The treasures you find after the lights go out: non-lighting savings opportunities in the small commercial sector

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ABSTRACT

Lighting savings have dominated small business program approaches since the beginning of energy efficiency. These programs are reaching market saturation while at the same time new lighting standards will soon wiping out the remaining savings potential for that end use. Where can a mature program look for new savings in the small commercial sector? How can a gas utility gain a foothold in this sector without having lighting to lead the way? What should new entries into the small business space start with?

This paper will identify possible savings opportunities - in areas ranging from HVAC to controls to plug loads to behavior - based on a rigorous market characterization of the Minnesota small commercial market. The study methodology includes surveying hundreds of small business owners and decision-makers, conducting in-depth on-site characterizations of 100 buildings, and examining opportunities from four major building types.

This paper will summarize both savings opportunities as well as detailed building characteristics. We'll also map these to promising program approaches designed to compel small business owners to consider reductions in heating, cooling, ventilation and process loads. This characterization builds the necessary foundation for new technology and program pilots, or for adapting ideas from other sectors and geographic regions to address the small commercial market. The paper documents the key characteristics of the building types studied, as well as the energy saving opportunities found, and what attitudes the owners of these businesses have to new energy savings opportunities.

Introduction

According to the US Census Bureau's 2013 County Business Patterns (CBP), there are roughly 138,000 small businesses in Minnesota, accounting for 94 percent of all businesses in the state and employing over one million people.

This sector is historically difficult for energy efficiency programs to reach due to its dispersed nature and disparate market barriers, and would benefit from a specific, targeted approach. Several Minnesota utilities do not have programs specifically targeting small businesses, and those energy efficiency programs that do target the sector have long been dominated by lighting-only retrofit programs. Though these lighting programs have enjoyed significant success, there is a need for more holistic programs in the small commercial sector. Programs will have increasing difficulty achieving savings goals through lighting in the future as federal lamp standards become more stringent and market penetration of efficient products grows. Additionally, gas utilities recognize a lack of options for cost effective program offerings in the small commercial sector. New, more holistic, programs are needed in Minnesota to serve

this market so that it can continue to contribute to achieving the 1.5 percent of gross annual retail sales savings goal[1].

To address these issues, Seventhwave characterized this market by identifying important sector segments using public data and identifying key energy savings opportunities in those segments using both telephone surveys and on-site data collection.[2] Coupling the primary data collected with best-practice research from around the country, we identify promising program strategies to compel small business owners to consider energy efficiency investments.

In this paper, we share results of this research and specifically highlight key building characteristics, attitudes related to energy and energy investments, and key energy savings opportunities. We then offer recommendations for utility programs to augment their current offerings with programs targeted at the small commercial sector.[3]

Methods

We define "small commercial" as businesses with less than 50 employees, the primary exception being food service establishments, which tend to have high number of employees per business. For those businesses, we increased the employee limit to 100 employees. Typically, a small commercial utility program includes businesses that have a maximum level of energy demand or usage; however, we were limited in this research because we did not have access to utility data to choose our sample population. Therefore, we used number of employees as a proxy since it is a readily available data point in the Census County Business Patterns.

We collected data from 1,440 small businesses in Minnesota using a telephone survey. Respondents provided information on types of equipment, energy conservation behaviors, and energy decision-making authority for the business. We recruited 100 businesses from the phone survey to participate in a site visit which gathered more detailed information. For purposes of the site visits, we limited our scope to four business segments: retail, grocery/convenience stores, food service, and offices; these segments were chosen based on levels of energy intensity, interest from interviewed Minnesota stakeholders, and gaps in existing knowledge in the state. The four segments in aggregate account for nearly 50% of small commercial energy usage. The sample from which businesses were selected was then stratified by number of employees, business segment and geography.

We developed a list of 100 measures spanning relevant end-uses, with measure opportunity incidence rates for each measure based on the building characteristics collected onsite. For some measures, we used the larger telephone survey to develop incidence rates; however, the telephone survey did not capture the level of detail we needed to fully explore the majority of measures. The measure saving values were developed using Minnesota Technical Reference Manual (TRM) savings assumptions and when that information was unavailable, we looked towards other states' TRMs or engineering calculations.

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[1] This savings goals for electric and gas utilities that operate in Minnesota was established as part of the Next Generation Energy Act of 2007.

[2] This project was supported 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.

[3] A full report that provides more detail on research methods, findings, and recommendations can be found in LeZaks et al. (2018).

