	5%	100%
Small Office - Public	Servers	Existing	100%	100%
Small Office - Public	Space Heat - Electric	Existing	2%	100%
Small Office - Public	Vending Machines	Existing	100%	100%
Small Office - Public	Ventilation And Circulation	Existing	100%	100%
Small Office - Public	Water Heat GT 55 Gal	Existing	4%	100%
Small Office - Public	Water Heat LE 55 Gal	Existing	49%	100%
Small Retail	Compressed Air	Existing	100%	100%
Small Retail	Computers	Existing	100%	100%
Small Retail	Cooling Chillers	Existing	0%	100%
Small Retail	Cooling Dx Evap	Existing	88%	100%
Small Retail	Dryer	Existing	100%	100%
Small Retail	Fax	Existing	100%	100%
Small Retail	Flat Screen Monitors	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Small Retail	Freezers	Existing	100%	100%
Small Retail	Heat Pump	Existing	0%	100%
Small Retail	Lighting Exterior	Existing	100%	100%
Small Retail	Lighting Interior Fluorescent	Existing	100%	100%
Small Retail	Lighting Interior HID	Existing	100%	100%
Small Retail	Lighting Interior Other	Existing	100%	100%
Small Retail	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Small Retail	Lighting Interior Screw Base - Standard	Existing	100%	100%
Small Retail	Other	Existing	100%	100%
Small Retail	Other Plug Load	Existing	100%	100%
Small Retail	Photo Copiers	Existing	100%	100%
Small Retail	Printers	Existing	100%	100%
Small Retail	Refrigerators	Existing	100%	100%
Small Retail	Room Cool	Existing	12%	100%
Small Retail	Room Heat - Electric	Existing	1%	100%
Small Retail	Servers	Existing	100%	100%
Small Retail	Space Heat - Electric	Existing	0%	100%
Small Retail	Vending Machines	Existing	100%	100%
Small Retail	Ventilation And Circulation	Existing	100%	100%
Small Retail	Water Heat GT 55 Gal	Existing	0%	100%
Small Retail	Water Heat LE 55 Gal	Existing	80%	100%
University - Public	Compressed Air	Existing	100%	100%
University - Public	Computers	Existing	100%	100%
University - Public	Cooking	Existing	100%	31%
University - Public	Cooling Chillers	Existing	92%	96%
University - Public	Cooling Dx Evap	Existing	8%	96%
University - Public	Dryer	Existing	100%	100%
University - Public	Fax	Existing	100%	100%
University - Public	Flat Screen Monitors	Existing	100%	100%
University - Public	Freezers	Existing	100%	100%
University - Public	Heat Pump	Existing	0%	100%
University - Public	Lighting Exterior	Existing	100%	100%
University - Public	Lighting Interior Fluorescent	Existing	100%	100%
University - Public	Lighting Interior HID	Existing	100%	100%
University - Public	Lighting Interior Other	Existing	100%	100%
University - Public	Lighting Interior Screw Base - Specialty	Existing	100%	100%
University - Public	Lighting Interior Screw Base - Standard	Existing	100%	100%
University - Public	Other	Existing	100%	100%
University - Public	Other Plug Load	Existing	100%	100%
University - Public	Photo Copiers	Existing	100%	100%
University - Public	Pool Pump	Existing	100%	100%
University - Public	Printers	Existing	100%	100%
University - Public	Refrigeration	Existing	100%	100%
University - Public	Refrigerators	Existing	100%	100%
University - Public	Room Cool	Existing	0%	100%
University - Public	Room Heat - Electric	Existing	0%	0%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
University - Public	Servers	Existing	100%	100%
University - Public	Space Heat - Electric	Existing	0%	0%
University - Public	Vending Machines	Existing	100%	100%
University - Public	Ventilation And Circulation	Existing	100%	100%
University - Public	Water Heat GT 55 Gal	Existing	3%	3%
University - Public	Water Heat LE 55 Gal	Existing	97%	3%
Warehouse	Compressed Air	Existing	100%	100%
Warehouse	Computers	Existing	100%	100%
Warehouse	Cooling Chillers	Existing	3%	100%
Warehouse	Cooling Dx Evap	Existing	83%	100%
Warehouse	Fax	Existing	100%	100%
Warehouse	Flat Screen Monitors	Existing	100%	100%
Warehouse	Freezers	Existing	100%	100%
Warehouse	Heat Pump	Existing	2%	100%
Warehouse	Lighting Exterior	Existing	100%	100%
Warehouse	Lighting Interior Fluorescent	Existing	100%	100%
Warehouse	Lighting Interior HID	Existing	100%	100%
Warehouse	Lighting Interior Other	Existing	100%	100%
Warehouse	Lighting Interior Screw Base - Specialty	Existing	100%	100%
Warehouse	Lighting Interior Screw Base - Standard	Existing	100%	100%
Warehouse	Other	Existing	100%	100%
Warehouse	Other Plug Load	Existing	100%	100%
Warehouse	Photo Copiers	Existing	100%	100%
Warehouse	Printers	Existing	100%	100%
Warehouse	Refrigerators	Existing	100%	100%
Warehouse	Room Cool	Existing	15%	100%
Warehouse	Room Heat - Electric	Existing	0%	100%
Warehouse	Servers	Existing	100%	100%
Warehouse	Space Heat - Electric	Existing	8%	100%
Warehouse	Vending Machines	Existing	100%	100%
Warehouse	Ventilation And Circulation	Existing	100%	100%
Warehouse	Water Heat GT 55 Gal	Existing	4%	100%
Warehouse	Water Heat LE 55 Gal	Existing	59%	100%
Assembly	Computers	New	100%	100%
Assembly	Cooking	New	100%	20%
Assembly	Cooling Chillers	New	15%	100%
Assembly	Cooling Dx Evap	New	75%	100%
Assembly	Fax	New	100%	100%
Assembly	Flat Screen Monitors	New	100%	100%
Assembly	Freezers	New	100%	100%
Assembly	Heat Pump	New	0%	100%
Assembly	Lighting Exterior	New	100%	100%
Assembly	Lighting Interior Other	New	100%	100%
Assembly	Other	New	100%	100%
Assembly	Other Plug Load	New	100%	100%
Assembly	Photo Copiers	New	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Assembly	Printers	New	100%	100%
Assembly	Refrigeration	New	100%	100%
Assembly	Refrigerators	New	100%	100%
Assembly	Room Cool	New	3%	100%
Assembly	Room Heat - Electric	New	0%	100%
Assembly	Servers	New	100%	100%
Assembly	Space Heat - Electric	New	12%	100%
Assembly	Vending Machines	New	100%	100%
Assembly	Ventilation And Circulation	New	100%	100%
Assembly	Water Heat GT 55 Gal	New	12%	100%
Assembly	Water Heat LE 55 Gal	New	23%	100%
Grocery	Computers	New	100%	100%
Grocery	Cooking	New	100%	55%
Grocery	Cooling Chillers	New	0%	100%
Grocery	Cooling Dx Evap	New	79%	100%
Grocery	Fax	New	100%	100%
Grocery	Flat Screen Monitors	New	100%	100%
Grocery	Freezers	New	100%	100%
Grocery	Heat Pump	New	0%	100%
Grocery	Lighting Exterior	New	100%	100%
Grocery	Lighting Interior Other	New	100%	100%
Grocery	Other	New	100%	100%
Grocery	Other Plug Load	New	100%	100%
Grocery	Photo Copiers	New	100%	100%
Grocery	Printers	New	100%	100%
Grocery	Refrigeration	New	100%	100%
Grocery	Refrigerators	New	100%	100%
Grocery	Room Cool	New	21%	100%
Grocery	Room Heat - Electric	New	2%	100%
Grocery	Servers	New	100%	100%
Grocery	Space Heat - Electric	New	5%	100%
Grocery	Vending Machines	New	100%	100%
Grocery	Ventilation And Circulation	New	100%	100%
Grocery	Water Heat GT 55 Gal	New	17%	100%
Grocery	Water Heat LE 55 Gal	New	28%	100%
Health Care Other	Computers	New	100%	100%
Health Care Other	Cooking	New	100%	42%
Health Care Other	Cooling Chillers	New	15%	99%
Health Care Other	Cooling Dx Evap	New	48%	99%
Health Care Other	Fax	New	100%	100%
Health Care Other	Flat Screen Monitors	New	100%	100%
Health Care Other	Freezers	New	100%	100%
Health Care Other	Heat Pump	New	5%	100%
Health Care Other	Lighting Exterior	New	100%	100%
Health Care Other	Lighting Interior Other	New	100%	100%
Health Care Other	Other	New	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Health Care Other	Other Plug Load	New	100%	100%
Health Care Other	Photo Copiers	New	100%	100%
Health Care Other	Printers	New	100%	100%
Health Care Other	Refrigeration	New	100%	100%
Health Care Other	Refrigerators	New	100%	100%
Health Care Other	Room Cool	New	28%	100%
Health Care Other	Room Heat - Electric	New	8%	80%
Health Care Other	Servers	New	100%	100%
Health Care Other	Space Heat - Electric	New	45%	7%
Health Care Other	Vending Machines	New	100%	100%
Health Care Other	Ventilation And Circulation	New	100%	100%
Health Care Other	Water Heat GT 55 Gal	New	17%	100%
Health Care Other	Water Heat LE 55 Gal	New	9%	100%
Hospital	Computers	New	100%	100%
Hospital	Cooking	New	100%	31%
Hospital	Cooling Chillers	New	75%	92%
Hospital	Cooling Dx Evap	New	25%	92%
Hospital	Dryer	New	100%	100%
Hospital	Fax	New	100%	100%
Hospital	Flat Screen Monitors	New	100%	100%
Hospital	Freezers	New	100%	100%
Hospital	Heat Pump	New	0%	100%
Hospital	Lighting Exterior	New	100%	100%
Hospital	Lighting Interior Other	New	100%	100%
Hospital	Other	New	100%	100%
Hospital	Other Plug Load	New	100%	100%
Hospital	Photo Copiers	New	100%	100%
Hospital	Printers	New	100%	100%
Hospital	Refrigeration	New	100%	100%
Hospital	Refrigerators	New	100%	100%
Hospital	Room Cool	New	0%	100%
Hospital	Room Heat - Electric	New	4%	13%
Hospital	Servers	New	100%	100%
Hospital	Space Heat - Electric	New	14%	13%
Hospital	Vending Machines	New	100%	100%
Hospital	Ventilation And Circulation	New	100%	100%
Hospital	Water Heat GT 55 Gal	New	0%	100%
Hospital	Water Heat LE 55 Gal	New	8%	100%
Large Office - Private	Compressed Air	New	100%	100%
Large Office - Private	Computers	New	100%	100%
Large Office - Private	Cooling Chillers	New	8%	100%
Large Office - Private	Cooling Dx Evap	New	82%	100%
Large Office - Private	Fax	New	100%	100%
Large Office - Private	Flat Screen Monitors	New	100%	100%
Large Office - Private	Freezers	New	100%	100%
Large Office - Private	Heat Pump	New	2%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Large Office - Private	Lighting Exterior	New	100%	100%
Large Office - Private	Lighting Interior Other	New	100%	100%
Large Office - Private	Other	New	100%	100%
Large Office - Private	Other Plug Load	New	100%	100%
Large Office - Private	Photo Copiers	New	100%	100%
Large Office - Private	Printers	New	100%	100%
Large Office - Private	Refrigerators	New	100%	100%
Large Office - Private	Room Cool	New	10%	100%
Large Office - Private	Room Heat - Electric	New	5%	100%
Large Office - Private	Servers	New	100%	100%
Large Office - Private	Space Heat - Electric	New	2%	100%
Large Office - Private	Vending Machines	New	100%	100%
Large Office - Private	Ventilation And Circulation	New	100%	100%
Large Office - Private	Water Heat GT 55 Gal	New	4%	100%
Large Office - Private	Water Heat LE 55 Gal	New	49%	100%
Large Office - Public	Compressed Air	New	100%	100%
Large Office - Public	Computers	New	100%	100%
Large Office - Public	Cooling Chillers	New	8%	100%
Large Office - Public	Cooling Dx Evap	New	82%	100%
Large Office - Public	Fax	New	100%	100%
Large Office - Public	Flat Screen Monitors	New	100%	100%
Large Office - Public	Freezers	New	100%	100%
Large Office - Public	Heat Pump	New	2%	100%
Large Office - Public	Lighting Exterior	New	100%	100%
Large Office - Public	Lighting Interior Other	New	100%	100%
Large Office - Public	Other	New	100%	100%
Large Office - Public	Other Plug Load	New	100%	100%
Large Office - Public	Photo Copiers	New	100%	100%
Large Office - Public	Printers	New	100%	100%
Large Office - Public	Refrigerators	New	100%	100%
Large Office - Public	Room Cool	New	10%	100%
Large Office - Public	Room Heat - Electric	New	5%	100%
Large Office - Public	Servers	New	100%	100%
Large Office - Public	Space Heat - Electric	New	2%	100%
Large Office - Public	Vending Machines	New	100%	100%
Large Office - Public	Ventilation And Circulation	New	100%	100%
Large Office - Public	Water Heat GT 55 Gal	New	4%	100%
Large Office - Public	Water Heat LE 55 Gal	New	49%	100%
Large Retail	Compressed Air	New	100%	100%
Large Retail	Computers	New	100%	100%
Large Retail	Cooking	New	100%	28%
Large Retail	Cooling Chillers	New	0%	100%
Large Retail	Cooling Dx Evap	New	88%	100%
Large Retail	Fax	New	100%	100%
Large Retail	Flat Screen Monitors	New	100%	100%
Large Retail	Freezers	New	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Large Retail	Heat Pump	New	0%	100%
Large Retail	Lighting Exterior	New	100%	100%
Large Retail	Lighting Interior Other	New	100%	100%
Large Retail	Other	New	100%	100%
Large Retail	Other Plug Load	New	100%	100%
Large Retail	Photo Copiers	New	100%	100%
Large Retail	Printers	New	100%	100%
Large Retail	Refrigeration	New	100%	100%
Large Retail	Refrigerators	New	100%	100%
Large Retail	Room Cool	New	12%	100%
Large Retail	Room Heat - Electric	New	1%	100%
Large Retail	Servers	New	100%	100%
Large Retail	Space Heat - Electric	New	0%	100%
Large Retail	Vending Machines	New	100%	100%
Large Retail	Ventilation And Circulation	New	100%	100%
Large Retail	Water Heat GT 55 Gal	New	0%	100%
Large Retail	Water Heat LE 55 Gal	New	80%	100%
Lodging	Computers	New	100%	100%
Lodging	Cooking	New	100%	43%
Lodging	Cooling Chillers	New	9%	100%
Lodging	Cooling Dx Evap	New	46%	100%
Lodging	Dryer	New	100%	100%
Lodging	Fax	New	100%	100%
Lodging	Flat Screen Monitors	New	100%	100%
Lodging	Freezers	New	100%	100%
Lodging	Heat Pump	New	3%	100%
Lodging	Lighting Exterior	New	100%	100%
Lodging	Lighting Interior Other	New	100%	100%
Lodging	Other	New	100%	100%
Lodging	Other Plug Load	New	100%	100%
Lodging	Package Terminal Ac	New	14%	100%
Lodging	Package Terminal HP	New	14%	100%
Lodging	Photo Copiers	New	100%	100%
Lodging	Pool Pump	New	100%	100%
Lodging	Printers	New	100%	100%
Lodging	Refrigeration	New	100%	100%
Lodging	Refrigerators	New	100%	100%
Lodging	Room Cool	New	31%	100%
Lodging	Room Heat - Electric	New	6%	100%
Lodging	Servers	New	100%	100%
Lodging	Space Heat - Electric	New	14%	100%
Lodging	Vending Machines	New	100%	100%
Lodging	Ventilation And Circulation	New	100%	100%
Lodging	Water Heat GT 55 Gal	New	18%	100%
Lodging	Water Heat LE 55 Gal	New	15%	100%
Miscellaneous - Private	Compressed Air	New	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Miscellaneous - Private	Computers	New	100%	100%
Miscellaneous - Private	Cooking	New	100%	63%
Miscellaneous - Private	Cooling Chillers	New	15%	100%
Miscellaneous - Private	Cooling Dx Evap	New	75%	100%
Miscellaneous - Private	Dryer	New	100%	100%
Miscellaneous - Private	Fax	New	100%	100%
Miscellaneous - Private	Flat Screen Monitors	New	100%	100%
Miscellaneous - Private	Freezers	New	100%	100%
Miscellaneous - Private	Heat Pump	New	0%	100%
Miscellaneous - Private	Lighting Exterior	New	100%	100%
Miscellaneous - Private	Lighting Interior Other	New	100%	100%
Miscellaneous - Private	Other	New	100%	100%
Miscellaneous - Private	Other Plug Load	New	100%	100%
Miscellaneous - Private	Package Terminal Ac	New	8%	100%
Miscellaneous - Private	Package Terminal HP	New	0%	100%
Miscellaneous - Private	Photo Copiers	New	100%	100%
Miscellaneous - Private	Pool Pump	New	100%	100%
Miscellaneous - Private	Printers	New	100%	100%
Miscellaneous - Private	Refrigeration	New	100%	100%
Miscellaneous - Private	Refrigerators	New	100%	100%
Miscellaneous - Private	Room Cool	New	3%	100%
Miscellaneous - Private	Room Heat - Electric	New	0%	100%
Miscellaneous - Private	Servers	New	100%	100%
Miscellaneous - Private	Space Heat - Electric	New	12%	100%
Miscellaneous - Private	Vending Machines	New	100%	100%
Miscellaneous - Private	Ventilation And Circulation	New	100%	100%
Miscellaneous - Private	Water Heat GT 55 Gal	New	12%	100%
Miscellaneous - Private	Water Heat LE 55 Gal	New	23%	100%
Miscellaneous - Public	Compressed Air	New	100%	100%
Miscellaneous - Public	Computers	New	100%	100%
Miscellaneous - Public	Cooking	New	100%	63%
Miscellaneous - Public	Cooling Chillers	New	15%	100%
Miscellaneous - Public	Cooling Dx Evap	New	75%	100%
Miscellaneous - Public	Dryer	New	100%	100%
Miscellaneous - Public	Fax	New	100%	100%
Miscellaneous - Public	Flat Screen Monitors	New	100%	100%
Miscellaneous - Public	Freezers	New	100%	100%
Miscellaneous - Public	Heat Pump	New	0%	100%
Miscellaneous - Public	Lighting Exterior	New	100%	100%
Miscellaneous - Public	Lighting Interior Other	New	100%	100%
Miscellaneous - Public	Other	New	100%	100%
Miscellaneous - Public	Other Plug Load	New	100%	100%
Miscellaneous - Public	Package Terminal Ac	New	8%	100%
Miscellaneous - Public	Package Terminal HP	New	0%	100%
Miscellaneous - Public	Photo Copiers	New	100%	100%
Miscellaneous - Public	Pool Pump	New	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Miscellaneous - Public	Printers	New	100%	100%
Miscellaneous - Public	Refrigeration	New	100%	100%
Miscellaneous - Public	Refrigerators	New	100%	100%
Miscellaneous - Public	Room Cool	New	3%	100%
Miscellaneous - Public	Room Heat - Electric	New	0%	100%
Miscellaneous - Public	Servers	New	100%	100%
Miscellaneous - Public	Space Heat - Electric	New	12%	100%
Miscellaneous - Public	Vending Machines	New	100%	100%
Miscellaneous - Public	Ventilation And Circulation	New	100%	100%
Miscellaneous - Public	Water Heat GT 55 Gal	New	12%	100%
Miscellaneous - Public	Water Heat LE 55 Gal	New	23%	100%
Multi-Family Common Area	Cooling Chillers	New	0%	100%
Multi-Family Common Area	Cooling Dx Evap	New	20%	100%
Multi-Family Common Area	Dryer	New	100%	100%
Multi-Family Common Area	Heat Pump	New	0%	100%
Multi-Family Common Area	Lighting Exterior	New	100%	100%
Multi-Family Common Area	Lighting Interior Other	New	100%	100%
Multi-Family Common Area	Other	New	100%	100%
Multi-Family Common Area	Other Plug Load	New	100%	100%
Multi-Family Common Area	Pool Pump	New	100%	100%
Multi-Family Common Area	Space Heat - Electric	New	0%	100%
Multi-Family Common Area	Vending Machines	New	6%	100%
Multi-Family Common Area	Ventilation And Circulation	New	100%	100%
Multi-Family Common Area	Water Heat GT 55 Gal	New	30%	6%
Multi-Family Common Area	Water Heat LE 55 Gal	New	70%	43%
Restaurant	Computers	New	100%	100%
Restaurant	Cooking	New	100%	29%
Restaurant	Cooling Chillers	New	2%	100%
Restaurant	Cooling Dx Evap	New	75%	100%
Restaurant	Fax	New	100%	100%
Restaurant	Flat Screen Monitors	New	100%	100%
Restaurant	Freezers	New	100%	100%
Restaurant	Heat Pump	New	0%	100%
Restaurant	Lighting Exterior	New	100%	100%
Restaurant	Lighting Interior Other	New	100%	100%
Restaurant	Other	New	100%	100%
Restaurant	Other Plug Load	New	100%	100%
Restaurant	Photo Copiers	New	100%	100%
Restaurant	Printers	New	100%	100%
Restaurant	Refrigeration	New	100%	100%
Restaurant	Refrigerators	New	100%	100%
Restaurant	Room Cool	New	23%	100%
Restaurant	Room Heat - Electric	New	0%	100%
Restaurant	Servers	New	100%	100%
Restaurant	Space Heat - Electric	New	7%	100%
Restaurant	Vending Machines	New	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Restaurant	Ventilation And Circulation	New	100%	100%
Restaurant	Water Heat GT 55 Gal	New	15%	100%
Restaurant	Water Heat LE 55 Gal	New	22%	100%
School - Private	Compressed Air	New	100%	100%
School - Private	Computers	New	100%	100%
School - Private	Cooking	New	100%	42%
School - Private	Cooling Chillers	New	15%	100%
School - Private	Cooling Dx Evap	New	81%	100%
School - Private	Fax	New	100%	100%
School - Private	Flat Screen Monitors	New	100%	100%
School - Private	Freezers	New	100%	100%
School - Private	Heat Pump	New	0%	100%
School - Private	Lighting Exterior	New	100%	100%
School - Private	Lighting Interior Other	New	100%	100%
School - Private	Other	New	100%	100%
School - Private	Other Plug Load	New	100%	100%
School - Private	Photo Copiers	New	100%	100%
School - Private	Pool Pump	New	100%	100%
School - Private	Printers	New	100%	100%
School - Private	Refrigeration	New	100%	100%
School - Private	Refrigerators	New	100%	100%
School - Private	Room Cool	New	1%	100%
School - Private	Room Heat - Electric	New	1%	36%
School - Private	Servers	New	100%	100%
School - Private	Space Heat - Electric	New	49%	5%
School - Private	Vending Machines	New	100%	100%
School - Private	Ventilation And Circulation	New	100%	100%
School - Private	Water Heat GT 55 Gal	New	3%	17%
School - Private	Water Heat LE 55 Gal	New	97%	17%
School K-12 - Public	Compressed Air	New	100%	100%
School K-12 - Public	Computers	New	100%	100%
School K-12 - Public	Cooking	New	100%	42%
School K-12 - Public	Cooling Chillers	New	15%	100%
School K-12 - Public	Cooling Dx Evap	New	81%	100%
School K-12 - Public	Fax	New	100%	100%
School K-12 - Public	Flat Screen Monitors	New	100%	100%
School K-12 - Public	Freezers	New	100%	100%
School K-12 - Public	Heat Pump	New	0%	100%
School K-12 - Public	Lighting Exterior	New	100%	100%
School K-12 - Public	Lighting Interior Other	New	100%	100%
School K-12 - Public	Other	New	100%	100%
School K-12 - Public	Other Plug Load	New	100%	100%
School K-12 - Public	Photo Copiers	New	100%	100%
School K-12 - Public	Pool Pump	New	100%	100%
School K-12 - Public	Printers	New	100%	100%
School K-12 - Public	Refrigeration	New	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
School K-12 - Public	Refrigerators	New	100%	100%
School K-12 - Public	Room Cool	New	1%	100%
School K-12 - Public	Room Heat - Electric	New	1%	36%
School K-12 - Public	Servers	New	100%	100%
School K-12 - Public	Space Heat - Electric	New	49%	5%
School K-12 - Public	Vending Machines	New	100%	100%
School K-12 - Public	Ventilation And Circulation	New	100%	100%
School K-12 - Public	Water Heat GT 55 Gal	New	3%	17%
School K-12 - Public	Water Heat LE 55 Gal	New	97%	17%
Small Office - Private	Computers	New	100%	100%
Small Office - Private	Cooling Chillers	New	8%	100%
Small Office - Private	Cooling Dx Evap	New	82%	100%
Small Office - Private	Fax	New	100%	100%
Small Office - Private	Flat Screen Monitors	New	100%	100%
Small Office - Private	Freezers	New	100%	100%
Small Office - Private	Heat Pump	New	2%	100%
Small Office - Private	Lighting Exterior	New	100%	100%
Small Office - Private	Lighting Interior Other	New	100%	100%
Small Office - Private	Other	New	100%	100%
Small Office - Private	Other Plug Load	New	100%	100%
Small Office - Private	Photo Copiers	New	100%	100%
Small Office - Private	Printers	New	100%	100%
Small Office - Private	Refrigerators	New	100%	100%
Small Office - Private	Room Cool	New	10%	100%
Small Office - Private	Room Heat - Electric	New	5%	100%
Small Office - Private	Servers	New	100%	100%
Small Office - Private	Space Heat - Electric	New	2%	100%
Small Office - Private	Vending Machines	New	100%	100%
Small Office - Private	Ventilation And Circulation	New	100%	100%
Small Office - Private	Water Heat GT 55 Gal	New	4%	100%
Small Office - Private	Water Heat LE 55 Gal	New	49%	100%
Small Office - Public	Computers	New	100%	100%
Small Office - Public	Cooling Chillers	New	8%	100%
Small Office - Public	Cooling Dx Evap	New	82%	100%
Small Office - Public	Fax	New	100%	100%
Small Office - Public	Flat Screen Monitors	New	100%	100%
Small Office - Public	Freezers	New	100%	100%
Small Office - Public	Heat Pump	New	2%	100%
Small Office - Public	Lighting Exterior	New	100%	100%
Small Office - Public	Lighting Interior Other	New	100%	100%
Small Office - Public	Other	New	100%	100%
Small Office - Public	Other Plug Load	New	100%	100%
Small Office - Public	Photo Copiers	New	100%	100%
Small Office - Public	Printers	New	100%	100%
Small Office - Public	Refrigerators	New	100%	100%
Small Office - Public	Room Cool	New	10%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Small Office - Public	Room Heat - Electric	New	5%	100%
Small Office - Public	Servers	New	100%	100%
Small Office - Public	Space Heat - Electric	New	2%	100%
Small Office - Public	Vending Machines	New	100%	100%
Small Office - Public	Ventilation And Circulation	New	100%	100%
Small Office - Public	Water Heat GT 55 Gal	New	4%	100%
Small Office - Public	Water Heat LE 55 Gal	New	49%	100%
Small Retail	Compressed Air	New	100%	100%
Small Retail	Computers	New	100%	100%
Small Retail	Cooling Chillers	New	0%	100%
Small Retail	Cooling Dx Evap	New	88%	100%
Small Retail	Dryer	New	100%	100%
Small Retail	Fax	New	100%	100%
Small Retail	Flat Screen Monitors	New	100%	100%
Small Retail	Freezers	New	100%	100%
Small Retail	Heat Pump	New	0%	100%
Small Retail	Lighting Exterior	New	100%	100%
Small Retail	Lighting Interior Other	New	100%	100%
Small Retail	Other	New	100%	100%
Small Retail	Other Plug Load	New	100%	100%
Small Retail	Photo Copiers	New	100%	100%
Small Retail	Printers	New	100%	100%
Small Retail	Refrigerators	New	100%	100%
Small Retail	Room Cool	New	12%	100%
Small Retail	Room Heat - Electric	New	1%	100%
Small Retail	Servers	New	100%	100%
Small Retail	Space Heat - Electric	New	0%	100%
Small Retail	Vending Machines	New	100%	100%
Small Retail	Ventilation And Circulation	New	100%	100%
Small Retail	Water Heat GT 55 Gal	New	0%	100%
Small Retail	Water Heat LE 55 Gal	New	80%	100%
University - Public	Compressed Air	New	100%	100%
University - Public	Computers	New	100%	100%
University - Public	Cooking	New	100%	31%
University - Public	Cooling Chillers	New	92%	96%
University - Public	Cooling Dx Evap	New	8%	96%
University - Public	Dryer	New	100%	100%
University - Public	Fax	New	100%	100%
University - Public	Flat Screen Monitors	New	100%	100%
University - Public	Freezers	New	100%	100%
University - Public	Heat Pump	New	0%	100%
University - Public	Lighting Exterior	New	100%	100%
University - Public	Lighting Interior Other	New	100%	100%
University - Public	Other	New	100%	100%
University - Public	Other Plug Load	New	100%	100%
University - Public	Photo Copiers	New	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
University - Public	Pool Pump	New	100%	100%
University - Public	Printers	New	100%	100%
University - Public	Refrigeration	New	100%	100%
University - Public	Refrigerators	New	100%	100%
University - Public	Room Cool	New	0%	100%
University - Public	Room Heat - Electric	New	0%	0%
University - Public	Servers	New	100%	100%
University - Public	Space Heat - Electric	New	0%	0%
University - Public	Vending Machines	New	100%	100%
University - Public	Ventilation And Circulation	New	100%	100%
University - Public	Water Heat GT 55 Gal	New	3%	3%
University - Public	Water Heat LE 55 Gal	New	97%	3%
Warehouse	Compressed Air	New	100%	100%
Warehouse	Computers	New	100%	100%
Warehouse	Cooling Chillers	New	3%	100%
Warehouse	Cooling Dx Evap	New	83%	100%
Warehouse	Fax	New	100%	100%
Warehouse	Flat Screen Monitors	New	100%	100%
Warehouse	Freezers	New	100%	100%
Warehouse	Heat Pump	New	2%	100%
Warehouse	Lighting Exterior	New	100%	100%
Warehouse	Lighting Interior Other	New	100%	100%
Warehouse	Other	New	100%	100%
Warehouse	Other Plug Load	New	100%	100%
Warehouse	Photo Copiers	New	100%	100%
Warehouse	Printers	New	100%	100%
Warehouse	Refrigerators	New	100%	100%
Warehouse	Room Cool	New	15%	100%
Warehouse	Room Heat - Electric	New	0%	100%
Warehouse	Servers	New	100%	100%
Warehouse	Space Heat - Electric	New	8%	100%
Warehouse	Vending Machines	New	100%	100%
Warehouse	Ventilation And Circulation	New	100%	100%
Warehouse	Water Heat GT 55 Gal	New	4%	100%
Warehouse	Water Heat LE 55 Gal	New	59%	100%

