MINNESOTA DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

Cost-effective Recommissioning of Restaurants

Conservation Applied Research & Development (CARD)
FINAL REPORT

Prepared for: Minnesota Department of Commerce, Division of Energy Resources

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COMM-03192012-CARD01 | October 2015

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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.

The authors would like to acknowledge the participating contractors, businesses and organizations that assisted with recruitment. This project would not have been possible without their open minds to try something new. The authors would also like to thank the following companies for contributing labor, equipment, and expertise to support the KE2 Evaporator Efficiency controller demonstration project: KE2 Therm Solutions, Inc. and Total Refrigeration.

DISCLAIMER

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Abstract

This research effort piloted a unique approach to delivering energy efficiency services to restaurants in the Minneapolis/Saint Paul metropolitan area. The pilot intended to utilize HVAC and refrigeration contractors to recruit customers, provide direct-install of measures and bid on recommissioning and preventative maintenance for refrigeration, heating and cooling equipment. Unfortunately, the intended program design did not perform well during the pilot. In response to challenges, the delivery model shifted to involve more delivery from the program engineers. The final report includes numerous lessoned learned with regard to working with contractors on an energy efficiency program – in particular, discussion of the pitfalls of contractor-led recruitment and suggestions for aligning energy efficiency program design with contractor business models. To bolster ideas for future program design, successful program models from around Minnesota and the country are discussed. Finally, the KE2 Evaporator Efficiency controller was field tested in two installations and results are shared in this report.

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Executive Summary

Based on previous CARD research, it is clear that restaurants present unique opportunities and challenges for energy efficiency programs. Capturing deeper savings in a cost effective manner from this sector requires new thinking and new programmatic approaches (Eureka Recycling, 2014). In an attempt to develop a program that would respond to those challenges, this study piloted a contractor-led direct install and recommissioning program for commercial kitchens. While some components were successful, the greater contribution is the continued conversation regarding obstacles encountered and potential solutions. These lessons learned as well as evidence from other programs models from Minnesota and around the U.S. are examined to determine ideas for best practices in program design for this sector.

Pilot Design

Recommissioning is the process of improving the performance of an existing building's equipment, through maintenance, repair, programming of controls, and/or the installation of controls. Recommissioning typically focused on opportunities available for improved central building control, enabled by a building automation system. In small businesses, like restaurants, there is no such central control. This pilot sought to address that gap, by adapting the recommissioning concept to include HVAC measures, such as fixing economizers controls, programming thermostats, cleaning filters and refrigeration measures like adjusting defrost time clocks, checking refrigeration charge, cleaning evaporators, and installation of strip curtains.

The pilot was designed to be delivered by licensed contractors. Utility programs serving small business frequently provide a very limited amount of technical consulting, but these businesses need a trusted source for information about energy efficiency. To address that gap, this pilot utilized HVAC, refrigeration and kitchen exhaust system contractors to implement the program. It was assumed that these contractors would have existing relationships with restaurant customers for preventative maintenance and on-going service. Adding an energy component would increase their value to the customer and provide the customer an on-going relationship with an energy expert.

Finally the program design created multiple opportunities for the contractor to work with the customer. The initial visit included some direct install items like LED lights and pre-rinse spray valves. The recommissioning work would happen subsequently. And finally, the contractor would be provided with reports tracking the customer's energy use every six months. The frequent communication was designed to put the contractor in the position to capture impromptu energy savings opportunities when a customer had a piece of equipment break or finally got a downtime and was ready to implement.

Supporting Research

To support this program design, additional research was conducted on small business programs with a direct install or contractor implemented component both in Minnesota and outside of Minnesota. For programs within Minnesota, interviews with the program managers were conducted to determine the successful components of the program. For programs outside

of the Minnesota research tools and public filings formed the basis of understanding the programs. Evidence from both programs helped to inform the recommendations of this study.

Smart Defrost Controller Field Test

During this study, two facilities installed a new technology, the KE2 Evaporator Efficiency controller. This gave the Project Team the opportunity to conduct field testing on the equipment to verify its energy savings potential. The measurement and verification (M&V) report stands alone as a product of this study. In short, the test data indicates that attractive energy efficiency opportunities exist for retrofitting existing walk-in freezers with this "smart defrost time clock" which only defrosts the walk-in unit as needed and also reduces evaporator fan and compressor runtime.

One of the installations of only the controller resulted in approximately 20% energy savings. Another more comprehensive installation that included a new evaporator with electronically commutated (EC) motors, LED lights, and an electronic expansion valve (EEV) reduced the energy consumption of the walk-in unit by nearly 50%. A fact sheet promoting the measure is available for use and included in Appendix A and the stand-alone M&V report is included in Appendix N.

Challenges Encountered

Implementation of the pilot encountered many challenges. Specifically challenges can be discussed during recruitment, direct install and recommissioning.

Recruitment

This project's pilot design rested on a key supposition. It was presumed that contractors would be able to recruit existing or prospective customers to work on energy efficiency with them. By recruiting their own customers, the contractor would be in the position of strengthening a trusted relationship. Services, implementation and follow-up would all happen naturally because of that relationship.

In reality, contractors were not successful at enrolling their current customers in this pilot. Selling a free pilot program required different business skills than responding to service calls. Recruiting customers involved work requiring administrative duties like collecting data release forms which didn't fit well with contractor field responsibilities. Demands of seasonal workloads delayed the project. And perhaps most significantly, contractors felt like they were already performing energy services for their customers, so they were concerned that offering new energy services would imply that their current energy services were inadequate.

To fix this recruitment challenge the Project Team stepped in and partnered with local utilities and business development organizations to find interested food service businesses. While successful at enrolling participants this approach compromised the key premise that the contractor would be a trusted entity for the business. In fact many of the businesses met the contractor for the first time as a result of this program.

Direct-Install

Only about half of the anticipated direct-install measures were appropriate for direct installation during an initial site visit. Adjusting controls, like programmable thermostats, economizer settings and defrost time-clock settings, did not make good direct installation measures. Liability concerns are the major reason, specifically because it's difficult to know the best setting for controls based on one visit and call-backs were considered too likely. Time consuming measures like insulating refrigeration suction lines or hot water lines were not done because of constraints to time and access.

Recommissioning

Recommissioning for a restaurant involves work performed on both HVAC and refrigeration systems. Unfortunately very few contracting firms specialize in both HVAC and refrigeration. As a result the work performed in a given restaurant was more likely to fall into only one of those two specialties. Recommissioning activities (preventative maintenance and other HVAC and refrigeration control retrofits) were initially subsidized at 50% of the cost. Only two businesses implemented at that incentive level. Later the incentive was increased to cover 100% of the costs and four additional businesses implemented.

Conclusions

Energy Savings Potential

Although this study draws from a small sample size, some of the finding can be used to illustrate the potential opportunity for this sector. Further substantiation of savings and potential is recommended.

Direct install activities saved an average of 5,700 kWh per year for the eighteen businesses that participated in this study. Further recommissioning activities saved an average of 17,500 kWh per year for the smaller subset of businesses that proceeded with those activities.

Some particularly good measures were identified. LED lights are extremely popular. Saloon style swinging plastic doors provide great energy savings for walk-in freezers without drawing the ire of restaurant staff the way that strip curtains do. Preventative maintenance is an important and under conducted measure for this sector.

Cost-Effectiveness

Ultimately whether a program is cost-effective comes down to one question. What are the competing options for producing kWh or saving kWh for the specific community? This study pulled data from eight small business programs across the country and found an average cost of $0.53 / first year kWh saved. This average price is certainly higher than most lighting programs and might be too high for a utility manager reading this study, so to add alternatives three other arbitrary price points were identified. The table below shows the budget for a direct-install program and a recommissioning program based on different requirements for cost-effectiveness.

Per Business Program Budget Tiers

	Expected kWh Savings	Budget/ business @ $0.15/kWh	Budget/ business @ $0.30/kWh	Budget/ business @ $0.53/kWh	Budget/ business @ $0.75
Direct-Install	5,700	$855	$1,710	$3,021	$4,275
Recommissioning	17,500	$2,625	$5,250	$9,275	$13,125

This project's research plan was tightly focused on determining whether a customer would implement a measure at a proposed rebate level and whether a contractor would provide the service at a proposed reimbursement level. The response to that was clear. The levels of incentives provided were not enough to drive 100% participation, either by the contractor or the business. As a result recommissioning savings were only available for three businesses and in general implementation was difficult to motivate.

Based on these cost per kWh saved program budgets, the pilot budget was well below any of these program cost tiers. Larger budgets would have helped motivate contractors and get more customers to move toward implementation of recommissioning projects.

A better research approach would have used grant funds to pay for all of the costs incurred by the business and contractor to implement measures. Then, recorded the costs incurred and used the implementation to record the savings achieved. Finally, in the analysis stage, a national benchmark for small business program costs could be used to determine whether the costs incurred could be justified based on the energy saved.

Partnering with Contractors

Utility programs considering the involvement of contractors need to understand the importance of finding the right fit with a contractor partner. Each contractor is a small business owner and each has a different way that they view their business model. Some are keenly tied to a fix-repair/replace model. Some prioritize selling preventative maintenance, while others only bill hourly and aren't interested in a preventative maintenance contract model. Some contractors are more motivated to evolve their business to include energy efficiency services.

Issuing an RFP to solicit proposals from interested contractors was a practice of some of the national programs reviewed and is recommended based on the experience of this pilot program. Offering a RFP would create a means for parties to express their interest in the program, while also providing a means for cost-efficiency and equity. Since the amounts paid to the participating contractors were determined by the Project Team, it was never clear whether contractors felt that they were being paid fairly, too little or too generously. A competitive process would also introduce better accountability to the work plan and hopefully motivate contractors to prioritize the work.

Other Programmatic Recommendations

A program exclusive to restaurants is not better than a more general small business energy efficiency program. Restaurants are the most energy intensive business type in the commercial

sector and thus have unique energy demands, but on the whole working with them is more similar to working with other small businesses than different. Many of the national programs reviewed served small businesses under a demand cap of either 100 kW or 200 kW. The vast majority of restaurants would fall under that cap. Thus a small business program could serve all business types and at the same time include some tailored measures to capture the unique opportunities present in food service.

Small utilities and those serving rural communities can especially appreciate the recommendation to provide an umbrella small business program rather than a restaurant specific program. In those service territories, the number of restaurants is few enough to not justify a targeted program. However, the motivation for serving the business type may be greater in those communities as a result of the limited industrial load and a higher percentage of small business customers.

The length of the interaction with the business is an important component of program design. A direct install program would be designed to be a one-touch interaction with a business. A more comprehensive program would seek to develop a long term relationship with the business and support deeper energy implementation over time. However, a program cannot do both at the same time, at the very least without some of the quality suffering. This was a mistake in the design of this pilot. A program for this market sector cannot efficiently capture direct-install savings while at the same time gathering energy data, producing audit reports, supporting implementation and developing long term relationships.

A fact sheet discussing the opportunities and strategies for approaching this sector, regardless of region or utility type, is included in Appendix B.

Final Thoughts

The energy use of the restaurant and small business sectors must be addressed in the coming years in order to meet energy efficiency and carbon reduction goals. There are undeniable barriers, but there is significant opportunity. Capturing that savings cost effectively will require clever approaches, good partnerships, and hard work. Definitions of cost effectiveness need to be fairly determined relative to other program success nation-wide and the imperative to work with small businesses.

Furthermore, additional engagement of HVAC and refrigeration contractors is necessary. At this point, contractors are still a prominent player in a small business' energy efficiency decision-making process, but their engagement in energy efficiency overall is not sufficient. Training, education, events, and easier paperwork are all important, but the market will ultimately motivate the contracting sector to support energy efficiency or not. Utilities should identify ways that their incentives and program structure can tie into the business plans of contractors and encourage them to make energy efficiency one of their value propositions.

Finally, program innovation is happening around the country and around Minnesota. These barriers for small business and contractors are recognized by utilities and implementers. Innovation, based on available community assets, is happening. Regulators should encourage utilities to think creatively and pilot programs as they assemble their conservation plans. This sector's challenges are not insurmountable, but neither should it assumed that a standardize approach will be the right solution.

Background

Past Research

A CARD Grant funded study awarded in 2009 and published in March 2014 served as the impetus for this study. The original study, conducted by Eureka Recycling in March 2014, included a broad survey of 70 food service businesses in Minneapolis and White Bear Lake, Minnesota[1]. The study population was predominantly comprised of restaurants, but also included a handful of small grocery stores and a few bars and coffee shops without food preparation. One of the unusual features of that study was the length– the small business participants received services and interaction for up to three years.

The research team conducted an energy audit of each participating business, identifying energy end uses and efficiency opportunities. After the audit, the team continued to collaborate with the business over the study period by tracking energy use, reporting progress, and supporting implementation of measures and behavioral changes.

The study's major findings were:

1) Minnesota restaurants had higher usage than existing Midwest benchmarks, most likely due to the colder climate.
2) On average, 15% savings were identified in no-cost/low-cost measures.
3) On average, 5% weather corrected savings were achieved by participating businesses.
4) Unique barriers exist in the food service industry that limit implementation.

Barriers and Opportunities in the Food Service Sector

The 2009 CARD study identified significant barriers to achieving energy efficiency in the food service sector, and stated that these barriers would need to be addressed, to the extent possible, in program design. The following barriers were identified:

- **Low prioritization**: Small business owners juggle many responsibilities and frequently do not have time to address energy usage. Energy use is viewed as a fixed cost and efficiency is not considered as significant as increasing sales or growing the business by other means.
- **Limited understanding of opportunities***:* Small businesses do not track energy use. They do not have an understanding of how much energy specific equipment uses or what opportunities present the most cost-effective means of reducing energy usage.
- **Lack of trusted relationships***:* This market sector is heavily solicited and, as a result, owners and managers are highly suspicious of offers (especially ones that seem too good

[1] Eureka Recycling. (2014, March). *Minnesota Department of Commerce.* Retrieved Dec 9, 2014, from Division of Energy Resources - CARD studies: Report available online: http://mn.gov/commerce/energy/images/B52738_Michaels_%202014_MN-Foodservice-EE_FINAL.pdf

to be true). Business owners do not have a source to turn to for energy efficiency information.

- **Poor maintenance, no planned replacement, and low first cost***:* Maintenance is frequently deferred on equipment, particularly out-of-sight equipment like water heaters and roof-top units. Replacement of equipment is delayed until the equipment breaks, at which point the replacement is urgent and energy efficiency is not considered. Since low first cost is important, used equipment is often purchased without consideration for its operating costs.
- **Contractors rarely sell energy efficiency to this sector***:* Contractors generally do not promote or stock energy efficient products over standard products, caused in part by this market sector's low first cost mentality, but also because of the extra time and skills required to complete energy efficiency calculations and rebate application paperwork.
- **Financing can be a barrier***:* Due to high business failure rates, paybacks of even two years can be difficult to manage. More established businesses did plan purchases, perform maintenance, and consider larger investments, but those successful businesses often self-financed or preferred existing banking relationships when low-interest financing options involved too much paperwork.

Specific energy efficiency opportunities regarding behavior change, preventative maintenance, retrofits and capital improvements were identified in the 2009 CARD study. In total, 30 opportunities were categorized with respect to the frequency they were identified in the field as an opportunity and the frequency that businesses implemented the measure, as well as the electric and gas savings. Table 1 has been compiled from data provided in four separate tables in the 2009 CARD study[2]. More specific analysis of each measure is available in the study to aid with program and rebate development (Eureka Recycling, 2014).

Table 1: 2009 CARD Study Measure Findings for a Typical Restaurant

Measure Category	Number of Measures Identified	Average Identification Percentage	Average Implementation Rate	Total kWh Savings	Total Therm Savings	Percent of Total Restaurant Energy Use
Behavior	5	69%	29%	5,120	1,780	12%
Preventative Maintenance	6	57%	34%	6,830	88	2%
Low-Cost Retrofits	10	69%	33%	11,150	440	5%
Capital Projects	9	66%	13%	52,820	6,120	N/A[3]

[2] See 2009 CARD study: tables 7, 8, 9 and 10 (pages 23-26)

[3] Only a portion of capital project measures would be found in any given restaurant, thus calculating a total percent savings is not practical.

Support for a Targeted Program

One deliverable of the 2009 CARD study was an energy use profile for an average Minnesota restaurant. That average, or profile restaurant, used 157,000 kWh of electricity and 11,161 therms of gas annually at a total cost of $19,074 (Eureka Recycling, 2014). Given the measures identified in the CARD study, annual energy savings of 8% would be conservative and realistically achievable in an efficiency program. That savings potential puts the energy savings at 12,560 kWh/year and 892 therms/year per restaurant, or an annual cost savings of $1,525[4].

Energy Savings Potential

Extrapolating this typical location to a state-wide scale provides an estimate of the potential impact of a restaurant energy efficiency program. Research on data from the North American Industry Classification System (NAICS) indicates that there are approximately 7,000 restaurants (full-service and limited service) in Minnesota, and another 2,000 cafeterias, cafes and bars, providing a total population of 9,000 food service businesses located in Minnesota[5]. Some of these businesses would have a smaller energy footprint than the profile restaurant developed in the 2009 CARD Study, so the conservative 8% annual savings is an appropriate floor for predicting the impact (considering that many businesses will have significantly more opportunity). That 8% estimate includes only maintenance and low-cost replacement opportunities, and does not consider capital equipment improvements. If 50% of those businesses participated in a program, the total savings would be 56,520 MWh/year and 401,400 dekatherms/year. That savings is equivalent to removing 12,685 cars from the road annually.[6] Of note, a significant portion of the overall savings is attributed to natural gas saving measures, a rarity among small facility types.

Guidance for Program Design

Regulators and utilities measure program viability by its cost effectiveness – how many kWh and/or therms are saved per dollar spent. An underserved market sector may have some leeway with this metric, but ultimately program costs must be justified. The 2009 CARD study did not determine how best to achieve cost-effectiveness, but did provide suggestions for program design.

Program design should not adhere to the current "audit / report" paradigm. Instead, the authors suggest relationship building with businesses through regular contact, utilizing direct–install of measures to eliminate nuisance barriers, and providing feedback to the business owner on their energy use over time. In addition, the authors did not determine who might best

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[4] 2009 CARD study, page 15 Table 3: Profile Restaurant Compared to CBECS Data

[5] NAICS Codes include: Full-Service Restaurants (722110), Limited Service Eating Places (722211), Cafeterias, buffets, and grill buffets (722212), Snack and Non-alcoholic beverage bars (722213), and Drinking Places (722410)

[6] EPA. (2014, April 16). *Greenhouse Gas Equivalency Calculator*. Retrieved December 9, 2014, from Environmental Projection Agency: http://www.epa.gov/cleanenergy/energy-resources/calculator.html

deliver such a program, but did suggest contractors or business development organizations as two possible entities (Eureka Recycling, 2014).

Methodology

Research Goal

In response to the barriers and opportunities identified in previous research, the current study pursues questions in two research areas:

1) Can mechanical contractors effectively deliver an energy efficiency program to restaurants? Does a contractor-led program mitigate barriers in this sector?
2) Would a restaurant energy efficiency program need a different model in Greater Minnesota than a contractor led program? What unanticipated barriers exist in other communities?

Mechanical contractors were thought be the perfect delivery partner for a restaurant energy efficiency program because they: 1) already have relationships with businesses for service and repair work; 2) are knowledgeable about energy usage and trusted by the customer; 3) are qualified to install all the needed low-cost upgrades; and 4) could receive added revenue as a result of this effort due to new preventative maintenance contracts and capital equipment upgrades.

Challenges were anticipated with a contractor-led program. Most restaurant owners surveyed in the initial CARD study showed unfamiliarity with energy opportunities as well as loans, tax credits, and rebates. Contractors would need to be knowledgeable about each of those offerings for this program to work, but may not be interested in assisting with these processes or obtaining rebates. Additionally, restaurant energy use crosses into many trade areas, and contractors generally specialize. That gap in services could present problems.

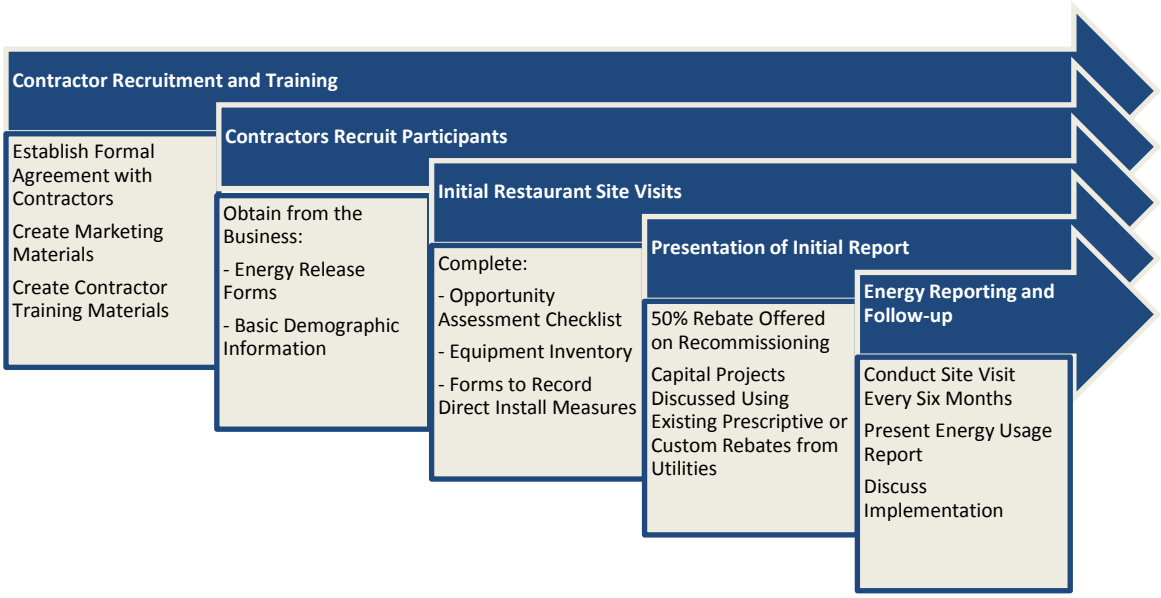
The second research focus area sought to determine what shape this pilot, if successful, would need to take to be effective in other parts of Minnesota. Conducting a pilot in a dense, urban area made sense, but easy replication of that program to other communities would not be guaranteed. Greater Minnesota communities have a different business landscape, contractor population, and utilities serving them. What would a successful program look like if it were to reach the restaurant population in greater Minnesota?

Initial Pilot Design

Pilot Demonstration Overview

The overall design of the Twin City based program demonstration and testing is shown in Figure 1 and included five phases: 1) contractor recruitment and training; 2) contractor-led recruitment of participants; 3) initial restaurant site visits; 4) presentation of initial findings; and 5) follow-up. The proposed schedule for this work was 18 months.

Figure 1: Overall Program Design for Restaurant Recommissioning



Contractor Role

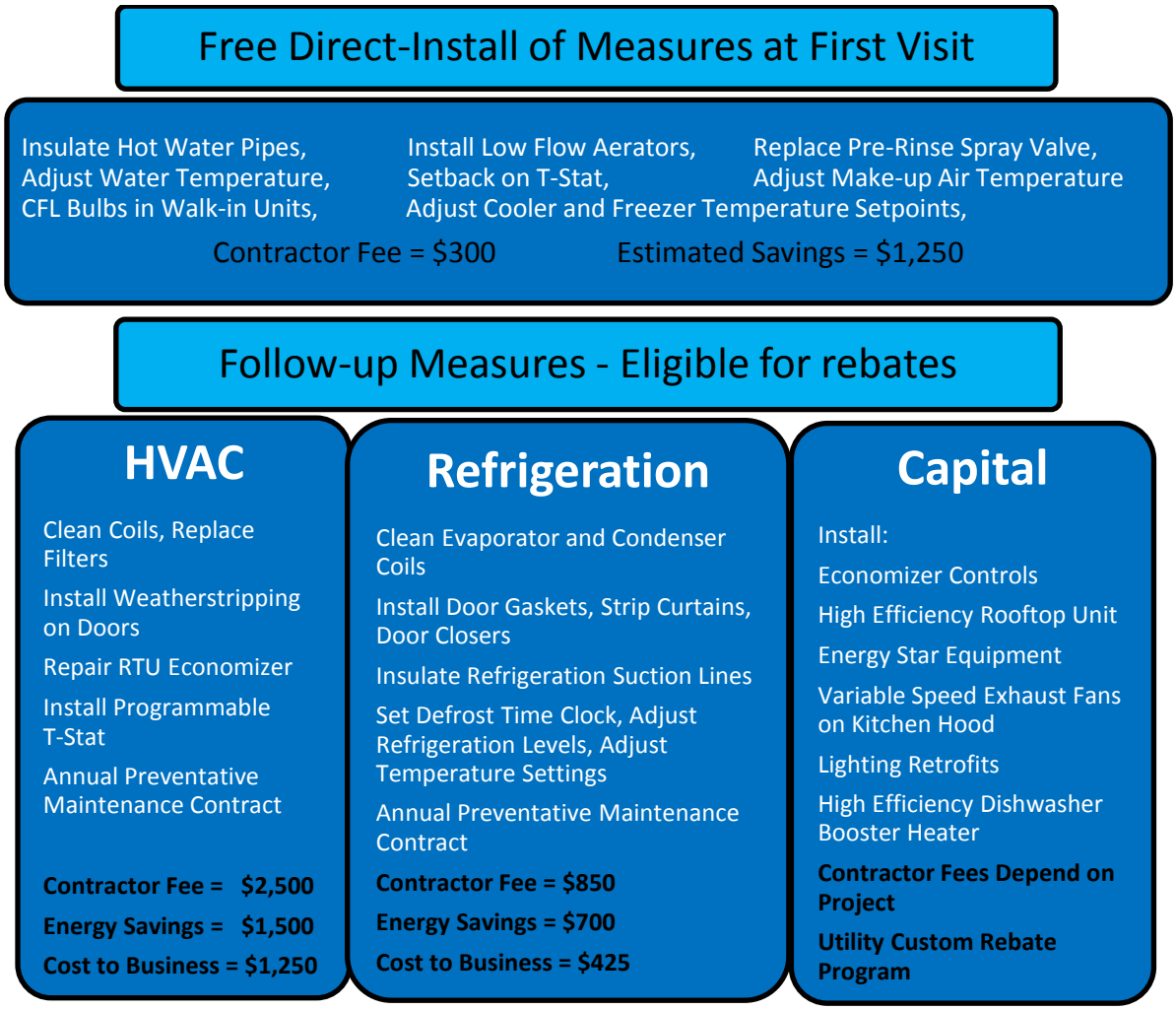
Each contractor attended a half-day in-person training session. Afterwards, the contractors were each asked to recruit 4-5 business participants for the program. The contractor was offered a $100 incentive for each restaurant recruited into the program. Recruitment was considered complete when basic demographic information was collected and signatures were obtained on energy release forms for the utility. A copy of the demographic data form is included in Appendix C.

The next step was the contractor-led site visits. These were free to the business and included direct installation of measures, identification of opportunities for refrigeration and HVAC recommissioning, and identification of capital measures.

Once the initial site visit was complete, the contractor was expected to generate proposals for the HVAC, refrigeration and capital measures identified. These proposals were to be presented by the contractor to the owners in a face-to-face meeting where the costs and benefits would be discussed. Grant funds were provided to support the implementation costs of HVAC and refrigeration recommissioning, while existing utility programs were expected to support the costs of capital projects with rebates.

In the final phase of the demonstration, the contractor would visit the business once every six months to follow-up on energy use and discuss opportunities. The opportunities expected in this program are detailed in Figure 2.

Figure 2: Site Visit Process



Project Team Role

The contractors' work in this pilot was supported by the Michaels Energy Project Team. The Project Team was responsible for contractor recruitment and training. Contractors known to work in the restaurant sector were invited to participate. Their participation required that they sign a contract, which outlined specific responsibilities and payment for tasks, and a Memorandum of Understanding, which expressed the shared sentiment behind this research.

The Project Team organized a half-day classroom training session for participating contractors to provide background information, recruitment materials, audit materials, examples of reports, and information on rebates and loans. Marketing brochures were provided for the contractors' use.

The Project Team's roles in the initial site visit were to support energy data collection and analysis, produce a report with recommendations based on the information gathered by the contractor, and help secure funding and rebates for capital improvement projects. An engineer

from the Project Team would attend the first site visit with each contractor for training purposes, but subsequent site visits were planned to be conducted solely by the contractor.

The Project Team led data collection and program evaluation during the research period. The quantitative data collected for this project consisted of baseline energy data and identification of opportunities for each restaurant. This included obtaining gas and electric usage from the utility, identifying opportunities at the site, calculating estimated savings, and obtaining costs for recommissioning or capital work. The energy use of the site would be tracked periodically throughout the grant period to determine if savings were achieved. Qualitative data was collected as well, primarily regarding the contractors' experience with the proposed program.

Alterations to Pilot Design

The work plan and budget were adjusted approximately six months into the project. The changes were fundamental to how the project would proceed. First, contractors would no longer be responsible for participant recruitment. Second, the contractors would now conduct all site visits and follow-up work with a member of the Project Team. The focus of the follow-up work shifted toward getting business to stay engaged with the contractors and implement measures. This required increasing the level of financial support for all the measures.

Based on the results obtained during the first six months, the grant period was also extended an additional six months to complete the follow-up activities with businesses and allow time for the work in Greater Minnesota. During this next phase, the list of measures was clarified regarding cost and appropriate rebate levels. Promising new capital measures would be evaluated in field installations. Work was done to explore how to recruit businesses and identify opportunities in Greater Minnesota through discussions with utilities, cities and Community Development Corporations (CDCs) in the state.

Participant Recruitment

Restaurant recruitment did not proceed as anticipated. The initial intent of the grant was to have contractors refer this program to their existing clients as a value added service.

After three months of poor results from contractor-led recruitment, the Project Team assembled a revised recruitment plan. The revised plan allowed contractors to proceed with recruitment efforts, but also supplemented that work with outreach to business, trade and community organizations, as well as to utilities to identify potential program participants. This model of recruitment via third party organizations was also the most successful recruitment model used during previous CARD funded research (Eureka Recycling, 2014).

The recruitment incentive was increased from $100 to $250 per restaurant recruited. This incentive would be provided to any third party organizations that brought in restaurants, as well as the contractors. Participation was opened up to include institutional facilities like schools or nursing homes. This broader population was thought to better reflect the population a utility food service program would serve.