We classified the measures into 10 bundles that could be applied in program implementation. We then combined this information with the results of our secondary research on small business program best practices to develop recommendations for program approaches to address this sector.

There are several possible sources of uncertainty involved in the study. There is sampling uncertainty associated with the survey data from which some of the characteristics and measure conclusions were derived. The uncertainty is greater with data gathered only during the site visits because our site data sample is significantly less than our survey sample. There is generally a margin of error of approximately ±5 percentage points for survey data and ±17 percentage points for site data. For ease of reading, we report the point estimates of technical savings only, but the reader should note that each estimate has a wide band of uncertainty.

Study Findings

Key Building and Business Characteristics

Our telephone survey results show that small businesses occupied spaces that tended to be smaller than 5,000 square feet and located in a one-story building.

Table 1: Building total area

	Overall	Retail	Grocery	Food Service	Office
Less than 5,000 square feet	73%	61%	76%	60%	78%
5-10,000 square feet	11%	10%	10%	19%	10%
10-25,000 square feet	9%	14%	7%	11%	7%
25-50,000 square feet	4%	6%	4%	8%	3%
More than 50,000 square feet	3%	9%	2%	3%	1%

We found a variety of ownership structures within the businesses evaluated, and these structures may drive an owner's rationale for making substantial energy investments (Table 2). Additionally, the type of building in which the business resides may drive the feasibility for energy investments. There are limitations to energy upgrades if a business is in a multi-tenant building or mall.

Table 2: Ownership structure and building type

	Overall	Retail	Grocery	Food Service	Office
Ownership structure					
Lease their business space	57%	61%	24%	60%	60%
Own and occupy the whole building	41%	38%	72%	39%	38%
Own the building but lease out space	2%	1%	4%	2%	2%
Building type					
Free-standing	46%	38%	71%	48%	44%

	Overall	Retail	Grocery	Food Service	Office
Multi-tenant commercial	38%	31%	14%	25%	48%
Enclosed mall or strip mall	19%	34%	18%	29%	11%

Attitudes of Business Owners and Managers

At the start of each site visit, our researchers asked the owner or manager a series of questions to explore perception of energy use, plans for investing in energy upgrades, and motivations behind those plans.

Energy cost. We found that while some owners and managers found their energy costs to be significant relative to other expenses, little time is spent devoted to thinking about energy usage in the business (Figure 1). On average, the owners or managers that we interviewed spent a small percent of their working time thinking about energy-related topics. This varied slightly depending on the business segment, with the highest proportion of time spent by food service owners or managers and the lowest spent by retail owners or managers. Similarly, food service and grocery business segments reported significantly higher energy costs, which is not surprising considering the energy consumption of refrigeration and food-service related equipment, as well as the competitive bottom lines of these two industries.

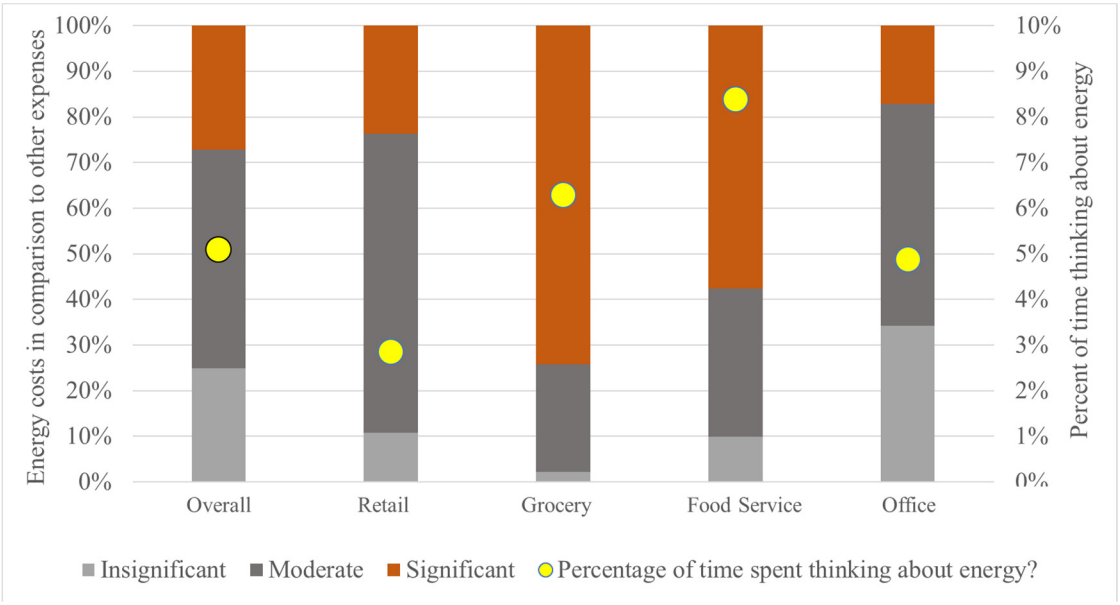

Figure 1: Energy costs in comparison to expense and percent of time thinking about energy-related equipment issues