Figure C-7. Commercial Baseline Forecast by Segment – Natural Gas

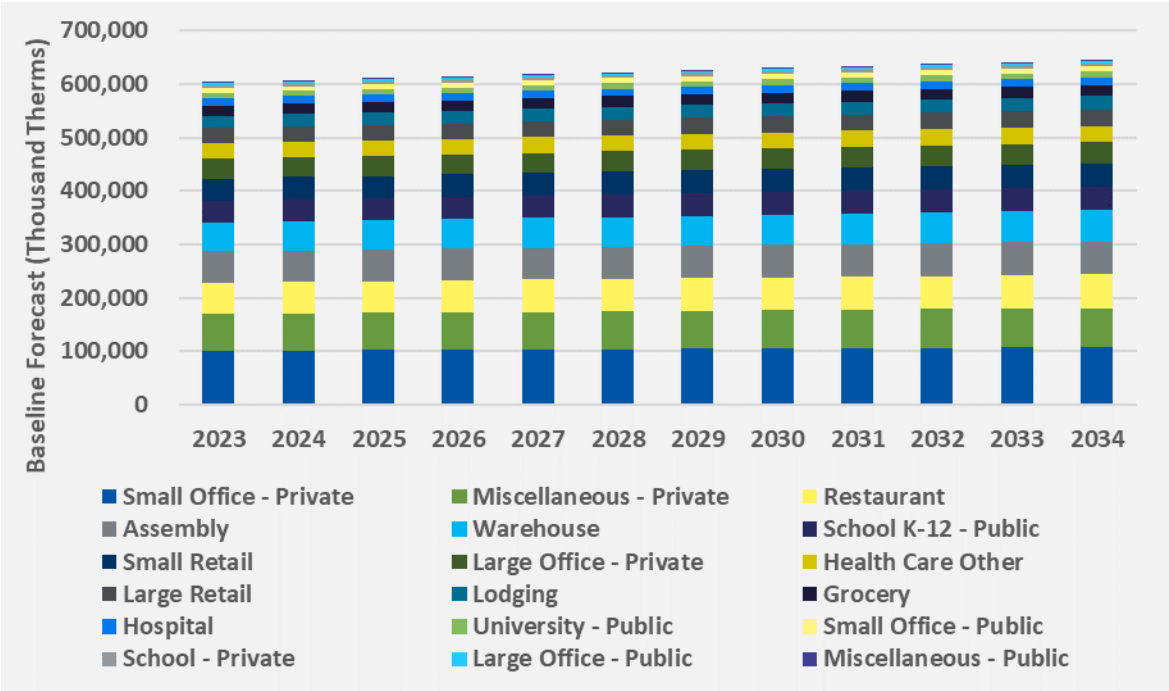


Figure C-8. Commercial Baseline Forecast by End Use Group – Natural Gas

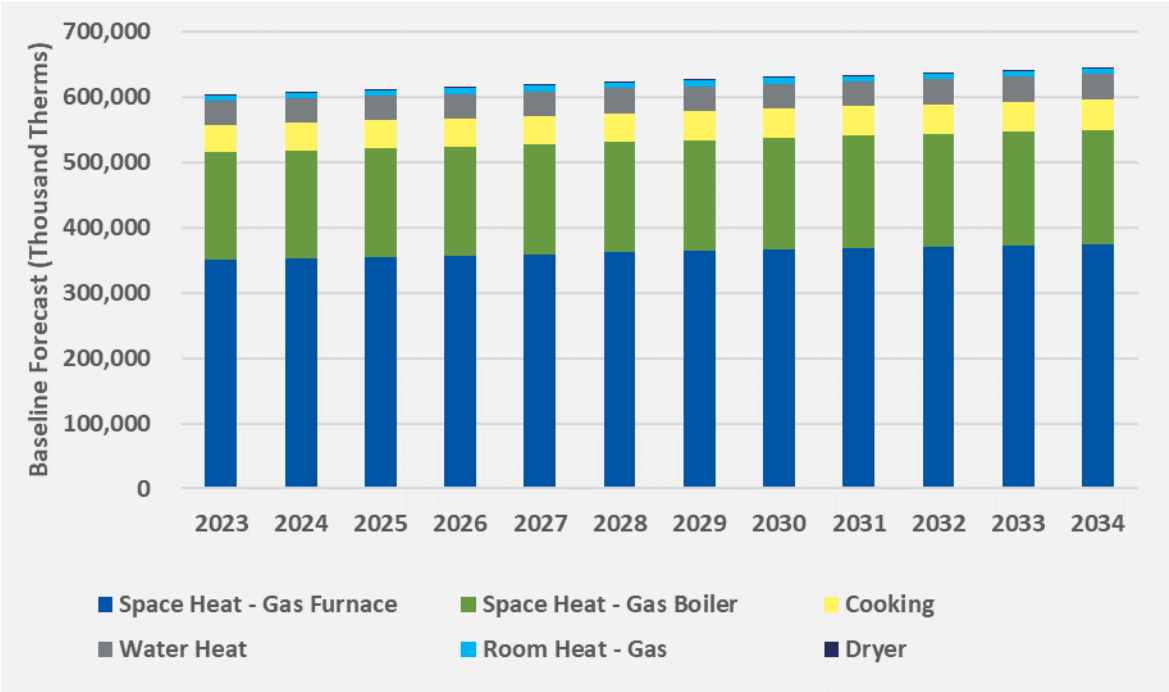


Table C-4. Commercial Baseline Assumptions – Natural Gas

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Assembly	Cooking	Existing	100%	84%
Assembly	Cooking	New	100%	84%
Grocery	Cooking	Existing	100%	68%
Grocery	Cooking	New	100%	68%
Health Care Other	Cooking	Existing	100%	57%
Health Care Other	Cooking	New	100%	57%
Hospital	Cooking	Existing	100%	61%
Hospital	Cooking	New	100%	61%
Large Retail	Cooking	Existing	100%	72%
Large Retail	Cooking	New	100%	72%
Lodging	Cooking	Existing	100%	57%
Lodging	Cooking	New	100%	57%
Miscellaneous - Private	Cooking	Existing	100%	34%
Miscellaneous - Private	Cooking	New	100%	34%
Miscellaneous - Public	Cooking	Existing	100%	34%
Miscellaneous - Public	Cooking	New	100%	34%
Restaurant	Cooking	Existing	100%	71%
Restaurant	Cooking	New	100%	71%
School - Private	Cooking	Existing	100%	60%
School - Private	Cooking	New	100%	60%
School K-12 - Public	Cooking	Existing	100%	60%
School K-12 - Public	Cooking	New	100%	60%
University - Public	Cooking	Existing	100%	70%
University - Public	Cooking	New	100%	70%
Hospital	Dryer	Existing	100%	100%
Hospital	Dryer	New	100%	100%
Lodging	Dryer	Existing	100%	100%
Lodging	Dryer	New	100%	100%
Miscellaneous - Private	Dryer	Existing	100%	100%
Miscellaneous - Private	Dryer	New	100%	100%
Miscellaneous - Public	Dryer	Existing	100%	100%
Miscellaneous - Public	Dryer	New	100%	100%
Multi-Family Common Area	Dryer	Existing	100%	100%
Multi-Family Common Area	Dryer	New	100%	100%
Small Retail	Dryer	Existing	100%	100%
Small Retail	Dryer	New	100%	100%
University - Public	Dryer	Existing	100%	100%
University - Public	Dryer	New	100%	100%
Assembly	Other	Existing	100%	100%
Assembly	Other	New	100%	100%
Grocery	Other	Existing	100%	100%
Grocery	Other	New	100%	100%
Health Care Other	Other	Existing	100%	100%
Health Care Other	Other	New	100%	100%
Hospital	Other	Existing	100%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Hospital	Other	New	100%	100%
Large Office - Private	Other	Existing	100%	100%
Large Office - Private	Other	New	100%	100%
Large Office - Public	Other	Existing	100%	100%
Large Office - Public	Other	New	100%	100%
Large Retail	Other	Existing	100%	100%
Large Retail	Other	New	100%	100%
Lodging	Other	Existing	100%	100%
Lodging	Other	New	100%	100%
Miscellaneous - Private	Other	Existing	100%	100%
Miscellaneous - Private	Other	New	100%	100%
Miscellaneous - Public	Other	Existing	100%	100%
Miscellaneous - Public	Other	New	100%	100%
Multi-Family Common Area	Other	Existing	100%	100%
Multi-Family Common Area	Other	New	100%	100%
Restaurant	Other	Existing	100%	100%
Restaurant	Other	New	100%	100%
School - Private	Other	Existing	100%	100%
School - Private	Other	New	100%	100%
School K-12 - Public	Other	Existing	100%	100%
School K-12 - Public	Other	New	100%	100%
Small Office - Private	Other	Existing	100%	100%
Small Office - Private	Other	New	100%	100%
Small Office - Public	Other	Existing	100%	100%
Small Office - Public	Other	New	100%	100%
Small Retail	Other	Existing	100%	100%
Small Retail	Other	New	100%	100%
University - Public	Other	Existing	100%	100%
University - Public	Other	New	100%	100%
Warehouse	Other	Existing	100%	100%
Warehouse	Other	New	100%	100%
Lodging	Pool Heat	Existing	100%	100%
Lodging	Pool Heat	New	100%	100%
Miscellaneous - Private	Pool Heat	Existing	100%	100%
Miscellaneous - Private	Pool Heat	New	100%	100%
Miscellaneous - Public	Pool Heat	Existing	100%	100%
Miscellaneous - Public	Pool Heat	New	100%	100%
Multi-Family Common Area	Pool Heat	Existing	100%	100%
Multi-Family Common Area	Pool Heat	New	100%	100%
School - Private	Pool Heat	Existing	100%	100%
School - Private	Pool Heat	New	100%	100%
School K-12 - Public	Pool Heat	Existing	100%	100%
School K-12 - Public	Pool Heat	New	100%	100%
University - Public	Pool Heat	Existing	100%	100%
University - Public	Pool Heat	New	100%	100%
Assembly	Room Heat - Gas	Existing	3%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Assembly	Room Heat - Gas	New	3%	100%
Grocery	Room Heat - Gas	Existing	0%	100%
Grocery	Room Heat - Gas	New	0%	100%
Health Care Other	Room Heat - Gas	Existing	8%	20%
Health Care Other	Room Heat - Gas	New	8%	20%
Hospital	Room Heat - Gas	Existing	4%	75%
Hospital	Room Heat - Gas	New	4%	75%
Large Office - Private	Room Heat - Gas	Existing	4%	100%
Large Office - Private	Room Heat - Gas	New	4%	100%
Large Office - Public	Room Heat - Gas	Existing	4%	100%
Large Office - Public	Room Heat - Gas	New	4%	100%
Large Retail	Room Heat - Gas	Existing	2%	100%
Large Retail	Room Heat - Gas	New	2%	100%
Lodging	Room Heat - Gas	Existing	4%	100%
Lodging	Room Heat - Gas	New	4%	100%
Miscellaneous - Private	Room Heat - Gas	Existing	3%	100%
Miscellaneous - Private	Room Heat - Gas	New	3%	100%
Miscellaneous - Public	Room Heat - Gas	Existing	3%	100%
Miscellaneous - Public	Room Heat - Gas	New	3%	100%
Restaurant	Room Heat - Gas	Existing	0%	100%
Restaurant	Room Heat - Gas	New	0%	100%
School - Private	Room Heat - Gas	Existing	1%	64%
School - Private	Room Heat - Gas	New	1%	64%
School K-12 - Public	Room Heat - Gas	Existing	1%	64%
School K-12 - Public	Room Heat - Gas	New	1%	64%
Small Office - Private	Room Heat - Gas	Existing	4%	100%
Small Office - Private	Room Heat - Gas	New	4%	100%
Small Office - Public	Room Heat - Gas	Existing	4%	100%
Small Office - Public	Room Heat - Gas	New	4%	100%
Small Retail	Room Heat - Gas	Existing	2%	100%
Small Retail	Room Heat - Gas	New	2%	100%
University - Public	Room Heat - Gas	Existing	0%	83%
University - Public	Room Heat - Gas	New	0%	83%
Warehouse	Room Heat - Gas	Existing	3%	100%
Warehouse	Room Heat - Gas	New	3%	100%
Assembly	Space Heat - Gas Boiler	Existing	31%	100%
Assembly	Space Heat - Gas Boiler	New	31%	100%
Grocery	Space Heat - Gas Boiler	Existing	14%	100%
Grocery	Space Heat - Gas Boiler	New	14%	100%
Health Care Other	Space Heat - Gas Boiler	Existing	42%	100%
Health Care Other	Space Heat - Gas Boiler	New	42%	100%
Hospital	Space Heat - Gas Boiler	Existing	82%	100%
Hospital	Space Heat - Gas Boiler	New	82%	100%
Large Office - Private	Space Heat - Gas Boiler	Existing	31%	100%
Large Office - Private	Space Heat - Gas Boiler	New	31%	100%
Large Office - Public	Space Heat - Gas Boiler	Existing	31%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Large Office - Public	Space Heat - Gas Boiler	New	31%	100%
Large Retail	Space Heat - Gas Boiler	Existing	12%	100%
Large Retail	Space Heat - Gas Boiler	New	12%	100%
Lodging	Space Heat - Gas Boiler	Existing	22%	100%
Lodging	Space Heat - Gas Boiler	New	22%	100%
Miscellaneous - Private	Space Heat - Gas Boiler	Existing	31%	100%
Miscellaneous - Private	Space Heat - Gas Boiler	New	31%	100%
Miscellaneous - Public	Space Heat - Gas Boiler	Existing	31%	100%
Miscellaneous - Public	Space Heat - Gas Boiler	New	31%	100%
Multi-Family Common Area	Space Heat - Gas Boiler	Existing	62%	100%
Multi-Family Common Area	Space Heat - Gas Boiler	New	62%	100%
Restaurant	Space Heat - Gas Boiler	Existing	7%	100%
Restaurant	Space Heat - Gas Boiler	New	7%	100%
School - Private	Space Heat - Gas Boiler	Existing	50%	100%
School - Private	Space Heat - Gas Boiler	New	50%	100%
School K-12 - Public	Space Heat - Gas Boiler	Existing	50%	100%
School K-12 - Public	Space Heat - Gas Boiler	New	50%	100%
Small Office - Private	Space Heat - Gas Boiler	Existing	31%	100%
Small Office - Private	Space Heat - Gas Boiler	New	31%	100%
Small Office - Public	Space Heat - Gas Boiler	Existing	31%	100%
Small Office - Public	Space Heat - Gas Boiler	New	31%	100%
Small Retail	Space Heat - Gas Boiler	Existing	12%	100%
Small Retail	Space Heat - Gas Boiler	New	12%	100%
University - Public	Space Heat - Gas Boiler	Existing	100%	100%
University - Public	Space Heat - Gas Boiler	New	100%	100%
Warehouse	Space Heat - Gas Boiler	Existing	5%	100%
Warehouse	Space Heat - Gas Boiler	New	5%	100%
Assembly	Space Heat - Gas Furnace	Existing	59%	100%
Assembly	Space Heat - Gas Furnace	New	59%	100%
Grocery	Space Heat - Gas Furnace	Existing	82%	100%
Grocery	Space Heat - Gas Furnace	New	82%	100%
Health Care Other	Space Heat - Gas Furnace	Existing	45%	93%
Health Care Other	Space Heat - Gas Furnace	New	45%	93%
Hospital	Space Heat - Gas Furnace	Existing	14%	75%
Hospital	Space Heat - Gas Furnace	New	14%	75%
Large Office - Private	Space Heat - Gas Furnace	Existing	56%	100%
Large Office - Private	Space Heat - Gas Furnace	New	56%	100%
Large Office - Public	Space Heat - Gas Furnace	Existing	56%	100%
Large Office - Public	Space Heat - Gas Furnace	New	56%	100%
Large Retail	Space Heat - Gas Furnace	Existing	80%	100%
Large Retail	Space Heat - Gas Furnace	New	80%	100%
Lodging	Space Heat - Gas Furnace	Existing	51%	100%
Lodging	Space Heat - Gas Furnace	New	51%	100%
Miscellaneous - Private	Space Heat - Gas Furnace	Existing	59%	100%
Miscellaneous - Private	Space Heat - Gas Furnace	New	59%	100%
Miscellaneous - Public	Space Heat - Gas Furnace	Existing	59%	100%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
Miscellaneous - Public	Space Heat - Gas Furnace	New	59%	100%
Multi-Family Common Area	Space Heat - Gas Furnace	Existing	19%	100%
Multi-Family Common Area	Space Heat - Gas Furnace	New	19%	100%
Restaurant	Space Heat - Gas Furnace	Existing	82%	100%
Restaurant	Space Heat - Gas Furnace	New	82%	100%
School - Private	Space Heat - Gas Furnace	Existing	49%	95%
School - Private	Space Heat - Gas Furnace	New	49%	95%
School K-12 - Public	Space Heat - Gas Furnace	Existing	49%	95%
School K-12 - Public	Space Heat - Gas Furnace	New	49%	95%
Small Office - Private	Space Heat - Gas Furnace	Existing	56%	100%
Small Office - Private	Space Heat - Gas Furnace	New	56%	100%
Small Office - Public	Space Heat - Gas Furnace	Existing	56%	100%
Small Office - Public	Space Heat - Gas Furnace	New	56%	100%
Small Retail	Space Heat - Gas Furnace	Existing	80%	100%
Small Retail	Space Heat - Gas Furnace	New	80%	100%
University - Public	Space Heat - Gas Furnace	Existing	0%	83%
University - Public	Space Heat - Gas Furnace	New	0%	83%
Warehouse	Space Heat - Gas Furnace	Existing	88%	100%
Warehouse	Space Heat - Gas Furnace	New	88%	100%
Assembly	Water Heat GT 55 Gal	Existing	41%	100%
Assembly	Water Heat GT 55 Gal	New	41%	100%
Grocery	Water Heat GT 55 Gal	Existing	32%	100%
Grocery	Water Heat GT 55 Gal	New	32%	100%
Health Care Other	Water Heat GT 55 Gal	Existing	72%	100%
Health Care Other	Water Heat GT 55 Gal	New	72%	100%
Hospital	Water Heat GT 55 Gal	Existing	63%	100%
Hospital	Water Heat GT 55 Gal	New	63%	100%
Large Office - Private	Water Heat GT 55 Gal	Existing	19%	100%
Large Office - Private	Water Heat GT 55 Gal	New	19%	100%
Large Office - Public	Water Heat GT 55 Gal	Existing	19%	100%
Large Office - Public	Water Heat GT 55 Gal	New	19%	100%
Large Retail	Water Heat GT 55 Gal	Existing	0%	100%
Large Retail	Water Heat GT 55 Gal	New	0%	100%
Lodging	Water Heat GT 55 Gal	Existing	57%	100%
Lodging	Water Heat GT 55 Gal	New	57%	100%
Miscellaneous - Private	Water Heat GT 55 Gal	Existing	41%	100%
Miscellaneous - Private	Water Heat GT 55 Gal	New	41%	100%
Miscellaneous - Public	Water Heat GT 55 Gal	Existing	41%	100%
Miscellaneous - Public	Water Heat GT 55 Gal	New	41%	100%
Multi-Family Common Area	Water Heat GT 55 Gal	Existing	30%	100%
Multi-Family Common Area	Water Heat GT 55 Gal	New	30%	100%
Restaurant	Water Heat GT 55 Gal	Existing	43%	100%
Restaurant	Water Heat GT 55 Gal	New	43%	100%
School - Private	Water Heat GT 55 Gal	Existing	87%	79%
School - Private	Water Heat GT 55 Gal	New	87%	79%
School K-12 - Public	Water Heat GT 55 Gal	Existing	87%	79%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
School K-12 - Public	Water Heat GT 55 Gal	New	87%	79%
Small Office - Private	Water Heat GT 55 Gal	Existing	19%	100%
Small Office - Private	Water Heat GT 55 Gal	New	19%	100%
Small Office - Public	Water Heat GT 55 Gal	Existing	19%	100%
Small Office - Public	Water Heat GT 55 Gal	New	19%	100%
Small Retail	Water Heat GT 55 Gal	Existing	0%	100%
Small Retail	Water Heat GT 55 Gal	New	0%	100%
University - Public	Water Heat GT 55 Gal	Existing	87%	81%
University - Public	Water Heat GT 55 Gal	New	87%	81%
Warehouse	Water Heat GT 55 Gal	Existing	10%	100%
Warehouse	Water Heat GT 55 Gal	New	10%	100%
Assembly	Water Heat LE 55 Gal	Existing	31%	100%
Assembly	Water Heat LE 55 Gal	New	31%	100%
Grocery	Water Heat LE 55 Gal	Existing	28%	100%
Grocery	Water Heat LE 55 Gal	New	28%	100%
Health Care Other	Water Heat LE 55 Gal	Existing	2%	100%
Health Care Other	Water Heat LE 55 Gal	New	2%	100%
Hospital	Water Heat LE 55 Gal	Existing	29%	100%
Hospital	Water Heat LE 55 Gal	New	29%	100%
Large Office - Private	Water Heat LE 55 Gal	Existing	28%	100%
Large Office - Private	Water Heat LE 55 Gal	New	28%	100%
Large Office - Public	Water Heat LE 55 Gal	Existing	28%	100%
Large Office - Public	Water Heat LE 55 Gal	New	28%	100%
Large Retail	Water Heat LE 55 Gal	Existing	20%	100%
Large Retail	Water Heat LE 55 Gal	New	20%	100%
Lodging	Water Heat LE 55 Gal	Existing	11%	100%
Lodging	Water Heat LE 55 Gal	New	11%	100%
Miscellaneous - Private	Water Heat LE 55 Gal	Existing	31%	100%
Miscellaneous - Private	Water Heat LE 55 Gal	New	31%	100%
Miscellaneous - Public	Water Heat LE 55 Gal	Existing	31%	100%
Miscellaneous - Public	Water Heat LE 55 Gal	New	31%	100%
Multi-Family Common Area	Water Heat LE 55 Gal	Existing	70%	80%
Multi-Family Common Area	Water Heat LE 55 Gal	New	70%	80%
Restaurant	Water Heat LE 55 Gal	Existing	20%	100%
Restaurant	Water Heat LE 55 Gal	New	20%	100%
School - Private	Water Heat LE 55 Gal	Existing	13%	79%
School - Private	Water Heat LE 55 Gal	New	13%	79%
School K-12 - Public	Water Heat LE 55 Gal	Existing	13%	79%
School K-12 - Public	Water Heat LE 55 Gal	New	13%	79%
Small Office - Private	Water Heat LE 55 Gal	Existing	28%	100%
Small Office - Private	Water Heat LE 55 Gal	New	28%	100%
Small Office - Public	Water Heat LE 55 Gal	Existing	28%	100%
Small Office - Public	Water Heat LE 55 Gal	New	28%	100%
Small Retail	Water Heat LE 55 Gal	Existing	20%	100%
Small Retail	Water Heat LE 55 Gal	New	20%	100%
University - Public	Water Heat LE 55 Gal	Existing	13%	81%

Segment	End Use	Construction Vintage	Saturation	Fuel Share
University - Public	Water Heat LE 55 Gal	New	13%	81%
Warehouse	Water Heat LE 55 Gal	Existing	32%	100%
Warehouse	Water Heat LE 55 Gal	New	32%	100%

Figure C-9. Industrial Baseline Forecast by Segment – Electric

Industrial Segment	Baseline Forecast (GWh)											
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Paper Mfg	4,159	4,196	4,223	4,254	4,283	4,319	4,346	4,375	4,406	4,439	4,468	4,499
Food Mfg	3,913	3,947	3,973	4,002	4,030	4,063	4,089	4,116	4,145	4,176	4,204	4,233
Fabricated Metal Products	2,686	2,710	2,727	2,747	2,766	2,789	2,807	2,826	2,846	2,867	2,886	2,906
Miscellaneous Mfg	2,372	2,393	2,408	2,426	2,443	2,463	2,479	2,495	2,513	2,532	2,548	2,566
Plastics Rubber Products	2,013	2,031	2,044	2,059	2,073	2,091	2,104	2,118	2,133	2,149	2,163	2,178
Primary Metal Mfg	1,793	1,809	1,821	1,834	1,847	1,862	1,874	1,886	1,900	1,914	1,926	1,940
Industrial Machinery	1,618	1,632	1,643	1,655	1,666	1,680	1,691	1,702	1,714	1,727	1,738	1,750
Chemical Mfg	1,614	1,628	1,638	1,650	1,662	1,676	1,686	1,698	1,710	1,722	1,734	1,746
Printing Related Support	1,133	1,144	1,151	1,159	1,167	1,177	1,185	1,193	1,201	1,210	1,218	1,226
Transportation Equipment Mfg	692	698	703	708	713	719	724	728	733	739	744	749
Electrical Equipment Mfg	663	669	673	678	683	688	693	697	702	708	712	717
Petroleum Coal Products	553	558	562	566	570	575	578	582	586	591	594	599
Nonmetallic Mineral Products	443	447	450	453	456	460	463	466	469	473	476	479
Wastewater	414	418	421	424	427	430	433	436	439	442	445	448
Wood Product Mfg	396	399	402	405	408	411	414	416	419	422	425	428
Beverage and Tobacco Mfg	301	304	306	308	310	313	315	317	319	321	324	326
Water	282	284	286	288	290	292	294	296	298	301	302	305
Mining	159	161	162	163	164	166	167	168	169	170	171	172
Furniture Mfg	128	129	130	131	132	133	134	135	136	137	138	138
Computer and Electronic Mfg	73	74	75	75	76	76	77	77	78	78	79	79
Textile Mills	62	62	63	63	64	64	65	65	66	66	66	67
Street Lighting	57	57	58	58	58	59	59	60	60	61	61	61
Apparel	42	42	42	43	43	43	44	44	44	45	45	45
Leather Mfg	19	19	20	20	20	20	20	20	20	21	21	21
Textile Product Mills	12	12	12	13	13	13	13	13	13	13	13	13
Total	**25,596**	**25,823**	**25,990**	**26,181**	**26,363**	**26,583**	**26,752**	**26,930**	**27,119**	**27,322**	**27,500**	**27,692**