Site Visit Coordination

The initial assumption was that a contractor would do one site visit with an engineer from the Project Team and would then independently complete site visits. The initial field training was mainly intended to familiarize the contractor with the forms to document the direct-install measures and data needed for estimating the HVAC, refrigeration or capital projects. If the contractor was already working with the business, they would be familiar with the facility and the business owner. With the recruitment plan changes, the contractor did not have an existing relationship with the business, a third party was involved in recruitment, and there was a lack of continuity in coordination with the business owner. The project staff took on the responsibility of relationship management, scheduling and coordinating all the site visits, and obtaining energy release forms and demographic data. The contractor shifted to the role of implementation expert, providing estimates on the work needed.

Presentation of Findings

The next step after the initial site visit was the presentation of findings. The project staff, as the primary contact for the business, presented the report to the business owner. The contractor was asked to be involved so that they could share information about their pricing on HVAC, refrigeration or capital projects.

Getting estimates from contractors after the initial site visit was difficult. Preparing quotes takes time, which wasn't supported with grant funds, and there wasn't always a sense that the businesses were really interested in the work. The work scope had to be well defined to protect the contractor for unforeseen issues that could arise and the business owner had to understand what was covered.

Pricing for these projects was not always attractive to the business owners, so rebate levels were increased to make projects more attractive. The Project Team came up with a budget of approximately $2,500 for each business to support proposed activities. The Project Team asked for bids from additional contractors if a needed service was not performed by the contractor involved (for instance, an HVAC contractor would not repair refrigeration units).

Follow-up and Tracking of Energy Savings

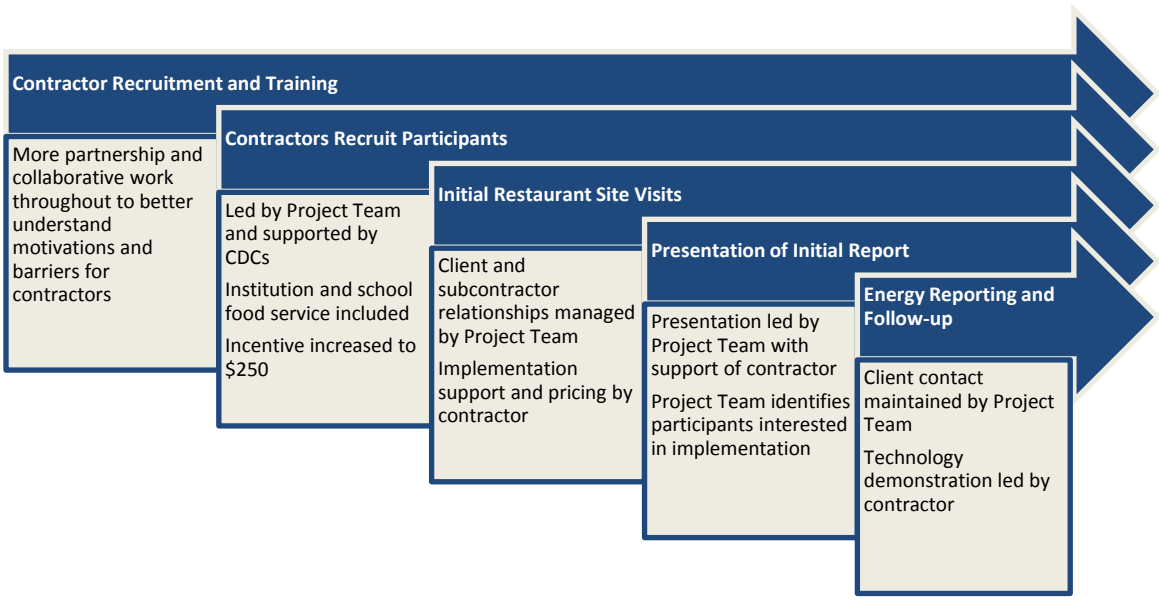
Energy reporting and regular follow-up meetings were intended to provide the contractors an opportunity to discuss additional projects with the business owners and capture more projects. The Project Team intended to provide energy use reports and support any utility rebate applications needed. The Project Team took over the task of conducting follow-up meetings as a part of managing the relationship with the customer.

The initial design was overly optimistic, assuming that all 20 restaurants would stay engaged. A more realistic assumption would have been that 5-10 business would likely take action and stay engaged. The grant funds, along with utility rebates, were used to motivate business owners to implement both the smaller projects and larger capital projects.

Final Pilot Design

The revised pilot design is shown in Figure 3. Revisions sought to address the challenges identified with the original design and described in the previous section. In the final pilot design, contractors did not lead as many activities, but did stay engaged in all phases. Recruitment was organized by project staff and outside groups who were enlisted to enroll participants based on existing relationships they had with small businesses. The site visit and presentation of findings was led by project staff, with the goal of finding businesses interested in taking additional steps toward implementation. Willing businesses received implementation support from the participating contractor best suited to deliver the needed service (with a preference for the contractor who attended the audit). Finally, one promising technology would be evaluated in detail. All of these activities were geared toward getting as much contractor involvement with these businesses as possible.

Figure 3: Revised Program Design for Restaurant Recommissioning



Technology Field Testing Design and Data Collection

Contractors and vendors provided lots of ideas for new technologies that might benefit the food service sector. The technologies included the KE2 Evaporator Efficiency controller (KE2), smart thermostats for better control of rooftop units, and energy management systems for monitoring and addressing high energy use equipment. One of the participating contractors hosted a KE2 demonstration at its office generating strong interest in the technology by one of the schools participating in the grant. This led to a demonstration of this technology at that site and one other business.

The KE2 could be called a "smart defroster" because it does more than just control the evaporator defrost heater. A defrost heater reduces the icing that forms on the evaporator coil in

walk-in freezer units, typically set to defrost for 15 to 30 minutes four times per 24 hours by a traditional time clock, regardless of the need for defrost. The KE2 controller reduces the defrost heater run time by detecting when the defrost heaters are needed. It reduces the run time of the evaporator fans and captures cooling energy in the evaporator that is normally wasted. Finally, the controller also replaces the traditional thermostat control and defrost termination device to better control space temperature.

This demonstration was intended to answer the following three questions:

1) What is the energy savings potential of the measure?
2) What is the typical cost to install and what is an appropriate rebate level?
3) What are the non-energy benefits?

The KE2 website provides a calculator that estimates energy savings[7] of this measure. This is based on initially estimating the annual energy usage based on the walk-in design and assumptions on operating conditions. A conservative savings estimate of 15% is applied to the estimated annual usage to predict annual savings. Actual savings depends on the condition of the equipment being retrofitted and actual operating conditions.

The first test was conducted on the walk-in freezer in a college cafeteria kitchen, which is similar to a walk-in freezer in a restaurant kitchen. The work included caulking seams to prevent air infiltration, installing LED lights and replacing the evaporator. The new evaporator has electronically commutated (EC) motors and an electronic expansion valve (EEV). The condensers for this unit are located indoors. Data loggers were installed to measure compressor energy consumption, defrost heater and evaporator fan energy consumption, and evaporator coil temperature. These parameters were logged for 15 days to establish baseline conditions. The retrofit work was then completed and the same parameters were logged for 12 days after the retrofit. The outdoor temperature and relative humidity were obtained through a commercial weather service[8]

The second test was conducted on a typical convenience store walk-in freezer. This unit has reach-in glass doors and since the store is open 24 hours per day, the doors are opened more frequently than a kitchen unit. The condensers are located outdoors. Data loggers were installed to measure compressor and condenser energy consumption, defrost heater and evaporator fan energy consumption, evaporator coil temperature and space temperature. The outdoor temperature and relative humidity were measured at the condenser. The baseline condition was monitored for 7 days. Then the KE2 was installed and the same parameters were measured for seven days.

Non-energy benefits of the KE2 may include improved food quality, less ice buildup, more stable freezer temperatures and remote monitoring capability. The remote monitoring feature alerts the customer through email notifications of minor problems with the refrigeration system before they become major issues. Food quality and ice buildup were measured through photos and feedback from site contacts, cooler temperature stability was monitored with data loggers,

[7] Per KE2 Energy Savings Calculator on company website (http://ke2therm.com/roi-evap-efficiency/)

[8] Weather Underground http://www.wunderground.com/

and the value of the remote monitoring capability was assessed using feedback from site contacts.

Program Replicability Research

This project placed a priority on understanding how this pilot could be replicated in Greater Minnesota. It was assumed that a pilot program tested only in Investor Owned Utility territory in an urban context would not be quickly adopted by other utilities and communities around the state. To improve the pilot's relevance, recommendations would be made for altering the pilot project based on a series of focus group discussions in communities across Minnesota. These results would then be incorporated into a one-page fact sheet for utilities, outlining the recommissioning program for restaurants.

The original research design specified that selection of the study regions would be done with consultation from the Clean Energy Resource Teams (CERTs). These regions would be representative communities in Minnesota, including some diversity of geography, utility type serving the region, and population. The Project Team would arrange focus groups, small group meetings, and one-on-one conversations. Local businesses, utility staff, contractors, and community organizations would be given results from the pilot effort and participate in a facilitated discussion about engaging small businesses in their communities in energy efficiency. Their comments, reactions and suggestions would be recorded to document recommendations for improvements to the program.

As planning conversations and the pilot research progressed, it became clear that this approach was flawed for at least two reasons. First, the pilot program encountered many setbacks and underwent adjustments and, as is, this pilot was not worthy of dissemination. Secondly, it was impractical to arrange focus group meetings with so many people for a discussion about a topic not originating from their own community.

Instead, the research design was amended to provide value to this research and still maintain its intent of determining the community assets, experience, and momentum that would help create successful small business programing in Greater Minnesota.

Revised Research Design

The amended research design includes two parts: 1) local outreach to understand existing work on small business energy efficiency in Minnesota, and 2) research to better understand what successful programs are being implemented elsewhere in the country.

In Minnesota, the Clean Energy Resource Teams helped to identify 3-5 communities that had attempted to work with the small business sector on energy efficiency. In each of those communities, a phone interview was conducted with the key utility or community contact. Additional phone interviews with other community members were completed if necessary. A matrix of results from the interviews was compiled and, in particular, attention was paid to understanding who the best program implementers might be (specifically, whether contractors would be suitable or whether another party made the most sense).

Beyond Minnesota, additional research was conducted to identify intriguing or particularly successful programs. E Source's Demand Side Management Insights (DSMi) was utilized to

review existing utility programs. Additionally, programs or pilots that were not utility sponsored were included if they were identified to have potentially meaningful results or a compelling design.

Results and Discussion

Results from Pilot

Contractor Recruitment and Training

Contractor selection was limited to contractors that were bonded and met state requirements to install gas piping, heating, ventilation, cooling, air conditioning, fuel burning or refrigeration equipment. Such a limitation was helpful to establish a minimum level of competency and understanding of liability for the contractors' work. There are approximately 2,600 of these contractors in Minnesota and over 400 are located in the Twin Cities area[9]. From this list, 15 contractors were contacted to discuss the program and recruit as participants. These 15 businesses were contacted because of their existing work with small businesses (in particular restaurants) or because they had expressed interest to the Project Team regarding this research.

Limiting participation to licensed mechanical contractors excluded some companies that frequently work with the restaurant sector and could have provided some of the needed services, such as companies providing preventative maintenance or appliance repair services, equipment distributors, and lighting contractors. While most contractors were hesitant to participate, three of the 15 contractors agreed to try the program and attend a training session.

A memorandum of understanding (MOU) and a signed contract were expected of contractors who wished to participate in this project. The MOU became a secondary concern as the contract became more detailed and robust. Having a contract was important because it clearly defined boundaries for payment, liability of work, and code compliance. Executing the contract took much more time than expected. Copies of the MOU and contract are included in Appendix D and Appendix E.

A single training day was organized with all three contractors in attendance. Coordinating half-day training was difficult, but the Project Team made it a priority so that the project could launch with collective enthusiasm. Training materials were prepared including program binders, a marketing brochure and a PowerPoint presentation that had all the necessary information and tools for contractors to get started. The contractors generally used the materials during the initial site visits, but transitioned to using their own equipment data forms as the audits progressed. A copy of the contractor training binder table of contents is included in Appendix F.

After the training, contractors were expected to buy material, including LED lamps, pre-rinse spray valves and faucet aerators, to install during their site visits. It was not anticipated, but the Project Team had to make a shopping list of materials describing what and where to buy equipment. Despite detailed description in the contract regarding pricing for measures, the Project Team had to spend additional time coordinating the process. In addition, the Project

[9] The State of Minnesota Department of Labor and Industry maintains a database on licensed and bonded contractors. (https://secure.doli.state.mn.us/lookup/licensing.aspx)

Team purchased some materials to have on hand because not all contractors provided their own.

Discussion of Contractor Recruitment and Training

Ultimately, contractor recruitment succeeded because three contractors joined the pilot. However, efforts to recruit contractors took significantly longer than anticipated and encountered more issues than anticipated given that two contractors provided letters of support for the grant proposal and were expected to participate.

The project's contractor contract itself proved a barrier. One of the contractors that initially provided a letter of support declined to participate, in part because he determined the lengthy contract and the nature of an unproven demonstration program to not be worth the effort. Other concerns arose around liability and subcontracting work.

The training felt successful on the day-of, but subsequently proved to be insufficient to motivate contractor involvement.

Participant Recruitment

It was hoped that contractors would come to the classroom training with their first business already recruited; however, none of the contractors had recruited a participant at the time of the classroom training. The unexpectedly lengthy contract negotiation process contributed to the delay, but in general, contractors faced challenges enrolling participants.

After three months of unsuccessful contractor-led recruitment, other avenues for enrolling participants were explored. The recruitment incentive was increased from $100 per restaurant to $250. CDCs, utilities and other local partners were invited to identify businesses. The recruitment pool was also expanded to include institutional food service. These changes did result in identification of the necessary number of participants.

Overall, 21 facilities were recruited into the program, but only 18 completed the initial site assessment. The group included 15 restaurants and 3 schools (a junior high, a high school and a university). The restaurant participants spanned from relatively large independently owned restaurants to chain restaurants to very small restaurants. Two of the participating restaurants were just opening or in the construction phase. Data from previous CARD grant funded work provided reliable benchmarking data to help estimate energy and water use for those sites without a pre-project baseline. A detailed list of key information on the participating sites is included in Appendix G.

Table 2 summarizes how many participants each type of organization recruited. The CDCs included Neighborhood Development Center, Lake Street Business Association and the Latino Economic Development Center. The utility organization was Dakota Electric. The "other" organizations are the Minnesota Technical Assistance Program (MnTAP) and the Clean Energy Resource Teams (CERTs).

Table 2: Participant Recruitment

Organization Type	Participants Recruited
CDC	10
Utility	4
Contractor	2
Other	2
Total	**18**

CDCs are nonprofit, community-based organizations focused on revitalizing the areas in which they are located: typically low-income, underserved neighborhoods that have experienced significant disinvestment.[10] One of the CDC's, The Neighborhood Development Center, worked with Michaels Energy under a separate but concurrent grant to better understand energy efficiency opportunities in businesses alone the University Avenue corridor.[11] One of the significant activities of that project was a training provided to the NDC account managers to help them identify the opportunities in the businesses and understand the barriers that prevent implementation.

Discussion of Participant Recruitment

There were multiple reasons for the problems with the contractor-led recruitment. The initial assumption that contractors could enroll their own customers was unrealistic. Contractors were concerned their existing customers might wonder why their current preventative maintenance work wasn't making them energy efficient, as they had been told. The commercial nature of their relationship with their customers made offing a free program feel unusual to both parties. Their customers suspected strings were attached. Contractors asked for more help explaining the program and selling the customer on the benefits of the program. While one contractor actually had a person in a sales role doing the recruitment, he was at a disadvantage because their company had not worked in the restaurant sector, so their calls were always cold calls. Previous research demonstrated that cold calling businesses was ineffective, so it was not the project's intent to have contractors conducting cold calls during this pilot.

Recruitment took time and persistence. Getting signed release forms required multiple follow-up calls and visits. Two of the contractors were maintenance focused and had a "Break/Fix" business model. When they hit their busy season (really hot or cold weather), they had no time to discuss the program with their customers. The $100 recruitment bonus was definitely not sufficient to motivate the contractors, but it is not clear whether the increased $250 bonus did a better job. Even with a contract and a MOU, there was a limited sense of accountability regarding recruitment.

[10] Definition of CDC (www.Community-Wealth.org)

[11] NDC Energy and Resource Demonstration Project as described on this page. (http://www.ndc-mn.org/news/201306/energy-efficiency-pilot-project)

Partnerships with CDCs proved successful. CDCs were motivated to use this program because their clients have little knowledge of energy efficiency opportunities or utility rebate programs. CDCs have an existing relationship with the businesses and can often also offer advice on the financing needed for capital investments.

Likewise, Dakota Electric proved very adept at identifying customers to participate in the program. The utility appreciated the support of a free energy audit for its customers, and Dakota Electric has very pro-active account managers with good existing relationships, even with smaller customers.

Initial Site Visits

This project started out with three contractors conducting the site visits. One of these contractors dropped out of the project so two contractors completed the bulk of the visits. The contractor that dropped out declined an exit interview, but expressed that he didn't have the time to support the project. Assumedly, he did not see the potential for additional work resulting from his participation. One restaurant already had their own contractor they wished to continue working with, so this contractor took part in that initial site visit.

The site visit was coordinated by the Project Team. The contractors were flexible with their schedules and available for the site visit once it was set up. The audits were a team activity with the Project Team leading the discussion, and the contractor gathering data and inspecting the equipment on which they were planning to bid an improvement or repair. The contractor was paid $300 for completing the site visit and reimbursed for materials they provided. Even though specific data collection forms were created for the project, the contractors used their own forms to collect data.

Unlike the broad scope intended to be covered by the contractor, each contractor was focused exclusively on equipment and systems they currently sell. That included their preferred method or business model for selling it. For example, the HVAC contractor prepared preventative maintenance contracts and proposals for replacement HVAC equipment, but was unable to complete common refrigeration tasks such as install strip curtains or EC motors. The refrigeration contractor provided bids for preventative maintenance for both HVAC and refrigeration work, but did not believe in bidding on a fixed fee basis and only bid on an hourly basis.

Direct-Install Opportunities

Table 3 provides a summary of results for the initial site visits and direct install measures. At the start of the grant there was a list of eight potential direct-install measures that would save a typical business about $1,250 per year. It was estimated that at least 80% of these measures would be addressed during the initial visit, resulting in $1,000 of savings. In practice, approximately 50% of potential direct-install opportunities were identified during the initial site visits and only 25% were addressed through directly installed measures. A detailed summary of the opportunities identified in the participating sites is included in Appendix H.

Table 3: Direct-Install Summary

Measure Description	Identified Opportunity	Direct Installs
Low Flow Faucet Aerators	94%	61%
Low Flow Pre-Rinse Spray Valves	61%	50%
Install LED Lights in Walk-in Units	61%	61%
Insulate Hot Water Lines	44%	0%
Set Back Hot Water Heater Temp	33%	6%
Insulate Refrigeration Suction Lines	17%	0%
Set Back Programmable T-stats	39%	6%
Set Back Make-up Air T-stat to 55F	33%	17%
Average	**48%**	**25%**

Recommissioning and Capital Opportunities

Table 4 provides a summary of the follow-up opportunities identified during the initial site visit or follow-up visits. Based on previous research, it was expected that 57% of these opportunities would be identified in a given business and 25% would lead to contractor work during the grant period. Similar to predictions, 43% of these opportunities were identified during site visits, but only 4% were installed in the grant period. Of the ones that were installed, they were heavily subsidized with grant funds.

Table 4: Recommissioning and Capital Measures

Measure Description	Expected Opportunity	Identified Opportunity	Expected Recomm. Project	Follow-up Install
HVAC				
Install Programmable Thermostats	46%	39%	23%	22%
Clean Evaporator and/or Condenser Coils	74%	39%	25%	0%
Install Weatherstripping on Exterior Doors	56%	22%	30%	0%
Place Appliances Completely Under Hood, Install Side Panels, and Rebalance Ventilation Hood	66%	0%	30%	0%
Maintain Economizers on AC Units	46%	28%	21%	0%
HVAC Preventative Maintenance Contract	49%	67%	23%	0%
Refrigeration				
Adjust Walk-in Defrost Time Clocks and Set Properly, Check for Icing Inside Unit or Drain Line Problems and Take Corrective Actions	26%	22%	10%	0%
Clean Evaporator and/or Condenser Coils	74%	56%	25%	0%
Replace/Repair Damaged Doors, Align and Ensure they Close Properly	46%	22%	50%	11%

Measure Description	Expected Opportunity	Identified Opportunity	Expected Recomm. Project	Follow-up Install
Install Strip Curtains and/or Door Closers on Walk-in Units	75%	83%	25%	22%
Refrigeration Preventative Maintenance Contract	72%	72%	28%	0%
Capital				
Install EMS on Kitchen Exhaust and Make-up Air Unit	84%	67%	25%	0%
Retrofit Walk-in Evaporator Fans with EC Motors	67%	83%	26%	0%
Controls Upgrades for Walk-in Units	New	72%	New	6%
Lighting Assessment	62%	61%	26%	6%
Purchase More Efficient Dishwasher	36%	6%	25%	0%
Install Condensing Water Heater	50%	0%	26%	0%
Purchase ENERGY STAR RTU or Boiler	46%	33%	10%	6%
Average	**57%**	**43%**	**25%**	**4%**

It was challenging to determine the level of incentive necessary get business owner to implement recommended recommissioning measures while also providing a good rate of return for the program. Some measures, such as EC motor retrofits, were covered by existing utility prescriptive programs. Measures that were not covered by prescriptive programs were provided an incentive from grant funds based on a typical custom rebate levels of $0.05 per kWh or $0.40 per therm saved.

Table 4 shows the average grant funded rebate proposed for the first 10 restaurants versus the second eight restaurants and schools. The first 10 restaurants were provided incentives based on existing prescriptive programs or a calculated incentive based on typical custom programs. This resulted in a 33% funding level and was definitely not adequate to drive implementation of measures.

Table 5: Average Recommissioning Savings, Costs, and Grant Funding

Recommissioning	Energy Savings Identified	Overall Estimated Costs	Funding Provided	Funding % of Cost
First 10 Restaurants	$710	$1,800	$600	33%
Second 8 Restaurants and Schools	$1,700	$2,100	$1,000	48%
Initial Estimate	**$2,000**	**$3,400**	**$1,700**	**50%**

Once it appeared that businesses were not responding to the proposed rebates, the strategy was altered. The percent of funding was increased from 33% to 48%. This level was essentially the budget level initially estimated. It was hoped that increasing the incentive rate from 33% to almost 50% would get more businesses to participate in the program.

Of the 18 restaurants visited, only eight were offered a formal preventative maintenance contract. Initially, these eight restaurants were offered the recommended schedule of quarterly visits. When there was not a positive response to this pricing, the schedule was reduced to semiannual visits. With this mix of schedules, the average price of a preventative maintenance contract offered to these businesses was $1,800.

Presentation of Findings

Of the 18 restaurants that participated in the initial site visit, 15 agreed to a face-to-face discussion of their energy usage and potential follow-up actions. One of the three that declined the meeting participated in a conference call to discuss the findings, and two were sent the reports via email with no further discussion. The format of the audit report also evolved over the course of the project. Initially there was an attempt to automate the report production and have it be table based. An example of one of the first reports is included in Appendix I. While the table-based report was relatively easy to create, it was missing some helpful reference information and persuasive language to motivate the owner. An example of the final version of audit report is included in Appendix J. Individual audit reports took about eight hours to complete once utility data was obtained and any cost estimates provided by the program subcontractor were incorporated.

Discussion of Initial Site Visit

Contractors and businesses alike responded to some direct-install measures more positively than others. Free LED lights installed in walk-in units were very popular with businesses. They reduced energy use, but also improved lighting in the space. Control adjustments like adjusting water heater setpoints or thermostat settings were met with skepticism from businesses because of comfort or health inspection concerns. Likewise, measures that were time consuming, dirty, and inaccessible (like insulating water heater pipes or refrigeration suction lines) were ones that contractors hesitated to perform.

Sometimes measures could not be properly evaluated during the initial visit. Things can be missed because of time constraints and demands of balancing completing a checklist with conversing with the client. Sometimes the equipment was located on a roof or other area that was not easily accessible. Some measures, like installing side panels and rebalancing the ventilation hood, were just not something these contractors were interested in pursuing. The contractor who focused on kitchen exhaust systems dropped out of the program, which limited options for that retrofit. Finally, some opportunities were intended to be evaluated more closely during the follow-up visits. Since it was difficult to maintain engagement with these businesses, these follow-up opportunities were not addressed.

The best opportunities for HVAC systems were programmable thermostats, preventative maintenance contracts, and EMS for the kitchen exhaust hood. For refrigeration, the best opportunities were strip curtains for the walk-in units, EC motors on the walk-in units, and preventative maintenance contracts. Strip curtains, a common opportunity now required by code on any new installations, were met with resistance by businesses because they make it difficult to enter the walk-in unit.

Lighting retrofits were not a focus of the initial site visits. Data on lighting retrofit opportunities was not collected for any sites in Xcel Energy territory, because those customers were referred to Xcel Energy's One Stop Lighting Program for small businesses. However, in Dakota Electric territory, if the restaurant was interested, a lighting contractor was brought in to help identify opportunities.

Overall, the total dollar savings identified in the field closely matched the expected result based on past research. Table 6 provides a comparison of findings. Institutional food service, and in particular schools, is separated into its own column.

Table 6: Summary of Initial Visit Findings

	Expected	Restaurants	Schools*
Size, Square Feet	5,800	6,200	397,265
Annual Electric Use	190,000	273,000	2,401,000
Peak Demand, kW	Not Available	80	1,000
Gas Use, Therms	13,000	17,000	166,000
Energy Cost	$ 30,000	$ 41,000	$ 300,800
Savings from Direct-Install	$ 1,000	$ 500	$ 220
Total Energy Savings Identified, $	$ 4,800	$ 4,900	$ 4,300
Energy Savings Identified, %	16%	13%	2%

*Size, Annual Energy Use and Annual Energy Cost Only From K-12 Schools

The direct install program savings was less than expected and was even less effective for schools. The overall savings identified from a food-service focused audit for schools is dwarfed by their large overall usage.

Follow-up and Implementation

Periodic Progress Reports

Approximately six months after the audits were complete the energy data for each business was reanalyzed to see if energy use had gone down. This was done to measure the effectiveness of the initial site visit. The data was adjusted for weather, but not for sales. An example of a periodic progress report is included in Appendix K. Of the original 18 sites that completed the initial site visit, 13 sites had data that could be evaluated. The five sites that could not be evaluated included the three schools, one business yet to open and still under construction, and one closed business. Of these 13 restaurants, five businesses agreed discuss their updated energy usage reports and potential next steps. Table 7 provides the average actual savings from the periodic progress reports for the 13 of the restaurants evaluated. The table also provides the predicted savings anticipated for this direct-install portion of this pilot. A table summarizing all the data associated with the follow-up activities is included in Appendix L.

Table 7: Energy Savings Summary from Periodic Progress Reports

	kWh	Elec, $	Therm	Gas, $	Total Energy Saved, $	Cars Off the Road	%Energy Saved
Average Actual Savings	5,700	$600	(330)	($300)	$300	0.5	1%
Predicted Savings	**12,560**	**$1,402**	**892**	**$673**	**$2,075**	**2.6**	**8%**

Proposed Project Lists

The five businesses, along with the three schools and the restaurant under construction, were also presented a proposed project list with grant funding and utility rebates that would support the installation. An example of a proposed project list for a participating restaurant is included in Appendix M. The proposal focused on items that had a high frequency of identified opportunity in the initial site visits. This included programmable thermostats, preventative maintenance contracts, EC motors, and strip curtains. The strip curtain was a specific saloon door-style curtain that made it easy to enter the coolers. The programmable thermostats were specified as easy-to-program commercial quality thermostats.

Table 8 provides a summary of the actual projects that were installed. Other than the large project at the school, which will be discussed in the next section, most projects were essentially free to the businesses.

Table 8: Installed Projects Summary

Participant ID	Project Description	Cost	Funding	% Funding	Energy Savings
Restaurant #4	Saloon Door Curtains on Cooler	$500	$500	100%	$100
Restaurant #6	Saloon Door Curtains on Freezer	$500	$500	100%	$600
Restaurant #8	Strip Curtains, Gasket Repair, New AC Unit, New T-stat	$1,100	$550	50%	$1,290
Restaurant #9	T-stat and LED Lighting	$1,983	$1,306	66%	$240
Restaurant #13	T-stats and Saloon Door Curtains	$1,800	$1,750	97%	$930
School #19	KE2 Therm Defrost Controller	$7,100	$1,620	23%	$1,089
Total		**$13,000**	**$6,200**	**73%**	**$4,200**

Two measures that were relatively inexpensive, programmable thermostats and saloon door curtains, were the focus of the implementation. The strip curtain retrofit is depicted before and after in Photo 1 and Photo 2. The restaurant owner was pleased with the results. Photo 3 and Photo 4 show the old and new thermostats at this restaurant as well. For this restaurant there was some back and forth discussion of the thermostat to ensure that the owner did not go with a low cost thermostat that was difficult to program.

Photo 1: Walk in Freezer with Strip Curtains Partially Removed

Photo 2: Walk-in Freezer with Saloon Door Curtain

Photo 3: Old Thermostat

Photo 4: New Thermostat with Setbacks

At the end of the grant period, the energy usage for three restaurants was re-evaluated. This activity was done to measure the effectiveness of the follow-up activities. These were all restaurants that engaged in the process and implemented measures. It was assumed that on top of the initial 8% savings that could be achieved by a direct install program, another 8% could be saved with recommissioning and capital measures installed for a total of 16% savings. Table 9 provides a summary of the savings achieved by the participants. While one restaurant achieved 11% savings, the average savings was only 4%.