Overall, a majority of businesses did not benchmark or did not know if they benchmarked their energy consumption data. Some used an auto-pay approach and didn't even see their utility bills. This highlights an opportunity for small business owners and managers to take a closer look at their energy consumption on a regular basis to understand how their business stacks up against other similar businesses—or for the utility to do it for them.

Awareness of programs. About two-thirds of business owners and managers were aware of utility rebates or technical assistance. Of those that were aware of such benefits, just over 50% said they were aware of lighting rebates, with a smaller percentage that said either a "general rebate" was offered (18%) or weren't sure of type. The remaining less frequent responses ranged from HVAC upgrades, audits and appliance rebates (16%). Although we did not quantify this, a number of respondents also remarked that while they were not aware of business rebates, they were aware of the residential rebates offered by the utility for their homes.

Less than half the businesses said they participated in energy programs, with the lowest rates of participation in food service and grocery establishments (Table *3*). Some who were aware of programs but hadn't participated in them reported a lack of knowledge on how to participate in the programs.

Table 3: Participation in utility energy efficiency program

	Overall	Retail	Grocery	Food Service	Office
Have participated	46%	43%	33%	30%	52%
Have not participated	53%	57%	63%	65%	48%
Don't know	1%	0%	4%	5%	0%

Making energy improvements. While business owners and managers may say they spend only a small portion of their time thinking about energy in their jobs, just over half reported that they have made some energy upgrades in the past five years; the most reported upgrades included lighting (21%), HVAC (13%) and envelope (9%).

For those that made recent energy efficiency investments, we probed on the primary reasons for making those investments. The two most prominent reasons were to save money or because they had to make an end-of-life equipment replacement. Comfort-related motivations also were prevalent especially in the office segment—some owners frequently recorded issues with both winter and summertime discomfort. In retail, another main reason was that the investment was part of another remodeling effort or move. For grocery stores, aesthetics of the system they were replacing played a role in making the investment.

Barriers to improvement. When asked about barriers, many respondents listed the lack of capital, and to a lesser extent, the question of payback was cited as a barrier to making investments. Owners remarked that they might take action if they knew which measures/projects were projected to be the most cost-effective and trusted the cost savings calculations.

Food service owners and managers had slightly higher responses for the barrier of lack of expertise to make a decision; this suggests that the investments they are considering are more complex than other business segments. Lack of time to think about investments was most prevalent in food service compared to other business segments. While we initially hypothesized that the owner and renter split incentive would be a strong disincentive to make investments, we actually found that relatively few of our respondents cited this.

Business associations. About half of the small commercial businesses in our study report belonging to a business organization. When asked about what kind of business organization, they often specified a chamber of commerce or similar general local business support entity. They

also reported belonging to business-specific organization, such as a restaurant organization or a grocery association.

Energy Efficiency Opportunities and Measure Bundles

This section explores the results of the measure analysis and provides context for developing our program recommendations. We first describe the overall results of our measure analysis in terms of relative cost savings and briefly describe the 10 measure bundles. We then provide high level results for four energy end-uses and their associated energy efficiency opportunities. Additional detail on the remaining end uses and bundles not covered in this paper can be found in the full report (LeZaks, 2018).

Statewide results and bundles

Using data from both the onsite visits and telephone surveys, we calculated savings impacts from 100 measures. Figure 2 illustrates the relative total cost-savings potential across business types and energy end uses in Minnesota. The size of each circle is proportional to the aggregate statewide savings potential, which is calculated using the opportunity incidence of individual measures and the savings potential from these opportunities. The savings are weighted by business segment. The largest opportunities shown in this figure relate to HVAC controls and ducts, refrigeration, water heating, commercial kitchen, and lighting.

