COMMERCE DEPARTMENT
ENERGY RESOURCES

Statewide Commercial Behavior Segmentation and Potential Study

08/04/2017
Contract # 104468

Conservation Applied Research and Development (CARD)
Final Report

Prepared for: Minnesota Department of Commerce, Division of Energy Resources
Prepared by: Illume Advising, LLC and Seventhwave

ILLUME seventhwave

Prepared by:

Anne Dougherty, Founder, ILLUME Advising, LLC
Eileen Hannigan, Principal, ILLUME Advising, LLC
Michele Scanze, Research Analyst, ILLUME Advising, LLC
Shannon Kahl, Associate Director, ILLUME Advising, LLC
Scott Pigg, Principal Researcher, Seventhwave
Scott Schuetter, Senior Energy Engineer, Seventhwave
Jeannette LeZaks, Senior Researcher, Seventhwave

440 Science Drive #202
Madison, WI 53711
608-512-3930
www.illumeadvising.com
Anne Dougherty
Contract Number: 104468

Prepared for Minnesota Department of Commerce, Division of Energy Resources

Mike Rothman, Commissioner, Department of Commerce
Bill Grant, Deputy Commissioner, Department of Commerce, Division of Energy Resources
Anthony Fryer, Conservation Improvement Program Coordinator
651.539.1858
Anthony.Fryer@state.mn.us

ACKNOWLEDGEMENTS

This project was supported in part (or in whole) by a grant from the Minnesota Department of Commerce, Division of Energy Resources, through the Conservation Applied Research and Development (CARD) program, which is funded by Minnesota ratepayers.

Table of Contents

Executive Summary

1.1 Introduction

Illume Advising, LLC and its subcontractors Seventhwave and Leede Research (hereafter, "the team") conducted this Statewide Commercial Behavior Segmentation and Potential Study to measure the technical and human potential of energy conservation behavior changes in the context of small and medium sized businesses (SMBs) in Minnesota. The study focused on six key business segments and ten behavior-based energy saving measures, in businesses with less than one-hundred employees. Using multiple sources of information, the research team estimated the savings potential of each energy conservation measure in the context of each business segment. While not exhaustive, this study provides estimates for potential savings in energy and costs resulting from low-cost/no cost actions small businesses may take.

Key study outcomes include: 1) statewide commercial segmentation scheme which groups small and medium sized businesses based on the similarity of energy conservation opportunities available to them, and 2) quantitative estimates of the statewide achievable energy savings potential by energy conservation behavior change in the commercial sector by type of measure, business segment, and energy utility, and 3) recommendations for energy conservation behavior change program design. We present segmentation and savings opportunities within a framework of behavior change program theory.

1.2 Methodology

The team collected data from 1,440 Minnesota small and medium sized businesses via a telephone survey administered between June and early October of 2016. Professional interviewers contacted each business and used screening questions to target an employee within the business with knowledge of the company's energy use practices and equipment. The interviewers gathered data on the energy management equipment, behaviors around energy use, and energy decision-making authority. The samples were stratified by number of employees, business segment, and location (Twin Cities vs the rest of Minnesota). The team talked with employees with a variety of job titles including:

- Manager: 29%
- President/Owner/CEO: 21%
- Employee: 17%
- Other: 14%
- Director/Administration/Company Management: 10%
- Facility Manager/Operations/Maintenance/Engineering: 10%

The team selected 10 measures with the greatest savings potential (see Table 1), after considering rough estimates of savings from an initial list of 15 measures. The team used survey responses to arrive at measures of applicability (does the business have a need for the measure) and opportunity (does the business have the appropriate conditions to implement the measure) for each measure. Next, the team defined detailed model inputs for each of the 10 measures using survey responses and secondary literature sources, including the Minnesota Technical Reference Manual (TRM) where applicable. The team performed quality control on savings estimates, resulting in a collection of models of energy consumption in small commercial buildings in Minnesota and predicting potential savings specific to each energy saving measure.

Table 1. Selected Energy Conservation Measures and their Descriptions

End Use	Energy Conservation Measure	Measure Description
HVAC	Thermostat set-backs	Set back heating and/or cooling set-points during periods of no occupancy.
	HVAC regular maintenance	Regular maintenance of HVAC equipment (e.g., service contract).
Lighting	Lighting optimized to occupancy	Turn off lights (or lights turn off automatically) during periods of no occupancy.
	Lighting optimized to daylight	Dim or turn off lights (or lights turn off or dim automatically) during periods of sufficient natural light.
Power Management	Computer power management	Turn off computers/monitors or set them to low power mode or implement power-management software.
	Equipment power management	Turn off printers, multifunction devices, or other plug loads or set them to low power mode.
Refrigeration	Refrigerated display case air leakage	Reduce air leakage (apply night curtains)
	Refrigeration maintenance	Regular refrigeration maintenance
	Refrigeration lighting	Turn off lights in refrigeration overnight.
Kitchen Ventilation	Kitchen exhaust fan	Turn off exhaust during periods of no cooking

The team developed models of buildings representative of those occupied by SMBs encountered in the study, using DOE-2[1] as the modeling engine. Model inputs were informed by the project survey, Commercial Buildings Energy Consumption Survey (CBECS) microdata, and other secondary literature sources. The team developed baseline models to represent the existing small commercial building stock in Minnesota.

The commercial building models produced quantitative estimates of technical potential savings, for the case in which all possible energy saving measures are carried out by the business, in addition to an achievable potential measure representing the savings from actions that are most likely to be carried out by the business. To arrive at the achievable potential measure, we applied adjustment factors representing: 1) the portion of businesses that will choose to participate in any energy saving action and; 2) the expected degree of compliance with repeated actions among businesses that do choose to participate. We based our adjustment factors on research on program participation by SMBs, and their compliance with repetitive actions like turning off lights and washing hands.

1.3 Results

Measure and Segment-Specific Savings Opportunities

Each business segment exhibits unique characteristics, which either facilitate or challenge the implementation of behavior change programs. Furthermore, segments contain sub-groups of businesses which may be more (or less) likely to take action than the segment as a whole. The size of the business, staff turnover rate, hours of operation, franchise status, ownership of building, varying degrees of control over equipment, whether or not the business pays a utility bill, and existing interest in energy efficiency all impact the types of approaches that are likely to succeed in each business.

Figure 1 shows the distribution of overall savings by measure. Table 2 compares the characteristics and opportunities across each business segment. Notable findings include:

Energy-Saving Measures

Thermostat set-backs: Of the actions included in this study, thermostat set-backs comprise the largest share of savings: 32% of electricity savings, 61% of natural gas savings, and 41% of total utility bill savings. Thermostat set-backs comprise a large share of achievable opportunity in each segment. Many businesses have a programmable thermostat, but have not adjusted the settings to save energy. Furthermore, 46% of the estimated achievable electricity savings occur in buildings with natural gas heat that have an opportunity for heating set-backs, while 80% of achievable natural gas savings occur in

[1] http://doe2.com/

buildings that also have a cooling set-back opportunity, offering opportunities for joint electricity/natural gas programs through thermostat initiatives.

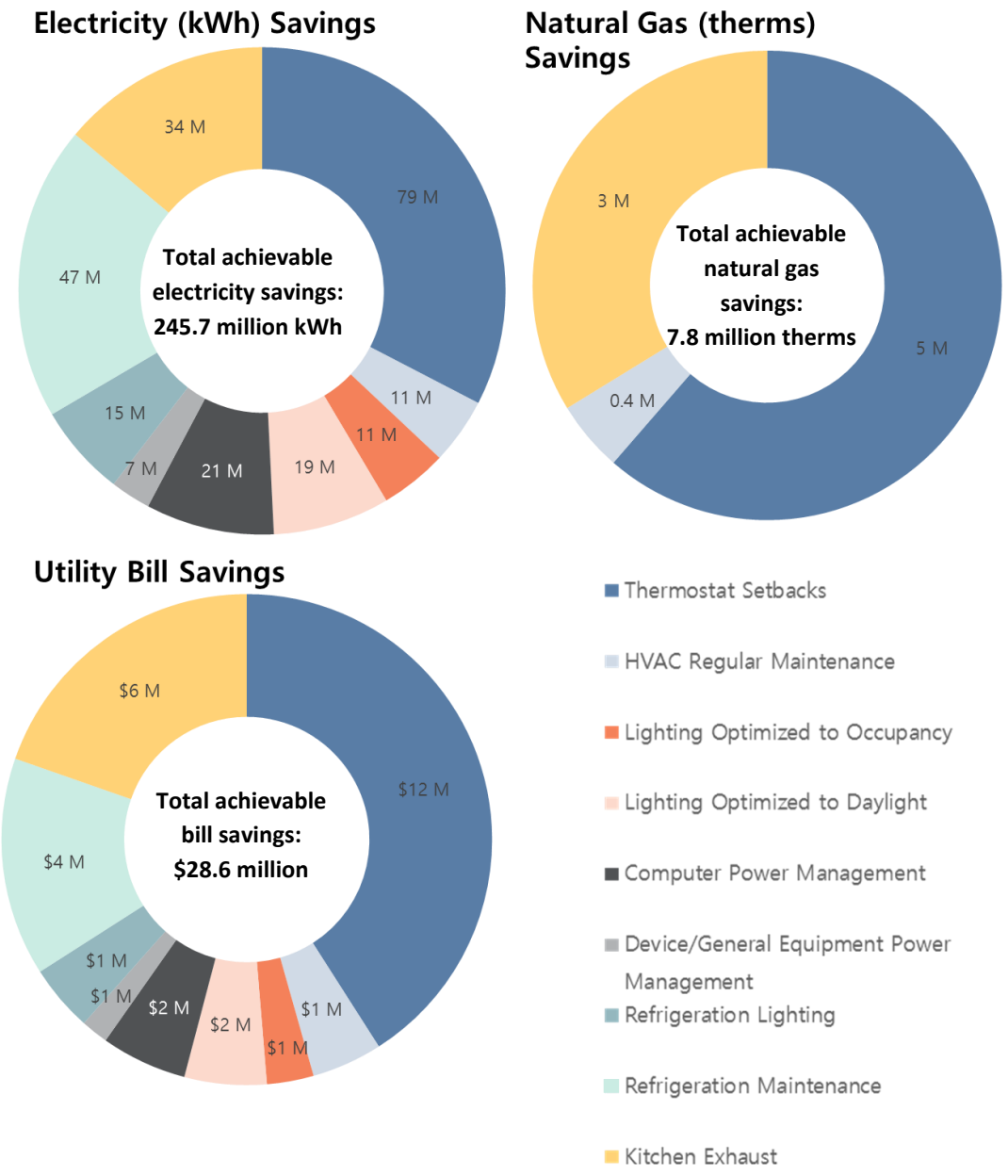
More advanced “smart” thermostats which are available on the market provide a good opportunity to pair behavioral approaches with automation to reduce the risk of changes to, or overrides of thermostat settings.

Kitchen exhaust: Kitchen exhaust has the second highest achievable potential accounting for 14% of overall electric savings and 34% of overall gas savings. Nearly all (97% of both electric and gas) of the kitchen exhaust potential occurs in food service with much smaller opportunities in grocery and education. Most (86%) businesses with an exhaust fan operate the fan manually, turning the fan on in the morning and turning it off at the close of business. However, during a typical day, there are often periods of time where no cooking occurs, and significant savings can be realized by turning the fans down or off either through manual adjustments or by installing automatic controls.

Refrigeration: Savings from refrigeration measures occur in the food service, grocery, and education segments. The measures, which include display case air leakage, lighting, and maintenance, account for 81% of potential electricity savings in the grocery segment and 25% of electricity savings in food service.

Power management and lighting: While power management and lighting are a smaller portion of overall savings (16% in total), they account for most of the savings (after thermostat set-backs) in the education and office segments.

Figure 1. Achievable Savings by Measure



Business Segments

Food Service: The food service segment accounts for 32% of total achievable savings in electricity, driven largely by opportunities to reduce kitchen exhaust fan usage along with opportunities in refrigeration maintenance and thermostat set-backs. Businesses in this segment tend to be small or very small, have high staff turnover, pay their own bills, and are equally likely to be in leased or owned buildings in free standing or mall settings. This segment is a good candidate for benefiting from start-up/shut down schedules containing energy saving actions, competitions between franchise members, and community-based approaches.

Grocery/Convenience: The grocery segment accounts for 21% of total achievable savings in electricity with 81% of the segment's savings coming from refrigeration measures. Businesses in this segment tend to be very small and located in owner-occupied, free standing buildings. The segment is a good candidate for implementing check-lists, schedules, and competitions to prompt energy saving actions.

Retail: Savings opportunities in retail come largely from thermostat set-backs, HVAC maintenance, and lighting optimization. Businesses tend to be small, or very small, and are frequently located in leased spaces in free standing buildings, multi-tenant buildings, or malls. The best program approaches for this segment include: 1) diagnostic programs that pair on-site audits or direct-install programs with education about behavior-based energy saving actions; 2) using schedules or checklists as prompts; 3) competitions between members of a franchise and; 4) community-based approaches in malls or retail/business districts.

Wholesale/warehouse: Savings opportunities for the wholesale segment come predominantly from thermostat set-backs and lighting optimization, though there are also savings opportunities through HVAC maintenance and power management. Businesses in the wholesale segment tend to be small, or very small, located in free-standing buildings that might be either leased or owned, and tend to have higher sales volumes than grocery, retail, or food service businesses. The best program approaches include diagnostic programs that employ on-site auditors who can identify additional actions and create feedback reports.

Education: The education segment has opportunities to save energy through thermostat set-backs, lighting, and computer power management as well as small savings through HVAC and refrigeration maintenance, and kitchen exhaust fans. The businesses in this segment tend to be small or medium sized and located in free standing buildings that might be either leased or owned. This segment has the second highest percentage of businesses that do not pay a utility bill. Good strategies to encourage energy saving actions within this segment include organizing competitions between classrooms and pairing in-school energy conservation efforts with K12 energy education kit programs.

Office: The office segment represents the greatest number of businesses. The main sources of savings in the office segment are thermostat set-backs, daylighting, and computer power management measures. Businesses in this segment tend to be very small and are located in leased properties that are free standing or multi-tenant buildings. The segment has the highest percentage of businesses who do

not pay a utility bill (27%). Medium-sized office businesses are good candidates for competition based incentive programs, while small and very small office businesses may benefit from feedback reports from auditors who can provide more specific energy-saving tips.

Table 2. Segment Descriptions

	 FOOD SERVICE	 GROCERY AND CONVENIENCE	 OFFICE	 RETAIL	 WHOLESALE	 EDUCATION
SAVINGS POTENTIAL IN UTILITY BILLS (dollars) ELECTRICITY (kWh) NATURAL GAS (therms)	$10.8 million 80.4 million kWh 3.8 million therms	$4.8 million 51.8 million kWh 0.4 million therms	$6.9 million 60.7 million kWh 2.1 million therms	$1.8 million 14.7 million kWh 0.5 million therms	$1.6 million 13.1 million kWh 0.5 million therms	$2.5 million 25.1 million kWh 0.5 million therms
MEASURES WITH MOST SAVINGS OPPORTUNITY	• Thermostat • Refrigerator maintenance • Kitchen exhaust	• Refrigerator maintenance • Refrigerator lighting • Thermostat	• Thermostat • Computer power management • Day lighting	• Thermostat • HVAC maintenance • Day lighting	• Thermostat • Occupancy lighting • Day lighting	• Thermostat • Occupancy lighting • Computer power management
SUGGESTED BEHAVIORAL PROGRAM APPROACHES	• Prompts • Community-based • Competitions	• Prompts • Community-based • Competitions	• Feedback • Competitions	• Diagnostic • Prompts • Community-based • Competitions	• Diagnostic • Feedback	• Competitions • Add-on to K12 programs
EQUIPMENT PURCHASE AND MAINTENANCE TENDS TO BE HANDLED BY:	Business owner or employee	Business owner or employee	Property manager (HVAC/Lighting) Business owner (computers)	Business owner or employee	Business owner or employee	Facility manager or employee
BUILDING OWNERSHIP TENDS TO BE:	Leased or owned; free standing, mall, or multi-tenant	Owned; free standing	Leased; free standing or multi-tenant	Leased; free standing, mall, or multi-tenant	Leased and owned; free standing	Leased and owned; freestanding
BUSINESSES USUALLY RESPONSIBLE FOR UTILITY BILLS	Yes	Yes	Yes, but 27% do not pay a bill	Yes	Yes	Yes, 21% do not pay a bill
FRANCHISES COMMON	Yes	Yes	No	Yes	No	No
BUSINESS SIZE TENDS TO BE:	Very small (1-9 employees) and small (10-49 employees)	Very small (1-9 employees)	Very small (1-9 employees)	Very small (1-9 employees) and small (10-49 employees)	Very small (1-9 employees) and small (10-49 employees)	Small (10-49 employees) and Medium (50-99 employees)

Statewide Savings Opportunities

The 10 behavior-based energy saving actions, shown in Table 1, have the technical potential to save 1.4 billion kWH and 41.2 million therms statewide, representing 1.5% and 1% respectively, of electric and gas retail sales in Minnesota.

We estimate total achievable savings of 245.7 million kWH, or enough to power nearly 23,000 houses for a year, and 7.8 million therms, or enough to heat nearly 12,600 houses in the winter. We calculated a total benefit of $28.6 million in customer bill savings for SMBs statewide. Figures 1 through 3 display the distribution of overall achievable opportunities by county. Regions that are densely populated have the greatest savings potential due to the geographical concentration of businesses, but the distribution of opportunities by measure and business type are similar across utility service territories and counties.

Figure 2. Achievable Electricity Savings Potential by County

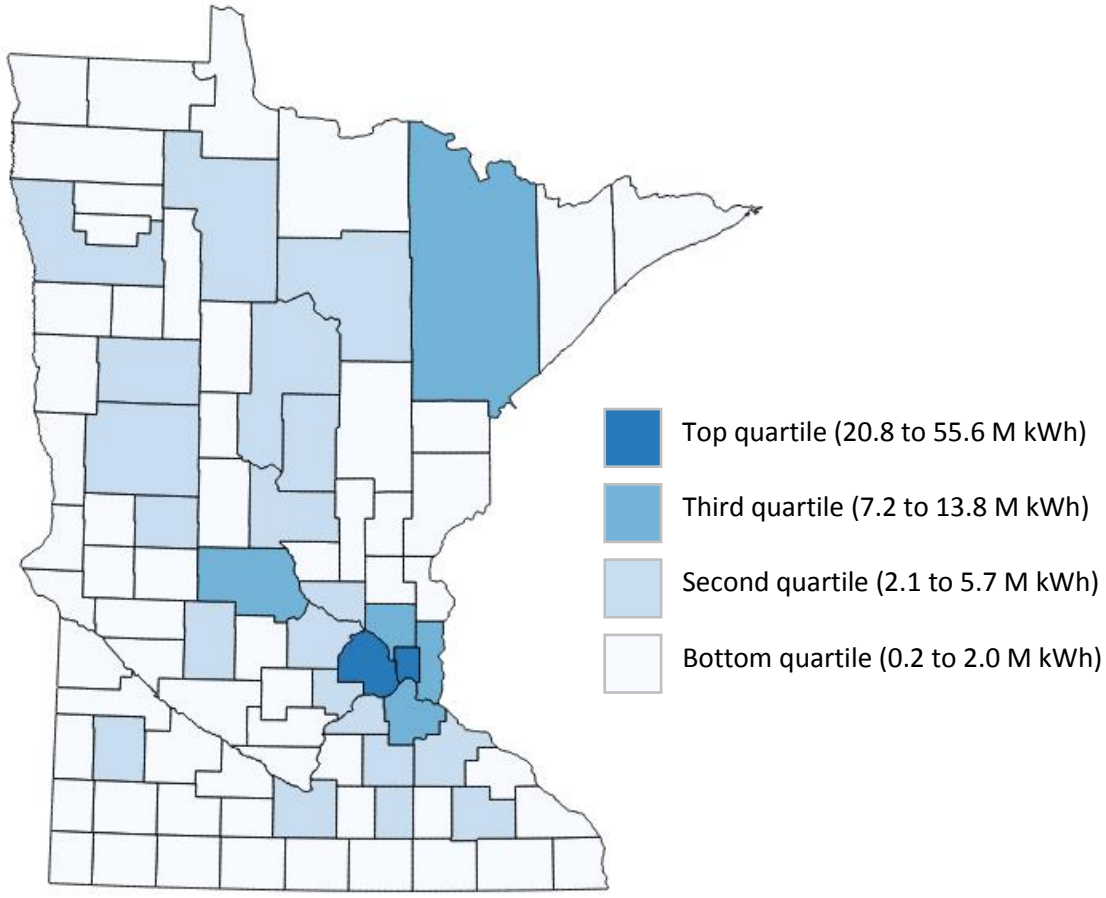


Figure 3. Achievable Natural Gas Savings by County

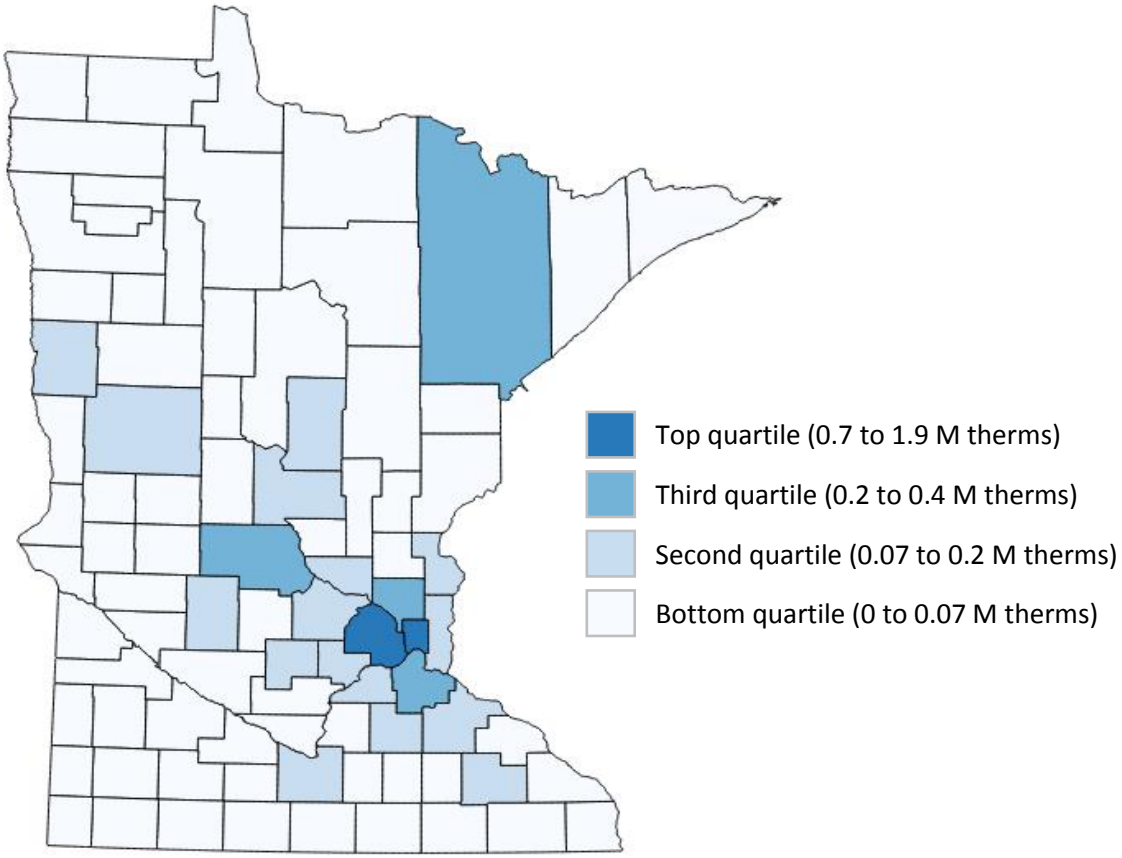
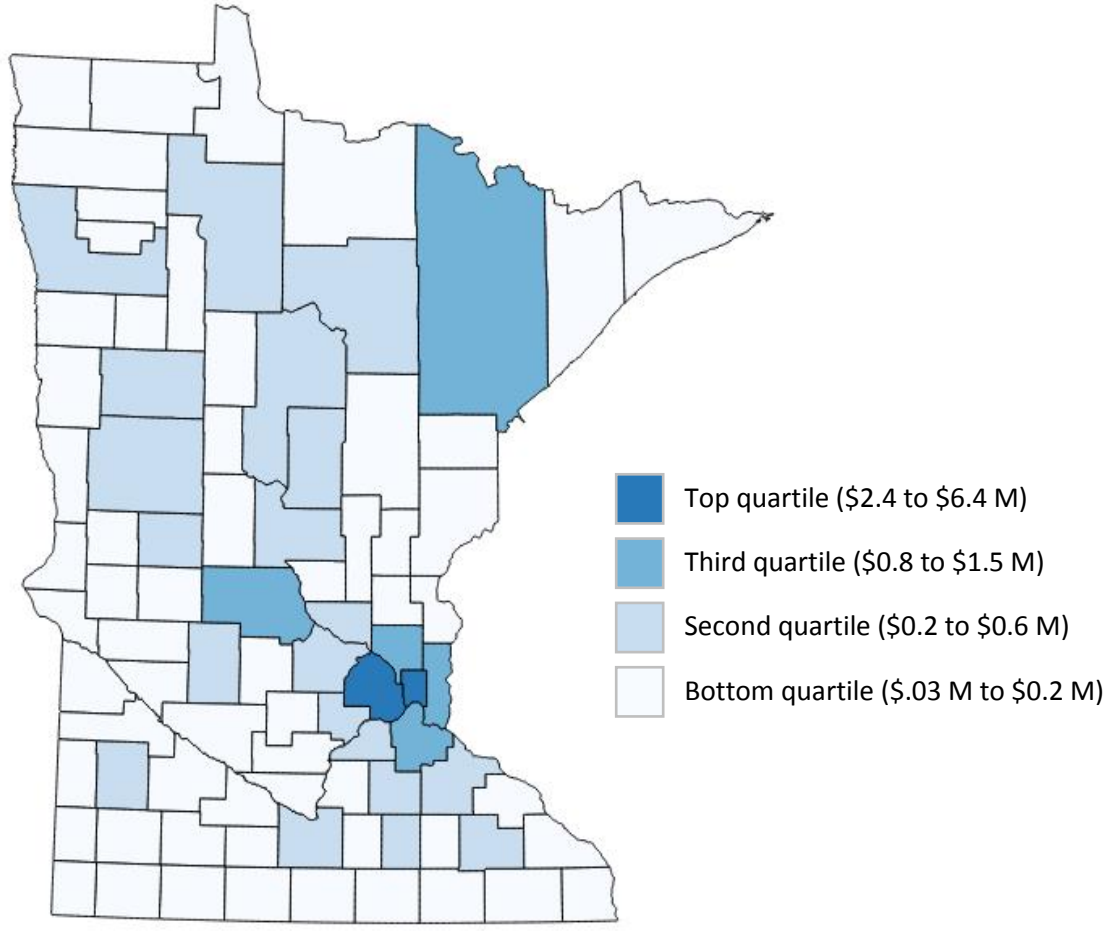


Figure 4. Achievable Customer Bill Savings by County



1.4 Program Recommendations

The results from the modeling and survey analysis in this study, lessons learned from case studies in behavioral-change programs, as well as research on behavioral interventions suggest approaches for implementing behavior change strategies in programs for SMBs.

Note that behavior change programs targeting SMBs are relatively new. These approaches are recommended based on the best information available. However, all new approaches should first be tested, piloted on a subset of businesses, and evaluated before widespread implementation.

Identify and recruit the energy decision-maker and influencer in the company. This will often be the business owner, but may be a staff or facility manager. This energy champion is crucial for getting other staff on board, implementing changes to processes to facilitate desired behaviors, and working with landlords, facility managers, business owners, as needed.

Craft messaging carefully. SMBs request and respond to messaging and energy-saving tips that are specific to their business and situation. Generally, programs will need different messaging and tips for different segments. Some of the business segments in this study overlap on some characteristics and may respond to similar messaging in certain circumstances. For example, food service, grocery, and retail share some characteristics. In other cases, there are segment subgroups such as medium versus small businesses that will benefit from different approaches. Program design and messaging needs to carefully consider the characteristics and needs of each type of targeted business.

Recognize the split incentive: Businesses that do not own their building will have limited control over HVAC and building-level changes, while the building owner may not be motivated to make changes if the business tenants pay the utility bills. Behavior-based actions that businesses can control will be more effective in these situations.

Look for opportunities for joint electricity/natural gas programs: Thermostat set-backs, HVAC maintenance, and kitchen exhaust offer opportunities for joint electric/natural gas programs. Thermostat set-backs, in particular, are applicable across all segments.

