Conservation Applied Research & Development (CARD) Program

FINAL REPORT

Improving Energy Efficiency in Convenience Stores

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Executive Summary

Convenience Stores (C Stores), defined here as small retail stores that are open long hours and sell groceries, snacks, and gasoline, are energy intensive buildings. As their business model has shifted from automotive services to retail sales of food and drink to travelers, their plug load, lighting, and refrigeration loads have grown rapidly. The intent of this study was to identify the energy efficiency opportunities for this market sector through energy audits in 50 C Stores and to recommend a program design to the State of Minnesota and Minnesota utilities to more effectively capitalize on those opportunities.

Project Goal

The goal of this applied research project is to design and deliver a hybrid Retro Commissioning pilot program targeting convenience stores in Minnesota. This pilot program will partner with multiple utilities statewide, especially municipal utilities and coops, to assist them with accomplishing their energy saving targets, enhance their limited budgets and resources, and address a customer type that is difficult for them to impact.

Project Scope of Work

1) Review of codes and market
2) Review of C Store energy use and conservation technologies
3) Development of standardized energy calculations and auditing materials
4) Pilot energy assessments in fifty (50) businesses
5) Data analysis and program design

Store Selection

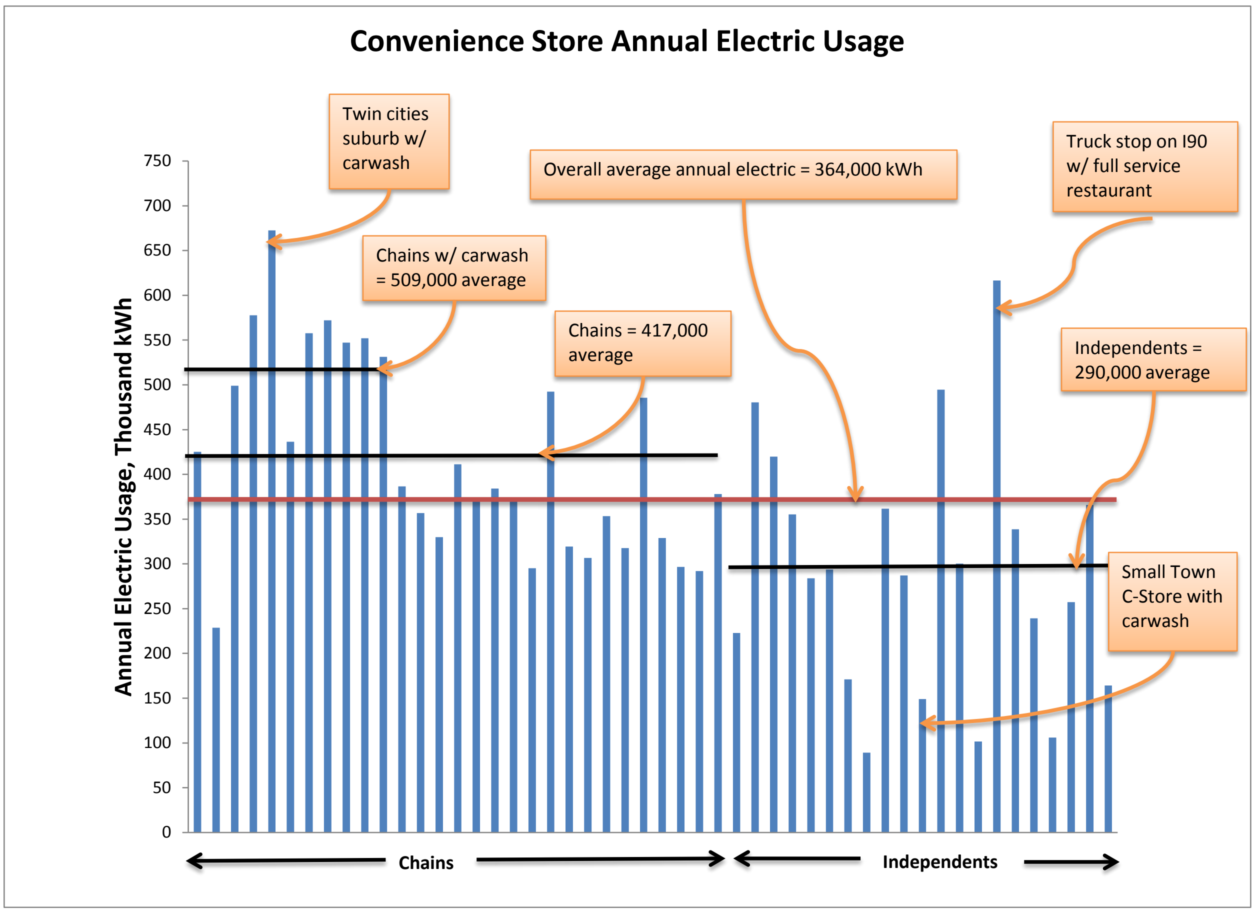
Special attention was paid during the recruitment of the 50 stores for this pilot program to achieve diversity of geography, utility territory, and company ownership structure. Twelve utilities participated in this program (four investor owned utilities, six municipal utilities, and two cooperative utilities). Participants were from throughout the state of Minnesota, including Albert Lea, Bemidji, Cloquet, Le Roy, Windom and points in between. The Clean Energy Resource Teams (CERTs); the Department of Commerce, Division of Energy Resources; and the participating utilities provided needed assistance in communicating the existence of and benefits of this study to their constituents and finding potential participants.

In addition, store ownership was split about half and half between corporate/chain ownership (29 stores) and independent/local ownership (21 stores). Independently owned stores might be branded as a national chain (Holiday or BP for example), but control of the store and decision-making are held locally. Typically an independent store owner would own fewer than five C Stores. These stores rarely had an employee dedicated to energy use in the facility. The study did not include small grocery stores that do not have a gas station on site because the exterior lighting associated with the gas canopy is a significant load in convenience stores.

Annual Energy Usage

The majority of C Store energy is consumed by lighting and refrigeration. Those two systems account for about two-thirds of the energy use. Average annual electric use was 364,000 kWh or 94 kWh/ft^2. Most of the chain stores were similar in size while the independents ranged in size from 700 ft^2 to 10,500 ft^2. Major differences in annual energy use within the sample population might be attributed to hours of operation (with higher lighting loads for 24 hour stores), the number of plug loads in the store, and whether there was a car wash on site. Generally chain stores with car washes had the highest energy use while independent stores had the lowest energy use.