Table 9: Energy Savings Summary

	kWh	Elec, $	Therm	Gas, $	Total Energy Saved, $	Cars Off the Road	%Energy Saved
Restaurant #8	5,748	$701	1,072	$1,034	$1,735	1.8	11%
Restaurant #9	35,000	$3,900	(2,600)	($2,300)	$1,600	2.2	2%
Restaurant #13	11,900	$1,500	100	$100	$1,600	1.7	5%
Average of 3 Restaurants	*17,500*	*$2,000*	*(500)*	*($400)*	*$1,600*	*1.9*	*4%*
Predicted Savings	**25,120**	**$1,402**	**1,784**	**$673**	**$2,075**	**2.6**	**16%**

Discussion of Follow-up

The expected number of direct-install opportunities was overly optimistic, both in regards to their existence in business and in the program ability to achieve implementation. At the start of the grant, it was hoped that 80% of the items on the list of direct-install measures would be addressed in the initial site visit. Ultimately only 25% of the measures were addressed. The energy savings from the periodic progress reports, while positive, was much less than was hoped for.

Engaging only five restaurants in further discussion of energy usage and potential next steps was clearly inadequate. Achieving only 4% implementation of recommissioning and capital measure opportunities was below expectations. Higher implementation might have been achieved if there was more time, great engagement from the businesses, and certainly if grant funding paid for the entire measure.

Keeping the businesses engaged in energy efficiency efforts involved more of a sales pitch than was expected. For many of these businesses, the projects almost had to be given away to achieve implementation. However, it appears that the follow-up activities were able to garner more energy savings than the initial site visit alone. Businesses also would have appreciated more energy monitoring, but this program could not justify the time required for that analysis.

Results from Technology Demonstration

The following section provides highlights from the technology testing. A complete measurement and verification report on the KE2 controller testing is included in Appendix N. The goal of this test was to evaluate the effectiveness of the KE2 defrost controller compared with a standard defrost time clock. A typical time clock is shown in Photo 5. The KE2 controller is shown in Photo 6. Two installations were evaluated – one in a college cafeteria and another in a convenience store.

Photo 5: Defrost Time Clock

Photo 6: KE2 Controller

Installation One: College Cafeteria

This project included a complete overhaul of a walk-in unit with the KE2 installation comprising only part of the project. The other work included sealing the box, installing LED lights and replacing the evaporator. The new evaporator had EC fan motors and an EEV (versus thermostatic expansion valve). The following data is based on a 7-day baseline measurement period and a 7-day period after the retrofit.

Energy Savings

Table 10: Annual Energy Use Estimate Cafeteria

ENERGY ANALYSIS						
		Compressor	**Defrost Heaters**	**Evaporator Fans**	**Lights**	**Total**
BASE	**Avg. kW**	2.24	3.27	0.676	0.192	6.38
	Annual kWh	19,634	3,262	5,251	841	28,988
POST	**Avg. kW**	1.48	2.88	0.100	0.11	4.57
	Annual kWh	12,981	471	863	473	14,789
kW Reduction		**0.76**	**0.39**	**0.58**	**0.08**	**1.81**
kWh Reduction		**6653**	**2791**	**4387**	**368**	**14,199**
% kWh Reduction/Component		**34%**	**86%**	**84%**	**44%**	
% kWh Reduction/Total		**23%**	**10%**	**15%**	**1%**	**49%**

The annual energy use estimate for the walk-in freezer for the base and post conditions is shown in Table 10. The results from the 7-day test periods are extrapolated to a full year without any corrections for humidity levels. The environmental conditions for these tests showed the relative humidity was greater than 60%. In summer months the humidity can certainly be higher than 60%, but in winter the humidity can be much lower. Therefore, extrapolating these test results out to an annual usage is rough, but likely a conservative savings estimate. This calculation estimates this retrofit will reduce annual energy usage by

approximately 50%. Again, this project included more than the KE2 controller. LED lights were installed, the seams were caulked, and the evaporator was replaced with EC motors and an EEV. The defrost heaters on the new evaporator were slightly smaller than on the original evaporator.

Non-Energy Benefits

The college cafeteria walk-in suffered from excessive icing, which made cleaning difficult, impaired worker safety and damaged food. The project improved all of these problems. The amount of icing in the box prior to the retrofit is shown in Photo 7 and the ceiling condition after the retrofit is shown in Photo 8: No Ice on Ceiling after Retrofit. These photos also show the original T8 light fixtures in the original installation and LED light fixtures in the retrofit. The food service manager was very impressed with the improved light levels that resulted from the LED lighting retrofit.

Photo 7: Ice on Ceiling before Retrofit

Photo 8: No Ice on Ceiling after Retrofit

Photo 9: Food Quality Prior to Retrofit

Photo 10: Food Quality after Retrofit

Freezing and thawing can form ice crystals which can negatively impact food quality. Examples of the food quality before and after the retrofit are shown in Photo 9 and Photo 10, respectively. Visually, it appears that fewer ice crystals form on the food after the retrofit.

Cost

This cost for this project is shown in Table 11. In addition to the labor and material, a temporary freezer trailer was rented to store all the food while the work was completed. This project was supported by a custom rebate from Xcel Energy and was eligible for a prescriptive rebate for the EC motors. Grant funding was provided as well.

Table 11: Cost Breakdown Cafeteria

Cost Analysis	
LED Lighting	$ 1,295
New Evap. & EC Motors	$ 1,289
KE2 Therm	$ 1,803
Material Total	**$ 4,387**
Labor	**$ 2,010**
Trailer Rental	**$ 400**
Freight	**$ 325**
PROJECT SUBTOTAL	***$ 7,122***
Grant Funding	**$ 1,320**
Custom Rebate	**$ 301**
Prescriptive Rebate	**$ 280**
PROJECT TOTAL	**$ 5,221**

Installation Two: Convenience Store

At the convenience stores, the only retrofit was replacing the defrost time clock with the KE2 controller. This walk-in unit already had LED lights, but did not have EC motors. This project was considered a likely retrofit for the typical small business with a walk-in freezer.

Energy Savings

The annual energy use estimate for the walk-in freezer for the baseline and retrofit conditions is shown in Table 12. As with the other test, the annual energy savings were extrapolated to a full year based on the results from the two 7-day test periods. There was no correction for humidity levels for the same reasons as the college cafeteria test. The savings estimates are likely conservative. Annual energy savings is calculated to be approximately 20%.

Table 12: Annual Energy Use Estimate Convenience Store

ENERGY ANALYSIS						
		Compressor	Defrost Heaters	Evaporator Fans	Lights	Total
Base	**Avg. kW**	2.50	3.46	0.6	0.023	6.59
	Annual kWh	21,900	2,358	4,887	127	29,273
Proposed	**Avg. kW**	2.09	3.47	0.6	0.02	6.15
	Annual kWh	18,322	733	4,418	127	23,600
kW Reduction		0.41	0.0	0.0	0.00	0.44
kWh Reduction		3,579	1,625	469	0	5,673
% kWh Reduction/Component		16%	69%	10%	0%	
% kWh Reduction/Total		12%	6%	2%	0%	**19%**

Non-Energy Benefits

The box condition pre- and post-retrofit is shown in Photo 11 and Photo 12**.** There was much less of an icing issue in this unit as compared to the college cafeteria unit (Photo 13Photo 13)

Photo 11: Icing Pre-Retrofit

Photo 12: No Icing Post-Retrofit

A picture of the food stored in the unit pre-retrofit is shown in Photo 13. The food quality was also not an issue for this unit and food quality remained good after the retrofit.

Photo 13: Food Quality Pre-Retrofit

Estimated Cost

This estimated cost for this project is shown in Table 13. Since this project was supported by the product manufacturer who donated the controller, and the contractor also donated his time for the installation, these are only estimated costs. This work was done without down time or emptying the freezer.

Table 13 Cost Breakdown Convenience Store

COST ANALYSIS	
Material Total	$ 1,200
Labor	$ 400
PROJECT TOTAL	**$ 1,600**

Discussion of Technology Demonstration

Energy Savings

The savings for these two tests were significantly different. The simpler convenience store project saved approximately 20% energy while the overhaul of the college walk-in saved approximately 50%. A comparison of the two projects is shown in Table 14. Based on the observations on-site and an analysis of the data, the difference in savings is due to two things. First, the unit at the college was not working properly at the start. This is clear from the excessive amount of icing that was observed pre-retrofit. The other obvious reason for the difference in savings is the components replaced in addition to the KE2 controller at the college site. For EC motors, the component energy savings is well documented at approximately 75%. EEVs are lesser known and understood, but the energy savings potential has been

demonstrated at greater than 15%.[12] If the evaporator fan motors were replaced with EC motors and the TXV replaced with an EEV, the savings at the convenience store may have been closer to 35%.

Table 14: Energy Savings Comparison

		Total College	Total C-Store
BASE	**Avg. kW**	6.38	6.59
	Annual kWh	28,988	29,273
POST	**Avg. kW**	4.57	6.15
	Annual kWh	14,789	23,600
kW Reduction		**1.81**	**0.44**
kWh Reduction		**14,199**	**5,673**
% kWh Reduction/Total		**49%**	**19%**

Financial

Table 15: Simple Financial Analysis

Cost Analysis	
LED Lighting	$ 1,295
New Evap. & EC Motors	$ 1,289
KE2 Therm	$ 1,803
Material Total	**$ 4,387**
Labor	**$ 2,010**
Trailer Rental	**$ 400**
Freight	**$ 325**
PROJECT SUBTOTAL	***$ 7,122***
Grant Funding	**$ 1,320**
Custom Rebate	**$ 301**
Prescriptive Rebate	**$ 280**
PROJECT TOTAL	**$ 5,221**

This measure is not inexpensive. A defrost time clock probably costs about $300 to install and a KE2 controller is in the range of $1,600. Table 15 provides a simple financial analysis of the two projects. For calculation purposes, energy costs of $0.06/kWh and $10/kW were used, which is

[12] See the following article published in the February 2009 ASHRAE Journal, Electronic Expansion Valves vs. Thermal Expansion Valves

based on what Xcel Energy may charge a small business customer. This project received a custom rebate and a prescriptive rebate for the EC motors is included as well.

There are two more things to consider when investigating this investment for a small business. First, did some of the work at the college (e.g. evaporator replacement, defrost control repairs) need to be done regardless? For the college, it was clear that there was some work needed and some money was going to be spent anyway. Possibly half of the project cost at the college would have been incurred in the next 12 months anyway, so the incremental cost of installing the controller, installing EC motors and choosing an EEV becomes an easier decision – especially if the utility provides a rebate. In addition, installing expensive retrofits on old equipment is often not considered because the equipment could have too many other potential problems. The contractor on this project stated it would not have installed the KE2 controller at this facility without the other upgrades because the equipment was in such bad shape.

The second consideration is the non-energy benefits of a project such as this. The risks of a fall are minimized by eliminating the icing on the floor. Food quality can be improved by reducing the high temperature extremes that cause freezer burn from the freeze/ thaw cycle. LED lighting lasts longer and the space is better lit. Tasks like cleaning and inventory are made easier as well. Finally, if a facility chooses to use the remote monitoring capability, a maintenance problem or operating issue can be caught before significant damage is done, improving reliability.

Results of Program Replicability Research

With the support of the Clean Energy Resource Teams (CERTs), four programs with a focus on small business energy efficiency were identified for interviews. Staff from CERTs is uniquely suited to support this identification process. CERTs are a partnership between the University of Minnesota Extension, the Department of Commerce Division of Energy Resources, and non-profit organizations. CERTs have a regional presence across Minnesota and familiarity with energy issues as a result of having staff and steering committees in every region of the state. [13]

The following entities were selected for individual interviews: Marshall Green Step Cities' program for small businesses, Ottertail Power's commercial refrigeration and preventative maintenance program, Lake Street Council and Great Plains Institute's energy coaches program, and Southern Minnesota Municipal Power Association's small business door to door outreach program. In addition, the Lawrence Berkeley National Laboratory's pilot of contractor-led auditing was included due to its similar research design to this pilot. Table 16 briefly describes the programs analyzed.

[13] For more information on CERTs visit their website www.cleanenergyresourceteams.org

Table 16: Small Business Programs Reviewed

Program	Audience, Location	Implementer	Program Goal	Key Strength
Marshall Green Step Cities	Commercial businesses, city in SW MN	Business associations, city staff, volunteers	Green business certification, provide recognition and engagement	Broad community engagement (businesses, non-profit, utility, and government).
Ottertail Refrigeration	Commercial businesses, NW MN	Utility staff, refrigeration contractors, consultants	Increase refrigeration energy savings through rebates, studies, and PM	Utility subsidized PM for refrigeration equipment offered directly through contractors.
Energy coaches	Small business, Twin Cities metro	CDC staff	Outreach to small businesses, opportunity identification and personal support for implementation	Energy coaches are community organization staff interested in developing long term relationships with businesses.
SMMPA small biz outreach	Small business, SE MN	CERTS staff, utility staff	Door-to-door outreach and marketing of utility programs	On-site support to fill out rebate forms immediately.
Lawrence Berkeley National Laboratory	Small business, multi-state pilot	Mechanical contractors	Contractor-led auditing and benchmarking	Interval data and/or online benchmark provide insight into usage. Designed as value-add to preventative maintenance services.

Program Descriptions

Marshall Green Step Businesses

Description:

The City of Marshall in Southwestern Minnesota participates in Green Step Cities, a voluntary challenge, assistance and recognition program to help cities achieve their sustainability goals. The City of Marshall's Green Step team created a supplemental certification program targeting their business community[14]. Interested businesses complete an online questionnaire about their green practices and, if they have completed enough actions, qualify for the green credential. Currently, 34 businesses have received the certification. The program has been mainly marketed through word of mouth, local business associations, and web traffic. The strength of the Marshall Green Step Business program is the partnerships developed to support the program, including city staff, county staff, community representatives, schools, businesses, business

[14] City of Marshall's Green Step Cities Web-page: http://www.marshallgreenstep.org/green-business.html

associations and economic development organizations. They are also leveraging these relationships to support community clean-up efforts and recycling.

Contractor and Utility Involvement:

Marshall Public Utilities is a member of the Marshall Green Step Business committee. Energy efficiency measures provide a significant source of points available for certification, but the goal of the program is not specifically energy efficiency. There is not a mechanism for tracking any energy savings associated with the program, nor has there been a focus on encouraging businesses to improve their score by conducting additional actions. Points are awarded for businesses that receive an annual HVAC tune-up, but specific engagement of contractors has not been done. The public utility does an annual training with trade allies, so local contractors are well aware of rebate programs. However, whether or not a contractor expresses additional interest in energy efficiency varies greatly between individuals.

Otter Tail Power Company Commercial Refrigeration Program

Description:

Otter Tail Power Company (Otter Tail) has used each triennial filing as an opportunity to innovatively focus on a specific business sector. In the current triennial, it focused on commercial refrigeration. Its offering includes a comprehensive set of rebates for refrigeration retrofits (14 different rebates are offered for retrofitting equipment). In addition to those rebates, Otter Tail also offers to subsidize the cost of preventative maintenance (PM). Otter Tail decided to subsidize PM as a way to build relationships with contractors and open the door for more commercial refrigeration retrofits. A customer schedules the PM work with a qualified refrigeration contractor, who submits an invoice to Otter Tail. The customer pays their portion of the cost (between $30-50) directly on their utility bill.

In addition to rebates and subsidized PM, Otter Tail also brought in a third party firm to do energy assessments for customers that have large refrigeration loads. These programs in combination have been successful. Otter Tail has seen savings from the refrigeration program double or triple as a result of these efforts. The majority of participants have been large grocery stores, but there is interest in growing the outreach down a level in customer size to capture some restaurants and convenience stores.

Contractor and Utility Involvement:

Otter Tail Power Company's account representatives work throughout their territory and are based in the region they serve. Its representatives regularly work with businesses to identify opportunities and encourage them to participate in programs. The subsidized PM offer was originally launched with the support of a handful of contractors who would conduct the work. The PM program was designed as a sales tool to help contractors and Otter Tail capture more savings from refrigeration. Engaging contractors, in general, is primarily done through a distribution list that includes 50-60 contractors and occasionally through in-person trainings and conferences.

Energy Coaches Training

Description:

The energy coaching model was created by a handful of community organizations in Minneapolis, including the Lake Street Council and the Great Plains Institute. Through work with small businesses, it was identified that most small business owners lack a trusted source of information regarding energy efficiency. Utilities support these customers primarily via a phone hotline. The energy coach would be a third party, non-biased individual who could develop a long term relationship with the business owner to support them in addressing energy efficiency. This is particularly useful because conservation program requirements can be complicated. In addition, businesses are not typically aware that opportunities exist – within their business and for external support.

In this pilot effort, local business associations or community development corporations (CDCs) were asked to volunteer their staff for the half-day training. These types of organizations are a good fit to become energy coaches because their mission is to support their local business community. Providing assistance with energy efficiency fits that objective – it helps businesses become more profitable, sustainable and resilient. Since small businesses have many barriers obstructing their path to energy efficiency, the long term relationship that energy coaches provide can hopefully achieve better implementation over the long term. This effort is currently being piloted in Minneapolis and some surrounding communities, and is supported with a private foundation grant. Results from the first year of pilot implementation are promising: 2,000 customers reached with electronic communications, 40 one-on-one conversations, 24 businesses audited and 9 lighting upgrades completed, resulting in 71,008 kWh of energy saved from energy efficiency and 129,792 kWh of energy generated through new solar installations.

Contractor and Utility Involvement:

Neither contractors nor utilities are directly involved in this effort. Energy coaches are promoting utility rebates and utility subsidized energy audits for small businesses, but no direct funding for the coaching is being provided by utilities. One expectation of the coaching process is that the coaches' involvement will make collaborating with contractors and utilities more positive. Utility programs can be confusing, so a trained coach can help navigate program requirements. Acronyms like EER, SEER and other efficiency concepts can be a foreign language when taking to contractors – a trained coach may be able to help translate between contractors and small business owners (in the case of some immigrant owned businesses, some translation may literally be required as well).

SMMPA Small Business Outreach

Description:

Southern Minnesota Municipal Power Association (SMMPA) has three energy service representatives that support their smallest 15 member utilities. These energy service representatives like to connect with local businesses to promote energy efficiency, but rarely have time to reach all of their members' customers in a personal way. The Clean Energy Resource Teams (CERTs) volunteered staff capacity to go door-to-door in the communities to

talk to business owners about their utility's rebate programs, discuss energy efficiency, and sign up businesses for SMMPA's email communication list. SMMPA staff tracked the impact of this outreach. The benefits of this outreach model lie both in outreach and in capturing projects. As a result of this outreach so far, over 700 businesses in nine Minnesota communities received information on their utilities' energy efficiency programs. In addition, thanks to good tracking over multiple months, rebate applications that are fulfilled get associated with the outreach. Over 300,000 kWh of energy savings have been linked to businesses that received outreach, with additional rebates in process.

Contractor and Utility Involvement:

This effort promotes utility efficiency programs, and SMMPA staff coordinates the outreach days and track the on-going results. Outreach is conducted by CERTs staff and volunteers. SMMPA energy service representatives were in the communities during the day of the outreach to work with the most interested businesses, answer questions, and help with rebates. Contractors are not involved.

Small Commercial Energy Management Package for HVAC Contractors

Description:

The Lawrence Berkeley National Laboratory (LBNL) is piloting a program in which HVAC contractors implement an energy management package of services for small businesses. This is a demonstration project worth watching as the results become public. The program relies on interval data for the contractor to do a pre-analysis of energy usage, ideally utilizing a software package for energy data analysis and benchmarking, followed by a short high-level site walkthrough, and follow-up visits. A goal for the contractors is to use these additional energy services to promote their preventative maintenance services. The program can be reviewed at LBNL's project website (http://eis.lbl.gov/smallcomm.html).

Contractor and Utility Involvement:

The core goal of this research is to equip HVAC contractors to provide a limited set of energy management services for their business customers. LBNL staff recruited contractors to pilot the package of services. Contractors were tasked with selling the program to their customers (either as a value added service to an existing PM contract or as a fee for service add-on), collecting utility data, conducting a walk-through audit, and following up with customers to discuss opportunities and track progress.

Other Programs Nationwide

To better understand existing small businesses programs, information was gathered from lists of top performing programs and from utility program filing databases (ACEEE, 2013). These programs were reviewed using ESource's DSMi (Demand Side Management Insights) tool. Utility programs were sorted by performance (in terms of kWh saved and cost effectiveness) and classification (searching on the terms: "small business," "direct install" and "tune-up").

Table 17: Out-of-State Energy Efficiency Programs

Program	Audience	Implementer	Direct Install	Audit/Turn-Key	Tune-up	On-bill financing	Cost ($) per first year kWh Saved	Significant Characteristics
CL&P Small Business Energy Advantage CT)	Small Business <200 kW	Competitively Selected Contractors (many electricians)	X	X		X	$0.41	Contractors recruit participants, no up-front cost for business, turn-key installation of recommendations including on-bill financing
PG&E Energy Fitness (CA)	Small Business <200 kW	Consultant	X	X		X	$0.39	Direct-install of lighting, exit signs, vending machine controllers, and occupancy sensors, measured identification, rebate processing and financing included
PG&E AirCare Plus (CA)	Commercial Business	HVAC Contractor			X		$1.00	HVAC tune-up program, 15 contractors are trained and utility rebates the tune-up directly to the contractors
Potomac Edison Audit with Direct Install (MD)	Small Business <100 kW	Consultant	X	X			$0.43	Installation of CFLs, exit signs, faucet aerators and PRSV (electric W/H only)
Arizona Public Service Express Solutions (AZ)	Small Business <100 kW	Contractor (mostly electricians)	X	X			$0.16	One of 26 approved contractors performs an audit, utility subsidized installation up to 90%, contractor installs product and processes rebate, covers lighting and commercial refrigeration
National Grid Small Business Direct Install (NY)	Small Business <100 kW	Contractor (electricians)	X			X	$0.23	Direct-install of lighting measures, on bill financing
San Diego Gas & Electric – HVAC QI and Tune-up	Commercial Business	HVAC Contractors			X		$1.45	Rebates provided for quality installation and quality maintenance, contractors manage and implement program
PPL Electric Small Business Tune-up	Small Business	HVAC Contractor			X		$0.16	Contractor uses Service Assistant diagnostic tool, incentives paid to contractors to off-set the cost of services

The selection of programs reviewed is not exhaustive, but provides examples of current programs in other parts of the country. Table 17 briefly describes the eight programs reviewed.

The programs reviewed fall into a few groupings: direct install programs, "turn-key" services, and subsidized tune-ups. Some of the programs reviewed had components of more than one of these types of programs embedded in their design.

The program costs vary significantly year to year (costs shown in Table 17 are for the most recent year available). For instance, the San Diego Tune-up program varies from $0.28/kWh saved in 2011 to $1.45/kWh saved in 2012.

Direct-install

Direct-install programs focus on a limited set of technologies that can easily be installed during a site visit. Lighting is the most common product installed, but typically some other small items are included. Five of the eight programs reviewed included some component of direct-install. All of the direct install programs reviewed were directed at small businesses and thus had a cap for participants' energy usage (either 100 kW or 200 kW). Installation of lighting comprises the bulk of the savings reported from a direct install program.

This type of program does a good job of addressing the nuisance barrier of energy efficiency for small businesses. The business owner doesn't need to complete subsequent actions after signing up for the visit. The direct installation is heavily subsidized or completely free.

Turn-key Services

A small business turn-key program seeks to capture deeper savings than a direct-install program by providing additional follow-up and implementation support. Some easy projects (like programmable thermostats, refrigeration case lighting, door heater controls, and lighting controls) require qualified personnel to install of the product. Connecticut Light and Power's Small Business Energy Advantage program is an example of a turn-key program. Contractors competitively bid to participant in the program. Once selected by the program manager, the contractors conduct site visits. During the site visit, some items are directly installed, but other items are installed at a later date by the contractor. The customer pays for those upgrades via interest free financing on their electric bill. This program's cost effectiveness ($/kWh) was somewhat lower than other programs, but the overall savings of the program was quite high – capturing a savings of 28 million kWh in 2012.

Subsidized Tune-ups

Subsidizing tune-ups is a way for utilities to promote good maintenance of equipment. Three examples of tune-up programs were reviewed. In most cases, the rebate was paid directly to the contractor with the expectation of reducing the cost to the end-user. Contractors are required to complete reporting on services performed for customers in order to be compensated. The three out-of-state programs provided tune-up services for HVAC systems. Otter Tail Power Company in Minnesota offers a tune-up program for refrigeration equipment.

On-bill Financing

A number of the programs reviewed combine their program approach with low-cost financing paid back via the utility bill. This addresses another common barrier for small businesses – the

lack of financing or the hassle of securing financing. At least three of the five direct install programs included on-bill financing. This type of offering helps to make the decision to implement easy for business owners.

Challenges Reported

The programs reviewed were some of the most successful small business programs nationwide, so their success and cost-effectiveness may not be common. Even these programs reported some challenges identifying participants and marketing the programs. In some cases the program implementer was responsible for recruiting participants, but frequently the utility supported with mass marketing, advertisement and bill inserts. In addition, the Connecticut program reported finding that the smallest of the customers (those with peak demand of <10kW) were drastically underserved even in the small business program. Their proposed response was to pilot outreach specifically to those businesses, frequently found in struggling urban areas and in areas already aligned with economic development zones.

Discussion of Results of Program Replicability Research

In comparing the two populations of programs reviewed, a few points of discussion stand out.

First, the out-of-state programs reviewed were primarily selected because they were delivered by contractors or electricians. Only one program in Minnesota was delivered by a contractor and, in that case, only part of the program was delivered by the contractor (the preventative maintenance on refrigeration equipment in the Otter Tail program). All the programs reviewed at the national level were utility-funded, publically-filed energy conservation programs, whereas in Minnesota, only one of the programs reviewed had been publically filed (Otter Tail). In addition, three of the programs were taking place without substantial utility funding – the energy coaching pilot, the Lawrence Berkeley pilot and the Marshall Green Step Cities Program (although in Marshall's case, the utility did serve on the steering committee). In those three non-utility sponsored programs (and in the case of SMMPA), existing utility rebates and programs were promoted. In those three situations, the program's benefit was development of a unique means of outreach to businesses – through means like a certification program, HVAC contractors, or door-knocking. In order to sustain that kind of outreach, additional funding, perhaps from utilities, would be needed in the future.

In fact, the existence of Xcel Energy supported programs for small business was a contributing factor in the success of the energy coaching model in Minneapolis. The pilot effort (and the results from this pilot), indicates that community organizations, with some training, can be great promoters of energy efficiency. However, the energy coaches relied on existing small business utility programs to provide technical information for the businesses. Energy coaches referred businesses to the Energy Smart program, a small business auditing program supported by Xcel Energy, as an initial step for getting information about their opportunities for conservation. Additionally, if lighting measures were identified by the energy coach, the business was referred to the One-Stop Efficiency Shop, a small business lighting program supported by Xcel Energy. Those existing resources, in combination with the relationships and persistence offered by the energy coaches, created a successful combination.

Working with Contractors

Many of the out-of-state programs reviewed worked directly with contractors. Some of the program filings specified that contractors competitively bid to deliver the program. Electricians were the most common type of contractor involved in the programs across the board, although a few nationally and in Minnesota targeted HVAC or refrigeration contractors. There seems to be less consensus or established best practices for how to design a mutually beneficial program working with contractors in these trade specialties. The evidence of program design challenges comes from conversations with staff at Otter Tail and Lawrence Berkeley National Laboratory, and the variable cost effectiveness of the tune-up programs reviewed.

Leverage Community Assets

In Minnesota, it is also clear that different communities have different local assets with which to develop a successful strategy. In some communities, like those served by Otter Tail and SMMPA, local utility reps are available to spend one-on-one time with customers. In other communities, there is a supportive local government and economic development agency (Marshall, MN). In others, there may be a motivated contractor or a wind developer encouraging action. What was clear from the conversations was that an asset in one community may not be present in others – local governments are not all engaged, utilities are not all well-staffed, and local businesses associations are not all well-organized. Each program started with the identification of an asset in a community that was worth further exploration.

Conclusions and Recommendations

Elements from each of the three focus areas of this project – the pilot program, the technology testing and program replicability research – combine into the conclusions from this project. Conclusions fall into the following categories: program development, ideas for delivering efficiency programs with contractors, and reflections on working in this market sector. Recommendations are woven into the conclusions, as each of the conclusions section is written with the intention of informing those interested in developing programs along the lines of this research.

Cost Effective Program Development

The review of eight out-of-state small business programs provides some baseline information as to what constitutes a realistic cost of program delivery. Those eight programs have costs that range from $0.16/kWh saved to $1.45/kWh saved with an average cost of $0.53/kWh saved. These programs were selected in part because of their cost-effectiveness, so nationally the average for this type of program might be higher.

Whether that cost is acceptable to a given utility is dependent on its circumstances. Historically programs like lighting retrofits have born a much lower price tag. However, a cost of $0.53/kWh saved might be justifiable for a utility facing a high cost of new generating capacity or a mandate to serve the small business segment. The ultimate determination of whether something is "cost effective" cannot be made as a blanket statement. This report summarized the costs and savings that could be anticipated in a small business or restaurant program. That data, along with other studies, can provide a target for program design.

Recruitment

The assumption that contractors would be able to enroll their current customers was wrong. Contractors were not able to successfully enroll participants. Reasons include the oddness of selling an unfamiliar "free" service, limited amount of time to follow-up with customers, and a lack of depth of contacts. Only two of the 18 participants were recruited by contractors.

Specific skills are required for recruitment. In many of the national programs, utilities marketed the program through advertisement and bill inserts to bolster the contractors' outreach. In Minnesota, community based organizations like CDCs or CERTs have better relationships building skills to reach this market sector. Likewise, many local utility representatives, especially in smaller communities, have those communication skills and relationships. In the pilot, the other 16 participants were identified by utility representatives or community/business organizations. Engaging and motivating these types of businesses presents a great program development opportunity.

Effective participant recruitment is a mandatory first step for any program. Recruiting businesses is challenging, requires specific skills, and must be better planned into a program. Community groups were able to recruit businesses effectively and the incentive of $250 per business recruited was sufficient to engage their services. Mass marketing and media approaches were not tried because of the scale of the pilot.

Utility Data

A small business program probably cannot afford to put its already limited resources into obtaining energy data and tracking energy usage over time. In this pilot, tracking energy data did not help to motivate implementation, particularly because attributing changes in energy usage to any specific measure was nearly impossible—too many variables affect energy usage in a restaurant. Additionally, restaurants cannot be easily benchmarked, primarily because usage per square foot does not provide an accurate comparison; another reason utility data is less useful.

A small business program could effectively be run without any utility energy data. Measure savings can be based on rules of thumb and calculated saving. Unless utility data are easily available and software tools are utilized to process the data, the benefit of data does not outweigh the cost. Online access to data trends, similar to what is provided to residential customers, would be beneficial to this market sector and would make a programmatic support of this market sector easier.