Integrate behavior-change actions into business processes: Food service, grocery, and retail all use or can benefit from, start-up and shut-down schedules and checklists for employees. These checklists can include all necessary business processes such as checking-in, tidying the sales floor, and starting food prep as well as energy-saving actions such as turning on and off equipment, exhaust fans, lighting, and computers at optimal times to reduce energy use. Implementing schedules and checklists requires the leadership of the general or shift manager, who may also be the business owner.

Encourage changes while having fun: Challenges and competitions can boost morale among employees while saving energy and ingraining behavior change. Competitions may work particularly well between members of the same franchise in the food service, grocery, and retail segments. Campaigns have shown success in office and education settings. Competitions and campaigns should: 1) Focus on the key actions that will result in quick energy savings and lead to long-term changes; 2) Reward all participants, not just winners; 3) Use prompts and reminders to change behavior; 4) Track progress and share success with staff.

Find a community. Community-based programs can be location-based, like city business districts or shopping mall food courts, or they can be segment-based. The key is to find individuals and organizations that business owners will view as trusted community members and then partner with these trusted members to recruit other businesses for energy conservation programs. The food service segment has professional organizations (e.g. National Restaurant Association ConServe[2] or Minnesota Clean Energy Resource Teams[3]) that provide education on saving energy. Retail businesses that are in business districts or shopping centers with a community organization may be open to learning from other businesses in their area.

[2] https://conserve.restaurant.org/

[3] http://www.cleanenergyresourceteams.org/

Partner with existing programs. Businesses view their utility as a trusted source of information. Materials on behavior-based approaches can be integrated with on-site audit/direct install programs, rebate programs (e.g. food service), or existing K12 energy education kit programs. Programs can also pair rebates or information on smart devices, such as smart thermostats, and automation with behavior change strategies to encourage lasting change (and avoid over-rides) to lighting, fan, and HVAC settings. Programs can also incorporate pledges and choice architecture to encourage follow-through.

Study Introduction

Key Takeaway:
The key objective of this study is to understand the human and technical potential of behavior change programs, to help inform behavior-change program development.

2.1 Study Overview and Objectives

Illume Advising, LLC and its subcontractors Seventhwave and Leede Research (hereafter, "the team") conducted this Statewide Commercial Behavior Segmentation and Potential Study to measure the human and technical potential of behavior change across key end uses among small and medium businesses (SMB) with less than 100 employees. The study achieved several key outcomes that will inform planning and implementation of behavior-based programs for SMBs in Minnesota: 1) The study created a statewide commercial customer segmentation scheme which groups small and medium businesses based on the behavior-change opportunities they exhibit, and 2) The study produced statewide estimates of the achievable energy savings potential of behavior changes in the commercial sector characterized by type of measure, business segment, and energy utility, and 3) The study presents segmentation and savings opportunities through a framework of behavior change program models to provide practical suggestions for program design and implementation. Altogether the study suggests where and how to target behavior change programs both geographically and according to business segment, and estimates the magnitude of potential savings associated with the implementation of programs.

Methodology Overview

Key Takeaway:
The team combined primary survey data, secondary research and data, and models of commercial buildings to identify promising business segments and energy saving actions, and to model their associated electricity, natural gas, and cost savings. Below we provide an overview of the survey and building modeling methodologies. We provide detailed methodologies in the technical appendices.

3.1 Survey Data Collection

The team collected data from 1,440 Minnesota small businesses via a telephone survey administered from June through early October of 2016. Professional interviewers contacted each business and used screening questions to identify an employee with knowledge of the company's energy use practices and equipment. The interviewers gathered data on the types of equipment, energy conservation behaviors, and the energy decision-making authority in the businesses surveyed.

The team collaborated with the CARD Market Characterization study to develop a combined survey instrument and joint data collection activity. This collaboration allowed the teams to expand their sample size and to ensure that the research projects did not over-burden small businesses with multiple requests for survey participation.

Sampling Strategy

To ensure a representative sample of SMBs, the team stratified the sample by:

Number of employees: very small (1 to 9 employees); small (10 to 49 employees); medium (50 to 99 employees). These definitions align with publicly available data from the 2013 US Census County Business Patterns (2013 CBP).

Business segment: food service, grocery and convenience, retail, wholesale, education, office. The team identified six business types (plus an "other" category) that align with both the Commercial Buildings Energy Consumption Survey (CBECS) data and NAICS codes to serve three purposes: 1) To stratify the sample based on the most common SMB types in Minnesota; 2) To enable extrapolation of potential estimates to county and utility service territories by merging results with the 2013 US Census Zip Code Business Patterns (2013 ZBP) and 2013 CBP data; and 3) align with CBECS building types for

developing baseline building models. The team identified the top six CBECs building types based on aggregate gas/electric bills and mapped NAICs codes to these types.

Location: Twin Cities vs rest of Minnesota. The team stratified the sample based on location to enable comparisons between the Twin Cities and the rest of the state (hereafter, Greater Minnesota) and to meet the sampling needs of the CARD Market Characterization study. The seven-county Twin Cities Metro Area contains about 60% of SMBs and SMB employees. Consequently, the team stratified the sample to reflect that split.

The final sample definition included 29 strata, shown in Appendix A.

Survey Instrument

The survey instrument included screening questions and questions on businesses practices, building details, decision-making, and end-uses as described in Table 3. The complete survey instrument is included in Appendix A.

Table 3. Survey Question Types

Data Class	Types of Data	Rationale for Inclusion
Screening criteria & firmographics	The responsibilities. and decision-making authority of the respondent with in the organization	To identify and screen for the individuals most likely to (a) be aware of, and (b) take action in response to their enegy use.
	Self reported business type and asociated NAICs codes	To align with NAICs codes and screen for eligible business types
	Size of the organization, number of employees	To screen for eligible businesses (<100 employees) and to align with census data to map back to the GIS database, for segmentation.
	Sales volume	To align with census data to map back to the GIS database, for segmentation.
Building detail	Building type: Free-standing, multi-unit; exterior materials window coverage, insulation	To support engineering estimates and assumptions and to better classify businesses based on opportunties.
	Building ownership: Lease or own	To determine the types of actions businesses take to reduce their use.

Data Class	Types of Data	Rationale for Inclusion
Business practices	Hours of operation: Determine hours during which the premises are occupied	To determine how impactful various end use behavior or setting modifications may be on the business.
	Decision-making practices: Determine who makes decisions about equipment purchases, maintenance, and operations	To identify whether decisions are made by the business owner, property manager, landlord, or corporate office.
End use detail	End uses and settings: Identify the presence of end uses in the business, including: heating, cooling, lighting, plug load, and specialty equipment	To identify the specific end uses in place within the data to inform segmentation and the engineering estimates of the savings potential of end use behaviors.
	End use practices: Identify any practices regularly carried through within the business, such as shutting down of equipment, temperature set-backs, etc.	To inform estimates of the savings potential of altered end use behaviors.
	Control over key end use practices : Determine the extent to which the respondent has control over the management of end uses, such as HVAC, lighting, plug load, settings	To determine whether or not there are barriers to behavior modifications within the business due to competiting priorities and users.

3.2 Measure Selection

The study focused on energy conservation measures that can be accomplished either through behavior changes or by installing controls to automate the task as described in our working definition of commercial behavioral measures:

"Any elective action, policy or default that manages the use of equipment (or space) in a business. This could include (1) employee behaviors, (2) building operator behaviors and maintenance practices, or (3) management or control of equipment or space that is facilitated by technology, such as occupancy sensors, EMS/BAS, timers (which could also include a measure-based solution to managing equipment)."

We selected 10 measures to evaluate for our models through a three-phase selection process:

1) **Measure identification**: We assembled a broad list of 26 measures based on literature reviews, market experience, and stakeholder input.

2) **Measure prioritization leading to survey fielding**: We prioritized each measure as high, medium or low priority based on the applicability of the measure across segments (e.g., is it broad-reaching or

niche?) and rough estimates of relative per-unit savings based on professional judgment and our literature review. In addition, we considered the potential to design a program or initiative around the behavioral measure, either through existing or new programs. We included questions pertaining to 15 high- and medium-priority measures on our survey.

3) **Identifying measures with the most potential opportunity**: Using survey responses and rough-cut estimates of savings for each measure, we narrowed the list to 10 measures with the highest saving potential. To estimate savings potential, we first developed a series of rules using survey and secondary data for each measure to flag the businesses that have an opportunity to reduce energy use by changing behavior related to the measure. The ten measures which exhibit the highest potential, and that became the focus of the study include measures in HVAC, lighting, power management, refrigeration, and kitchens as described in Table 4.

Table 4. Energy Conservation Measures Selected for Consideration

End Use	Measure	Measure Description	Business has opportunity to implement if
HVAC	Thermostat set-backs	Set back heating and/or cooling set-points during periods of no occupancy.	Business is not open 24/7 and has a thermostat that can be controlled by owner/employee and there is less than a 3 degree difference in temperature settings between occupied and unoccupied hours.
	HVAC regular maintenance	Regular maintenance of HVAC equipment (e.g., service contract).	Business has heating or cooling equipment and does not already do regular maintenance and someone other than a corporate office is responsible for maintenance.
Lighting	Lighting optimized to occupancy	Turn off lights (or lights turn off automatically) during periods of no occupancy.	Business is not open 24/7 and percent of lights left on exceeds amount typically needed for safety/egress (based on ASHRAE) and lights are not controlled by occupancy sensors.
	Lighting optimized to daylight	Dim or turn off lights (or lights turn off or dim automatically) during periods of sufficient natural light.	Business is not only open during evening/night hours and lights are not controlled by daylight sensors and respondent identifies an opportunity to turn off lights during the day.

End Use	Measure	Measure Description	Business has opportunity to implement if
Power Management	Computer power management	Turn off computers/monitors or set them to low power mode or implement power-management software.	Business is not open 24/7 and has at least one computer in regular use and computer settings are not implemented to put computers to sleep at the end of the day.
	Equipment power management	Turn off printers, multifunction devices, or other plug loads or set them to low power mode.	Business is not open 24/7 and has at least one printer/multi-function imaging device and a business owner or employee/subcontractor is responsible for maintaining computer equipment and computer settings.
Refrigeration in Food Sales	Refrigerated display case air leakage*	Reduce air leakage (apply night curtains)	Business has open refrigerated display cases or open freezer cases and the business does not pull down a curtain on a nightly basis.
	Refrigeration maintenance**	Regular refrigeration maintenance	Business has open refrigerated pr freezer display cases, refrigerated or freezer display cases with doors, walk-in coolers or walk-in freezers and does not already conduct regularly scheduled maintenance and either the business owner, facility manager, employee, or external contractor is responsible for maintenance on refrigeration equipment.
	Refrigeration lighting**	Turn off lights in refrigeration overnight.	Business is not open 24/7 and business has open refrigerated pr freezer display cases, refrigerated or freezer display cases with doors, walk-in coolers or walk-in freezers
Kitchen	Kitchen exhaust fan**	Turn off exhaust during periods of no cooking	The business has kitchen exhaust hoods that have manual hoods that are always on or are switched off only when business is closed.

**Savings evaluated only for the Grocery/Convenience segment.*

***Savings evaluated only for the Food Service, Grocery/Convenience, Food Sales, and Education (schools with commercial kitchens) segments.*

3.3 Potential Savings Estimates

Building Modeling for Technical Potential Estimation

We used building energy modeling to quantify the electricity and natural gas savings from the ten identified energy saving measures across six business segments. To accomplish this, the team first developed building models representing the characteristics of the small businesses sampled in the study, using DOE2.2[4] as the modeling engine.

The building energy models were informed by the project survey, CBECS microdata and other secondary literature sources. The team developed baseline models to represent the existing small commercial building stock in Minnesota, with separate models for each of the six business segments, and variants of these models for different building types, sizes and HVAC systems within each segment (144 models in total).

Next, we defined measure inputs using survey responses and secondary literature sources, including the Minnesota Technical Reference Manual (TRM)[5] where applicable. We calculated savings for each measure by comparing predicted energy consumption for the baseline condition and the implemented-measure condition. We performed quality control on measure savings estimates to ensure reasonable predictions. The result is a series of more than 11,000 sets of modeling results representing the existing energy consumption of small commercial buildings in Minnesota, capable of predicting savings specific to Minnesota for each energy saving action. We provide additional detail on the building-energy modeling methodology in the Appendix B.

Finally, to estimate the total technical potential for the measures across the state—and to estimate potential by county and utility service territory—we extrapolated the survey-based estimates of building characteristics and measure opportunity incidence to the state population of businesses, and applied the modeled energy savings to this population. We accomplished this using a purchased database of all Minnesota businesses combined with statistical techniques to extrapolate the survey data to the population. We used geographic information systems (GIS) tools to allocate potential to counties and utility service territories. We describe these methods in more detail in Appendix C.

Achievable Potential Estimation

To derive estimates of more realistically achievable potential for the ten measures, we applied a series of factors that address the willingness and compliance aspects of implementing measures. We developed factors based on research on participation in SMB programs (Nadel, Pye, and Jordan, 1994; Martinez, 2016) and compliance with repeated behaviors like turning off lights (Rea, Dillon, and Levy,

[4] DOE-2 based Building Energy Use and Cost Analysis Software (http://doe2.com/)

[5] State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs, Version 2.0, January 1, 2017 – December 31, 2019.

1987; Sussman and Gifford, 2012) and hand-washing in food service (Allwood, et al, 2004), as well as professional judgement.

We first defined each measure in terms of how repetitive the task is and whether controls are available to assist in implementing a measure. An example of a measure that could be implemented daily—either manually or with controls–is thermostat set-back. In contrast, refrigeration maintenance is an example of a behavioral measure that occurs infrequently and has no associated control mechanism. For measures where automatic controls are a possibility, we assigned a factor for each measure that reflects the percent of businesses who are likely to implement these controls, primarily reflecting whether the building is leased or owned, as this determines the levels of motivation to invest in controls. Of businesses that would be willing to implement a measure at all, we generally assumed that 25% and 10% of owned- and leased-spaced businesses, respectively, would implement automatic controls, Thermostat set-back stands as a special case in this regard, since many businesses already have the relevant automatic control (a programmable thermostat), but simply do not use it. We further assume a manual-compliance factor for repetitive measures for businesses that choose to implement the measure manually. This reflects the fraction of time where a manual control is applied, as even the most well-intentioned employee may forget to take an action regularly.

Finally, we applied an overall willingness-to-implement factor, which reflects the idea that even if there were a program incentivizing measure implementation, not all businesses would be willing to do so. They may have competing priorities for their attention and time, or they may not see the value of implementing the measure. We applied a 30% willingness factor to all measures.

The full table of factors applied is shown in Appendix B.

Uncertainty Estimation

There are several sources of uncertainty involved in the study. At the first level, there is sampling uncertainty associated with the survey data that underlies much of the analysis: one would expect repeated survey samples to yield slightly different results simply due to random variation from one sample to the next. This uncertainty also affects the statistical models used to extrapolate the survey results to the larger population of Minnesota businesses.

For example, our analysis indicates that the margin of error for the statewide proportion of businesses with an opportunity for thermostat set-back is about ±5.5 percentage points.[6] In theory, in nine cases out of 10, the survey results would differ by no more than 5.5 percentage points from the results that we would get if we could survey all businesses in the state. (In practice, survey non-response and other factors may introduce other sources of error into the results: these are difficult to quantify.)

[6] At a 90 percent confidence level.

The sampling uncertainty is higher for subgroups where the number of survey respondents is lower. For example, among retail establishments, the margin of error for the proportion of businesses with an opportunity for thermostat set-back is ±12 percentage points.

In terms of aggregate potential savings, we calculate that sampling and extrapolation uncertainty amount to about ± 14 percent uncertainty around our point estimates of statewide achievable potential.

An additional source of uncertainty is the energy modeling used to estimate the magnitude of the savings from the various measures, which we conservatively estimated at ± 25 percent.[7] When this is added to the sampling uncertainty above, the combined uncertainty in total achievable potential is increased to ± 26 percent.

Potential studies have documented the many sources of uncertainty and studies typically identify uncertainty around human behavior as the largest source of uncertainty.[8] Likewise, in this study, the largest source of uncertainty for achievable potential arises in the factors used to translate theoretical technical potential into more realistically achievable savings (see Appendix C). We estimated uncertainty bounds for the various achievability factors described above, and factored these into the analysis. When combined with the sampling and modeling uncertainty above, the uncertainty in aggregate achievable potential is increased to ± 70 percent. While this indicates that there is considerable uncertainty in the overall magnitude of achievable behavioral savings, the study's findings regarding which business types and measures are the most important ones are robust.

For ease of reading, we report the point estimates of achievable savings only, but the reader should note that each estimate has a wide band of uncertainty.

Behavioral Programs Background

Key Takeaway:
Effective behavioral programs for SMBs need to identify the key decision-maker in the business and provide specific, actionable recommendations that fit within business processes to overcome barriers to participation such as limited staff time and the split incentive problem.

[7] For example, ASHRAE Guideline 14-2014, "Measurement of Energy and Demand Savings" has two threshold criteria for an energy model to be considered calibrated to actual measured building performance. 15% CV(RSME) for monthly data and 30% hourly. These values are therefore reasonable for energy savings estimates for those models as well and Abdullah, A. et al, "Whole Building Energy Analysis: A Comparative Study of Different Simulation Tools and Applications in Architectural Design", 2014 ACEEE Summer Study on Energy Efficiency in Buildings claims 10-30% from a review of several sources.

[8] For example, see discussions of uncertainty in Xcel Energy Minnesota DSM Market Potential Assessment, April 20, 2012 or in the California Energy Efficiency Potential Study, July 2008.

4.1 Types of Behavioral Programs

The 2015 CARD behavioral programs literature review (Dougherty, et al, 2015) defined, cataloged, and benchmarked residential and commercial behavioral programs. The review defined behavior programs as programs "that deliberately apply models and approaches drawn from the social and behavioral sciences to affect energy use" (Ignelzi, Peters, Randazzo, Dougherty, Dethman, and Lutzenhiser, 2013). The study organized behavioral programs into three families and five categories (see Figure 5) The three program families are: 1) Calculus programs that provide information on energy use so that customers can make economically rational decisions; 2) Social interaction programs that provide information through in-person or online social interactions; and 3) Cognition programs that appeal to emotions and/or rely primarily on delivering information to customers as a means of driving change.

Figure 5. Taxonomy for Residential and Commercial Behavioral Change Programs

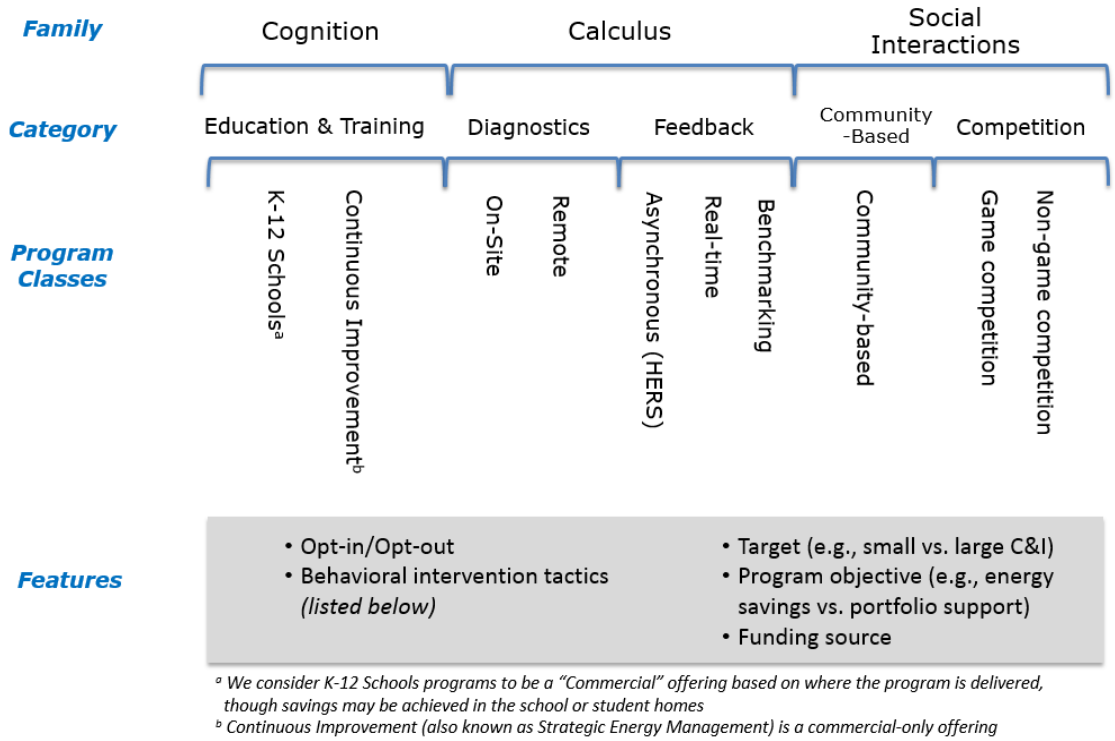


Figure Source: Dougherty, et al. (2015) Energy Efficiency Behavioral Program: Literature Review, Benchmarking Analysis, and Evaluation Guidelines

This program taxonomy provides a framework for applying segmentation to program design. We particularly focus on the following behavior change approaches for SMBs, described in Figure 6, below.

Figure 6. SMB Behavior Change Approaches

Asynchronous Feedback Programs provide feedback to customers after energy consumption has occurred, often in the form of a report that shows historical energy usage and usage compared to other customers. The most common models include Home Energy Reports (HERs) delivered to residential customers. Residential programs have been extensively evaluated and typically deliver greater relative and absolute savings when targeting electricity consumption. Only a few programs have implemented and evaluated Business Energy Reports.

Diagnostics Programs include audit or energy assessment programs delivered in-person, online, or with coaching. On-site commercial energy assessment programs typically feature direct installation of low-cost measures and recommendations for follow-up measures.

Community-Based Programs use in-person outreach and trusted community members to prompt energy-saving actions as people are more likely to trust information that they receive through interactions from a trusted community member or from individuals who are similar to themselves.

Energy Champions are one element of Continuous Energy Improvement Programs. Energy Champions are the voice and inspiration for energy conservation in a business. Energy efficiency program staff work with the Energy Champion on education and training, goal-setting, and commitment around energy use reductions.

Competitions include programs where individuals or organizations compete in events, contests, or challenges and may include games. Competitions which involve measuring reductions in energy use work best between buildings.

4.2 SMB-Specific Considerations for Behavioral Programs

Behavior-change approaches in SMB settings are new compared to traditional approaches such as direct-install programs. While low cost/no cost behavior change approaches offer many advantages in SMB settings, program implementers should note specific considerations that may support or hinder the

implementation of energy efficiency programs in general, and behavioral programs specifically. Below we outline some over-arching considerations. In the segment-specific sections we offer frameworks for program approaches for each segment. Program approaches should be tested through pilots, feedback from customers, and formative evaluation.

Split incentives. Many small-business customers do not own their facilities, so they are not motivated to upgrade equipment or add controls for end uses like lighting. Based on survey responses, 44 percent of Minnesota SMBs in the six segments included in this study pay their utility bill, but rent or lease their space. Rental and leasing expenses can represent a larger share of operating expenses than electricity or natural gas expenses, making utility expenses seem like a lower priority. For example, among retail establishments, leasing expenses comprise 9.5 percent of operating expenses while electricity comprises 2.5 percent of operating expenses (US Census, 2012). Furthermore, if the building owner does not pay the utilities, the owner has less impetus to make energy efficiency upgrades. In Minnesota, among business who pay either their electricity or natural gas bill, 39% lease their space. These businesses may be better candidates for low cost/no cost energy saving measures.

Staff time. Small businesses have limited staff, and owners have multiple responsibilities, so these businesses often lack the time and resources to focus on energy management (Research into Action and TetraTech, 2014). Among Minnesota SMBs with fewer than 100 employees, 74 percent have fewer than 10 employees. Having fewer employees may make communication around energy saving actions easier, but it also makes it less likely the business can devote staff time to championing the effort. In many cases the busy business owner or general manager may also have to be the energy champion.

Identifying energy decision-makers. Evaluations of business energy reports (an asynchronous feedback approach) note challenges ensuring that the report made it into the hands of an energy decision maker. Unlike home energy reports, which are delivered to the homeowner who both uses the energy and pays the bills, business energy reports may end up in the hands of a utility account manager, who may pay the bills, but not be at the specific facility to which the report applies. Alternatively, reports may end up in the hands of someone at the facility who doesn't pay the bills (Miknaitis et al, 2014, Mogilner, 2014).

Our survey of SMBs in Minnesota suggests that business owners or other employees are frequently involved in decisions related to the purchase and maintenance of equipment, which would facilitate implementing new energy saving actions. For example, in 60 percent of businesses, the business owner or an employee is responsible for setting temperatures of heating and cooling equipment which can facilitate the implementation of thermostat set-backs. However, implementing set-backs may be hindered in the 40 percent of businesses where settings are controlled by the owner or manager of leased space, or by corporate policies.

Delivering recommendations with the right level of customization and specificity. Recent evaluations of business energy reports found that recommendations were not specific enough for SMBs, even though one of the programs attempted to provide industry-specific tips. Two evaluations found that businesses felt the tips were too generic or basic, while other businesses felt the tips were not realistic for their situation (Miknaitis et al, 2014, Mogilner, 2014).

SMBs see their business and situation as unique. Generic messaging may not resonate with business owners. Messaging around energy-saving opportunities will need to be segment-specific. For example, rather than suggesting the business turn off un-needed lights, messaging should couch the suggestion within the processes of particular business segments. Later in the report we describe using the food service start-up/shut-down schedule or retail business checklists to ensure lights are turned off when not needed.

Time and Support. Programs targeted at SMBs may need adequate ramp-up time and time for business owners to respond. For example, The Energy Trust of Oregon piloted a Strategic Energy Management Intro for small businesses (PWP and Michaels Energy, 2014). The objective of this program was to introduce Strategic Energy Management concepts to businesses that didn't qualify for the full Strategic Energy Management program. The pilot program ran for 12 weeks but found that the 12-week period was not sufficient for the participant to implement the desired number of measures. In addition, the program found that the participant needed more guidance in prioritizing audit recommendations.

Even programs that emphasize low cost/no cost changes through installation of controls or through habitual behavior changes require time and support to generate persistent savings. Simple actions like turning off un-needed lights can take time to become habitual. Installing controls requires time for proper commissioning and maintenance.

Competitions. Competitions are programs where individuals or organizations compete in events, contests, or challenges to reduce energy use. Throughout the segmentation summaries, we highlight the use of competitions in food service, grocery/convenience, retail, and education segments. Research on competitions suggests the best **practices** for implementing competitions in any setting.[9] We include those best practices below and within each business segment section, we note only specific considerations or applications to that segment.

1. **Focus on key energy saving actions**. Competitions should encourage behavior changes around a small set of actions. Incorporating too many strategies may be confusing or inadvertently lead participants to implement less effective changes.
2. **Use competitions to kick-start long term changes**. Behavior changes should focus on actions that are sustainable long-term and contribute to longer-term business goals.
3. **Reward all participants, not just winners**. Competition implies that there are winners and losers. However, even among members of the same franchise, business realities will not be identical and participants may not all have the same opportunity to reduce energy usage. Further, lower performing participants may find the competition de-motivating and be less likely to change behaviors. To increase the motivation of all participants to do well, provide recognition (prizes, points, awards) based on levels of participation or for achieving goals, rather than just for being the winner.

[9] Vine, Ed, and Christopher Jones, May 2015. "A Review of Energy Reduction Competitions: What We have Learned?" California Institute of Energy and Environment, 2087 Addison Street, Berkeley, CA 94704-1103. (https://uc-ciee.org/downloads/Competitions%20CIEE%20Report.pdf)

4. **Track and communicate progress**. To keep participants engaged, track and communicate progress regularly. Some programs use software with features such as leaderboards, goal tracking, and social media features. This can also be accomplished with posters, emails, and announcements at staff meetings.

Statewide Potential Savings Opportunities

Key Takeaway:
We estimate that achievable savings total 245.7 million kWH and 7.8 million therms for a benefit of $28.6 million in customer bill savings for SMBs statewide in the six business segments. The distribution of opportunities by measure and business type are similar across utility service territories.

5.1 Statewide Technical and Achievable Estimates

Aggregate savings potential is a combination of the (survey-based) estimated fraction of businesses where a savings opportunity exists (Figure 7) and the (energy-modeling-based) savings when there is an opportunity (Figure 8). Across all 10 measures and 6 business segments, we estimate technical potential annual savings of nearly 1.4 billion kWh and 42 million therms, representing about 2% and 0.8% of retail electricity and natural gas sales, respectively.