EXECUTIVE SUMMARY FIGURE 1: ANNUAL ELECTRIC USAGE



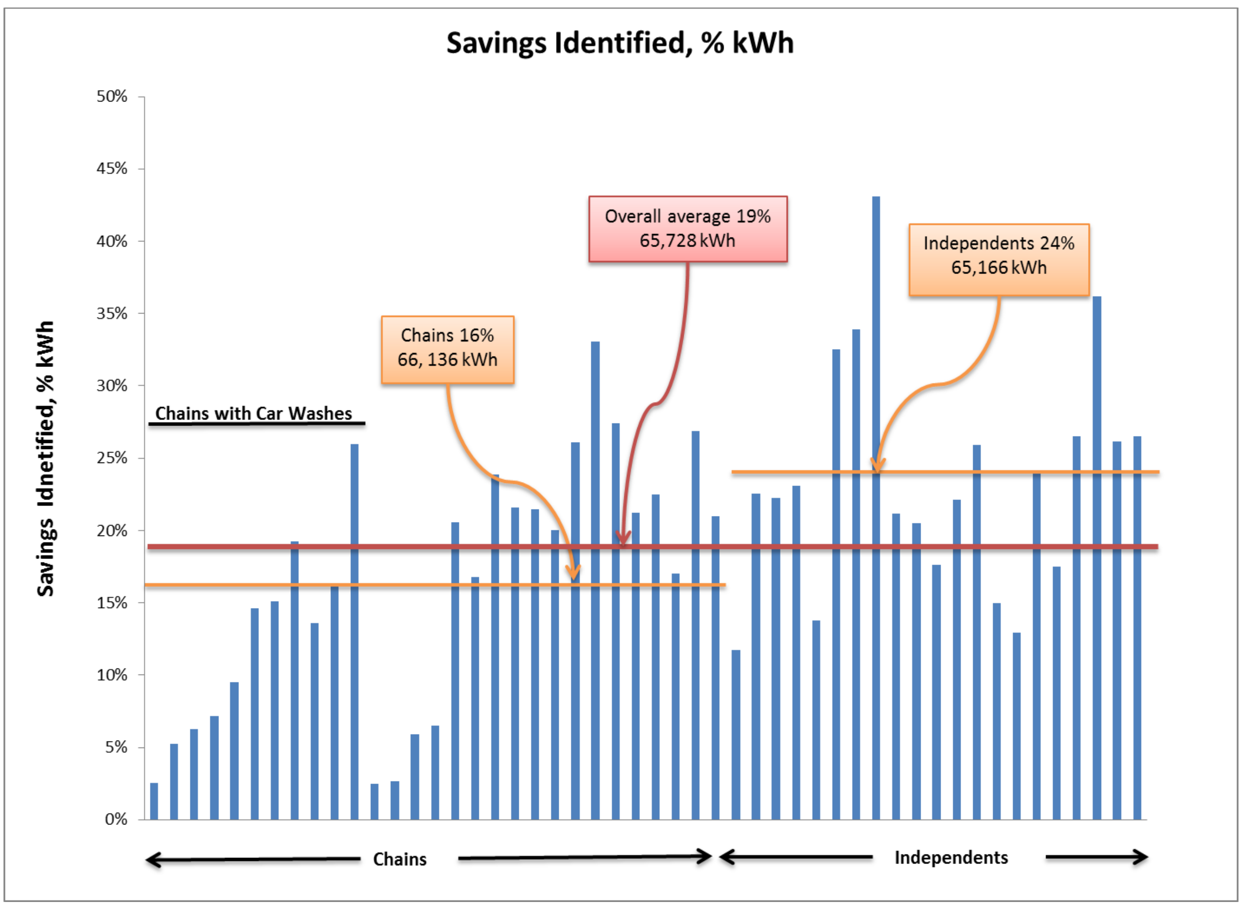
Savings Opportunities

Each audit report identified cost-effective equipment upgrades in addition to operation and maintenance savings opportunities. An average total energy savings of 19% was identified for the participating stores.[1]

That potential savings equates to about $5,000 per year for each store in reduced energy expenses. That savings amount was consistent among the majority of the stores reviewed, in part because the higher energy user typically had fewer opportunities than the lower energy users. These opportunities generally fall into refrigeration systems, controls, lighting, and motors.

There are approximately 2,000 C Stores in Minnesota. If the energy efficiency measures identified in this study were implemented in all stores that had those opportunities, almost 120 GWh of energy and 7.5 million dollars would be saved by Minnesota businesses. In addition this would reduce peak demand on the state's electrical system by about 21 MW.

EXECUTIVE SUMMARY FIGURE 2: SAVINGS IDENTIFIED



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[1] Based on capital projects which have a payback of less than 5 years when existing available rebates are included.

Technology Recommendations

The following chart shows top recommendations for C Stores and savings estimates based on the average store in this study's participant pool.