Figure C-10. Industrial Baseline Forecast by End Use Group – Electric

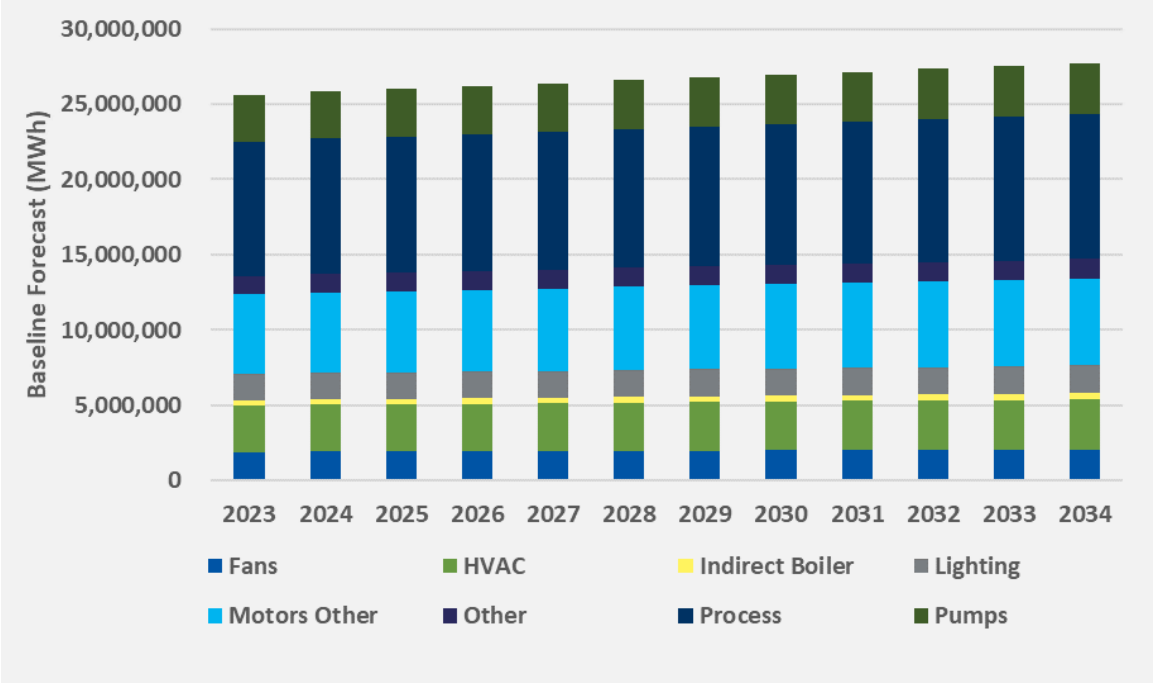


Figure C-11. Industrial Baseline Forecast by Segment – Natural Gas

Industrial	Baseline Forecast (Thousand Therms)											
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Food Mfg	49,937	50,252	50,539	50,843	51,168	51,504	51,796	52,090	52,385	52,683	52,983	53,285
Miscellaneous Mfg	42,845	43,115	43,362	43,622	43,901	44,189	44,439	44,691	44,945	45,201	45,458	45,717
Fabricated Metal Products	35,468	35,691	35,895	36,111	36,342	36,580	36,788	36,996	37,207	37,418	37,631	37,845
Industrial Machinery	33,164	33,373	33,564	33,766	33,981	34,204	34,398	34,593	34,790	34,988	35,187	35,387
Chemical Mfg	15,360	15,457	15,545	15,639	15,739	15,842	15,932	16,022	16,113	16,205	16,297	16,390
Nonmetallic Mineral Products	11,352	11,423	11,489	11,558	11,632	11,708	11,774	11,841	11,909	11,976	12,044	12,113
Plastics Rubber Products	11,177	11,248	11,312	11,380	11,453	11,528	11,593	11,659	11,725	11,792	11,859	11,927
Paper Mfg	10,506	10,572	10,632	10,696	10,764	10,835	10,896	10,958	11,021	11,083	11,146	11,210
Wood Product Mfg	9,791	9,853	9,909	9,969	10,032	10,098	10,155	10,213	10,271	10,329	10,388	10,447
Primary Metal Mfg	9,650	9,711	9,766	9,825	9,888	9,953	10,009	10,066	10,123	10,181	10,239	10,297
Transportation Equipment Mfg	9,273	9,331	9,385	9,441	9,501	9,564	9,618	9,673	9,728	9,783	9,839	9,895
Printing Related Support	8,619	8,673	8,723	8,775	8,831	8,889	8,939	8,990	9,041	9,093	9,144	9,196
Electrical Equipment Mfg	7,504	7,551	7,595	7,640	7,689	7,739	7,783	7,827	7,872	7,917	7,962	8,007
Beverage and Tobacco Mfg	3,565	3,587	3,608	3,629	3,653	3,677	3,697	3,718	3,740	3,761	3,782	3,804
Furniture Mfg	3,351	3,372	3,392	3,412	3,434	3,456	3,476	3,496	3,516	3,536	3,556	3,576
Petroleum Coal Products	2,789	2,806	2,822	2,839	2,857	2,876	2,893	2,909	2,925	2,942	2,959	2,976
Textile Mills	2,739	2,756	2,772	2,788	2,806	2,825	2,841	2,857	2,873	2,889	2,906	2,922
Apparel	841	847	851	857	862	868	873	878	883	888	893	898

Industrial	Baseline Forecast (Thousand Therms)											
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Textile Product Mills	351	353	355	358	360	362	364	366	368	370	373	375
Computer and Electronic Mfg	256	257	259	260	262	264	265	267	268	270	271	273
Total	**268,537**	**270,228**	**271,775**	**273,410**	**275,155**	**276,961**	**278,530**	**280,111**	**281,702**	**283,303**	**284,916**	0

Figure C-12. Industrial Baseline Forecast by End Use Group – Natural Gas

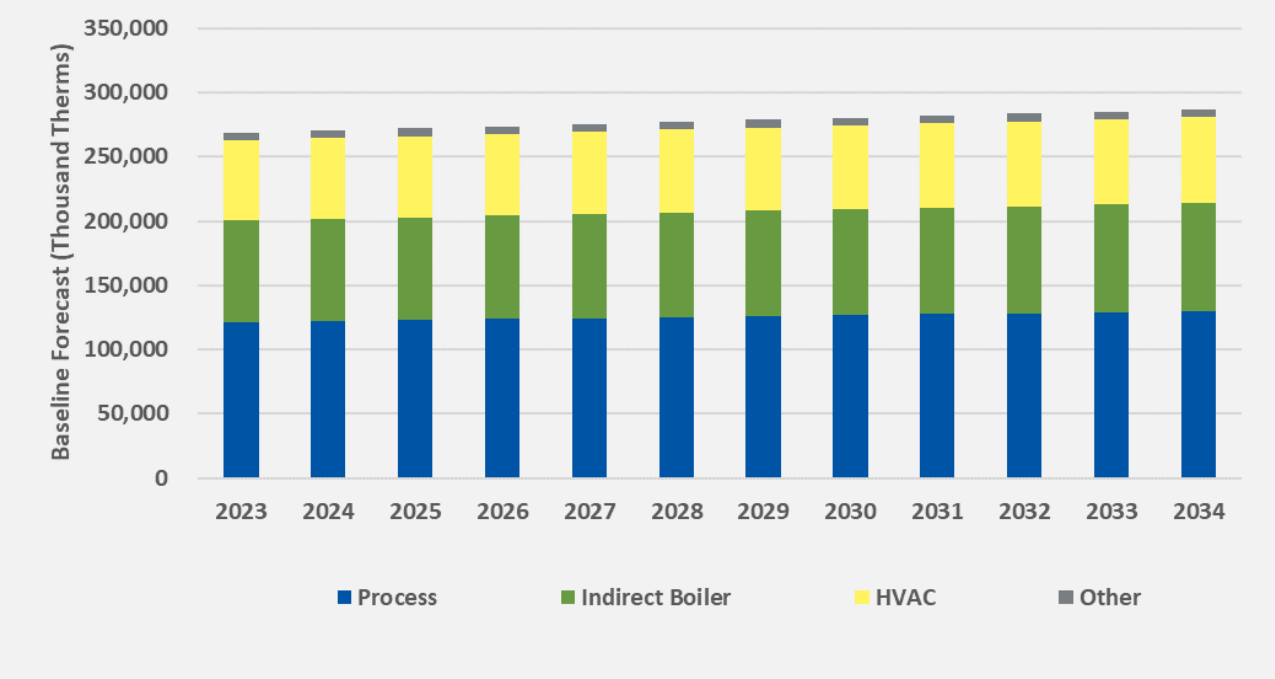


Figure C-13. Agriculture Baseline Forecast by Segment – Electric

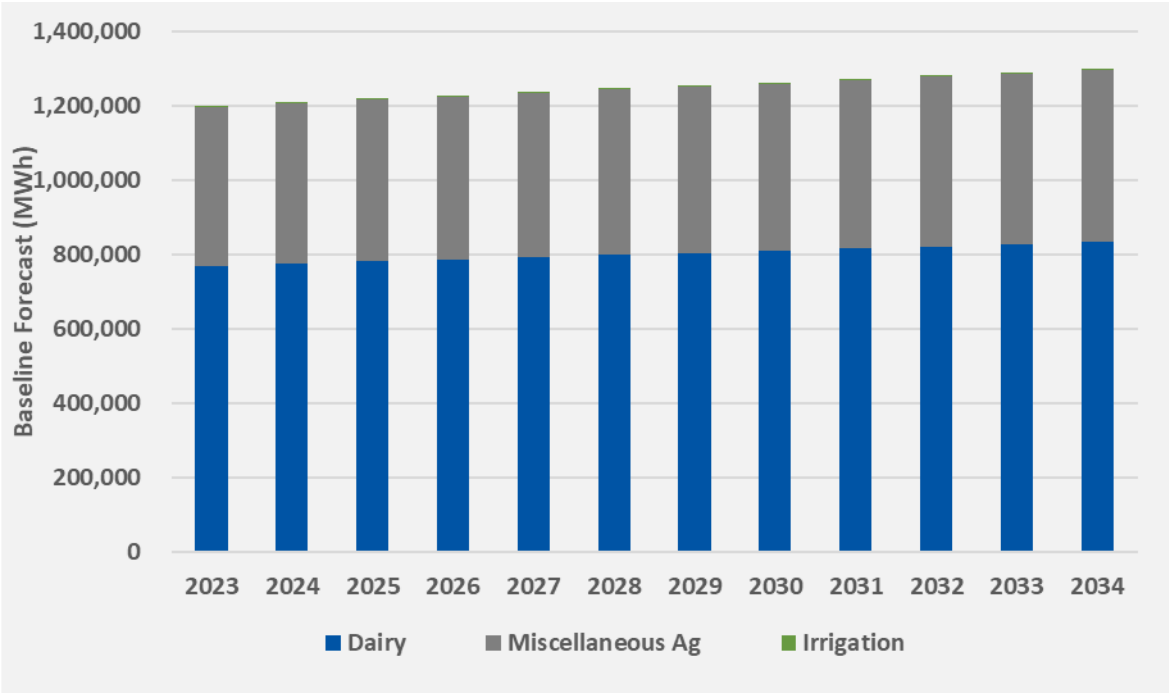


Figure C-14. Agriculture Baseline Forecast by End Use Group – Electric

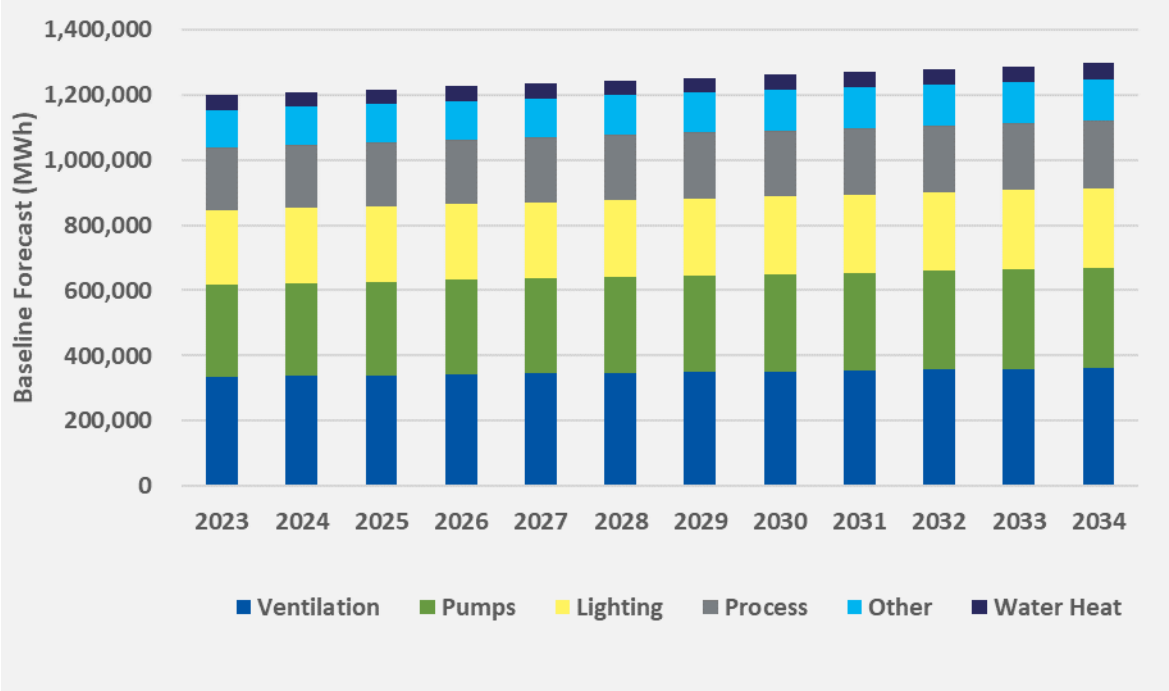


Figure C-15. Agriculture Baseline Forecast by Segment – Natural Gas

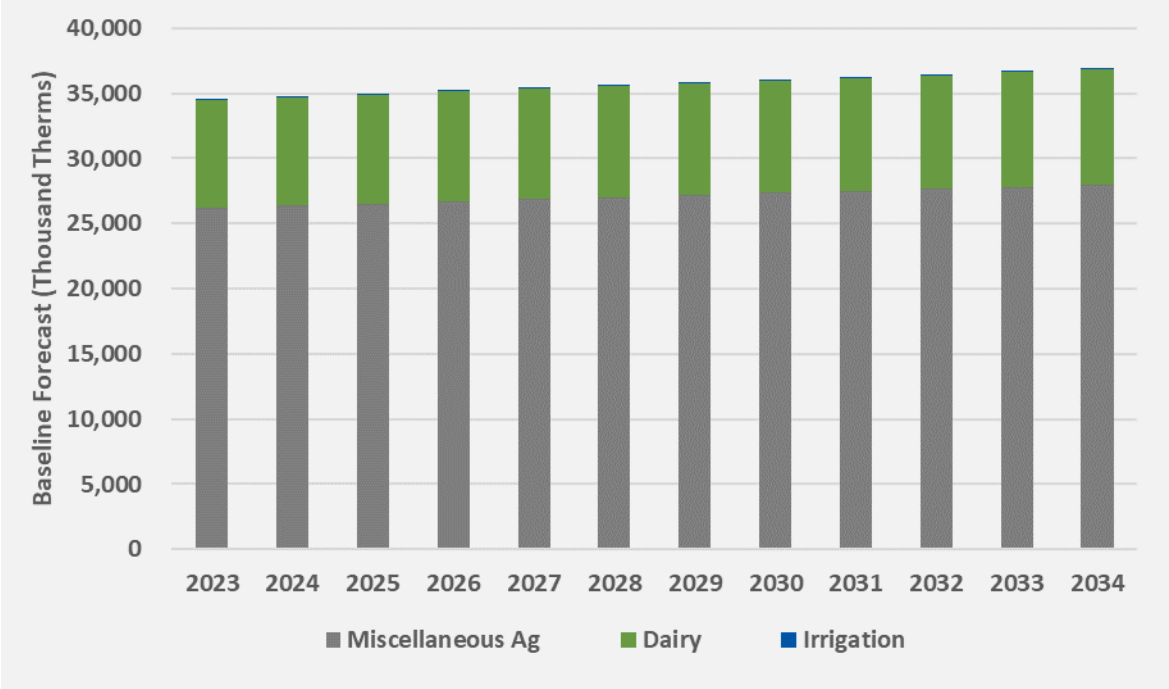
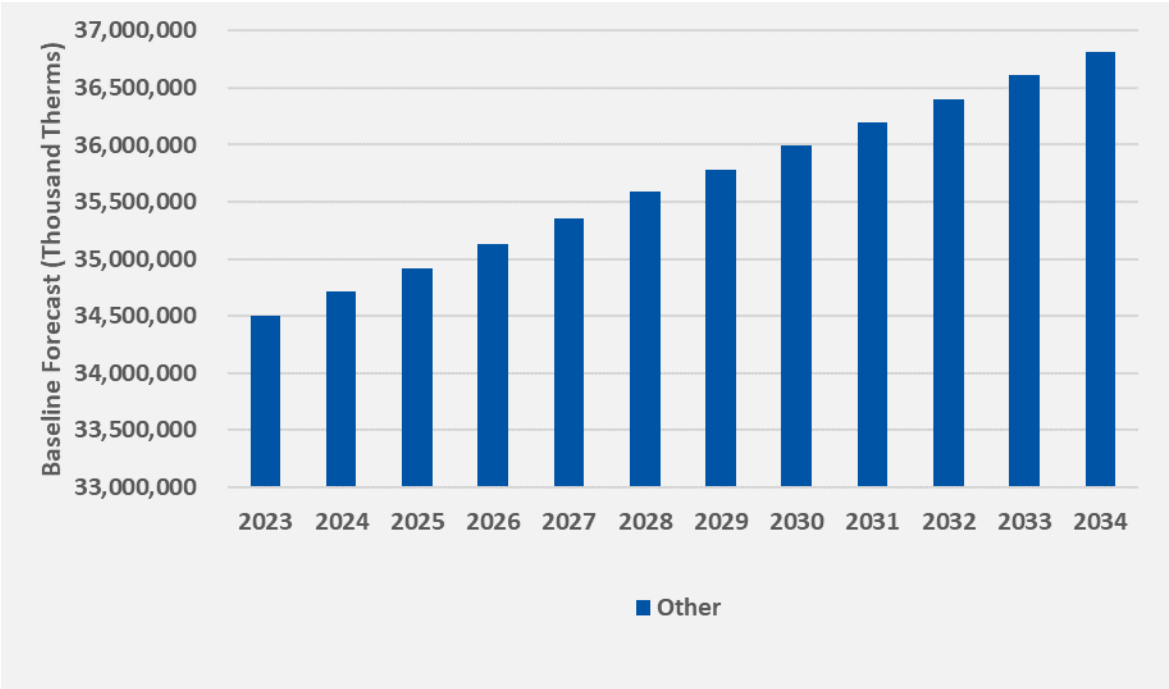


Figure C-16. Agriculture Baseline Forecast– Natural Gas



Note: Agriculture natural gas end use classified as "Other" due to the small amount agriculture customers that have natural gas and the limited data to characterize end use into discrete loads.

Appendix D. Detailed Results from Scenario Analysis

Cadmus performed sensitivity analyses on key cost-effectiveness inputs—including discount rates, carbon values, and avoided transmission and distribution (T&D) costs—that resulted in different estimates of economic and optimized potential. The evaluation team also performed scenario analysis to estimate economic potential using the utility cost test (UCT) and the societal cost test (SCT) in place of the modified total resource cost (MTRC), which was used to develop the base economic potential estimates.

Cadmus also created two scenarios specific to lighting assumptions related to the 2020 EISA backstop, which was rescinded in December of 2019. Given the uncertainty of changes under a new administration, Cadmus evaluated commercial and residential lighting potential based on two potential policy outcomes:

- **Accelerated EISA Compliance Scenario 1** assumes compliance is advanced by two years from the base scenario for residential lighting specialty and standard and commercial screw base.
- **Accelerated EISA Compliance Scenario 2** assumes all residential standard-income and commercial customers are EISA compliant by January 1, 2024, and all income-qualified residential customers are EISA compliant by January 1, 2027.

This appendix includes the following (**bold** numbers represent base case assumptions) scenarios:

- Economic potential scenario analyses
  - Alternate avoided transmission and distribution (T&D) benefits
  - Social cost of carbon
  - Discount rate scenarios (0%, **2%**, 5%)
  - Cost test scenarios (**MTRC**, UCT, and SCT)
  - Modified TRC threshold estimates (**1.0**, 0.75, and 0.50)
- Residential and commercial lighting alternate scenarios

Economic Scenarios

Base Economic Potential Estimates

Economic potential represents a subset of technical potential, consisting only of measures meeting cost-effectiveness criteria. Cadmus used the MTRC to identify cost-effective measures in a manner consistent with Focus on Energy's program evaluation.

Table D-1 summarizes costs and benefits considered in calculating MTRC benefit-cost ratios to develop the economic potential serving as the basis of the optimized potential.

Table D-1. Summary of Costs and Benefit Components

Type	Component
Costs	Incremental measure equipment and labor cost
	Administrative adder
Benefits	PV avoided energy supply benefits
	Non-energy benefits
	Secondary energy benefits
Discount rate	2.0%
Carbon value	$15/ton

Table D-2 presents the base electric energy efficiency economic and achievable potential, by sector.

Table D-2. Base Electric Energy Efficiency Economic Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	5,456,186	30.3%
Multifamily	3,064,670	560,524	18.3%
Commercial	18,190,973	3,112,928	17.1%
Government	3,059,850	484,583	15.8%
Industrial	27,691,821	5,124,906	18.5%
Agriculture	1,295,590	270,406	20.9%
Total	**71,325,393**	**15,009,533**	**21.0%**

Table D-3 shows the base natural gas energy efficiency potential, by sector.

Table D-3. Base Natural Gas Energy Efficiency Economic Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	227,968	14.9%
Multifamily	203,624	27,175	13.3%
Commercial	574,108	108,136	18.8%
Government	69,891	17,614	25.2%
Industrial	286,539	61,299	21.4%
Agriculture	36,814	448	1.2%
Total	**2,701,800**	**442,641**	**16.4%**

Alternate Avoided Transmission and Distribution Benefits Scenario

The base economic potential estimates assume no avoided T&D benefits. As an alternative to this approach, Cadmus estimated the cost-effectiveness of energy efficiency potential based on the Public Service Commission of Wisconsin (PSC) recommended T&D benefits,[21] provided in Table D-4.

[21] Public Service Commission of Wisconsin. January 20, 2021. Ref#: 403255: Quadrennial Planning Process III. https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=403255

Table D-4. Avoided Transmission and Distribution Benefits

Year	Avoided T&D Cost ($/kW-Year)	Year	Avoided T&D Cost ($/kW-Year)
2023	$66.54	2038	$67.97
2024	$66.61	2039	$68.09
2025	$66.69	2040	$68.21
2026	$66.76	2041	$68.34
2027	$66.85	2042	$68.47
2028	$66.93	2043	$68.61
2029	$67.02	2044	$68.74
2030	$67.11	2045	$68.88
2031	$67.21	2046	$69.03
2032	$67.31	2047	$69.17
2033	$67.41	2048	$69.32
2034	$67.51	2049	$69.48
2035	$67.62	2050	$69.63
2036	$67.73	2051	$69.79
2037	$67.85		

Table D-5 and Table D-6 show the economic electric and natural gas potential when avoided T&D benefits are included, respectively. Overall, when the avoided T&D benefits are included, electric economic potential increased by 234,802 MWh (1.6%) relative to the base economic potential. The natural gas potential increased by 68.95 million therms (15.6%) relative to the base economic potential.

Table D-5. Included Avoided T&D Benefits Electric Energy Efficiency Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	5,632,964	31.3%
Multifamily	3,064,670	575,226	18.8%
Commercial	18,190,973	3,134,869	17.2%
Government	3,059,850	491,079	16.0%
Industrial	27,691,821	5,139,585	18.6%
Agriculture	1,295,590	270,612	20.9%
Total	**71,325,393**	**15,244,335**	**21.4%**

Table D-6. Included Avoided T&D Benefits Natural Gas Energy Efficiency Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	291,454	19%
Multifamily	203,624	29,113	14%
Commercial	574,108	110,020	19%
Government	69,891	19,258	28%
Industrial	286,539	61,299	21%
Agriculture	36,814	448	1%
Total	**2,701,800**	**511,592**	**19%**

Social Cost of Carbon Scenario

As a key input, the base economic potential estimates include a carbon value of $15 per ton of carbon dioxide emissions. The evaluation team estimated the economic potential when the cost of carbon is set to the levelized social cost of carbon, $69/ton.[22]

Table D-7 and Table D-8 show the economic electric and natural gas potential, respectively, using the social cost of carbon. Overall, the electric economic potential increased by 947,723 MWh (6.3%) relative to the base economic potential. The natural gas potential increased by 126.96 million therms (28.7%) relative to the base economic potential.

Table D-7. Social Cost of Carbon Electric Energy Efficiency Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	5,848,252	32.4%
Multifamily	3,064,670	643,821	21.0%
Commercial	18,190,973	3,443,738	18.9%
Government	3,059,850	577,813	18.9%
Industrial	27,691,821	5,172,264	18.7%
Agriculture	1,295,590	271,369	20.9%
Total	**71,325,393**	**15,957,256**	**22.4%**

Table D-8. Social Cost of Carbon Natural Gas Energy Efficiency Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	320,284	20.9%
Multifamily	203,624	33,011	16.2%
Commercial	574,108	129,818	22.6%
Government	69,891	21,899	31.3%
Industrial	286,539	61,746	21.5%
Agriculture	36,814	2,840	7.7%
Total	**2,701,800**	**569,598**	**21.1%**

Discount Rate Scenarios

As a primary global input, the base economic potential estimates include a 2% discount rate. The evaluation team estimated the economic potential under two additional scenarios using discount rates of 0% and 5%. Table D-9 and Table D-10 show the economic electric and natural gas potential, respectively, from the 0% discount rate scenario. Overall, the electric economic potential increased by

[22] United States Environmental Protection Agency. (n.d.). "The Social Cost of Carbon: Estimating the Benefits of Reducing Greenhouse Gas Emissions." Accessed July 2021: https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html

346,232 MWh (2.3%) relative to the base economic potential, while the natural gas potential increased by more than 94.5 million therms (21.3%) compared with the base economic potential.

Table D-9. 0% Discount Rate Electric Energy Efficiency Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	5,688,793	31.6%
Multifamily	3,064,670	590,593	19.3%
Commercial	18,190,973	3,192,378	17.5%
Government	3,059,850	488,734	16.0%
Industrial	27,691,821	5,124,854	18.5%
Agriculture	1,295,590	270,413	20.9%
Total	**71,325,393**	**15,355,765**	**21.5%**

Table D-10. 0% Discount Rate Natural Gas Energy Efficiency Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	302,249	19.7%
Multifamily	203,624	32,665	16.0%
Commercial	574,108	117,666	20.5%
Government	69,891	20,510	29.3%
Industrial	286,539	61,278	21.4%
Agriculture	36,814	2,774	7.5%
Total	**2,701,800**	**537,143**	**19.9%**

Table D-11 and Table D-12 show the economic electric and natural gas potential, respectively, from the 5% discount rate scenario. Overall, the electric economic potential decreased by 620,668 MWh (4.1%) relative to the base economic potential, while the natural gas potential fell by more than 29.7 million therms (6.7%) compared with the base economic potential.

Table D-11. 5% Discount Rate Electric Energy Efficiency Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	5,181,653	28.8%
Multifamily	3,064,670	506,750	16.5%
Commercial	18,190,973	2,865,151	15.8%
Government	3,059,850	458,889	15.0%
Industrial	27,691,821	5,108,491	18.4%
Agriculture	1,295,590	267,930	20.7%
Total	**71,325,393**	**14,388,864**	**20.2%**

Table D-12. 5% Discount Rate Natural Gas Energy Efficiency Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	221,455	14.5%
Multifamily	203,624	25,980	12.8%
Commercial	574,108	88,351	15.4%
Government	69,891	15,645	22.4%
Industrial	286,539	61,060	21.3%
Agriculture	36,814	448	1.2%
Total	**2,701,800**	**412,940**	**15.3%**

Cost Test Scenarios

The base economic potential estimates relied upon the MTRC test. The evaluation team performed two additional scenario analyses to estimate the economic potential using the SCT and UCT.

Societal Cost Test Scenario

For the SCT scenario, the team altered the following cost-effectiveness test inputs from those used in the MTRC benefit-cost ratio to estimate the base economic potential:

- A 10% conservation benefits adder, applied to the present value of avoided energy and capacity (deferred generation) benefits
- Annual, incremental measure operation and maintenance (O&M) costs were included

Table D-13 and Table D-14 show the economic electric and natural gas potential, respectively, from the SCT scenario. Overall, the electric economic potential increased by 268,572 MWh (1.8%) compared with the base economic potential scenario. The economic natural gas potential increased by approximately 80.6 million therms (18.2%) compared with the base economic potential scenario.

Table D-13. Societal Cost Test Electric Energy Efficiency Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	5,669,352	31.5%
Multifamily	3,064,670	572,719	18.7%
Commercial	18,190,973	3,148,855	17.3%
Government	3,059,850	498,320	16.3%
Industrial	27,691,821	5,118,445	18.5%
Agriculture	1,295,590	270,413	20.9%
Total	**71,325,393**	**15,278,104**	**21.4%**

Table D-14. Societal Cost Test Natural Gas Energy Efficiency Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	289,947	18.9%
Multifamily	203,624	31,768	15.6%
Commercial	574,108	116,975	20.4%
Government	69,891	20,462	29.3%
Industrial	286,539	61,299	21.4%
Agriculture	36,814	2,775	7.5%
Total	**2,701,800**	**523,225**	**19.4%**

Utility Cost Test Scenario

For the UCT scenario, the team altered the following cost-effectiveness test inputs from those used in the MTRC benefit-cost ratio used to estimate the base economic potential:

- Removed incremental labor and equipment costs from the benefit-cost ratio calculation
- Added an incentive amount estimated based on Focus on Energy historical equipment incentive spending

Table D-15 and Table D-16 show the economic electric and natural gas potential, respectively, from the UCT scenario. Overall, the electric economic potential increased by nearly 2.8M MWh (18.6%) compared with the base economic potential scenario. The economic natural gas potential increased by approximately 257 million therms (58.1%) compared with the base economic potential scenario.