Achievable savings are considerably lower than technical potential savings, because businesses may be uninterested in implementing measures or will not implement them perfectly. Estimates of achievable potential are 246 million kWh, 7.8 million therms, and $28.6 million in customer energy-bill savings (see Figure 9 and Figure 10). Achievable potential is substantially lower than the technical potential, but still offers opportunities for SMBs to save energy and save on utility bills.

Figure 7. Portion of businesses with an opportunity for savings, by business segment and conservation measure

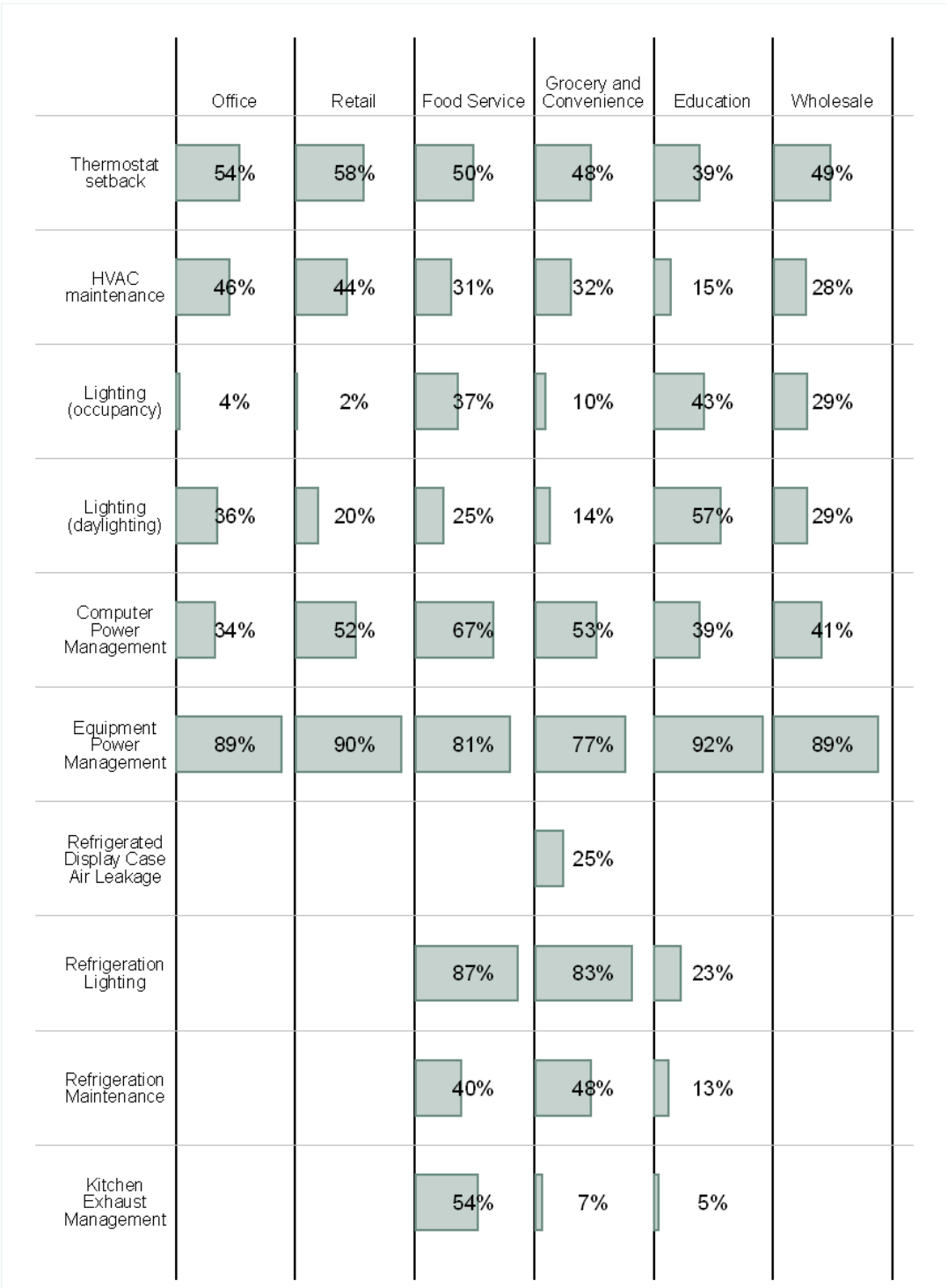


Figure 8. Median estimated savings by conservation measure, business segment, and energy modality (assumes perfect measure implementation).

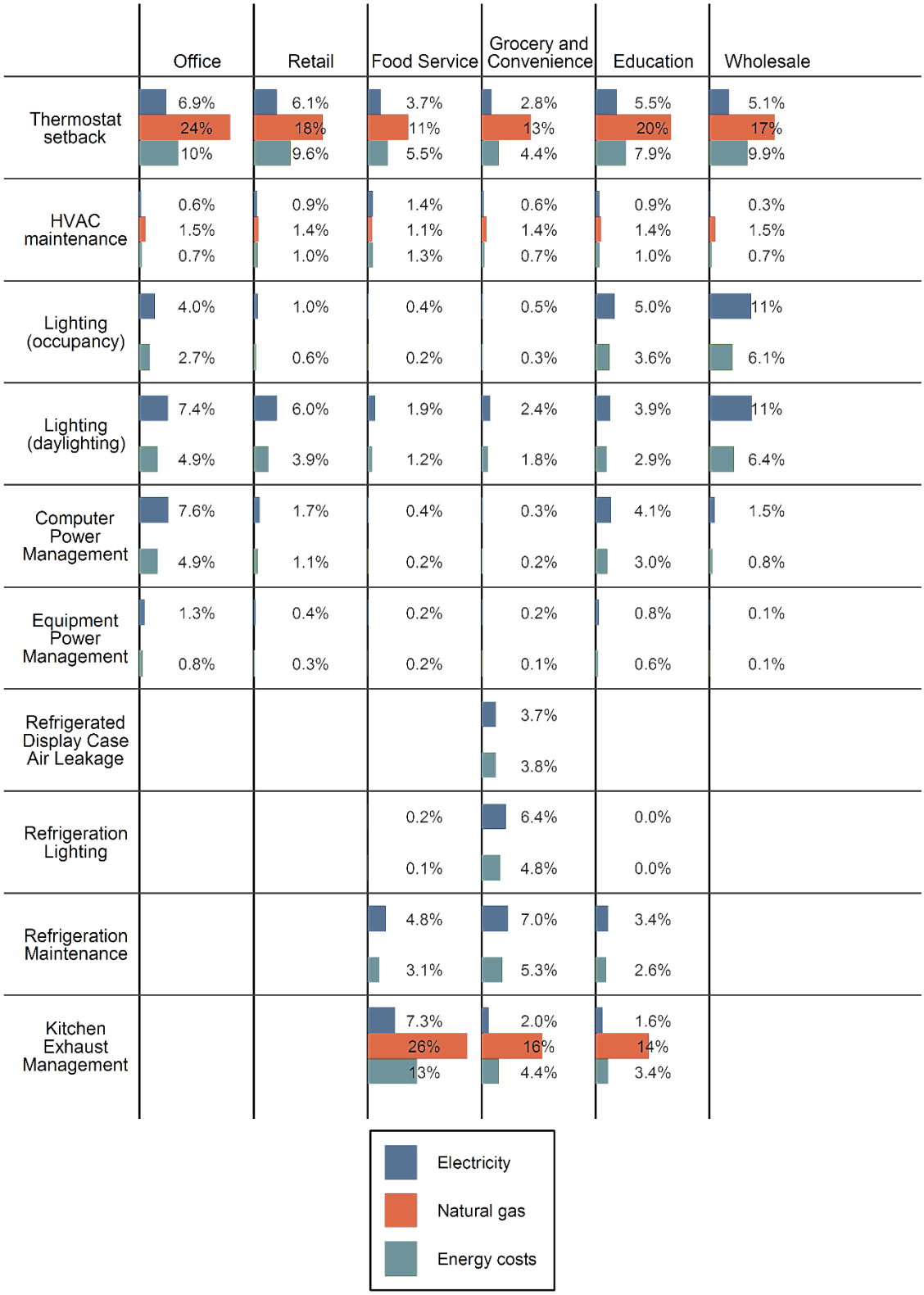


Figure 9. Statewide Achievable Annual Electricity and Natural Gas Savings by Segment

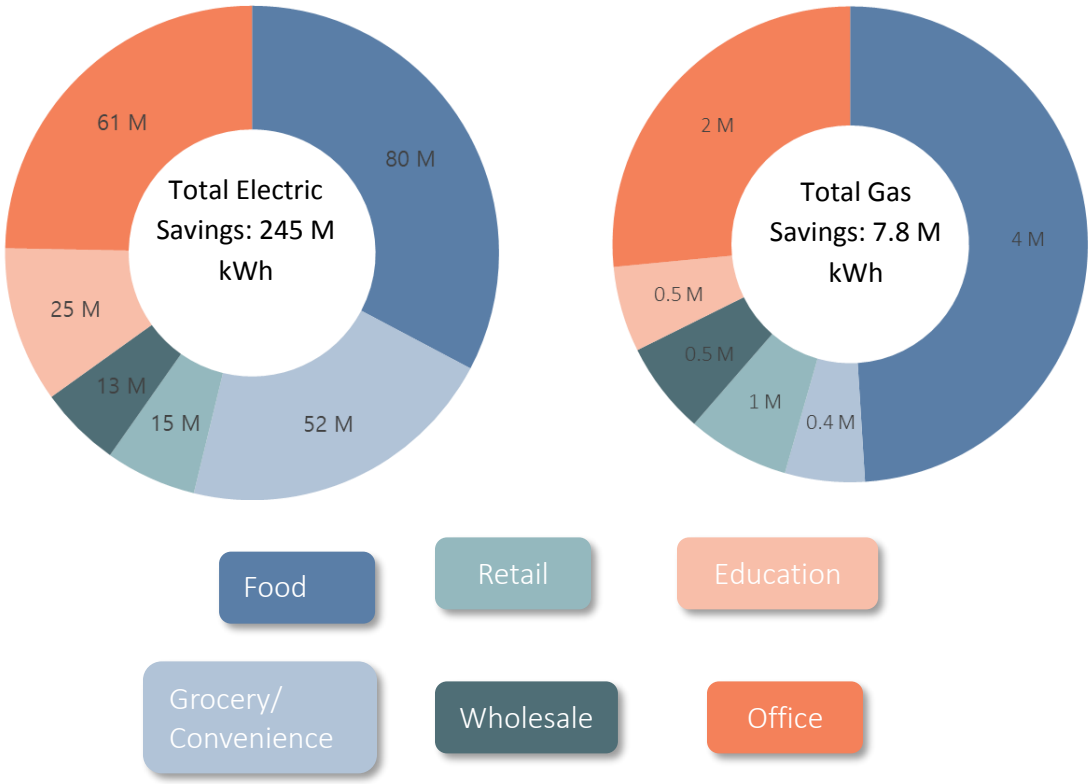


Figure 10. Customer Energy Bill Savings

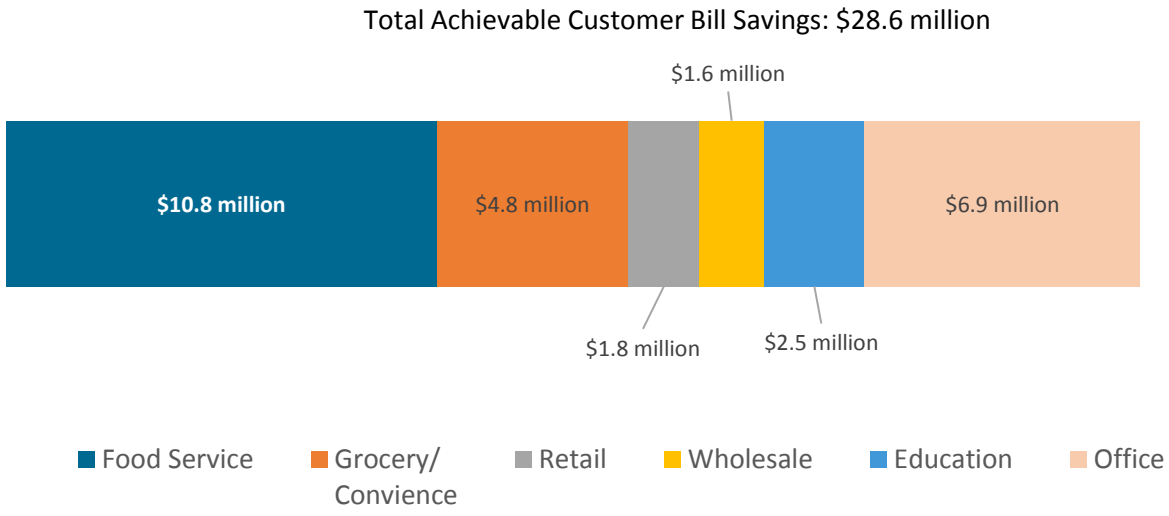


Figure 11 through Figure 13 show the distribution of achievable potential energy savings across the state. Not surprisingly, aggregate savings are concentrated in the most populous counties. The distribution of opportunities by segment and measure tend to be similar from county to county.

Figure 11. Aggregate Achievable Electricity Savings by County

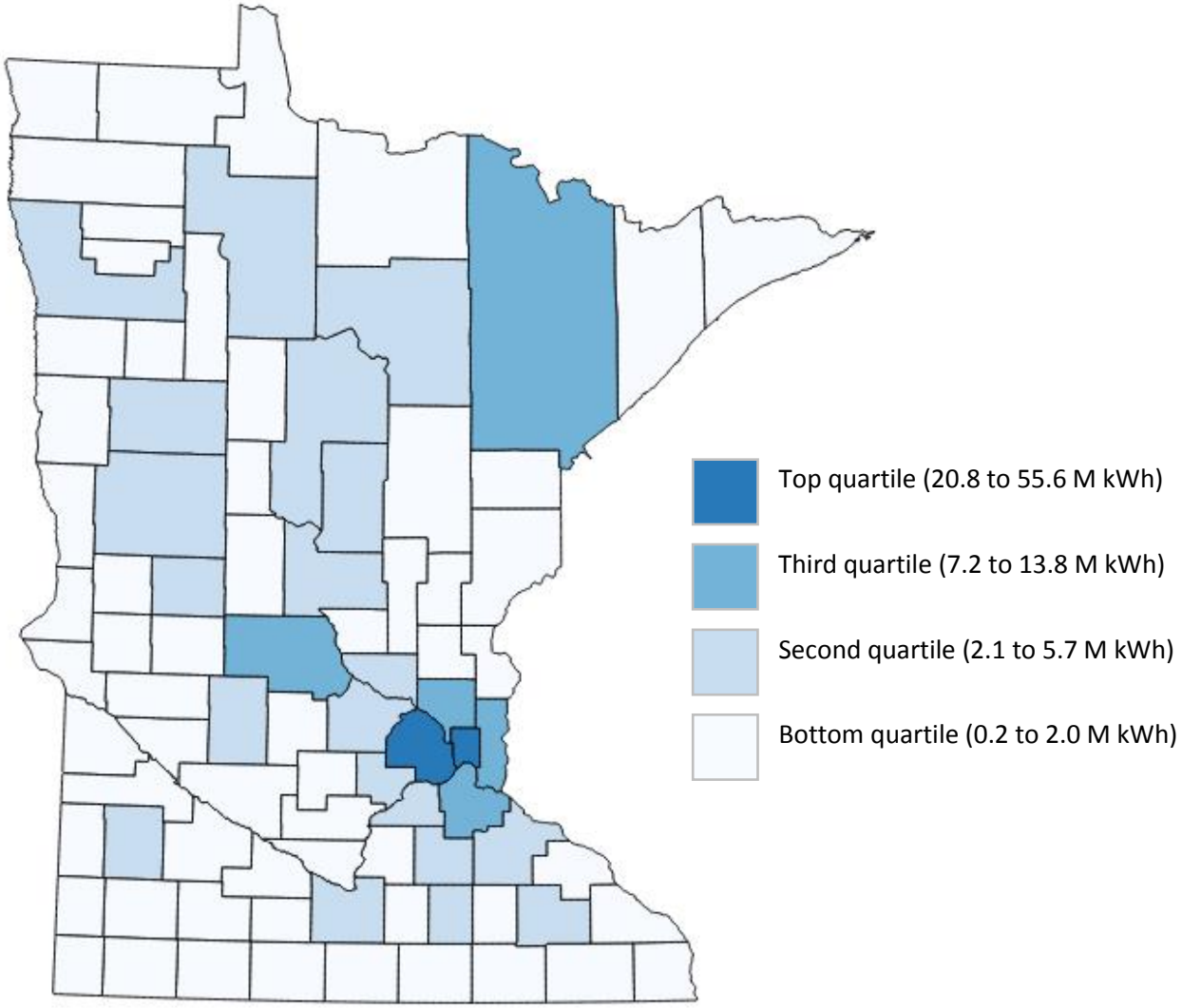


Figure 12. Aggregate Achievable Natural Gas Savings by County

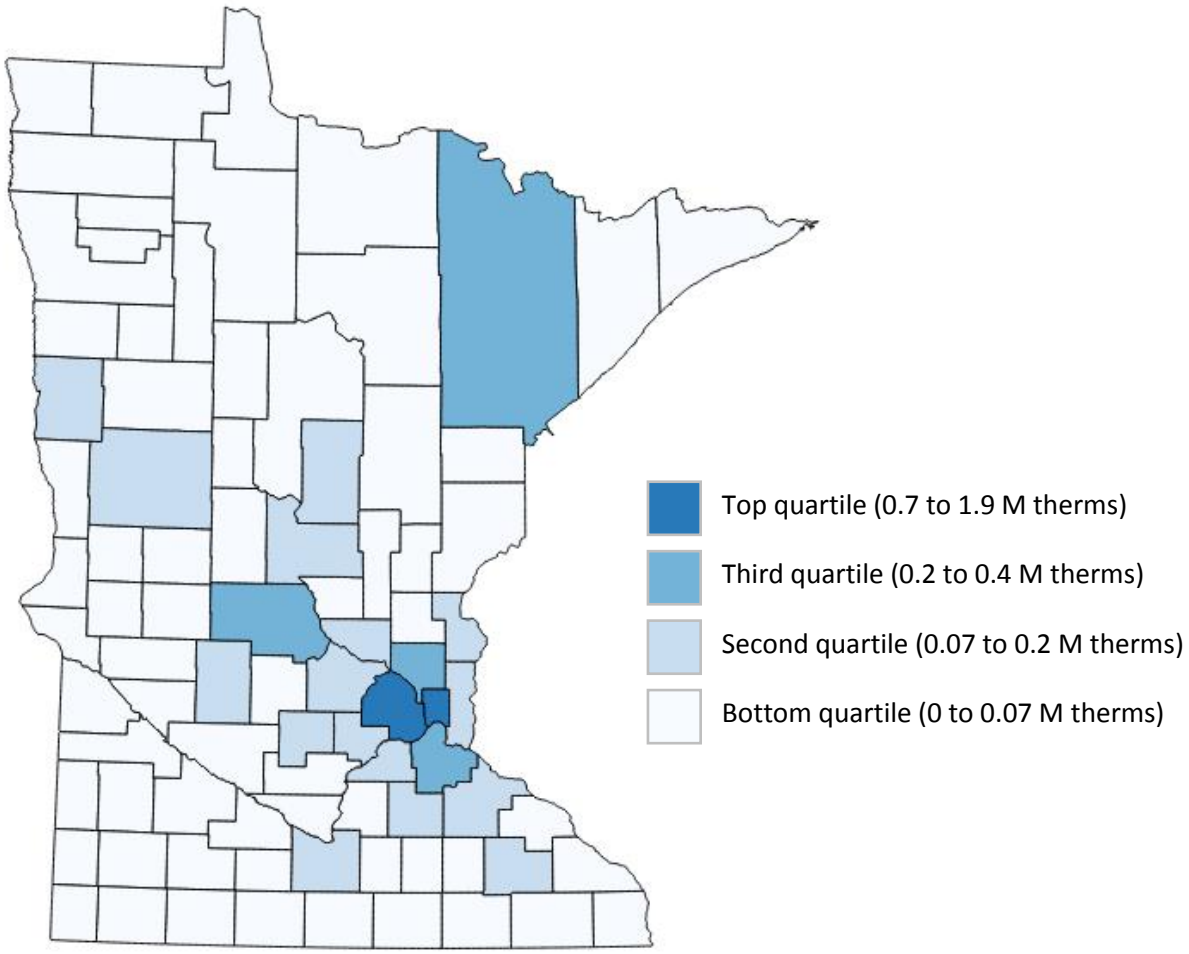
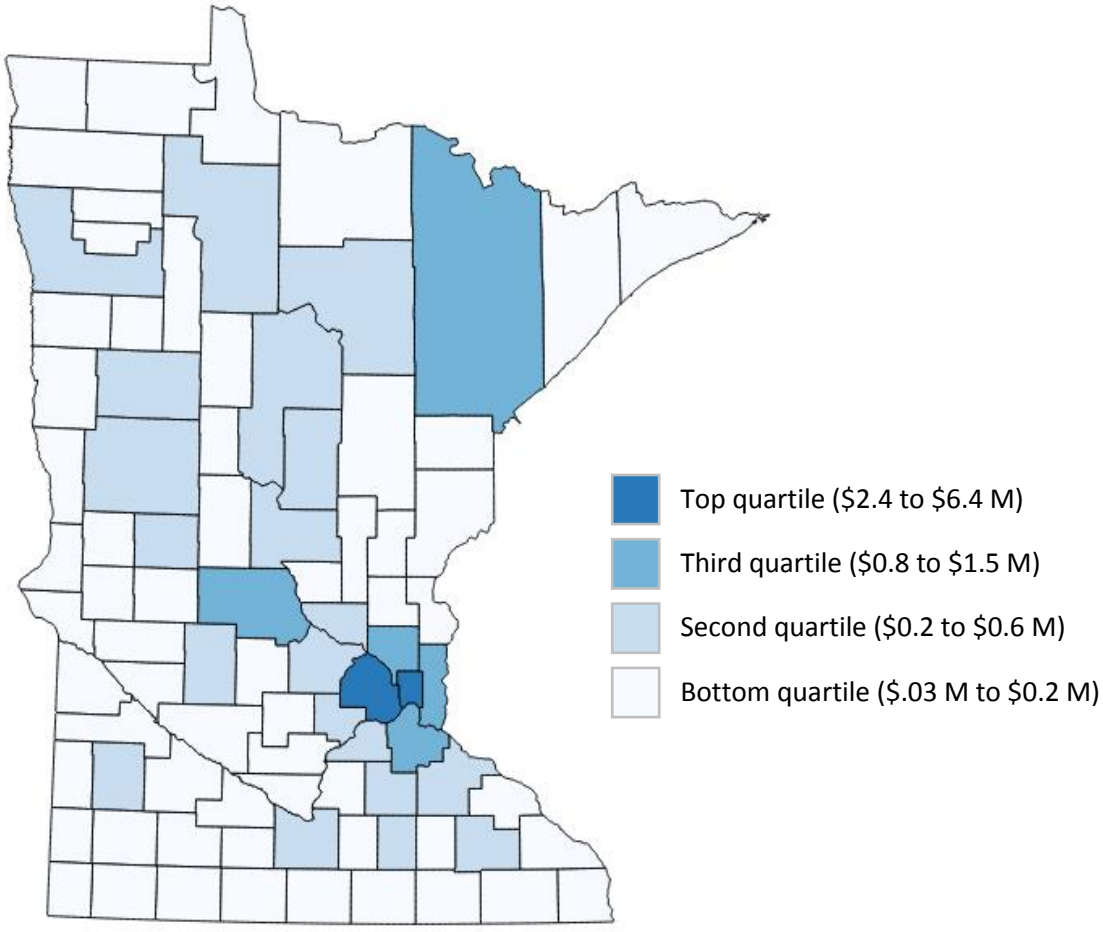


Figure 13. Aggregate Achievable Customer Energy-Bill Savings by County



5.2 Statewide Savings by Utility Type

Table 5 shows achievable potential savings by type of utility and for individual investor-owned utilities. Also of note: the distributions of savings across business segments and measures are very similar across utilities.

Table 5. Aggregate Achievable Electric and Gas Savings Potential by Utility Type

Electric Utility Type	Electric Utility Category	Electric Savings (million kWH)	Gas Utility Type	Gas Utility Category	Gas Savings (million Therms)
Community-owned utiliies (COU)	GRE Co-ops	35.8	COU	Municipality-owned	0.6
	Non-GRE co-ops	12.2	IOU	CenterPoint	3.7
	Municipality-owned	47.9		Great Plains Natural Gas	0.2
Invester-owned utilities (IOU)	Minnesota Power	16.0		Greater Minnesota Gas	0.1
	Otter Tail	10.5		MERC	1.2
	Xcel Energy	123.4		Northwest Gas	0.1
				Xcel Energy	7.8

6.0 Savings Opportunities by Measure

Key Takeaway:
Thermostat set-backs and kitchen exhaust fans provide 41% and 19% of total electrical bill savings, respectively. Thermostat set-backs offer savings in every segment, while kitchen fans are a key measure in food service. Savings from refrigeration measures are substantial in the grocery segment. While power management and lighting are a smaller portion of overall savings (16% in total), they account for most of the savings (after thermostat set-backs) in the education and office segments.
Thermostat set-backs, kitchen exhaust fans, and HVAC maintenance save both electricity and natural gas and offer opportunities for collaboration between electricity and natural gas utilities.

6.1 Measure Opportunities

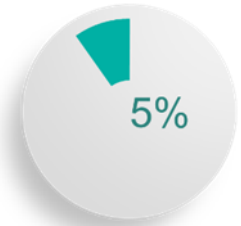
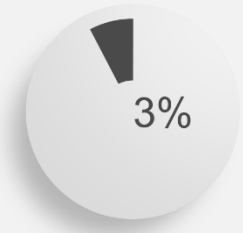
We summarize the potential savings opportunities for the 10 measures included in this study in Table 6. Figure 14 provides another way to look at the savings associated with each measure. The larger the circle, the more aggregate savings potential was found within each segment. Note that we have omitted certain graph labels in the interest of readability. Key findings from Table 6 and Figure 14 include:

Thermostat set-backs offer the most energy-saving opportunity. Set-backs can save energy in every business segment and can save both electricity and natural gas.

Kitchen exhaust fans have substantial potential to save energy in the Food Service segment as well as providing savings in the Grocery and Education segments. Responses to the survey revealed that many businesses leave kitchen exhaust fans running continuously when they could be turned off (either manually or with a control) during periods of low or no cooking.

Lighting and power management settings are smaller contributors to overall savings, but collectively provide the bulk of savings opportunities (after thermostat set-backs) for the Office, Education, and Wholesale segment.