EXECUTIVE SUMMARY TABLE 3: RECOMMENDED MEASURES

Capital Investments/Retrofits										
Efficiency Measures /Action	**Rebates[1]**		**kW**	**kWh Savings**			**$ Savings[2]**		**Payback, years**	
Lighting	**High**	**Low**	**Savings**	**24 hrs.**	**18 hrs.**	**Cost**	**Max**	**Min**	**Max**	**Min**
Total of 4 Wall Packs, 250W MH to 59W LED	$300	$40	0.9	4,100	2,100	$960	$360	$240	1.8	3.9
Total of 4 Parking Lot Luminaires, 400W MH to 100W LED	$700	$40	1.4	6,200	6,200	$2,600	$540	$540	3.4	4.6
Total of 20 Gas canopy lights, 400W MH to 100W LED	$3,500	$200	7.1	31,100	15,500	$7,800	$2,700	$1,800	1.6	4.3
Total of 136 Store T8 lamps - 32W 4'T8s to 25W 4'T8	$70	$70	1.4	11,900	7,900	$680	$900	$650	0.7	0.9
Case Lighting 9 coolers and 4 freezers - 107 W T12 to 20 W LED	$1,300	$130	1.5	13,000	13,000	$2,900	$960	$960	1.7	2.9
Controls										
Occupancy Sensors for 2 restrooms and 2 storage rooms	$120	$60	0.0	2,800	1,900	$440	$170	$110	1.9	3.4
Anti-sweat Htr controls - 8 coolers @ 0.85 and 3 freezer @ 1.3 amp	$660	$0	1.0	10,200	10,200	$2,300	$730	$730	2.2	3.1
Motors										
EC Motors for 4 freezer and 4 cooler evap fans @ 1/20 hp	$560	$0	0.7	6,000	6,000	$2,200	$450	$450	3.6	4.9
Refrigeration										
Floating Head Pressure Control - 4 hp walk-in freezer comp. moto	$240	$0	0	5,500	5,500	$2,100	$340	$340	5.5	6.2
Retrofit Measures Total	**$7,450**	**$540**	**14.0**	**90,800**	**68,300**	**$21,980**	**$7,150**	**$5,820**	**2.0**	**3.7**
Maintenance Measures										
Install strip curtains	$0	$0	0	570	570	$80	$30	$30	2.3	2.3
Clean 2 Condenser Coils (4 hp freezer/3 hp cooler)	$160	$0	0.2	1,600	1,600	$400	$120	$120	3.3	4.8
Clean 2 Evaporator Coils (4 hp freezer/3 hp cooler)	$160	$0	0.2	1,600	1,600	$400	$120	$120	2.0	4.8
Maintenance Measures Total	**$320**	**$0**	**0.4**	**3,770**	**3,770**	**$880**	**$270**	**$270**	**2.1**	**3.3**
Overall Totals	**$7,770**	**$540**	**14.4**	**94,570**	**72,070**	**$22,860**	**$7,420**	**$6,090**	**2.0**	**3.7**
Note 1: The table lists the highest and lowest rebates observed in the 12 Minnesota utility territories in the study										
Note 2: Maximum savings were based on 24 hr. operation with highest rebate and lowest savings were based on 18 hr. operation with lowest rebate										

Chains versus Independent Stores

An observation of this study is that ownership structure of the store does affect energy use and management practices. Corporately managed chain stores typically used more energy on an annual basis but had, proportionally, a smaller opportunity to save energy. In addition, they were more likely to have a series of energy management practices already in place. Chain stores were also more likely to be open 24/7 and have a large plug load, which is difficult to reduce without eliminating equipment. Corporate energy managers were generally employed by each chain and that staff member had a good understanding of the variety of technologies available to reduce their stores' energy use. Often the implementation of those technologies was only done in new store builds rather than as a retrofit, which means technology implementation company-wide will be a slow process and limit potential energy savings.

Independently owned stores generally used less energy, but a larger portion could be saved, in part, because their energy use went to more controllable energy uses like refrigeration and lighting (rather than plug load). Independent store owners were appreciative of the information and recommendations from the audits. Many of the measures were new to them since, as busy small business owners, they don't have time (or staff) to research energy conservation.

A New Approach to Energy Conservation

Given the basically standard savings opportunity of about $5,000 per year and the consistent set of opportunities, there is a straightforward set of measures around which to design a conservation program. However, complication enters when considering the needs of the various types of business structures, their internal capacity to address these issues, the varying quantity of C Stores in each individual utility territory and the current rebate philosophy. This report intends to propose an alternative program design model to incent businesses to commit to more comprehensive implementation. Finally, rebate levels should be increased in order to move the market toward implementation; therefore, this report outlines a proposed rebate justification philosophy that may help move the status quo towards more aggressively rebating technologies.

Program Design

Existing rebate programs generally rely on an energy auditor or contractor to recommend a measure and the store to implement the measure and apply for a rebate. That system is not broken, but it is also not as effective as any of the involved parties would like. Energy savings tend to be cherry-picked for quick payback and the effectiveness of the program greatly depends on the quality of the information provided by the auditor, the experience and willingness of the contractor to work with innovative technology, and the tenacity of the business owner to complete a project and submit rebate paperwork.

In contrast to this traditional pathway, this report proposes a different, more comprehensive approach, where a pre-screened and benchmarked business would commit to saving a certain amount of energy. By making that commitment, a business would gain access to more generous rebates to incentivize the businesses to make comprehensive reductions in order to maximize energy savings.

EXECUTIVE SUMMARY TABLE 4: PROGRAM DESIGN DIAGRAM

	Current Practice **"Per Measure"**	Recommended Alternative **"Comprehensive"**
Step One	No pre-screening	Store is Prequalified and Benchmarked
Step Two	No commitment from business	Store formally agrees to work towards energy reduction target (in return getting higher rebates)
Step Three	Information Gathering Variety of information sources: energy audits, employee knowledge, contractor recommendations	Information Gathering Utility funded Energy Assessment
Step Four	Implementation Store selects measures with best payback and selects a contractor to install the measures	Implementation Store implements multiple measures in order to reach their energy savings target
Step Four	Rebates available on specific technologies, rates vary based on many factors	Rebates paid out, calcuated at higher lifetime kWh rate available only to businesses that commit to reaching their reduction target

Rebate Justification

Setting the level for a rebate is a complicated process that utilities undertake on an individual basis – selecting a rebate for a specific technology and for their specific territory based on a number of market factors. It is in a utility's interest to pay as little in a rebate as possible to still achieve the desired result of moving the market toward energy efficiency.

However, rebate levels are often not high enough to truly influence decision makers and push them towards implementation. This point is proven best by the exceptions – the clear examples of when a generous rebate drastically increased participation. One such example is the LED Refrigerated Case Lighting rebate of $100 per door that has recently been offered by at least one Minnesota utility. This rebate had the desired impact of vastly shifting the market – case lighting is quickly approaching widespread acceptance. More of the technologies in the convenience store market could benefit from that level of investment, and low levels of implementation indicate the incentives are not sufficient.

In order to justify those higher rebate levels, the authors propose a cost per lifetime kWh calculation. From a utility perspective, this calculation compares the cost to generate or purchase the kWh needed to run a piece of inefficient equipment versus the cost to supply energy to an efficient piece of equipment. That "lifetime kWh savings" becomes the value to the utility of the more efficient technology. Any rebate that comes in under that amount would represent a net cost savings. This calculation allows for generous rebates, for instance $0.01 per lifetime kWh, which coupled with customer commitment to reduce energy use to a specific target could result in a real market transformation in convenience stores.