Site Visit

Site visits do not need to identify a long list of measures, as would be done in a standard ASHRAE Level II Audit. In a direct-install program, that time is better spent installing another measure or moving on to the next business. In an audit program, the priority should be identifying the measures that fall in the nexus of "likely to be implemented" and "cost effective energy savings." The auditor should identify the best 3-5 measures to implement in the next six months and communicate them in an accessible action-oriented way. A surplus of measures does not add value to the program or increase the likelihood of implementation.

Direct-Install

Only about half of the anticipated direct-install measures were appropriate for direct installation during an initial site visit. Adjusting controls, like programmable thermostats, economizer settings and defrost time-clock settings, did not make good direct installation measures. Liability concerns are the major reason, specifically because it's difficult to know the best setting for controls based on one visit and call-backs were considered too likely.

Nevertheless, 5,700 kWh per business were saved on average based on post-implementation utility data analysis. Licensed contractors were paid $300 to complete those installations in this pilot. Licensed contractors would not be required for these installations, so costs could be reduced. However, that price should be revisited because $300 was too little to adequately motivate contractors in this pilot. More direct-install items should be added if possible, but the list that was achieved would be sufficient to justify a program. In order to achieve savings of 5,700 kWh at a cost of $0.53/kWh, a direct-install program would need to work with a program delivery budget of $3,000 or less per business. That needs to include all marketing and administration costs, but it does provide for more leeway in the budget than was taken during this pilot.

Recommissioning Incentives

The sample size of recommissioning activities implemented during this pilot is small. Three restaurants implemented projects and their energy savings were tracked in depth. Recommissioning activities (preventative maintenance and other HVAC and refrigeration control retrofits) were initially subsidized at 50% of the cost. Only two businesses implemented at that incentive level. Later the incentive was increased to cover 100% of the costs and four additional businesses implemented. The average preventative maintenance contract was $1,800. The original cost estimate for recommissioning was $3,400 per business, an estimate that is still fairly accurate.

Averaged savings, measured for three of those businesses, was 17,500 kWh. This number provides an estimate for the average savings for a restaurant that might be achieved if good follow-up and implementation is conducted. That level of savings, at $0.53/kWh saved, creates a recommissioning program budget of approximately $9,000 per business.

Cost Effectiveness Recommendations

Ultimately whether this price per kWh saved is justified depends on how important it is to serve the small business community and what the competing options are for producing kWh or saving kWh. Table 18 shows the budget for a direct-install program and a recommissioning program based on different requirements for cost-effectiveness. The average of the eight existing utility programs reviewed, $0.53/kWh, is shown, as well as three other arbitrary tiers.

Table 18: Per Business Program Budget Tiers

	Expected kWh Savings	Budget/ business @ $0.15/kWh	Budget/ business @ $0.30/kWh	Budget/ business @ $0.53/kWh	Budget/ business @ $0.75
Direct-Install	5,700	$855.00	$1,710.00	$3,021.00	$4,275.00
Recommissioning	17,500	$2,625.00	$5,250.00	$9,275.00	$13,125.00

This project's research plan was tightly focused on determining whether a customer would implement a measure for at a proposed rebate level and whether a contractor would provide the service at a proposed reimbursement level. The response to that was clear. The levels of incentives provided were not enough to drive 100% participation, either by the contractor or the business. As a result recommissioning savings were only available for three businesses and in general implementation was difficult to motivate.

An alternative and perhaps better research approach would have used grant funds to pay for all of the costs incurred by the business and contractor to implement measures. Then, record the costs incurred and use the implementation to record the savings achieved. Finally, in the analysis stage, use a national benchmark for small business program costs to determine whether the costs incurred could be justified based on the energy saved. This approach would have given the research team more data to analyze, which could have resulted in more robust conclusions.

Delivering Energy Efficiency Programs with Contractors

Utility programs considering the involvement of contractors need to understand the importance of finding the right fit with a contractor partner. Each contractor is a small business owner and each has a different way that they view their business model. Some are keenly tied to a fix-repair/replace model. Some prioritize selling preventative maintenance, while others only bill hourly and aren't interested in a preventative maintenance contract model. Some contractors are more motivated to evolve their business to include energy efficiency services. Anecdotally, it seems that quality, a desire to include energy efficiency in their business model, was most common among electricians and equipment distributors.

Liability is highly important to the decision making process for a contractor. An insurance claim's high deductible and increased premiums could threaten the viability of their business. As a result, contractors are generally cautious when installing unfamiliar equipment or doing retrofits to old equipment. High efficiency equipment can have the reputation of requiring more maintenance. Negotiating a contract, as was done at the beginning of this pilot, proved excessively difficult. In fact, at least one contractor didn't participate in the pilot as a result of the contract.

Issuing an RFP to solicit proposals from interested contractors was a practice of some of the national programs reviewed and is recommended based on the experience of this pilot program. Offering a RFP would create a means for parties to express their interest in the program, while also providing a means for cost-efficiency and equity. Since the amounts paid to the participating contractors were determined by the Project Team, it was never clear whether contractors felt that they were being paid fairly, too little or too generously. A competitive process would also introduce better accountability to the work plan and hopefully motivate contractors to prioritize the work.

It is recommended to develop a relationship with only one contractor to pilot such a program. The effort to cast a broad net and recruit many contractors was time consuming, ineffective, and weakened the sense of exclusivity the contractor felt. The contracting business is competitive, so an exclusive relationship gives a contractor an opportunity to commercialize a project successfully with less competition, an incentive that can be very motivating for the right contractor.

Finally, a good fit with the contractor's business model is required. A program needs to be developed in such a way that a contractor sees the advantage of participating for their business. Whether the advantage is increased sales from installations, increased number of customers, or even increased customer good will, identifying and describing that value proposition is important when seeking to attract contractors to an efficiency program. Additionally, only a very few (larger) contractors provide HVAC, refrigeration and electrical work all in-house. Energy efficiency opportunities in a restaurant do not segment nicely along contractor trade lines. A recommendation of this pilot is to attempt to align the program demands with the practice area of the participating contractor. Lighting programs have been so successful in part because of the easy alignment. A one-stop program is very desirable for this business sector; but not at the cost of complicated sub-contracting relationships, liability barriers and poor customer relationship management.

New Approaches to the Market Sector

Restaurant Only versus Small Business

Based on this pilot and previous CARD research, it is clear that restaurants are unique. The opportunity to save energy is significant, but there are many challenges in working with the sector. The concept of utilizing contractors shows mixed results. Alternative delivery partners may be more helpful. In fact, the evidence from national programs and pilot efforts in Minnesota demonstrate that more than one approach may be successful.

Furthermore, a program exclusive to restaurants is not better than a more general small business energy efficiency program. Restaurants are the most energy intensive business type in the commercial sector and thus have unique energy demands, but on the whole working with them is more similar to working with other small businesses than different. Many of the national programs reviewed served small businesses under a demand cap of either 100 kW or 200 kW. The vast majority of restaurants would fall under that cap. Thus a small business program could serve all business types and at the same time include some tailored measures to capture the unique opportunities present in food service. This approach is recommended as a way to bolster the overall savings from a program.

Small utilities and those serving rural communities can especially appreciate the recommendation to provide an umbrella small business program rather than a restaurant specific program. In those service territories, the number of restaurants is few enough to not justify a targeted program. However, the motivation for serving the business type may be greater in those communities as a result of the limited industrial load and a higher percentage of small business customers.

"In and Out" versus "Here to Stay"

The length of the interaction with the business is an important component of program design. A direct install program would be designed to be a one-touch interaction with a business. A more comprehensive program would seek to develop a long term relationship with the business and support deeper energy implementation over time. However, a program cannot do both at the same time, at the very least without some of the quality suffering. This was a mistake in the design of this pilot. A program for this market sector cannot efficiently capture direct-install savings while at the same time gathering energy data, producing audit reports, supporting implementation and developing long term relationships.

Different programmatic approaches require different skill sets. Contractors may be better suited to participate in a direct install program where the contractor is provided with an already committed participant and simply installs a set of measures. On the other hand, CDCs with staff on the ground and a vested interest in the businesses they serve may be better suited to building a long term relationship. Utilities, depending on their model for customer service, may fall into either category.

Recommended Program Designs

Therefore, two distinct models for program implementation can be envisioned – one that strives for quick implementation of a limited list of measures, and another that seeks deeper implementation over a longer period of time. Table 19 illustrates those two examples. These two program types somewhat mirror the two savings estimates discussed in previously in the conclusions. The high touch program would achieve more of the recommissioning savings, but also quite a bit of capital improvement savings. The one touch program would capture the direct-install savings.

Table 19: Two Program Models

High Touch, Deep Implementation	One-Touch, Direct Install
Trusted relationship, repeat contact	One Visit, impersonal
Simplified energy data tracking might be done to provide a reason for frequent contact	No energy data necessary, deemed savings are used for measures installed
Direct-installs provide some savings, subsequent equipment installation provides majority of savings	Direct-installs provide 100% of savings
Includes walkthrough audit (perhaps done by third party), top measures are recommended, including recommissioning measures, implementation support is provided	Minimal or no audit report - limited list of measures identified quickly on-site, rule of thumb savings estimates
Average of 5% energy savings, 17,500 kWh saved annually per restaurant	1.5% energy savings, approximately 5,700 kWh saved annually per restaurant
Capital measures are captured over time as equipment fails	No focus on capital measures
Models: Minneapolis energy coaches pilot	Models: direct install programs for various utilities nationwide
Who Implements: CDCs, local utility rep	Who Implements: consultants, electricians

Concluding Thoughts

The energy use of the restaurant and small business sectors must be addressed in the coming years in order to meet energy efficiency goals and carbon reduction standards. There are undeniable barriers, but there is significant opportunity. Capturing that savings cost effectively will require clever approaches, good partnerships, and hard work. Definitions of cost effectiveness need to be fairly determined relative to other program success nation-wide and the imperative to work with small businesses.

Furthermore, additional engagement of HVAC and refrigeration contractors is necessary. At this point, contractors are still a prominent player in a small business' energy efficiency decision-making process, but their engagement in energy efficiency overall is not sufficient. Training, education, events, and easier paperwork are all important, but the market will ultimately motivate the contracting sector to support energy efficiency or not. Utilities should identify ways that their incentives and program structure can tie into the business plans of contractors and encourage them to make energy efficiency one of their value propositions.

Finally, program innovation is happening around the country and around Minnesota. These barriers for small business and contractors are recognized by utilities and implementers. Innovation, based on available community assets, is happening. Regulators should encourage utilities to think creatively and pilot programs as they assemble their conservation plans. This sector's challenges are not insurmountable, but neither should it assumed that a standardize approach will be the right solution.

Appendices

Appendix A: KE2 Evaporator Efficiency Fact Sheet
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Appendix A: KE2 Evaporator Efficiency Fact Sheet

MichaelsEnergy

WALK-IN FREEZER **ENERGY SAVINGS**

Fixing Issues with Icing & Over-Defrosting

THE **PROBLEM**

Many walk-in freezers suffer from icing, which is unpleasant, slippery, can damage food and reduce equipment efficiency. Ice is primarily caused by too much humidity or poor humidity control. Humidity enters a walk-in through the door either in the form of warm, moist air drifting in when the door opens or in the form of hot food, which releases moisture as it cools. Reducing icing involves limiting the amount of moisture that enters a cooler and properly defrosting to control the moisture that accumulates as ice.

THE **LOW COST** SOLUTION

Strip curtains do the best job of keeping warm, moist air out of walk-in freezers during periods when the door is open. Strip curtains aren't popular to walk-through, so swinging saloon-door style strip curtains may be a good alternative. A new door gasket is a cheap and necessary component to stop any moist air from entering the box when the door is closed. Finally, moisture can be limited by cooling some foods (such as soups or stocks) in an ice bath prior to putting them in the freezer.

However, some moisture will enter the walk-in. The refrigeration process removes moisture from the air. Evaporators have a defrost coil to melt any ice that forms in the evaporator so it can drain away from the coil. The defrost coil is controlled by a time-clock, typically set to run for 30 minutes four times per day. That level of defrosting can be excessive and result in wasted energy. Adjusting a defrost time clock can be something the facility manager does, or a refrigeration contractor can perform the task. It's always a good idea to ensure that the time clock is properly re-set after service has been performed on the walk-in.

Funding

This project was supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources.

Contact Us to Get Started!

Carl Samuelson, Michaels Energy
cwsamuelson@michaelsenergy.com

THE **BETTER** SOLUTION

While some basic energy savings and icing mitigation are possible with simple fixes, a "smart defrost controller" like the KE2 Evaporator Efficiency Controller will provide better results and energy savings. The KE2 controller senses the level of icing and only defrosts as needed. In addition, the KE2 unit controls the evaporator fan and compressor to reduce runtime. The result is more aggressive energy savings, better moisture control in the walk-in and more consistent temperature control.

The KE2 controller saves energy, confirmed by two installations tested in Minnesota. An installation of the controller alone at a convenience store reduced energy usage by 20%. In a deluxe upgrade, a college cafeteria installed the KE2 controller, LED lighting, a new efficient electrically commutated (EC) motor, and an electronic expansion valve (EEV). The saving at the college was nearly 50%

Figures 1 and 2 show how the KE2 controller reduced the frequency of defrost spikes from four per day to about one per day. It also shows how the evaporator cycled on and off frequently giving the appearance of a solid bar from 0 to 1 amp. Finally, thanks to the EC motor the baseline amp draw dropped from 3 amps to 1 amp.

Figure 1: Before installation, college cafeteria walk-in

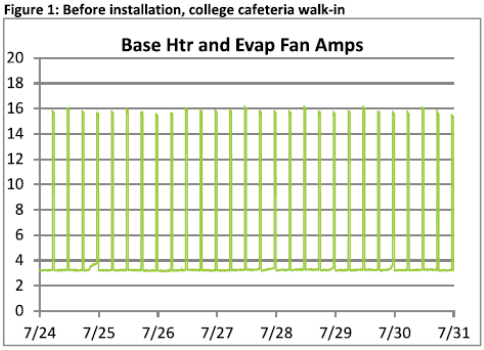
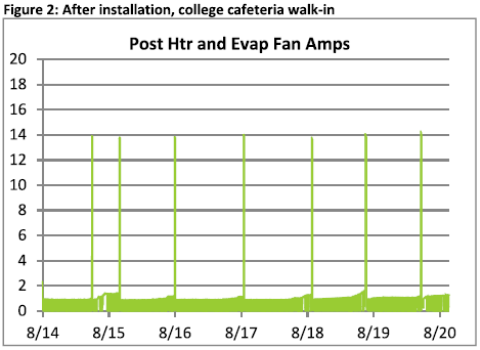


Figure 2: After installation, college cafeteria walk-in



The KE2 controller provides a better method of controlling icing in a walk-in cooler and reduces the energy consumption of the unit. The cost of the KE2 upgrade, after a custom rebate, put the simple payback at 3.3 years. Beyond the energy savings, reducing icing in the walk-in also helps improve food quality and maintain safety and cleanliness. Those impacts have a value to users of the walk-in not captured in the simple payback.

	Total College	Total C-Store
kW Reduction	1.81	0.44
kWh Reduction	14,199	5,673
Savings at $0.06/kWh and $10/kW	$ 1,089	$ 402
Approximate Cost	$ 7,122	$ 1,600
Custom Rebate @ $0.05/kWh	$ 710	$ 284
Prescriptive Rebate $70/ECM	$ 280	$ -
Simple Payback w/ Rebate	5.6	3.3

www.michaelsenergy.com

Appendix B: Restaurant Program Fact Sheet

MichaelsEnergy

ENERGY EFFICIENCY FOR **RESTAURANTS**
(and Small Businesses too)

ENERGY SAVINGS **POTENTIAL**

Restaurants are energy intensive. They use two and a half times more energy per square foot than the average commercial business. However supporting restaurants (and other small businesses) to implement energy efficiency can be difficult. It can be challenging getting the decision maker's attention and reaching them at a time when they are ready to act. In addition, there are lots of businesses to reach and savings per business can be small.

Working in the sector adds-up. One estimate puts the total potential to save energy, in Minnesota, at over 50,000 MWh and 400,000 Deka-therms per year. For utilities looking to reach out to a market sector that hasn't been fully tapped – restaurants specifically or small business in general could make sense.

PROGRAM **MUST HAVES**

FREE
Any initial cost is too much of a barrier for this sector.

EASY ENTRY
Requiring signed utility release forms or other paperwork for enrollment hurts the program.

ONE-ON-ONE
Don't expect these business owners to attend workshops – meet them at their business.

SIMPLE NEXT STEPS
Focus on the recommendations with the most traction and come back later with more recommendations – don't overwhelm decision makers.

PROGRAM **STRATEGIES**

Direct Install Programs: Installing energy saving items for free (or at very reduced cost) is great for this market sector. Small businesses don't have dedicated maintenance staff so the nuisance of completing an upgrade is often sufficient to make it not happen. Consider items like pre-rinse spray valves, walk-in strip curtains, programmable thermostats, and screw-in LED lighting.

Tune-up Program: Small businesses often neglect their HVAC and refrigeration equipment until it breaks. Adding preventative maintenance can improve equipment efficiency and extend equipment life. Regular maintenance also puts a qualified specialist in touch with the business to recommend efficiency upgrades like installing an economizer or programmable thermostat. However, customers balk at the price tag for preventative maintenance, so a rebate or subsidy from their utility might help them turn the corner. It could also help the utility develop better relationships with contractors.

Energy Coaching: Small businesses respond well to a trusted, local contact for energy information. Unfortunately, they are often only supported with a business hot-line or on-line resources. Consider partnering with local community development corporations (CDCs), business associations, or economic development entities to provide a more personal contact. With training and some financial incentive, these entities could effectively leverage their mission to help small businesses thrive by connecting businesses with energy efficiency programs and rebates.

Funding

This project was supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources.

Contact Us to Get Started!

Carl Samuelson, Michaels Energy
cwsamuelson@michaelsenergy.com

Appendix C: Demographic Data Collection Form

Contact Information

Business Name: _____

Address: _____

Hours (specify for each day of the week):

_____

Contact Name, title: _____

Phone: _____

Cell Phone: _____

Email: _____

Other owners or authorized contacts?

Year your building was built: _____

How long have you owned your business _____?

Gross Floor Area (sq. ft.): _____

Do you own or rent your space? _____

Do you anticipate adding or replacing appliances in the next year?

Appendix D: Contractor Memorandum of Understanding

Memorandum of Understanding

Between **Michaels Energy** and "**Contractor**"

PURPOSE:

This Memorandum of Understanding establishes the guidelines for collaboration between Michaels Energy and "the Contractor" in the demonstration and testing of a cost effective recommissioning rebate program for restaurants for the 2012 Conservation Applied Research and Development grant program.

Restaurants are energy intensive, using two and a half times more energy per square foot than the average commercial building. However, due to their small size and specific equipment, restaurants are not well served by existing recommissioning or rebate programs. Previous work by FSELP has demonstrated that restaurants can achieve approximately 8% energy savings through no & low cost measures and up to 27% energy savings from recommissioning activities and capital improvements. Minnesota has 2,000 restaurants appropriate for intervention—50% participation with modest energy savings of 8% each would result in savings statewide of more than 155,000 MMBtus. This energy savings is equivalent to taking 1,500 cars off the road each year.

The pilot program is essential toward building the case that this type of program can be replicated for more restaurants and in other areas of Minnesota. Successful delivery of this pilot program will require a commitment from the Contractor, Michaels Energy and the businesses participating to strive to work together to achieve energy efficiency.

Mutually Agreed Upon Goals

Michaels Energy and the Contractor will work together and mutually agree to promote energy efficiency with the participating businesses in this program.

Restaurant Recommissioning Energy Program	**Contractor Name**
Nancy Kelly	_____
Michaels Energy	**Company**
	_____
Signature	**Signature**
_____	_____
Date	**Date**
_____	_____

Appendix E: Mechanical Sub-contract Agreement

MICHAELS

Subcontractor Agreement

This Subcontractor Agreement ("Agreement") is made as of the date last signed below ("Effective Date") between Michaels Energy ("Michaels" or "Prime Contractor"), a Wisconsin corporation with principal offices at 400 Main Street, Suite 200, La Crosse, WI 54601, and (Insert Contractor Name), located at (Insert Address) ("Subcontractor"). Michaels and Subcontractor may be referred to as "Party" and together as "the Parties."

WHEREAS, Michaels has been awarded a contract by the State of Minnesota, Division of Energy Resources (the "Client") to demonstrate a cost effective recommissioning program for restaurants (the "Prime Contract"); and

WHEREAS, the parties desire to define the terms and conditions under which Subcontractor will perform as a subcontractor to Michaels in connection with the Prime Contract and this Agreement.

NOW, THEREFORE, in consideration of the promises exchanged herein, Michaels and Subcontractor agree as follows:

RELATIONSHIP OF THE PARTIES

Michaels will act as Prime Contractor and (Insert Contractor Name) will act as a first-tier subcontractor to Michaels under the Prime Contract with the Client.

Neither Party may assign this Agreement, or subcontract any portion of the work to be performed hereunder to any other person without the express written approval of the other Party which shall not be unreasonably withheld.

RESPONSIBILITIES OF THE PARTIES; SCOPE OF WORK

Specific services (the "Services") to be performed by Subcontractor are set forth in individual Task Orders ("TO") to be agreed upon and signed by both Parties. Subcontractor will provide to Prime Contractor all Services, including labor, materials, travel and expenses, and other resources incidental to the Services, necessary to provide and perform the requirements set forth in each signed TO. Subcontractor represents that it has or shall secure at its own expense, all personnel required to perform the Services, and that such personnel shall not have any interests or contractual relationships that might pose a conflict of interest.

Changes to the Services will be subject to the mutual agreement of the Parties, and, if required, the Client. Within 10 days of receiving notice from Prime Contractor of a proposed change, Subcontractor will provide Prime Contractor with a written statement of the costs required to complete the change and any proposed price increase or decrease that would result from the proposed change, including justification. Subsequently, on issuance by Prime Contractor of a Change Order, Subcontractor will proceed in accordance with the change.

Subcontractor will complete work as requested by the Prime Contractor's Project Manager.

WARRANTY

Subcontractor warrants that all Services provided hereunder will be performed in a professional and workmanlike manner and in accordance with the applicable professional standards currently recognized by such profession, and shall be responsible for the quality, accuracy, and completeness of the Services and all deliverables furnished under this Agreement.

PAYMENT

For the duration of the Agreement, Subcontractor will provide the Services or any mutually agreed upon additional services at the rates set out in an applicable TO.

Subcontractor will invoice Prime Contractor monthly for time spent and expenses incurred. Invoices will indicate the number of hours worked by individual and provide a summary of expenses incurred. Proper support for time and expenses will be provided to Prime Contractor on request. Prime Contractor will include Subcontractor's charges with its next invoice to Client. Prime Contractor invoices clients in the first week, beginning with the first Monday, of each month. Prime Contractor will make reasonable efforts to collect payment from Client and will issue payment for Subcontractor's invoices within 10 days of receiving payment from Client.

Should Prime Contractor dispute any item(s) on an invoice, Prime Contractor may deduct the amount of these item(s) from the total and will process the balance of the invoice. Subcontractor will be promptly advised of disputed amounts and reasons for the disputed item(s). Disputed items which are subsequently justified to Prime Contractor will be included in the next monthly invoice to Client. Specific invoicing instructions will be provided in the applicable TO.

CONFIDENTIALITY

During the course of the Services, each Party may be given access to information that (i) relates to the past, present, and future research, development, business activities, products, services, and technical knowledge of the other Party or of Client, and (ii) has been identified as confidential ("Confidential Information"). In connection therewith, the following subsections will apply:

1.1.1 The Confidential Information of the other Party or of Client may be used by the receiver only in connection with the Services.

1.1.2 Each Party agrees to protect the confidentiality of the Confidential Information of the other Party and the Confidential Information of Client in the same manner that it protects the confidentiality of its own proprietary and confidential information of like kind. Access to the Confidential Information will be restricted to those Prime Contractor, Subcontractor and Client's personnel with a need to know and engaged in a use permitted by this Agreement.

1.1.3 All Confidential Information made available, including copies thereof, will be returned or destroyed on the first to occur of the following: (a) completion of the Services or (b) request by the discloser. Prime Contractor or Subcontractor may retain, however, subject to the terms of this Section, copies of the Confidential Information required for compliance with its quality assurance requirements.

1.1.4 Nothing in this Agreement will prohibit or limit either Party's use of information (including, but not limited to, ideas, concepts, know-how, techniques, and methodologies) (i) previously known to it without obligation of confidence, (ii) independently developed by it, (iii) acquired by it from a third party which is not, to its knowledge, under an obligation of confidence with respect to such information, or (iv) which is or becomes publicly available through no breach of this Agreement.

1.1.5 In the event either Party receives a subpoena or other validly issued administrative or judicial process requesting Confidential Information of the other Party or Confidential Information of Client which that Party has received from the other, it will provide prompt notice to the other of such subpoena or other process. The Party in receipt of process will thereafter be entitled to comply with such process to the extent permitted by law.

The obligations under this Article 5 will be binding on the Parties and all of its related entities and will survive the expiration or termination of this Agreement.

OWNERSHIP

Data developed under this Subcontract shall be the property of Michaels. Subcontractor may share only the findings and data obtained from a facility with that facility's rate-paying tenant or rate-paying owner.

COMPLIANCE WITH LAWS

Prime Contractor and Subcontractor will comply with all applicable laws, ordinances, regulations, and codes in the performance herewith including the procurement of any necessary permits and licenses, including state conflict of interest laws.

INDEMNITY

Subcontractor will indemnify and defend Prime Contractor and the Client from and against all claims, damages, losses and expenses (including attorneys' fees) arising out of or in connection with (a) any negligent acts or omissions or willful misconduct of Subcontractor in the performance of the Services, and (b) any infringement or misappropriation of any U.S. patent, copyright, trade secret, trademark or other intellectual property right by work product or other materials created or furnished by Subcontractor under this Agreement. The foregoing indemnities shall not apply unless: (a) Subcontractor is notified promptly in writing by Prime Contractor of any notice of such claim and is given the exclusive authority required for the defense of such claims and reasonable assistance from Prime Contractor defending such claims, at Subcontractor's expense, and (b) should any Subcontractor product or the provision of any Service become, or in Subcontractor's opinion become, the subject of any such claim, Prime Contractor shall permit Subcontractor either to procure for Prime Contractor the right to continue using such Subcontractor product or receive the benefit of such services with products or services that are noninfringing, or grant Prime Contractor credit for such products or services.

LIMITATION OF LIABILITY

Neither the Prime Contractor nor the Client shall be liable for lost profits or indirect, special, incidental, exemplary, punitive or consequential damages arising out of this Agreement, even if it

has been notified of the possibility of such damages. Under no circumstances will the Prime Contractor or the Client's liability to the Subcontractor exceed the amounts paid under this Agreement.

EXCUSABLE DELAY

Neither Party will be liable for any delay or failure in performance hereunder arising out of causes beyond its control and without its negligence or fault. Subcontractor, in the event of such a cause, will notify Prime Contractor immediately in writing of its delay or failure in performance, describing the cause and its effect on Subcontractor's performance and the anticipated duration of the inability to perform.

BOOKS AND RECORDS

At all times during the term of this Agreement, Subcontractor will maintain a complete and accurate set of files, records, books, papers and accounts ("Records") of all business activities and operations conducted by Subcontractor in connection with Subcontractor's performance under this Agreement. Subcontractor will make such Records available to Prime Contractor on request. All accounts required under this Agreement will be maintained and prepared in accordance with generally accepted accounting principles.

Subcontractor will maintain all Records pertaining to its performance under this Agreement for a period of not less than three years after the date of termination or expiration of this Agreement. At all times during the term of this Agreement and during the three year period following the expiration or termination of this Agreement, Subcontractor will make available Records related to its performance under this Agreement to Prime Contractor for inspection, audit and copying, if requested.

GOVERNING LAW

This Agreement and its interpretation shall be governed and determined by the laws of the State of Wisconsin without regard to its choice of law provisions. The parties agree that the United Nations Convention on Contracts for the International Sale of Goods is specifically excluded from application to this Agreement.

INDEPENDENT CONTRACTOR

It is understood that in connection herewith, Subcontractor will be acting as an independent contractor. The management, employees, officers and agents of one Party, in the performance of this Agreement, will act only in the capacity of representatives of that Party and not as employees, officers or agents of the other Party and will not be deemed for any purpose to be employees of the other. Subcontractor assumes full responsibility for the actions of its personnel while they are performing services pursuant to this Agreement and will be solely responsible for their supervision, daily direction and control, payment of salary (including withholding of income taxes and social security), workers compensation, disability benefits and the like. Neither Party will commit, nor be authorized to commit or bind, the other Party in any manner.

Subcontractor engaged to provide these services assumes all liabilities related to business interruption, property damage, personal injuries and related consequences incurred in travel to/from participant sites and performance of duties.

Subcontractors must meet the requirements of Minnesota Statute, Section 326B.197 which states:

"A person contracting to do gas, heating, ventilation, cooling, air conditioning, fuel burning, or refrigeration work must give and maintain bond to the state in the amount of $25,000 for all work entered into within the state. The bond must be for the benefit of persons suffering financial loss by reason of the contractor's failure to comply with the requirements of the State Mechanical Code. A bond given to the state must be filed with the commissioner of labor and industry and is in lieu of all other bonds to any political subdivision required for work covered by this section. The bond must be written by a corporate surety licensed to do business in the state."

INCORPORATION OF PRIME CONTRACT TERMS

The Prime Contract(s) that Subcontractor may work under as assigned by TO, including all amendments, are hereby incorporated by reference and made a part of this Agreement. Subcontractor assumes toward Prime Contractor all obligations and responsibilities which Prime Contractor assumes toward the Client under the applicable Prime Contract(s). In the event of inconsistencies between provisions of this Agreement or the Client'(s) Prime Contract, the provisions of the Prime Contract shall control.

INSURANCE

During the term of this Agreement, Subcontractor shall obtain and keep in force insurance coverage as specified herein. The insurance policies shall be with insurance companies authorized to do business in the state in which the Services are to be performed and shall be rated at least "A-VII" by Best's insurance company rating service.