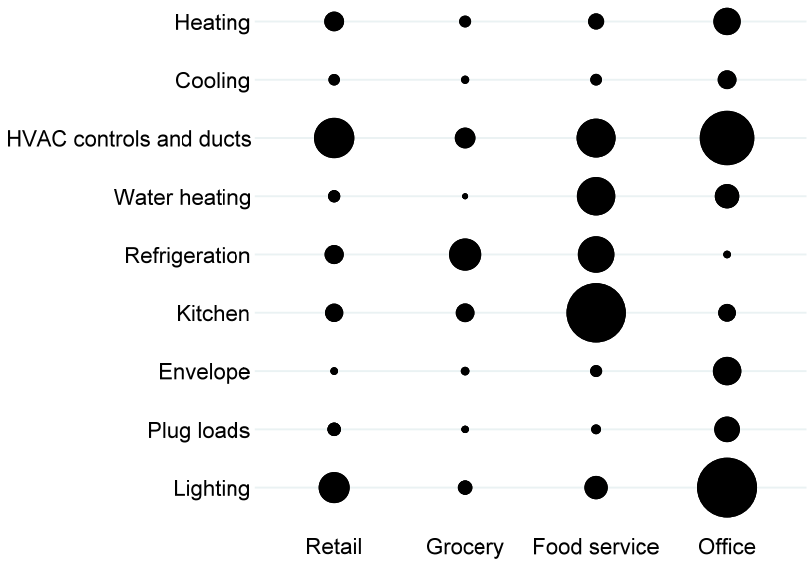

Figure 2: Relative energy cost savings potential across business types and energy end uses

Through our interviews with business owners and managers, we found that utility customers respond better to more focused, targeted messages that offer a discrete number of choices. To address this feedback, we categorized each measure into 10 bundles based on criteria that includes end-use, fuel-type or business function (Table 4).

Table 4: Measure bundle overview and description

Bundle	Description
Capture gas savings	Focus on natural gas measures, such as heating system tune-ups or replacements, controls, and envelope
Tackle rooftop units	Measures that focus on the most predominant HVAC system type in small commercial in Minnesota
Retrocommissioning	Tune-up type measures including low-cost/no-cost improvements to a building's mechanical and sometimes electrical system
Taming kitchen energy intensity	Improving all the high-energy using equipment found in commercial kitchens, and addressing exhaust issues
HVAC crossover: from residential to commercial	Taking advantage of the synergy between residential and small business HVAC, and the trade allies that serve both
Everyone has a thermostat	Continued focus on the thermostat-associated measures, such as setbacks
Keeping it cool with refrigeration	A targeted approach to refrigeration retrofits
Selling energy efficiency to retail	Measures that target retail stores
If it's plugged in, it's plug load	A bundle of measures targeted at this often-overlooked end use
Exterior lighting	Adding exterior lighting to an interior lighting program

We also recognized the need to plan for a customer's journey through an efficiency program over time. Small commercial customers are unlikely to begin with a major capital project to save energy. We recommend offering a progression of products from low-cost or direct-install type measures, to more capital-intensive measures, with the program helping the business move one step at a time through this journey. Within each bundle, we categorized measures by the predominant program delivery type provide in Figure 3. For each end use highlighted in this paper, we provide our suggestions for appropriate program bundles and delivery types that may motivate small business owners and managers to take action.

Figure 3: Customer journey through an energy efficiency program

Cooling systems

Cooling in Minnesota small businesses is provided mainly with split air conditioner systems (43% of businesses in the study) or rooftop units (RTUs) (46%). They tend to be small

capacity systems that are quite old—generally older than what is thought to be their useful life (46% are 15 years or older).

The full load cooling efficiency is currently the major driver of how much electricity a split air conditioner or RTU consumes. A recent Minnesota CARD study characterized the RTUs in Minnesota, finding that the average of efficiency of RTUs with smaller cooling capacities most associated with small business is below the code-minimum and well-below the CEE Tier 2[4] recommendation (Schuetter, 2017).

Two bundles of measures incorporate a savings targeted at cooling systems: The *HVAC crossover: from residential to commercial* addresses the number of systems in small commercial businesses that also can be found in residential homes, and trade allies that serve residential programs may also benefit to reaching out to small commercial customers (Table 5). Additionally, *Tackle Rooftop Units* targets the numerous measures that can be applied to the RTU systems often found in this sector.