Table D-15. Utility Cost Test Electric Energy Efficiency Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	6,536,682	36.3%
Multifamily	3,064,670	884,607	28.9%
Commercial	18,190,973	4,218,937	23.2%
Government	3,059,850	727,136	23.8%
Industrial	27,691,821	5,162,857	18.6%
Agriculture	1,295,590	273,729	21.1%
Total	**71,325,393**	**17,803,948**	**25.0%**

Table D-16. Utility Cost Test Natural Gas Energy Efficiency Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	397,203	25.9%
Multifamily	203,624	47,303	23.2%
Commercial	574,108	164,180	28.6%
Government	69,891	26,261	37.6%
Industrial	286,539	61,708	21.5%
Agriculture	36,814	3,296	9.0%
Total	**2,701,800**	**699,950**	**25.9%**

Modified TRC Threshold Scenarios

Whereas the base economic potential was determined using an MTRC benefit-cost ratio threshold of 1.0, two additional scenarios incorporate non-cost-effective measures from lowering the cost-effectiveness threshold to 0.75 and 0.50. The base economic potential used the MTRC benefit-cost ratio threshold of 1.0 to screen for cost-effectiveness at the measure level.

However, Focus on Energy requires only that the overall residential and nonresidential portfolios achieve cost-effectiveness, and those cost-effectiveness standards could be met with programs that include some non-economic measures in addition to economic measures.

Because these scenarios, as modeled, still would likely meet Focus on Energy's requirement to maintain overall cost-effectiveness in its residential and nonresidential portfolios, each scenario provides an estimate of the degree to which these factors could affect the difference between economic potential presented here and program potential that could be achieved by Focus on Energy.

Table D-17 and Table D-18 present the economic potential results from lowering the MTRC benefit-cost ratio from 1.0 to 0.75. This scenario provides total electric economic potential of 21.9% of forecasted electric sales (2.1% of annual sales) and natural gas potential of 20.6% of forecasted natural gas sales (1.9% of annual sales).

Overall, the electric economic potential increased by nearly 312,000 MWh (2.6%) compared with the base economic potential scenario. The economic natural gas potential increased by approximately 94 million therms (26.1%) compared with the base economic potential scenario.

Table D-17. MTRC 0.75 Threshold Electric Economic Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	5,704,059	31.6%
Multifamily	3,064,670	622,908	20.3%
Commercial	18,190,973	3,318,527	18.2%
Government	3,059,850	537,846	17.6%
Industrial	27,691,821	5,143,470	18.6%
Agriculture	1,295,590	271,478	21.0%
Total	**71,325,393**	**15,598,290**	**21.9%**

Table D-18. MTRC 0.75 Threshold Natural Gas Economic Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	310,010	20.3%
Multifamily	203,624	32,817	16.1%
Commercial	574,108	126,464	22.0%
Government	69,891	21,639	31.0%
Industrial	286,539	61,746	21.5%
Agriculture	36,814	2,840	7.7%
Total	**2,701,800**	**555,516**	**20.6%**

Table D-19 and Table D-20 show the economic potential results from lowering the MTRC benefit-cost ratio from 1.0 to 0.50. This scenario identifies total electric economic potential of 23% of forecasted electric sales (2.2% of annual sales) and natural gas potential of 22.3% of forecasted natural gas sales (2.1% of annual sales).

For the 0.5 MTRC scenario, the electric economic potential increased by 971,345 (8.2%) compared with the base economic potential scenario. The economic natural gas potential increased by approximately 132 million therms (36.5%) compared with the base economic potential scenario.

Table D-19. MTRC 0.50 Threshold Electric Economic Potential

Sector	2034 Forecast Sales (MWh)	12-Year Economic Potential (MWh)	Economic Potential Percentage of Sales
Single-family	18,022,489	5,892,653	32.7%
Multifamily	3,064,670	679,858	22.2%
Commercial	18,190,973	3,780,037	20.8%
Government	3,059,850	598,988	19.6%
Industrial	27,691,821	5,189,026	18.7%
Agriculture	1,295,590	271,478	21.0%
Total	**71,325,393**	**16,412,041**	**23.0%**

Table D-20. MTRC 0.50 Threshold Natural Gas Economic Potential

Sector	2034 Forecast Sales (Thousand Therms)	12-Year Economic Potential (Thousand Therms)	Economic Potential Percentage of Sales
Single-family	1,530,824	336,720	22.0%
Multifamily	203,624	36,786	18.1%
Commercial	574,108	140,899	24.5%
Government	69,891	24,406	34.9%
Industrial	286,539	61,746	21.5%
Agriculture	36,814	2,900	7.9%
Total	**2,701,800**	**603,456**	**22.3%**

Residential and Commercial EISA Lighting Standards Scenario

At the time this report was published, considerable uncertainty remained regarding an updated EISA backstop. In December of 2019, DOE issued a Final Determination in which it formalized full rescission of the 2007 Energy Independence and Security Act (EISA) backstop requirement, which would have established a 45 lumen/watt baseline beginning in 2020. However, there are still pending legal challenges and, with the change in presidential administrations, uncertainty remains regarding if, how, and when this standard will be reintroduced.

For example, the Biden-Harris Administration, through the Department of Energy, has introduced a semiannual Unified Agenda of Federal Regulatory and Deregulatory Actions that includes possible amendments to EISA. In addition, market adoption for LEDs continues to grow and has implications on the remaining potential. For these reasons, Cadmus conducted a sensitivity analysis to changes in the implementation year of the LED lighting standard baseline.

In the Cadmus potential model, the baseline is used to replace any equipment that burns out. For example, if a new federal standard air purifier goes into effect in 2025, then beginning in 2025, any air purifier that burns out and is below the federal standard will be replaced by the federal standard. This leads to the saturation of the market with the federal standard air purifier. For the various lighting scenarios, Cadmus changed the year when the LED baseline went into effect based on differing assumptions about the possibility of the EISA standard being reintroduced.

For the base case scenario, Cadmus assumed screw base LEDs would saturate the market for commercial and standard-income residential customers by 2027. This was informed by regional market trends and Focus on Energy's evaluation team. For specialty lamps, residential customer LED market saturation is assumed to occur in 2029. Income-qualified residential customer market LED saturation is assumed to be slower for both screw base and specialty lamps. Market saturation of LEDs for the income-qualified customer segment occurs in 2031. Table D-21 lists these assumptions.

Table D-21. Base Case Residential and Commercial Lighting Standard Scenario

Scenario	Sector	Bulb Type	Baseline in Base Year	Baseline Change Year [a]	Baseline Through Final Year
Base Case	Residential Standard-Income	General service	General service lamp – halogen	2027	General service lamp - ENERGY STAR LED
		Specialty	Specialty lamp - incandescent/halogen (EISA exempt)	2029	Specialty lamp - ENERGY STAR LED
	Residential Income-Qualified	General service	General service lamp – halogen	2031	General service lamp - ENERGY STAR LED
		Specialty	Specialty lamp - incandescent/halogen (EISA exempt)	2031	Specialty lamp - ENERGY STAR LED
	Commercial	Screw base	EISA 2014 halogen	2027	ENERGY STAR LED

[a] Baseline changes occur on January 1 of the change year.

This study looks at two alternate lighting scenarios that assume an accelerated EISA compliance timeline. Table D-22 presents the first alternate scenario, assuming all timelines are accelerated by two years.

Table D-22. Accelerated EISA Compliance Scenario 1

Scenario	Sector	Bulb Type	Baseline in Base Year	Baseline Change Year [a]	Baseline Through Final Year
Accelerated EISA Compliance Scenario 1	Residential Standard-Income	General service	General service lamp – halogen	2025	General service lamp - ENERGY STAR LED
		Specialty	Specialty lamp - incandescent/halogen (EISA exempt)	2027	Specialty lamp - ENERGY STAR LED
	Residential Income-Qualified	General service	General service lamp – halogen	2029	General service lamp - ENERGY STAR LED
		Specialty	Specialty lamp - incandescent/halogen (EISA exempt)	2029	Specialty lamp - ENERGY STAR LED
	Commercial	Screw base	EISA 2014 halogen	2025	ENERGY STAR LED

[a] Baseline changes occur on January 1 of the change year.

The second alternate scenario, in Table D-23, assumed that the residential standard-income and commercial halogen baseline for general service and specialty lamps would remain in place through 2023 before switching to an LED baseline. For income-qualified residential customers, the LED baseline transition occurs on January 1, 2027.

Table D-23. Accelerated EISA Compliance Scenario 2

Scenario	Sector	Bulb Type	Baseline in Base Year	Baseline Change Year [a]	Baseline Through Final Year
Accelerated EISA Compliance Scenario 2	Residential Standard-Income	General service	General service lamp – halogen	2024	General service lamp - ENERGY STAR LED
		Specialty	Specialty lamp - incandescent/halogen (EISA exempt)	2024	Specialty lamp - ENERGY STAR LED
	Residential Income-Qualified	General service	General service lamp – halogen	2027	General service lamp - ENERGY STAR LED
		Specialty	Specialty lamp - incandescent/halogen (EISA exempt)	2027	Specialty lamp - ENERGY STAR LED
	Commercial	Screw base	EISA 2014 halogen	2024	ENERGY STAR LED

[a] Baseline changes occur on January 1 of the change year.

The base case potential study scenario identified over 1.6 million megawatt-hours of residential specialty, residential general service, and commercial screw base lighting technical potential and 944,020 megawatt-hours of optimized potential within the first four years (2023 to 2026) of the study. Figure D-1 provides the total residential and commercial equipment lighting technical, economic, and optimized potential for the base case, accelerated EISA compliance scenario 1, and accelerated EISA compliance scenario 2.

Figure D-1. Total Lighting Potential

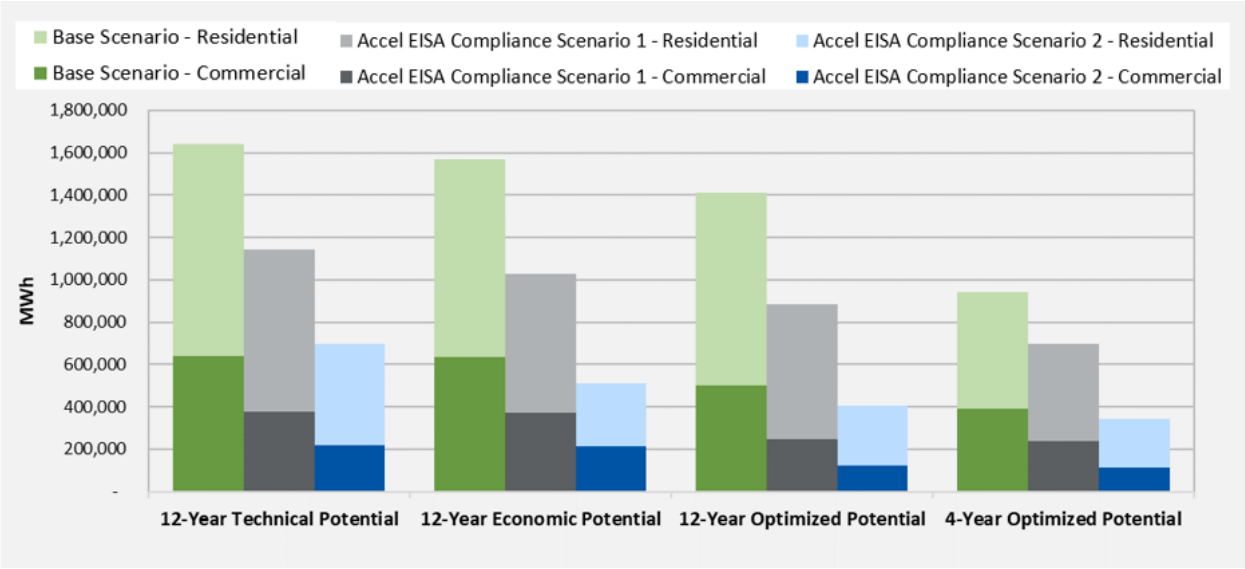


Figure D-2 shows the residential general service lamp potentials resulting from the scenario analysis. When moving from the base case analysis to the accelerated EISA compliance scenario 1, the technical potentials decreased by 28%, while the 12-year economic and the 12- and four-year optimized potential decreased 37%. These decreases in general service lamp potential under accelerated EISA compliance scenario 1 resulted from shortening the halogen baseline by two years.

When moving from the base case analysis to accelerated EISA compliance scenario 2, the general service lighting technical potentials decreased by 50%, while the 12-year economic and optimized potential decreased 71%. Furthermore, the only remaining general service lighting economic potential in accelerated EISA compliance scenario 2 is for income-qualified customers. There are two reasons for this. In 2023, LED general service bulbs are not cost-effective for standard-income customers, and the halogen bulb is the baseline only for standard-income customers. Since accelerated EISA compliance scenario 2 assumed an LED baseline for standard-income residential customers beginning on January 1, 2024, potential cannot be collected for these customers beginning in 2024.

Figure D-2. Residential General Service Lamp Scenario Potentials

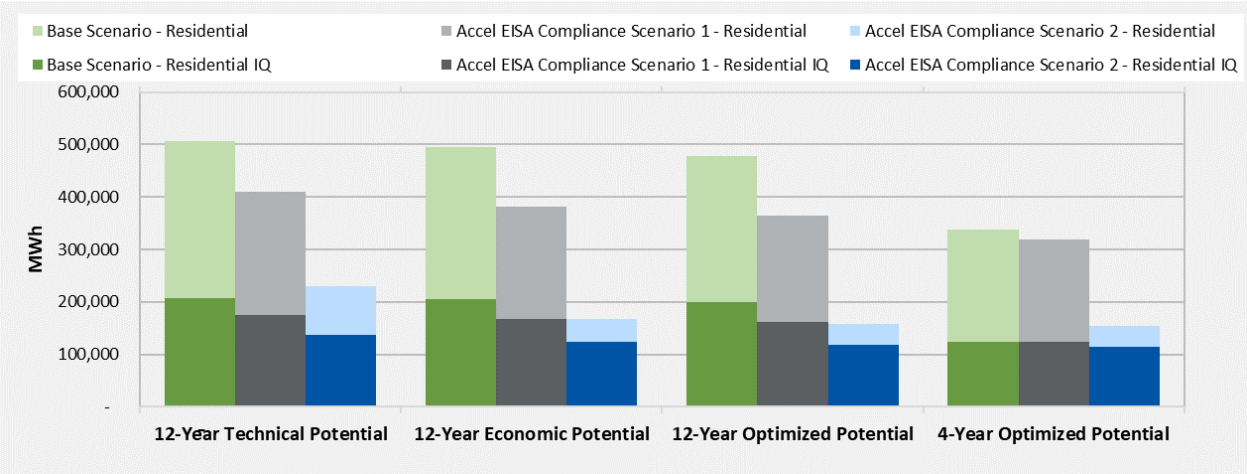


Figure D-3 shows residential specialty lamp potentials resulting from the scenario analysis. The overall 12-year technical, economic, and optimized potential decreased between the base case scenario and accelerated EISA compliance scenario 1 by 19%, 23% and 24%, respectively. As shown above in Table D-22 and Table D-23, the decreased potential occurred from assuming that the baseline for residential specialty lamps would transition to LEDs two years earlier than in the base case scenario.

When moving from the base case analysis to accelerated EISA compliance scenario 2, technical potential decreased by 55%, while economic and optimized potentials decreased by 66% and 67%, respectively. In the first four years, the optimized potential decrease is slightly more modest at 55%.

Figure D-3. Residential Specialty Lamp Scenario Potentials

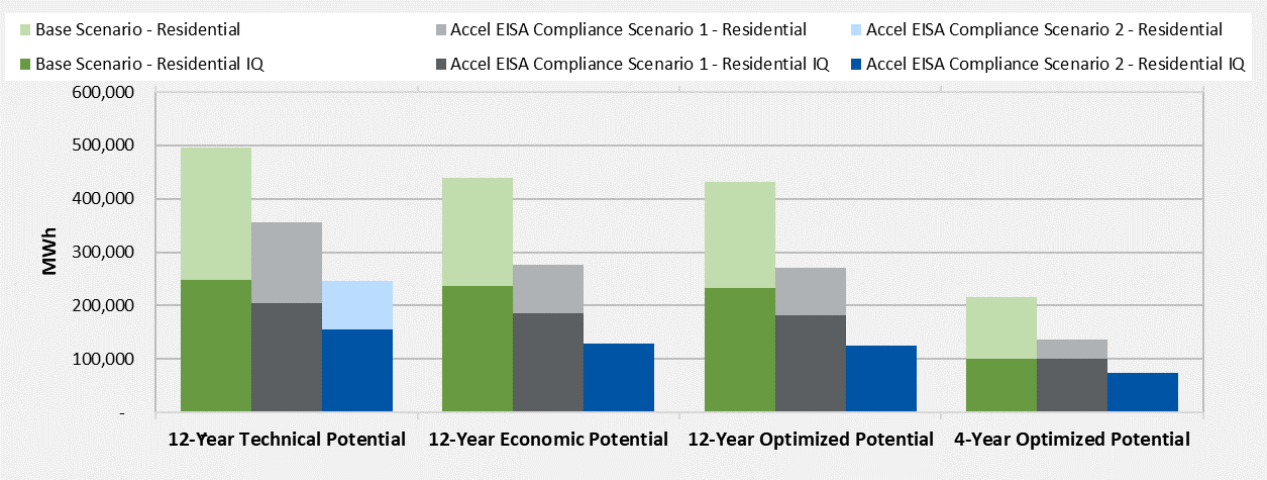
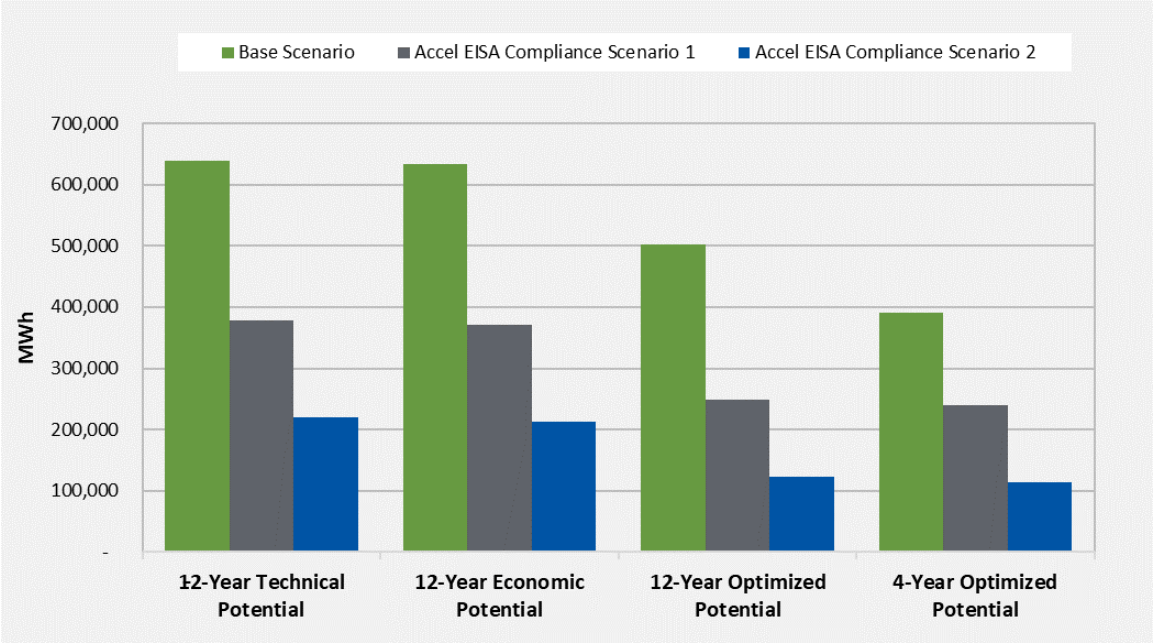


Figure D-4 shows commercial screw base lighting potentials resulting from the scenario analysis. The base case scenario shows the greatest potential because it assumes the longest time before LEDs saturate the commercial lighting market. Between the base case scenario and accelerated EISA compliance scenario 1, the commercial screw base technical and economic potential decrease by 41%. The 12-year optimized potential decreases by 50% and the four-year optimized potential decreases by 39% between the base case scenario and accelerated EISA compliance scenario 1.

Figure D-4. Commercial Screw Base Lighting Scenario Potentials



The decrease between the base case scenario and accelerated EISA compliance scenario 2 is even more severe, because LEDs are assumed to saturate the commercial screw base lighting market on January 1, 2024, rather than 2027 (as is assumed in the base case scenario). The 12-year technical and economic commercial screw base lighting potentials are 66% lower for the accelerated EISA compliance scenario 2

than the base case scenario. Compared to the base case scenario, the 12-year optimized potential is 75% lower and the four-year optimized potential is 71% lower when the LED baseline takes effect in 2024.

Appendix E. Ramp Rates Review Detail

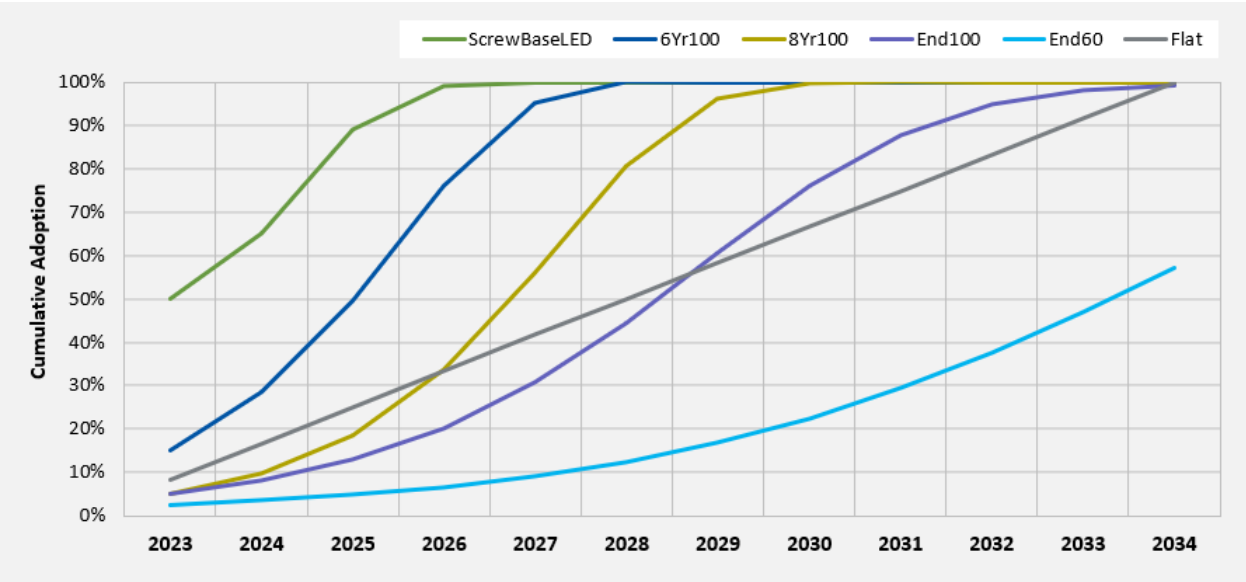
Optimized potential is a subset of economic potential that considers market barriers to technology adoption and represents the theoretical opportunities for cost-effective savings that can be achieved when program funding is not considered. Two key inputs to estimate optimized potential from economic potential for a measure are a ramp rate and a maximum achievability percentage.

Ramp Rate Assignment Process

Cadmus worked with Focus on Energy stakeholders to assign ramp rates from a predetermined selection of S-curves. Ramp rates determine the incremental, year-to-year optimized potential for an energy efficiency measure. Ramp rates are not sector-specific; rather, they are generalized S-curves that assume an initial saturation rate in the study's first year (2023) before progressing to the maximum achievability percentage on either an incremental or cumulative basis, depending on if the resource is a lost opportunity or a retrofit resource. For each measure in this study, Cadmus assigned maximum achievability values of either 95% or 85%, based on if a federal standard exists or not.

Cadmus assigned the initial ramp rate groups using historical Focus on Energy program performance and market trends. The groups contained similar measures that would be adopted at similar rates. The result was 179 ramp rate groups, also referred to as measure groups, organized by sector—53 residential, 81 commercial, 33 industrial, and 12 agriculture. The six ramp rates considered, as shown in Figure E-1, represent the different rates of annual adoption considered in this study. The ScrewBaseLED curve shows the most aggressive adoption, while the End60 curve is least aggressive, never reaching 100% adoption.[23]

Figure E-1. Ramp Rate S-Curves



[23] Ramp rates are discussed in detail in the *Ramp Rates* section of the main report.

Ramp Rate Review Process

In December 2020, Cadmus worked with the Focus on Energy administrator and Public Service Commission of Wisconsin (PSC) staff to identify 37 market experts with knowledge on specific measure groups and a high familiarity of energy efficiency adoption rates in Wisconsin. Experts were recruited from implementation firms, research firms, and utilities, and their roles included technical leads, program managers, engineers, advisors, among others. In February 2021, Cadmus hosted a webinar to give the experts an overview of the work and review the initial assignments.

In March 2021, Cadmus sent market experts the ramp rate assignments, by measure group, in an Excel file and gave them approximately two weeks to respond. Experts reviewed the measures assigned to them, determined if the ramp rates for those measure groups were appropriate, and offered recommendations. Table E-1 provides an example of the type of review and possible feedback.

Table E-1. Example of Ramp Rate Review

Sector	Technology Group	Measure Group	Reviewer	Original Ramp Rate	Reviewer Recommended Ramp Rate	Reviewer Feedback	Reviewer Additional Comments
Industrial	Process	Waste Heat Preheat	Jane Doe	8Yr100	End100	Recommend change to ramp rate assignment	Historical adoption has not been aggressive

Cadmus reviewed and summarized experts' feedback, revised original ramp rates as necessary, and presented results to stakeholders.

Response Rate

Cadmus sent requests to 31 market experts and received responses from 25 individuals. Figure E-2 shows the response rate by measure group in each sector. The vertical axis represents the 179 measure groups. Each stacked bar represents the proportion of these measure groups that received between zero and four responses. For example, all of the approximately 10 agricultural measure groups received one response. Of the measures groups in the commercial sector, 52% received one response, 21% received two responses, and 7% received three responses. Overall, the experts did not provide feedback for 20% of the measure groups.

Figure E-2. Ramp Rate Expert Response Rate

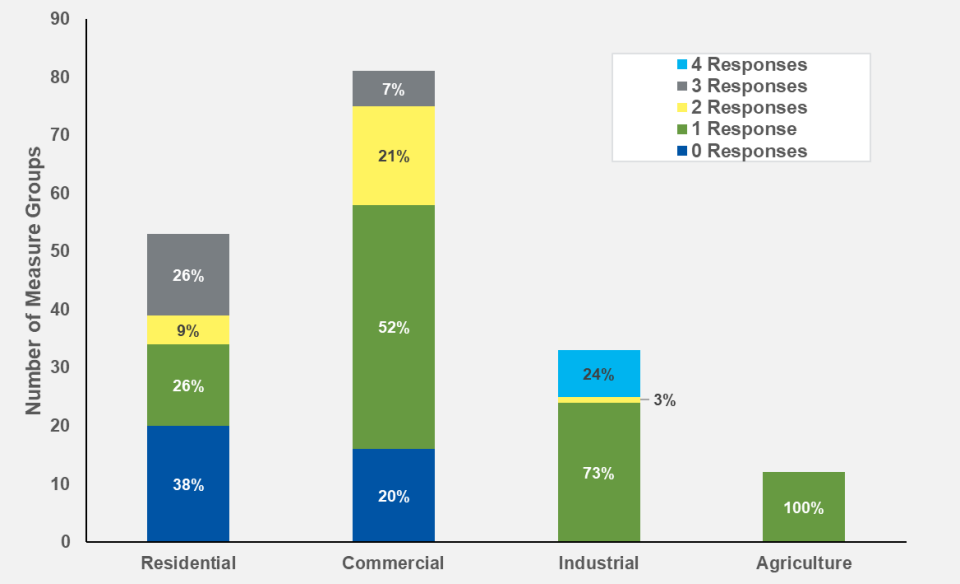


Figure E-3 shows the percentage of the 93 responses that recommended no change, a slower ramp rate, or a faster ramp rate than assigned for the eight technology groups in the residential sector. These technology groups combine the 53 residential measure groups for the purpose of review. A technology group is less granular than a measure group but more granular than an end-use group. As the figure shows, all reviewers of plug load measures recommended faster ramp rates, while reviewers were split on ramp rates for behavioral measures. When reviewers were split, Cadmus reviewed feedback and made adjustments based on experts' qualitative responses.