When those larger rebates are included, a package of recommendations for this sector can be achieved for less than a two year payback, as shown below. This rebate strategy is a way to achieve the deeper energy retrofits that both the State of Minnesota and utilities would like to achieve, while making the case to businesses that buying inefficient equipment for short term cost savings is not a smart business decision.

EXECUTIVE SUMMARY FIGURE 5: PROPOSED REBATE PROGRAM

Example	Store usage		415,000	kWh/yr					
Higher Use Store	Store operations		24	hr/day			**With Proposed Rebates**		
	Qualify for program?		Yes						
	Avg Elec Rate		$ 0.0789	per kWh					
	Annual Energy		$ 32,744	per year					
	En Svg Target	20%	83,000	kWh/yr					
Measures from Audit		**$ Capital**	**Annual kWh Savings**	**Annual $ Savings**	**Lifetime kWh Savings**	**Proposed Rebate**	**Simple PB**	**Annual Cum % Savings**	
	Lighting	$ 14,925	66,405	$ 5,480	776,519	$ 7,765	1.3	16%	
	Controls	$ 2,750	12,979	$ 902	164,151	$ 1,642	1.2	3%	
	Motors	$ 2,200	5,984	$ 450	89,760	$ 898	2.9	1%	
	Refrigeration	$ 2,125	5,505	$ 340	55,050	$ 551	4.6	1%	
		$ 22,000	90,873	$ 7,172	1,085,480	$ 10,855	1.6	22%	

Introduction and Background

Convenience Store Markets and Operations

Convenience Stores (C Stores), defined here as small retail stores that are open long hours and sell groceries, snacks, and gasoline, are substantial energy users within the small business segment of utility customers. These stores are a subset of the "Food Sales" sector as defined by the Commercial Buildings Energy Consumption Survey (CBECS). The food sales sector has the highest electrical energy use with an intensity of 49.4 kWh/ft^2 (Energy Information Adminstration, 2003). There are about 2,000 C Stores in Minnesota.[2]

Market Evolution

C Stores are the market evolution of better cars and roads and resulting less time to travel between destinations. C Stores have evolved from the "gas stations" of the past to the modern stores that offer self-service gasoline, restrooms and refreshments. The revenue and profits are generated from the gasoline sales and other items inside the store. The products for sale inside the store have evolved as owner/operators have discovered what customers will purchase on their stops in addition to the gasoline. In some cases, stops occur only for the "convenience" of purchasing an item without a trip to a grocery store. Whatever the nuances of the business model for each owner, their business is to make sales at a profit. Energy efficiency doesn't make sales, but it does make sales more profitable. If a store manager were to follow the recommendations of this report, an average energy savings of $5,000 per year would flow directly to the profit margin for the store. To make an equivalent profit from sales with an assumed profit margin of 10%, the store would need to increase sales by $50,000 per year.

C Stores use the tactic of increasing sales as a basic strategy to make and/or increase profits. Increasing sales can come from new products, a different product mix, or better merchandising including lighting, better comfort, more convenience, wider selection, longer hours open, etc. Some of these merchandising efforts directly affect energy use, thus, it is important that the store's equipment and systems be energy efficient. As an indicator of business, the inventory "turn rate" or turnover is used. As business increases, the turn rate goes up and presumably so does profit.

Overview of Energy Use in C Stores

Size of Facilities and Energy Intensity

In this study, store size ranged from 700 ft^2 to 10,500 ft^2 while the CBECS average for food sales was 5,600 ft^2 (U.S. Energy Information Administration, 2003) The largest store served over-the-road trucks, as well as passenger vehicles and had a full service restaurant. The

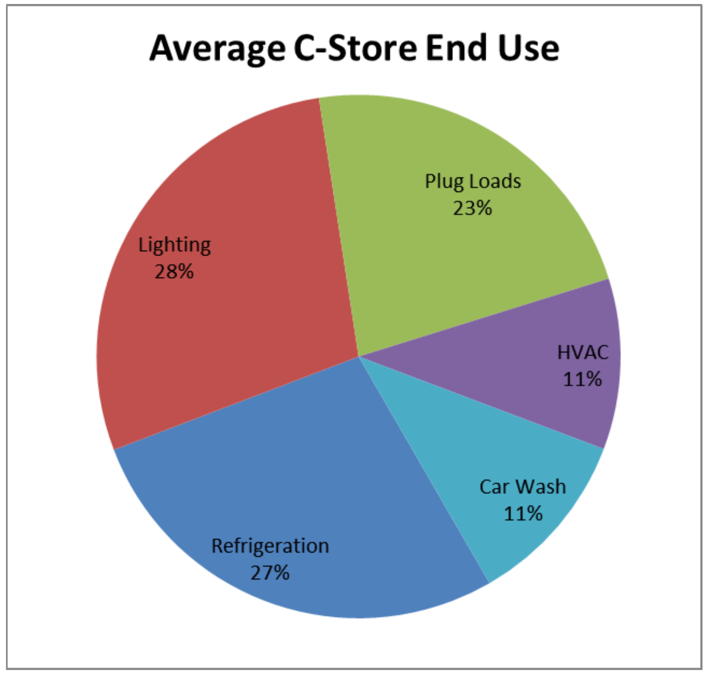
[2] Per Reference USA database available at the public library there were 2,279 convenience stores in MN in July 2013.

smallest was an older store without as much space dedicated to sale of dry goods, prepared foods, or drink machines. The average size was approximately 4,000 ft^2. Stores typically operated 18 -24 hours a day.

The 2003 CBECS data provides a starting point for understanding energy use in C Stores. The Food Sales sector has an average electric intensity of 49.4 kWh/ft^2-yr and gas intensity of 50.2 cu ft/ft^2-yr (U.S. Energy Information Administration, 2003). On an energy basis, electricity accounts for 80% of the energy usage in these stores.

In this study, stores averaged 94 kWh/ft^2-yr, which is considerably higher than the 2003 CBECS average. This might be due to the inclusion of supermarkets with C stores. Supermarkets are not likely to be as energy dense (kWh per square foot) due to their larger square footage, the abundance of dry goods which require less energy intense display/storage, and the lack of plug loads (e.g. small ovens, coffee makers, etc.).