Table 5: Customer journey for cooling systems

Customer journey path	Measures
	• Adjust airflow, tune refrigerant charge, and fix economizers on RTUs • Insulate and seal ductwork • Tune and clean split systems, and add pipe insulation where missing • Address outdoor air scheduling and program thermostats • Retrocommissioning bundle measures
	• Advanced rooftop unit controls (including variable frequency drives, economizer, optimal start, and strip heat control) • Demand controlled ventilation with CO_2 sensors • Electrically commutated supply motors
	• Cooling system upgrade to high-efficiency

HVAC and heating systems

The HVAC systems we surveyed are predominately single zone rooftop units (41%) or furnaces (43%). Food service is the exception where we found predominantly RTUs (81%). We found that three quarters of the buildings with RTUs have less than five RTUs. Most of the sites we visited do not have economizers. And for those that do, the age of the RTU may be the more important metric in determining whether it had an economizer.

We did not find any demand controlled ventilation (DCV) in the establishments we visited. In our site visits, we identified areas of the building where DCV may be applied based on the size of the space and density of people, and whether it lent itself to DCV via an occupancy sensor or CO_2 sensor. The highest opportunities for DCV is in food service and sales floors of grocery and other retail due to the fluctuations in occupants.

[4] This recommendation is based on the cooling capacity and can be found in detail in Jensen, 2016.

Only about half of the buildings bring in outside ventilation air through the HVAC system. RTUs typically provide outside air, but residential style furnaces do not. A few buildings, primarily offices, have operable windows for ventilation. Other buildings depend on air entering through open doors for ventilation air. We found a high saturation of programmable thermostats but setbacks (turning up/down the temperature when unoccupied) are often not being applied.

HVAC systems are the most likely jumping off point from traditional lighting-focused programs. There are a number of potential program bundles to target with this overall end use in mind, including our *Capture Gas Savings*, *Retrocommissioning,* and *HVAC crossover: from residential to commercial* (Table 6). The bundle *Capture Gas Savings* specifically draws attention to the number of opportunities that gas utilities might find for their customers. The *Retrocommissioning* bundle includes low-cost and no-cost improvements to a building's mechanical and electrical systems; this program approach is akin to direct-install but involves deeper technical modifications and highly skilled trade allies. And the *HVAC crossover*, as mentioned above, provides similar routes for implementation as can be found in a typical residential heating system upgrade.

Table 6: Customer journey for HVAC and heating systems

Customer journey path	Measures
	• Program thermostats • RTU and furnace tune-up and airflow • Outdoor air scheduling • Furnace fan controls
	• Advanced rooftop unit controls (including variable frequency drives, economizer, optimal start, and strip heat control) • Demand controlled ventilation with CO_2 sensors • Electronically commutated supply motors
	• Heating system replacements with high efficiency systems

Refrigeration

There are three major areas for saving energy in refrigeration systems: display cases, walk-in coolers and freezers, and the compressor and condenser units. In a small business program, the first two areas represent the majority of savings opportunities. Compressor and condenser units certainly have potential for energy savings as well, but are large capital expenditures that small businesses are nearly always going to replace only upon burnout.

The program bundle *Keeping It Cool* addresses the refrigeration end uses by targeting those customers with increase refrigeration loads, such as grocery and convenience stores, food service establishments and some retail (

Table 7). Refrigeration measure have the highest per premise savings of any bundle.

Table 7: Customer journey for refrigeration measures

Customer journey path	Measures
	• Refrigeration tune-up/maintenance, including clearing space around condensers • Display-case LEDs • Automatic door closers and LED bulbs in walk-ins
	• Anti-sweat heater control, EC motors, and night covers on cases • EC motors, evaporator fan control, and smart defrost in walk-ins • Head and suction pressure control on compressors
	• Add doors to refrigerated display cases • Add variable frequency drives to condenser fans

Plug loads

Plug loads in this context refer to all miscellaneous electric loads that are not for refrigeration, cooking, or servers. Plug loads were common in all building types in our study, though they were most prominent in office and retail buildings, as well as certain types of food service. Almost every small commercial building (all but three of them) that we visited had at least one computer. Computers use energy in a variety of ways including the PC operating both actively and in standby or sleep mode, the monitor's operation, as well as any other peripherals using energy. Televisions are increasingly common in commercial buildings. They are used not just as televisions but as computer monitors, conference room displays, or for streaming announcements. Where they are left on all day to provide information, they use a substantial amount of energy. Point-of-sale terminals, which functionally similar to computers, are found in any building where customers pay for goods or services. Most retail, grocery, and food service establishments had one to three point-of-sale terminals. They use nearly as much energy as computers, and have similar potential for savings through measures.