Figure E-3. Residential Ramp Rate Recommendations by Technology Group

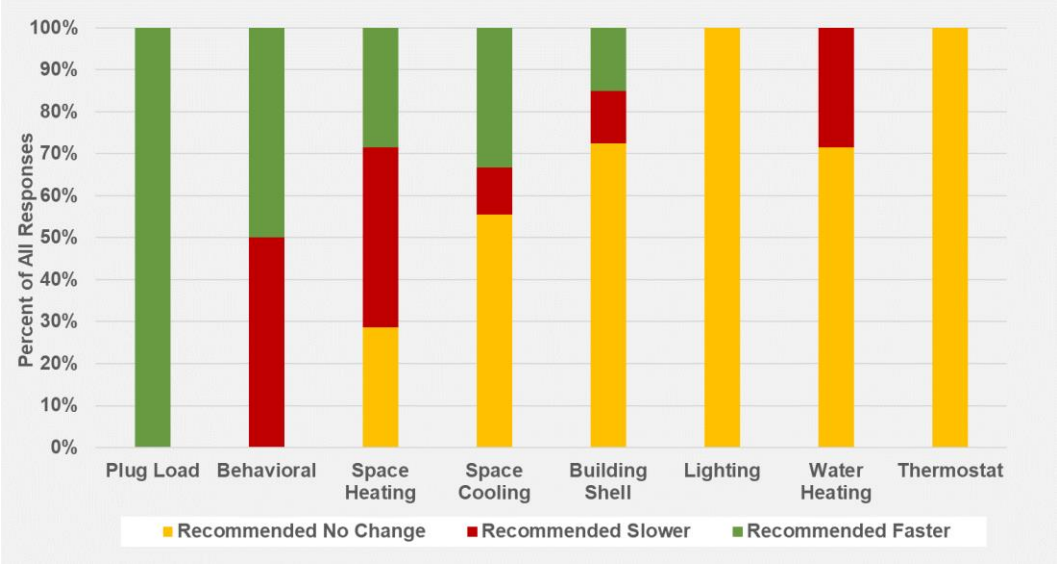


Figure E-4 shows the commercial ramp rate recommendations by technology group. Cadmus received 140 responses for the 81 measure groups in the commercial sector. The most consistent responses for change were for accelerating ramp rates for IT systems (three responses) and slowing down the ramp rates for cooking systems (two responses).

Figure E-4. Commercial Ramp Rate Recommendations by Technology Group

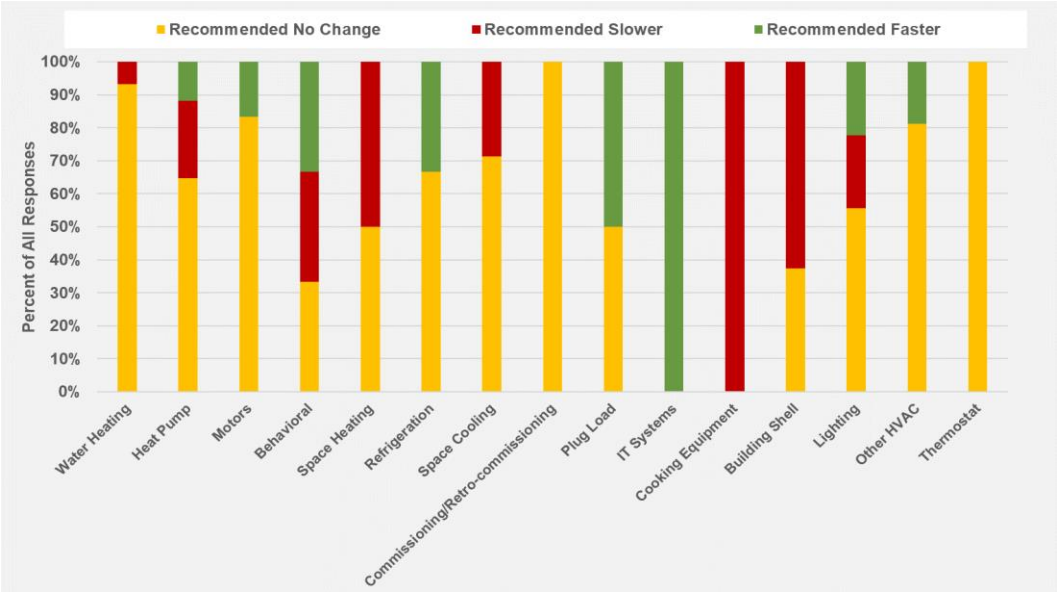


Figure E-5 shows the 58 industrial responses to ramp rate assignments by technology group. Most technology groups received few recommendations for changes. Only process and lighting received recommendations to slow the initial assigned ramp rates.

Figure E-5. Industrial Ramp Rate Recommendations by Technology Group

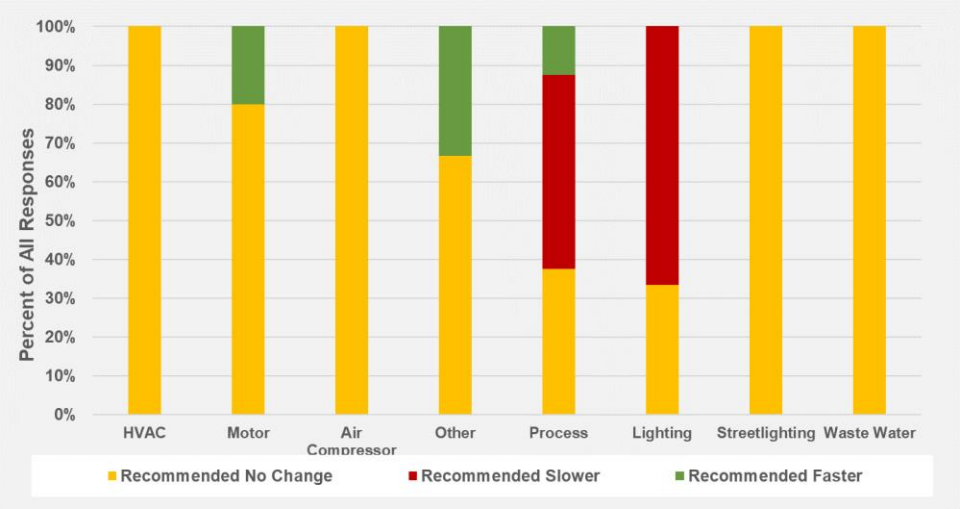
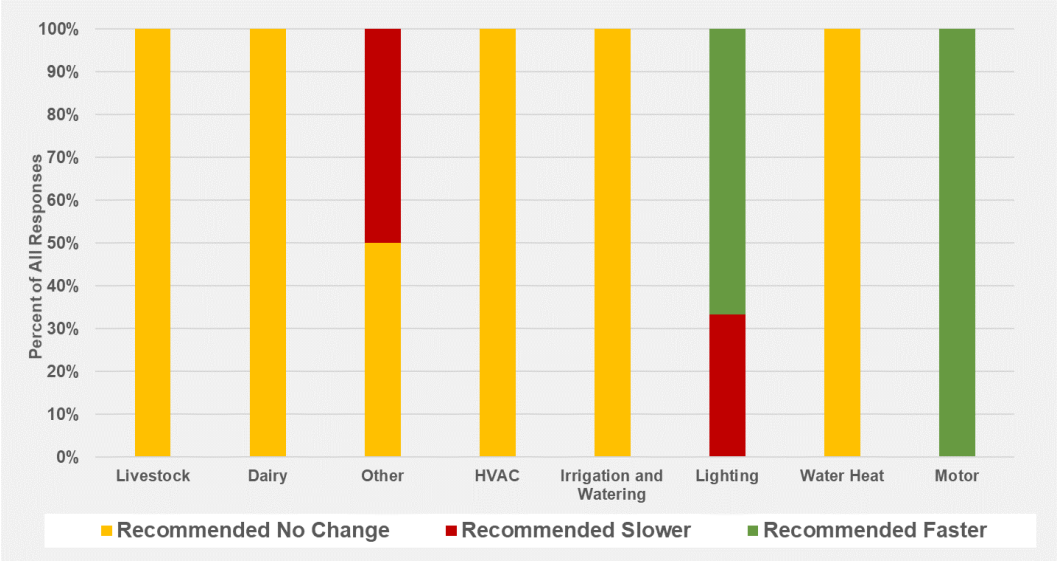


Figure E-6 provides recommendations from 12 experts for the 12 measure groups in the agriculture sector. Though many experts recommended leaving agriculture ramp rates as assigned by Cadmus, some recommended accelerating ramp rates for lighting and motor measures.

Figure E-6. Agriculture Ramp Rate Recommendations by Technology Group



Ramp Rate Adjustments

After reviewing expert feedback, Cadmus revised the ramp rates for 39 measure groups. Table E-2 shows the original and updated ramp rates for these measure groups. Changes were made to 11 residential measure groups, 19 commercial measure groups, and nine industrial measure groups. No changes were made to agriculture.

The overall impact of these changes was a 0.72% increase in cumulative, 12-year electric optimized potential and a 3.03% decrease in cumulative, 12-year natural gas optimized potential[24].

Table E-2. Updated Ramp Rate Assignments

Sector	Technology Group	Measure Group	Original Ramp Rate	Updated Ramp Rate
Residential	Appliances	Clothes Dryer	8Yr100	End100
	Heat Pump	Quality Installation	8Yr100	End100
	Plug Load	Advanced Power Strip	End60	6Yr100
		Electronics	End60	8Yr100
		EV Charger	End60	ResLEDLighting
	Space Heating	Boiler	6Yr100	8Yr100
		Furnace	6Yr100	8Yr100
		Tune Up	8Yr100	6Yr100
	Water Heating	Indirect Water Heat	8Yr100	End100
		Pipe Insulation and Tank Wrap	End100	8Yr100
		Showerhead	8Yr100	End100

[24] Note: this analysis was done when results the potential analysis was still at the draft stage. Actual impacts may differ slightly.

Sector	Technology Group	Measure Group	Original Ramp Rate	Updated Ramp Rate
Commercial	Building Shell	Cool/Green Roof	8Yr100	End60
		Duct Sealing	8Yr100	End100
		Efficient Windows	8Yr100	End100
	Heat Pump	Air Source Heat Pump	8Yr100	End100
	IT Systems	Computer Server / Data Center	8Yr100	6Yr100
		IT Systems	8Yr100	6Yr100
	Lighting	Lighting Controls	6Yr100	8Yr100
		New Construction Lighting	8Yr100	6Yr100
	Other	EMS System	End100	8Yr100
	Plug Load	Computer	8Yr100	ResLEDLighting
		Office Equipment	8Yr100	ResLEDLighting
		Plug load energy reduction	8Yr100	6Yr100
	Refrigeration	Display Case LED, Control, and Cover	End100	8Yr100
		Refrigerator Measures	End100	8Yr100
	Space Cooling	Chiller	8Yr100	End100
	Space Heating	Boiler	6Yr100	End60
		Fan Motor	8Yr100	End100
		Furnace	8Yr100	End100
	Water Heating	Solar Assisted Water Heater	8Yr100	End100
Industrial	HVAC	Boiler Blowdown	6Yr100	8Yr100
	Lighting	LED Lighting	8Yr100	End100
		Lighting Controls and Operation	8Yr100	End100
	Motor	Pulper Rotors	8Yr100	6Yr100
	Other	Injection Mold Machine	8Yr100	6Yr100
	Process	Behavioral	8Yr100	6Yr100
		Process Water Reduction	8Yr100	End100
		Side Entry Agitators	8Yr100	End100
		Waste Heat Preheat	6Yr100	8Yr100

Appendix F. Industrial Expert Interview Findings

To estimate energy efficiency potential for the industrial sector Cadmus interviewed 11 industry experts. The experts were identified as part of the stakeholder engagement process. This appendix summarizes 11 experts' responses to the questions asked during the industrial interviews. *Appendix J* provides the interview instrument for the interviews.

Industry Type and Operating Characteristics

The first few questions in the survey focused on the types of industries and these industries' operational characteristics that the expert was most familiar with.

Industries Covered

Respondents had the most familiarity with the following industries:

- Paper manufacturing
- Electrical equipment manufacturing
- Waste water
- Fabricated metal product manufacturing
- Food or beverage manufacturing

Operating Shift hours and Seasonality

The majority of the respondents said the industries they were familiar with operate 24 hours a day, seven days a week (24/7) with very little, if any, seasonal variability. Downtime is typically under one week per year (for holidays). Reductions in operational hours are typically due to external market factors (such as lower demand for product) and not due to internal factors. Larger 24/7 operations have planned outages for approximately two weeks every three to four years for equipment maintenance. One respondent who discussed electrical equipment manufacturing said the typical hours of operation in that sector are Monday through Friday, 7 a.m. to 11 p.m.

Equipment Saturations and Available Potential

The remainder of the survey questions were intended to uncover current trends in the industries regarding energy efficiency and the remaining potential for using certain energy-efficient technologies.

Lighting

Most respondents said lighting is a very small portion of the electrical load for a typical large energy use (LEU) industrial facility. Facilities have a mix of fluorescent, high-intensity discharge (HID), and LED technologies. Respondents estimated that 50% of the floor area has been upgraded to LEDs but that only 43% of the exterior lighting has been upgraded.

Lighting Controls

According to the survey results, the prevalence of lighting controls in the industrial sector is quite low. Respondents said only 29% of lighting in their facilities is controlled. In general, certain production areas cannot accommodate lighting controls due to safety concerns and the need for adequate lighting for employees. Respondents said that a good opportunity for lighting controls was in warehouse and storage facilities. They estimated that 58% of the areas currently not controlled could be upgraded to save energy.

HVAC Controls

Advanced HVAC controls systems in industrial facilities seems to be uncommon. Survey respondents' facilities are not fully conditioned but rather have sporadically spaced office areas that are conditioned within larger unconditioned spaces. The typical system was described as a unitary system that may or may not have been equipped with a programmable thermostat. Respondents estimated that 41% of facilities use energy management systems for non-process related activities (such as lighting).

Energy Management and Preventative Maintenance

The survey results indicated that facilities with dedicated energy managers was uncommon. Typically, a person with energy manager duties also had several other job responsibilities. Respondents estimated that only 37% of their facilities had some form of an energy manager.

Most facilities had a preventive maintenance program, but only 40% of these "focused on reducing energy costs."

Compressed Air Potential

Approximately 45% potential remains for implementing variable speed air compressors and 57% potential for correctly sizing them for the loads. Technically, a variable speed air compressor makes up for oversizing issues due to its variable speed design. Oversizing issues are most applicable to constant speed compressors or variable speed compressors that are grossly oversized and do not have the turndown capability to meet the load.

All respondents said there was very moderate potential for air filters and/or air dryers on air compressors. Most of their equipment operates in an environment (with dust, wood chips, etc.) in which the equipment would not survive without some form of intake filtration.

Most respondents said leak checking will always be necessary because pneumatic systems will continue to develop leaks over time and that they could always perform leak checks more frequently.

Other items for upgrading compressed air equipment that respondents mentioned were these:

- Eliminate improper compressed air end uses (cooling, material conveyance)
- Install a master controller for overall system control (systems with multiple compressors)

Pumping Potential

Approximately 41% potential remains for the implementation of variable frequency drives (VFDs) on pumping systems in the industrial sector. Pumps are typically sized for the worst case design scenario and include a safety factor, which typically makes them oversized (this is common design practice). Respondents said belt-driven plumps are very uncommon , so the potential for efficient belts is very low.

Respondents said the majority of pumps are regularly maintained, as failure equates to downtime and downtime equates to lost revenue. The potential for controls to minimize operation varies across industries—the potential for processes that are 24/7 is lower than for industries where processes are batch-oriented.

Fan Potential

The potential for VFDs on fans is approximately 67%. The majority of fans are oversized due to the same design process as pumping systems. Some facilities have processes that require a substantial amount of ventilation air. Advanced controls could reduce ventilation air during production downtime. There are also opportunities for analyzing the fan end use and reducing the amount of flow to match the load.

Other Motors Potential

Many of the other motors in the surveyed facilities are associated with third-party equipment that was purchased for specific processes. Typically, facility owners do not want to make changes to this equipment due to manufacturing warranties and/or service contracts. Overall, the potential across other motors is fairly low.

Process Heating Potential

Approximately 42% potential remains for utilizing high-efficient equipment. Most respondents' facilities have very large systems for process heating, which would be costly to replace and result in downtime. These systems are typically well maintained because they are integral to the process. There is a very large opportunity for waste heat recovery; however, typically these projects are costly and difficult to implement.

Process Cooling Equipment

The remaining potential for process cooling is approximately 52%. Respondents noted that cooling towers are an area of concern. Many industries allow their towers to be used beyond their expected life and sometimes maintenance is not kept up.

Computer Equipment Potential

Very few respondents had experience with computer/server systems. Therefore, it was difficult to determine the potential for measures in this category.

Overall Potential and Process improvements

Overall, respondents said that energy efficiency measures applied to the process load for their industries are constantly evolving. On average, it takes 4.8 years to achieve an additional 10% energy savings from a plant that is currently at optimal operation. Respondents said 46% potential remains for process end use.

Appendix G. Benchmarking Sources

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GDS Associates and Cadmus. November 2019.*Vermont Energy Efficiency Market Potential Study.* Prepared for Vermont Department of Public Service. https://publicservice.vermont.gov/sites/dps/files/documents/VT%20EE%20Potential_2019%20Final%20110619.pdf

Navigant Consulting. Updated December 10, 2019. *2019 Integrated Ontario Electricity and Natural Gas Achievable Potential Study*. Prepared for Independent Electricity System Operator. https://www.oeb.ca/sites/default/files/2019_Achievable_Potential_Study_20191218.pdf

Appendix H. Sector Survey Instruments

Several different surveys are provided on the following pages:

- 2020 Agricultural Survey
- 2020 Commercial Survey
- 2020 Income Qualified Residential Survey
- 2020 Residential Survey

Focus on Energy Potential Study Agricultural Survey

To inform the energy-efficiency potential study and future program design, Cadmus will conduct telephone surveys with 70 agricultural facilities in Focus on Energy territory. Cadmus will use the surveys to gather data to supplement existing saturation data and collect information on building characteristics. The survey explores the research topics presented the table.

Agricultural Sector Research Topics

Section Name	Researchable Questions	Questions
Introduction and Screening	Screening to identify target respondent Ownership	A
Farm Characteristics	Size (acreage, number of animals)	B
Saturation	Dairy Farming Crop Farming Greenhouse Non-Farming (Lighting, water heating, etc.)	C D E F G
Willingness to Pay	Willingness to pay for specific upgrades	H

Target Quota = 70 completes: 35 dairy, 35 non-dairy.

General Instructions

- Interviewer instructions are in green **[LIKE THIS]** (the style is "Survey: Interviewer Instructions").
- CATI programming instructions are in red **[LIKE THIS]** (the style is "Survey: Programming").
- Items that should not be read by the interviewer are in parentheses like this ( ).

A. Introduction and Screening

My name is [INTERVIEWER NAME] and I'm calling on behalf of Wisconsin Focus on Energy. We are conducting an important study to understand how agriculture-related businesses in Wisconsin use energy. This is not a sales call. Your answers are confidential and will help Focus on Energy design programs to help you save energy and money.

A1. **[IF RESPONDENT ASKS "HOW LONG": This survey should take about XYZ minutes.]**

A2. Are you the person in your organization who is responsible for facilities and/or energy-related decisions?

1. Yes **[RECORD NAME AND TITLE: _____]**
2. No **[ASK IF YOU CAN SPEAK TO THE PERSON WHO WOULD BE INVOLVED. IF AVAILABLE, START AT BEGINNING.]**
3. Not a convenient time **[ASK IF RESPONDENT WOULD LIKE TO ARRANGE A MORE CONVENIENT TIME]**

98. (Don't know) **[ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]**
99. (Refused) **[THANK AND TERMINATE]**

A3. What type of agriculture does your farm **primarily** engage in?

1. Dairy **[COUNT TOWARD "DAIRY" QUOTA]**
2. Poultry **[COUNT TOWARD "NON-DAIRY" QUOTA]**
3. Livestock (cows, sheep, etc.) **[COUNT TOWARD "NON-DAIRY" QUOTA]**
4. Crop farm **[COUNT TOWARD "NON-DAIRY" QUOTA]**
5. Greenhouse **[COUNT TOWARD "NON-DAIRY" QUOTA]**
6. Other **[SPECIFY]** **[COUNT TOWARD "NON-DAIRY" QUOTA]**

98. (Don't know) **[THANK AND TERMINATE]**
99. (Refused) **[THANK AND TERMINATE]**

99. **[IF QUOTA FOR FACILITY TYPE REACHED: "WE DON'T NEED ANY ADDITIONAL DATA FOR THAT TYPE OF FACILITY RIGHT NOW. THANK YOU FOR YOUR TIME." AND TERMINATE]**

A4. What other types of agriculture does your farm engage in? **[ALLOW MULTIPLE RESPONSES]** **[READ LIST IF NEEDED]**

1. Dairy
2. Poultry
3. Livestock (cows, sheep, etc.)
4. Crop farm
5. Greenhouse
6. Other **[SPECIFY]**
7. **No other types of agriculture**

98. (Don't know)
99. (Refused)

A5. Do you own or lease your farm? **[ALLOW MULTIPLE RESPONSES WHEN FARM IS PARTIALLY LEASED AND PARTIALLY OWNED]**

1. Own
2. Lease

98. (Don't know)
99. (Refused)

B. Farm Characteristics

B1. **[IF A3=1,2,3 OR A4=1,2,3]** How many head of animals are on your farm? **[IF INITIAL RESPONSE IS DON'T KNOW, ASK IF THEY HAVE AN ESTIMATE]**

1. **[SPECIFY]**

98. (Don't know)
99. (Refused)

B2. **[IF A3=4,5,6 OR A4=4,5,6]** How many acres of crop land do you **own** that are harvested? **[IF INITIAL RESPONSE IS DON'T KNOW, ASK IF THEY HAVE AN ESTIMATE]**
   1. **[SPECIFY]**
   98. (Don't know)
   99. (Refused)

B3. **[IF A3=4,5,6 OR A4=4,5,6]** How many acres of crop land do you **lease** that are harvested? **[IF INITIAL RESPONSE IS DON'T KNOW, ASK IF THEY HAVE AN ESTIMATE]**
   1. **[SPECIFY]**
   98. (Don't know)
   99. (Refused)

B4. **[IF A3=4,5,6 OR A4=4,5,6]** What is the total acreage of your land that is irrigated? **[IF INITIAL RESPONSE IS DON'T KNOW, ASK IF THEY HAVE AN ESTIMATE]**
   1. **[SPECIFY]**
   98. (Don't know)
   99. (Refused)

B5. **[IF A3=1 OR A4=1]** How many cows are milked daily? **[IF INITIAL RESPONSE IS DON'T KNOW, ASK IF THEY HAVE AN ESTIMATE]**
   1. Less than 50 cows
   2. 51 – 100 cows
   3. 101 – 200 cows
   4. 201 – 300 cows
   5. More than 300 cows
   98. (Don't know)
   99. (Refused)

C. Dairy Saturations

[ASK SECTION IF A3=1]

Next, we'd like to ask you a few questions about your dairy farm and some dairy-specific questions.

C1. What type of milking system does your facility use?
   1. Parlor
   2. Pipeline
   3. Robotic
   4. Other
   98. (Don't know)
   99. (Refused)

C2. Does your milking system vacuum pump use variable speed controls?
1. Yes
2. No
98. (Don't know)
99. (Refused)

C3. Does your milk pump use variable speed controls?
1. Yes
2. No
98. (Don't know)
99. (Refused)

C4. Does your dairy facility have a milk pre-cooler (plate heat exchanger or plate cooler)?
1. Yes
2. No
98. (Don't know)
99. (Refused)

C5. **[IF C4=1]** Does the milk pre-cooler have a single-pass, double, or triple pass configuration?
1. Single
2. Double
3. Triple
4. Other (multi-pass)
98. (Don't know)
99. (Refused)

C6. What type of milk cooling compressor does your dairy facility use?
1. Reciprocating
2. Scroll
3. Other **[SPECIFY]**
98. (Don't know)
99. (Refused)

C7. How many compressors do you have?
1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

C8. Can you estimate the total combined horsepower of the compressors currently in use at your facility?
1. **[SPECIFY]**
98. (Don't know)
99. (Refused)

C9. How often does your facility participate in refrigeration tune-ups? **[IF NEEDED**: A refrigeration tune-up would include cleaning coils, inspecting and cleaning fans, and/or adding or removing refrigerant.**]**

1. Never
2. Every 5+ years
3. Every 3-5 years
4. Every 2 years
5. Annually

98. (Don't know)
99. (Refused)

C10. Does your facility have a refrigeration heat recovery unit?

1. Yes
2. No

98. (Don't know)
99. (Refused)

C11. **[IF C10=1]** Does the refrigeration heat recovery unit have a heating element?

1. Yes
2. No

98. (Don't know)
99. (Refused)

D. Farming Saturations

Now I am going to ask you about motorized equipment such as ventilation fans, circulations fans, and irrigation pumps.

D1. Does your farm have ventilation fans?

1. Yes
2. No

98. (Don't know)
99. (Refused)

D2. **[IF D1=1]** About how many ventilation fans do you have? Would you say… **[READ LIST]**

1. 1-15
2. 16-30
3. 31-50
4. 51-100
5. 101-200
6. More than 200

98. (Don't know)
99. (Refused)

D3. **[IF D1=1]** Which fan diameter range do your most common ventilation fans fall into?

1. 24-35 inches
2. 36-47 inches
3. 48-52
4. 53or greater inches

98. (Don't know)
99. (Refused)

D4. **[IF D1=1]** What types of ventilation controls do you have? **[READ LIST IF NECESSARY, MULTIPLE RESPONSES ALLOWED]**

1. Manual on/off control
2. Timer control
3. Thermostatic control
4. Manual adjust variable speed control
5. Auto variable speed control
6. Other **[SPECIFY]**

98. (Don't know)
99. (Refused)

D5. Does your farm have circulation fans?

1. Yes
2. No

98. (Don't know)
99. (Refused)

D6. **[IF D5=1]** About how many high-speed circulation fans do you have? Would you say… **[READ LIST] [IF NEEDED: a ventilation fan takes inside air and moves it outside, a circulation fan moves inside air around.]**

1. 1-15
2. 16-30
3. 31-50
4. 51-100
5. 101-200
6. More than 200

98. (Don't know)
99. (Refused)

D7. **[IF D5=1]** What fan diameter range do your most common high-speed circulation fans fall into?

1. 24-35 inches
2. 36-47 inches
3. 48-52 inches
4. 53 or greater inches

98. (Don't know)
99. (Refused)

D8. **[IF D5=1]** What types of circulation fan controls do you have? **[READ LIST IF NECESSARY, MULTIPLE RESPONSES ALLOWED]**

1. Manual on/off control
2. Timer control
3. Thermostatic control
4. Manual adjust variable speed control
5. Auto variable speed control
6. Other (please specify): **[TEXT ENTRY]**

98. (Don't know)
99. (Refused)

D9. **[IF D5=1]** What percent, if any, of the circulation fans are considered to be High Volume Low Speed Fans?

1. **[SPECIFY]**

98. (Don't know)
99. (Refused)

D10. **[IF D9>0]** What fan diameter range do your most common High Volume Low Speed fans fall into?

1. 16 feet
2. 18 feet
3. 20 feet
4. 22 feet
5. 24 feet
6. Other **[TEXT ENTRY]**

98. (Don't know)
99. (Refused)

D11. Does your facility have irrigation well pumps?

1. Yes
2. No

98. (Don't know)
99. (Refused)

D12. **[IF D11=1]** How many irrigation well pumps do you have?

1. **[SPECIFY]**
98. (Don't know)
99. (Refused)

D13. **[IF D11=1]** Of the **[ANSWER FROM D12]** irrigation well pumps, how many have an average horsepower in the ranges below? [MULTIPLE RESPONSE; AND RECORD FOR EACH SELECTED RESPONSE]

1. Less than 15 HP **[RECORD QUANTITY]**
2. 15-30 HP **[RECORD QUANTITY]**
3. 31-60 HP **[RECORD QUANTITY]**
4. 61-100 HP **[RECORD QUANTITY]**
5. More than 100 HP **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

D14. **[IF D11=1]** What percent of the well pumps are controlled by a Variable Frequency Drive (VFD)? **[READ OPTIONS]**

1. 0%
2. 25%
3. 50%
4. 75%
5. 100%
98. (Don't know)
99. (Refused)

D15. Besides ventilation, circulation, irrigation pumps, or dairy equipment does your facility have any other Variable Frequency Drives (VFDs) such as in your water systems, conveyors, and auger or mixer?

1. Yes
2. No
98. (Don't know)
99. (Refused)

D16. **[IF D15=1]** Please describe the VFD application.

1. **[SPECIFY]**
98. (Don't know)
99. (Refused)

D17. Does your facility use livestock waterers?
1. Yes
2. No
98. (Don't know)
99. (Refused)

D18. **[IF D17=1]** How many of the following types of livestock waterers do you have? **[READ LIST AND RECORD QUANTITY BELOW]**
1. Non-heated waterers **[RECORD QUANTITY]**
2. Waterers with electrical heating elements less than 250 watts **[RECORD QUANTITY]**
3. Waterers with electrical heating elements more than 250 watts **[RECORD QUANTITY]**
4. Waterers with solar power **[RECORD QUANTITY]**
5. Waterers with any other heating source **[RECORD QUANTITY]**
6. **Other [RECORD TYPE AND QUANTITY]**
98. (Don't know)
99. (Refused)

D19. How many unit heaters installed at your facility?
1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

D20. **[IF D19>0]** What is the fuel type of the unit heaters?
1. Gas
2. Electric
3. Propane
4. Other **[SPECIFY]**
98. (Don't know)
99. (Refused)

E. Crop Farm Saturation

[ASK SECTION E IF A3=4 or A4=4]

Next, we'd like to ask about farming equipment associated with field crops.

E1. Do you have Engine Block Heater Timers at your facility?
1. Yes
2. No
98. (Don't know)
99. (Refused)

E2. Do you have a Grain Dryer at your facility?
1. Yes
2. No
98. (Don't know)
99. (Refused)

E3. **[IF E2=1]** What fuel does the grain dryer use?
1. Electric
2. Gas
3. Other **[SPECIFY]**
98. (Don't know)
99. (Refused)

E4. **[IF E2=1]** How many bushels of crops do you dry annually?
1. **[SPECIFY]**
98. (Don't know)
99. (Refused)

E5. Is there an irrigation pressure reduction system installed on your farm?
1. Yes
2. No
98. (Don't know)
99. (Refused)

E6. Is there an irrigation timer installed on your farm?
1. Yes
2. No
98. (Don't know)
99. (Refused)

F. Greenhouse Saturations

[ASK SECTION F IF A3=5 or A4=5]

Next I'd like to ask you about your greenhouse space.