FIGURE 1: AVERAGE C STORE ELECTRICITY END USE



Major Energy Using Systems

Since gas use was so minor, electricity use was a primary focus of research in this report. The major electric energy using systems of C Stores can be broken down into four major end use categories: lighting, refrigeration, HVAC, and plug loads. Car washes are also a significant end use if they are part of the operation. Figure 1 shows the average energy end use for the five convenience stores that were studied in detail.

Lighting loads in convenience stores are one of the largest loads, and can be one-third of the total electrical load or more. Lighting is used to illuminate the interior of the store, as well as the exterior. Exterior lighting typical consists of soffit lighting around the perimeter of the store, gas canopy lighting, and large pole lighting to illuminate the parking lot. The exterior lighting is ideally only operating during night time hours. Interior lighting consists of overhead lighting and product lighting. Many individual product displays contain their own lighting. This includes dry merchandising and stand alone coolers. The walk-in coolers also contain overhead lighting, as well lighting between the glass doors for product illumination. Other overhead spot lighting may exist to place emphasis on certain areas, such as the cash registers.

Refrigeration loads in convenience stores are another large load, and can account for up to a third of the energy consumption in a store. The refrigeration load generally consists of several condensing units that serve the walk-in coolers and freezers. These units are in the three to five horsepower range. There are also typically several stand alone coolers and freezers in the stores. These may be display units out on the sales floor, or storage units in the back rooms for maintaining back stock, or frozen food to be cooked in the stores and sold as ready to eat food. Ice machines are also common in convenience stores, both to create ice (i.e. soda machines) and to store ice made off site and delivered from another company.

The HVAC load in convenience stores is another considerable load. This is typically 10 percent or more of the store's electricity consumption. This is primarily electrical consumption, as little natural gas heating is required in convenience stores due to the large amount of internal gain provided by all the plug loads. The electrical portion of the HVAC load is primarily from fans and direct expansion cooling equipment. Heating energy consumption has not been studied in detail here, but anecdotally it has been stated by several convenience store energy managers that "a typical residential home uses about as much natural gas for heating as a convenience store."

Plug loads are a large energy user in convenience stores. It is hard to generalize plug loads, as they seem to vary from chain to chain, and even store to store. But, in newer convenience stores, it seems that plug loads can make up nearly a quarter of the energy consumption based on our research. Plug loads consist of many different pieces of equipment that are used for food preparation or service. This includes, but is not limited to, soda fountains, slushy machines, coffee machines, cappuccino machines, nacho machines, pizza warmers, warming stations, hot dog rollers, microwaves, turbo ovens, and many others.

Hot water is the last significant energy use category for convenience stores. Domestic hot water is not typically a large load in convenience stores, unless there is a kitchen or car wash, as it is only used in the rest rooms, and for some cooking and cleaning needs. Typically domestic water heaters are of the electric variety. If the convenience store contains a car wash, it is not typically served by the same water heater that supplies domestic hot water. A separate gas water heater is usually used for the car wash. Car washes also contain several large motors for hydraulic pumps and blower fans.

Evolution of Energy Standards

C Store facilities have a range of ages and related construction and code characteristics. Many of the older stores were built as "gas stations" in the 1950's, 60's and 70's. Facility energy use was not a concern, so there was typically limited roof or wall insulation, possibly single pane glazing, low cost/low efficiency heating equipment and some mix of incandescent and fluorescent lighting. Large garage doors were often uninsulated, single layered and loose fitting in tracks. Air compressors and perhaps hydraulic pumping were the major functional loads. The gas stations typically had little retail energy use aside from the "pop machine."

Many of these facilities have evolved to the C stores in this report. Their building shell may have been insulated, the roof insulated and replaced, windows and doors upgraded and replaced, and the old garage doors replaced with permanent insulated walls. Lighting has been upgraded to fluorescent, heating equipment is higher efficiency and air conditioning has been added.

There may be an air compressor yet in place, but it is smaller and used only by the occasional customer with low tire pressure.

For buildings built in the 1980s, the energy crisis began to influence construction, including updated building codes with added requirements for more insulation, better windows, more efficient lighting and heating/cooling equipment. Along with gradually more efficient buildings, the sales mix changed as a result of better and more sophisticated automobiles and less need for light/moderate maintenance and repairs. The routine servicing of cars shifted from the "gas stations" to specialized shops and dealers while the gas stations evolved their strategies to increase cash flow through more retail sales albeit to customers "on the move" and still in need of gasoline for their cars.

C stores built in the 2000s and later are more specialized retail buildings, little resembling the reworked gas stations of the earlier eras. Now the majority of the floor area is retail offerings of food, drinks, convenience items and some food items for home preparation. The space conditions are designed for the comfort of the customer and to encourage purchases of retail goods. Refrigerated beverages, pre-made sandwiches, frozen treats, and ice cream are all at the finger tips of the customer.

New Federal Refrigeration Energy Standards

The Federal government adopted new Appliance Energy Standards for refrigeration equipment beginning in 2009. This new code incorporates many technologies that have been developed and are available, but not yet used extensively. New performance standards for self-contained equipment (reach-in refrigerators and freezers and open refrigeration equipment) went into effect in 2009 and standards for walk-in coolers were effective in 2011.

The importance of these standards for this study is that the new more efficient equipment is already starting to influence the efficiency of the industry. This is beneficial especially for new packaged equipment, because retrofitting existing packaged equipment is not likely to be feasible. However, retrofitting walk-in coolers and freezers with some of these new technologies may be feasible and cost-effective. The details of the code can be found in Appendix A1.

New Technologies Available

Indirectly, these new energy standards have a significant effect on the availability of new technologies for retrofit applications. As new technologies are developed and applied in new equipment, manufacturers will also identify markets with existing equipment where the technologies can be sold and used. This is one way new technologies can migrate to existing C Stores and systems.

Some of the prescriptive items listed in the Federal Energy Standards are excellent for consideration by both a C Store owner and a utility seeking to encourage energy investments by C Stores. Other items listed, such as increased wall and floor insulation levels, are not likely to be applicable for retrofit situations. The following items included in the federal standards are appropriate in a retrofit situation:

1. Automatic door closers and/or strip curtains to minimize infiltration;
2. Electrically commutative motors (ECM) for evaporator fans;
3. ECM, permanent split capacitor or 3 phase motors for condenser fans;
4. Within the refrigerated spaces, use lighting with an efficacy factor of greater than 40 lumens/watt, and/or use occupancy controls on the lighting;
5. Use double or triple pane, insulated and low e glass in doors (when upgrading cooler and freezers);
6. Install and use door heater controls or use reduced energy heaters.