Table 6. Opportunity by Measure Type

THERMOSTAT SET-BACK	HVAC REGULAR MAINTENANCE	LIGHTING OPTIMIZED TO OCCUPANCY	LIGHTING OPTIMIZED TO DAYLIGHT	KITCHEN EXHAUST
Set back heating and/or cooling set-points during periods of no occupancy	Regular maintenance of HVAC equipment (e.g., service contract)	Turn off lights (manually or automatically) during periods of no occupancy	Dim or turn off lights (manually or automatically) during periods of sufficient natural light	Turn off exhaust during periods of no cooking
SAVINGS OPPORTUNITIES				
PERCENT SAVINGS OVER TOTAL ENERGY USE				
				
TOTAL ELECTRICAL, NATURAL GAS AND ENERGY BILL SAVINGS				
$ 11.6 million 79.2 million kWh 4.7 million therms	$ 1.3 million 10.6 million kWh 4.7 million therms	$0.87 million 10.9 million kWh -	$ 1.5 million 18.8 million kWh -	$ 5.6 million 33.8 million kWh 2.6 million therms
BUSINESS SEGMENTS WITH MOST OPPORTUNITY				
Office, Food Service, Retail, Education, Wholesale, Grocery	Food Service, Office, Retail, Food Sales, Wholesale, Education	Education, Wholesale, Office, Food Service	Office, Education, Wholesale, Retail, Food Service	Food Service. Grocery, Education

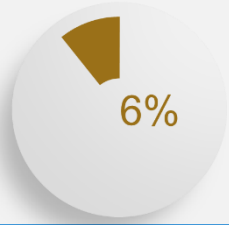
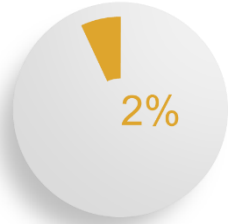
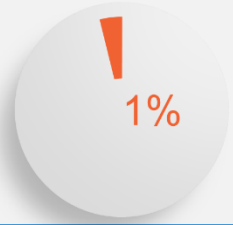
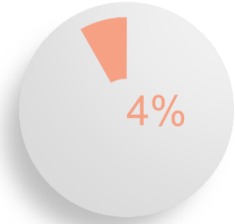
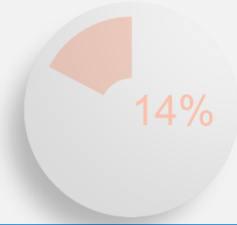
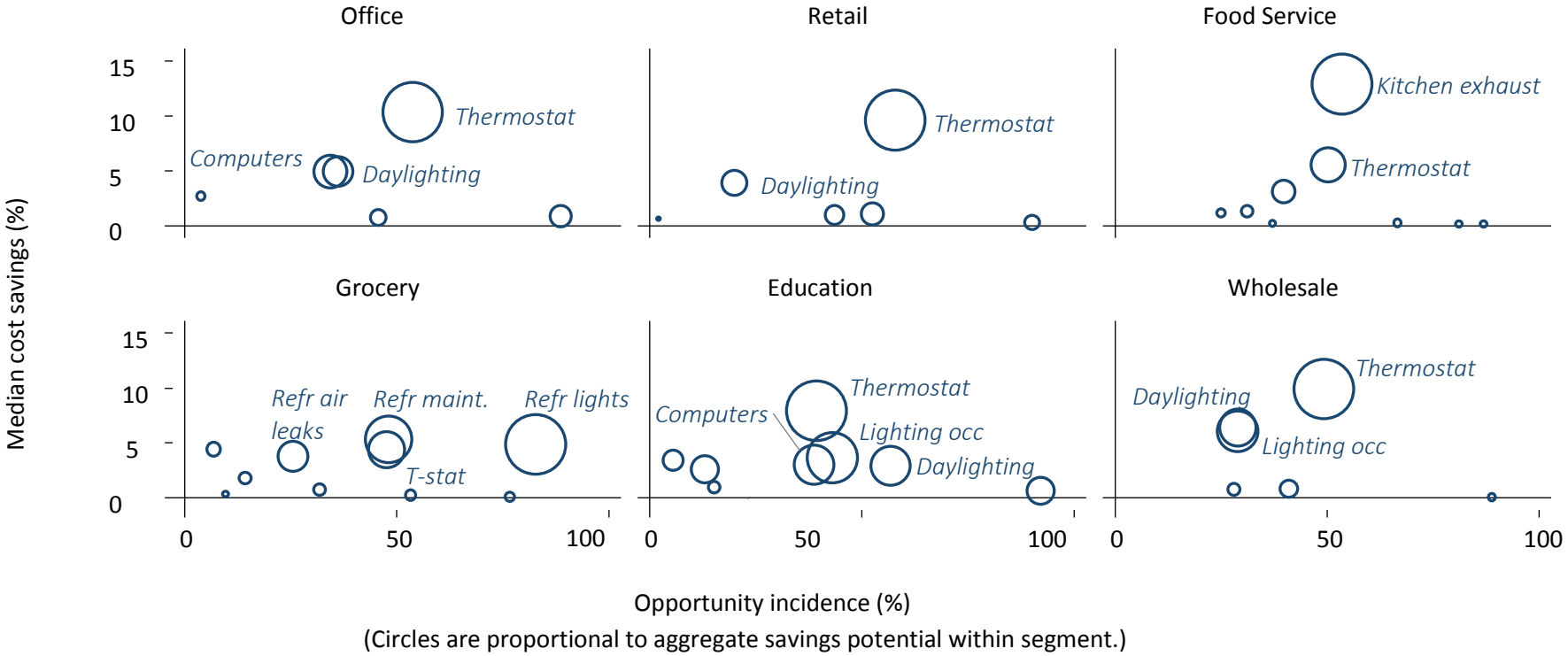
COMPUTER POWER MANAGEMENT	EQUIPMENT POWER MANAGEMENT	REFRIGERATED DISPLAY CASE AIR LEAKAGE	REFRIGERATION LIGHTING	REFRIGERATION MAINTENANCE
Turn off computers /monitors or set them to low power mode	Turn off printers, multifunction devices, or other plug loads or set them to low power mode	Reduce air leakage by applying night curtains	Turn off lights in refrigeration overnight.	Refrigerant charge, Clean evaporator coils, Adjust pressure set-points, Calibrate temperature set-points.
SAVINGS OPPORTUNITIES				
PERCENT OF TOTAL CUSTOMER BILL SAVINGS				
				
TOTAL ELECTRICAL, NATURAL GAS AND ENERGY BILL SAVINGS				
$ 1.6 million 20.7 million kWh 4.7 million therms	$ 0.5 million 6.5 million kWh -	$ 0.3 million 2.8 million kWh 0.047 million therms	$ 1.2 million 14.7 million kWh -	$ 4.1 million 47.8 kWh -
BUSINESS SEGMENTS WITH MOST OPPORTUNITY				
Office, Education, Retail, Food Service, Wholesale, Grocery	Office, Education, Food Service, Retail, Grocery, Wholesale	Grocery	Grocery, Food Service	Grocery, Food Service, Education

Figure 14. Measure Savings and Incidence

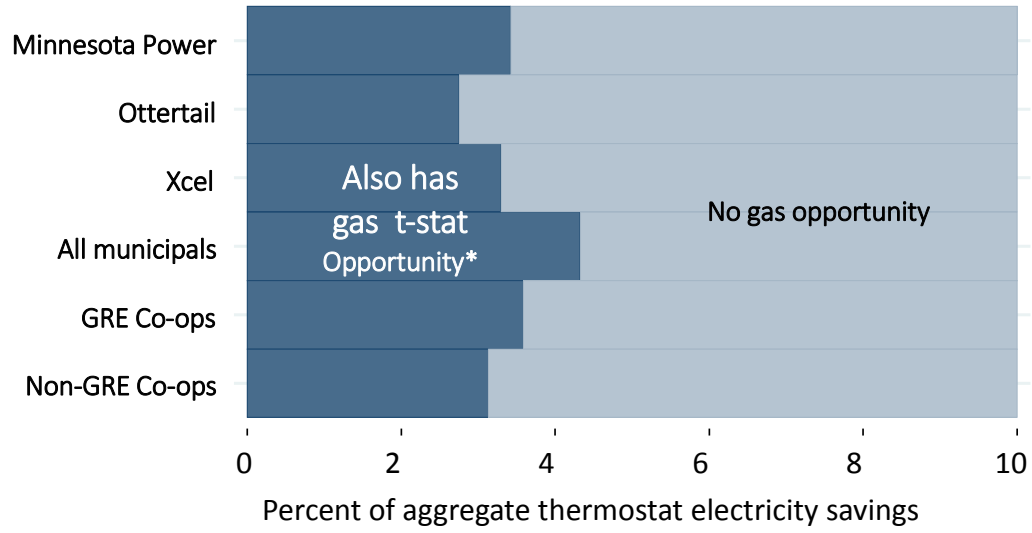


6.2 Joint Electric and Gas Measure Opportunities

Thermostat set-backs, kitchen exhaust, and HVAC maintenance offer substantial opportunity for both electric and natural gas savings. These measures could be good candidates for joint programs between electric and natural gas utilities.

Through the team's modeling efforts, we overlaid the natural gas and electric utility service territory boundaries to estimate the shared savings potential. Figure 15 illustrates the thermostat opportunity shared by natural gas and electric utilities. We found, for example, that 49 percent of Xcel Energy's electricity savings from thermostats, overlaps with natural gas saving opportunities for non-Xcel utilities (an additional 16 percent overlaps with Xcel's own natural gas territory). This analysis takes into consideration that not all businesses have natural gas heat and that not all set-back opportunities are for both heating and cooling. Likewise, most of the achievable savings for thermostats in gas utility service territories overlaps with achievable savings in electric territories.

Figure 15. Cross-utility thermostat savings



*excludes Xcel when Xcel is the electric utility

7.0 Detailed Segment Descriptions

Key Takeaway:
Each business segment has a unique combination of characteristics, some of which facilitate the implementation of programs to encourage behavior while others present challenges to implementation. Size of business, staff turnover, hours of operation, presence of franchises, ownership of building, control over equipment, whether a business pays a utility bill, and prior interest in energy efficiency all impact the types of approaches that are likely to be successful. Furthermore, segments have sub-groups that may be more or less likely to take action than the segment as a whole.
Overall, behavior change programs in SMBs are new and should be piloted and evaluated carefully prior to full-scale implementation.

7.1 Segmentation Overview

Table 7 summarizes estimated achievable electricity and natural gas bill savings for each segment and conservation measure. The food service segment offers the most opportunity for savings, followed by the office segment. The office segment has high potential mainly due to the number of offices in the state: More than half of the businesses in the state are offices. Many offices can reap small savings through changes in lighting, thermostat settings, and power management. Food service has a high potential for energy savings through improved use of kitchen exhaust fans.

Table 7. Customer Bill Savings by Segment and Measure, in millions

	Food Service	Office	Grocery/ Convenience	Education	Retail	Wholesale	Total
Thermostat set-back	$2.88	$4.50	$0.86	$1.07	$1.29	$0.98	$11.57
HVAC maintenance	$0.48	$0.42	$0.14	$0.05	$0.18	$0.06	$1.32
Lighting: occupancy	$0.05	$0.06	$0.02	$0.44	$0.00	$0.29	$0.87
Lighting: daylight	$0.12	$0.71	$0.07	$0.26	$0.15	$0.23	$1.53
Computer power management	$0.11	$0.97	$0.06	$0.29	$0.13	$0.06	$1.60
Equipment Power management	$0.06	$0.29	$0.03	$0.09	$0.04	$0.01	$0.51
Refrigerated display case air leakage			$0.30				$0.30
Refrigeration lighting	$0.06		$1.19				$1.24
Refrigeration maintenance	$1.71		$2.08	$0.27			$4.07
Kitchen exhaust	$5.39		$0.09	$0.07			$5.55
Total	$10.84	$6.94	$4.82	$2.54	$1.79	$1.63	

7.2 Segment Characteristics

The following pages provide details on the key characteristics of each of the six business segments including business size, business type, tenancy, building type, control over energy-using equipment, and others. These descriptive summaries highlight the key characteristics relevant to implementing programs to encourage adoption of low cost/no cost energy-saving actions.

It is important to note that within each segment, there may be sub-groups of businesses with varying characteristics or program design considerations. For example, some approaches may be more effective with medium-sized businesses than with very small businesses or with businesses that own their building compared to businesses that do not. These differences within segment are noted and should be considered in program designs.

Conversely, some businesses share characteristics across segments which may provide opportunities to implement similar, or slightly modified, programs across segments. For example, food service, grocery, and retail share many characteristics. All three segments tend to:

- occupy free-standing buildings
- pay their own utility bills,
- have fewer than 50 employees
- be more likely to be franchises than other segments
- have high staff turnover with many non-staff occupants in the business throughout the day
- be good candidates for programs incorporating prompts or competitions

However, retail and food service have higher rates of leasing than grocery and are more likely than grocery to be in a multi-tenant building or mall. Unlike retail, grocery and food service both have opportunities to save energy through refrigeration and kitchen exhaust measures. Even where businesses seem similar, program design and messaging will need to account for key differences to ensure that programs meet the individual needs of each business type.

7.3 Segment Summaries

The segment summaries on the following pages contain recommendations for program design considerations. Behavior-change focused programs for businesses are still very new. While case studies and pilots have shown promising results, there is still much that is untested and unknown. The recommendations provided here are based on the best information available to date. However, new program approaches should always include testing, pilots, and formative evaluation before wide-scale roll out.

Please note that due to rounding, percentages may not add to 100%.

FOOD SERVICE

The Food Service segment includes full and limited-service restaurants, cafeterias, snack bars and alcoholic beverage bars. This segment is a good candidate for program approaches that incorporate start-up/shut-down schedules, competitions, and community-based approaches. Food Service has many opportunities to save energy, with end uses including plug loads, kitchen exhaust fans, HVAC, refrigeration, and lighting. Compared to other segments, the Food Service segment has larger staff sizes (15% have 50 to 99 employees) with high employee turnover and frequently changing building occupants. These factors pose challenges to making lasting changes in behavior. In addition, more than half of the businesses (60%) rent or lease their space. While most businesses (96%) pay a utility bill, higher rental rates mean that businesses will be unable or unwilling to make expensive investments in equipment or retrofits, and may benefit more from low cost or no cost changes.

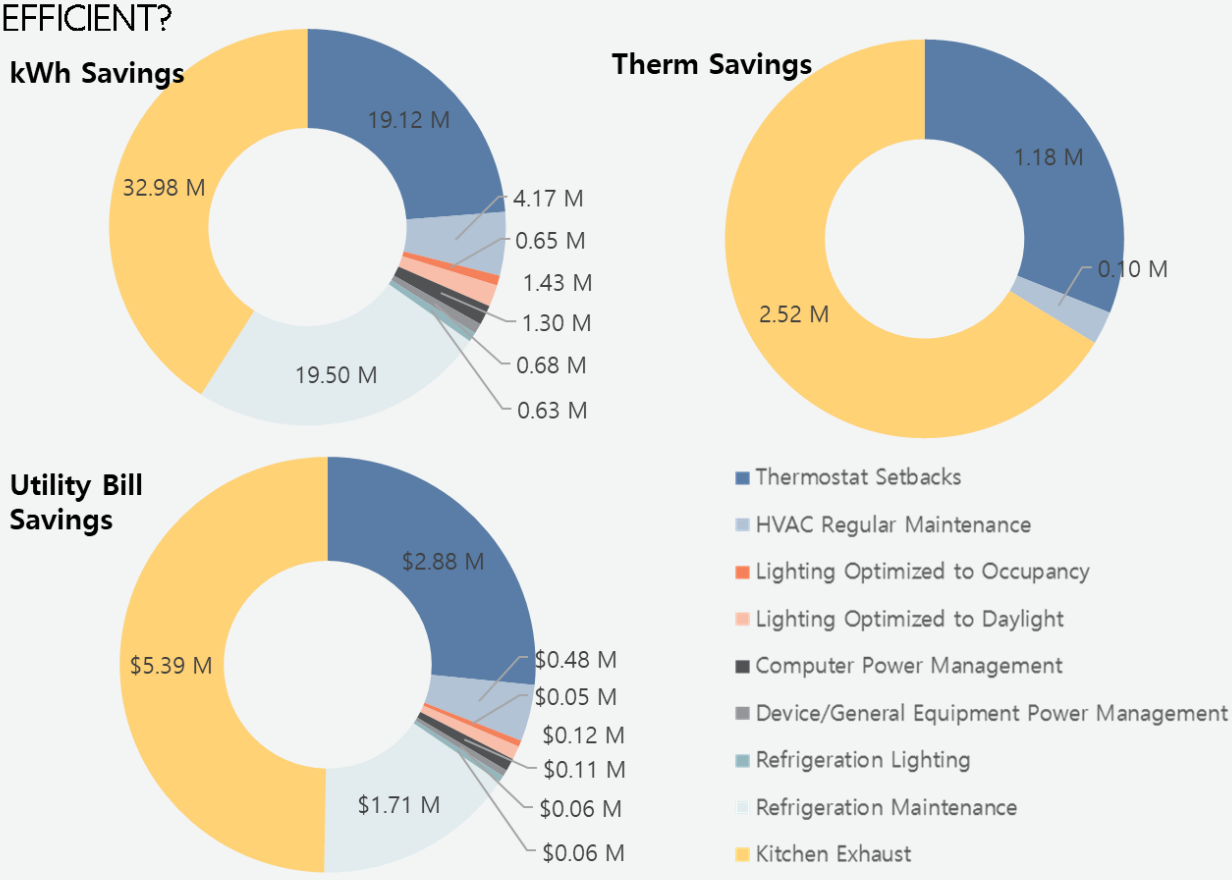
WHAT BUSINESSES ARE IN FOOD SERVICE?

6,622 restaurants and other eating places

1,176 drinking establishments

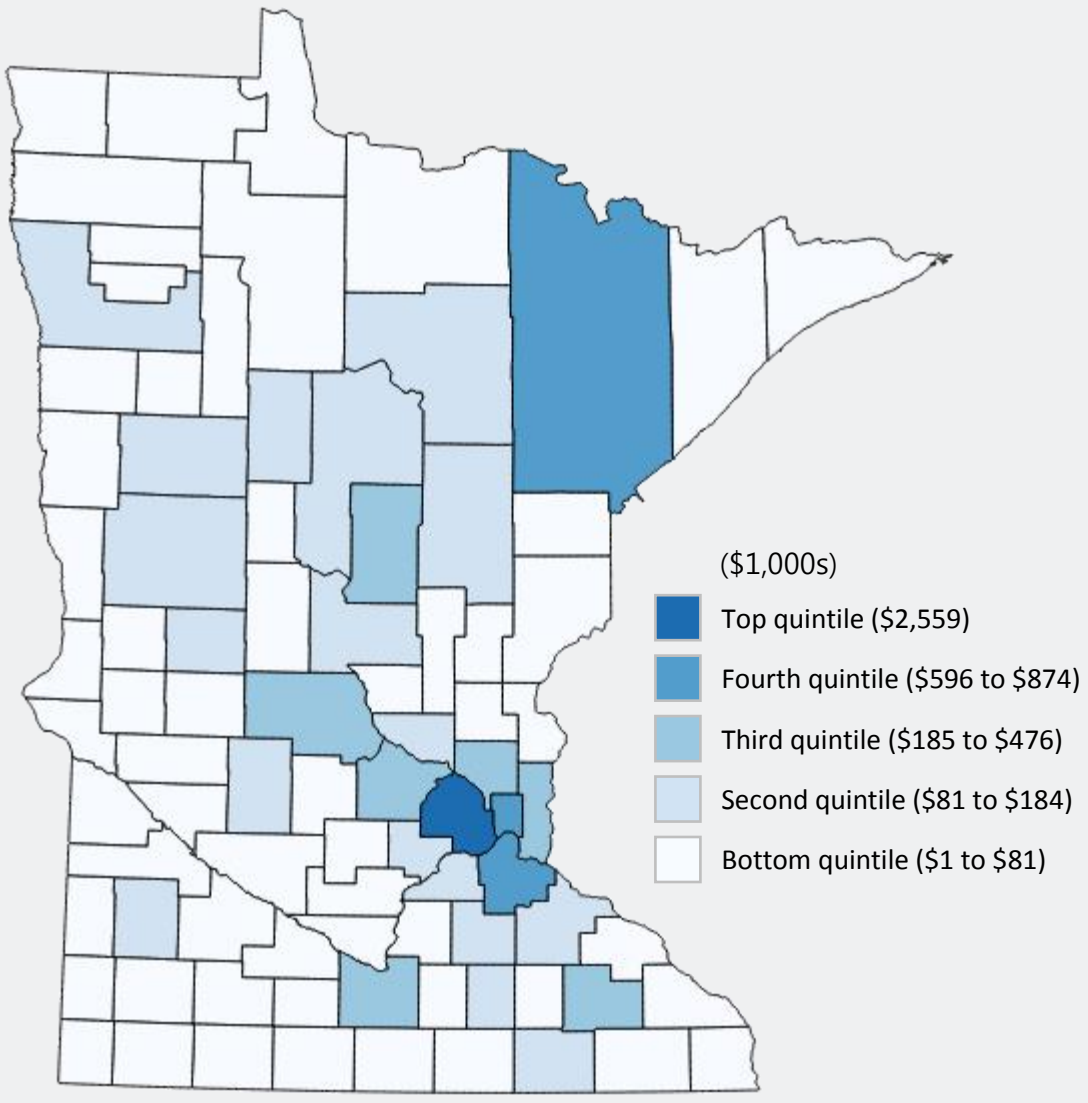
This segment includes full and limited-service restaurants, cafeterias, snack bars and alcoholic beverage bars.

WHERE IS THERE OPPORTUNITY TO MAKE BUSINESSES MORE ENERGY EFFICIENT?



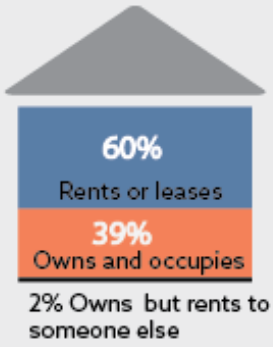
FOOD SERVICE

The map below shows achievable customer bill savings for the food service segment by county. Hennepin county has the greatest aggregate opportunity for savings. For additional detailed segment maps, see Appendix D.

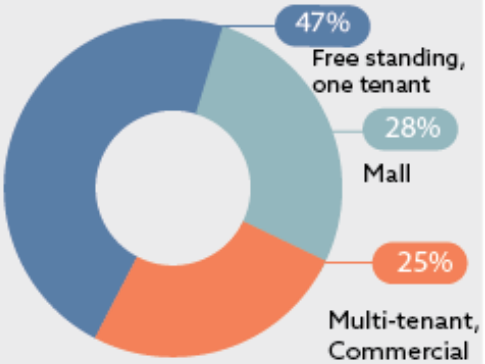


FOOD SERVICE

BUILDING OWNERSHIP

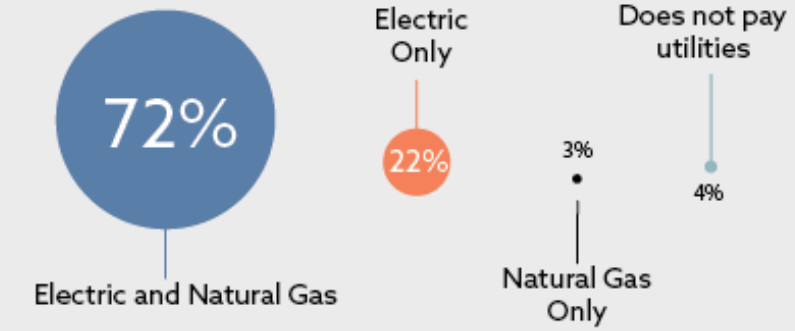


BUILDING TYPE



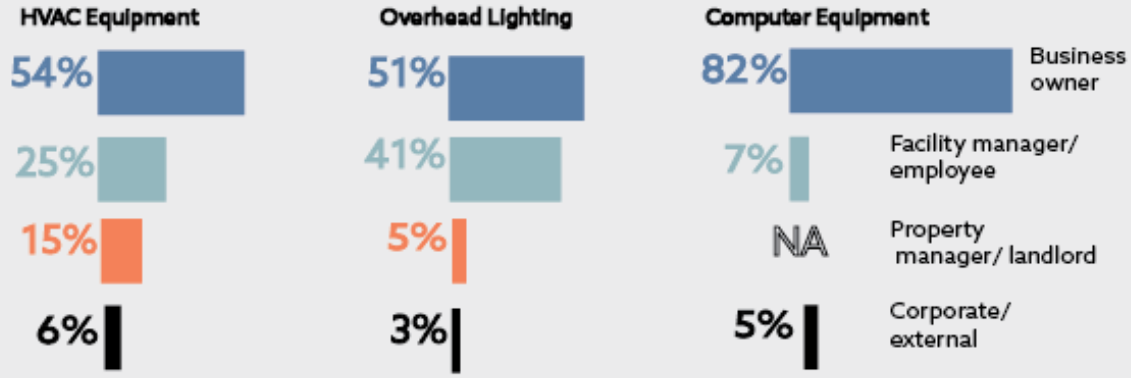
This segment is split on ownership with 60% of businesses renting or leasing their space and 39% owning and occupying their space. Likewise, just over half (53%) of businesses are in malls or multi-tenant buildings while just under half (47%) are in free standing buildings. Food service businesses in owner-occupied and free standing buildings may have more control over energy use and energy saving actions.

WHICH UTILITY BILLS DOES YOUR BUSINESS PAY?



This segment has the largest percentage of businesses (72%) that pay both an electricity and natural gas bill and 96% of businesses pay an electricity and/or natural gas bill. Businesses that pay utility bills are more likely to be motivated by a cost-savings

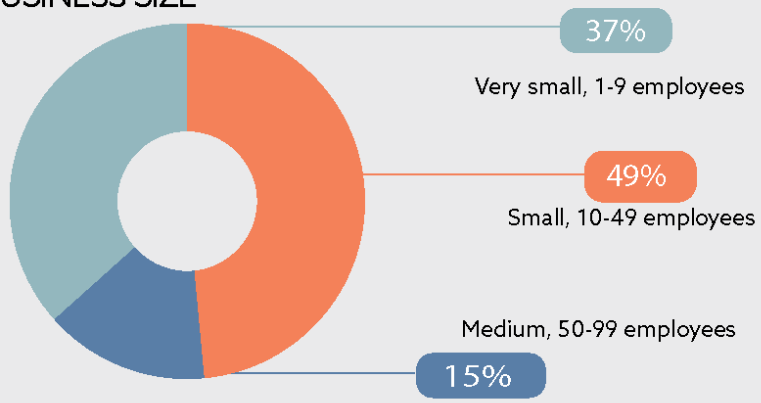
WHO PURCHASES AND REPLACES EQUIPMENT?



Food service business owners are very involved in the purchase of equipment, though facility managers/employees also play a strong role. Having a member of the business with responsibility for purchasing and using equipment facilitates changes to how equipment is used. This can be led by an "Energy Champion" who might be the owner or designated by the owner.

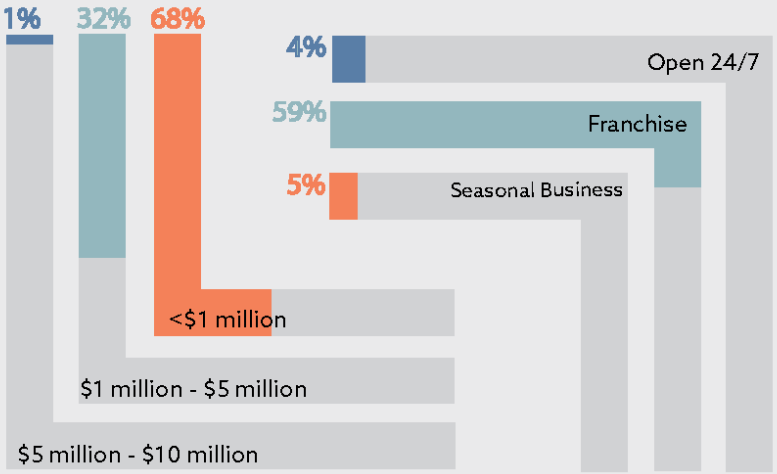
FOOD SERVICE

BUSINESS SIZE



Businesses in the food service segment tend to be larger than grocery and retail segments with more small (10-49 employees) and medium (50-99 employees) businesses and fewer very small (1-9 employees) businesses. Food service businesses tend to have higher turnover compared to retail establishments and other segments.

SALES

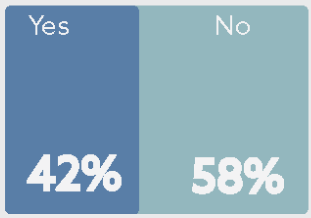


BUSINESS TYPE

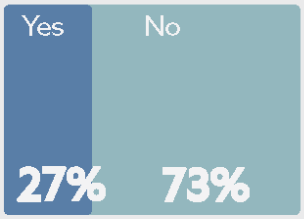
Businesses with lower sales volume may be more motivated by the cost savings achievable with low-cost behavioral changes.

Competitions between franchise locations may be the best strategy for implementing competition-based programs.

ENERGY STAR PREFERENCE



ENERGY REDUCTION GOALS



27% of businesses have goals to reduce energy use. Businesses with established goals may be more receptive to behavior-based suggestions to save energy.

FOOD SERVICE

ENERGY CHAMPIONS

The key to successful efforts in any segment is to identify the person within the business that is most likely to create consistent change. Fortunately, in Food Service, control over equipment is very local: the owner or an employee is most likely to be responsible for the use and purchase of energy using equipment. Behavior change efforts will be most likely to be successful when they are championed by the general manager who, in some restaurants, may also be the business owner. The general manager can be responsible for training other staff, modeling preferred actions, and ensuring that internal processes facilitate behavior change.

PROGRAM APPROACHES: START-UP/SHUT-DOWN SCHEDULE

The start-up/shut-down schedule specifies times throughout the day when equipment should be turned on and off. This can include actions and equipment highlighted in this report such as temperature settings, interior lighting, computer equipment, and kitchen exhaust hoods as well as additional energy-using equipment such as cooking equipment, exterior lighting and signage, and televisions. The National Restaurant Association's ConServe program provides many suggestions and resources for restaurants, including guidance for integrating energy-saving actions into start-up and shut-down schedules.[10] The Minnesota-based Clean Energy Resource Teams (CERTs) offers similar food service-specific guidance in their Food Service Energy Efficiency Toolkit.[11]

Best practices for utilizing the start-up/shut-down schedule to save energy include:

1. **Create the start-up/shut-down schedule**. List all cooking equipment, lighting, thermostats, and other equipment that staff need to turn on and off throughout the day. Line those needs up with the restaurant's schedule: pre-service prep times, service busy times, and when service slows down to identify the proper settings for each piece of equipment during each time of day.