F1. What is the total square footage of your greenhouses?
1. **[SPECIFY]**
98. (Don't know)
99. (Refused)

F2. Are there thermal curtains installed in your greenhouses?
1. Yes
2. No
98. (Don't know)
99. (Refused)

F3. Is there energy efficient glazing installed on your greenhouse?
1. Yes
2. No
98. (Don't know)
99. (Refused)

F4. Are your greenhouses heated?
1. Yes
2. No
98. (Don't know)
99. (Refused)

F5. **[IF F4=1]** What fuel is used to heat the greenhouses?
1. Electric
2. Gas
3. Propane
4. Fuel Oil
5. Other **[SPECIFY]**
98. (Don't know)
99. (Refused)

F6. **[IF F4=1]** Is your greenhouse equipped with climate controls?
1. Yes
2. No
98. (Don't know)
99. (Refused)

G. Non-Farming Equipment Saturations

G1. What is the total gross square footage of all your primary operation buildings in your facility combined? **[IF NEEDED: 'PRIMARY OPERATION' MEANS BUILDINGS RELATED TO THE PRIMARY AGRICULTURE OF THE FARM (I.E., DAIRY-RELATED BUILDINGS FOR A DAIRY FARM). IF YOU DON'T KNOW EXACTLY, PLEASE GIVE ME YOUR BEST ESTIMATE.]**
1. **[RECORD SQUARE FOOTAGE]**
98. (Don't know)
99. (Refused)

G2. About what percent of your primary operation building square feet are heated? **[IF NEEDED: 'PRIMARY OPERATION' MEANS BUILDINGS RELATED TO THE PRIMARY AGRICULTURE OF THE FARM (I.E., DAIRY-RELATED BUILDINGS FOR A DAIRY FARM). IF YOU DON'T KNOW EXACTLY, PLEASE GIVE ME YOUR BEST ESTIMATE.]**

1. **[SPECIFY]**

98.998 (Don't know)
99.999 (Refused)

G3. **[IF G1>0]** What is the main fuel used to heat your facility?

1. Electricity
2. Natural Gas
3. Propane
4. Fuel Oil
5. None, no space heating

98. (Don't know)
99. (Refused)

G4. About what percent of your primary operation building square feet are cooled? **[IF NEEDED: IF YOU DON'T KNOW EXACTLY, PLEASE GIVE ME YOUR BEST ESTIMATE.]**

1. **[SPECIFY]**

98. (Don't know)
99. (Refused)

G5. **[IF G1>0 or G4>0]** Has maintenance been performed on your heating and/or cooling system in the last year?

1. Yes, on both
2. Yes, on heating system
3. Yes, on cooling system
4. No

98. (Don't know)
99. (Refused)

G6. How many water heaters do you have in your facility? **[IF NEEDED: "IF YOU DON'T KNOW EXACTLY, PLEASE GIVE ME YOUR BEST ESTIMATE."]**

1. **[SPECIFY]**

98. (Don't know) [SKIP TO G11]
99. (Refused) [SKIP TO G11]

G7. **[IF G6=1]** What type of water heater do you have? **[READ LIST IF NEEDED]**

1. Electric storage tank
2. Natural gas storage tank
3. Natural gas condensing storage tank
4. Electric tankless, also known as demand or instantaneous
5. Natural gas tankless, also known as demand or instantaneous
6. Heat pump water heater
7. Propane storage tank
8. Solar
9. Other **[SPECIFY]**

98. (Don't know)
99. (Refused)

G8. **[IF G7=1,2,3 OR 6]** What is the size of the tank?

1. Less than 55 gallons
2. 55 gallons or more

98. (Don't know)
99. (Refused)

G9. **[IF G6>1]** Of the **[RESPONSE FROM G6]** total water heaters, how many do you have of each of these types of water heater? **[READ LIST, RECORD QUANTITY FOR EACH TYPE]**

1. Electric storage tank
2. Natural gas storage tank
3. Natural gas condensing storage tank
4. Electric tankless, also known as demand or instantaneous
5. Natural gas tankless, also known as demand or instantaneous
6. Heat pump water heater
7. Propane storage tank
8. Solar
9. Other **[SPECIFY]**

98. (Don't know)
99. (Refused)

G10. **[IF G9=1,2,3 OR 6]** What is the size of the tank on your water heaters. If the sizes vary, tell me which size range is most common.

1. Less than 55 gallons
2. 55 gallons or more

98. (Don't know)
99. (Refused)

G11. Next I have a few questions about your lighting, first I'm going to ask about interior lighting, and then we'll move on to exterior lighting. Interior lighting fixtures could be screw-in bulbs, linear fixtures or high-bay lights mounted higher than 15 feet. Can you estimate what percentage of your interior lighting fixtures are… **[RECORD PERCENTAGE BETWEEN 0-100; 998 = (DON'T KNOW), 999 = (REFUSED)]**

1. Screw-based lighting like incandescent, CFL, or LEDs? **[RECORD PERCENT]**
2. Linear lamps or fixtures, like linear fluorescent, linear LEDs, or LED panels? **[RECORD PERCENT]**
3. High-bay lights mounted higher than 15 feet, such as metal halide, high intensity discharge, or LED fixtures? **[RECORD PERCENT]**

G12. **[IF G11.1>0]** Of the interiors screw in lights, please estimate what percentage of those bulbs are… **[RECORD PERCENTAGE BETWEEN 0-100; 998 = (DON'T KNOW), 999 = (REFUSED)]**

1. Incandescent **[RECORD PERCENT]**
2. LEDs **[RECORD PERCENT]**
3. Halogen **[RECORD PERCENT]**
4. CFLs **[RECORD PERCENT]**
5. Other **[SPECIFY AND RECORD PERCENT]**

G13. **[IF G11.2>0]** Of the interior linear lamps or fixtures, estimate what percentage are… **[RECORD PERCENTAGE BETWEEN 0-100; 998 = (DON'T KNOW), 999 = (REFUSED)]**

1. T-12, in which the bulb diameter is 1½ inch **[RECORD PERCENT]**
2. T-8, in which the bulb diameter is 1 inch **[RECORD PERCENT]**
3. T-5, in which the bulb diameter is 5/8 inch **[RECORD PERCENT]**
4. Linear LEDs, also known as TLEDs **[RECORD PERCENT]**
5. LED Panel or fixture other than Linear LED **[RECORD PERCENT]**
6. Other interior linear fluorescent fixtures **[RECORD PERCENT]**

G14. **[IF G11.3>0]** Of the interior high bay fixtures, estimate what percentage are… **[RECORD PERCENTAGE BETWEEN 0-100; 998 = (DON'T KNOW), 999 = (REFUSED)]**

1. Mercury Vapor **[RECORD PERCENT]**
2. High Pressure Sodium **[RECORD PERCENT]**
3. Pulse Start Metal Halide **[RECORD PERCENT]**
4. Ceramic Metal Halide **[RECORD PERCENT]**
5. Standard Metal Halide **[RECORD PERCENT]**
6. Induction **[RECORD PERCENT]**
7. High output T5 (T5HO) **[RECORD PERCENT]**
8. LEDs **[RECORD PERCENT]**

G15. Now I'd like to know about your exterior lighting for the same categories: Can you estimate what percentage of your exterior lighting fixtures are… **[RECORD PERCENTAGE BETWEEN 0-100; 998 = (DON'T KNOW), 999 = (REFUSED)]**

1. Screw-based lighting like incandescent, CFLs, or LEDs? **[RECORD PERCENT]**
2. Linear lamps or fixtures, like linear fluorescent, linear LEDs, or LED panels? **[RECORD PERCENT]**
3. High-bay lights mounted higher than 15 feet, such as metal halide, high intensity discharge, or LED fixtures? **[RECORD PERCENT]**

G16. What percentage of your indoor lighting fixtures are controlled by…? **[READ LIST IF NEEDED]**

1. Occupancy sensors **[RECORD PERCENTAGE (0-100)]**
2. Dimmers **[RECORD PERCENTAGE (0-100)]**
3. Electronic sweep timers **[RECORD PERCENTAGE (0-100)]**
4. Photosensors, or daylight sensors **[RECORD PERCENTAGE (0-100)]**
5. Networked lighting controls **[RECORD PERCENTAGE (0-100)]**
6. Lighting controlled by Energy Management System **[RECORD PERCENTAGE (0-100)]**
7. No automatic controls, just light switches **[RECORD PERCENTAGE (0-100)]**
8. Other **[SPECIFY] [RECORD PERCENTAGE (0-100)]**

98. (Don't know)
99. (Refused)

G17. Does your facility include commercial refrigeration equipment, such as walk-in coolers or freezers?

1. Yes
2. No

98. (Don't know)
99. (Refused)

G18. **[IF G17=1]** Please tell me how many of each type of refrigeration equipment your facility has. **[READ LIST, RECORD QUANTITY; 998 = (DON'T KNOW), 998 = (REFUSED)]**

1. Walk-in coolers **[RECORD QUANTITY]**
2. Walk-in freezers **[RECORD QUANTITY]**
3. Ice machine **[RECORD QUANTITY]**
4. Other refrigerator equipment **[SPECIFY AND RECORD QUANTITY]**

G19. **[IF G17=1]** Do you recover waste heat from any of your refrigeration systems to heat water?

1. Yes
2. No

98. (Don't know)
99. (Refused)

G20. **[IF G17=1]** Has some or all of your refrigeration equipment been re-commissioned in the past five years? **[IF NEEDED: Re-commissioning is bringing existing equipment back up to optimal working condition.]**

1. Yes, all of the equipment
2. Yes, some but not all of the equipment
3. No

98. (Don't know)
99. (Refused)

H. Willingness to Pay

H1. It sometimes costs more to buy energy-efficient equipment up front, but then operating costs are less over the life of the equipment because of energy savings. Please indicate if you would be very likely, somewhat likely, not too likely, or not at all likely to install each of the technologies we will be asking about. **[DROPDOWN RESPONSE FOR I, II, III AND IV :OPTION OF 1 = Very likely, 2 = Somewhat likely, 3 = Not too likely, 4 = Not at all likely, 5 = Already have it/have done it, 98 = Don't know, 99 = Refused]**

Options		i.	ii.	iii.	iv.
	The estimated price difference between standard and efficient technology is:	How likely would you be to [A-J] in the next five years if Focus on Energy paid for 25% of the difference in cost between the standard and efficient option? [PRICE DIFFERENCE TEXT IF NEEDED] [IF RESPONSE = 2-4, ASK ii]	What if Focus on Energy paid for half of the difference in price? [IF RESPONSE = 2-4, ASK iii]]	And what if Focus on Energy paid 75% of the difference in price? [IF RESPONSE = 2-4, ASK iv]	What if Focus on Energy paid the full difference in price for the more efficient option? [INSERT OPTION]?
(a) **[IF A3 =1]** Install energy-efficient dairy process cooling equipment?	$6,000 more expensive for the efficient technology.				
(b) **[IF A3 =1]** Install energy-efficient dairy milking equipment?	$3,500 more expensive for the efficient technology.				
(c) **[IF A3 =1,2,3 OR A4 =1,2,3]** Install energy-efficient livestock waterers?	$700 more expensive for the efficient technology.				
(d) Install energy-efficient circulation and ventilation fans?	$150 per fan more than standard equipment.				

Options		i.	ii.	iii.	iv.
	The estimated price difference between standard and efficient technology is:	How likely would you be to [A-J] in the next five years if Focus on Energy paid for 25% of the difference in cost between the standard and efficient option? [PRICE DIFFERENCE TEXT IF NEEDED] [IF RESPONSE = 2-4, ASK ii]	What if Focus on Energy paid for half of the difference in price? [IF RESPONSE = 2-4, ASK iii]]	And what if Focus on Energy paid 75% of the difference in price? [IF RESPONSE = 2-4, ASK iv]	What if Focus on Energy paid the full difference in price for the more efficient option? [INSERT OPTION]?
(e) **[IF A3 =5 OR A4 =5]** Install energy-efficient greenhouse climate controls?	$800 more than standard controls.				
(f) **[IF A3 =4 OR A4 =4]** Install energy-efficient irrigation improvements?	15% to 20% more expensive than standard equipment.				
(g) **[IF A3 =4 OR A4 =4]** Install energy-efficient grain drying controls?	$20,000 more than standard equipment.				
(h) Install energy-efficient lighting?	About $20 more expensive per linear fixture for the efficient technology.				
(i) Install energy-efficient water heating equipment?	$1,100 more than standard equipment.				
(j) Install energy-efficient space heating equipment?	$1,200 more than standard equipment.				

Those are all the questions I have. Thank you for your time and the valuable information you shared with us.

Focus on Energy 2020 Potential Study Commercial Survey

To inform the energy-efficiency potential study and future program design, Cadmus will conduct telephone surveys with 630 commercial facilities in Focus on Energy territory. Cadmus will use the surveys to gather data to supplement existing saturation data and collect information on building characteristics. The survey explores the research topics presented the following table.

Commercial Sector Research Topics

Section Name	Researchable Questions	Questions
Introduction and Screening	Screening to identify target respondent	A
Building Characteristics	Facility type (office, retail, etc.) Facility size (sq. ft. and # of stories) Ownership Number of employees Hours of operation	B
Fuel Shares and Saturations	HVAC Water heat Water-use Lighting Refrigeration Other	C D E F G H
Willingness to Pay	Willingness to Pay	I

Target Quota = 630 completes: 70 in each building segment: Office, Retail, Health Care, Lodging, Grocery, Warehouse, Restaurant, School, Other. Additional upper and lower energy consumption quotas provided.

General Instructions

- Interviewer instructions are in green **[LIKE THIS]** (the style is "Survey: Interviewer Instructions").
- CATI programming instructions are in red **[LIKE THIS]** (the style is "Survey: Programming").
- Items that should not be read by the interviewer are in parentheses like this ( ).

A. Introduction and Screening

My name is **[INTERVIEWER NAME]** and I'm calling on behalf of Wisconsin Focus on Energy. We are conducting an important study to understand how businesses in Wisconsin use energy. This is not a sales call. Your answers are confidential and will help Focus design programs to help you save energy and money. Our questions are primarily about how your business uses energy.

[IF RESPONDENT ASKS "HOW LONG": THIS SURVEY SHOULD TAKE ABOUT 10 MINUTES.]

A1. Are you the person in your organization who is responsible for facilities and/or energy-related decisions? **[IF NEEDED: THIS WOULD BE THE PERSON WHO OVERSEES SPENDING ON ELECTRICITY AND EQUIPMENT THAT USES ENERGY, SUCH AS LIGHTING AND HEATING. IT MAY BE THE BUSINESS OWNER, OR THE DIRECTOR OF FACILITIES, OPERATIONS, OR ENGINEERING.]**
   1. Yes **[RECORD NAME AND TITLE]**
   2. No **[ASK IF YOU CAN SPEAK TO THE PERSON WHO WOULD BE INVOLVED. IF AVAILABLE, REPEAT INTRODUCTION AND CONTINUE. IF NOT AVAILABLE, SCHEDULE BETTER TIME TO CALL BACK.]**
   98. (Don't know) **[ASK IF YOU CAN SPEAK TO THE PERSON WHO WOULD BE INVOLVED. IF AVAILABLE, REPEAT INTRODUCTION AND CONTINUE. IF NOT AVAILABLE, SCHEDULE BETTER TIME TO CALL BACK.]**
   99. (Refused) **[THANK AND TERMINATE]**

A2. What is the primary use of your facility? Is it primarily used for **[READ LIST]**, or something else?
   1. Retail
   2. Office, including government offices, banking centers, or any other type of office space
   3. Restaurant
   4. School (K-12 or College/University)
   5. Healthcare (Hospital or Clinic)
   6. Lodging
   7. Grocery (Supermarket/Convenience)
   8. Warehouse (Refrigerated/Non-Refrigerated)
   9. Other type of commercial facility **[SPECIFY]**
   98. (Don't know) **[THANK AND TERMINATE]**
   99. (Refused) **[THANK AND TERMINATE]**

[IF A2 ≠ 1-9 <u>OR</u> IF QUOTA FOR FACILITY TYPE REACHED] "We don't need any additional data for that type of facility right now." **[THANK AND TERMINATE]**

A3. **[ASK IF A2 = 2, 4, 5, OR 9]** Is your facility operated by the local, county, state or federal government?
   1. Yes
   2. No
   98. (Don't know)
   99. (Refused)

B. Building Characteristics

I have a few questions about your facility.

B1. How many buildings are in your facility?
   1. **[RECORD QUANTITY]**
   98. (Don't know)
   99. (Refused)

B2. **[IF B1 QUANTITY = 1 OR B1 = 98-99]** What is the total gross square footage of your building? **[IF B1 QUANTITY>1]** What is the total gross square footage of all the buildings in your facility combined? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**

1. **[RECORD SQUARE FOOTAGE]**
98. (Don't know)
99. (Refused)

B3. **[IF B1 QUANTITY = 1 OR B1 = 98-99]** How many stories does your building have? **[IF B1 QUANTITY>1]** On average, about how many floors do the buildings in your facility have?

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

B4. What percentage of the total gross square footage of your facility is heated or cooled? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**

1. **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

B5. **[TEXT : IF B1 QUANTITY = 1 OR B1 = 98-99]** When was the building built? **[IF B1 QUANTITY > 1]** When were the buildings built? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]** **[READ LIST IF NEEDED]** **[ALLOW MULTIPLE RESPONSES]**

1. Before 1950
2. 1950 – 1959
3. 1960 – 1969
4. 1970 – 1979
5. 1980 – 1989
6. 1990 – 1999
7. 2000 – 2009
8. 2010 or after
98. (Don't know)
99. (Refused)

B6. Do you own or lease your building?

1. Own
2. Lease
3. Other **[SPECIFY]**
98. (Don't know)
99. (Refused)

B7. How many hours does your facility operate during a typical weekday? **[IF NEEDED:** If operation varies day to day, please estimate the average hours per day between Monday and Friday.**]**
1. **[RECORD NUMBER (0-24)]**
98. (Don't know)
99. (Refused)

B8. How many hours does your facility operate on a typical Saturday? **[IF NEEDED:** If operation varies, please estimate the hours for an average Saturday.**]**
1. **[RECORD NUMBER (0-24)]**
98. (Don't know)
99. (Refused)

B9. How many hours does your facility operate on a typical Sunday? **[IF NEEDED:** If operation varies, please estimate the hours for an average Sunday.**]**
1. **[RECORD NUMBER (0-24)]**
98. (Don't know)
99. (Refused)

B10. How many employees work in your facility? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**
1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

B11. Does your facility have a parking garage?
1. Yes
2. No
98. (Don't know)
99. (Refused)

B12. **[IF B11 = 1]** Does the parking garage have carbon monoxide sensors to control ventilation fans?
1. Yes
2. No
98. (Don't know)
99. (Refused)

C. Saturation: HVAC

Now I have some questions about heating and cooling in your facility.

C1. What is the main fuel used to heat your facility? **[READ LIST IF NEEDED]**

1. Electricity
2. Natural Gas
3. Propane
4. Fuel Oil
5. None, no space heating

98. (Don't know)
99. (Refused)

C2. **[IF C1 ≠ 3, 4, 5]** About what percent of your floor space is heated? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**

1. **[RECORD PERCENTAGE (0-100)]**

98. (Don't know)
99. (Refused)

C3. **[IF C2 > 0]** What is the main type of equipment used for space or comfort heating in your facility? **[READ LIST IF NEEDED]**

1. Hot water boiler
2. Steam boiler
3. Forced air furnace
4. Electric resistance baseboard
5. Air source heat pump
6. Ground source heat pump
7. Mini-split heat pump
8. In-room packaged units
9. Rooftop packaged units
10. Other **[SPECIFY]**

98. (Don't know)
99. (Refused)

C4. **[IF C3 = 5, 6, 7]** What is the fuel type for back-up heating systems that supplement heat pump heating, if any?

1. Electricity
2. Natural Gas
3. Propane
4. Fuel Oil
5. None, no back-up heating
6. Other **[SPECIFY]**

98. (Don't know)
99. (Refused)

C5. **[IF C1 ≠ 3, 4, 5 AND C2 > 0 AND C3 ≠ 4]** About how old is the main heating equipment? **[READ LIST IF NEEDED]**

1. 2 years or less
2. 3 to 5 years
3. 6 to 10 years
4. 11 to 15 years
5. Over 15 years

98. (Don't know)
99. (Refused)

C6. What is the main type of equipment used for space or comfort cooling in your facility? **[READ LIST IF NEEDED]**

1. Central chilled water plant with constant volume air handler
2. Central chilled water plant with local variable air volume terminal units
3. Chiller – water cooled
4. Chiller – air cooled
5. Packaged rooftop units
6. Air source heat pumps
7. Ground source heat pumps
8. Mini-split air conditioner
9. Mini-split heat pump
10. Window in-room units
11. Packaged Terminal Air Conditioner
12. None, no space cooling
13. Other **[SPECIFY]**

98. (Don't know)
99. (Refused)

C7. **[IF C6 ≠ 12]** About what percent of your floor space is cooled? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**

1. **[RECORD PERCENTAGE (0-100)]**

98. (Don't know)
99. (Refused)

C8. **[IF C6 ≠ 12]** About how old is this cooling equipment? **[IF NEEDED:** If you have multiple units, please give me an estimate of their average age.**]** **[READ LIST IF NEEDED]**

1. 2 years or less
2. 3 to 5 years
3. 6 to 10 years
4. 11 to 15 years
5. Over 15 years

98. (Don't know)
99. (Refused)

C9. **[IF C6 = 1–6]** Does your cooling system use an economizer or free cooling? **[IF NEEDED:** An economizer uses outside air to cool a space when the temperature outside is below the temperature inside or uses water from a cooling tower when possible to reduce use of the chiller.**]**

1. Yes
2. No
98. (Don't know)
99. (Refused)

C10. **[IF C3 = 1, 2, 3, 5, 6 OR C6 = 1–7]** Has maintenance been performed on your heating and/or cooling system in the last year?

1. Yes, on both
2. Yes, on heating system
3. Yes, on cooling system
4. No
98. (Don't know)
99. (Refused)

C11. **[IF C3 = 1-7 OR C6 = 1–7]** What sort of device controls your primary heating and cooling system? **[ALLOW MULTIPLE RESPONSES]**

1. Manual setpoint control
2. Programmable setpoint thermostat
3. Wi-Fi–enabled programmable thermostat
4. Smart thermostat (i.e., Nest, Ecobee 3)
5. Energy Management System
6. Direct Digital Controls (DDC)
7. Other (please specify) **[TEXT ENTRY]**
98. (Don't know)
99. (Refused)

D. Saturation: Water Heat

D1. How many water heaters do you have in your facility? Note that this number should not include a boiler, even if it is used to provide domestic hot water. **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

D2. **[IF D1 QUANTITY = 1]** What type of water heater do you have? **[READ LIST IF NEEDED]**

1. Electric storage tank
2. Natural gas storage tank
3. Natural gas condensing storage tank
4. Electric tankless **[ALSO KNOWN AS DEMAND OR INSTANTANEOUS]**
5. Natural gas tankless **[ALSO KNOWN AS DEMAND OR INSTANTANEOUS]**
6. Heat pump water heater
7. Solar
8. Other **[SPECIFY; PROMPT FOR FUEL AND TYPE]**

98. (Don't know)
99. (Refused)

D3. **[IF D1 QUANTITY = 1 AND D2 = 1, 2, 3, 6]** What is the size of the tank? **[READ LIST IF NEEDED]**

1. Less than 55 gallons
2. 55 gallons or more

98. (Don't know)
99. (Refused)

D4. **[IF D1 QUANTITY > 1]** How many do you have of each of these types of water heater?

1. Electric storage tank water heater **[RECORD QUANTITY]**
2. Natural gas storage tank water heater **[RECORD QUANTITY]**
3. Natural gas condensing storage tank water heater**[RECORD QUANTITY]**
4. Electric tankless water heater **[RECORD QUANTITY] [IF NEEDED:** This type is also known as demand or instantaneous.**]**
5. Natural gas tankless water heater **[RECORD QUANTITY] [IF NEEDED:** This type is also known as demand or instantaneous.**]**
6. Heat pump water heater **[RECORD QUANTITY]**
7. Solar water heater **[RECORD QUANTITY]**
8. Other **[SPECIFY; PROMPT FOR FUEL AND TYPE] [RECORD QUANTITY]**

98. (Don't know)
99. (Refused)

D5. **[FOR EACH D4 IF 1, 2, 3, 6]** What is the size of the tank on your **[D4 RESPONSE] [IF D4 QUANTITY = 1]** water heater? **[IF D4 QUANTITY>1]** water heaters? If the sizes vary, tell me which size range is most common. **[READ LIST IF NEEDED]**

1. Less than 55 gallons
2. 55 gallons or more

98. (Don't know)
99. (Refused)

E. Saturation: Water-Use Equipment

E1. How many showers does your facility currently have? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**
   1. **[RECORD QUANTITY]**
   98. (Don't know)
   99. (Refused)

E2. **[IF E1 QUANTITY > 1]** How many of your showers have low-flow showerheads installed on them? **[IF NEEDED:** Low-flow showerheads use less water than conventional showerheads.**] [IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**
   1. **[RECORD QUANTITY] [QUANTITY SHOULD BE LESS THAN OR EQUAL TO E1]**
   98. (Don't know)
   99. (Refused)

E3. **[IF E1 QUANTITY = 1]** Does your shower have a low-flow showerhead?
   1. Yes
   2. No
   98. (Don't Know)
   99. (Refused)

E4. How many kitchen sinks does your facility have? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**
   1. **[RECORD QUANTITY]**
   98. (Don't know)
   99. (Refused)

E5. **[IF E4 QUANTITY > 1]** How many of your kitchen sink faucets have low-flow aerators installed on them? **[IF NEEDED:** Low-flow aerators are installed on the tip of faucets to save water.**] [IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**
   1. **[RECORD QUANTITY] [QUANTITY SHOULD BE LESS THAN OR EQUAL TO E4]**
   98. (Don't know)
   99. (Refused)

E6. **[IF E4 QUANTITY = 1]** Does your kitchen sink have a low-flow faucet aerator?
   1. Yes
   2. No
   98. (Don't Know)
   99. (Refused)

E7. How many lavatory sinks does your facility have? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**
   1. **[RECORD QUANTITY]**
   98. (Don't know)
   99. (Refused)

E8. **[IF E7 QUANTITY > 1]** How many of your lavatory sink faucets have low-flow faucet aerators installed on them? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**
   1. **[RECORD QUANTITY] [QUANTITY SHOULD BE LESS THAN OR EQUAL TO E7]**
   98. (Don't know)
   99. (Refused)

E9. **[IF E7 QUANTITY = 1]** Does your lavatory sink have a low-flow faucet aerator?
   1. Yes
   2. No
   98. (Don't Know)
   99. (Refused)

F. Saturation: Lighting

Next, I have a few questions about your lighting. First, I'm going to ask about interior lighting, and then we'll move on to exterior lighting.