Prior to commencing the Services, Subcontractor shall furnish Michaels with Certificates of Insurance showing the company or companies providing the specified coverage as specified in the paragraph below. The certificates shall reflect the effective date and dates of expiration of the policies. If requested, Subcontractor shall provide copies of the policies to Michaels.

The required insurance coverages are as follows:

(a) Statutory workers compensation insurance and Employer's Liability insurance covering all persons employed by Subcontractor and/or performing Services under this Agreement. Workers compensation policies shall contain a Waiver of Subrogation Endorsement waiving subrogation rights against Michaels;

(b) Commercial automobile liability insurance covering all owned, hired, and other non-owned vehicles of Subcontractor with minimum coverage in the amount of $1,000,000 for the injury or death of any person in any one occurrence and $1,000,000 per occurrence for property damage;

(c) Commercial general liability insurance, including all obligations imposed by the Agreement, including but not limited to general bodily injury and property damage, with minimum coverage in the amount of $2,000,000 for the injury or death of any person in any one occurrence

and $2,000,000 per occurrence for property damage. The liability insurance coverage should be primary to any insurance that the Prime Contractor carries and should name the Prime Contractor as an additional insured.

TERM AND TERMINATION

The term of this Agreement will run from the Effective Date through the date Subcontractor completes the Services under any associated TO(s) unless sooner terminated in accordance with the terms of this Agreement.

Prime Contractor may terminate this Agreement or any TO hereunder with or without cause at any time by giving the Subcontractor thirty (30) days written notice of termination. In such an event, Subcontractor agrees to use all reasonable efforts to mitigate its expenses and obligations hereunder. In such an event, the Prime Contractor shall pay the Subcontractor for all satisfactory services performed under any TO prior to such notice of termination and for all expenses approved and incurred by Subcontractor which could not by reasonable efforts of Subcontractor have been avoided. Upon termination, Subcontractor shall immediately return all documents or any other items supplied to Subcontractor or developed by Subcontractor under this Agreement and/or the TO so terminated.

Either Party may terminate this Agreement by providing the other Party with written notice if a Party (i) becomes insolvent, executes a general assignment for the benefit of creditors or becomes subject to bankruptcy or receivership proceedings; (ii) breaches its obligations related to Confidential Information; or (iii) commits a material breach of this Agreement that remains uncured for 30 days following delivery of written notice of such breach (including, but not necessarily limited to, a statement of the facts relating to the breach or default, the provisions of this Agreement that are in breach or default and the action required to cure the breach or default).

NOTICES

Any notices required to be delivered by one Party or another under or in connection with this Agreement will be deemed sufficiently given if actually received or if sent by overnight delivery, to the attention of the individual signing this Agreement for the Party to which the notice is directed, at the address indicated below:

	Prime Contractor:	**Subcontractor:**
Company:	Michaels Energy	(Insert Name)
Address:	400 Main Street, Suite 200	(Address)
City, State, Zip:	La Crosse, WI 54601	(Address)

PUBLICITY

Prime Contractor or Subcontractor will not issue or sponsor any advertising or publicity that states or implies, either directly or indirectly, that either Party endorses, recommends or prefers the other's Services. Either Party will not use the other Party's logo in any fashion without prior written approval from the other Party.

SURVIVAL

Any provision of this Agreement that contemplates performance or observance subsequent to termination or expiration of this Agreement shall survive termination or expiration and continue in full force and effect for the period so contemplated.

CHANGE ORDER PROCESS

A project Change Order form ("Change Order") will be used for communicating changes to Services. The Change Order must describe the change requested, the rationale for the change, the estimated price, and the effect the change will have on the overall Project. All Change Orders must be approved by Michaels and Subcontractor.

NON-INTERFERENCE

Subcontractor agrees that during the term of this Agreement, including any extensions thereof, and for a period of three (3) years thereafter, it will not, either directly or indirectly:

(a). solicit on behalf of any party other than Michaels, any Michaels Client for whom it performed work pursuant to any Task Order hereunder, to perform work that is the same as, or substantially similar to, that work set forth in the Prime Contract associated with such Task Order;

(b). perform any services or provide any products to any Michaels Client for whom it performed work pursuant to any Task Order hereunder, that are the same as, or substantially similar to, those services and/or products set forth in the Prime Contract associated with such Task Order.

NON-SOLICITATION

Subcontractor agrees that during the period of performance of this Agreement and for two (2) years thereafter, it will neither directly nor indirectly solicit for employment, engage as a contractor, hire, nor otherwise induce any employee or contractor of Michaels to leave the employ of Michaels.

ENTIRE AGREEMENT

This Agreement and the applicable terms and conditions of the Clients' Prime Contract, included in Attachment D, constitute the entire agreement of the Parties. No other agreements, oral or written, pertaining to the Services to be performed under this Agreement exists between the parties. This Agreement can only be modified by an amendment in writing signed by both parties.

[Signature Page Follows]

INTENDING TO BE BOUND, each Party represents and warrants that it has all necessary power and authority to enter into this Agreement.

Subcontractor		**Michaels Energy**	
By		**By**	
Name		**Name**	
Title		**Title**	
Date		**Date**	

[Signature Page to Subcontractor Agreement]

TASK ORDER # 1
UNDER THE MICHAELS SUBCONTRACTOR AGREEMENT

1. Name of Client:	Minnesota Department of Energy Resources
2. Scope of Work:	See Attachment A to this Task Order
3. Period of Performance:	Effective Date through June 30th, 2014
4. Total Value of this Task Order:	**Fixed Fee Based on the Following Tasks**: Classroom Training **$160** per employee, up to 2 employees. Recruit Participants **$250** per restaurant enrolled up to 7 (program participation is capped at 20). Reimburse for installed energy materials **$120** per restaurant up to 7 restaurants. Initial site visit and completed report per prime-contractor-provided format; **$300** per restaurant up to 7 restaurants. Delivery and discussion of 6-month progress reports and **$80** up to 14 visits.
5. Method of Payment:	Check
6. Prime Contractor Project Manager	Venbing Jogwuia Tel: (612) 418-4462 Fax: (608) 784-2270 Email: vjogwuia@michaelsenergy.com
7. Prime Contractor Point of Contact:	Nancy Kelly Tel: (612) 418-3432 Fax: (608) 784-2270 Email: nmkelly@michaelsenergy.com
8. Subcontractor Point of Contact:	(Name) Tel: (xxx) xxx-xxxx Fax: (xxx) xxx-xxxx

[Signature Page Follows]

Agreed to and accepted by:

SUBCONTRACTOR		MICHAELS ENERGY	
Signature:	_____	Signature:	_____
Name:	_____ (Type or Print)	Name:	Jeffrey L. Ihnen
Title:	_____	Title:	Vice President
Date:	_____	Date:	_____

[Signature Page to Task Order # 1]

Attachment A
Scope of Work

Work performance and products described in this Scope of Work are subject to approval by Michaels Energy Project Manager. The services to be performed by Subcontractor under the terms of this Agreement include the following:

2012 Conservation Applied Research and Development Grant

Provide mechanical contracting services to support the 2012 Conservation and Applied Research and Development grant program to demonstrate a cost effective recommissioning program for restaurants. This is identified as State Contract 56702 with the Minnesota Department of Energy Resources (DER) and is in effect until June 30, 2014.

The following work will be included in this scope of work:

1. **Classroom Training**: Subcontractor will attend classroom training of up to 4 hours in duration. The session will include the following:
    a. Discussion of program goals and expectations;
    b. Review program's list of top energy saving opportunities; and
    c. Review forms and procedures for the program.
2. **Recruitment**: The Subcontractor will be paid an incentive payment for each restaurant brought into the program (participant). Subcontractor will not receive an incentive for participants that Michaels Energy recruits on Subcontractor's behalf. The program enrollment is capped at 7 participants per Subcontractor.
3. **Materials**: Subcontractor to obtain materials needed to implement low cost measures which include the following per site:
    a. Up to 10 low flow (0.5 to 1.5 GPM) faucet aerators
    b. One low flow pre-rinse spray valve (<1.4 GPM)
    c. Insulation for up to 20 feet of refrigerant suction lines
    d. Insulation for up to 40 feet of hot water pipes for hot water heater
    e. Installation of up to 2 LED bulbs for walk-in cooler and walk-in freezer
4. **One Training Site Visit**: Subcontractor will conduct an initial site visit to one participant with Michaels Energy to complete field training on energy opportunities and program requirements. This site visit could be up to 4 hours in duration.
5. **Initial Site Visits**: Subcontractor will conduct an initial site visit to the remaining participants (up to 6) independently. This site visit could be up to 4 hours in duration. Site visit must be using forms prepared by Michaels Energy. Photos of all affected equipment shall be taken before and after any implementation of corrective action. Photos of any

damaged door gaskets recommended for replacement are required. Photos will be available for Michaels Energy if requested.

6. **Prepare Bids for Refrigeration System Recommissioning:** The Subcontractor shall prepare a bid for applicable refrigeration system recommissioning tasks may which include the following:
    a. Set defrost time-clock and temperature settings;
    b. Corrective action for icing on refrigerant lines;
    c. Check and adjust refrigerant charge for optimal performance;
    d. Clean/replace/insulate faulty condensate drain line;
    e. Evaporator cleaning for coolers and freezers;
    f. Condenser cleaning for coolers and freezers;
    g. Install/replace door gaskets, strip curtains and door closers;
    h. Replace/repair damaged refrigerator doors, align doors and make sure they close properly;
    i. Insulate suction lines and hot water lines; or
    j. A one-year preventative maintenance contract for refrigeration equipment per minimum requirements described in Attachment C.

    The bids should be prepared for the participant and Michaels will determine a rebate amount after reviewing the bid. The rebate to the participant to be delivered upon verified payment for services. The rebate amount will be up to 50% of the bid amount.
7. **Prepare bids for HVAC System Recommissioning:** The Subcontractor shall prepare a bid for applicable HVAC system recommissioning tasks which may include the following:
    a. Clean AC condenser coils and comb damaged fins as appropriate;
    b. Check and adjust refrigerant charge for optimal performance;
    c. Replace dirty air handler filters;
    d. Weather-strip exterior doors, windows;
    e. Repair, adjust /maintain RTU economizer controls (if present);
    f. Install and set programmable t-stat;
    g. Seal ductwork if needed;
    h. Ensure appliances are completely under hood; or
    i. Provide a one-year preventative maintenance contract for HVAC equipment per minimum requirements described in Attachment C.

    The bids should be prepared for the participant and Michaels will determine a rebate amount after reviewing the bid. The rebate to the participant to be delivered upon verified payment for services. The rebate amount will be up to 50% of the bid amount.
8. **Prepare bids for applicable Capital Projects:** The Subcontractor shall prepare a bid for applicable Capital improvements which may include the following:
    a. Icemakers;
    b. Heat recovery water heaters;
    c. Walk-in cooler modifications;

d. High efficiency gas powered water heaters;
e. Door heater controllers;
f. Split condensing units;
g. Economizer controls for Rooftop Units;
h. High efficiency Rooftop Units;
i. Energy Star dish machines, fryers, or other energy efficient appliances;
j. T12 to T8 with ballast upgrade and incandescent to LED lighting retrofits;
k. High efficiency dishwasher booster heaters; or
l. Automatic kitchen hood exhaust control with (Melink or similar).

Michaels will not provide direct rebates for capital projects. These projects will be covered by existing utility rebate programs or submitted under the custom rebate program. Custom projects will be evaluated by the Michaels program manager and submitted to the utility for their custom rebate program. Michaels will not provide rebates for measures that are already covered by a utility prescriptive rebate program. Michaels may provide assistance in filling out the rebate forms if needed.

9. **Deliver 6-Month Progress Reports:** Subcontractors will return to participant sites with two 6-Month Progress Reports, prepared by Michaels Energy, showing energy usage since the initial site visit. The visit should be a ½ hour to 1 hour discussion with the participant to provide some motivation and support for taking action to reduce energy usage. The Subcontractor shall report any significant feedback on the meeting with the Michaels Energy Project Manager.

The following expenses will <u>not</u> be reimbursed by Michaels Energy:

1. **Mileage**
2. **Preparation of Bids:** The Subcontractor will be responsible for preparing bids for all applicable energy efficiency measures identified in the initial site visit.
3. **Program Follow-up Visits**: The Subcontractor will be responsible for scheduling an in-person follow-up visit to the participating businesses and provide the following:
    a. Findings from the initial site visit;
    b. Referrals for the One-Stop Lighting Program if applicable;
    c. A bid for applicable refrigeration and HVAC recommissioning activities which includes a grant funded rebate; and
    d. A bid for applicable capital improvements which includes estimated custom and prescriptive rebates from the utility.

Attachment B
Detailed Subcontractor Invoice Instructions

This Task Order 1 covers Subcontractor's work on the project through June 30, 2014 to be invoiced on a fixed fee basis.

OUT-OF-POCKET COSTS: Travel time, Mileage, meals, postage, graphics, and outside computer time shall be assumed by Subcontractor.

Billing Instructions

Each invoice shall provide sufficient detail to identify the following elements:

1. Task description, employees completing task, and dates task completed.
2. Receipts for materials procured.

All work completed for this Task order will reference Michaels project number MJ812AAN.

Hard copy invoices should be sent to:

Michaels Energy
P.O. Box 2377
La Crosse, WI 54602-2377

OR Invoices may be submitted by e-mail to:

Wendy Clemment (wjc@michaelsenergy.com)

If submitting via e-mail, please do not also remit a hard copy.

Attachment C

Minimum Requirements for Preventative Maintenance Contracts

Background:

Preventative maintenance is a planned activity to clean, inspect, and test heating, cooling, and refrigeration equipment to ensure they run efficiently, reliably, and have a long service life. Most businesses practice reactive maintenance or "run it till it breaks" which has low upfront costs but will ultimately degrade equipment performance and reliability. Over 50% of business owners in the small business sector still operate with a philosophy of reactive maintenance.

At a minimum a Preventative Maintenance contract shall include the following:

- Replace all filters quarterly
- Inspect and clean condenser coils in the spring
- Inspect and clean evaporator coils once a year
- Inspect and replace worn out door gaskets and properly align doors
- Check refrigeration defrost control settings
- Check for any visible leaks (Water, refrigerant, gas, etc.);

Special Issues:

Thermostat Settings: Programmable thermostats can be confusing so if there are any questions these should be checked out. A lot of energy is wasted by not having the units "set back" when the building is unoccupied. Settings should be checked and adjusted to prevent excessive run-time, maintain comfortable conditions during occupied hours, and achieve the maximum practical setback/setup during unoccupied hours.

Economizer Damper Controls: These controls provide excellent energy savings. If operating properly they can save at least 10% of operating costs of the unit. However, if they are not inspected and tested at least twice a year there is a chance they might not be working properly. About half of all newly installed economizers don't work properly. If they are not working properly they can waste more energy than they save.

Attachment D

Prime Contract

[Copy of Prime Contract Follows]

Appendix F: Contractor Training Table of Contents

Restaurant Recommissioning Binder

CARD 2012 Funded Research

Table of Contents

Appendix G: Key Information Participating Sites

ID	Type*	Recruited By	Initial Visit Date	Present Initial Report	Follow-up Visit	Square Feet	Owner-ship	Hr/ Wk	Annual kWh	kW per Month	Annual Electric Cost ($)	Average $/kWh	Annual Therm	Annual Gas Cost	Average $/Therm	Total Cost	Annual kBtu/ft2
1	Rest	Contr.	7/25/2013	9/18/2013	None	23,500	Own	77	800,607	191	$78,943	$0.10	47,693	$30,724	$0.64	$109,666	319
2	Rest	Contr.	8/16/2013	10/3/2013	None	10,000	Own	45	512,408	114	$50,101	$0.10	27,852	$14,812	$0.53	$64,913	453
3	Rest	Utility	8/27/2013	10/2/2013	None	7,905	Own	45	516,080	115	$51,506	$0.10	26,548	$18,702	$0.70	$70,208	559
4	Rest	CDC	10/4/2013	8/19/2014	8/19/2014	2,500	Own	30	86,800	26	$9,615	$0.11	3,607	$2,842	$0.79	$12,457	263
5	Rest	CDC	10/22/2013	12/10/2013	None	1,500	Rent	91	88,000	20	$8,935	$0.10	0	$	$	$8,935	200
6	Rest	CDC	10/15/2013	12/5/2013	7/29/2014	5,000	Rent	92	0	0	$	$	4,236	$3,413	$0.81	$3,413	85
7	Rest	CDC	10/24/2013	11/15/2013	None	1,500	Rent	98	101,948	23	$10,124	$0.10	4,802	$4,022	$0.84	$14,146	552
8	Rest	CDC	11/12/2013	11/22/2013	7/11/2014	3,286	Rent	77	83,120	27	$10,364	$0.12	7,508	$5,561	$0.74	$15,925	315
9	Rest	Utility	11/18/2013	12/26/2013	7/22/2014	5,500	Own	91	521,280	134	$54,777	$0.11	25,800	$19,200	$0.74	$73,977	793
10	Rest	CDC	11/27/2013	12/12/2013	None	2,500	Rent	91	96,105	98	$11,836	$0.12	5,513	$4,169	$0.76	$16,006	352
11	Rest	CDC	12/30/2013	1/22/2014	None	2,625	0	102	247,120	51	$25,869	$0.10	15,563	$11,335	$0.73	$37,204	914
13	Rest	CDC	1/20/2014	7/24/2014	7/24/2014	5,300	Own	48	167,520	55	$22,844	$0.14	8,914	$6,788	$0.76	$29,632	276

ID	Type*	Recruited By	Initial Visit Date	Present Initial Report	Follow-up Visit	Square Feet	Owner-ship	Hr/ Wk	Annual kWh	kW per Month	Annual Electric Cost ($)	Average $/kWh	Annual Therm	Annual Gas Cost	Average $/Therm	Total Cost	Annual kBtu/ft2
15	Rest	CDC	1/10/2014	1/13/2014	None	7,400	?	112	222,240	45	$20,889	$0.09	20,870	$14,144	$0.68	$35,033	385
17	Rest	CDC	2/6/2014	4/1/2014	None	3,050	Rent	60	68,503	20	$8,501	$0.12	7,125	$5,947	$0.83	$14,448	310
18	Sch	Other	2/12/2014	3/20/2014	None	188,000	Own	40	1,009,136	280	$66,613	$0.07	125,978	$66,254	$0.53	$132,867	85
19	Sch	Other	2/25/2014	4/18/2014	7/23/2014	NA	Own	0	0	0	$	$	0	$	$	$	0
20	Sch	Utility	3/10/2014	3/21/2014	None	606,530	Own	50	3,792,240	1,341	$262,507	$0.07	206,128	$206,128	$1.00	$468,635	55
21	Rest	Utility	3/20/2014	3/31/2014	None	12,000	Own	0	308,366	175	$44,126	$0.14	27,595	$27,595	$1.00	$71,721	318
					Restaurant Average	6,200		80	273,000	78	$29,000	$0.11	17,000	$12,000	$0.75	$41,000	410
					Profile Restaurant	**5,800**		**84**	**190,420**		**$19,042**	**$0.10**	**12,770**	**$10,682**	**$0.84**	**$29,724**	**332**
					School Average	397,265		77	2,401,000	1,000	$164,600	$0.07	166,000	$136,200	$0.76	$300,800	70

* Type: Rest = Restaurant; Sch = School

Appendix H: Detailed Summary of Opportunities Identified

			Restaurant ID																			Expected Opportunity	Identified Opportunity "O"		Expected For Grant	Actual Direct Installs "DI"		Actual Follow-up Install "FI"	
	ID	Measure Description	1	2	3	4	5	6	7	8	9	10	11	13	15	17	18	19	20	21	Total	#	%		#	%	#	%
Initial Site Visit	**Initial Site Visit**																												
	1	Low Flow Pre-Rinse Spray Valves	DI	DI	DI	DI	E	DI	X	DI	E	DI	E	O	O	E	DI	E	DI	E	48%	11	61%	38%	9	50%	0	0%
	2	Low flow faucet aerators	DI	DI	DI	DI	DI	DI	DI	E	O	DI	DI	DI	O	O	O	O	O	DI	98%	17	94%	78%	11	61%	0	0%
	8	Insulate hot water lines	O	O	E	O	O	O	O	O	E	E	X	O	NI	NI	NI	NI	NI	NI	77%	8	44%	62%	0	0%	0	0%
	3	Setback make-up air T-stat to 55F	O	E	E	X	DI	X	X	DI	E	DI	X	X	O	NI	X	NI	X	O	59%	6	33%	47%	3	17%	0	0%
	4	Set back hot water heater temp	DI	E	E	O	E	O	O	E	E	E	NI	FI	NI	NI	NI	O	NI	NI	51%	6	33%	41%	1	6%	1	6%
	5	Setback Programmable T-stats	O	O	X	X	X	X	X	O	O	E	O	X	O	X	X	X	X	DI	84%	7	39%	67%	1	6%	0	0%
	6	Install LED lights in Walk-in units.	DI	DI	DI	E	X	DI	X	DI	X	X	DI	DI	DI	X	DI	X	DI	DI	85%	11	61%	68%	11	61%	0	0%
	11	Insulate refrigeration suction lines	O	E	E	E	X	E	E	E	E	X	NI	E	NI	E	NI	E	O	O	28%	3	17%	22%	0	0%	0	0%
HVAC - Heating/Cooling, Ve	**HVAC - Heating/Cooling**																												
	1	Install programmable thermostats	E	E	O	FI	O	E	O	FI	FI	E	E	FI	E	X	X	X	X	E	46%	7	39%	23%	0	0%	4	22%
	3	HVAC Preventive Maintenance Contract	E	O	E	O	O	X	O	O	E	O	E	O	O	O	X	O	O	O	49%	12	67%	23%	0	0%	0	0%
	4	Maintain economizers on AC units	E	O	E	O	X	X	O	X	E	E	NI	O	NI	NI	NI	NI	NI	O	46%	5	28%	21%	0	0%	0	0%
	5	Weatherstrip exterior doors	E	E	E	O	E	X	E	E	E	O	O	NI	NI	O	X	X	NI	E	56%	4	22%	30%	0	0%	0	0%
	6A	Clean evaporator or condenser coils	E	O	E	O	O	X	O	O	E	E	NI	E	NI	O	NI	NI	NI	O	74%	7	39%	25%	0	0%	0	0%
	9	Place Appliances Completely under Hood, install side panels, and rebalance ventilation hood	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	66%	0	0%	30%	0	0%	0	0%
Refrigeration	**Refrigeration**																												
	8	Adjust walk-in defrost timeclocks and set properly, check for icing inside unit, or drain line problems and take corrective actions.	O	E	E	E	X	E	E	E	E	X	X	O	NI	X	NI	O	O	NI	26%	4	22%	10%	0	0%	0	0%
	1/3A	Replace/repair damaged doors, align and make sure they close property	E	O	E	E	X	O	E	FI	E	X	E	FI	E	X	E	E	E	E	46%	4	22%	50%	0	0%	2	11%
	4/7A	Install strip curtains and/or door closers on walk-ins	O	O	O	FI	X	FI	O	FI	O	X	O	FI	O	X	O	O	O	O	75%	15	83%	25%	0	0%	4	22%
	9A	Clean refrigeration evaporator or condenser coils	O	O	E	O	X	O	X	E	O	X	O	O	O	X	E	O	NI	O	74%	10	56%	25%	0	0%	0	0%
	12	Refrigeration Preventative Maintenance Contract	O	O	E	O	X	O	O	O	E	X	O	O	O	O	NI	O	O	O	72%	13	72%	28%	0	0%	0	0%
Capital Intensive Projects	**Capital Projects**																												
	1	Install EMS on kitchen exhaust and make-up air unit	O	O	O	X	O	X	O	O	O	O	O	O	O	NI	X	E	X	O	84%	12	67%	25%	0	0%	0	0%
	2	Purchase ENERGY STAR RTU or Boiler	E	E	O	E	O	X	O	FI	E	E	NI	X	NI	O	X	X	X	O	46%	6	33%	10%	0	0%	1	6%
	3	Retrofit Walk-in evaporator fans to ECM	O	O	O	O	X	O	O	O	O	X	O	O	O	X	O	O	O	O	67%	15	83%	26%	0	0%	0	0%
	5A	Controls Upgrades for Walk-in Units	O	O	O	O	X	O	O	O	O	X	NI	O	NI	X	O	FI	O	O	New	13	72%	New	0	0%	1	6%
	6A	Lighting Assessment	O	O	O	O	O	O	O	O	FI	NI	NI	NI	NI	O	NI	NI	NI	O	62%	11	61%	26%	0	0%	1	6%
	12	More Efficient Dishwasher	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	O	X	X	X	E	36%	1	6%	25%	0	0%	0	0%
	14	Install Condensing Water Heater	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	50%	0	0%	26%	0	0%	0	0%

Key: O = Opportunity; E = Existing Measure in Place; DI = Direct Install; FI = Follow-up Install; NI = Not Identifiable During Site Visit; X = Measure Not Applicable

Appendix I: Initial Audit Report Format

MichaelsEnergy

Energy Efficiency in Food Service

Site Information

Restaurant, Address, City, State Zip

Executive Summary

Restaurant is a 23,500 ft^2 building built in 1933 and primarily used as a full service restaurant.

Restaurant is open 7 days a week. Hours open include: Monday to Saturday 11am – 10pm and Sunday 10am – 9:30pm. 100% of the building is heated and cooled with the exception of the basement.

On-site energy assessment of Restaurant was conducted on July 25th 2013 with a program subcontractor. The goal was to implement low /no cost energy efficiency direct installs, identify and document recommissioning and investment opportunities to improve energy efficiency and conservation at Restaurant. This report includes estimated costs, eligible rebates and calculated energy savings with simple payback periods based on deemed savings best practices.

If all the recommendations in this report are followed, annual energy savings of $9,000 or 8% in annual energy savings based on 2012 energy use.

Energy Use History

Chart 1: Gas Use History

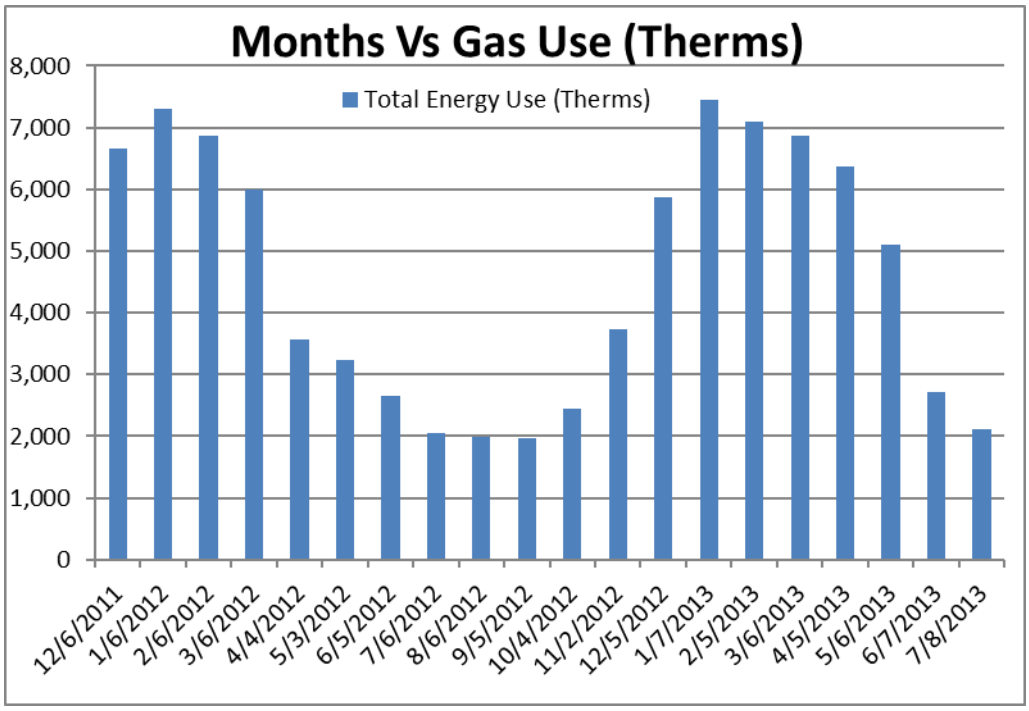
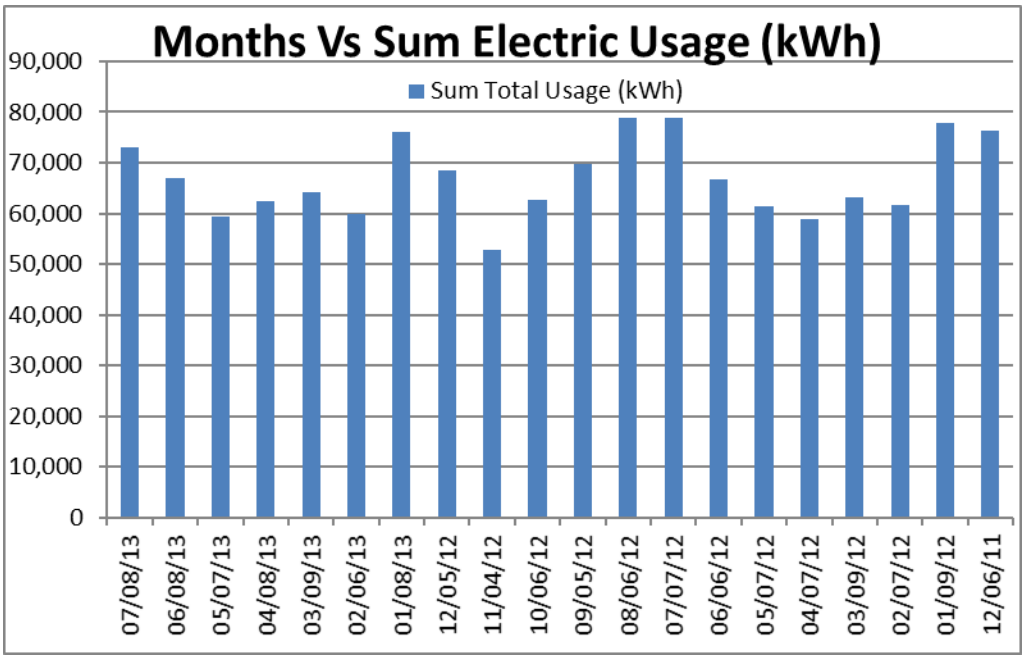