[10] The National Restaurant Association's Conserve Program website. (http://conserve.restaurant.org/Best-Practices/Conserve-Energy/Start-up-and-shut-down-schedules)

[11] The Clean Energy Resource Teams Food Service Energy Efficiency Kit (http://www.cleanenergyresourceteams.org/food-service-energy-efficiency-toolkit)

FOOD SERVICE

2. **Engage staff and assign responsibility**. Engaging staff members with the start-up/shut-down schedule fosters a sense of accountability and community by involving them in the overall operation of the business.[12] Assigning specific responsibilities for start-up/shut-down procedures for each shift promotes consistent compliance.[13]
3. **Post the start-up/shut-down schedules prominently and augment with signage and stickers**.
   Research shows that prompts are effective in reminding people to take actions that they are predisposed to take.[14] Prompts such as stickers and signs on equipment will remind busy staff of energy saving actions.[15] For example, restaurants with manually-controlled kitchen exhaust fans can use prompts to remind staff to turn down or turn off the fan during periods of low or no cooking.

COMPETITIONS

Competitions are programs where individuals or organizations compete in events, contests, or challenges to reduce energy use. Competitions may be most successful between businesses that are natural rivals such as those that have the same owner, are part of a restaurant group, or that are members of a franchise. With the high percentage of franchises in this segment (59%), this segment has more opportunity for competitions than other segments.

PROGRAM APPROACHES

1. **Focus on key energy-saving actions**. For food service those actions should include: kitchen exhaust settings, lighting, thermostat settings, and refrigeration.
2. **Use competitions to kick-start long-term changes**. For example, competitions among food service businesses can incorporate the start-up/shut-down schedule to encourage habitual compliance among staff in following the schedule. Or, the

[12] Henry, Karen, 2015. "Energy Efficiency in Food Service Businesses," Energy Management Today (https://www.energymanagertoday.com/energy-efficiency-in-food-service-businesses-0111215/)

[13] Smart Energy Design Assistance Center, Restaurant Fact Sheet. (https://smartenergy.illinois.edu/fact-sheets-building-type/restaurants)

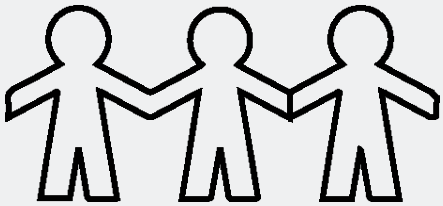
[14] Fostering Sustainable Behavior, "Prompts: Remembering to Act," (http://www.cbsm.com/pages/guide/prompts:-remembering-to-act/)

[15] Food Service Equipment & Supplies, "Why Energy Efficiency Mattes at Arby's," (http://www.fesmag.com/departments/green-tip/13512-why-efficiency-matters-at-arby%E2%80%99s)

competition can encourage installation of controls on lighting and HVAC to ensure persistence of energy savings.

3. **Reward all participants, not just winners**.
4. **Track and Communicate Progress**

COMMUNITY-BASED PROGRAMS



Community-based programs can be location-based, like city business districts or shopping mall food courts, or they can be segment-based. The key is to find individuals and organizations that Food Service business owners will view as trusted community members.

PROGRAM APPROACHES

Partnerships with industry organizations. Utility programs can help business owners learn about energy saving actions from trusted sources by forging partnerships between associations such as the Tavern League of Minnesota, Minnesota Restaurant Association, and Hospitality Minnesota with groups like the National Restaurant Association ConServe[16] and CERTs that educate businesses on sustainability practices.

Partnerships with utility programs. Businesses view their utility as a trusted source of information.[17] Utilities may leverage this advantage by coupling messaging about behavior changes with existing rebate programs. For example, some Minnesota utilities (e.g. Xcel, Minnkota Power Cooperatives, CenterPoint) offer rebates on equipment for food service businesses. These programs could also provide educational materials on using a start-up/shut-down schedule, signage and stickers, and engaging staff in low cost energy-saving actions.

[16] https://conserve.restaurant.org/

[17] http://www.marketstrategies.com/news/2598/1/Utility-Brand-Trust-Up-Among-Businesses-But-Women-Owned-Businesses-Not-So-Quick-to-Trust.aspx

GROCERY AND CONVENIENCE

This segment includes grocery and specialty food stores, liquor stores and gas stations. The grocery and convenience segment is a good candidate for feedback, diagnostic, community-based programs, Energy Champions, and competitions. Key characteristics of this segment include: (1) Varied energy uses including refrigeration, plug loads, HVAC, and lighting; (2) Smaller numbers of employees coupled with frequently changing building occupants as customers come and go; (3) Business owner responsibility for equipment decisions and utility bills; (4) A large number of franchises.

WHAT BUSINESSES ARE IN GROCERY/CONVENIENCE?

1,331 grocery stores

1,029 specialty food stores

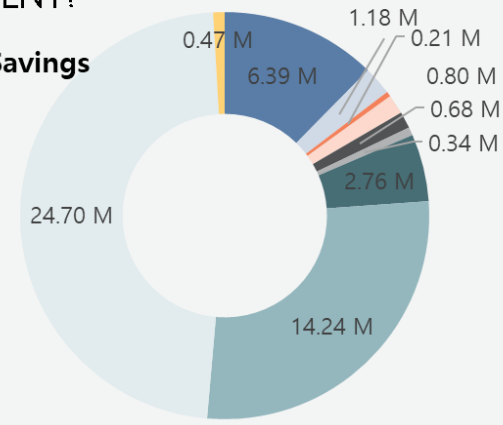
1,276 gasoline stations

760 beer, wine and liquor stores

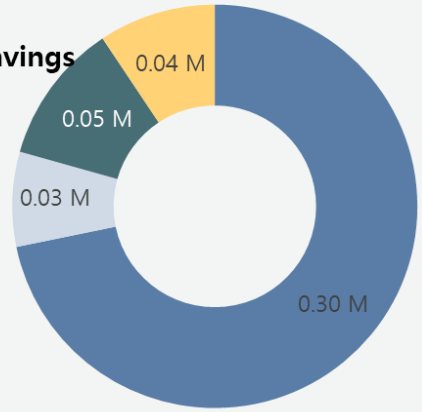
Specialty food stores include stores such as meat and fish markets, fruit and vegetable markets, bakeries and candy stores. There are several business associations for this segment that can be leveraged for community-based programs.

WHERE IS THERE OPPORTUNITY TO MAKE BUSINESSES MORE ENERGY EFFICIENT?

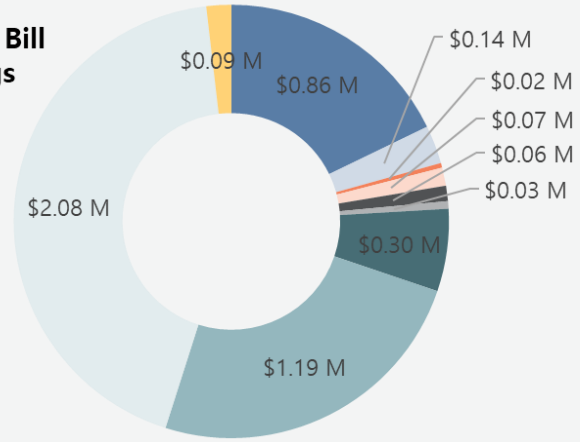
kWh Savings



Therm Savings

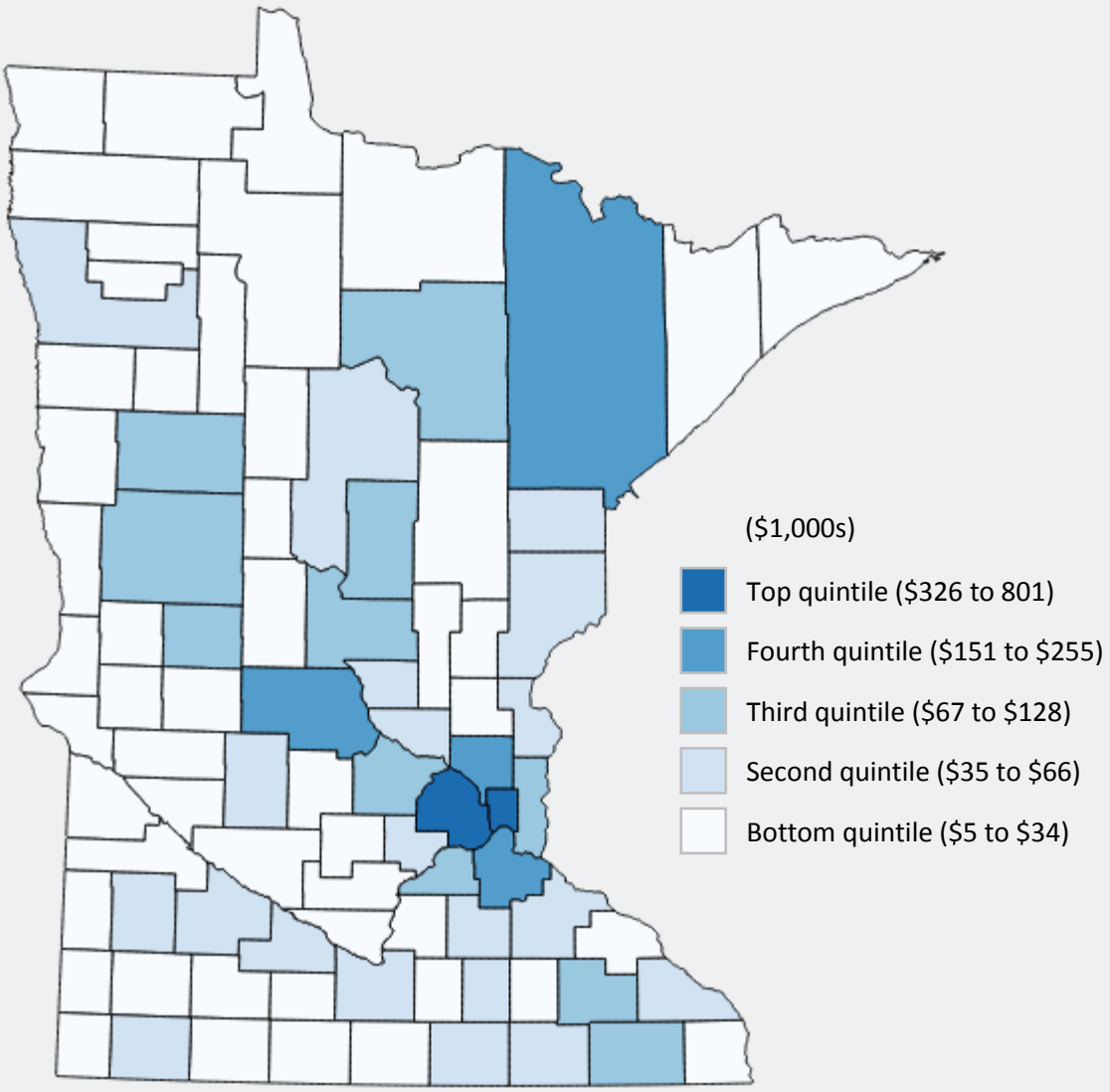


Utility Bill Savings



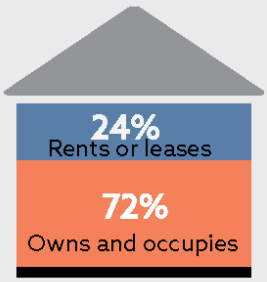
GROCERY AND CONVENIENCE

The map below shows achievable customer bill savings for the grocery segment by county. The greatest aggregate opportunity lies in Hennepin and Ramsey counties with the next highest opportunities Stearns, St. Louis, Ankora, and Dakaota. See Appendix D for additional maps.



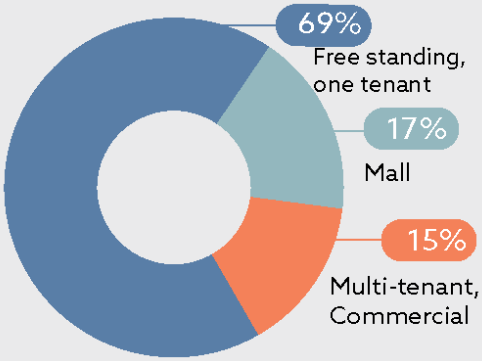
GROCERY AND CONVENIENCE

BUILDING OWNERSHIP



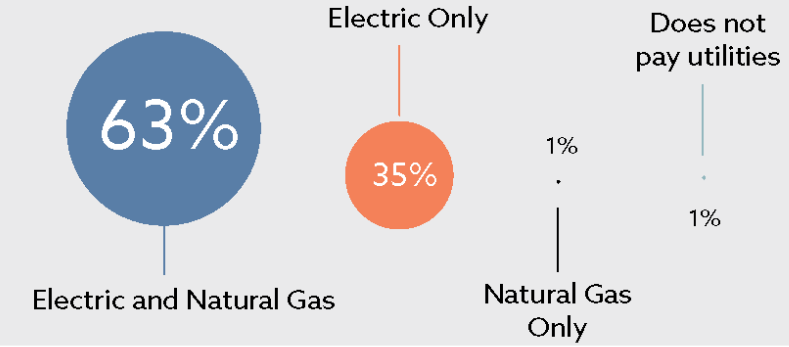
4% Owns but rents to someone else

BUILDING TYPE



Many businesses in this segment are in owner-occupied (72%) and free standing (69%) buildings, giving the owner more control over energy use and energy savings actions.

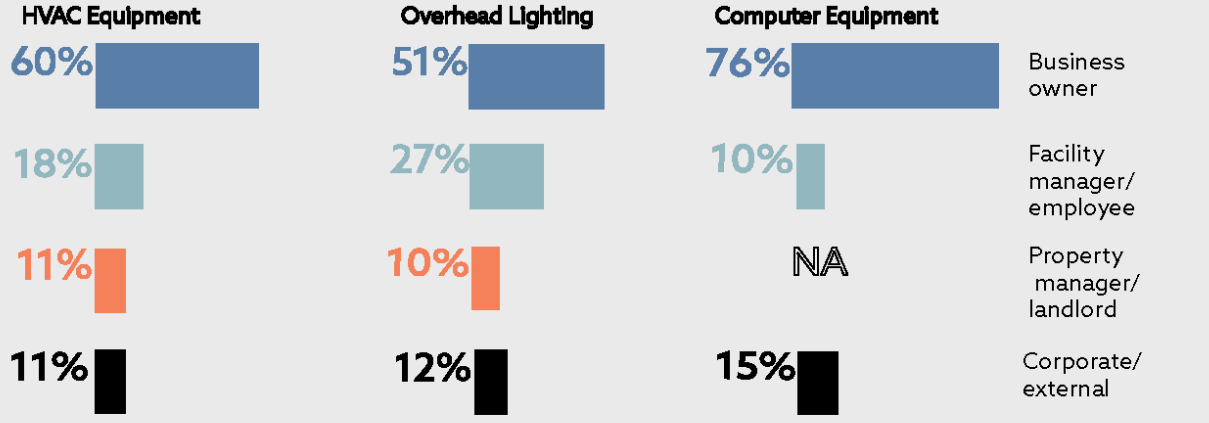
WHICH UTILITY BILLS DOES YOUR BUSINESS PAY?



99% of businesses pay a utility bill. These businesses are more likely to be motivated by a cost-saving message.

Businesses that pay utility bills are good candidates for feedback programs that are based on bills.

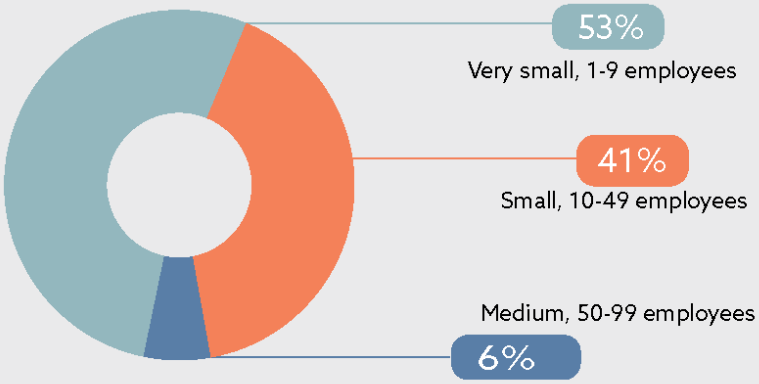
WHO PURCHASES AND REPLACES EQUIPMENT?



Having a member of the business with responsibility for purchasing and using equipment facilitates changes to how equipment is used. This can be spearheaded by an "Energy Champion" who might be the owner or designated by the owner.

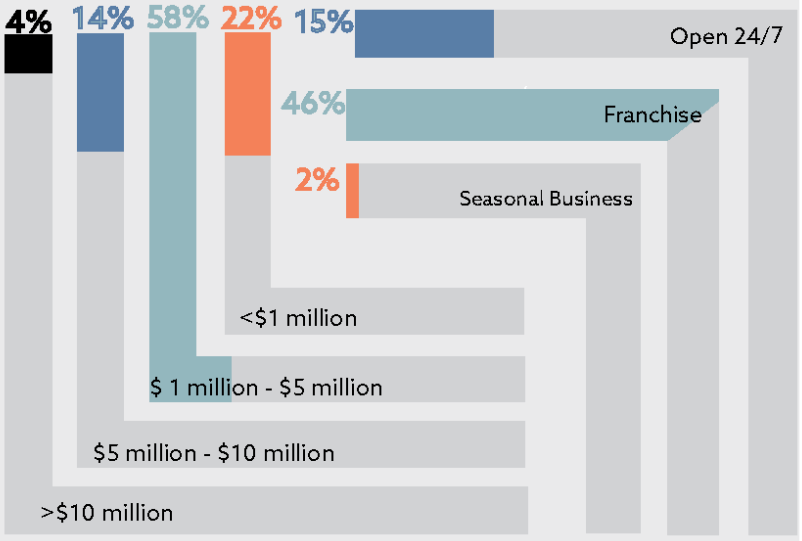
GROCERY AND CONVENIENCE

BUSINESS SIZE



A small number of employees means it will be easier to communicate about energy saving actions to all staff and to have greater accountability and sense of responsibility.

SALES

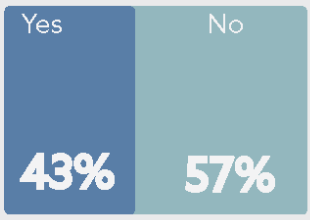


BUSINESS TYPE

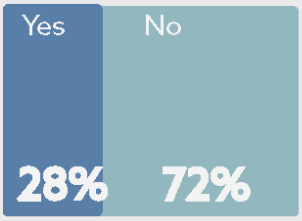
Businesses open 24/7 have fewer opportunities to reduce lighting or change thermostat settings, but still have opportunities with refrigeration and power management.

Competitions between franchise locations may be the best strategy for implementing competition based programs.

ENERGY STAR PREFERENCE



ENERGY REDUCTION GOALS



43% of businesses have a stated preference for ENERGY STAR equipment and 28% of businesses have goals to reduce

GROCERY AND CONVENIENCE

ENERGY CHAMPIONS

A high percentage of businesses in this segment pay their own utility bills. Owners or an employee who is familiar with the utility bill may be more responsive to reports or online tools that show energy use and provide segment specific energy saving tips. The energy champion should also be someone who can integrate energy savings actions into business practices.

PROGRAM APPROACHES: REFRIGERATION AND LIGHTING FOCUS

Coordinating programs around expenses associated with refrigeration and electricity can help grocers save money and keep their prices competitive for customers. Below are behavioral strategies to address refrigeration and lighting energy consumption that might use an energy champion to spearhead and lead the coordination of these efforts.

Refrigeration. Grocers and convenience stores are not able to turn off refrigeration equipment to save energy, therefore maintenance of equipment is critical. While this study focused on refrigeration air leakage, lighting, and maintenance, businesses can combine efforts in those areas with other approaches, such as checking temperature settings to maximize savings. Simple, behavioral approaches might include designating one employee to check the temperature setting of refrigeration and to be responsible for applying night-covers at the end of the day. Grocers and convenience stores can create monthly schedules for cleaning their cooling coils[18]and can create semi-annual schedules for regular maintenance on their refrigeration equipment.

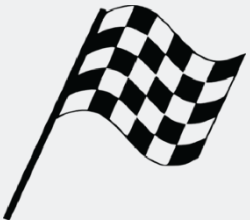
Lighting. Grocers and convenience store managers should inventory when certain equipment can be turned on and at what point during the day. While they can invest in green power-strips, occupancy sensors, or daylighting, these businesses can also train staff to turn off lighting when not in use. This can also be applied to other equipment not included in this study, such as turning off deli-meat cutters and cash registers when they are not in use or at certain points during the day.

The grocery and convenience segment might also benefit from incorporating best practices from the food service segment, such as creating a start-up/shut-down schedule. This schedule can identify which equipment or lighting should be turned on and off and which employees

[18] Energy Savings Tips for Small Businesses: Grocery and Convenience Stores. (https://www.energystar.gov/buildings/facility-owners-and-managers/small-biz/grocery-and-convenience-stores)

are responsible for taking the action. Research shows that prompts are effective in reminding people to take actions that they are disposed to take. Posting stickers on equipment or light switches that act as prompts can help remind staff.

COMPETITIONS

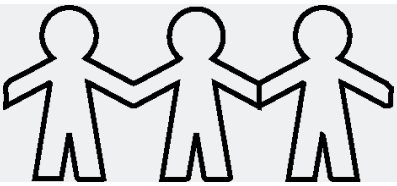


Competitions may be particularly successful between businesses that are member of the same franchise. Forty-six percent of businesses in this grocery/convenience segment are members of franchises.

PROGRAM APPROACHES

1. **Focus on key energy-saving actions**. For grocery and convenience those actions should include: lighting, thermostat settings, and refrigeration.
2. **Use competitions to kick-start long-term changes**. For example, competitions among grocery and convenience businesses can incorporate the start-up/shut-down and maintenance schedules to encourage habitual compliance among staff in following the schedule. Or, the competition can encourage installation of controls on lighting and refrigeration to ensure persistence of energy savings.
3. **Reward all participants, not just winners**.
4. **Track and communicate progress.**

COMMUNITY-BASED PROGRAMS



Community-based programs can be location-based, like local area Chambers of Commerce and city business districts or they can be segment-based or tied to existing utility programs.

PROGRAM APPROACHES

GROCERY AND CONVENIENCE

Industry organizations. Programs for this segment could potentially partner with some of the following associations to promote energy efficiency through these organizations newsletters, annual meetings, and other member events:

1) Minnesota Licensed Beverage Association;
2) Minnesota Grocers Association;
3) Minnesota Service Station and Convenience Store Association;

Utility programs. Utilities can also help grocery and convenience stores become more energy efficient. Trail Edge Food Fuel and Liquor, located in Buckman Minnesota[19], had help from Minnesota Power's commercial energy conservation team to determine the store could become efficient. Trail Edge installed LEDs in their parking lot, gas canopy, refrigeration and interior canisters; Minnesota Power provided guidance on the right bulbs to select and estimated energy cost and savings. Existing programs such as this one can add education and other low-cost steps businesses can take and include recommendations for adding energy savings actions as part of regular business practices.

[19] Minnesota Power, Power of One Trails Edge Food, Fuel, and Liquor Business Profile. (2012). (http://www.mnpower.com/Content/Documents/EnergyConservation/OneBusiness/CustomerProfiles/trails-edge.pdf)

RETAIL

The Retail segment includes retailers from clothing stores to car dealers to used merchandise stores. This segment has opportunities to save energy via thermostat set-backs, lighting, power settings, and HVAC maintenance. These businesses tend to be very small, with less than 10 employees (63%). Few businesses are open 24/7 and about 44% are franchises. Challenges to implementing behavior change programs in this segment include:

(1) Less control over their space: They are more likely than other segments to rent or lease their space (60%) and to be located in a mall (33%) or multi-tenant building (30%).
(2) Largest share (11%) of businesses that do not pay a utility bill.
(3) Less control over their equipment than food service and grocery, but more control than education and office. In 38% of businesses responsibility for HVAC equipment resides with someone external to the business.

WHAT ARE THE TOP BUSINESS TYPES IN RETAIL?

2,800 health and personal care stores

2,000 sporting goods, hobby, and musical instrument stores

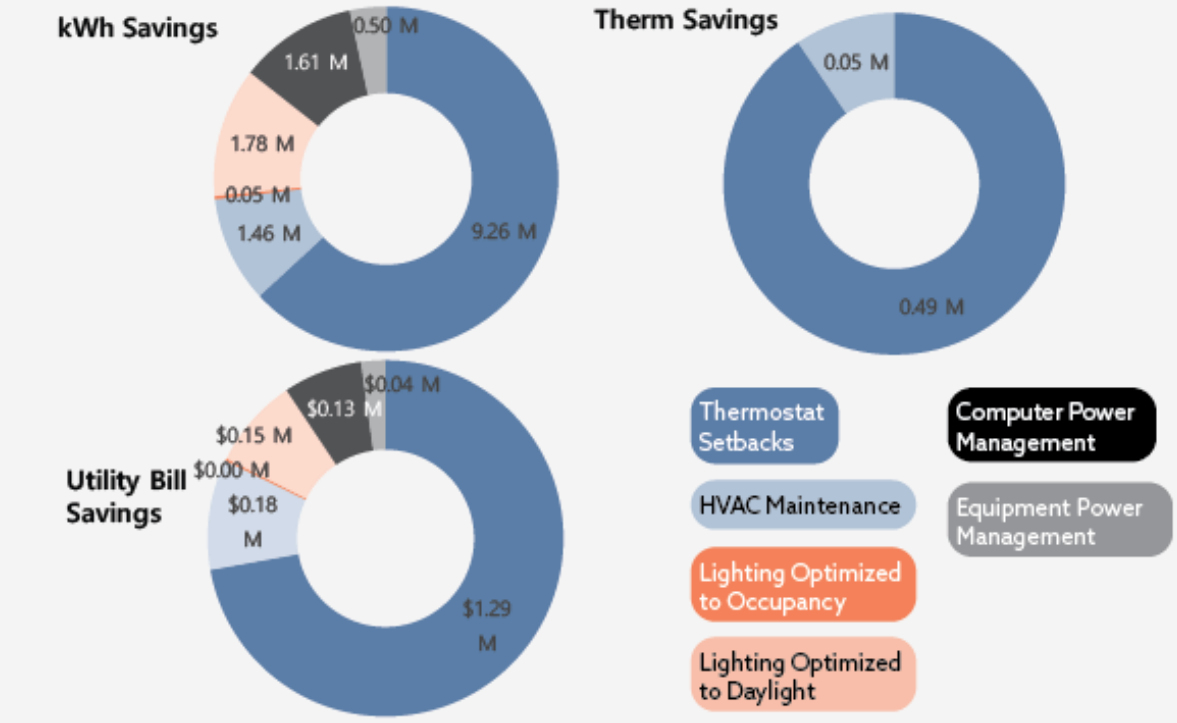
2,000 clothing stores

2,700 miscellaneous retailers

2,000 car dealers

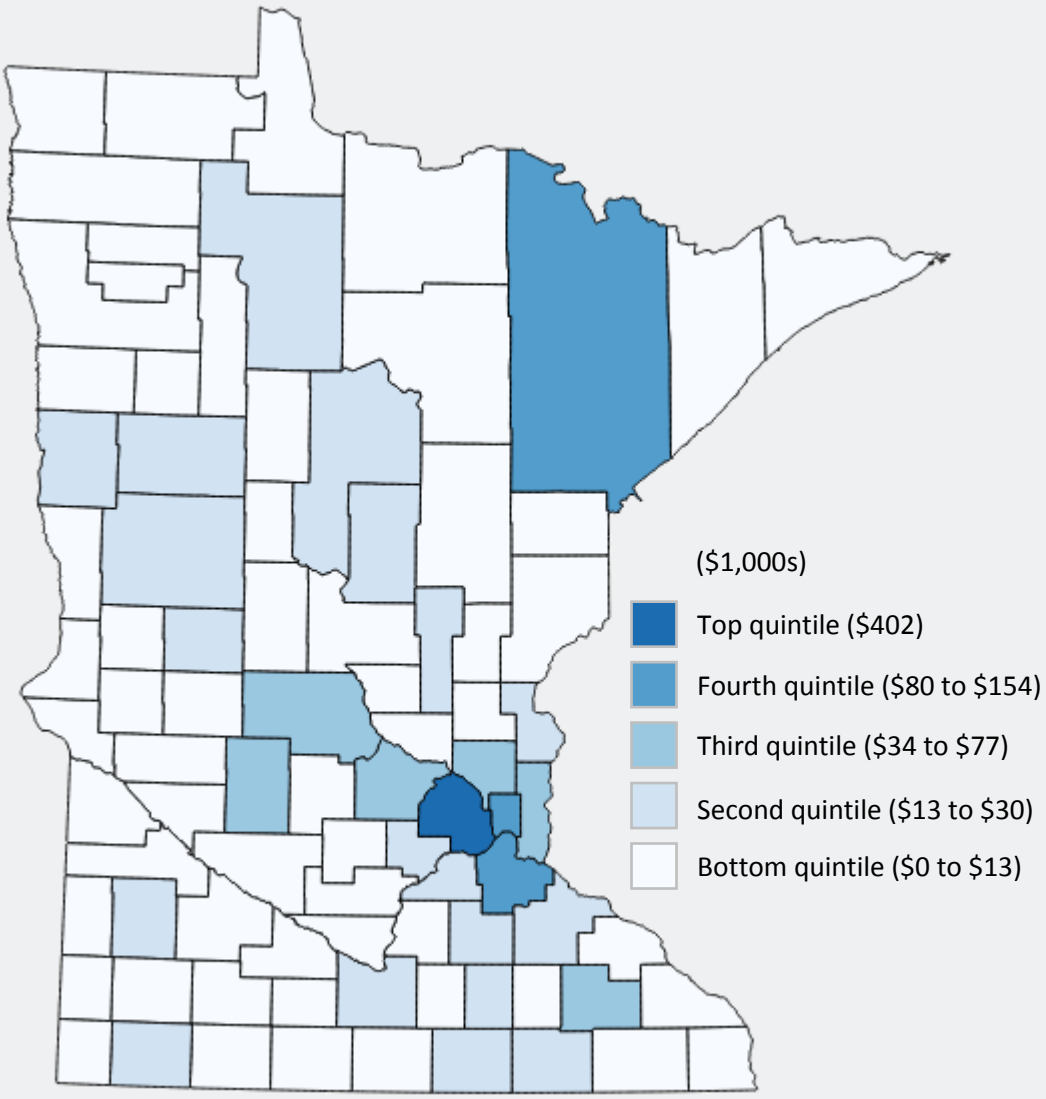
1,800 used merchandise stores

WHERE IS THERE OPPORTUNITY TO MAKE BUSINESSES MORE ENERGY EFFICIENT?