F1. Please estimate what percentage of your interior lighting fixtures are screw-base bulbs; linear lamps; or high bay fixtures (15 ft or higher)? Let's start with… **[ENSURE TOTAL ACROSS RESPONSE OPTIONS SUMS TO 100%]**
   1. Screw-based incandescent, compact fluorescent, halogen, or LED bulbs **[RECORD PERCENTAGE (0-100)] [IF NEEDED:** This includes several types of light bulbs that are screwed in.**]**
   2. Linear lamps (i.e., fluorescent or LED tubes, troffer fixtures) **[RECORD PERCENTAGE (0-100)]**
   3. High bay fixtures (15 ft or higher) (e.g., high-intensity discharge lights) s **[RECORD PERCENTAGE (0-100)] [IF NEEDED:** HID lighting includes metal halide and high-pressure sodium, and LED.**]**
   4. Other **[SPECIFY] [RECORD PERCENTAGE (0-100)]**
   98. (Don't Know)
   99. (Refused)

F2. **[IF F1.1 QUANTITY > 0]** Of the interior screw-based bulbs, please estimate what percentage of the bulbs are incandescent, CFL, halogen, and LED. Let's start with… **[ENSURE TOTAL ACROSS RESPONSE OPTIONS SUMS TO 100%]**

1. Incandescent **[RECORD PERCENTAGE (0-100)]** **[IF NEEDED:** Incandescent bulbs are traditional lightbulbs.**]**
2. CFL, or compact fluorescent **[RECORD PERCENTAGE (0-100)]** **[IF NEEDED:** CFL bulbs are typically spiral shaped and have a ceramic base.**]**
3. Halogen **[RECORD PERCENTAGE (0-100)]** **[IF NEEDED:** Halogen bulbs look like traditional incandescent bulbs but use a tube rather than a filament.**]**
4. LED, or light emitting diode **[RECORD PERCENTAGE (0-100)]** **[IF NEEDED:** LED bulbs typically look like traditional incandescent bulbs but have a heavier bulb and a ceramic base.**]**

98. (Don't Know)
99. (Refused)

F3. **[IF F1.2 QUANTITY > 0]** Of the interior linear fixtures, please estimate what percentage are T-12, T-8, T-5, linear LEDs, and LED panels. Let's start with… **[ENSURE TOTAL ACROSS RESPONSE OPTIONS SUMS TO 100%]**

1. T-12, in which the bulb diameter is 1½" **[RECORD PERCENTAGE (0-100)]**
2. Reduced-wattage T-8, in which the bulb diameter is 1" **[RECORD PERCENTAGE (0-100)]**
3. High-performance T-8, in which the bulb diameter is 1" **[RECORD PERCENTAGE (0-100)]**
4. T-5, in which the bulb diameter is 5/8" **[RECORD PERCENTAGE (0-100)]**
5. Linear LEDs **[RECORD PERCENTAGE (0-100)]**
6. LED Panels **[RECORD PERCENTAGE (0-100)]**

98. (Don't Know)
99. (Refused)

F4. **[IF F1.3QUANTITY > 0]** Of the interior high bay fixtures, please estimate what percentage are Mercury Vapor, High Pressure Sodium, Metal Halide, Pulse Start Metal Halide, Ceramic metal halide, Induction, High output T5 (T5HO), and LEDs. Let's start with… **[ENSURE TOTAL ACROSS RESPONSE OPTIONS SUMS TO 100%]**

1. Mercury Vapor **[RECORD PERCENTAGE (0-100)]**
2. High Pressure Sodium **[RECORD PERCENTAGE (0-100)]**
3. Metal Halide **[RECORD PERCENTAGE (0-100)]**
4. Pulse Start Metal Halide **[RECORD PERCENTAGE (0-100)]**
5. Ceramic metal halide **[RECORD PERCENTAGE (0-100)]**
6. Induction **[RECORD PERCENTAGE (0-100)]**
7. High output T5 (T5HO) **[RECORD PERCENTAGE (0-100)]**
8. LEDs **[RECORD PERCENTAGE (0-100)]**

98. (Don't Know)
99. (Refused)

F5. What percentage of your indoor lighting fixtures are controlled by…? **[READ LIST IF NEEDED] [ALLOW MULTIPLE RESPONSES] [MUST SUM TO 100%]**
   1. Occupancy sensors **[RECORD PERCENTAGE (0-100)]**
   2. Dimmers **[RECORD PERCENTAGE (0-100)]**
   3. Electronic sweep timers **[RECORD PERCENTAGE (0-100)]**
   4. Photosensors, or daylight sensors **[RECORD PERCENTAGE (0-100)]**
   5. Networked lighting controls **[RECORD PERCENTAGE (0-100)]**
   6. Lighting controlled by Energy Management System **[RECORD PERCENTAGE (0-100)]**
   7. No automatic controls, just light switches **[RECORD PERCENTAGE (0-100)]**
   8. Other **[SPECIFY] [RECORD PERCENTAGE (0-100)]**
   98. (Don't know)
   99. (Refused)

F6. Approximately, how many Exit lighting signs do currently have in your facility?
   1. **[RECORD QUANTITY]**
   98. (Don't know)
   99. (Refused)

Now I'd like to know about your exterior lighting.

F7. Can you estimate what percentage of your exterior lighting fixtures screw-base bulbs; linear fluorescents; and high-intensity discharge lights? Let's start with… **[ENSURE TOTAL ACROSS RESPONSE OPTIONS SUMS TO 100%]**
   1. Incandescent, compact fluorescent, halogen, or LED screw-base bulbs **[RECORD PERCENTAGE (0-100)] [IF NEEDED:** This includes several types of light bulbs that are screwed in.**]**
   2. Linear fluorescent **[RECORD PERCENTAGE (0-100)]**
   3. High intensity discharge or HID and metal halides **[RECORD PERCENTAGE (0-100)] [IF NEEDED:** HID lighting includes metal halide and high-pressure sodium.**]**
   98. (Don't Know)
   99. (Refused)

G. Saturation: Refrigeration

G1. Does your facility include commercial refrigeration equipment?
   1. Yes
   2. No
   98. (Don't know)
   99. (Refused)

G2. **[IF G1 = 1]** Please tell me how many your facilities has of each of these types of equipment. **[IF NEEDED:** If you don't know exactly, please give me your best estimate.] **[RECORD QUANTITY FOR EACH, 98=DON'T KNOW, 99=REFUSED]**

1. Standalone front opening refrigerator with glass door **[RECORD QUANTITY]**
2. Standalone front opening refrigerator with solid door **[RECORD QUANTITY]**
3. Retail display refrigerator case **[RECORD QUANTITY]**
4. Walk-in coolers **[RECORD QUANTITY]**
5. Walk-in freezer **[RECORD QUANTITY]**
6. Standalone front opening freezer with glass door **[RECORD QUANTITY]**
7. Standalone front opening freezer with solid door **[RECORD QUANTITY]**
8. Retail display freezer case **[RECORD QUANTITY]**
9. Ice machine **[RECORD QUANTITY]**

G3. **[IF G2.3 QUANTITY > 0]** Do you use night covers on some or all of your open refrigerator display cases?

1. Yes, on all of the open cases
2. Some, but not all of the open cases
3. No

98. (Don't know)
99. (Refused)

G4. **[IF G2.3 OR G2.8 QUANTITY > 0]** Do you have LED lighting in some or all of your refrigerator and freezer display cases? **[IF NEEDED:** LED is an efficient type of lighting that can be used in display cases instead of linear fluorescent lights.**]**

1. Yes, in all of the cases
2. Some, but not all of the cases
3. No

98. (Don't know)
99. (Refused)

G5. **[IF G2.3 OR G2.8 QUANTITY > 0]** Do you have motion sensors in some or all of your display cases to control the lighting?

1. Yes, in all of the cases
2. Some, but not all of the cases
3. No

98. (Don't know)
99. (Refused)

G6. **[IF G2.3 OR G2.8 QUANTITY > 0]** Do you have anti-sweat controls in some or all of your display cases?

1. Yes, in all of the cases
2. Some, but not all of the cases
3. No
98. (Don't know)
99. (Refused)

G7. **[IF G2.3, G2.4, G2.5, G2.8, OR G2.9 QUANTITY > 0]** Do you recover waste heat from any of your refrigeration systems to heat water?

1. Yes
2. No
98. (Don't know)
99. (Refused)

G8. **[IF G2.3, G2.4, G2.5, G2.8, OR G2.9 QUANTITY > 0]** Has some or all of your refrigeration equipment been re-commissioned in the past five years?

1. Yes, all of the equipment
2. Yes, some but not all of the equipment
3. No
98. (Don't know)
99. (Refused)

H. Saturation: Other Equipment

H1. Does your facility include a commercial kitchen?

1. Yes
2. No
98. (Don't know)
99. (Refused)

H2. **[IF H1 = 1]** Please tell me how many your facility has of each of these types of kitchen equipment. **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**

1. Microwave **[RECORD QUANTITY]**
2. Electric convection oven **[RECORD QUANTITY]**
3. Gas convection oven **[RECORD QUANTITY]**
4. Electric Combination Oven **[RECORD QUANTITY]**
5. Gas Combination Oven **[RECORD QUANTITY]**
6. Electric conveyor oven **[RECORD QUANTITY]**
7. Gas conveyor oven **[RECORD QUANTITY]**
8. Electric fryer **[RECORD QUANTITY]**
9. Gas fryer **[RECORD QUANTITY]**
10. Electric griddle **[RECORD QUANTITY]**

11. Gas griddle **[RECORD QUANTITY]**
12. Electric hot food holding cabinet **[RECORD QUANTITY]**
13. Electric Steam cooker **[RECORD QUANTITY]**
14. Gas Steam cooker **[RECORD QUANTITY]**
15. Gas rack oven **[RECORD QUANTITY]**
16. Gas Broiler **[RECORD QUANTITY]**
17. Commercial dishwasher **[RECORD QUANTITY]**
18. Pre-rinse spray valves **[RECORD QUANTITY]**
19. Hand wrap machine **[RECORD QUANTITY]**
20. Residential size dishwasher **[RECORD QUANTITY]**

98. (Don't know)
99. (Refused)

H3. Do you have any clothes washers in your facility?

1. Yes
2. No

98. (Don't know)
99. (Refused)

H4. **[IF H3 = 1]** How many commercial-sized clothes washers do you have? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**

1. **[RECORD QUANTITY]**

98. (Don't know)
99. (Refused)

H5. **[IF H3 = 1]** How many residential-sized clothes washers do you have? **[IF NEEDED:** If you don't know exactly, please give me your best estimate.**]**

1. **[RECORD QUANTITY]**

98. (Don't know)
99. (Refused)

H6. **[IF H3 = 1]** Which of the following best describes the majority of the clothes washers?

1. Front-loading
2. Top-Loading
3. Other **[SPECIFY]**

98. (Don't know)
99. (Refused)

H7. Has your building been commissioned during the last year? **[IF NEEDED:** Commissioning ensures installed energy-using systems operate in an optimal fashion to maximize energy efficiency. The commissioning process can be applied to existing buildings, restoring them to optimal performance, or to new construction, ensuring that the building operates as designed. Commissioning is a systematic, documented process, identifying low-cost operational and maintenance improvements.**]**

1. Yes
2. No

98. (Don't know)
99. (Refused)

I. Willingness to Pay

I1. It sometimes costs more to buy energy-efficient equipment up front, but then operating costs are less over the life of the equipment because of energy savings. Please indicate if you would be very likely, somewhat likely, not too likely, or not at all likely to install each of the technologies we will be asking about: [Dropdown response for each option of 1 = Very likely, 2 = Somewhat likely, 3 = Not too likely, 4 = Not at all likely, 5 = Already have it/have done it, 98 = Don't know, 99 = Refused]

Options		i.	ii.	iii.	iv.
	The estimated price difference between standard and efficient technology is:	How likely would you be to install [ITEMS A-D] in the next five years if Focus on Energy paid for 25% of the difference in cost between the standard and efficient option? [READ TEXT ON ESTIMATED PRICE DIFFERENCE IF NEEDED] [IF RESPONSE = 2-4, ASK ii]	What if Focus on Energy paid for half of the difference in price? [IF RESPONSE = 2-4, ASK iii]]	And what if Focus on Energy paid 75% of the difference in price? [IF RESPONSE = 2-4, ASK iv]	What if Focus on Energy paid the full difference in cost for the more efficient option? [INSERT OPTION]?
(a) Install energy-efficient lighting to replace a lamp/fixture that has failed?	[IF F1.2 > 0] About $20 more expensive per linear fixture for the efficient technology. [IF F1.2 = 0] 15 to 25 percent more expensive for the efficient technology.				

Options		i.	ii.	iii.	iv.
	The estimated price difference between standard and efficient technology is:	How likely would you be to install [ITEMS A-D] in the next five years if Focus on Energy paid for 25% of the difference in cost between the standard and efficient option? [READ TEXT ON ESTIMATED PRICE DIFFERENCE IF NEEDED] [IF RESPONSE = 2-4, ASK ii]	What if Focus on Energy paid for half of the difference in price? [IF RESPONSE = 2-4, ASK iii]]	And what if Focus on Energy paid 75% of the difference in price? [IF RESPONSE = 2-4, ASK iv]	What if Focus on Energy paid the full difference in cost for the more efficient option? [INSERT OPTION]?
(b) Install energy-efficient air conditioning equipment to replace equipment that has failed?	This would be about $250 more expensive per ton for the efficient model compared to a standard model.				
(c) Install energy-efficient space heating equipment to replace equipment that has failed?	About $21 more expensive per kBTUH for the efficient technology. For example, a 100 kBTUH (about 8-tons) system would be $2,100 more expensive for the efficient technology				
(d) Make improvements to your building envelope, such as insulation or energy-efficient windows?	About 90 cents per square foot. For example, for a 10,000 square foot building, it would cost about $9,000 to improve the envelope.				

Those are all the questions I have. Thank you for your time and the valuable information you shared with us.

Focus on Energy 2020 Potential Study: Income Qualified Residential Survey

To inform the energy-efficiency potential study and future program design, Cadmus will conduct telephone surveys with 140 income qualified residential utility customers in Focus on Energy territory. Cadmus will use the surveys to estimate residential energy efficiency potential in the income-qualified sector. The table illustrates the research topics of this survey.

Commercial Sector Research Topics

Section Name	Researchable Questions	Questions
Introduction and Screening	Screening to identify target respondent	A
Home characteristics	Home vintage Home size	B
Lighting Saturations	Saturations of different blub types	C
HVAC Saturations	Fuel shares Heating system type Cooling system type Thermostat type	D
Water Heater Saturations	Water heater type and fuel Water heater insulation	E
Large Appliance Saturations	Refrigerators and freezers Cooking/kitchen appliances Clothes washers/dryers	F
Small Appliance Saturations	Electronics Advanced power strips	G
Water-using Equipment Saturations	Showers/faucets Aerators	H
Building Shell	Windows Insulation Air sealing	I

Target Quota = [140 completes, 70 in single-family homes and 70 in multifamily homes]

General Instructions

- Interviewer instructions are in green **[LIKE THIS]** (the style is "Survey: Interviewer Instructions").
- CATI programming instructions are in red **[LIKE THIS]** (the style is "Survey: Programming").
- Items that should not be read by the interviewer are in parentheses like this ( ).

A. Introduction and Screening

My name is **[INTERVIEWER NAME]** and I'm calling on behalf of Wisconsin Focus on Energy. **[IF NEEDED**: Focus on Energy is a statewide Program funded through contributions from participating utilities. Focus on Energy provides financial incentives for energy efficient equipment.**]** We are conducting an important study to understand how households in Wisconsin use energy. This is not a sales call. Your answers are confidential and will help Focus design programs to help you save energy and money. Our questions are primarily about how you use energy and the energy-using appliances in your home.

For this survey we are specifically collecting information from households that would qualify for additional assistance from Focus on Energy based on their income level and family size. The information that we gather from this survey will help Focus on Energy design programs for customers whose income is 80% or less of the Wisconsin Median Income.

[IF RESPONDENT ASKS "HOW LONG": THIS SURVEY SHOULD TAKE ABOUT 20 MINUTES.]

First, I need to establish if you meet income qualification criteria for additional incentives through Focus on Energy programs.

A1. How many members does your household currently have, including children?

1. **[RECORD QUANTITY]**
98. (Don't know) **[THANK AND TERMINATE]**
99. (Refused) **[THANK AND TERMINATE]**

A2. **WHAT IS YOUR APPROXIMATE MONTHLY HOUSEHOLD INCOME BEFORE TAXES?**

1. **[RECORD QUANTITY]**
98. (Don't know) **[THANK AND TERMINATE]**
99. (Refused) **[THANK AND TERMINATE]**

[DETERMINE INCOME ELIGIBLITY BASED ON RESPONSES TO A1 AND A2, AND TABLE BELOW. IF MONTHLY INCOME LESS THAN INCOME IN TABLE FOR HOUSHOLD SIZE ELIGIBLE. IF NOT, NOT ELEIGIBLE. IF RESPONDENT ELIGIBILE: You qualify to take this survey based on your household size. We now have some additional questions for you**. IF INELIGIBLE: THANK YOU, UNFORTUNATELY YOU DO NOT QUALIFY FOR THIS SURVEY.]**

Focus on Energy Tier 2 Benefits

Persons in Household	1	2	3	4	5	6	7	8	9	10	11
80% of State Monthly Median Income ($)	3,186	4,166	5,146	6,127	7,107	8,087	8,271	8,455	8,639	8,822	9,006

98. **(DON'T KNOW) [TERMINATE]**
99. **(REFUSED) [TERMINATE]**

A3. Are you typically involved in making decisions about how energy is used in your home, such as buying appliances or heating equipment, or making your home more energy efficient?
1. Yes
2. No **[ASK TO SPEAK WITH SOMEONE WHO IS INVOLVED AND REPEAT QUESTION]** **[TERMINATE]**

A4. Which of the following best describes your home?
1. Single-family home
2. Apartment with 4 or more units
3. Condominium with 4 or more units
4. Duplex with 2 units
5. Townhome
6. Apartment or condominium with 2 to 3 units
7. Manufactured home
98. (Don't know) **[TERMINATE]**
99. (Refused) **[TERMINATE]**

A5. Do you own or rent your home?
1. Own
2. Rent
98. (Don't know) **[TERMINATE]**
99. (Refused) **[TERMINATE]**

[IF A4=1,4,5,6, 7 : SECTOR=SINGLE-FAMILY. IF A4=2,3 : SECTOR=MULTIFAMILY]

[TERMINATE MESSAGE POST-QUOTA: WE HAVE ALREADY CONDUCTED ALL OF THE SURVEYS WE NEED FOR THAT TYPE OF HOME. THANK YOU FOR YOUR TIME.]

[TERMINATE MESSAGE: THANK YOU FOR YOUR WILLINGNESS TO HELP US PROVIDE OUR BEST SERVICE TO WISCONSIN HOUSEHOLDS. UNFORTUNATELY, BASED ON YOUR RESPONSE, YOU ARE NOT ELIGIBLE FOR THIS SURVEY.]

B. Home Characteristics

B1. In what year was your home built? If you don't know exactly, an estimate is fine.
1. **[RECORD YEAR]**
98. (Don't know)
99. (Refused)

B2. What is the approximate square footage of your home? Please only include the basement, attic, or garage if these are heated or cooled spaces.
1. **[RECORD SQUARE FOOTAGE]**
98. (Don't know)
99. (Refused)

B3. How many stories is your **[IF SECTOR=MULTIFAMILY "UNIT" IF SECTOR=SINGLE-FAMILY "HOME"]** (not including an unfinished attic, unfinished basement, or garage)?

1. 1 floor
2. 2 floors
3. 3 floors
4. More than 3 floors
98. (Don't know)
99. (Refused)

B4. Does your building or home have a pool?

1. Yes (Please specify how many): **[RECORD QUANTITY]**
2. No
98. (Don't know)
99. (Refused)

C. Lighting Saturations

C1. What percentage of lightbulbs installed in your home are … **[ENTER NUMBER FOR EACH TYPE OF BULB]**

1. Compact fluorescent light bulbs **[RECORD PERCENTAGE]**
2. LEDs **[RECORD PERCENTAGE]**
3. Incandescent light bulbs **[RECORD PERCENTAGE]**
98. (Don't know)
99. (Refused)

D. HVAC Equipment Saturations

D1. What fuel do you use primarily to heat your home?

1. Electricity
2. Natural Gas
3. Oil
4. Other (please specify): **[RECORD FUEL]**
98. (Don't know)
99. (Refused)

D2. What is the main type of heating system in your home?

1. Central forced air furnace
2. Hot water boiler with radiators or radiant floor heating
3. [D1=1] Air-source heat pump
4. [D1=1] Ground-source heat pump
5. [D1=1] Ductless heat pump
6. [D1=1] Baseboard heat
7. [D1=1] Wall heaters with fans

8. [D1=1] Portable heaters
9. [D1=2 or 3] Steam boiler with radiators
10. [D1=2 or 3] Fireplace or stove
11. Other (please specify): **[RECORD TYPE]**
12. I have no heating system
98. (Don't know)
99. (Refused)

D3. What is the main type of cooling system in your home?

1. Central air conditioner
2. Air source heat pump
3. Ground source heat pump
4. Room or window air conditioners
5. Ductless mini-split air conditioner
6. Evaporative cooler, or swamp cooler
7. Portable fans
8. Whole-house fan
9. Ceiling fans
10. Other (please specify): **[RECORD TYPE]**
11. I have no cooling system
98. (Don't know)
99. (Refused)

D4. **[IFD3=4]** How many room or window air conditioners do you use?

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

D5. What type of thermostat do you use to control the temperature in your home?

1. Programmable thermostat
2. Wi-Fi–enabled smart thermostat
3. Manual digital thermostat
4. Dial control thermostat
5. Other (please specify): **[RECORD TYPE]**
98. (Don't know)
99. (Refused)

D6. [IF D5=1 or 2] Is your thermostat set to adjust the temperature depending on the time of day or day of the week?

1. Yes
2. No
98. (Don't know)
99. (Refused)

D7. **[IF A5=1 and D2≠12 and D3D3≠11]** Have you tuned up your heating or cooling equipment in the last two years?

1. Yes
2. No
98. (Don't know)
99. (Refused)

E. Water Heating Saturations

E1. What type of water heater do you have in your home?

1. Storage tank water heater
2. Tankless water heater
3. Heat pump water heater
4. Other (please specify): **[RECORD TYPE]**
98. (Don't know)
99. (Refused)

E2. **[IF E1≠3]** What fuel does your water heater use?

1. Electricity
2. Natural Gas
3. Oil
4. Solar
5. Other (please specify): **[RECORD TYPE]**
98. (Don't know)
99. (Refused)

E3. **[IF E1≠2 OR 98 OR 99]** Does your water heater have insulating tank wrap installed?

1. Yes
2. No
98. (Don't know)
99. (Refused)

E4. **[IF E1≠98 OR 99]** Do the pipes coming from your water heater have insulation?

1. Yes
2. No
98. (Don't know)
99. (Refused)

F. Large Appliances Saturations

F1. Do you have more than one refrigerator in your home?
1. Yes
2. No
98. (Don't know)
99. (Refused)

F2. **[IF A5=1 and F1=1]** And about how old is your second refrigerator?
1. 2 years less
2. 3 to 5 years old
3. 6 to 10 years old
4. 11 to 15 years old
5. Over 15 years old
98. (Don't know)
99. (Refused)

F3. How many stand-alone freezers are in your home?
1. **[RECORD TYPE]**
98. (Don't know)
99. (Refused)

F4. **[IF A5=1 and G3>0]** About how old is your [IF G3> 1: "main"] stand-alone freezer?
1. 2 years less
2. 3 to 5 years old
3. 6 to 10 years old
4. 11 to 15 years old
5. Over 15 years old
98. (Don't know)
99. (Refused)

F5. Is your cooking range electric or natural gas?
1. Electric
2. Natural Gas
3. Other **[RECORD TYPE]**
98. (Don't know)
99. (Refused)

F6. Is your oven electric or natural gas?
1. Electric
2. Natural Gas
3. Other **[RECORD TYPE]**
98. (Don't know)
99. (Refused)

F7. Do you have a dishwasher in your home?
1. Yes
2. No
98. (Don't know)
99. (Refused)

F8. Do you have a clothes washer in your home?
1. Yes
2. No
98. (Don't know)
99. (Refused)

F9. **[IF F8=1]** Is your clothes washer a front-loading or top-loading model?
1. Front-load washing machine
2. Top-load washing machine
3. Other (please specify): **[RECORD TYPE]**
98. (Don't know)
99. (Refused)

F10. Do you have a clothes dryer in your home?
1. Yes
2. No
98. (Don't know)
99. (Refused)

F11. **[IF F10=1]** Is your clothes dryer electric or natural gas?
1. Electric
2. Natural Gas
3. Other (please specify): **[RECORD TYPE]**
98. (Don't know)
99. (Refused)

G. Small Appliances Saturation

G1. How many of the following do you have in your home? **[READ OPTIONS 1-4 AND RECORD QUANTITY FOR EACH]**

1. Televisions **[RECORD QUANTITY]**
2. Air Purifiers **[RECORD QUANTITY]**
3. Dehumidifiers **[RECORD QUANITITY]**
4. Microwaves **[RECORD QUANTITY]**
5. Soundbars **[RECORD QUANTITY]**

98. (Don't know)
99. (Refused)

G2. **[IF 1>0]** What type of television(s) do you have? Do you have LCD, LED, plasma, or tube type? **[MULTIPLE RESPONSE ALLOWED]**

1. LCD
2. LED
3. Plasma
4. Tube-type
5. Other (please specify): **[RECORD TYPE]**

98. (Don't know)
99. (Refused)

G3. **[IF G1.1>0]** How many set-top boxes for cable or satellite television do you have in your home?

1. **[RECORD QUANTITY]**

98. (Don't know)
99. (Refused)

G4. How many audio systems do you have in your home, other than soundbars?

1. **[RECORD QUANTITY]**

98. (Don't know)
99. (Refused)

G5. How many computers do you use in your home? (Please only count laptop or desktop computers, and exclude iPads or tablets) **[MULTIPLE RESPONSE ALLOWED]**

1. Laptops **[RECORD QUANTITY]**
2. Desktop monitors **[RECORD QUANTITY]**
3. Desktop computers **[RECORD QUANTITY]**

98. (Don't know)
99. (Refused)

G6. How many power strips do you use in your home for…

1. Entertainment centers **[RECORD QUANTITY]**
2. Home office (computers, printers, etc.) **[RECORD QUANTITY]**
3. All other uses **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

G7. **[IF G6>1 FOR RESPONSES 1-3]** How many of these power strips are advanced power strips? **[IF NEEDED:** Advanced power strips detect if appliances plugged into them are turned on.**]** **[RECORD QUANTITY FOR EACH CATEGORY WHERE THEY PROVIDED A COUNT IN G6]**

1. Entertainment centers **[RECORD QUANTITY]**
2. Home office **[RECORD QUANTITY]**
3. Other **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

H. Water-Using Equipment Saturations

H1. How many showers does your home have?

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

H2. **[IF H1=1]** Does this shower have a low flow or WaterSense shower head?

1. Yes
2. No
98. (Don't know)
99. (Refused)

H3. **[IF I1>1]** Of those showers, how many, if any, have low flow or WaterSense shower heads?

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

H4. How many kitchen sinks does your home have?

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

H5. **[IF H4=1]** Does your kitchen sink have a low flow faucet aerator?

1. Yes
2. No
98. (Don't know)
99. (Refused)

H6. **[IF H4>1]** How many, of your kitchen sink faucets have low flow aerators installed on them?

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

H7. How many bathroom sinks does your home have?

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

H8. **[IF I7H7=1]** Does your bathroom sink have a low flow faucet aerator?

1. Yes
2. No
98. (Don't know)
99. (Refused)

H9. **[IF H7>1]** How many, of your bathroom sink faucets have low flow faucet aerators installed on them?

1. **[RECORD QUANTITY]**
98. (Don't know)
99. (Refused)

I. Building Shell

I1. Do any of your windows have window coverings? **[MULTIPLE RESPONSES ALLOWED]**

1. Yes – window film
2. Yes – storm windows
3. Yes – window awnings
4. Yes – thermal shades
5. No, no windows have coverings
98. (Don't know)
99. (Refused)

I2. **[IF A5=1]** Have you or a contractor reduced air leaks in your home by adding weather-stripping, door-strips, or caulking?

1. Yes
2. No
98. (Don't know)
99. (Refused)

I3. Would you say the level of insulation in your home is… **[READ LIST]**
   1. Poor
   2. Medium, or
   3. Good
   98. (Don't know)
   99. (Refused)

End of Survey Message

Those are all the questions we have. Thank you for participating in our survey.

Focus on Energy offers a variety of energy efficiency programs that could help you save energy and manage your monthly bills. For more information on other ways to save, please visit https://focusonenergy.com/.

Focus on Energy 2020 Potential Study: Residential Survey

Target Audience: Residential customers of Focus-on-Energy-participating utilities.

Expected number of completions: 70 (single-family), 70 (multifamily)

Estimated timeline for fielding: August 2020

Variables to be Pulled into Survey

- **Email**
- **First Name**
- **Last Name**

Email Invitation

To: [EMAIL]
From: Focus on Energy
Subject: Please tell Focus on Energy about your home energy use

Dear [FIRSTNAME AND LASTNAME],

We would like you to take part in an important study to better understand how Wisconsin residents use energy at home. Your participation in this study will help Focus on Energy, Wisconsin's energy efficiency and renewable resource program, design programs to save residential customers like you energy and money. Your answers will be kept confidential. **The survey will take no more than 20 minutes**.

Click the link below to take the survey:

[auto-generated link]

Or you may copy and paste the URL below into your internet browser: [auto-generated URL]

If you have any questions about this research, or any difficulties taking the survey, please contact Althea Koburger at The Cadmus Group, the national research firm conducting this survey on our behalf. You can reach Althea at (303) 389-2513 or althea.koburger@cadmusgroup.com.

Thank you in advance for sharing your experiences and your time.

Reminder Invitation

To: [EMAIL]
From: Focus on Energy
Subject: Don't forget to tell Focus on Energy about your home energy use

Dear [FIRSTNAME AND LASTNAME],

We recently invited you to help Wisconsin utilities better serve customers across the state by sharing information about how you use energy at home. This information is only used to help Focus on Energy

(partnering with state utilizes) to better understand your needs and improve the energy efficiency programs available to customers like you. **Please take 20 minutes today to complete the survey**.

Click the link below to take the survey:

[auto-generated link]

Or you may copy and paste the URL below into your internet browser: [auto-generated URL]

If you have any questions about this research, or any difficulties taking the survey, please contact Althea Koburger at The Cadmus Group, the national research firm conducting this survey on our behalf. You can reach Althea at (303) 389-2513 or althea.koburger@cadmusgroup.com. Thank you in advance for sharing your experiences and your time.

Survey Introduction and Screener

[RECOMMENDED: FOCUS ON ENERGY LOGO ON START SCREEN]

We would like you to take part in an important study to better understand how Wisconsin residents use energy at home. Your participation in this study will help Focus on Energy design programs to save residential customers like you energy and money. We appreciate your willingness to help Focus on Energy better serve residents of Wisconsin. We will keep all of your responses confidential and only report on the results of this survey in aggregate.