Chart 2: Electric Use History



Energy Use End Use and Benchmark

Chart 2: Energy use and Cost Breakdown

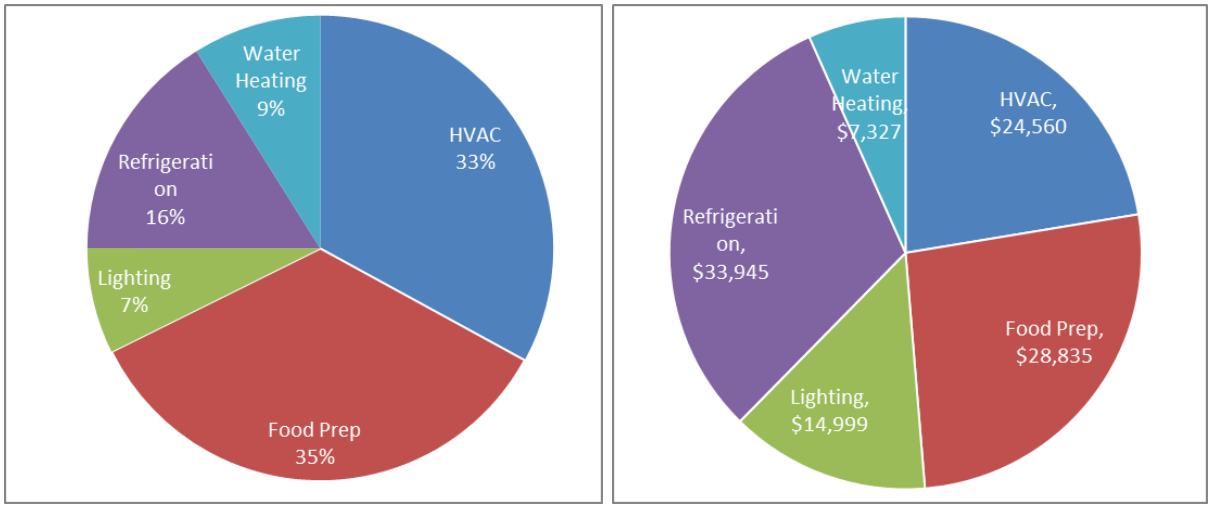


Table 1: Benchmark – Energy Use intensity comparison to restaurants in the Twin Cities and surrounding metro

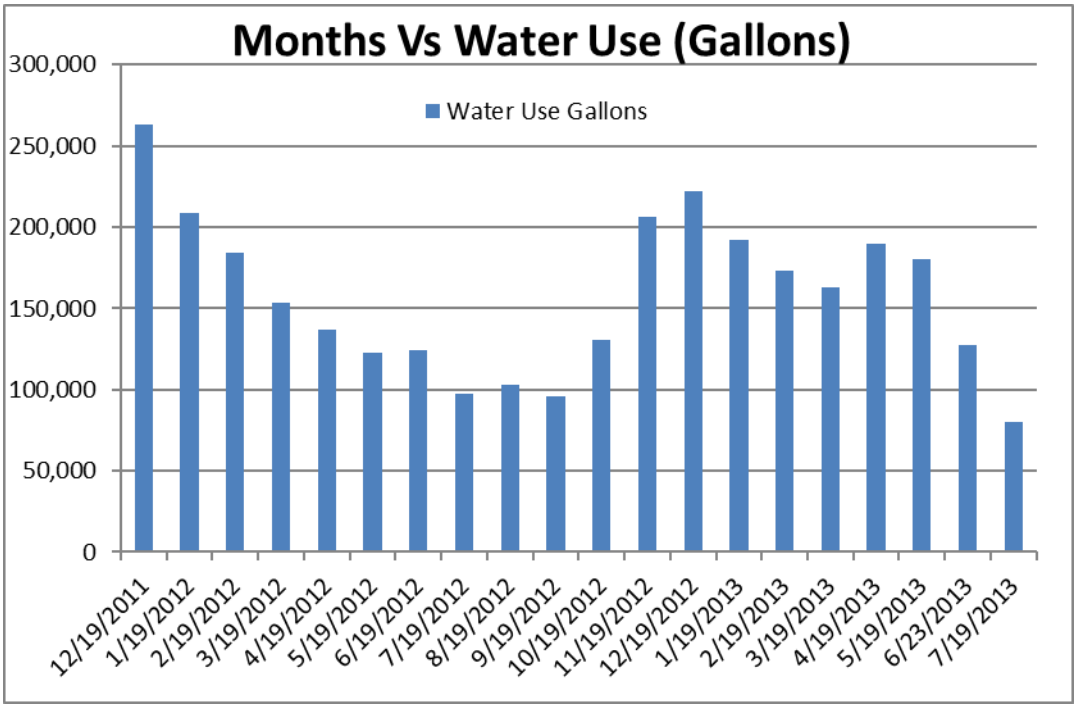
23,500	Electric Use Jax	Electric Avg. Restaurant	Gas Use Jax	Gas Avg. Restaurant	Total Use Jax	Total Avg. Restaurant
Energy Intensity	kBtu /sq ft 116	kBtu /sq ft 116	kBtu /sq ft 203	kBtu /sq ft 240	kBtu /sq ft 319	KBtu /sq ft 356
Energy Use (2012)	Kwh 800,607	Kwh 688,550	Therms 47,693	Therms 56,400	kBtu 7,501,772	kBtu 8,366,000
Energy Cost $ (2012)	Elec @$0.09 $78,943	Elec @$0.09 $67,894	Gas @$0.84 $30,724	Gas @$0.84 $36,333	Total $109,667	Total $104,227

Electric Use is the same and gas use is 18% lower than the values for energy use intensity in restaurants in Minneapolis and the surrounding metro area.

Energy Use intensity is a ratio of energy use to total square footage and does not account for hours of operation in a year or sales volumes.

Water Use History

Chart 3: Water Use History



Total Water Use in 2012 was 1,785,476 gallons of water at a cost of $15,958.

Water Use at Restaurant typically peaks between the months of November and June when the heating system is in use. The boiler operations should be evaluated to determine if there is excessive water use or waste.

Initial Site Visit

Key	Not Applicable	X	Existing	E	Opportunity	O

Table 2: Retrofit Measures Energy Assessment

Measures for Direct Installs	Status	Therms Savings	Monthly kW Savings	kWh Savings	Savings $	Rebate $	Final Cost $	Payback
Install up to (5) 1.0 GPM or less low flow faucet aerators	O	160	0.00	0	$90	$10	$0	0.00
Install (1) 1.1 GPM or less pre-rinse spray valve	O	40	0.00	0	$20	$40	$0	0.00
Setback make-up air duct thermostat to 55F in winter mode	E	0	0.00	0	$0	$0	$0	0.00
Set back hot water heater temperature to efficient temperature	E	0	0.00	0	$0	$0	$0	0.00
Adjust programmable T-stats to 55F for unoccupied heating and 85F for unoccupied cooling*	O	330	0.00	2,930	$360	$0	$0	0.00
Install LED lights in Walk-in units. (2) installed in walk-in Cooler replacing 100W incandescents.	O	0	0.21	370	$50	$60	$0	0.00
Adjust refrigeration and freezer temperature settings*	O	0	0.32	2,780	$210	$0	$0	0.00
Adjust Walk-in freezer Defrost time clocks	E	0	0.00	0	$0	$0	$0	0.00
Total Initial Site Visit Measures		**530**	**0.53**	**6,080**	**$730**	**$110**	**$0**	**0.00**

Direct Installs are no cost /low cost measures that can be done immediately to achieve annual energy savings. Measures identified for more savings during the initial site visit include:

1. Increasing the temperature setbacks for some or all thermostats from 75F to 80F in the summer and from 60F to 55F in the summer during the unoccupied times (Midnight – 8am).
2. The walk-in freezer was set at -10F. FDA recommends walk-in freezer ranges of (-10 to 0) F. There is an opportunity to increase the freezer set point from -10F to -5F.

Refrigeration Recommissioning

Key	Not Applicable	X	Existing	E	Opportunity	O

Table 3: Preventive Maintenance Measures Energy Assessment

Efficiency Measures /Action	Status	Monthly kW Savings	kWh Savings	Savings $	Initial Cost $	Rebate $	Payback
Install strip curtain at walk in freezer doors	O	1.37	390	$190	$230	$110	0.63
Install Strip Curtain at walk-in Cooler doors	O	1.10	1,230	$210	$450	$230	1.05
Clean Condenser Coils	O	0.00	0	$0	$0	$0	0.00
Clean Evaporator Coils	E	0.00	0	$0	$0	$0	0.00
Install New door gaskets and align doors to close properly	E	0.00	0	$0	$0	$0	0.00
Insulate refrigerant suction lines	O	0.00	0	$0	$0	$0	0.00
Total Refrigeration Measures		**2.47**	**1,620**	**$400**	**$680**	**$340**	**0.85**

HVAC Recommissioning

Table 4: Preventive Maintenance Measures Energy Assessment

Efficiency Measures /Action	Status	Therms savings	kW Savings	kWh Savings	Savings $	Initial Cost $	Rebate $	Payback
Insulate Hot water heater pipes	O	70	0.00	0	$40	$250	$75	4.38
Insulate 15psig steam boiler pipes	O	370	0.59	1,730	$380	$380	$100	0.74
Clean HVAC condenser coils	E	0	0.00	0	$0	$0	$0	0.00
clean HVAC evaporator coils	E	0	0.00	0	$0	$0	$0	0.00
Install programmable thermostat and adjust settings for energy savings	E	0	0.00	0	$0	$0	$0	0.00
Total HVAC Measures		**440**	**0.59**	**1,730**	**$420**	**$630**	**$175**	**1.08**

Preventive maintenance	Status	Initial Cost	Rebate $	Final Cost $
Perform Boiler Tune-up	O	$1,547	$390	$1,160
Forced air HVAC preventive Maintenance	O	$947	$250	$700
Refrigeration Preventive Maintenance	E			$0
Total 1st year Preventive Maintenance		**$2,494**	**$640**	**$1,860**

Capital Projects Recommissioning

Table 5: Capital Project Measures Energy Assessment

Efficiency Measures /Action	Status	Therm savings	kW Savings	kWh Savings	Savings $	Initial Cost $	Rebate $	Payback
Install CO2 Sensors on HVAC system	O	3,000	0.00	9,500	$2,200	$6,800	$2,700	1.86
Exterior building Lights	E	0	0.00	0	$0	$0	$0	0.00
Install EMS on kitchen exhaust and make-up air unit	O	1,000	8.35	35,100	$3,700	$20,000	$2,700	4.68
Retrofit Walk-in evaporator fans to ECM	O	0	0.21	1,870	$140	$700	$140	4.00
Replace electric booster heater in kitchen with a gas powered water heater *	O	0	0.00	0	$0	$0	$0	0.00
Floating head pressure Walk-in unit	O	0	0.00	6,900	$400	$2,100	$300	4.50
Parking Lot Area Lights	O	0	2.84	7,900	$800	$5,800	$680	6.40
Total Capital RCx Measures		**4,000**	**11.40**	**61,270**	**$7,240**	**$35,400**	**$6,520**	**3.99**
Total All Retrocommissioning Measures		**4,970**	**14.99**	**70,700**	**$8,790**	**$ 36,810**	**$7,035**	**3.39**

Program rebate and final cost values are based on our best estimates and may vary depending on the contractor selected to do the work and the equipment installed.

Other Tasks /Summary notes

1. Options for aqua tower replacement to achieve water and energy savings.
2. Referral to CEE one stop for a lighting audit.

Financial Impact

Table 6: Free'd Cash from Energy Savings

FREE'd Cash from Energy Savings

To Invest in Energy Savings or Not ??

Investment and Escalation	
Investment of	$ 29,775
Energy Price Escalation	5%
Percent Savings (Scenario #1)	8%
Percent Savings (Scenario #2)	0%

Annual Energy Costs	
Electricity	$ 78,942
Natural Gas	$ 30,724
Propane	
Other	
Total	$ 109,666

Scneario #1 Make Energy Improvements | **Scenario #2 Do Nothing**

Year	Cost of Improvements	Energy Spend	Savings	Cost of Improvements	Energy Spend	Savings
0	$ 29,775	$ 109,666		$ -	$ 109,666	
1		105,920	9,230		115,149	-
2		111,216	9,691		120,907	-
3		116,777	10,176		126,952	-
4		122,615	10,684		133,300	-
5		128,746	11,219		139,965	-
6		135,183	11,779		146,963	-
7		141,943	12,368		154,311	-
8		149,040	12,987		162,027	-
9		156,492	13,636		170,128	-
10		164,316	14,318		178,634	-
Totals	**$ 29,775**	**$ 1,332,248**	**$ 116,088**	**$ -**	**$ 1,448,336**	**$ -**

NET Cost #1 $ 1,362,023 | **NET Cost #2 $ 1,448,336**

10 Year FREE'd Cash Flow $ 86,313

Note: This analysis does not discount the value of money in time. A more sophisticated analysis will provide that information.

Photos

Top Left: water heater with un-insulated pipes and automatic flue damper
Top right: Un-insulated pipes for boiler
Bottom left: Old exhaust fans with huge old constant speed motors
Bottom right: Walk-in cooler and freezer with exposed suction lines

Top Left: Downstairs Kitchen exhaust hood.
Top right: Roof top unit economizers
Bottom Left: Air handling Unit water Lines connecting city water to aqua tower and condensers
Bottom right: Fresh air MUA for basement and dining areas.

Appendix J: Audit Report Formal Final Version

MichaelsEnergy

Energy Efficiency in Food Service

Site Information

Restaurant, Address, City, State Zip

Photos of Restaurant

Executive Summary

In March, 2014, RESTAURANT completed an energy audit to look for ways to save energy. RESTAURANT requested this audit from UTILITY after seeing significant energy costs for their first month of operation. The high cost is related to **electric demand** which is the peak electric usage in a given month.

The initial site visit was provided at no cost and included installing two LED light bulbs in the walk-in coolers, three low flow faucet aerators and resetting three thermostats for a 10 degree setback during unoccupied periods. The items provided at the initial visit should result in an annual energy savings of **$1,500**. Additional measures were identified which would save approximately **$6,200** per year at an initial cost of approximately **$13,000**. Grant funding of approximately **$3,000** is available to support these measures. Rebates from utilities may also be available. The majority of the savings identified for this facility are related to preventative maintenance and lighting. There are also many cost effective measures identified for the refrigeration systems.

This effort was supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources. CONTRACTOR was on site to evaluate opportunities for preventative maintenance and other energy efficiency measures.

Natural gas service is provided by UTILITY. Chart 1 shows the projected annual gas usage. Electric service is provided by UTILITY.

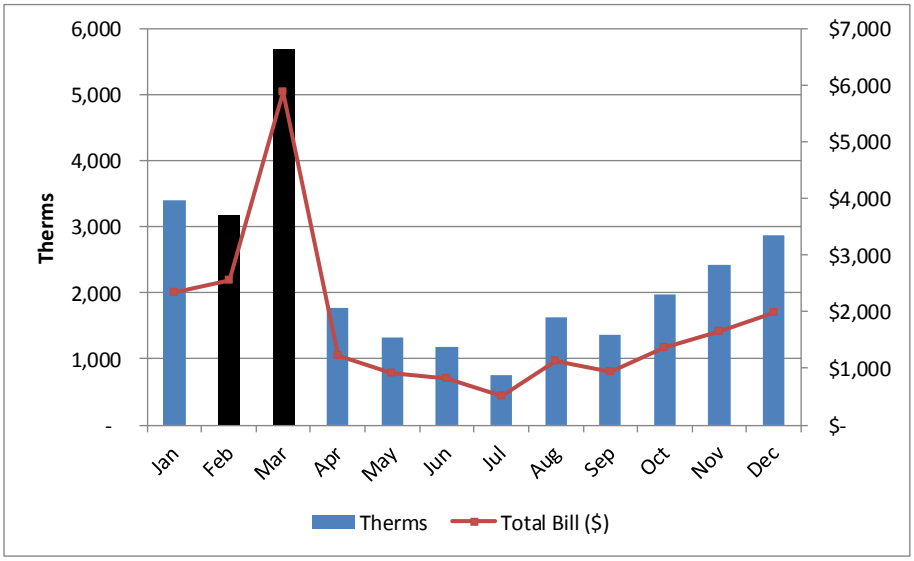


Chart **2** shows the projected annual electric usage. The average cost for electricity is $0.14/kWh and natural gas average cost is $0.77/therm, based on available utility bills. Demand charges are a significant portion of the cost of electricity for RESTAURANT.

Since RESTAURANT has only been open one month, annual energy use was estimated by using data from similar restaurants. The columns in black in the charts below are the actual usage by RESTAURANT while the blue columns are projected use. Gas use in March was high due to problems during initial operations and is expected to reduce significantly in the future.

Chart 1: Projected Annual Gas Usage

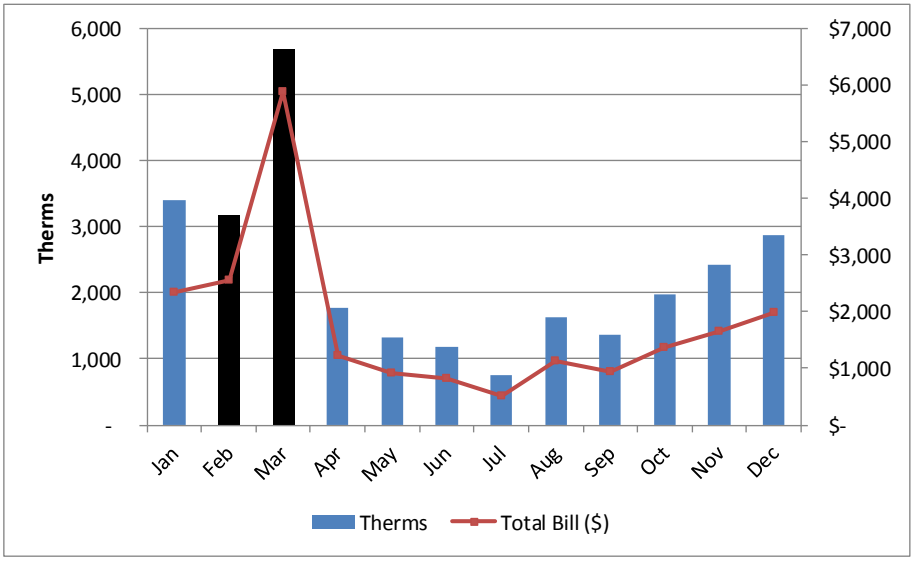
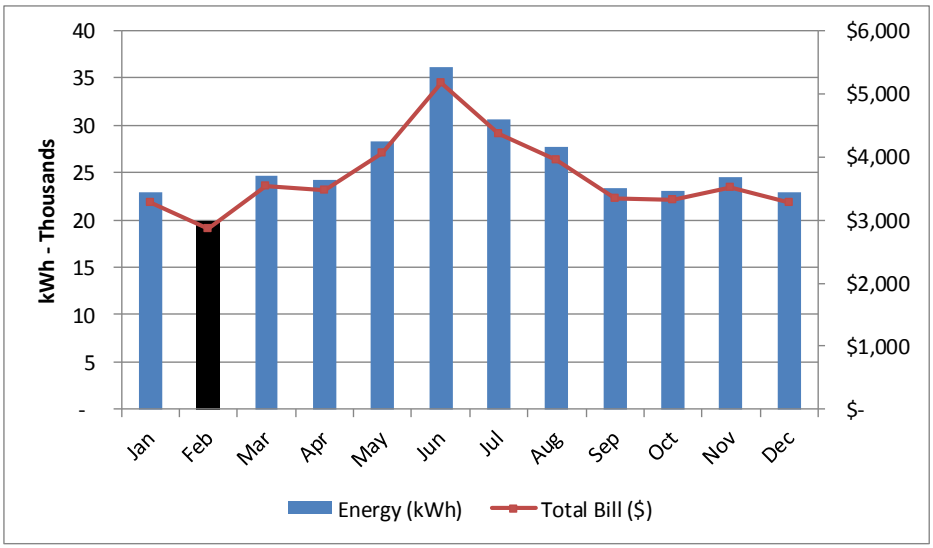
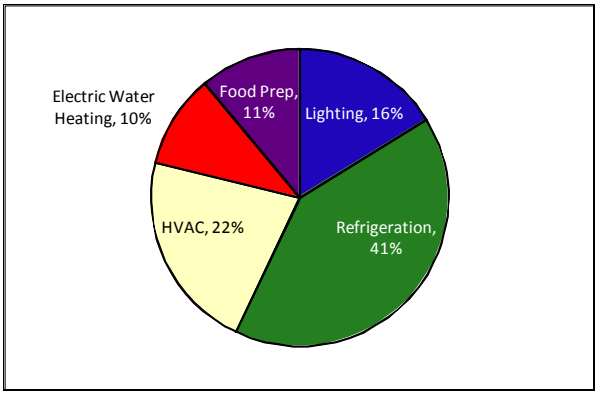


Chart 2: Projected Annual Electric Usage



The estimated End Use of Energy by major energy using systems is presented in Figures 1, 2 and 3. Electric use and electric demand were estimated from the equipment identified during the audit. Gas use is only an estimate and based on gas use profiles of similar restaurants. This report highlights low cost and no cost measures to reduce both energy consumption and electric demand. Installing strip curtains in the walk-in coolers is one example for reducing energy consumption. Running the icemaker only at night to fill up the storage bin, is a no cost way to reduce peak demand.

Figure 1: Electrical End Use (left) and Figure 2: Gas End Use (right)



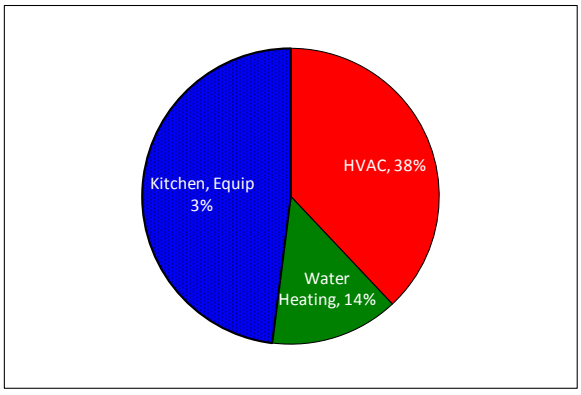


Figure 3: Demand

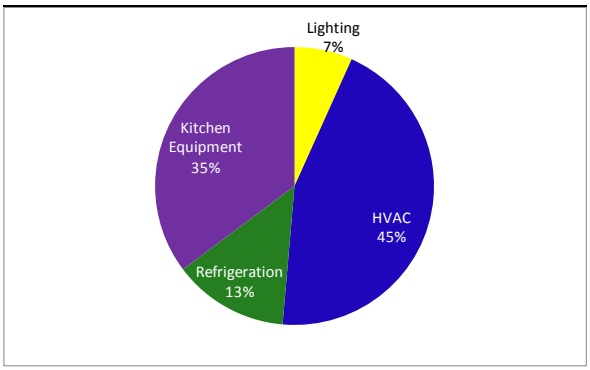


Table 20 compares the energy consumption per square foot of RESTAURANT to a similar restaurant in the Twin Cities area. This comparison shows demand is relatively high at RESTAURANT while energy consumption is almost the same. Gas use is relatively high also. These show there are opportunities to reduce energy costs.

Table 20: Benchmark of Energy Use Intensity

	Electric Use RESTAURANT	Electric Similar Restaurant	Gas Use RESTAURANT	Gas Similar Restaurant	Total RESTAURANT	Total Avg. Restaurant
Energy Intensity	kWh/sq ft 25.7	kWh/sq ft 28	Therm/sq ft 2.3	Therms/sq ft 1.82	kBtu /sq ft 318	KBtu /sq ft 278
Demand	121.6	29	NA	NA	NA	NA
Annual Energy Use	kWh 308,366	kWh 308,880	Therms 27,595	Therms 20,058	kBtu 3,811,952	kBtu 3,060,007
Annual Energy Cost $	Cost $44,126	Cost $29,164	Cost $21,310	Cost $16,901	Total $65,436	Total $46,065

Initial Site Visit

Table 21 provides a summary of the direct install measures that were installed at RESTAURANT. These measures will provide over $1,500 annually in energy savings and were installed at no cost. There is still an opportunity to set back the temperature controller on the makeup air unit as this was set at 72F during the inspection.

Table 21: Summary of Direct Install Measures

Direct Install Measures	Rough Estimated Demand Savings (kW)	Rough Estimated Electrical Savings (kWh)	Rough Estimated Gas Savings (therms)	Rough Annual Energy Savings ($)
Retrofit three sinks with low flow aerators	0.00	0	200	$ 100
Implement Setback Controls on Thermostats and MUA	0.00	2900	1500	$ 1,300
Install LED Lights in Walk-in Cooler	0.12	1000	0	$ 100
Total	0.12	3,900	1,700	$ 1,500

Recommended Measures

Table 22 provides a summary of recommended measures for energy savings at RESTAURANT. These measures will provide approximately $6,200 in annual energy savings. Grant funding of approximately $3,000 is available to support these actions. Utility rebate funds are also available and for "custom" measures require further evaluation to determine rebate levels.

Table 22: Summary of Recommended Measures

Energy Saving Strategy	Rough Estimated Measure Cost ($)	Rough Estimated Demand Savings (kW)	Rough Estimated Electrical Savings (kWh)	Rough Estimated Gas Savings (therms)	Rough Annual Energy Savings ($)	Grant Funding	Est. Utility Rebate	Approx. Payback (Years)	Recommended Action*
Five 13.5-watt LED bulbs in Walk-in Coolers and	$ 100	0.31	2,700	0	$ 200	$ -	$ 80	0.1	1
Strip Curtain and Door Closer in Walk-in Freezer	$ 500	0.01	3,400	0	$ 200	$ 100	$ -	1.6	1
Strip Curtains / Door Closers in Two Walk-in Coolers	$ 900	0.00	2,700	0	$ 200	$ 300	$ -	3.3	1
Replace 8 Evaporator Fan Motors with ECM Motors	$ 2,800	0.85	7,500	0	$ 600	$ 800	$ 80	3.2	1
Floating Head Pressure Controller on Walk-in Freezer	$ 2,100	0.00	4,100	0	$ 300	$ 200	$ 200	6.4	3
Preventative Maintenance	$ 4,500	7.81	14,000	100	$ 1,900	$ 1,500	$ -	1.5	1
Install Defrost Controller on Walk-in Freezer	$ 800	0.00	5,500	0	$ 400	$ 300	$ -	1.4	1
Replace Incandescent Lighting with LED and Timers	$ 3,600	5.85	28,000	0	$ 2,500	$ -	$1,400	0.8	1
Run Icemaker at Night to Reduce Demand	$ -	1.45	0	0	$ 200	$ -	$ -	-	1
Total	**$ 13,200**	**16.28**	**63,800**	**100**	**$ 6,200**	**$ 3,000**	**$1,560**	**2.1**	

*Recommended Actions
1 Obtain Specifications for Implementation
2 Further Study Required
3 Drop / Not Recommended
4 Implementation on Equipment Failure / End of Life

** Only projects with Recommended Action 1 and 2 are included in the totals.

Preventative Maintenance:

As a rule of thumb, approximately 5% of compressor energy use will be saved by cleaning dirty evaporator and condenser coils. This applies to both refrigeration units like the walk-in coolers and the rooftop HVAC units that provide air conditioning. Preventative maintenance also includes an inspection of the economizer controls on the HVAC units. The savings estimate assumes this work shall result in a small reduction in outdoor air which means less air conditioning and heating load.

Lighting

This report includes only a rough estimate of the potential energy savings achieved by replacing the incandescent lighting with LED lighting. It was assumed that the parking lot lights are on a photocell and installing a timer to shut the lights off at 11 pm could reduce energy consumed by the parking lot lights by 50%.

Evaporator Defrost Controller for Walk-in Freezer:

Typically the defrost heaters on walk-in freezers run on a timer that turns on the heaters for 15 minutes 3 times per day. More sophisticated controllers monitor coil temperature and only run the defrost cycle when needed. Case studies have shown that this reduces the amount of time the heaters run by approximately 80%. Michaels Energy is working with another facility to conduct an on-site test of the technology provided by KE2 Therm to measure and confirm the estimated savings. This measure should be considered when the older evaporator in the walk-in freezer is replaced. This measure should also be evaluated under the utilities custom rebate program.

Floating Head Pressure Controllers for Walk-in Coolers:

The existing compressors for the walk-in units control to a constant head pressure. In colder outdoor air conditions the head pressure can run at a lower pressure and still reject heat adequately. The floating head pressure controller monitors outdoor air temperature and adjusts the compressor head pressure to minimize energy usage. Michaels Energy and Total Refrigeration have tested the controller by Efficient Refrigeration System and have documented a 30% energy savings on a smaller convenience store walk-in freezer. This measure should be considered when capital dollar are available.

Financial Impact

Table 23 provides a life cycle analysis of the financial impact of savings from energy efficiency. In 10 years approximately $89,000 of cash should become available from implementing the recommended measures.

Table 23: Financial Analysis

FREE'd Cash from Energy Savings

To Invest in Energy Savings or Not ??

Investment and Escalation	
Investment of	$ 13,000
Energy Price Escalation	5%
Percent Savings (Scenario #1)	12%
Percent Savings (Scenario #2)	0%

Annual Energy Costs	
Electricity	$ 44,000
Natural Gas	$ 21,000
Propane	
Other	
Total	$ 65,000

Scneario #1 Make Energy Improvements

Year	Cost of Improvements	Energy Spend	Savings
0	$ 13,000	$ 65,000	
1		60,080	8,170
2		63,084	8,578
3		66,238	9,007
4		69,550	9,458
5		73,028	9,931
6		76,679	10,427
7		80,513	10,948
8		84,539	11,496
9		88,766	12,071
10		93,204	12,674
Totals	**$ 13,000**	**$ 756,000**	**$ 103,000**

NET Cost #1 $ 769,000

Scenario #2 Do Nothing

Cost of Improvements	Energy Spend	Savings
$ -	$ 65,000	
	68,250	-
	71,663	-
	75,246	-
	79,008	-
	82,958	-
	87,106	-
	91,462	-
	96,035	-
	100,836	-
	105,878	-
$ -	**$ 858,000**	**$ -**

NET Cost #2 $ 858,000

10 Year FREE'd Cash Flow $ 89,000

Note: This analysis does not discount the value of money in time. A more sophisticated analysis will provide that information.