A previous CARD-funded study published in 2016 (Hackel, 2016) strictly focused on plug loads in Minnesota offices. This study looked at offices of all sizes, but data was normalized by workstation. The average workstation had 0.65 desktop PCs, 0.43 laptops, 1.3 monitors, 0.8 task lights, and 1.4 other plug loads. These inventories of workstation plug loads compare very closely to the computer, laptop, and monitor frequencies from the current study.

The *If it's plugged in, it's plug load* program bundle includes plug load measures that are often low cost; many have no upfront cost apart from the hand-holding that is sometimes needed to get an owner on board changing plug load settings (

Table 8). The program bundle has the largest impact in the office and retail segments. This is simply where the most devices are plugged in, and many of them are left on overnight. But all four business segments have plug loads, so some elements of the plug load bundle could be used in any holistic small business program.

Table 8: Customer journey for plug load measures

Customer journey path	Measures
DIRECT INSTALL	• Tier 2 advanced power strips and/or computer power management • Server power management and elevated server room temperatures • LED task lights • Behavior campaign for staff to remember to turn off key devices • Power management of all large devices
STANDARD PROGRAM	• Add exhaust to server closet
CAPITAL INVESTMENT	• High efficiency uninterruptible power supply (UPS) and power distribution unit (PDU)

Program recommendations

Just understanding opportunities, and bundling them together, does not guarantee a program will attract customers. Utility programs that understand the challenges and constraints of their small commercial customers can develop outreach and implementation approaches that overcome these barriers. We identified a number of such approaches through secondary research of nationwide best practices, and conversations with business owners in Minnesota.

Table 9: Recommended implementation strategies

Implementation strategy	Benefits
Vertically integrated program	Addresses varied and holistic nature of the measures. Allows the program administrator to be nimble and flexible in finding the appropriate trade allies from a variety of trades.
Needs-based marketing and outreach	Engages customers because the program targets issues that matter most. Customer needs identified by not only segment (e.g. occupant comfort for restaurants, profit margin for grocery) but also by specific end uses (e.g. those customers with high plug loads).

Implementation strategy	Benefits
Ally with trusted information channels (e.g. business associations)	Provides marketing through trusted networks. Follow-up allows for multiple points of entry into the program to address the ebbs and flows of the business cycle.
Easy financing options	Provide alternatives for financing high capital expenditures
Selling non-energy benefits (e.g. productivity, comfort)	More motivation beyond simply saving money, including thermal comfort, visual and acoustic comfort, indoor air quality, maintenance, and productivity
Customer journey to deeper savings	Have a planned process for a customer to move from low-cost direct-install measures to standard program offerings to more capital-intensive projects. Allows for the flexibility that is needed for small businesses.
Using residential marketing channels	Improved outreach connection to busy small business owners.

Conclusion

The small commercial sector in Minnesota offers considerable potential for energy savings. Our research focused on four business segments that comprise nearly 50% of the small business energy in the state. This paper presents results from characterizing four end uses to identify energy efficiency opportunities. While barriers to participation in energy efficiency programs exist, our research suggests that utility program designers can overcome challenges by pairing appropriate customer program approaches with bundles that target particular end uses or customer type. The customer approaches include strategies that address the unique challenges faced by small commercial business owners and leverage the opportunities identified through this research.

References

Hackel, S., C. Plum, M. Colburn, G. Marsicek, T. Rozenbergs, N. Kessler, R. Carter and L. Kieffaber. 2016. Impacts of Office Plug Load Reduction Strategies. Prepared for Minnesota Department of Commerce.

Jensen, Bjorn. 2016. High Efficiency Commercial Air-conditioning and Heat Pumps Initiative. Consortium for Energy Efficiency.

LeZaks, J., S. Hackel, S. Schuetter, K. Swartz, M. Lord, and A. Lick. 2018. Small Commercial Characterization. Minnesota Department of Commerce, Division of Energy Resources.

Schuetter, S., M. Hancock, A. Haynor, B. Schoenbauer, J. LeZaks, and M. Lord. 2017. Commercial Rooftop Units in Minnesota: Characteristics and Energy Performance. Minnesota Department of Commerce, Division of Energy Resources.

United States Census Bureau County Business Patterns. https://www.census.gov/programs-surveys/cbp.html . Last accessed March 2018. US Census Bureau, 2018.