Advanced Refrigeration Strategies and Controls

The following strategies are not part of the Federal Efficiency Standards but are available from certain manufacturers, distributors and contractors. They take advantage of new computer control capabilities to minimize the loads imposed on the refrigeration system and to minimize the energy used in responding to the system requirements.

1. Floating Condenser Pressure Control – this strategy uses controls to allow a lower condenser pressure (and energy use) when weather conditions allow; systems normally set up to operate at peak summer conditions can operate at much lower pressures, saving 29% energy use in a third party test in Cottage Grove, MN.
2. Floating Suction Pressure Control – this strategy is similar to the Floating Condenser Control but operates in the opposite manner; this allows the refrigeration system to raise its suction pressure to reduce the pulling effect required of the compressor. This is effective when there are minimal loads on the system and only a partial refrigeration effect is required. This technology requires the installation of electronic expansion valves, and is much more attractive in new construction as opposed to retrofit situations.
3. Variable Speed Compressors, Evaporative Fans and Condenser Fans – variable speed compressors and fans are another approach to modulating the mass flow in systems to match the refrigerant flow to the load requirements with minimum energy use. New technology with ECM motors and electronic controls have recently enabled this strategy.
4. Automated Defrost Control with Auto-Stop – defrosting is a necessary evil for refrigeration systems. Humidity in the air condenses on cold evaporator surfaces, freezes into ice

PHOTO 1: ICING EVAPORATOR COIL

crystals, and eventually accumulates into ice chunks that stop air flow and reduce refrigeration effects (see Photo 1). Defrosting can be done using one of several methods:

a) Use electric resistance heaters on the evaporator coil to melt the ice;
b) Use a reversing refrigerant control valve to pass hot gas in reverse through the evaporator coil to melt the ice off the coil; or
c) In coolers, shut down the refrigeration system and run the evaporator fans to circulate air until the ice is melted when the refrigeration system is restarted.

Methods a) and b) are the most energy intensive, but a big variable (and opportunity) is the typical control set up for the defrost cycles. These controls are typically set up for "three defrosts every 24 hours" (for example) and are operated automatically whether the coil is actually frosted or not, or whether the coil is only lightly or heavily frosted. If lightly frosted the defrost cycle could be stopped after a much shorter time (15 minutes for instance). The technology application is to incorporate a temperature sensor at the evaporator coil to sense when the ice is gone and the cooler or freezer begins to heat up. With an increase in temperature inside the cooler or freezer, the defrosting is completed and the cycle can be terminated. This arrangement eliminates unnecessary energy use for the defrost cycle and minimizes the excess energy required to remove additional heat from the defrost cycle – the compounded benefit. Variations on this defrost strategy have been used for years with older technology sensors and controllers with nominal success. However, test reports from a defrost control manufacturer using digital technology has shown a 19% savings in energy used in compressors, fans and heaters for a middle school in Georgia with a holding cooler and freezer in the kitchen[3].

There are control systems which incorporate all these approaches (#1 – 4), but they may not be needed and may be duplicative depending on the systems

PHOTO 2: HEAT RECOVERY UNIT FROM PARTICIPATING C STORE

5. Heat Recovery – since refrigeration systems inherently move heat, it may be an option to use some or all of the heat in a useful way in another place or process. With the right equipment and controls, heat from the condenser might be used in heating ventilation air or domestic water. The rejected heat is relatively low grade and requires more equipment, piping and controls to install, but it may be attractive since it is "free" heat.

[3] Per correspondence with KE2 Therm Solutions and their case study on Osborn Middle School.

Project Methodology

Research Methodology

A high level methodology for this project is as follows:

Stage One: Complete a market study in a small group of convenience stores to collect field data (data loggers were used in each store) and to gain a sense of the opportunities, energy use and energy efficiency opportunities (five stores studied).

Stage Two: Develop a pilot Retro Commissioning program to be tested. Included in this was the development of a standardized report and calculator spreadsheets which made data collection and report writing efficient.

Stage Three: Implement a pilot in C Stores across Minnesota. In total 50 stores were audited (including the five from the market study in stage one).

Stage Four: Complete data analysis and final report writing, drawing on findings from the field research to refine a program design. This stage included making recommendations for a pilot program for Utilities to consider adopting, which includes evaluation of market penetration of various measures and financial calculations.

Typical to research projects there was a process of evolution as an approach was tested, found to be unsuccessful, altered and then tested again. Major shifts were the results of a few findings:

1) HVAC maintenance was assumed to be an area of significant opportunity for C Stores. A proprietary analysis program called "Check Me!" was tested in C Stores as a tool to deliver savings on HVAC equipment. Field testing determined this was not a good opportunity (see discussion below titled "Store HVAC"). This led to a reduced emphasis on HVAC in the pilot program.
2) There was the assumption that Utilities would be willing to pay for a large portion of this project. It was determined that was not viable, although in the end a few utilities did pay a small contribution for audits conducted in their customers' stores.

Pilot Program Methodology

The development of this pilot program was guided by the goal of creating a cost effective Retro Commissioning program which delivered high quality results. This goal resulted in an audit process focused on the highest impact measures and the most frequently needed measures. And to deliver it efficiently, a set of audit tools – calculators and report templates – were created and sub-contractors were trained to conduct the audits in the field.

The energy audits covered 50 convenience stores, both chains and independents, in 36 different cities in Minnesota (see map below). Electric service and associated rebates were provided by 12 different utilities and included investor-owned, cooperatives, and municipal utilities. A full summary of store characteristics including square footage, operating hours, base year electric usage, ownership structure, car wash capability, and overall savings is included in Appendix A2. The study did not include small grocery stores that did not have a gas station on site because the exterior lighting associated with the gas canopy is a significant load in convenience stores.