A. Screening Questions

A1. What is your current age?

1. [TEXT ENTRY BOX] **[IF <18, SURVEY TERMINATE]**

A2. Are you typically involved in making decisions about how energy is used in your home, such as buying appliances or heating equipment, or making your home more energy efficient?

1. Yes
2. No [TERMINATE]

A3. Which of the following best describes your home?

1. Single-family home
2. Apartment with 4 or more units
3. Condominium with 4 or more units
4. Duplex with 2 units
5. Townhome
6. Apartment or condominium with 2 to 3 units
7. Manufactured home

98. Don't know **[TERMINATE]**

A4. Do you own or rent your home?
1. Own
2. Rent

A5. What is the highest level of education you have completed?
1. Some high school
2. High school graduate
3. Some college, but no degree
4. Associate's degree
5. Bachelor's degree
6. Master's degree
7. Doctorate degree

A6. With which of the following do you most closely identify?
1. White
2. Back or African American
3. Hispanic
4. American Indian or Alaska Native
5. Asian
6. Native Hawaiian or Pacific Islander
7. Other (please specify): [TEXT BOX]
8. I do not wish to self-identify

A7. What is the zip code of your current residence?
1. [TEXT ENTRY BOX] **[IF NOT INCLUDED IN LIST OF SERVICE TERRITORY ZIP CODES, SURVEY TERMINATE]**

2. [IF A3=1,4,5,6,7 : SECTOR=SINGLE-FAMILY. IF A3=2,3 : SECTOR=MULTIFAMILY]

3. [TERMINATE MESSAGE POST-QUOTA: WE HAVE ALREADY CONDUCTED ALL OF THE SURVEYS WE NEED FOR THAT TYPE OF HOME. THANK YOU FOR YOUR TIME.]

4. [TERMINATE MESSAGE: THANK YOU FOR YOUR WILLINGNESS TO HELP US PROVIDE OUR BEST SERVICE TO WISCONSIN HOUSEHOLDS. UNFORTUNATELY, BASED ON YOUR RESPONSE, YOU ARE NOT ELIGIBLE FOR THIS SURVEY.]

B. Home Characteristics

B1. In what year was your home built? If you don't know exactly, an estimate is fine. (Numerical validation)
1. [TEXT ENTRY BOX]
98. Don't know

B2. What is the approximate square footage of your home? Please only include the basement, attic, or garage if these are heated or cooled spaces.
   1. [TEXT ENTRY BOX]

B3. How many stories is your [IF SECTOR=Multifamily "unit" IF SECTOR=Single-family "home"] (not including an unfinished attic, unfinished basement, or garage)?
   1. 1 floor
   2. 2 floors
   3. 3 floors
   4. More than 3 floors

B4. Does your building or home have a pool?
   1. Yes (Please specify how many:) [TEXT ENTRY BOX]
   2. No

C. Demographics

C1. Including yourself, how many people live in your home year-round? (Numerical validation)
   1. [TEXT ENTRY BOX]

C2. Which category best describes your total household income in 2019 before taxes?
   1. Less than $25,000
   2. $25,000 to less than $35,000
   3. $35,000 to less than $45,000
   4. $45,000 to less than $55,000
   5. $55,000 to less than $65,000
   6. $65,000 to less than $75,000
   7. $75,000 to less than $100,000
   8. $100,000 to less than $125,000
   9. $125,000 to less than $150,000
   10. $150,000 or higher
   11. I am not comfortable disclosing this
   98. Don't know

D. Saturations (Lighting)

D1. What percentage of lightbulbs installed in your home are … [INCLUDE IMAGES OF BULB TYPES] (multiple responses allowed, numerical validation for responses 1 and 2)
   1. Compact fluorescent light bulbs [TEXT ENTRY BOX]
   2. LEDs [TEXT ENTRY BOX]
   3. Incandescent or Halogen light bulbs [TEXT ENTRY BOX]
   98. Don't know

E. Saturations (HVAC)

E1. What fuel do you use primarily to heat your home?
1. Electricity
2. Natural Gas
3. Oil
4. Other (please specify): [TEXT ENTRY BOX]
98. Don't know

E2. What is the main type of heating system in your home?
1. Central forced air furnace
2. Hot water boiler with radiators or radiant floor heating
3. [D1=1] Air-source heat pump
4. [D1=1] Ground-source heat pump
5. [D1=1] Ductless heat pump
6. [D1=1] Baseboard heat
7. [D1=1] Wall heaters with fans
8. [D1=1] Portable heaters
9. [D1=2 or 3] Steam boiler with radiators
10. [D1=2 or 3] Fireplace or stove
11. Other (please specify): [TEXT ENTRY BOX]
12. I have no heating system
98. Don't know

E3. What is the main type of cooling system in your home?
1. Central air conditioner
2. Air source heat pump
3. Ground source heat pump
4. Room or window air conditioners
5. Ductless mini-split air conditioner
6. Evaporative cooler, or swamp cooler
7. Portable fans
8. Whole-house fan
9. Ceiling fans
10. Other (please specify): [TEXT ENTRY BOX]
11. I have no cooling system
98. Don't know

E4. [D3=D3.4] How many room or window air conditioners do you use? (Numerical validation)
1. [TEXT ENTRY BOX]

E5. What type of thermostat do you use to control the temperature in your home?
1. Programmable thermostat
2. Wi-Fi–enabled smart thermostat
3. Manual digital thermostat
4. Dial control thermostat
5. Other (please specify): [TEXT ENTRY BOX]
98. Don't know

E6. [IF E5=D5.1 or D5.2] Is your thermostat set to adjust the temperature depending on the time of day or day of the week?
1. Yes
2. No
98. Don't know

E7. [IF A5=1 and 0.-1181790640.98.99≠D2.12 and D3≠D3.11] Have you tuned up your heating or cooling equipment in the last two years?
1. Yes
2. No
98. Don't know

F. Saturations (Water Heating)

F1. What type of water heater do you have in your home?
1. Storage tank water heater
2. Tankless water heater
3. Heat pump water heater
4. Other (please specify): [TEXT ENTRY BOX]
98. Don't know

F2. [IF E1≠5] What fuel does your water heater use?
1. Electricity
2. Natural Gas
3. Oil
4. Solar
5. Other (please specify): [TEXT ENTRY BOX]
98. Don't know

F3. [IF E1≠2 or 5] Does your water heater have insulating tank wrap installed?
1. Yes
2. No
98. Don't know

F4. [IF E1≠5] Do the pipes coming from your water heater have insulation?

1. Yes
2. No
98. Don't know

G. Saturations (Large Appliances)

G1. Do you have more than one refrigerator in your home?

1. Yes
2. No

G2. [IF A5=1 and F1=1] And about how old is your secondary refrigerator?

1. 2 years or less
2. 3 to 5 years old
3. 6 to 10 years old
4. 11 to 15 years old
5. Over 15 years old
98. Don't know

G3. How many stand-alone freezers are in your home? (Numerical validation)

1. [TEXT ENTRY BOX]

G4. [IF A5=1 and G3>0] About how old is your [IF G3> 1: "main"] stand-alone freezer?

1. 2 years or less
2. 3 to 5 years old
3. 6 to 10 years old
4. 11 to 15 years old
5. Over 15 years old
98. Don't know

G5. Is your cooking range electric or natural gas?

1. Electric
2. Natural Gas
3. Other (please specify): **[**TEXT ENTRY BOX**]**
98. Don't know

G6. Is your oven electric or natural gas?

1. Electric
2. Natural Gas
3. Other (please specify): [TEXT ENTRY BOX]
4. Don't know

G7. Do you have a dishwasher in your home?
1. Yes
2. No

G8. Do you have a clothes washer in your home?
1. Yes
2. No

G9. [IF F8=1] Is your clothes washer a front-loading or top-loading model?
1. Front-load washing machine
2. Top-load washing machine
3. Other (please specify): [TEXT ENTRY BOX]

G10. Do you have a clothes dryer in your home?
1. Yes
2. No

G11. [IF F10=1] Is your clothes dryer electric or natural gas?
1. Electric
2. Natural Gas
3. Other (please specify): [TEXT ENTRY BOX]
98. Don't know

H. Saturation (Small Appliances)

H1. How many of the following do you have in your home? (Numerical validation)
1. Televisions [TEXT ENTRY BOX]
2. Air Purifiers [TEXT ENTRY BOX]
3. Dehumidifiers [TEXT ENTRY BOX]
4. Microwaves [TEXT ENTRY BOX]
5. Soundbars [TEXT ENTRY BOX]

H2. [G1.1>0] What type of television(s) do you have? Do you have LCD, LED, plasma, or tube type? (multiple response allowed)
1. LCD
2. LED
3. Plasma
4. Tube-type
5. Other (please specify): [TEXT ENTRY BOX]
98. Don't know

H3. [IF H1.1H3>0] How many set-top boxes for cable or satellite television do you have in your home? (Numerical validation)
1. [TEXT ENTRY BOX]

H4. How many audio systems do you have in your home, excluding soundbars? (Numerical validation)
1. [TEXT ENTRY BOX]

H5. How many computers do you use in your home? (Please only count laptop or desktop computers, and exclude iPads or tablets) (Numerical validation)
1. Laptops: [TEXT ENTRY BOX]
2. Desktop monitors: [TEXT ENTRY BOX]
3. Desktop computers: [TEXT ENTRY BOX]
98. Don't know

H6. How many power strips do you use in your home for… (Numerical validation)
1. Entertainment centers [TEXT ENTRY BOX]
2. Home office (computers, printers, etc.) [TEXT ENTRY BOX]
3. All other uses [TEXT ENTRY BOX]
98. Don't know

H7. [IF H6>1 for responses 1, 2, or 3] How many of these power strips are advanced power strips? (Advanced power strips detect if appliances plugged into them are turned on) (Numerical validation)
1. Entertainment centers [TEXT ENTRY BOX]
2. Home office [TEXT ENTRY BOX]
3. Other [TEXT ENTRY BOX]
98. Don't know

I. Saturations (Water-using equipment)

I1. How many showers does your home have? (Numerical validation)
1. [TEXT ENTRY BOX]

I2. [IF I1=1] Does this shower have a low flow or WaterSense shower head?
1. Yes
2. No
98. Don't know

I3. [IF I1>1] Of those showers, how many, if any, have low flow or WaterSense shower heads? (Numerical validation)
1. [TEXT ENTRY BOX]
98. Don't know

I4. How many kitchen sinks does your home have? (Numerical validation)
1. [TEXT ENTRY BOX]

I5. [IF I4=1] Does your kitchen sink have a low flow faucet aerator?
1. Yes
2. No
98. Don't know

I6. [IF I4>1] How many of your kitchen sink faucets have low flow aerators installed on them? (Numerical validation)
1. [TEXT ENTRY BOX]
98. Don't know

I7. How many bathroom sinks does your home have? (Numerical validation)
1. [TEXT ENTRY BOX]

I8. [IF I7=1] Does your bathroom sink have a low flow faucet aerator?
1. Yes
2. No
98. Don't know

I9. [IF I7>1] How many of your bathroom sink faucets have low flow faucet aerators installed on them? (Numerical validation)
1. [TEXT ENTRY BOX]
98. Don't know

J. Building Shell

J1. Do any of your windows have window coverings? (Multiple responses allowed)
1. Yes – window film
2. Yes – storm windows
3. Yes – window awnings
4. Yes – thermal shades
5. No, none of my windows have coverings
98. Don't know

J2. [IF A5=1] Have you or a contractor reduced air leaks in your home by adding weather-stripping, door-strips, or caulking?
1. Yes
2. No
98. Don't know

J3. Would you say the level of insulation in your home is…
1. Poor
2. Medium
3. Good
98. Don't know

K. Willingness to Pay

K1. It sometimes costs more up front to purchase energy-efficient products compared to standard products. Please indicate if you would be very likely, somewhat likely, not too likely, or not at all likely to: [Dropdown response for each option of 1 = Very likely, 2 = Somewhat likely, 3 = Not too likely, 4 = Not at all likely, 5 = Already have it/have done it, 98 = Don't know, 99 = Refused]

Options		i.	ii.	iii.	iv.
	[FOR (A)–(F), (H)-(M)] The Estimated price difference between standard and efficient technology is: **[FOR (G)]** The estimated cost is:	How likely would you be to install each item listed below in the next five years if Focus on Energy paid for 25% of the difference in cost between the standard and efficient option? [IF RESPONSE = 2-4, ASK ii]	What if Focus on Energy paid for half of the difference in price? [IF RESPONSE = 2-4, ASK iii]]	And what if Focus on Energy paid 75% of the difference in price? [IF RESPONSE = 2-4, ASK iv]	What if Focus on Energy paid the full difference in price of the more efficient option? [INSERT OPTION]?
(a) Install energy-efficient LED light bulbs	$2 for a 10 Watt LED that gives the same amount of light as a traditional 60W incandescent bulb.				
(b) Install energy-efficient dehumidifiers?	$50 per dehumidifier.				
(c) [ASK IF A5 = 1] K2. Install energy-efficient central air conditioning?	$500 per installed central air conditioner.				
(d) [ASK IF A5 = 1] K3. Install energy-efficient gas furnace	$1,000 per installed furnace.				
(e) [ASK IF A5= 1] K4. Install energy-efficient appliances, such as a refrigerator?	$80 for top-mount refrigerator without an ice dispenser.				
(f) [ASK IF A5 = 1] K5. Install an energy-efficient gas water heater?	$600 for a 40 gallon gas water heater.				
1.(g) [ASK IF A5 = 1] K6. Weatherize your home with insulation?	$1,900 for ceiling insulation for a 2,000 square foot home.				
(h) [ASK IF A5 = 2]	$200 per thermostat.				

Options		i.	ii.	iii.	iv.
	[FOR (A)–(F), (H)-(M)] The Estimated price difference between standard and efficient technology is: **[FOR (G)]** The estimated cost is:	How likely would you be to install each item listed below in the next five years if Focus on Energy paid for 25% of the difference in cost between the standard and efficient option? [IF RESPONSE = 2-4, ASK ii]	What if Focus on Energy paid for half of the difference in price? [IF RESPONSE = 2-4, ASK iii]]	And what if Focus on Energy paid 75% of the difference in price? [IF RESPONSE = 2-4, ASK iv]	What if Focus on Energy paid the full difference in price of the more efficient option? [INSERT OPTION]?
1.Install energy- efficient advanced thermostat					
(i) [ASK IF A5 = 2] 2.Install energy- efficient showerhead	$5 per showerhead.				
(j) [ASK IF A5 = 2] 3.Install energy- efficient advanced power strip	$50 per advanced power strip.				
(l) [ASK IF A5 = 2] Install energy- efficient microwave	$5 per microwave.				
(m) [ASK IF A5 = 2] 4.Install energy- efficient sound bar	$10 per sound bar.				

End of Survey Message

Those are all the questions we have. Thank you for participating in our survey.

Focus on Energy offers a variety of energy efficiency programs that could help you save energy and manage your monthly bills. For more information on other ways to save, please visit https://focusonenergy.com.

Appendix I. Industrial Expert Interview Guide

The Public Service Commission of Wisconsin, in collaboration with Cadmus, is conducting a study of overall energy efficiency potential in Wisconsin. This study is designed to inform future development of Focus on Energy's energy efficiency incentive programs.

To inform the energy-efficiency potential study, Cadmus will conduct interviews with industrial experts within the Focus on Energy territory. Cadmus will use the interviews to assess current large energy user industrial facilities' standard practice regarding energy efficiency along with the types of processes in operation. The survey explores the research topics presented in the table. Results from these interviews will inform assessment of industrial energy efficiency potential in Wisconsin.

Industrial Expert Interview Research Topics

Key Area of Investigation	Research Topic	Question Number
Gather industrial characteristic information	Industry types and area of expertise Typical operating schedule	A1-A2 A3-A4
Equipment saturations	Lighting Energy management Process loads	A5-A8 A9-A12 A13-A14
Remaining potential	Remaining potential savings	A15-A25

Target Quota = 10 completes

General Instructions

- Interviewer instructions are in green **[LIKE THIS]**

A. Industry Type

A1. My name is **[INTERVIEWER NAME]** and I'm calling on behalf of Wisconsin Focus on Energy. Thank you for taking the time to discuss your knowledge of industrial facilities that are large energy users located in Wisconsin. First, I have a few questions about your areas of expertise.

1. What industries would you say you are most familiar with? **[READ LIST]**
2. Chemical Manufacturing
3. Electrical Equipment Manufacturing
4. Computer and Electronic Product Manufacturing
5. Fabricated Metal Product Manufacturing
6. Food or Beverage Manufacturing
7. Furniture Manufacturing
8. Machinery Manufacturing
9. Mining
10. Nonmetallic Mineral Product Manufacturing
11. Paper Manufacturing
12. Petroleum or Coal Manufacturing
13. Plastics or Rubber Manufacturing

14. Primary Metal Manufacturing
15. Printing
16. Refrigerated Warehouse
17. Textile or Apparel Manufacturing
18. Leather and Hide Manufacturing
19. Transportation Equipment Manufacturing
20. Waste Water
21. Water
22. Wood Product Manufacturing
23. Miscellaneous Manufacturing **[SPECIFY]**
24. Other Industrial **[SPECIFY]**
25. What are your particular areas of expertise? **[READ LIST]**
26. Air compressor systems
27. Industrial motor and pump systems
28. Manufacturing process loads
29. Industrial process heating
30. Process cooling and refrigeration systems
31. Energy management
32. Air or Water Purification Systems
33. Other systems **[SPECIFY]**

[ASK REMAINING QUESTIONS FOR EACH INDUSTRY NOTED IN Q1]

A2. What is the typical shift or operating schedule for this industry **[PROBE FOR NUMBER AND LENGTH OF SHIFTS ON WEEKDAYS, SATURDAYS, AND SUNDAY]**?

A3. Do shift or operating schedules vary seasonally? If yes, how?

B. Equipment Saturations

Lighting

B1. About what percentage of the interior floor space for this industry has been converted to LED fixtures? **[RECORD PERCENTAGE BETWEEN 0-100]**

B2. About what percentage of the interior lighting fixtures used in this industry would you say are controlled? **[IF NEEDED: "OCCUPANCY SENSORS, DIMMERS, TIMERS, ETC." RECORD PERCENTAGE BETWEEN 0-100]**

B3. About what percentage of those interior lighting fixtures remaining, that aren't controlled, do you estimate could be controlled to save energy? **[RECORD PERCENTAGE BETWEEN 0-100]**

B4. About what percentage of that outdoor lighting do you estimate has converted to LED fixtures? **[RECORD PERCENTAGE BETWEEN 0-100]**

Energy Management

B5. What percentage of the facilities in this industry use HVAC controls such as programmable thermostats and building management systems (BMS) to manage space heating and cooling? **[RECORD PERCENTAGE BETWEEN 0-100]**

B6. What percentage of the facilities in this industry use energy management systems for non-space heating or cooling needs, such as lighting schedules and process loads? **[RECORD PERCENTAGE BETWEEN 0-100]**

B7. About what percentage of the facilities in this industry do you estimate employ an energy manager? **[RECORD RESPONSE (PERCENT OR RANGE)]**

B8. About what percentage of these facilities have an active preventative maintenance program that includes a focus on reducing energy costs? **[RECORD RESPONSE (PERCENT OR RANGE)]**

Process Loads

B9. Please describe the energy consuming processes in this industry. **[RECORD RESPONSE (PROBE TO UNDERSTAND EQUIPMENT AND HOW IT IS USED SO THAT IT CAN INFORM REMAINING QUESTIONS ABOUT OPPORTUNITIES)]**

B10. What are the major types of equipment used in the processes for this industry? **[CHECK ALL THAT APPLY]**

1. Compressed Air
2. Pumps
3. Fans
4. Other motors for process
5. Process heating
6. Process cooling and refrigeration
7. Industrial computer equipment (including manufacturing and data center areas)
8. Other **[PLEASE DESCRIBE]**

C. Remaining Potential Savings

C1. **[IF A14.1 CHECKED]** For compressed air equipment, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures? These estimates should be based only on the end uses where the utilization of these technologies results in energy savings. For example, consider potential savings from a variable speed drives only when the drives are installed with equipment where energy savings can be achieved.

1. Variable speed drives **[RECORD PERCENTAGE BETWEEN 0-100]**
2. Compressors optimally sized for the loads **[RECORD PERCENTAGE BETWEEN 0-100]**
3. Compressors have air filters **[RECORD PERCENTAGE BETWEEN 0-100]**
4. Compressors regularly checked for leaks **[RECORD PERCENTAGE BETWEEN 0-100]**
5. Other **[SPECIFY (RECORD PERCENTAGE BETWEEN 0-100)]**

C2. **[IF A14.2 CHECKED]** For pumps, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures?
1. Variable speed controls **[RECORD PERCENTAGE BETWEEN 0-100]**
2. Efficient belts **[RECORD PERCENTAGE BETWEEN 0-100]**
3. Are optimally sized **[RECORD PERCENTAGE BETWEEN 0-100]**
4. Regularly maintenance **[RECORD PERCENTAGE BETWEEN 0-100]**
5. Controls to minimize operation **[RECORD PERCENTAGE BETWEEN 0-100]**
6. Other **[SPECIFY (RECORD PERCENTAGE BETWEEN 0-100)]**

C3. **[IF A14.3 CHECKED]** For fans, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures?
1. Variable speed controls **[RECORD PERCENTAGE BETWEEN 0-100]**
2. Optimally sized **[RECORD PERCENTAGE BETWEEN 0-100]**
3. Controls to minimize operation **[RECORD PERCENTAGE BETWEEN 0-100]**
4. Other **[SPECIFY (RECORD PERCENTAGE BETWEEN 0-100)]**

C4. **[IF A14.4 CHECKED]** For motors, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures?
1. Variable speed controls **[RECORD PERCENTAGE BETWEEN 0-100]**
2. Efficient belts **[RECORD PERCENTAGE BETWEEN 0-100]**
3. Optimally sized **[RECORD PERCENTAGE BETWEEN 0-100]**
4. Regularly maintained **[RECORD PERCENTAGE BETWEEN 0-100]**
5. Controls to minimize operations **[RECORD PERCENTAGE BETWEEN 0-100]**
6. Other **[SPECIFY (RECORD PERCENTAGE BETWEEN 0-100)]**

C5. **[IF A14.5 CHECKED]** For process heating, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures?
1. High-efficient equipment **[RECORD PERCENTAGE BETWEEN 0-100]**
2. Regularly maintained to save energy **[RECORD PERCENTAGE BETWEEN 0-100]**
3. Controls to minimize operations **[RECORD PERCENTAGE BETWEEN 0-100]**
4. Waste heat recovery **[RECORD PERCENTAGE BETWEEN 0-100]**
5. Heat containment such as insulation **[RECORD PERCENTAGE BETWEEN 0-100]**

C6. **[IF A14.6 CHECKED]** For process cooling and refrigeration, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures?
1. High-efficient equipment **[RECORD PERCENTAGE BETWEEN 0-100]**
2. Regularly maintained to save energy **[RECORD PERCENTAGE BETWEEN 0-100]**
3. Cooling towers **[RECORD PERCENTAGE BETWEEN 0-100]**
4. Controls to minimize operations **[RECORD PERCENTAGE BETWEEN 0-100]**
5. Outside air when temperatures are low **[RECORD PERCENTAGE BETWEEN 0-100]**

C7. **[IF A14.7 CHECKED]** For industrial computer equipment, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures?
   1. Server power management **[RECORD PERCENTAGE BETWEEN 0-100]**
   2. Direct liquid cooling of chips **[RECORD PERCENTAGE BETWEEN 0-100]**
   3. Energy efficient data storage **[RECORD PERCENTAGE BETWEEN 0-100]**
   4. Containment for hot or cold equipment configuration **[RECORD PERCENTAGE BETWEEN 0-100]**

C8. **[IF A1.9 CHECKED FOR PULP AND PAPER ONLY]** In the pulp and paper industry, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures?
   1. High-efficiency lime kiln improvements **[RECORD PERCENTAGE BETWEEN 0-100]**
   2. High-efficiency pulper motors **[RECORD PERCENTAGE BETWEEN 0-100]**
   3. Waste heat recovery **[RECORD PERCENTAGE BETWEEN 0-100]**
   4. High efficiency paper dry systems **[RECORD PERCENTAGE BETWEEN 0-100]**

C9. **[IF A14.8 CHECKED]]** For **[OTHER EQUIPMENT SPECIFIED]**, can you estimate the remaining percentage of energy efficiency potential for each of the following technologies or measures?
   1. High efficiency equipment **[RECORD PERCENTAGE BETWEEN 0-100]**
   2. Controls to minimize operations **[RECORD PERCENTAGE BETWEEN 0-100]**

C10. In your opinion, when thinking about the process end use gas and electric load in this industry, and with all available technologies available to improve the process load, what percent of the load can be still improved? Put in another way, in percentage terms, how much remaining potential is there within the process end use? **[RECORD PERCENTAGE between 0-100]**

K7. Do you consider process load energy efficiency savings to be constantly evolving or improving, through incremental process improvements?
   1. If so, after improving process cycles initially, after how many years would you be able to achieve an additional 10% in savings through further improvements? **[RECORD ANSWER _____]**

Those are all the questions I have. Thank you for your time and the valuable information you shared.

Appendix J. CAP Stakeholder Interview Guide

Research Objectives	Corresponding Items
Identify and better understand the barriers to energy efficiency among the income-qualified segment	B1-B7
Identify opportunities that could address energy efficiency barriers for the income-qualified segment	C1-C2
Identify and better understand the barriers to solar PV adoption among the income-qualified segment	D1-D2
Identify opportunities that could address solar PV barriers for the income-qualified segment	D3

Cadmus conducted six interviews with directors, administrators, and program managers from these CAP stakeholder agencies in Wisconsin:

- Couleecap
- Elevate Energy
- Slipstream
- Sustain Dane
- Wisconsin Dept. of Administration: Division of Energy, Housing and Community Resources
- Wisconsin Housing Preservation Corp.

These interviews were conducted over the phone by Cadmus staff.

Introduction

Hello, I'm [NAME] from Cadmus on behalf of Wisconsin's Focus on Energy. Thank you for scheduling some time to talk with me about your agency/organization. As part of a statewide study on energy efficiency potential, Cadmus is conducting interviews with various community stakeholders who provide energy efficiency programs and services to income-qualified households. We'd like to get your perspective on the barriers to energy efficiency that income-qualified households in Wisconsin face. We will use this information to better understand the income-qualified segment. Your responses will be kept anonymous and will be reported in aggregate in the 2021 Focus on Energy Efficiency Potential Study. Do you have any questions or concerns before we begin?

A. Roles and Services

A1. Please tell me about your role at [AGENCY/ORGANIZATION NAME].

A2. What energy efficiency services does your agency/organization provide to income-qualified households?
   a. Does your agency/organization provide any services related to solar PV to income-qualified households?
   b. Of the income-qualified households that you serve, what proportion are tenants vs. homeowners?
   c. What proportion are rural vs. urban?
   d. Of the income-qualified households that you serve, what is their median age range?
   e. What is their highest level of education?

A3. Are there any best practices that your organization has developed for delivering energy efficiency services to income-qualified households?

B. Barriers to Energy Efficiency

B1. What would you say the primary barriers are to delivering energy efficiency services to income-qualified households?

B2. Do you view a lack of customer education and outreach as a barrier?

B3. From your observations, how interested are income-qualified households in energy efficiency?
   a. Why do you think their interest level is high/moderate/low?

B4. What services or products do income-qualified households often express interest and pursue?
   a. Why do you think those are popular with them?

B5. What services or products do income-qualified households often shy away from?
   a. Why do you think they shy away from them?

B6. What role do contractors play in getting income-qualified households interested in energy efficiency?
   a. What barriers do contractors face in delivering energy efficiency services to income-qualified households?
   b. What barriers do you face in enlisting contractors to work with income-qualified households?

B7. Are there any specific groups of people or communities within the income-qualified segment that are harder to engage with on energy efficiency?
   a. [IF YES] Which groups/communities are they?
   b. [IF YES] Why are they difficult to engage with?

C. Opportunities for Energy Efficiency

C1. You noted several barriers related to income-qualified households adopting energy efficiency. What are the best ways to address these barriers?
   a. What has your agency/organization done, if anything, to educate and reach out to income-qualified households about energy efficiency?
   b. How effective were those education and outreach efforts? I'd like to hear about any success stories. (Probe on the most effective and least effective methods and communication styles)

C2. Are there any emerging technologies, innovative programmatic approaches, or policies that are well suited to delivering energy efficiency service to income-qualified households? (If yes, probe for details.)

D. Barriers to and Opportunities for Solar

D1. Have you seen any interest in solar PV projects from income-qualified communities?
   a. [IF YES] Which communities have expressed interest?
   b. [IF YES OR NO] What do they say about solar projects?

D2. What would you say the primary barriers are to income-qualified communities adopting solar PV?

D3. What do you think are the best ways to address these barriers?
   a. A study last year identified three types of interventions that would be effective at increasing solar adoption equity – targeted incentives, leasing, and financing programs. How effective do you think these interventions would be for income-qualified communities in Wisconsin? (Probe for reasons.)
   b. Have you heard of any innovative approaches, policies, or success stories in Wisconsin on income-qualified solar adoption? (If yes, probe for details.)

Those were all the questions I had for you. I appreciate your time and insights. Thank you!