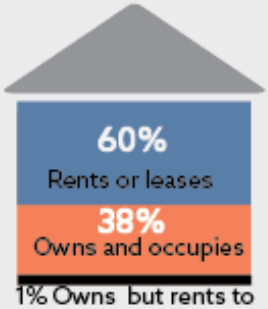
RETAIL

The map below shows achievable customer bill savings for the retail segment by county. Greatest aggregate opportunity lies in Hennepin, Ramsey, Dakota, and St. Louis counties. For additional detailed segment maps, see Appendix D.



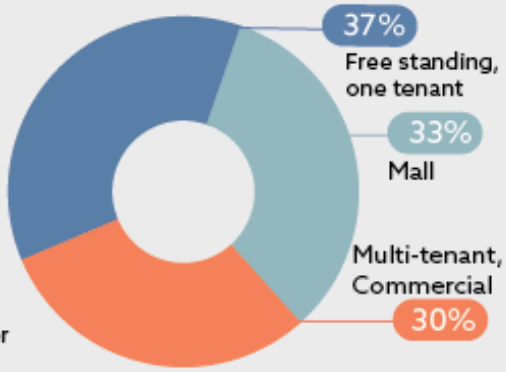
RETAIL

BUILDING OWNERSHIP



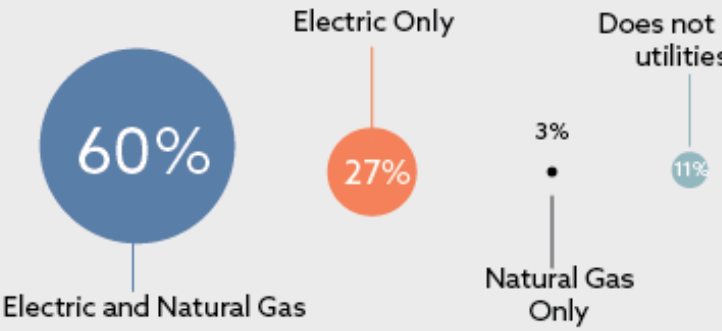
1% Owns but rents to someone else or have other building ownership

BUILDING TYPE



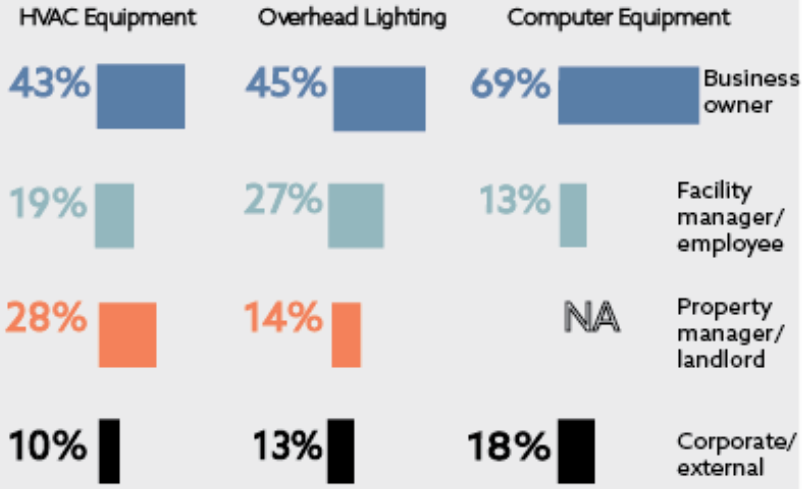
More than half of the businesses (60%) rent or lease their space. Businesses in this segment are more likely to be in a mall (33%) and less likely to be in a free-standing building (37%) compared to businesses in other segments. Businesses in leased space in malls and multi-tenant commercial buildings have less control over energy saving actions than businesses in owner-occupied and free-standing buildings.

WHICH UTILITY BILLS DOES YOUR BUSINESS PAY?



90% of businesses pay a utility bill. These businesses are more likely to be motivated by a cost-savings message.

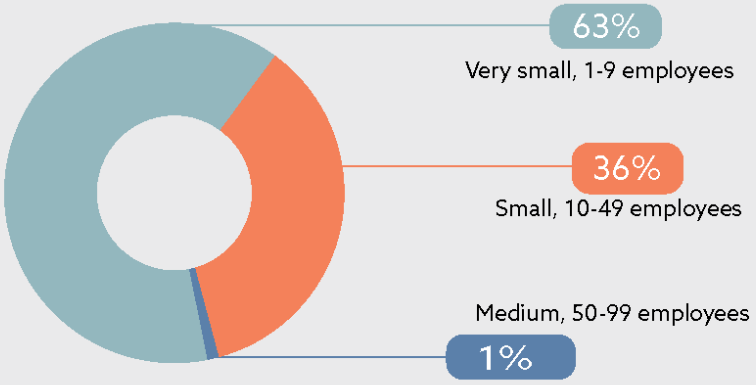
WHO PURCHASES AND REPLACES EQUIPMENT?



Business owners or employees have the most control over computer equipment (82%) and least control over HVAC equipment (62%). This segment is more likely than others to have facility managers or employees that are responsible for equipment. Having a member of the business with responsibility for purchasing and using equipment facilitates changes to how the equipment is used. This can be led by an "Energy Champion" who might be the owner or designated by the owner.

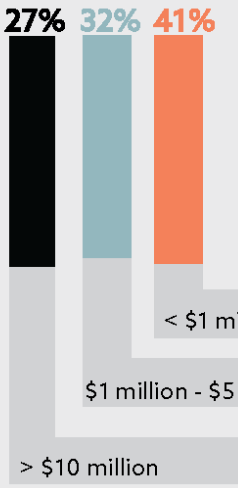
RETAIL

BUSINESS SIZE

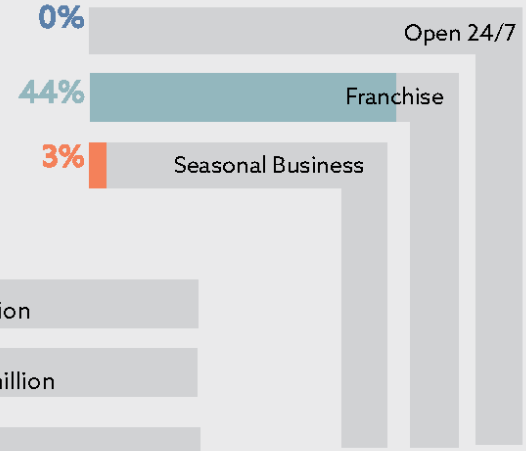


Businesses in this segment are mostly very small (63% with 1-9 employees) with almost no medium-sized businesses (1% with 50-99 employees). A very small number of employees means it will be easier to communicate about energy savings actions to all staff and to have greater accountability and sense of responsibility.

SALES



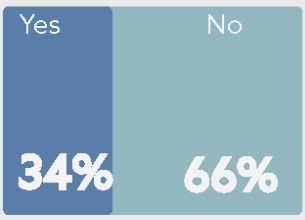
BUSINESS TYPE



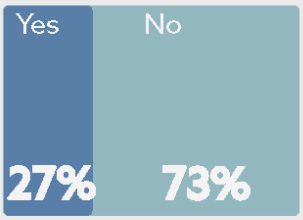
Few, if any, businesses are open 24/7. Businesses can use unoccupied hours to save energy through thermostat and lighting adjustments and power management.

Businesses with lower sales volume may be more motivated by the cost savings messages.

ENERGY STAR PREFERENCE



ENERGY REDUCTION GOALS



Compared to other segments, the retail segment is less likely to prefer ENERGY STAR products and less likely to have energy reduction goals.

RETAIL

ENERGY CHAMPIONS

In small retail establishments, the business owner or manager is the most likely candidate for spearheading behavior changes to save energy. While most businesses retain some control over equipment, 38% of business owners/managers may need to work through a landlord or corporate office to make changes to equipment or maintenance practices. Furthermore, programs may need to emphasize changes that can be controlled locally such as thermostat settings and lighting use.

PROGRAM APPROACHES: OPENING/CLOSING CHECKLISTS

Some retailers have checklists for staff to follow for opening and closing the store. These checklists include tidying the sales floor, securing merchandise, emptying cash drawers, and enabling/disabling alarms. These lists also include turning on and off: lights, retail displays, televisions, and modifying HVAC settings.

Retailers that do not have an opening/closing checklist can improve their overall business processes by implementing one. All businesses can promote energy savings by including energy-using equipment in the checklist. Some approaches for using opening/closing checklists to save energy in a retail setting include:

1. **Mandatory use of checklist.** Ensuring staff comply with standard processes for opening and closing will contribute to a smooth-running business and good customer experience. In a busy retail setting, including energy saving actions like checking lights and thermostat settings on a mandatory checklist will improve compliance among staff.
2. **Align checklist with role**. While very small businesses may have one person doing everything, some retail businesses may have different staff working in the stockroom or in different departments. Staff are more likely to comply with the energy saving actions on the checklist if they are tied more closely to their jobs and departments.
3. **Shift-starting checklist**. In addition to an open/close checklist, retail businesses that have employees starting shifts mid-day, can also implement a shift-starting checklist. Checklists often include businesses processes like clocking in and preparing cash drawers. It can also include having staff take a quick walk through bathrooms, stockrooms, and other areas to turn off un-needed lights, fans, plug loads, and displays.

RETAIL

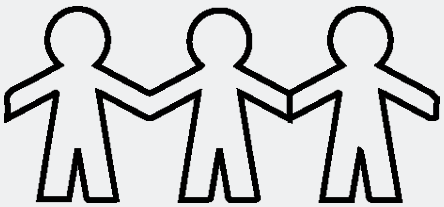
DIAGNOSTICS

Small retail establishments are good candidates for Diagnostics Programs including on-site energy assessments that feature direct installation of low-cost measures and recommendations for follow-up measures.

PROGRAM APPROACHES

Diagnostic programs can be enhanced with behavior change techniques to encourage additional low-cost/no-cost energy savings actions. For example, on-site auditors can ask businesses to make a commitment to energy saving actions by presenting the business with a list of several possible actions (including lighting and thermostat settings) and asking the business owner to commit to two or three actions. Or, the list can present the options in groups and have the business owner select one action from each group. For example, the business owner might choose one action from a lighting category, one action from a temperature setting category, and one action from a maintenance category.

COMMUNITY-BASED PROGRAMS



Retail businesses are often located near other retail businesses in shopping districts, enclosed or strip malls, or multi-tenant spaces. Utility programs can leverage these location-based communities to help business owners learn about energy saving actions from trusted sources.

PROGRAM APPROACHES

To take advantage of location-based communities, programs can offer the following: 1) Energy advisors or auditors can visit tenant meetings to educate business owners about available rebate or direct install programs and behavior-based actions businesses can take; 2) Programs can offer signs for businesses to place in windows to show their participation

in utility programs. This will communicate to customers that the business cares about saving energy and will communicate to other business owners the value of participation.

COMPETITIONS

Competitions (events, contests, or challenges) to reduce energy use in the retail segment will be more successful between businesses that have existing friendly competitive connections such as those that have the same owner, are members of a franchise, or are members of a business or shopping district that interacts regularly. Like food service, the franchises in this segment (44%), offer good opportunities for competitions.

PROGRAM APPROACHES

1. **Focus on key energy-saving actions**. For retail settings those actions should include: lighting, particularly in less-used areas like stockrooms, breakrooms, restrooms; thermostat settings; and power management for computers, printers, displays, etc.
2. **Incorporate business processes into competitions**. For example, competitions can incorporate the opening/closing checklists and include elements to further business goals in the areas like customer service.
3. **Reward all participants, not just winners**.
4. **Track and communicate progress**. Some retailers that may attract customers more likely to be interested in energy conservation (e.g. thrift stores or outdoor/sporting goods stores) may benefit from sharing information about the competition with customers.

WHOLESALE AND WAREHOUSE

The warehouses and wholesalers segment includes diverse goods such as machinery and auto parts, household appliances and furniture, food and beverages, pet products, agricultural supplies, and others. This segment is a good candidate for feedback and diagnostic programs. This segment tends to be very small (50% have 1-9 employees) or small (44% have 10-49 employees) and businesses tend to be in free-standing (60%) or multi-tenant commercial (33%) buildings. Businesses in this segment are likely to pay a utility bill (93%). Businesses have higher sales volumes than the retail and grocery segments and are less likely to have energy reduction goals.

WHAT BUSINESSES ARE IN WAREHOUSE/WHOLESALE?

5,000 miscellaneous merchant wholesalers

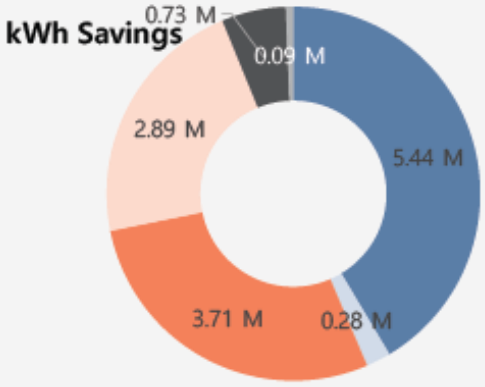
1,100 household appliances and furniture wholesalers

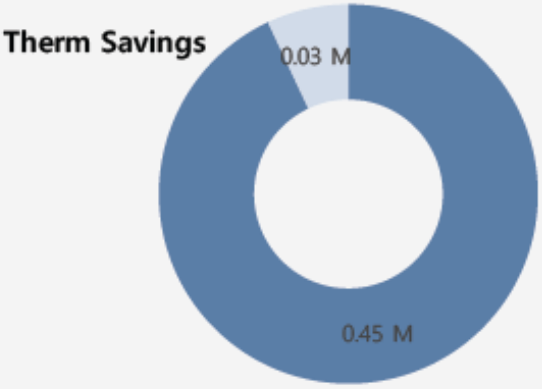
1,900 machinery and professional equipment wholesalers

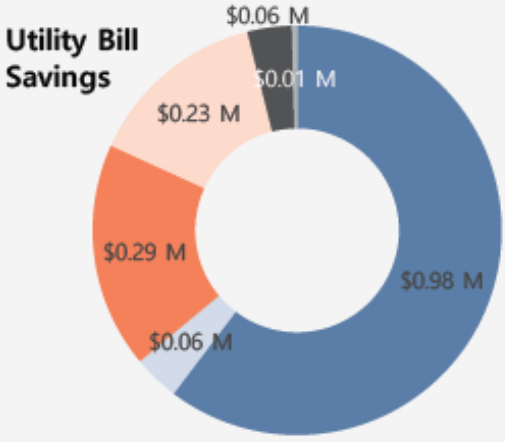
800 grocery and beverage wholesalers

The segment also includes agricultural supplies, auto parts, building supplies, medical supplies, office equipment, pet products, and others.

WHERE IS THERE OPPORTUNITY TO MAKE BUSINESSES MORE ENERGY EFFICIENT?







Thermostat Setbacks

Computer Power Management

HVAC Maintenance

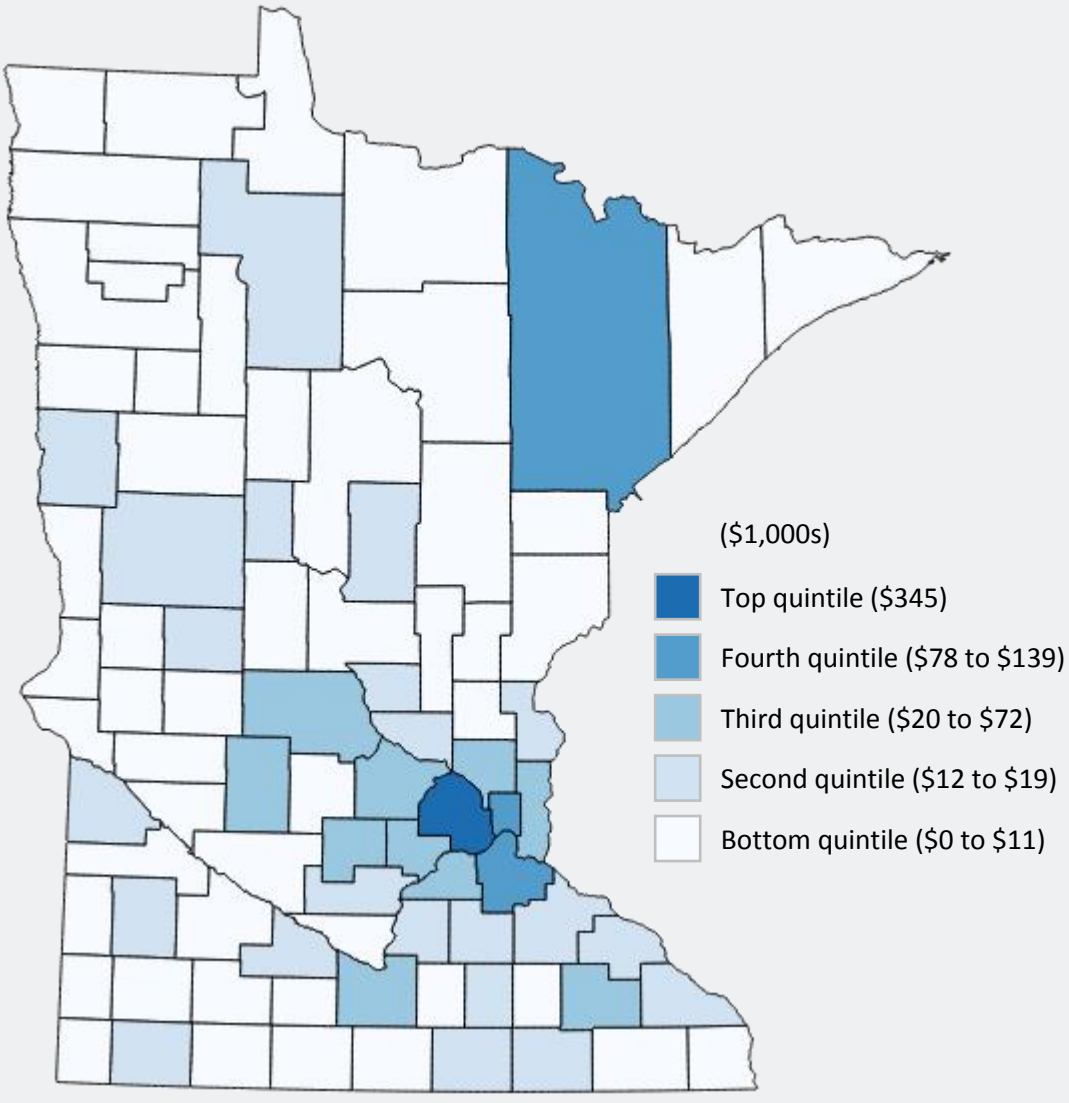
Equipment Power Management

Lighting Optimized to Occupancy

Lighting Optimized to Daylight

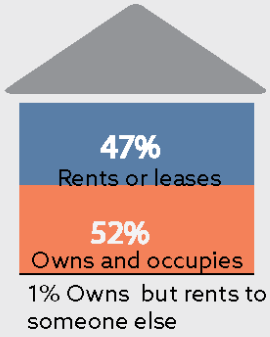
WHOLESALE AND WAREHOUSE

The map below shows achievable customer bill savings for the wholesale segment by county. For additional detailed segment maps, see Appendix D.



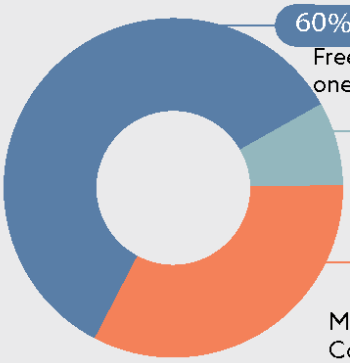
WHOLESALE AND WAREHOUSE

BUILDING OWNERSHIP



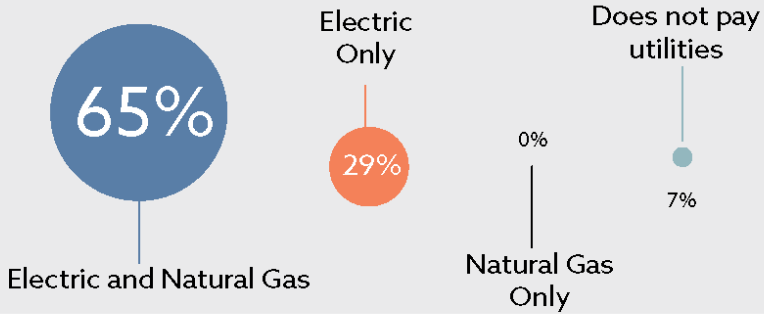
1% Owns but rents to someone else

BUILDING TYPE



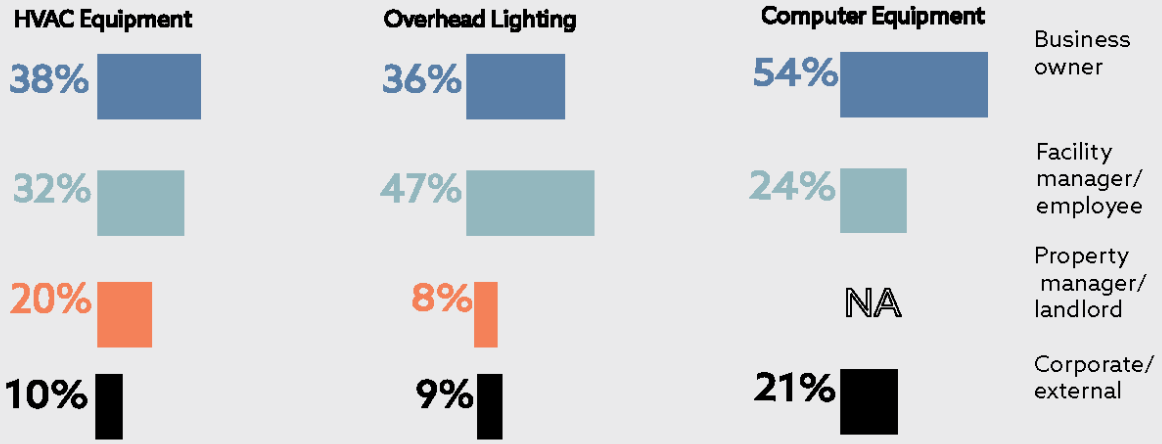
About half (52%) of the segment are in owner-occupied buildings and 60% are in free-standing buildings.

WHICH UTILITY BILLS DOES YOUR BUSINESS



94% of businesses pay a utility bill. These businesses are more likely to be motivated by a cost-savings message.
Businesses that pay utilities bills are good candidates for feedback programs that are based on bills.

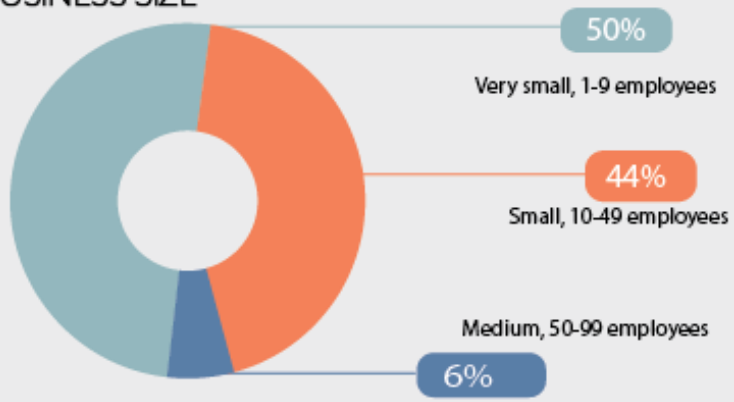
WHO PURCHASES AND REPLACES EQUIPMENT?



Having a member of the business with responsibility for purchasing and using equipment facilitates changes to how the equipment is used. This segment is more likely than others to have facility managers or employees that are responsible for equipment. These staff can lead efforts to reduce energy use as an "Energy Champion".

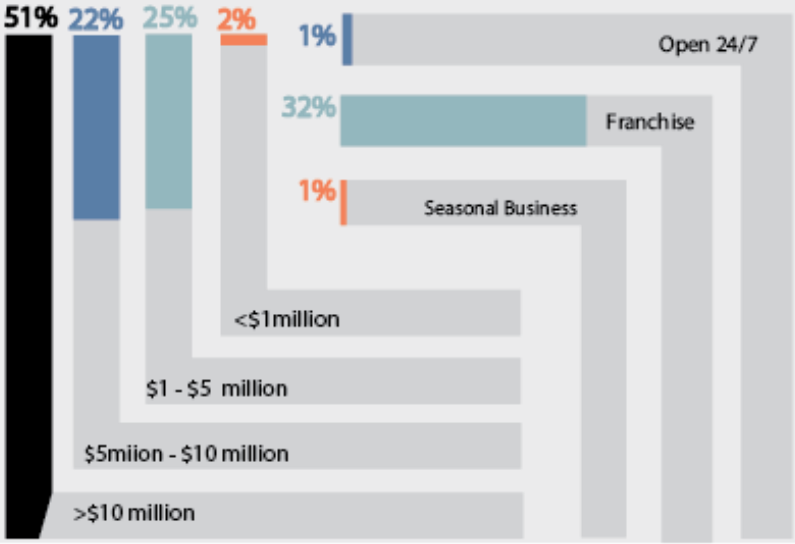
WHOLESALE AND WAREHOUSE

BUSINESS SIZE



About half of the businesses in this segment are very small (1 to 9 employees). A small number of employees means it will be easier to communicate about energy savings actions to all staff and to have greater accountability and sense of responsibility.

SALES

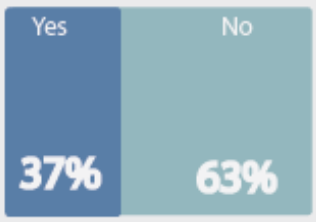


BUSINESS TYPE

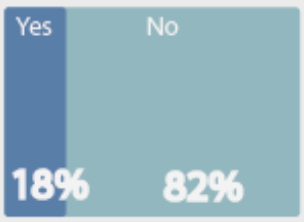
Few businesses are open 24/7. Businesses can use unoccupied hours to save energy through thermostat and lighting adjustments and power management.

More than a quarter of all wholesale businesses are franchises. Friendly competition between franchises is a good strategy to encourage energy reduction.