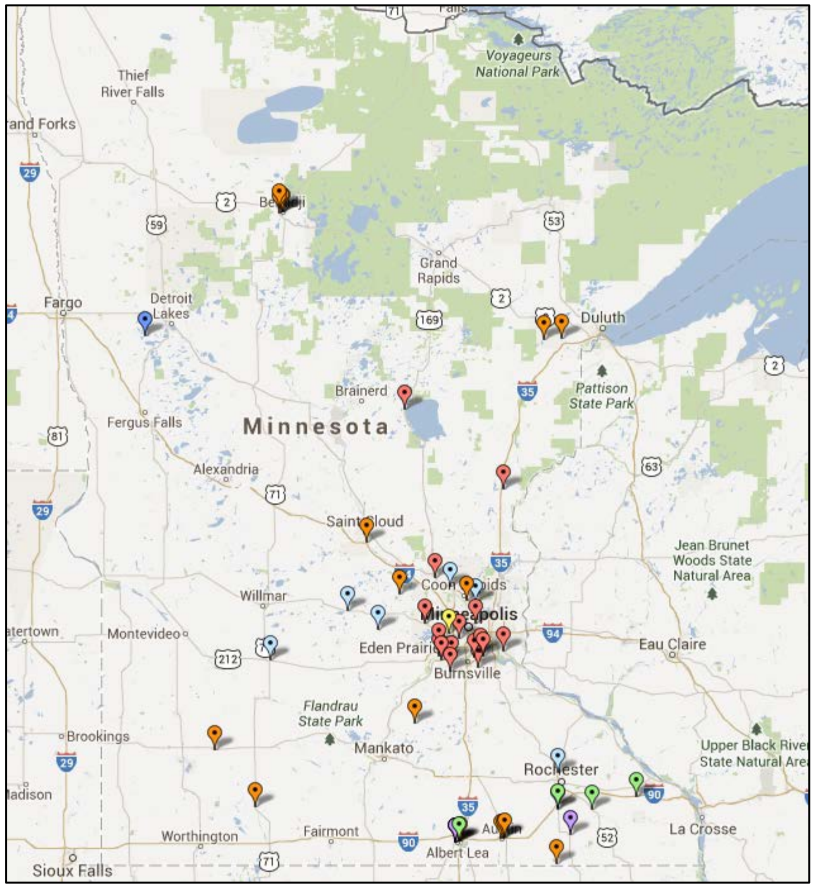


FIGURE 2: LOCATION OF MINNESOTA C STORE AUDITS

Utility Territories:

- Alliant Energy
- Austin Utilities
- Buffalo Municipal Utility
- Connexus Energy
- Lake Region Electric Coop
- Minnesota Power
- Olivia Municipal Power
- Ottertail Power
- Rochester Public Utility
- Spring Valley Utilities
- Windom Electric
- Xcel Energy

As a pilot of how this program might be delivered, a group of sub-contractors was trained to conduct the audit. Each sub-contractor had an engineering degree and brought with them their own expertise in the technologies being evaluated and their own level of comfort using the spreadsheet to estimate savings in the field. In addition to the subcontractors, the audit process was demonstrated in the field to contractors, auditors without engineering degrees, and energy coordinators from the Clean Energy Resource Team in Greater Minnesota. All of these participants could have a role in a utility delivered C Store energy efficiency program. They all would need some training and background in the sector specific technologies and in the use of the calculations spreadsheet. Once a person was knowledgeable in the technologies and understood how to use the spreadsheet, they could complete audits in approximately 3 hours or less. This time included the site visit, discussions with the store manager, report creation and delivery (by email) of the summary report. Travel time to the site would be additional.

The audit in this pilot test was designed to specifically focus on the targeted areas with the highest potential for impact. As a result the on-site audit work could be done relatively quickly; as was mentioned, the process was geared towards evaluating a store and creating a report in 3 hours. To do this, a utility-specific spreadsheet was created with applicable rebates and contractor based cost data included so realistic financial information could be presented to the store representative. Photos of site equipment were taken using a smart phone which could be used with the laptop on site to create the final reports.

The energy audits focused primarily on the lighting and refrigeration systems in convenience stores, as this is where the most opportunities could be justified on energy savings alone, with only superficial evaluation at this stage of HVAC systems and car washes. Typical data collected included number and wattage ratings for lighting, amp ratings of the anti-sweat heaters for the glass door reach-in units, horsepower (hp) ratings for the compressors and the evaporator fan motors, and notes on how exterior lights were controlled. General inspections of maintenance issues were completed for such items as evaporator and condenser coils or door gaskets on reach-in coolers. In addition, annual electric use data was collected from the customer or utility, as well as operating characteristics used to benchmark energy usage. An example of a typical report is included in Appendix A4.