Site Pictures

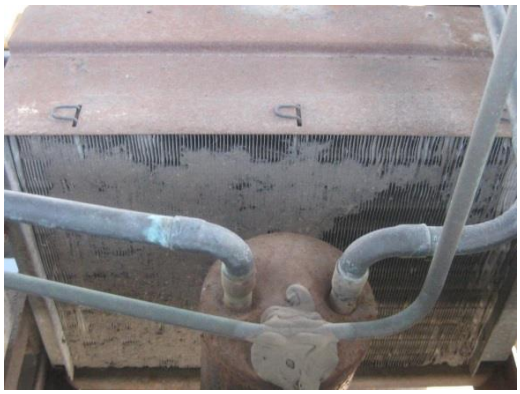
Picture 1: Walk-in Cooler Lights and Evaporator

Picture 2: Icing on Freezer Door

Picture 3: Old Style Strip Curtains (sample photo)

Picture 4: New Style Strip Curtains (sample photo)

Picture 5: Dirty Condenser Coil



Picture 6: Dirty Evaporator Coil

Picture 7: Hot Water Drain on Steamer

Picture 8: Door not closed on Cooler

Picture 9: High Watt Parking Lot Lights

Picture 10: T12 Lighting in Kitchen

Picture 11: Temperature Control for Make-up Air

Picture 12: Damaged Suction Line Insulation

Picture 13: Attic Insulation

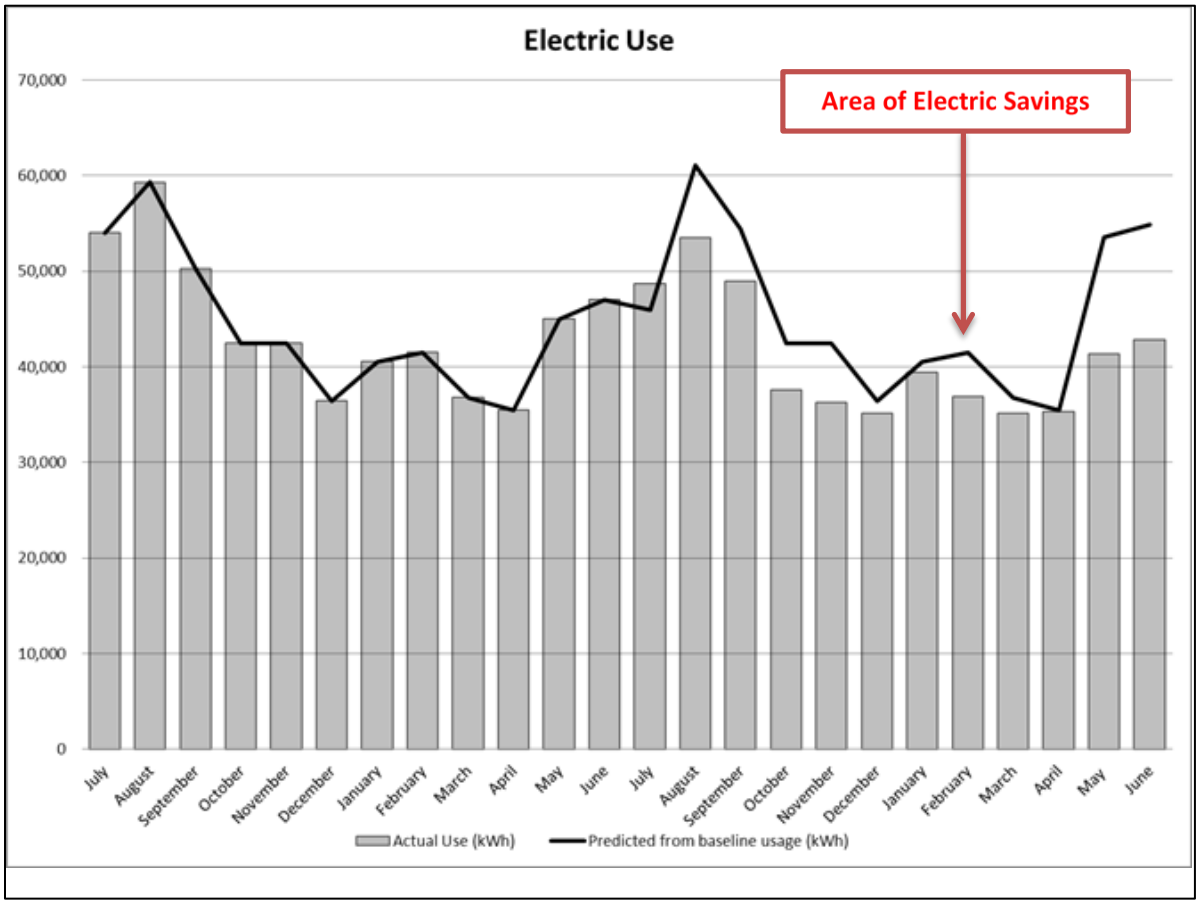
Appendix K: Example of Periodic Report

Periodic Energy Use Report

Baseline Year: July 2012 – June 2013 **Audit: August 2013**

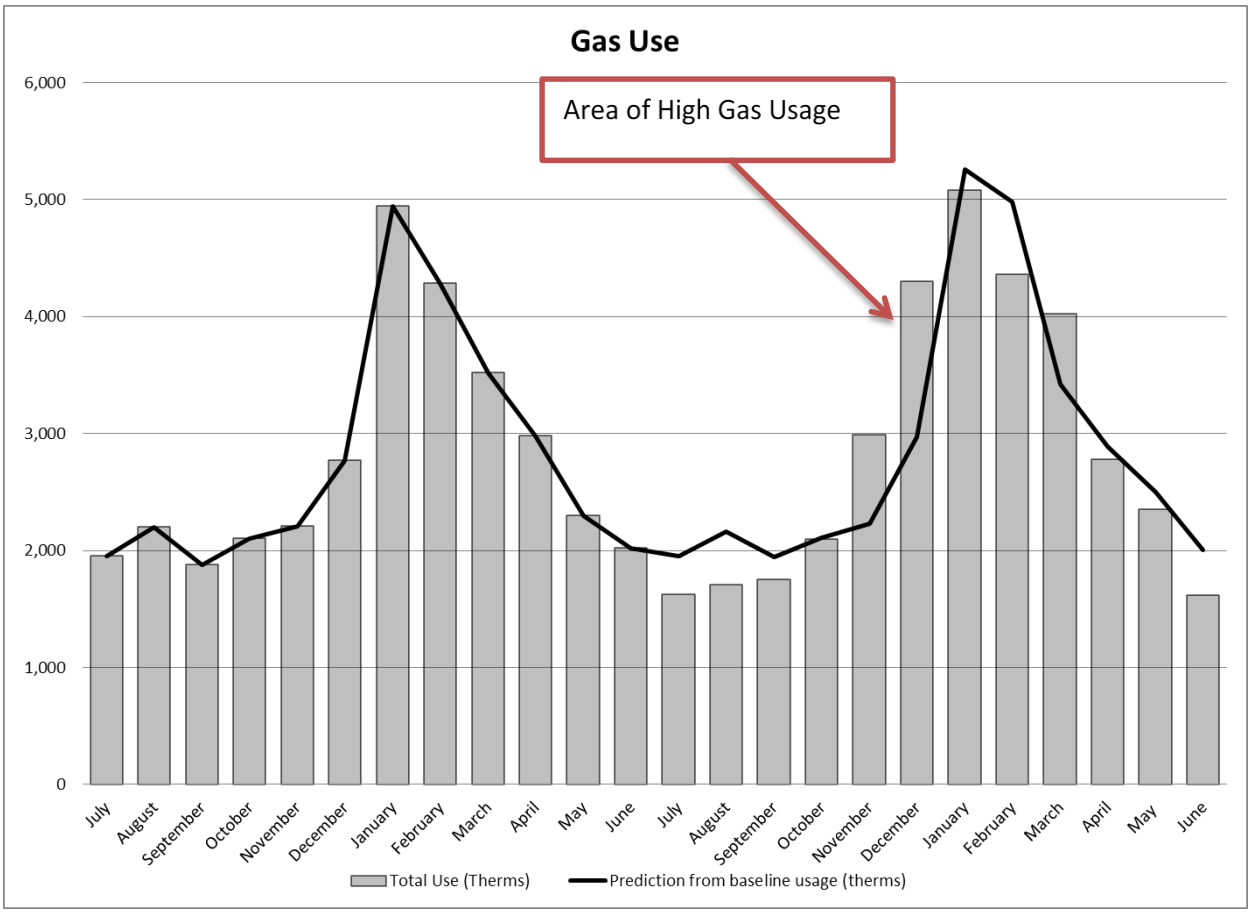
Year Two: July 2013 – June 2014

Restaurant Name - Location



Base Year Data:	**531,000 kWh**	**$53,500**
Year 2 Usage:	**491,000 kWh**	**$51,900**
Projected Usage (weather corrected)	**545,000 kWh**	**$57,600**

Savings (weather corrected) **$5,700**	**Savings (weather corrected)** **9.9%**



Base Year Data:	**33,100 Therms**	**$24,600**
Year 2 Usage:	**34,700 Therms**	**$29,600**
Projected Usage (weather corrected)	**34,400 Therms**	**$29,400**

Loss (weather corrected)	Loss (weather corrected)
($300)	**-0.9%**

Overall Impact:

Dollars Saved:	Cars off the Road Annually:	10 Year value of Energy Savings/Increase:
$5,400	7	$65,700

Appendix L: Detailed Information for Follow-up Activities

ID	Type*	Date of Report	Proposed Project List	Cost of Projects	Estimated Savings	Proposed Funding	Actual Projects	Actual Funding	Cost to Business	Follow-up?	Proposed Project List?	On-Site Discussion?	Energy Use Relevant?	More info?	Better Calcs?
1	Rest	7/16/2014								No	No	None	No	No	No
2	Rest	7/16/2014								No	No	None	Not sure	No	No
3	Rest	7/11/2014								No	No	None	Not sure	No	No
4	Rest	7/16/2014	8/11/2014	$1,574	$480	$1,200	$500	$500	$0	Yes	Yes	8/19/2014	Yes	Yes	Yes
5	Rest	7/16/2014								No	No	None	No	No	No
6	Rest	7/16/2014	8/7/2014	$500	$600	$500	$500	$500	$0	Yes	Yes	7/29/2014	No	Yes	Yes
7	Rest	8/7/2014								No	Yes	None	No	No	No
8	Rest	7/11/2014	8/7/2014	$1,000	$500	$1,000	$500	$500	$0	Yes	No	7/11/2014	Yes	Yes	Yes
9	Rest	8/4/2014	7/31/2014	$10,331	$3,810	$3,500	$1,983	$1,306	$677	Yes	Yes	7/22/2014	Yes	Yes	Yes
10	Rest	6/3/2014								No	No	None	Not sure	Yes	Yes
11	Rest	7/7/2014								No	No	None	Not sure	No	No
13	Rest	8/1/2014	9/2/2014	$4,862	$1,780	$2,370	$1,850	$1,750	$100	Yes	Yes	7/24/2014	Yes	Yes	Yes
15	Rest	None	8/15/2014	$2,108	$3,050	$1,300	$0	$0	$0	No	Yes	None	Not sure	No	No
17	Rest	7/22/2014								No	No	None	Not sure	No	No
18	Sch	None		$3,920	$724	$1,930	$0	$0	$0	No	Yes	None	No	No	No
19	Sch	None	5/22/2014	$7,122	$1,089	$1,621	$7,122	$1,621	$5,501	Yes	Yes	7/23/2014	Yes	Yes	Yes
20	Sch	None	8/6/2014	$1,700	$500	$750	$0	$0	$0	No	Yes	None	No	No	No
21	Rest	None								No	No	None	Yes	No	No
	Total:			**$33,117**	**$12,533**	**$14,171**	**$12,455**	**$6,177**	**$6,278**	**6**	**9**	**0**	**6**	**7**	**7**
	Average:			**$3,680**	**$1,393**	**$1,575**	**$1,384**	**$686**	**$698**						

* Type: Rest = Restaurant; Sch = School

		Periodic Progress Report June 2014									Periodic Progress Report Nov 2014						
ID	Type*	Base Cost of Energy	kWh	%	Therm	Therm, $	%	Total%	Cars	10 Yr Savings, $	kWh	kWh, $	Therm	Therm, $	Cars	Total %	10 Yr Savings, $
1	Rest	$109,666	5,000	0.6%	4,400	$3,700	7.7%	4%	5	$52,300							
2	Rest	$64,913	(23,000)	-4.7%	(2,300)	($1,800)	-7.2%	-7%	-5	($52,300)							
3	Rest	$70,208	54,000	9.9%	(300)	($300)	-0.9%	8%	7	$65,700							
4	Rest	$12,457	8,000	9.8%	(700)	($600)	-14.0%	4%	0	$6,100							
5	Rest	$8,935	(13,000)	-14.6%				-17%	-2	($18,300)							
6	Rest	$3,413			(200)	($200)	-4.5%	-6%	0	($2,400)							
7	Rest	$14,146	(5,000)	-5.4%	300	$300	5.1%	-2%	0	($3,700)							
8	Rest	$15,925	(5,180)	-5.9%	945	$868	10.3%	1%	0	$2,600	5,748	$701	1,072	$1,034	1.8	11%	$21,100
9	Rest	$73,977	44,000	8.6%	(2,900)	($2,500)	-10.4%	3%	3	$29,200	35,000	$3,900	(2,600)	($2,300)	2.2	2%	$19,500
10	Rest	$16,006	(8,020)	-8.3%	(1,707)	($1,621)	-28.1%	-16%	-3	($32,000)							
11	Rest	$37,204	10,000	3.9%	(1,700)	($1,500)	-10.7%	-1%	0	($4,900)							
13	Rest	$29,632	(1,000)	-0.6%	(1,000)	($900)	-7.5%	-3%	-1	($12,200)	11,900	$1,500	100	$100	1.7	5%	$19,500
15	Rest																
17	Rest	$14,448	3,000	4.2%	1,200	$ 1,100	15.8%	10%	2	$ 18,300							
18	Sch																
19	Sch																
20	Sch																
21	Rest																
Total:		**$470,900**	**69,000**		**(4,000)**	**($3,500)**		**3%**	**6.2**	**$48,400**	**53,000**	**$6,100**	**(1,400)**	**($1,200)**	**5.7**	**4%**	**$ 60,100**
Average:		**$36,200**	**5,700**		**(300)**	**($300)**		**1%**	**0.5**	**$3,723**	**17,500**	**$2,000**	**(500)**	**($400)**	**1.9**	**4%**	**$ 20,000**

* Type: Rest = Restaurant; Sch = School

Appendix M: Example Proposed Project List

Description	Estimated Cost	Estimated Savings	Grant Funding	Utility Rebate	Estimated Payback
Replace 4 manual T-Stats with Programmable T-Stats	$1,744	$140	$1,000	$0	5.3 years
Quarterly Preventative Maintenance Contract	$2,348	$1,200	$550	$0	1.5 years
Semi - Annual Preventative Maintenance Contract	$1,418	$600	$350	$0	1.8 years
Install high efficiency motors with new evaporator for cooler	$600 (estimated cost for high efficiency motors only)	$100	$200	$80	3.6 years
Clear Vu Swinging Door for Walk-in Freezer (FREE)	$500	$680	$500	$0	Immediate
Install booster heating for dishwasher	TBD	TBD	TBD	$750 for gas	TBD
TurboPot for boiling noodles	$100	$150	$20	$0	8 months

Traditional Strip Curtains

Swinging Door Curtain

Turbpot

Honeywell Vision Pro Thermostat

Appendix N: KE2 Therm Evaporator Efficiency M&V Report

The following report highlights the findings of tests done on walk-in freezers retrofitted for energy efficiency. The primary measure evaluated was the KE2 Evaporator controller for walk-in freezers. The intent of the research was to demonstrate and evaluate this energy efficient technology to Minnesota utilities and small businesses in the food service sector. In addition to the KE2 controller, there was an opportunity to observe the impact of electronically commutated motors, LED lights, electronic expansion valves and caulking seams in the box.

[Report follows this page]

Energy Analysis of KE2 Controllers for Walk-in Freezers

January 20, 2015

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Division of Energy Resources
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Contents

Executive Summary

This report highlights the findings of tests done on walk-in freezers retrofitted for energy efficiency. The primary measure evaluated was the KE2 Evaporator controller for walk-in freezers. The intent of the research was to demonstrate and evaluate this energy efficient technology to Minnesota utilities and small businesses in the food service sector. In addition to the KE2 controller, there was an opportunity to observe the impact of electronically commutated motors, LED lights, electronic expansion valves and caulking seams in the box.

One project, which included a complete overhaul of the walk-in unit, achieved 50% energy savings. In the second project, the only retrofit was replacing the defrost time clock with the KE2 controller and this project demonstrated 20% savings. These savings values can be compared to 15% savings claimed by the equipment manufacturer.

With estimated utility rebates included, the simple paybacks for these retrofits were approximately 5.6 years for the complete overhaul and 3.3 years for the simple replacement of the defrost time clock. If the non-energy benefits and incremental costs are evaluated, these are investments worth consideration.

Background

This analysis was funded by the Conservation Applied Research & Development (CARD) grant program managed by the Minnesota Department of Commerce, Division of Energy Resources, as part of a project evaluating methods for delivering energy efficiency programs to restaurants. During this research, a group of technologies were identified as being particularly well suited for the food service sector but lacking in market penetration. The technologies included the KE2 Evaporator Efficiency controller (KE2), smart thermostats for better control of rooftop units, and energy management systems for monitoring and addressing high energy use equipment. Of those technologies, the KE2 was selected for demonstration because of interest from host sites for piloting the technology.

The KE2 could be called a "smart defrost controller" because it does more than just control the evaporator defrost heater. A defrost heater reduces the icing that forms on the evaporator coil in walk-in freezer units, typically set to defrost for 15 to 30 minutes four times per 24 hours by a traditional time clock regardless of the need for defrost. The traditional defrost time clock is shown in Figure 1 and the KE2 is shown in Figure 2. The KE2 controller reduces the defrost heater run time by detecting when the defrost heaters are needed. It reduces the run time of the evaporator fans and captures cooling energy in the evaporator that is normally wasted. Finally, the controller also replaces the traditional thermostat control and defrost termination device to better control space temperature.

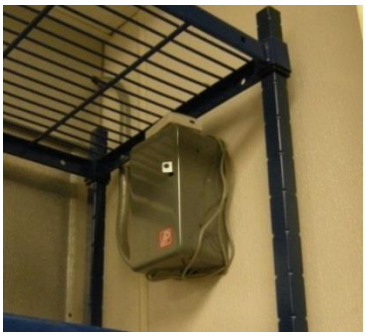

FIGURE 1: DEFROST TIME CLOCK

FIGURE 2: KE2 CONTROLLER

Two sites were identified to host a demonstration of the KE2 technology. The first site was a university that has a walk-in freezer in the kitchen serving the student cafeteria. The facility management was looking to do a complete overhaul of their 12-year-old walk-in unit and the KE2 would be part of the project. The other work included caulking seams to prevent infiltration, installing LED lights and replacing the evaporator. The new evaporator would have electronically commutated (EC) motors and an electronic expansion valve (EEV) instead of the typical thermostatic expansion valve (TXV). The second site was a convenience store that has a glass door walk-in freezer. At this site the only change to the refrigeration system would be to replace the defrost time clock with a KE2 controller.

Methodology

Research Goal

This research was intended to answer three questions about this technology as it pertains to small business applications in Minnesota.

1) What is the energy savings potential of the measure?
2) What is the typical cost to install and what is an appropriate rebate level?
3) What are the non-energy benefits?

The KE2 website provides a calculator estimating energy savings[1] of approximately 15% when the defrost time clock is replaced with the KE2 controller. This provides a starting point for estimating savings.

The first test was conducted on the walk-in freezer in a college cafeteria kitchen, which is similar to a walk-in freezer in a restaurant kitchen. The work included caulking seams to prevent air infiltration, installing LED lights and replacing the evaporator. The new evaporator has EC motors and an electronic expansion valve (EEV). The condensers for this unit are located indoors. Data loggers were installed to measure compressor energy consumption, defrost heater and evaporator fan energy consumption, and evaporator coil temperature. These parameters were logged for 15 days to establish baseline conditions. The retrofit work was then completed and the same parameters logged for 12 days after the retrofit. The outdoor temperature and relative humidity were obtained through a commercial weather service[2].

The second test was conducted on a convenience store walk-in freezer. This is a typical walk-in freezer for a convenience store. This unit has reach-in glass doors and since the store is open 24 hours a day they are opened more frequently than a kitchen unit. The condensers are located outdoors. Data loggers were installed to measure compressor energy consumption, defrost heater and evaporator fan energy consumption, evaporator coil temperature and space temperature. The outdoor temperature and relative humidity were measured at the condenser. The baseline condition was monitored for 12 days. Then the KE2 was installed and the same parameters were measured for seven days.

Non-energy benefits of the KE2 may include improved food quality, less ice buildup, more stable cooler temperatures and remote monitoring capability. Food quality and ice buildup were measured through photos and feedback from the site contacts, cooler temperature stability was monitored with data loggers, and the value of the remote monitoring capability was assessed using feedback from the site contacts.

[1] Per KE2 Energy Savings Calculator on company website
[2] Per Weather Underground web site on internet.

Results

College Cafeteria

The following data is based on a seven day period during the baseline measurement and a seven day period after the retrofit once the KE2 controller was able to settle out from the initial transition from the time clock control.

Energy Use

The environmental conditions during the base and proposed tests are shown in Chart 1 and Chart 2. Humidity levels were above 55% during both periods.

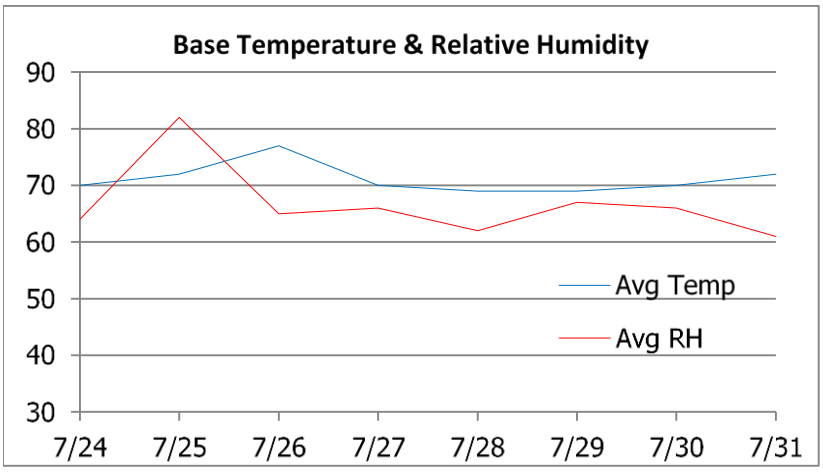

CHART 1: BASE TEMPERATURE AND RELATIVE HUMIDITY

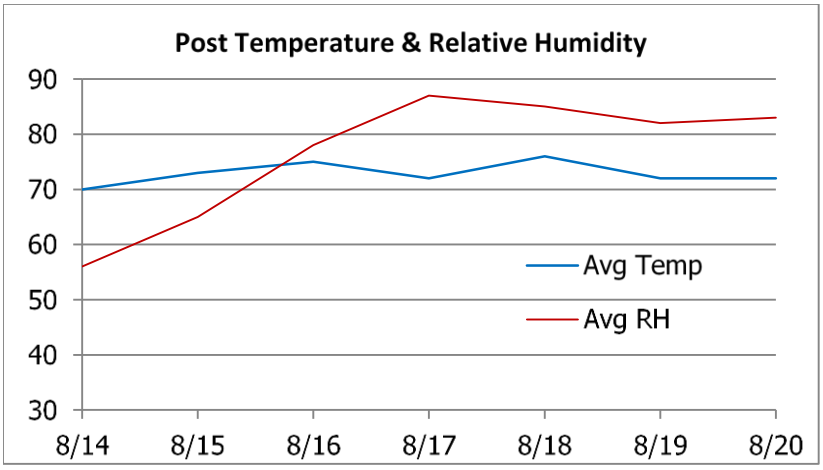

CHART 2: POST TEMPERATURE AND RELATIVE HUMIDITY

The evaporator coil temperature during the base and post test is shown in Chart 3 and ERROR! REFERENCE SOURCE NOT FOUND.. The peaks on both charts are the temperatures during the defrost

cycle. The low temperatures are the temperatures of coil during normal operation. While the normal coil temperature is relatively constant in both conditions at approximately -10 F, the defrost coil temperature was much higher in the base condition. After the retrofit, the maximum coil temperature during defrosts was only about 37°F as compared to up to 140°F pre retrofit.

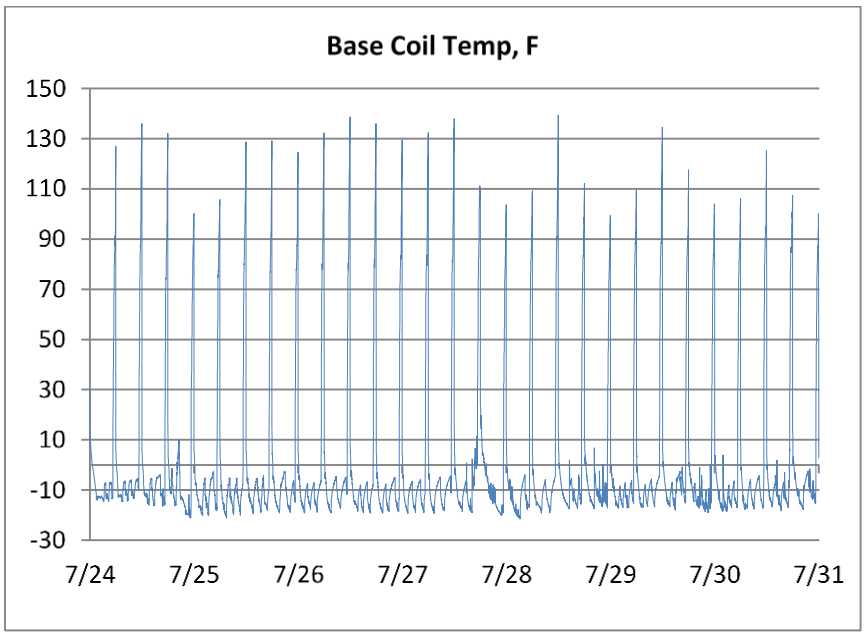

CHART 3: BASE COIL TEMPERATURE

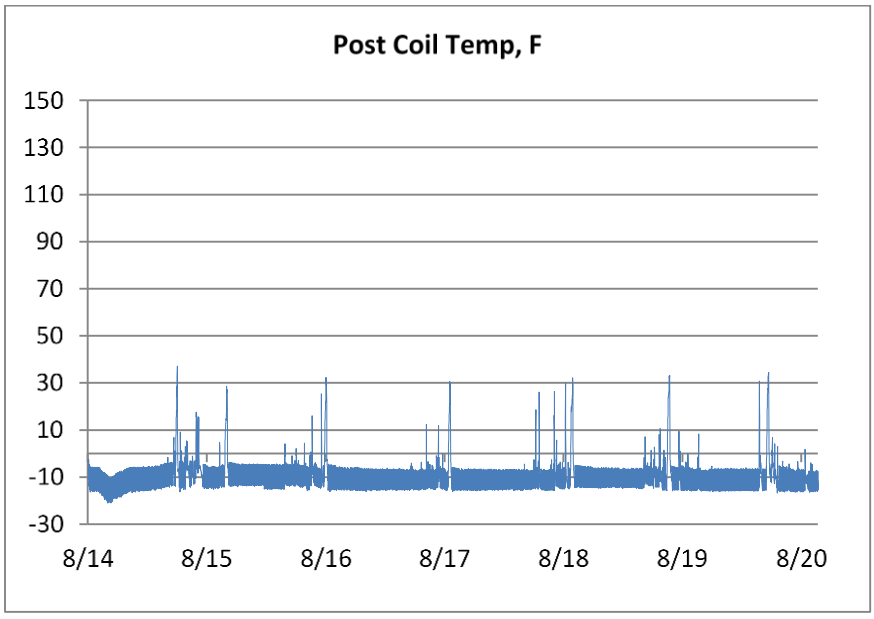

CHART 4: POST COIL TEMPERATURE

The defrost heater and evaporator fan amps during the baseline and post case tests are shown Chart 5 and ERROR! REFERENCE SOURCE NOT FOUND.. A comparison of the charts shows the reduction in defrost heater amp draw and frequency of defrosts. The lower line on the charts is the

evaporator fan motor amp draw. This shows the lower power consumption of the new EC motors and the defrost controls shutting off the evaporator fans when cooling is not needed (amps go to zero).

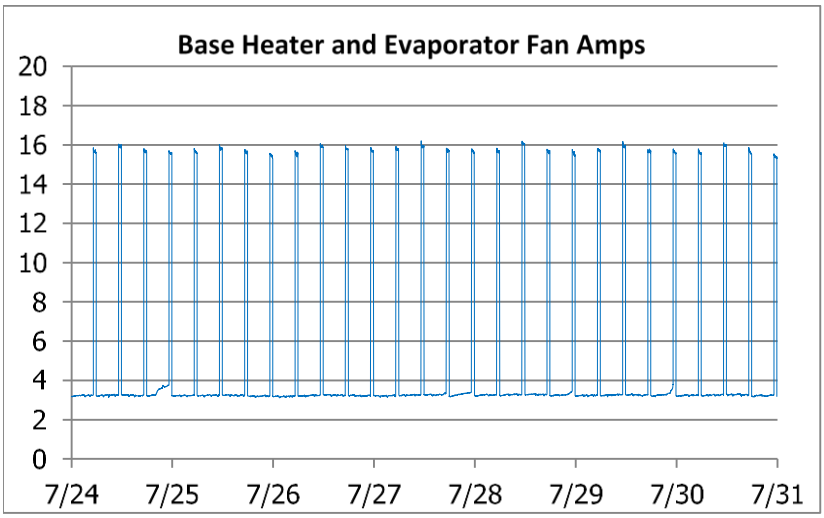

CHART 5: BASE HEATER AND EVAPORATOR FAN AMPS

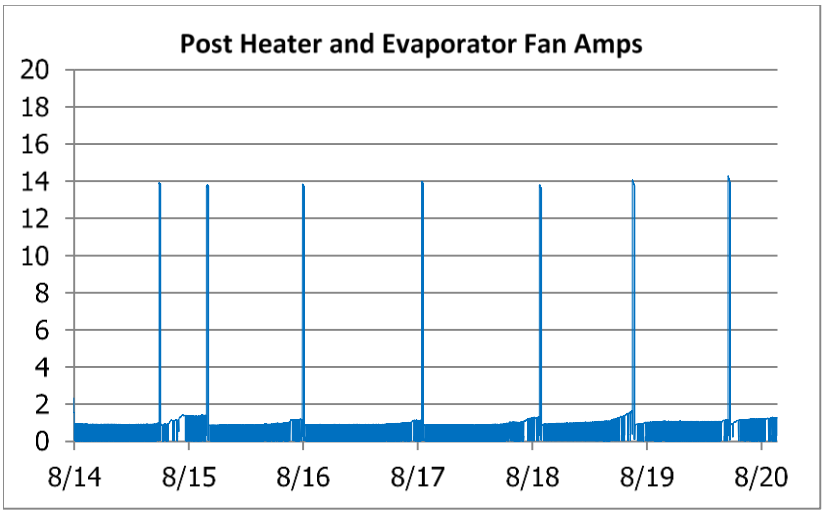

CHART 6: POST HEATER AND FAN AMPS

The equipment run time reduction estimates are show in Table 1. In the base case, the defrost heaters ran about 40 minutes, 4 times a day. In the post case, the defrost heaters only ran when needed to reduce frost or approximately 27 minutes once per day, or an 84% run time reduction. In the base case, the evaporator fans ran all the time except when the defrost heaters were running. After the retrofit, the KE2 shut down the evaporator fans if there was no call for cooling. This reduced fan run time 26%.