ENERGY STAR PREFERENCE



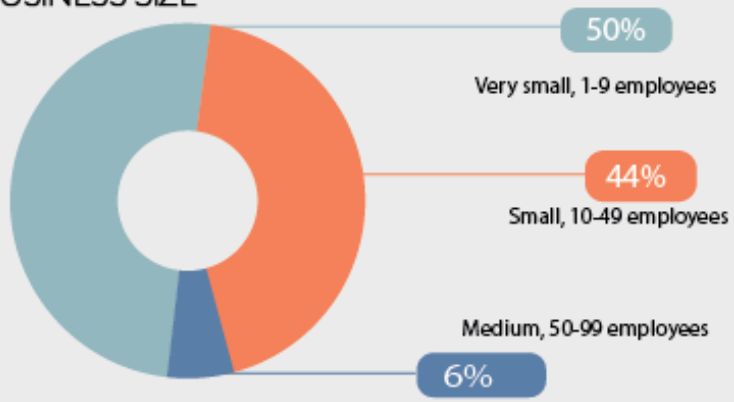
ENERGY REDUCTION GOALS



Only 18% of businesses in this segment have energy reduction goals. Having competitions can help warehouse and wholesale businesses first create energy reduction goals, then work to achieve those goals in a systematic manner.

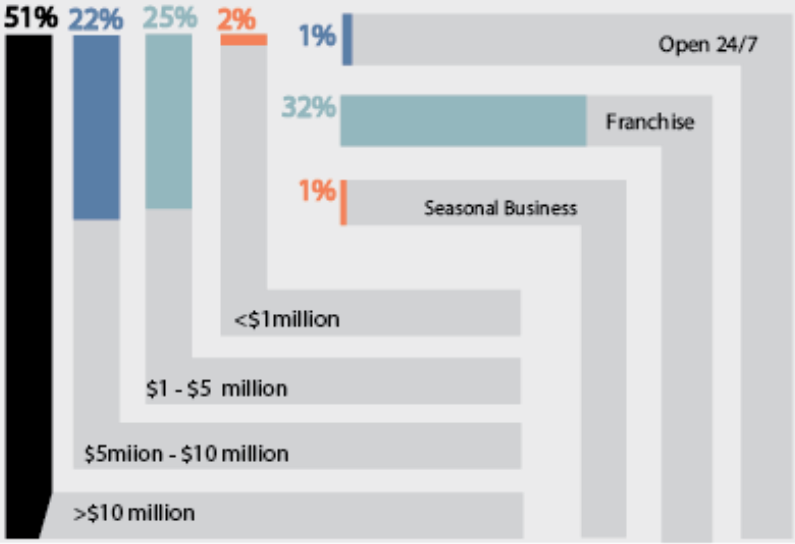
WHOLESALE AND WAREHOUSE

BUSINESS SIZE



About half of the businesses in this segment are very small (1 to 9 employees). A small number of employees means it will be easier to communicate about energy savings actions to all staff and to have greater accountability and sense of responsibility.

SALES

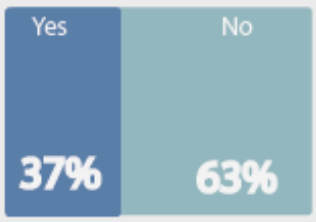


BUSINESS TYPE

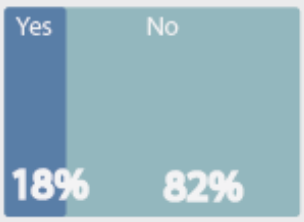
Few businesses are open 24/7. Businesses can use unoccupied hours to save energy through thermostat and lighting adjustments and power management.

More than a quarter of all wholesale businesses are franchises. Friendly competition between franchises is a good strategy to encourage energy reduction.

ENERGY STAR PREFERENCE



ENERGY REDUCTION GOALS



Only 18% of businesses in this segment have energy reduction goals. Having competitions can help warehouse and wholesale businesses first create energy reduction goals, then work to achieve those goals in a systematic manner.

WHOLESALE/WAREHOUSE

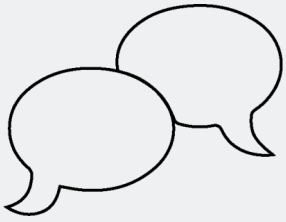
ENERGY CHAMPIONS

The wholesale segment has the largest percentage of businesses where responsibility for equipment resides with a facility manager/employee. The facility manager can play an important role, along with the business owner, in this segment to ensure lighting, thermostat settings, and HVAC maintenance are optimized to reduce energy use. A strong leader can spearhead changes in behavior, equipment usage, and other sustainability goals.[20]

PROGRAM APPROACH

Messaging. To get the facility manager and business on board to encourage energy saving actions in the business, messaging should emphasize cost savings and maintenance benefits. A cost-saving message may be compelling for this segment: Energy costs for some warehouses may exceed 10% of total revenue[21] and comprise 4% to 5% of operating expenses[22]. Facility managers may also be motivated by the maintenance benefits of regular HVAC maintenance contracts and reducing un-necessary lighting usage.

ASYNCHRONOUS FEEDBACK



Asynchronous Feedback Programs provide feedback to customers after energy consumption has occurred, often in the form of a report that shows historical energy usage and usage compared to other customers along with energy-saving tips. These reports have a consistent track record of success for residential customers of 1% to 2% savings.

[20] For one example, see Reynolds Transfer and Storage, which implemented changes to thermostat settings, equipment operation, and business processes through the leadership of a manager: https://www.reynoldstransfer.com/overview-1/

[21] E Source Customer Direct: Improving Energy Efficiency in Warehouses, (http://bea.touchstoneenergy.com/sites/beabea/files/PDF/Sector/Warehouses.pdf)

[22] Detail from BizCosts® Report, The Cost of Operating a Distribution Warehouse, (http://www.distributiongroup.com/articles/DCM0310we_boyd.pdf)

WHOLESALE/WAREHOUSE

PROGRAM APPROACHES

Feedback programs in a wholesale/warehouse setting will likely be most effective when the energy champion (the business owner or facility manger) receives and reviews the report. Recommended practices for deploying feedback reports in wholesale/warehouse include:

1. **Include specific tips and guidance for wholesale and warehouses**. Reports should include specific tips around HVAC maintenance, lighting, thermostat settings, and computer and power management. Tips should also suggest ways to lead and motivate other staff to make changes, since success may depend on the actions of other staff. Images and design elements should also be specific to the wholesale segment.
2. **Emphasize "self-comparison" trends over comparisons to other businesses**. SMBs report higher satisfaction with self-comparisons on reports than comparisons to other businesses and question the accuracy of the comparisons to other businesses.[23] Given the smaller number of businesses in this segment compared to others, developing groups of businesses that SMBs will perceive as similar may be challenging.
3. **Pair tips on quick-fix behavior-changes and longer-term investments** to help businesses maximize persistent savings. For example, 37% of warehouse electricity costs come from lighting.[24] Reports should provide tips on how to reap savings in short-term with manual adjustments to lighting use while also guiding businesses to plan for changes to lighting equipment and controls for longer-term lighting savings that might include participation in a utility rebate program.

DIAGNOSTIC

[23] Cornish, Laura, October 21, 2015. "What do businesses really think of energy reports?" Enernoc, 2015 Behavior, Energy & Climate Change Conference. (http://beccconference.org/wp-content/uploads/2015/10/presentation_cornish.pdf)

[24] E Source Customer Direct: Improving Energy Efficiency in Warehouses, (http://bea.touchstoneenergy.com/sites/beabea/files/PDF/Sector/Warehouses.pdf)

WHOLESALE/WAREHOUSE

Wholesalers and warehouses are good candidates for Diagnostics Programs including on-site energy assessments that feature direct installation of low-cost measures and recommendations for follow-up measures.

PROGRAM APPROACHES

Diagnostic programs aimed at the wholesale and warehouse segment can help businesses realize long-term savings through behavior and equipment changes by guiding business owners/facility managers through the ENERGY STAR 7 steps of energy management.[25] Recommendations include:

1. **Make a commitment**. The on-site assessor/auditor can ask the business owner to make a commitment to implement changes.
2. **Assess performance**. ENERGY STAR provides benchmarks for warehouses and distribution centers.
3. **Set goals**. Set measurable and achievable goals with target dates.
4. **Create an action plan.** The on-site technician can help the business owner/facility manager create an action that includes both quick-fix behavior changes and longer-term retrofits. Savings from earlier efforts can be used to fund later efforts.
5. **Implement the action plan**. Train operators and building occupant on the change. Establish maintenance schedules and building operation schedules and checklists to help make changes part of the daily routine.
6. **Evaluate progress**. Compare performance to goals and adjust plan as needed.
7. **Recognize achievement**. Recognize achievement internally, and seek external recognition. Share success on company websites, social media, etc.

[25] Smart Energy Design Assistance Center, Warehouse Fact Sheet. (https://smartenergy.illinois.edu/fact-sheets-building-type/warehouses)

OFFICE

The office segment is comprised of over 40 different types of businesses working out of office space. Some of the key features of the office segment include: (1) Most likely to be located in multi-tenant commercial buildings; (2) Least likely to pay utility bills; (3) More reliance on property managers or landlords for purchasing or replacing equipment and overhead lighting; (4) Fewest franchises and building owners. The high percentage of renters in this segment may make behavioral changes more attractive than equipment or building efficiency upgrades.

WHAT ARE THE TOP TYPES OF BUSINESSES IN THE OFFICE SEGMENT?

43,900 leasing/real estate

20,700 direct selling /electronic shopping and mail-order

17,200 services to buildings and dwellings

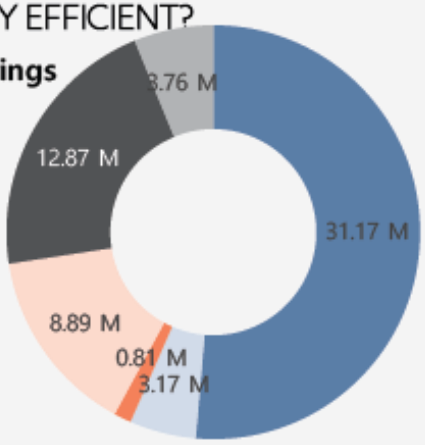
20,800 professional, scientific, and technical services

15,900 consulting

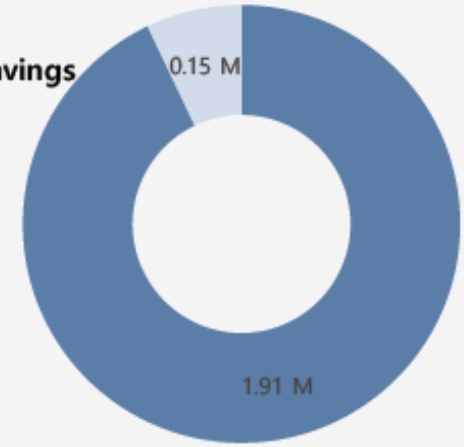
16,200 accounting, finance and investment

WHERE IS THERE OPPORTUNITY TO MAKE BUSINESSES MORE ENERGY EFFICIENT?

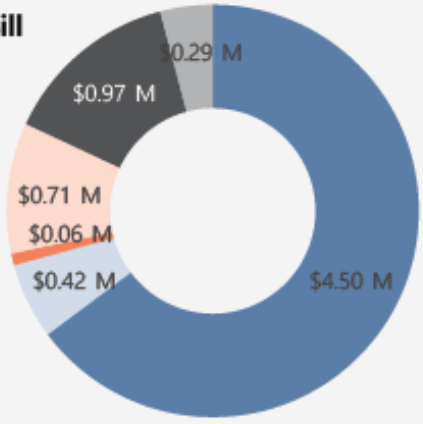
kWh Savings



Therm Savings



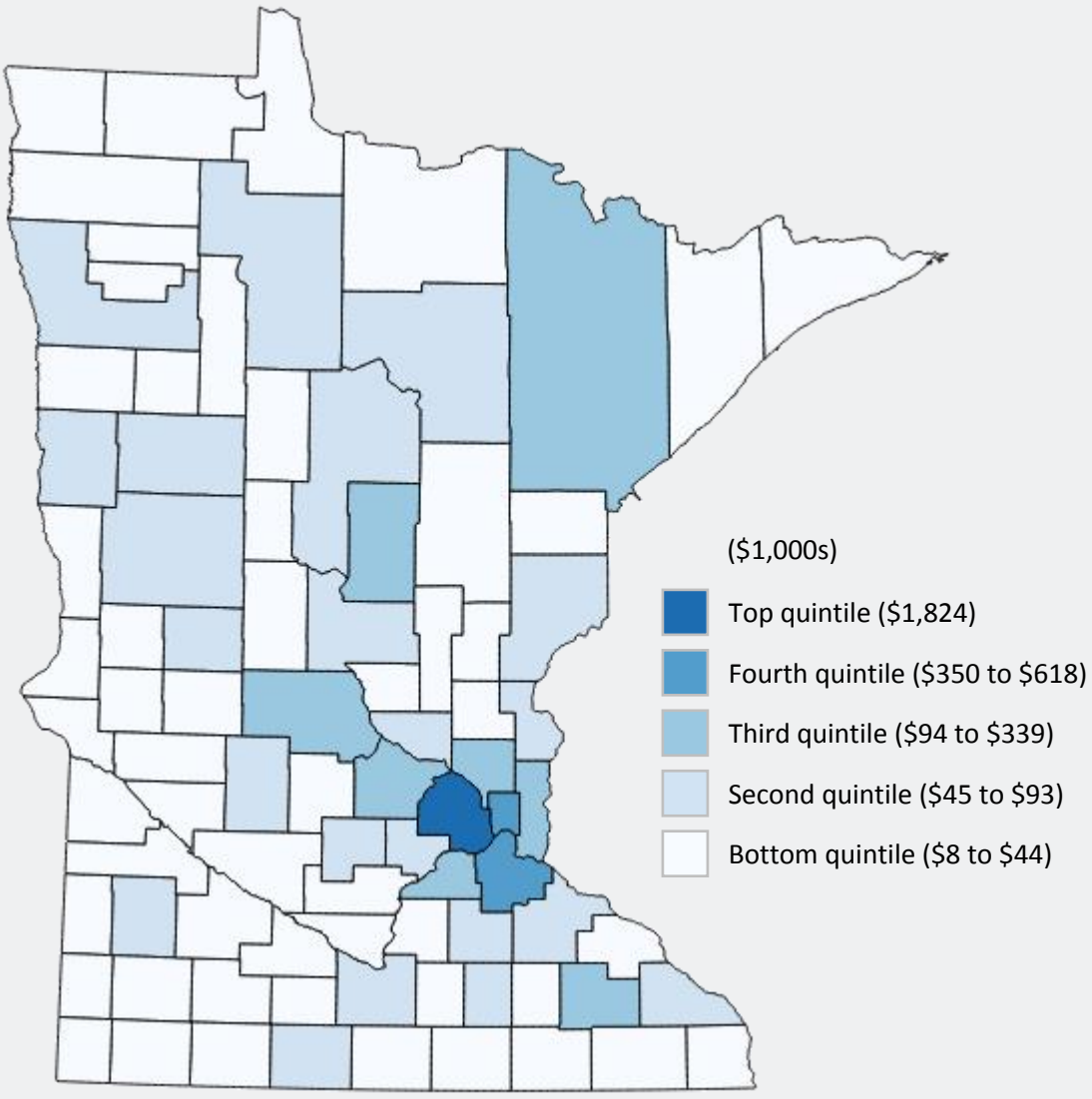
Utility Bill Savings



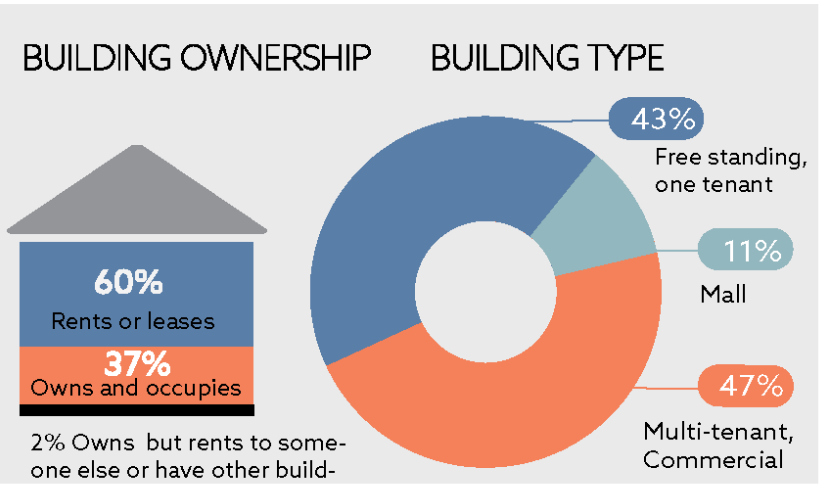
- Thermostat Setbacks
- Computer Power Management
- HVAC Maintenance
- Equipment Power Management
- Lighting Optimized to Occupancy
- Lighting Optimized to Daylight

OFFICE

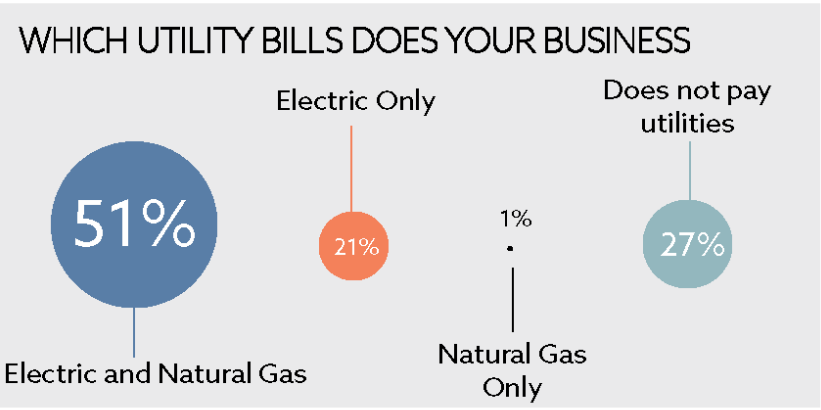
The map below shows achievable customer bill savings for the office segment by county. For additional detailed segment maps, see Appendix D.



OFFICE

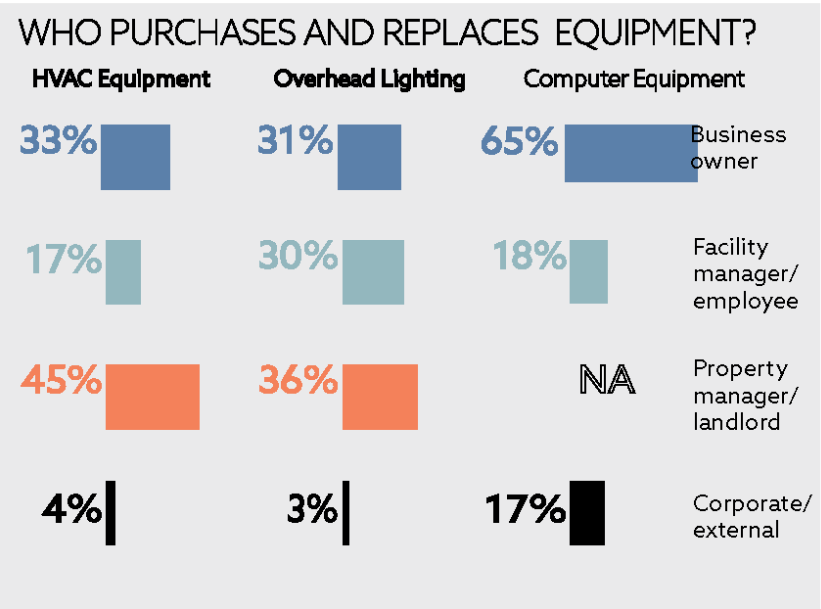


Businesses in this segment are primarily located in multi-tenant, commercial (47%) and freestanding sing-tenant buildings. Over half (60%) are renters, giving them less control over energy-saving actions than those in owner-occupied and free-standing buildings.



27% of businesses **do not** pay a utility bill. These businesses are less likely to be motivated by a cost-saving message.

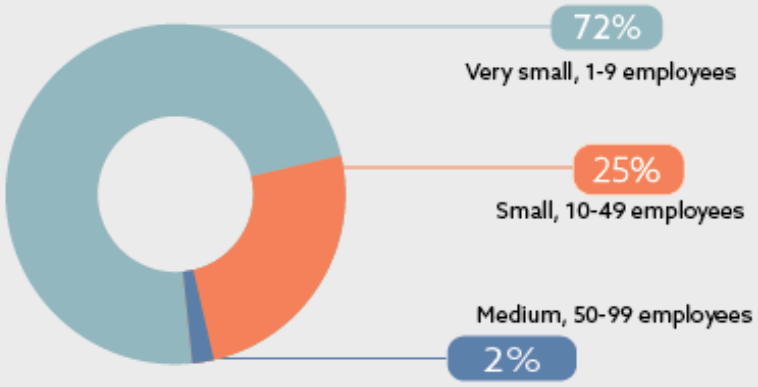
The 73 % of businesses that do pay utility bills are better candidates for feedback programs that are based on bills.



Greater reliance on property managers/landlords for replacing HVAC and overhead lighting may make it harder for this segment to install sensors or controls. Behavior-based options may be more successful. Since, business owners and employees have more control over computer equipment there may be more success implementing power management savings.

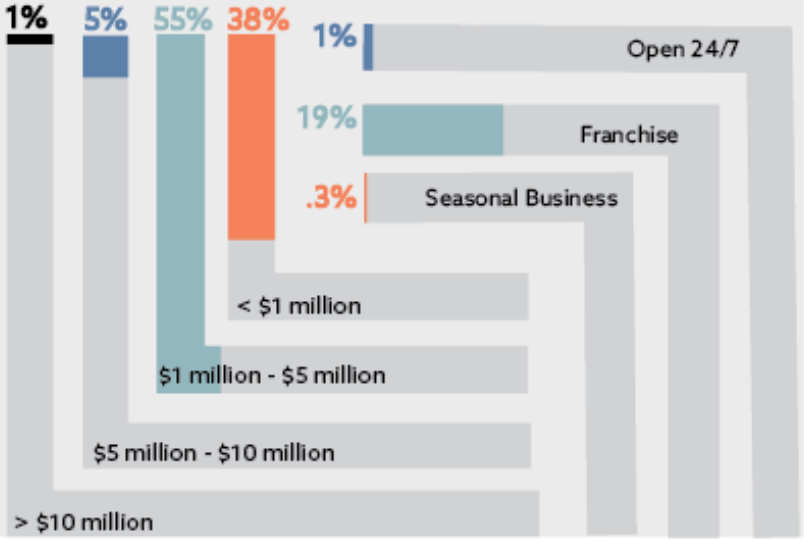
OFFICE

BUSINESS SIZE



The office segment has the highest percentage of very small (1-9 employees) businesses. Office-based businesses also tend to have less turnover, making it easier to communicate and consistently change behaviors.

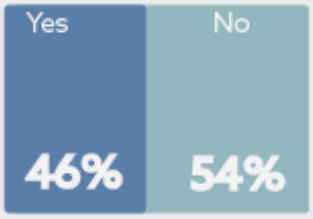
SALES



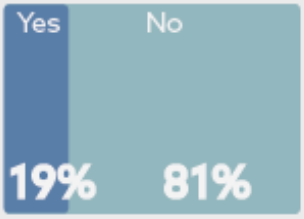
BUSINESS TYPE

With few businesses that are open 24/7, many businesses have opportunities to optimize lighting and thermostat settings for occupancy.
Businesses with lower sales volume that pay their utility bills may be more motivated by the cost savings achievable with behavioral changes. However, the 27% of businesses who do not pay a utility bill will not benefit from the bills savings.

ENERGY STAR PREFERENCE



ENERGY REDUCTION GOALS



Stated preferences for ENERGY STAR equipment are most prevalent in the office segment.

OFFICE

ENERGY CHAMPIONS

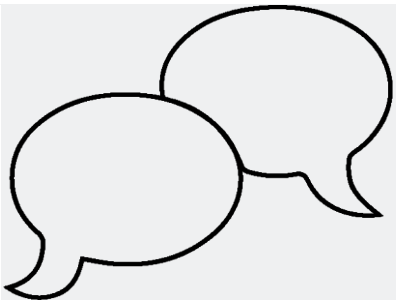
In the office segment programs may need to reach out to business owners, facility managers, and property managers to locate the person with influence over energy use. More than other segments, control over equipment purchases and use is spread among roles, with 36% of computer equipment purchase decisions made by business owners and 45% of HVAC equipment decisions made by property managers/landlords.

PROGRAM APPROACH

Outreach. Messaging to business owners on the value of behavior changes should emphasize actions that the owner or employees likely have control over: lighting use, thermostat settings, computer and equipment power management. Educational materials and messaging should also guide business owners in how to talk to property managers/landlords about other changes such as implementing regular HVAC maintenance.

Call to action: Issuing a simple call to action can help engage an energy champion: 1) Join the program; 2) Make a plan; 3) Implement the plan.[26]

ASYNCHRONOUS FEEDBACK



Asynchronous Feedback Programs provide feedback to customers after energy consumption has occurred, often in the form of a report that shows historical energy usage and usage compared to other customers along with energy-saving tips. These reports have a track record of consistent success of 1% to 2% savings for residential customers.

[26] See, for example, Urban Smart Bellevue, (http://beccconference.org/wp-content/uploads/2016/10/Johnson_presentation.pdf)

OFFICE

PROGRAM APPROACHES

Feedback programs in an office setting will likely be most effective when the environment mimics a residential environment: The person receiving and reviewing the report is the same person who pays the utility bill and has control over most of the energy use in the business. The best targets are likely very small businesses that also pay a utility bill. Recommended practices for deploying feedback reports in offices include:

1. **Include specific tips and guidance**. Reports should include specific tips around lighting, thermostat settings, and computer and power management. Tips should help office managers/business owners encourage staff to follow through on actions. For example, rather than just recommending that computers should be turned off at night, the feedback report tips section can suggest the energy champion leave "thank you" notes (and candy) on equipment that is turned off, and, perhaps "oops" notes on equipment that is not turn off.
2. **Show "self-comparison" trends**. Research suggests that small business owners like to track their own progress in reducing energy use.[27] Reports should highlight changes in the business's energy use over time.
3. **Contextualize comparisons to other businesses carefully**. Social science research demonstrates that normative messages and comparisons drive changes in behavior. However, research on home energy reports suggests that seeing an unfavorable comparison may engender dissatisfaction among customers as they see their situation as unique compared to other nearby households. Any normative comparisons used for small businesses should include messaging that acknowledges the uniqueness of each business and explains how the business should interpret and use the comparison.[28]

COMPETITIONS

[27] Cornish, Laura, October 21, 2015. "What do businesses really think of energy reports?" Enernoc, 2015 Behavior, Energy & Climate Change Conference. (http://beccconference.org/wp-content/uploads/2015/10/presentation_cornish.pdf)

[28] Ibid

OFFICE

Medium-sized offices may be able to structure competitions to have departments, or floors, compete in events, contests, or challenges to reduce energy use. Case studies suggest that energy saving campaigns or challenges are popular with employees and boost office morale.[29] Examples of campaigns in offices suggests several considerations for designing programs.

PROGRAM APPROACHES

1. **Focus on key energy-saving actions**. In offices, key actions include thermostat set-backs, lighting, and powering down computers and other equipment. Incorporating too many strategies may be confusing or inadvertently lead participants to implement less effective changes.
2. **Use prompts and immediate feedback**. Fun notes, stickers, or treats can let staff know when they've remembered or not remembered to turn off computers and other equipment.
3. **Gamification engages participants.** Gamification applies game-design strategies to non-game situations to make those efforts more fun and engaging.[30] Ensure that all game rules are simple, clearly explained, and that all employees have an opportunity to participate.
4. **Track and communicate progress**. To keep participants engaged, track and communicate progress regularly. Some programs use software with features such as leaderboards, goal tracking, and social media features. Take measurements (of lights and computers left on, for example) before the campaign to provide more meaningful tracking of progress.
5. **Celebrate success at the end of the campaign**. Rewarding all participants and celebrating as an office community will tie changes to office culture and norms an encourage persistence of behavior changes.

[29] The Smart Energy in Offices program focused on large offices, but many lesson learned are also applicable to medium-sized businesses. Donnelly, Kat A., "Workplace Engagement: Finding and Filling the Gaps for Fruitful Energy Savings," October 20, 2016, empower efficiency, 2016 Behavior, 2016 Behavior, Energy and Climate Change Conference, (http://beccconference.org/wp-content/uploads/2016/10/Donnelly_presentation.pdf)

[30] For example, see background information on Cool Choices: Kuntz, Kathy, Rajan Shukla and Ingo Bensch, 2012. "How Many Points for That? A Game-Based Approach to Environmental Sustainability," 2012 ACEEE Summer Study on Energy Efficiency in Buildings, (http://aceee.org/files/proceedings/2012/data/papers/0193-000221.pdf)

EDUCATION

In addition to school districts, this segment includes child care services, fine-art schools, recreation instruction, business and computer training schools, technical and trade schools, and colleges. The education segment is a good candidate for existing K12 programs and competitions. Key characteristics of this segment include: (1) Building occupants who are not employees; (2) More free-standing, single tenant buildings than other segments; (3) More seasonal businesses than other segments; (4) Reliance on facility managers or employees for equipment purchases.

WHAT BUSINESSES ARE IN EDUCATION?

1,415 child care services

282 fine art schools

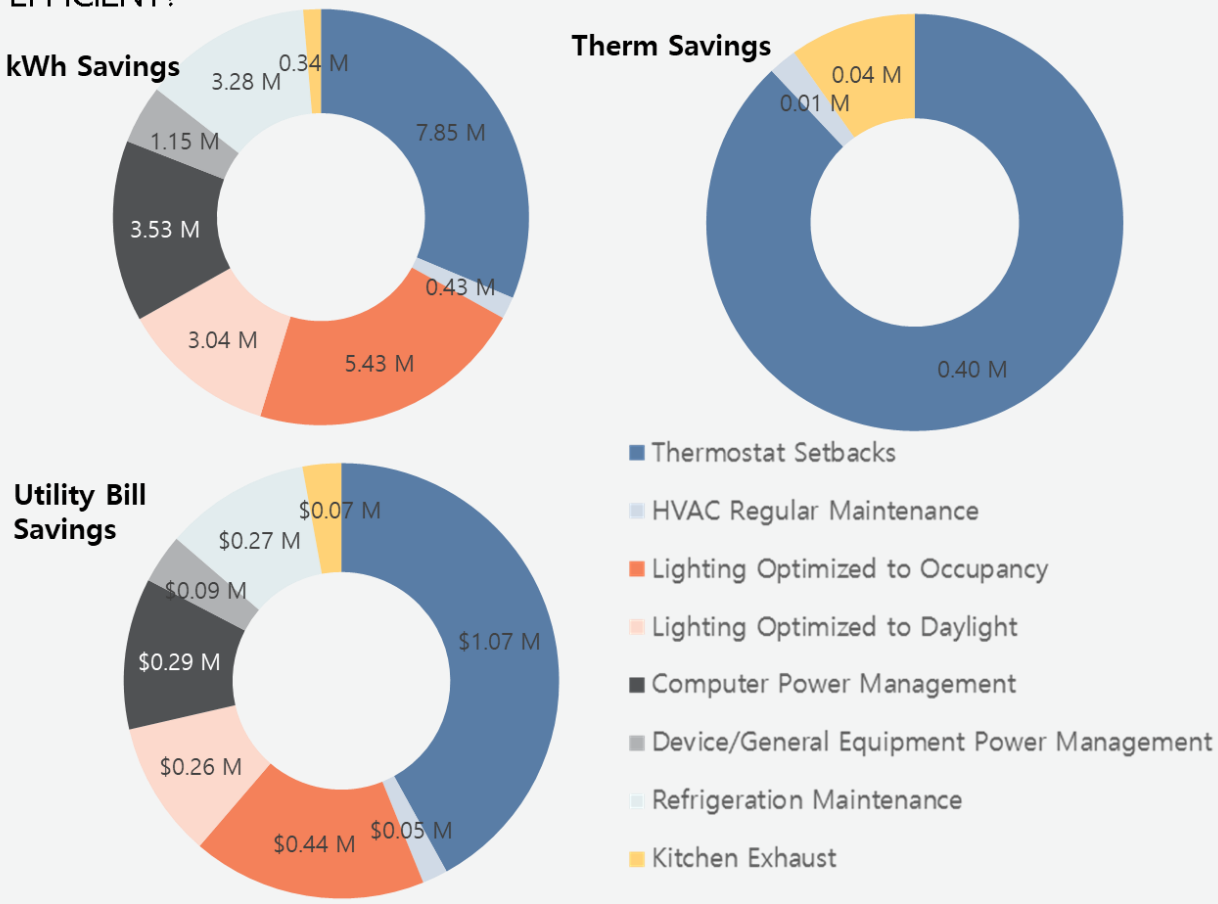
167 business and computer training schools

506 school districts

255 recreation instruction

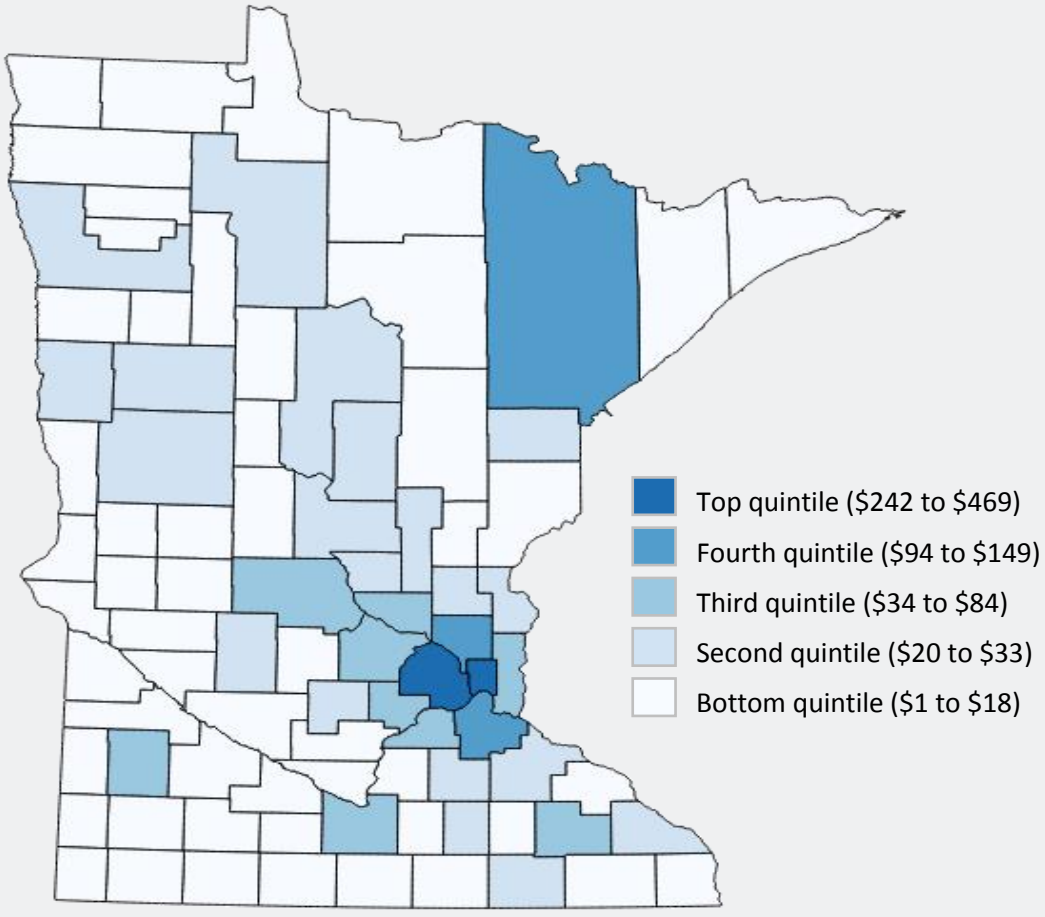
115 technical and trade schools

WHERE IS THERE OPPORTUNITY TO MAKE BUSINESSES MORE ENERGY EFFICIENT?



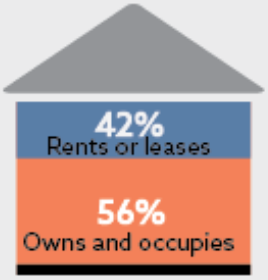
EDUCATION

The map below shows achievable customer bill savings for the education segment by county. For additional detailed segment maps, see Appendix D.



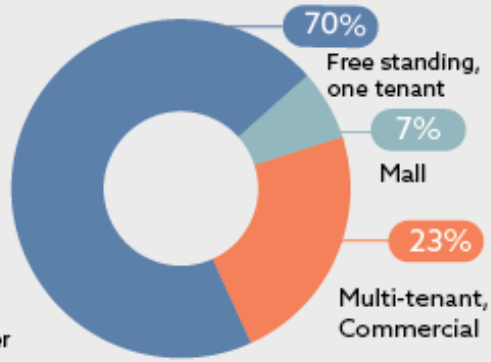
EDUCATION

BUILDING OWNERSHIP



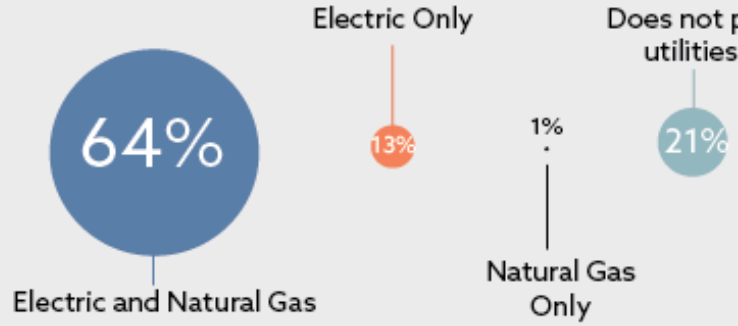
2% Owns but rents to someone else or have other

BUILDING TYPE



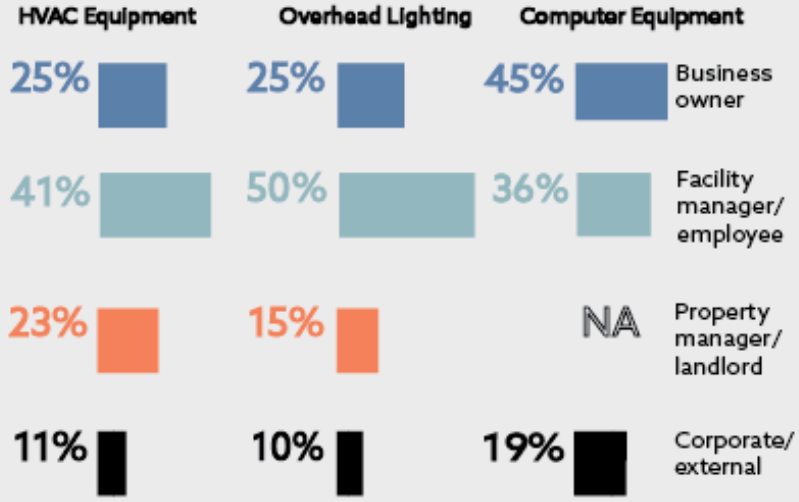
While over half of the businesses in this segment are in owner-occupied (56%) and freestanding (70%) buildings, nearly one-quarter (23%) are located in multi-tenant commercial spaces giving them less control over energy-saving actions than those in owner-occupied and free-standing buildings.

WHICH UTILITY BILLS DOES YOUR BUSINESS PAY?



21% of businesses do not pay a utility bill. These businesses are less likely to be motivated by a cost-saving message. The 79% of businesses that pay utilities bills are good candidates for feedback programs that are based on bills.

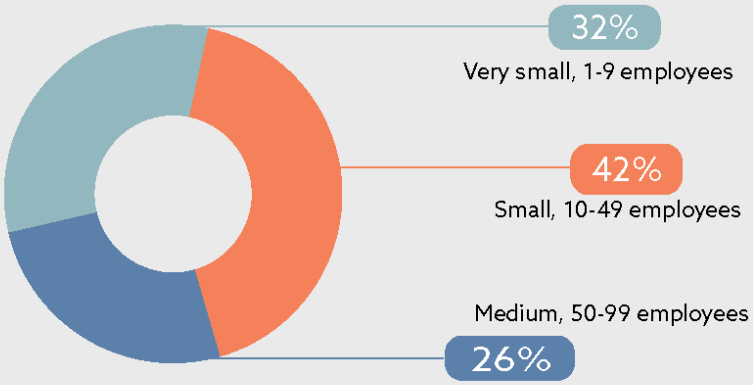
WHO PURCHASES AND REPLACES EQUIPMENT?



The education segment is most likely to have facility managers or employees that are responsible for equipment. With the support of the business owner, these staff can lead efforts to reduce energy use as an "Energy Champion," without burdening the business owner with additional responsibilities.

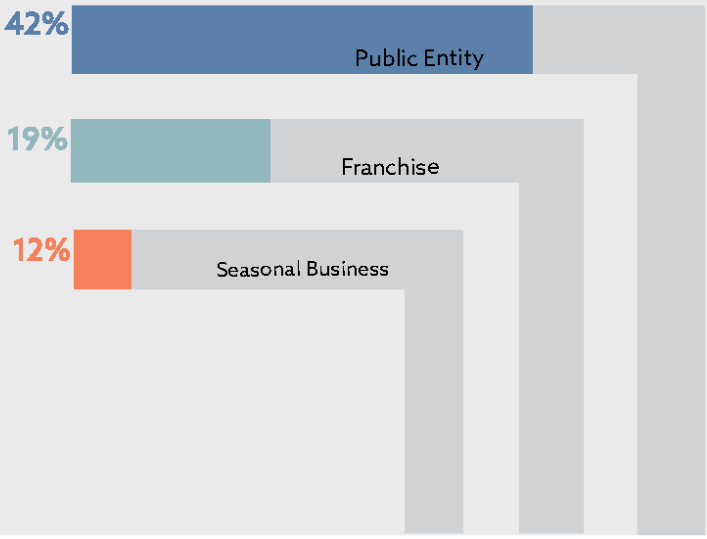
EDUCATION

BUSINESS SIZE



Businesses in the education segment tend to be larger (more businesses with 50-99 employees) than other segments. However, on average, these businesses have lower turnover than other segments, facilitating consistency in employee actions over time.

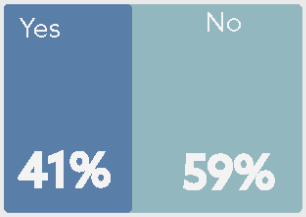
BUSINESS TYPE



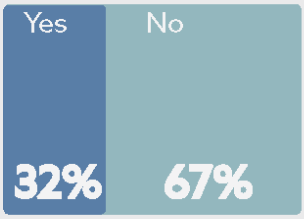
This segment has the highest percentage of seasonal businesses. Seasonal businesses can ensure lighting and HVAC settings are modified appropriately for unoccupied time periods.

Competitions between classrooms or school buildings within a district may be the best strategy for implementing competition based programs in the education segment.

ENERGY STAR PREFERENCE



ENERGY REDUCTION GOALS



Businesses in the education segment are more likely to have energy reduction goals, potentially demonstrating higher levels of interest in reducing energy usage.

EDUCATION

ENERGY CHAMPIONS

In K-12 schools in the education segment, the role of energy champion may be played by classroom teachers or a schoolwide coordinator of the curriculum or student services. The energy champion will need to coordinate efforts related to lighting and plug loads across a diverse group of building users and may have to work with the facilities staff to implement changes to temperature settings or HVAC maintenance.

PROGRAM APPROACH

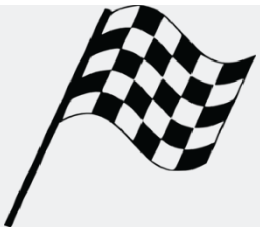
In K12 schools: Leverage existing energy education programs. Some schools in Minnesota participate in energy education programs[31] typically consisting of lessons on energy and energy conservation combined with a take-home kit of energy efficiency light bulbs and low-flow devices. While these programs usually focus on saving energy at home, the lessons educate the students and staff on the importance and value of energy conservation in general. There is an opportunity to pair the effort to change behaviors at school with these existing home-focused education programs. School-based programs should consider:

1) Targeting lighting and computer power management as measures that teachers and students can easily fulfill.
2) Encouraging a lead teacher or K12 energy education program liaison to work with kitchen/cafeteria staff on kitchen exhaust fan usage and with custodial staff to encourage regular HVAC maintenance and modifications to thermostat settings.
3) Engaging students by having them distribute fun reminders for energy saving measures, and thank you notes when equipment is successfully turned off.
4) Implementing competition/campaign strategies described below.

[31] See, for example, the Xcel Energy School Education Program, (http://thinkenergy.org/xcelenergy-mn/)

EDUCATION

COMPETITIONS AND CAMPAIGNS



Educational settings can structure competitions between classrooms, grades, or departments to motivate consistent energy-saving behaviors. Below we describe some considerations for implementing competitions in an educational setting:[32]

PROGRAM APPROACHES

1. **Focus on key energy-saving actions.** In education settings, key actions that students can control include lighting, and powering down computers and other equipment. Custodial staff can help with temperature settings.
2. **Inclusive team**. Include school-based custodial staff to ensure lights are turned off at night and that school can take advantage of savings from HVAC opportunities. Engage students in conducting energy checkups and baseline measurements.
3. **Communicate with other building users**. If the facility is used by different groups on nights or weekend, communicate with those groups directly and through signs and prompts on the importance of turning off lights and equipment.
4. **Keep activities grade-appropriate and integrate into learning** where possible. Pre-schoolers can notice when lights are left on while older students can learn about electrons and vampire power.
5. **Combine with other efforts/target certain grades.** Busy teachers may be more likely to participate when the activities tie directly to grade-level standards or curricula. Activities can be combined with other community-building events like spirit week.
6. **Track and communicate progress**. To keep participants engaged, track and communicate progress regularly using visual displays in the school. Take measurements (of lights and computers left on, for example) before the campaign to provide more meaningful tracking of progress.
7. **Celebrate success at the end of the campaign.** Rewarding all participants and celebrating as a school community will encourage persistence of behavior changes.

[32] The Center for Green Schools, Powering Down: A Toolkit for Behavior-Based Energy Conservation in K-12 Schools (http://www.centerforgreenschools.org/sites/default/files/resource-files/Behavior-based-Efficiency.pdf)

8.0 Conclusion

Much has been written about the barriers small and medium sized businesses face in trying to reduce their energy consumption. The split incentive problem, limited capital for large investments, limited staff time, and concern about business disruptions make energy conservation a tough sell to smaller businesses. Low-cost behavior change approaches to energy conservation has the potential to overcome many of the monetary hurdles for small businesses, but face other challenges. The actual savings potential of behavior change approaches for small businesses has been largely unknown.

This study addressed these barriers by estimating the achievable potential of behavior change among small businesses in Minnesota across key end uses in six business segments. Combining primary data collection with secondary data, we estimated the technical maximal potential and achievable potential savings from behavior changes related to varied end-uses including lighting, HVAC, plug loads, refrigeration, and kitchen exhaust fans.

Our estimates of achievable potential and recommendations for implementation take in to account the distinct needs and concerns of different business segments. Each business segment has a unique combination of characteristics, some of which facilitate the implementation of programs to encourage behavior while others present challenges to implementation. Size of business, staff turnover, hours of operation, presence of franchises, ownership of building, control over equipment, whether a business pays a utility bill, and prior interest in energy efficiency all impact the types of approaches that are likely to be successful.

While not exhaustive, this study provides estimates of potential savings from many common low-cost/no-cost actions across common small business types in Minnesota, and suggests practical ways businesses can implement these changes with assistance from their utility providers.

9.0 References

Aksamija, A., Abdullah, A., & Cross, B. (2014). Whole Building Energy Analysis: A Comparative Study of Different Simulation Tools and Applications in Architectural Design. Proceedings of the 2014 ACEEE Summer Study on Energy Efficiency in Buildings. Retrieved from https://works.bepress.com/ajla_aksamija/88/

Allwood, P. B., Jenkins, T., Paulus, C., Johnson, L., & Hedberg, C. W. (2004). Hand washing compliance among retail food establishment workers in Minnesota. Journal of Food Protection, 67(12), 2825–2828.

ASHRAE. (1999). Energy Standard for Buildings Except Low-Rise Residential Buildings.

ASHRAE. (2016). Energy Standard for Buildings Except Low-Rise Residential Buildings.

ASHRAE Guideline 14-2014: Measurement of Energy, Demand and Water Savings. (n.d.). American Society of Heating, Refrigerating and Air Conditioning Engineers.

BizCosts. (2010). The cost of operating a distribution warehouse. Retrieved from http://www.distributiongroup.com/articles/DCM0310we_boyd.pdf

Commercial roof-top units in Minnesota: characteristics and energy performance. (2015, March 24). Retrieved April 12, 2017, from http://www.seventhwave.org/rtu-study

Cornish, L. (2015). What do businesses really think of energy reports? Presented at the BECC Conference. Retrieved from http://beccconference.org/wp-content/uploads/2015/10/presentation_cornish.pdf

Deru, M., Field, K., Studer, D., Benne, K., Griffith, B., Torcellini, P., … Crawley, D. (2011). U.S. Department of Energy commercial reference building models of the national building stock. Publications (E), 1–118.

DiLaura, D. (2011). The Lighting Handbook. The Illuminating Engineering Society.

Donnelly, K. (2016). Workplace Engagement: Finding and Filling the Gaps for Fruitful Energy Savings. Presented at the BECC Conference. Retrieved from http://beccconference.org/wp-content/uploads/2016/10/Donnelly_presentation.pdf

Dougherty, A., Henderson, C., Jayaraman, M., Dwelley, A., Vine, E., & Mazur-Stommen, S. (n.d.). Energy Efficiency Behavioral Program: Literature Review, Benchmarking Analysis, and Evaluation Guidelines. Prepared for Minnesota Department of Commerce Division of Energy Resources. Retrieved from 2015

Ehrhardt-Martinez, K. (n.d.). Behavior-based Energy Savings Opportunities in Commercial Buildings: Estimates for Four U.S. Cities. ACEEE Summer Study on Energy Efficiency in Buildings, 2016.

Energy Center of Wisconsin. (2014). Peoples Gas Light and Coke Company Wasted Energy Study. Prepared for: Peoples Gas Light and Coke Company.

Energy savings from implementing and commissioning demand control ventilation. (2015, April 21). Retrieved April 12, 2017, from http://www.seventhwave.org/publications/implementing-commissioning-dcv

E-Source. (2007). Improving Energy Efficiency in Warehouses. Retrieved from http://bea.touchstoneenergy.com/sites/beabea/files/PDF/Sector/Warehouses.pdf

Future of DCV For Commercial Kitchens - ProQuest. (n.d.). Retrieved April 12, 2017, from http://search.proquest.com/openview/6f37d29578562df01b90c48f1ecb21eb/1?pq-origsite=gscholar&cbl=41118

Gowri, K., Winiarski, D. W., & Jarnagin, R. E. (2009). Infiltration Modeling Guidelines for Commercial Building Energy Analysis (No. PNNL-18898). Pacific Northwest National Laboratory (PNNL), Richland, WA (US). Retrieved from https://www.osti.gov/scitech/biblio/968203

Hackel, S., Plum, C., Colburn, M., Marsicek, G., Rozenbergs, T., Kessler, N., … Kieffeber, L. (n.d.). Impacts of Office Plug Load Reduction Strategies. Retrieved from http://mn.gov/commerce-stat/pdfs/card-office-plug-load-reduction.pdf

Heinemeier, K. (2014). Free Cooling: At What Cost? 2014 ACEEE Summer Study on Energy Efficiency Buildings.

Ignelzi, P., Peters, J., Randazzo, K., Dethman, L., & Lutzenhiser, L. (2013). Paving the Way for a Richer Mix of Residential Behavior Programs. Prepared for: The California Investor-Owned Utilities: Pacific Gas & Electric, Southern California Edison, San Diego Gas & Electric, and Southern California Gas. Retrieved from http://energycenter.org/sites/default/files/docs/nav/programs/swmeo/Residential_Behavior_White_Paper_5-31-13_FINAL.pdf

Itron, Inc. (2008). California Energy Efficiency Potential Study. Prepared for Pacific Gas & Electric Company. Retrieved from http://www.calmac.org/publications/PGE0264_Final_Report.pdf

James J. Hirsch & Associates. (n.d.). The Home of DOE-2 based Building Energy Use and Cost Analysis Software. Retrieved from http://doe2.com/

Johnson, E., & Rassmusan, T. (2016). Urban Smart Bellevue. Presented at the BECC Conference. Retrieved from http://beccconference.org/wp-content/uploads/2016/10/Johnson_presentation.pdf

Katipamula, S., Underhill, R. M., Goddard, J. K., Taasevigen, D. J., Piette, M. A., Granderson, J., … Kuruganti, T. (2012). Small- and Medium-Sized Commercial Building Monitoring and Controls Needs: A Scoping Study (No. PNNL-22169). Pacific Northwest National Laboratory (PNNL), Richland, WA (US). Retrieved from https://www.osti.gov/scitech/biblio/1063081

KEMA. (2012). Xcel Energy Minnesota DSM Market Potential Assessment. Prepared for Xcel Energy. Retrieved from https://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/MN-DSM/MN-DSM-Market-Potential-Assessment-Vol-1.pdf

Kuntz, K., Shukla, R., & Bensch, I. (2012). How Many Points for That? A Game-Based Approach to Environmental Sustainability. 2012 ACEEE Conference Proceedings. Retrieved from http://aceee.org/files/proceedings/2012/data/papers/0193-000221.pdf

Market Strategies International. (2012). Strategic Energy Management Market Assessment Study: Small, Medium, and Metals Manufacturers. Prepared for Northwest Energy Efficiency Alliance.

Michael Knowles, & David Baglee. (2012). The role of maintenance in energy saving in commercial refrigeration. Journal of Quality in Maintenance Engineering, 18(3), 282–294. https://doi.org/10.1108/13552511211265848

Miknaitis, G., Lux, J., Dynako, D., Hamann, M., & Burns, W. (2014). Tapping Energy Savings from an Overlooked Source: Results from Behavioral Change Pilot Program Targeting Mid-Sized Commercial Customers. Retrieved from http://aceee.org/files/proceedings/2014/data/papers/7-153.pdf

Mogilner, L. (2014). PG&E Business Energy Reports Pilot Results. Behavior, Energy and Climate Change Conference.

Nadel, S., Pye, M., & Jordan, J. (1994). Achieving high participation rates: Lessons taught by successful DSM programs. Retrieved from https://www.osti.gov/scitech/biblio/160544

Opinion Dynamics. (n.d.). ComEd Commercial and Industrial Saturation/End-Use, Market Penetration and Behavioral Study. Prepared for ComEd.

PWP, Inc, & Michaels Energy. (2014). Strategic Energy Management Intro Pilot Evaluation Report. Prepared for Energy Trust of Oregon.

Rea, M. S., Dillon, R. F., & Levy, A. W. (1987). The effectiveness of light switch reminders in reducing light usage. Lighting Research & Technology, 19(3), 81–85. https://doi.org/10.1177/096032718701900304

Reinhart, C. F. (2005). A simulation-based review of the ubiquitous window-head-height to daylit zone depth rule-of-thumb.

Research into Action, & TetraTech. (2014). Small Commercial Energy Efficiency Program Market and Process Evaluation. Prepared for NYSERDA.

Small Business Administration Office of Advocacy. (2016). Minnesota Small Business Profile.

Smart Energy Design Resistance Center. (2011). Energy Smart Tips for Warehouses. Retrieved from http://smartenergy.illinois.edu/pdf/Warehouses%20Niche%20Market%20Report%20FINAL%20-%2005.02.2011.pdf

State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs, Version 2.0. (2017). Retrieved from http://mn.gov/commerce-stat/pdfs/mn-trm-v2.0-041616.pdf

Sussman, R., & Gifford, R. (2012). Please turn off the lights: The effectiveness of visual prompts. Applied Ergonomics, 43(3), 596–603. https://doi.org/10.1016/j.apergo.2011.09.008

The Center for Green Schools. (2013). Powering Down: A toolkit for behavior based energy conservation in K-12 schools. Retrieved from http://www.centerforgreenschools.org/sites/default/files/resource-files/Behavior-based-Efficiency.pdf

United States Census Bureau. (2012). Businesses Expenses Survey.

US Energy Information Administration. (2017). Natural Gas Prices. Retrieved from https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_SMN_m.htm

US Energy Information Administration. (n.d.-a). Commercial Buildings Energy Consumption Survey (CBECS). Retrieved from https://www.eia.gov/consumption/commercial/

US Energy Information Administration. (n.d.-b). Electric Power Monthly. Retrieved from https://www.eia.gov/electricity/monthly/

Williams, A., Atkinson, B., Garbesi, K., Page, E., & Rubinstein, F. (2012). Lighting Controls in Commercial Buildings. LEUKOS, 8(3), 161–180. https://doi.org/10.1582/LEUKOS.2012.08.03.001

Wisconsin Focus on Energy Technical Reference Manual. (2015).

Xcel Energy School Education Program. (2017). Retrieved from http://thinkenergy.org/xcelenergy/minnesota/