TABLE 1: RUN TIME REDUCTION ESTIMATES

Run Time Estimate	Base	Post	Run Time Reduction
Defrost Heaters	11.4%	1.9%	84%
Evaporator Fans	89%	63%	26%

The 5-minute average compressor power from the base case and post case are shown in Chart 7 and Chart 8. It appears that the compressor has more start/stop cycles in the post case. This may be due to the tighter controls on compressor starts from the KE2 controller.

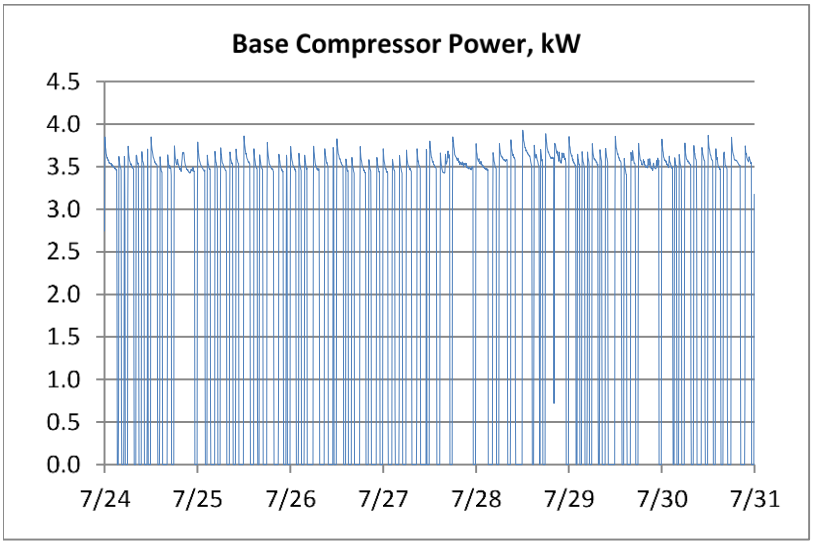

CHART 7: BASE COMPRESSOR POWER

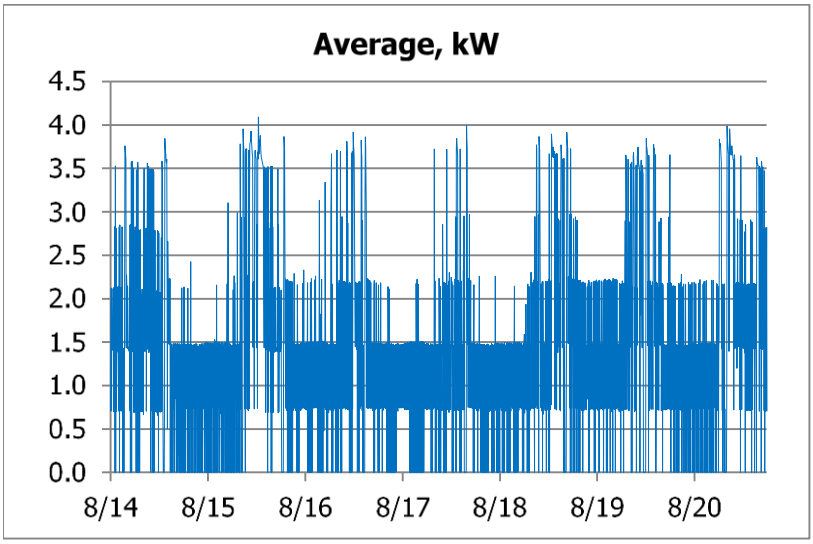

CHART 8: POST COMPRESSOR POWER

The annual energy use estimate for the walk-in cooler for the base and post conditions is shown in Table 2. The results from the 7-day test periods are extrapolated to a full year without any corrections for humidity levels. The environmental conditions for these tests showed the

relative humidity was greater than 60%. In summer months the humidity can certainly be higher than 60%, but in winter the humidity can be much lower. Therefore, extrapolating these test results out to an annual usage is rough, but likely a conservative savings estimate. This calculation estimates this retrofit will reduce annual energy usage by approximately 50%. Again, this project included more than the KE2 controller. LED lights were installed, the seams were caulked, and the evaporator was replaced with EC motors and an EEV.

TABLE 2: ANNUAL ENERGY USE ESTIMATE COLLEGE KITCHEN

ENERGY ANALYSIS						
		Compressor	**Defrost Heaters**	**Evaporator Fans (4)**	**Lights**	**Total**
BASE	**Avg kW**	2.24	3.27	0.676	0.192	6.38
	Annual kWh	19,634	3,262	5,251	841	28,988
POST	**Avg kW**	1.48	2.88	0.100	0.11	4.57
	Annual kWh	12,981	471	863	473	14,789
kW Reduction		**0.76**	**0.39**	**0.58**	**0.08**	**1.81**
kWh Reduction		**6653**	**2791**	**4387**	**368**	**14,199**
% kWh Reduction/Component		**34%**	**86%**	**84%**	**44%**	
% kWh Reduction/Total		**23%**	**10%**	**15%**	**1%**	**49%**

Cost

The cost for this project is shown in Table 3. In addition to the labor and material, a temporary freezer trailer was rented to store all the food while the work was completed. This project was supported by a custom rebate from Xcel Energy and was eligible for a prescriptive rebate for the EC motors. Grant funding was provided as well.

TABLE 3: INSTALLATION COSTS FOR COLLEGE

Cost Analysis		
LED lighting	$	1,295
New Evap and EC motors	$	1,289
KE2 Therm	$	1,803
Material Total	**$**	**4,387**
Labor	**$**	**2,010**
Trailer Rental	**$**	**400**
Freight	**$**	**325**
PROJECT SUBTOTAL	***$***	***7,122***
Grant Funding	**$**	**1,320**
Custom Rebate	**$**	**301**
Prescriptive Rebate	**$**	**280**
PROJECT TOTAL	**$**	**5,221**

Non-Energy Benefits

The amount of icing on the ceiling pre- and post-retrofit is shown in Figure 3 and Figure 4. The floor condition before the retrofit is shown in Figure 5. The elimination of icing in the box improved safety and food quality. These photos also show the original T8 light fixtures in the original installation and LED light fixtures in the retrofit. The food service manager was impressed with the improved light levels that resulted from the LED lighting retrofit.

FIGURE 3: ICING ON CEILING BEFORE RETROFIT AND T8 LIGHTS

FIGURE 4: NO ICE ON CEILING AFTER RETROFIT AND LED LIGHTS

FIGURE 5: ICE ON FLOOR BEFORE RETROFIT

Examples of the food quality before and after the retrofit are shown in Figure 6 and Figure 7. Freezing and thawing can form ice crystals which can negatively impact food quality. Visually, it appears that fewer ice crystals form on the food after the retrofit.

FIGURE 6: FOOD QUALITY PRIOR TO RETROFIT

FIGURE 7: FOOD QUALITY AFTER RETROFIT

The KE2 controller has the capability to connect to the internet so the walk-in condition can be monitored remotely or operating parameters trended over time. Alarms can be programmed to notify personnel if there is a need for corrective action. The capability to remotely monitor the cooler was configured for this project by pulling a communications cable from the controller in the walk-in unit. All that remained was to connect the device to the facility internet server. Due to other priorities, this final connection was not completed during this test. Based on conversations with site personnel, they intend to install this feature and felt this was a value added feature of the device.

Convenience Store

At the convenience store, the only retrofit was replacing the defrost time clock with the KE2 controller. This walk-in unit already had LED lights but did not have EC motors. This project was considered a likely retrofit for the typical small business with a walk-in freezer.

Energy Use

The outdoor environmental conditions during the pre- and post-tests are shown in Chart 9 and Chart 10.

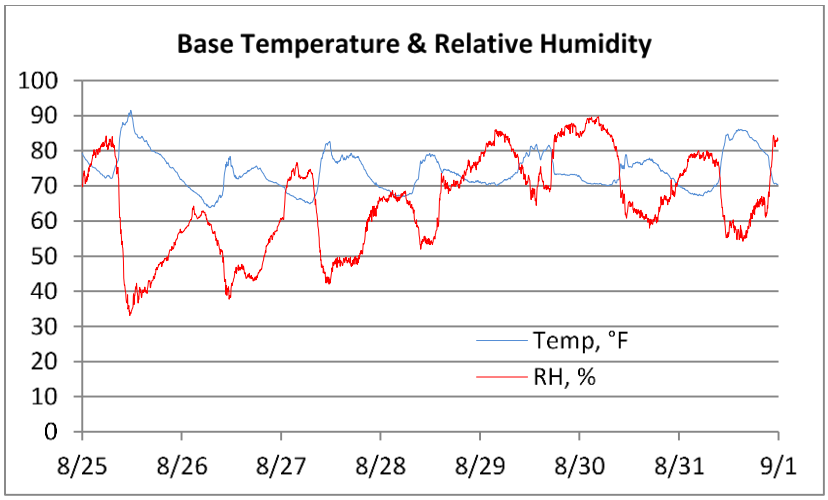

CHART 9: BASE TEMPERATURE AND RELATIVE HUMIDITY

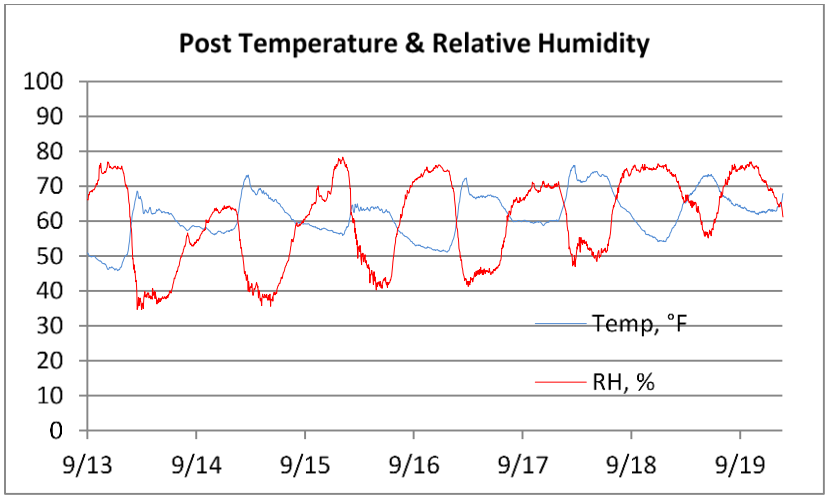

CHART 10: POST TEMPERATURE AND RELATIVE HUMIDITY

The evaporator coil temperature during the pre- and post-condition is shown in Chart 11 and Chart 12. The equipment run time estimates are shown in Table 4. While the standard coil temperature is relatively constant in both conditions, the defrost coil temperature got much higher in the base condition. After the retrofit, the maximum coil temperature was only about 70°F as compared to up to 115°F pre-retrofit. In the base case, the defrost heaters ran 28 minutes 4 times per day. In the proposed case, the defrost heaters ran only 20 minutes every 14 hours.

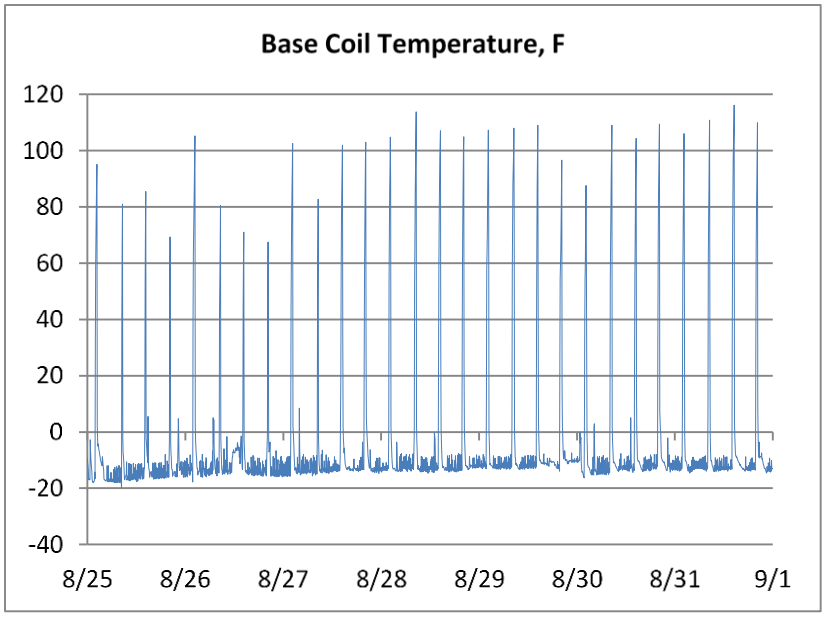

CHART 11: BASE COIL TEMPERATURE

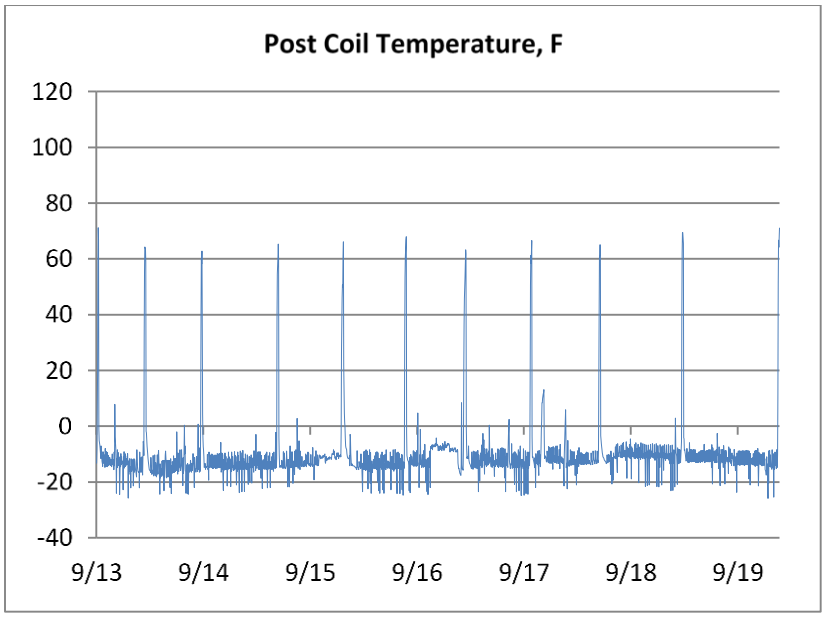

CHART 12: POST COIL TEMPERATURE

TABLE 4: EQUIPMENT RUN TIMES CONVENIENCE

Run Time Estimate	Base	Post	Run Time Reduction
Defrost Heaters	7.8%	2.4%	69%
Evaporator Fans	92%	89%	3%

The defrost heater and evaporator fan amps during the base and post tests are shown in Chart 13 and Chart 14. A comparison of the charts shows the defrost heater power is constant but the

frequency of defrosts has reduced. The lower line is the evaporator fan power. The comparison shows the fan power level is constant, but that the KE2 controller is shutting off the fans more frequently.

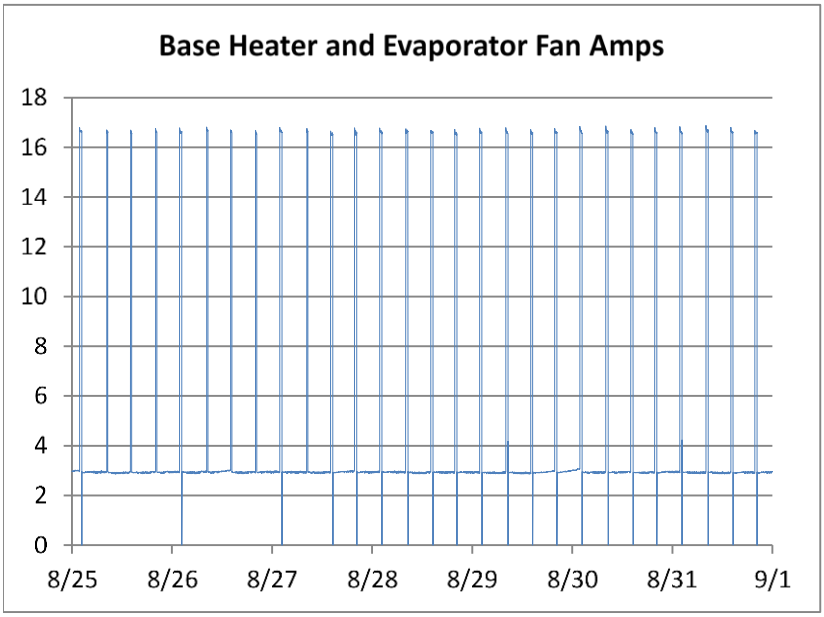

CHART 13: BASE HEATER AND EVAPORATOR FAN AMPS

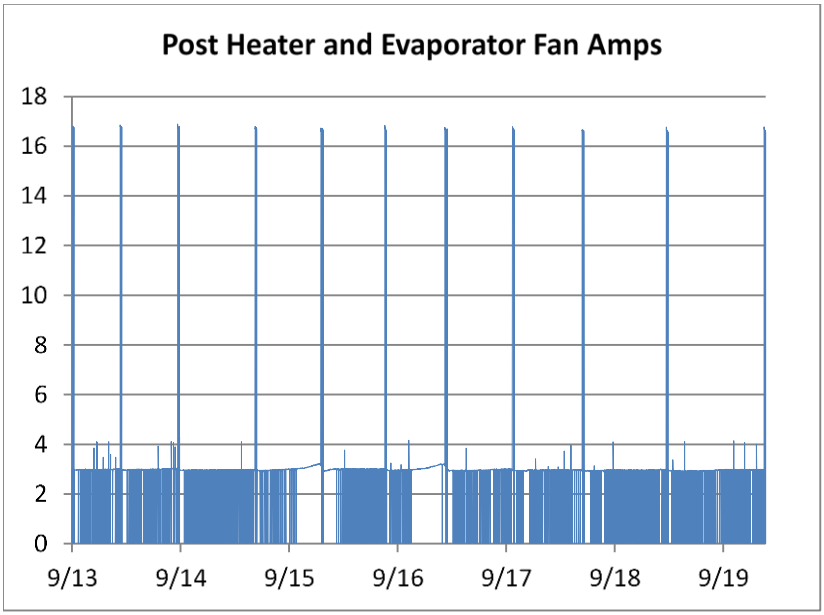

CHART 14: POST HEATER AND EVAPORATOR FAN AMPS

The 15-minute average compressor power from the base case and post case are shown in Chart 15 and Chart 16. While in the base case the compressor power spikes above 4.5, it never gets above 3.5 kW in the post case.

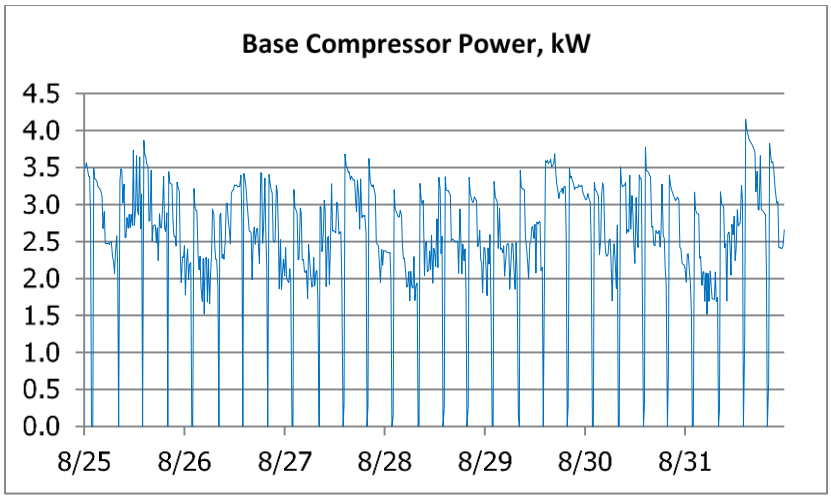

CHART 15: BASE COMPRESSOR POWER

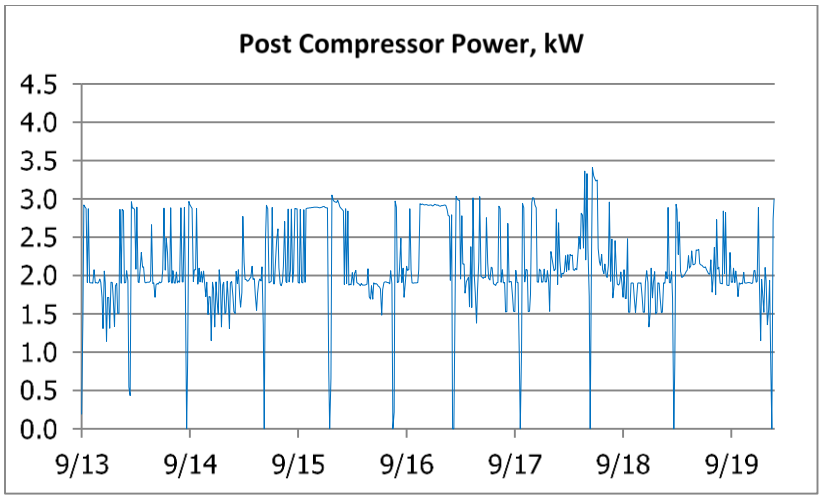

CHART 16: POST COMPRESSOR POWER

The annual energy use estimate for the walk-in cooler for the baseline and retrofit conditions is shown in Table 5. As with the other test, the annual energy savings were extrapolated to a full year based on the results from the two seven day test periods. There was no correction for humidity levels for the same reasons as the college cafeteria test. The savings estimates are conservative. Annual energy savings is calculated to be approximately 20%.

TABLE 5: ANNUAL ENERGY USE ESTIMATE CONVENIENCE STORE

ENERGY ANALYSIS						
		Compressor	Defrost Heaters	Evaporator Fans	Lights	Total
Base	Avg kW	2.50	3.46	0.6	0.023	**6.59**
	Annual kWh	21,900	2,358	4,887	127	**29,273**
Proposed	Avg kW	2.09	3.47	0.6	0.02	**6.15**
	Annual kWh	18,322	733	4,418	127	**23,600**
kW Reduction		0.41	0.0	0.0	0.00	0.44
kWh Reduction		3,579	1,625	469	0	5,673
% kWh Reduction/Component		16%	69%	10%	0%	
% kWh Reduction/Total		12%	6%	2%	0%	**19%**

Cost

This estimated cost for this project is shown in Table 6. Since this project was supported by the product manufacturer who donated the controller and the contractor also donated his time for the installation these are only estimated costs. This work was done without down time or emptying the freezer.

TABLE 6: COST ANALYSIS CONVENIENCE STORE

Cost Analysis	
Material Total	**$ 1,200**
Labor	**$ 400**
PROJECT TOTAL	**$ 1,600**

Non-Energy Benefits

The box condition pre- and post-retrofit is shown in Figure 8 and Figure 9. There was much less of an icing issue in this unit as compared to the college cafeteria unit. A picture of the food stored in the unit pre-retrofit is shown in Figure 10. The food quality was not an issue for this unit pre-retrofit and food quality remained good after the retrofit.

FIGURE 8: ICING PRE-RETROFIT

FIGURE 9: NO ICING POST-RETROFIT

FIGURE 10: FOOD QUALITY

Analysis

Environmental Conditions

The amount of icing formed in a walk-in unit is primarily based on two conditions: how long the doors are left open and how much humidity is in the air. If the door is left open for long periods during loading operation and if the relative humidity is high, the defrost heaters have to work harder to ensure icing does not occur. The humidity levels for these tests ranged from approximately 30% to 80%. Since this was not done during extremely low levels of relative humidity, extrapolating these test results out to an annual usage is rough, but likely a conservative savings estimate.

Energy Savings

The savings for these two tests were significantly different. The simpler convenience store project saved approximately 20% energy while the overhaul of the college walk-in saved approximately 50%. A comparison of the two projects is shown in Table 7: Energy Savings Comparison

. Based on the observations on-site and an analysis of the data, the difference in savings is due to two things. First, the unit at the college was not working properly at the start. This is clear from the excessive amount of icing that was observed pre-retrofit. The other obvious reason for the difference is the replacement of components in addition to the KE2 controller. For EC motors, the component energy savings is well documented at approximately 75%. EEVs are lesser known and understood, but the energy savings potential has been demonstrated at greater than 15%.[3] If the evaporator fan motors were replaced with EC motors and the TXV replaced with an EEV, the savings at the convenience store may have been closer to at least 35%.

TABLE 7: ENERGY SAVINGS COMPARISON

		Total College	Total C-Store
BASE	**Avg kW**	6.38	6.59
	Annual kWh	28,988	29,273
POST	**Avg kW**	4.57	6.15
	Annual kWh	14,789	23,600
kW Reduction		**1.81**	**0.44**
kWh Reduction		**14,199**	**5,673**
% kWh Reduction/Total		**49%**	**19%**

The college saved more because:

- The excessive icing observed pre-retrofit indicated the unit was not working properly.
- Additional measures were installed including caulking the seams, installing EC motors, EEV controls, and LED lights.

[3] See the following article published in the February 2009 ASHRAE Journal, Electronic Expansion Valves vs. Thermal Expansion Valves

Financial Analysis

This measure option is not inexpensive. A defrost time clock costs about $300 to install, while a KE2 controller is in the range of $1,600. Table 8 provides a simple financial analysis of the two projects. Energy costs are for the convenience store instead of the large university where the test was conducted. For calculation purposes, energy costs of $0.06/kWh and $10/kW were used.

Utilities will likely provide rebates for these projects. Table 8 provides estimates for a custom rebate for the overall project savings and prescriptive rebates for the EC motors, so the paybacks can be more realistically evaluated. For the C-Store an estimate for a custom rebate for the KE2 is provided. The question is whether small businesses will see the value in this investment.

TABLE 8: SIMPLE FINANCIAL ANALYSIS

	Total College	Total C-Store
kW Reduction	1.81	0.44
kWh Reduction	14,199	5,673
Savings at $0.06/kWh and $10/kW	$ 1,089	$ 402
Approximate Cost	$ 7,122	$ 1,600
Simple Payback w/o Rebate	6.5	4.0
Custom Rebate @ $0.05/kWh	$ 710	$284
Prescriptive Rebate $70/EC motor	$ 280	$ -
Simple Payback w/ Rebate	5.6	3.3

There are two more things to consider when investigating this investment for a small business. First, did some of the work at the college (e.g. evaporator replacement, defrost control repairs) need to be done regardless? For the college, it was clear that there was some work needed and some money was going to be spent anyway. Possibly half of the project cost at the college would have been incurred in the next 12 months anyway, so the incremental cost of installing the controller, installing EC motors and choosing an EEV becomes an easier decision – especially if the utility provides a rebate. In addition, installing expensive retrofits on old equipment is often not considered because the equipment could have too many other potential problems. The contractor on this project stated it would not have installed the KE2 controller at this facility without the other upgrades because the equipment was in such bad shape.

The second consideration is the non-energy benefits of a project such as this. The risks of a fall are minimized by eliminating the icing on the floor. Food quality can be improved by reducing the high temperature extremes that cause freezer burn from the freeze thaw cycle. LED lighting lasts longer and the space is better lit. Tasks like cleaning and inventory are made easier as well. Finally, if a facility chooses to use the remote monitoring capability, a maintenance problem or operating issue can be caught before significant damage is done and reliability is improved.

Conclusions

The following conclusions are presented based on the data obtained and analysis conducted.

The KE2 controller is a costly retrofit when compared to defrost time clocks. It may be a tough sell to the small business owner running a restaurant. The small restauranteur is not well versed in refrigeration technology and the initial price will be a difficult obstacle to overcome. It may be more worthwhile to provide more education regarding how to better control icing with the defrost time clock. It appears that most defrost time clocks are set for longer defrost cycles than is necessary. In addition, some discussions can be had on controlling humidity by keeping the doors closed or installing less costly strip curtains.

The KE2 controller provides significant savings over the traditional defrost controller.

The KE2 controller may be a tough sell to small business.

EC motors and Electronic Expansion Valves should be considered in all retrofit projects.

Prescriptive rebates should be considered for KE2 controllers and electronic expansion valves.

For those food service organizations that have energy management personnel such as chain restaurants, chain convenience stores, or institutional organizations, the KE2 controller costs may not be as significant a deterrent, especially when the non-energy benefits are considered. These controllers, along with EC motors and EEVs, should be discussed for new construction and retrofits.

The KE2 controller is a sophisticated controller that has significant potential for energy savings in walk-in freezer units. The 15% savings claimed by the manufacturer for a "typical' retrofit is conservative based on this analysis.

The overall savings achieved by the KE2 controller is based on tighter control of the defrost heaters, compressor, and evaporator fans. In addition, there is savings achieved by the lower heating load put on the refrigeration system from the reduction in run time by the defrost heaters and evaporator fans.

Prescriptive rebates should be considered by utilities for measures like the KE2 controller and electronic expansion valves. While theses measure provide significant savings on a component basis, the estimated custom rebate amount does not justify the time needed for a custom rebate process. These rebates could be set up similar to the existing rebates for EC motors.