Energy Use and Benchmark

FIGURE 3: CONVENIENCE STORE ANNUAL ELECTRIC USAGE

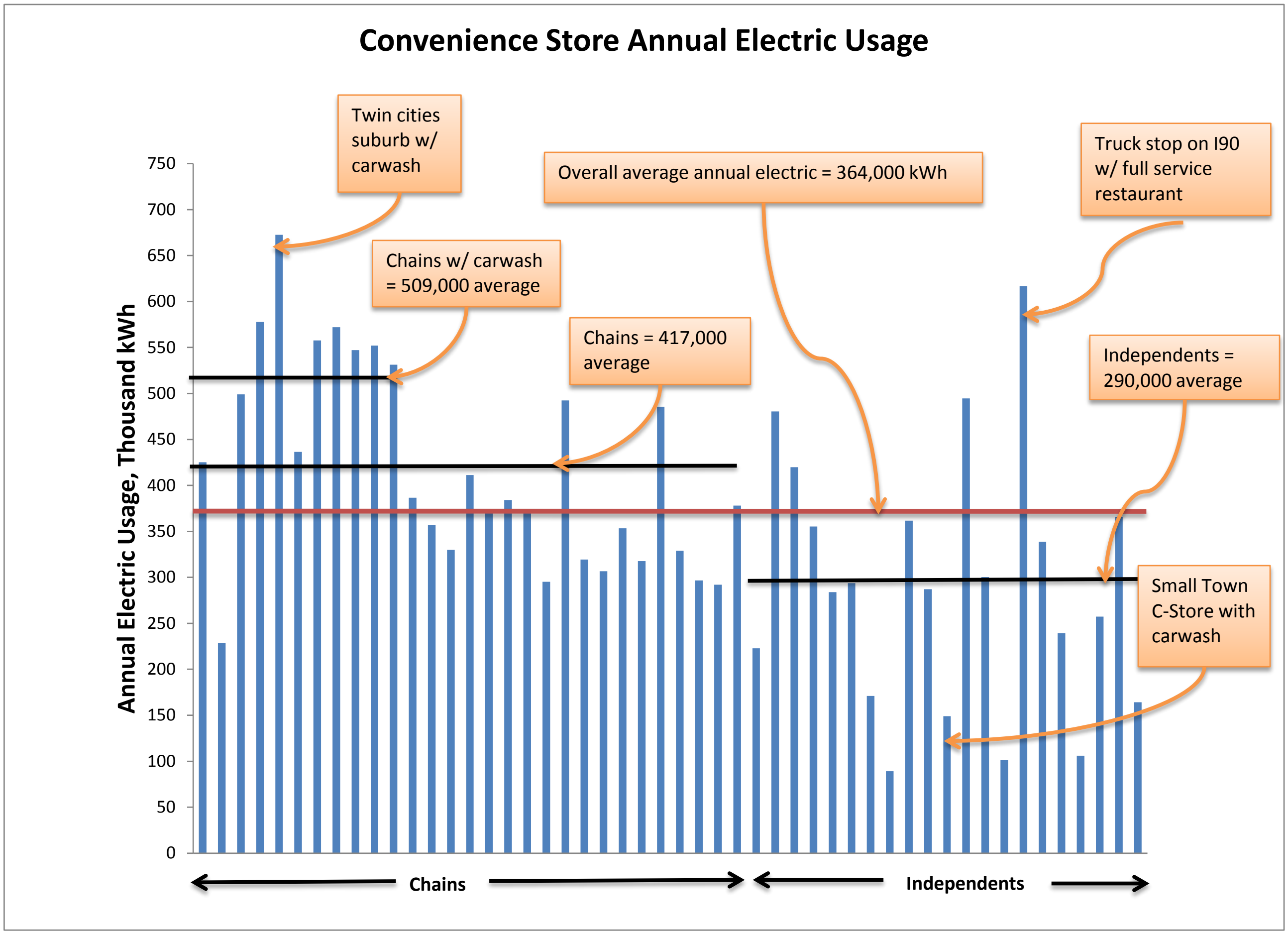


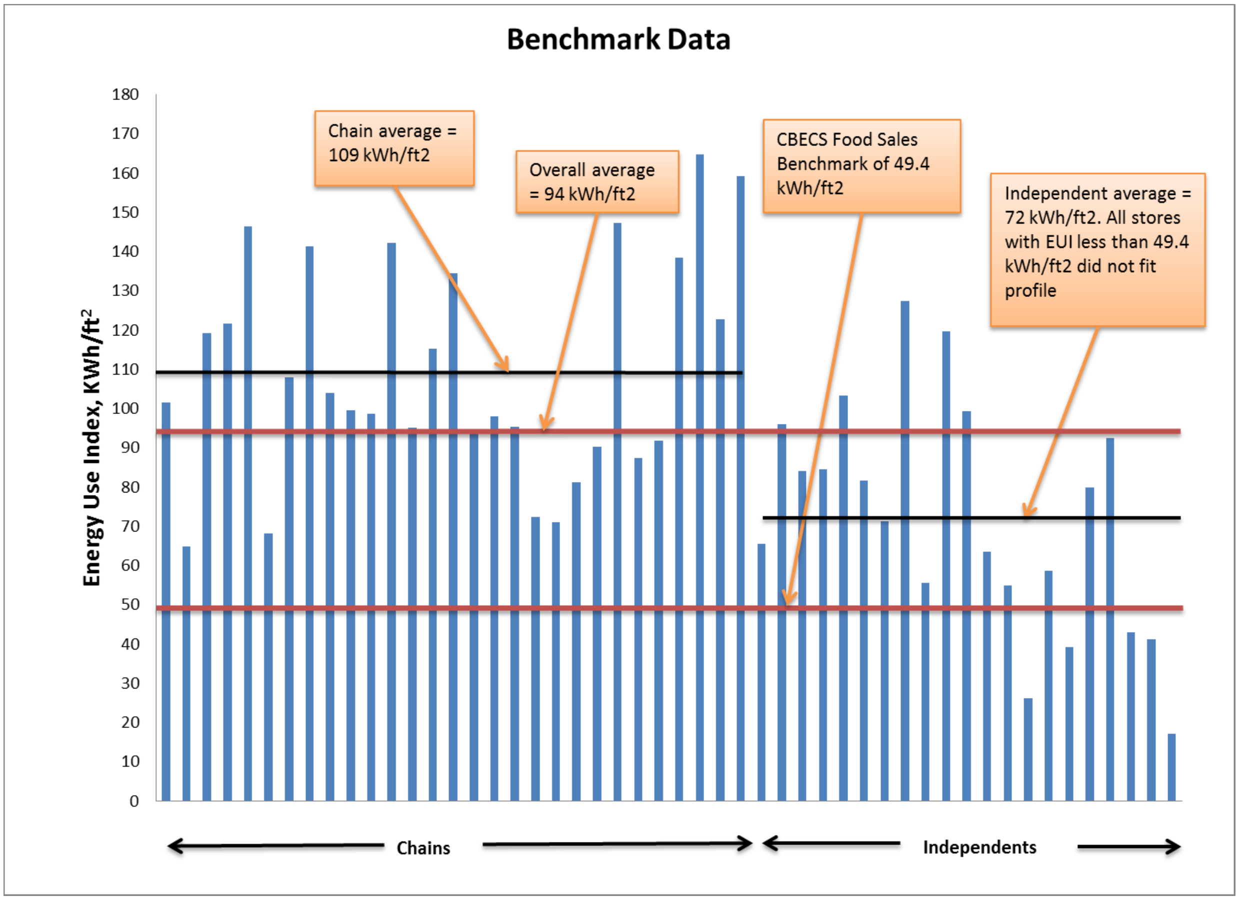
Figure 3, above, shows the annual electric use for the 50 stores that were audited. These numbers may provide some basis of comparison for "average" energy use. The average energy usage for this group overall was approximately 364,000 kWh per year. Since there are about 2,000 C Stores in Minnesota, this results in a consumption of 725 GWh per year.[4]

The study included 29 chain stores with 11 of those having car washes on site and 21 independently owned stores with 12 of those having car washes on site. Chains had higher average annual energy usage than independents, and chains with car washes had the highest use overall. Chains were typically open longer hours than independents and typically had more plug loads, which may explain the higher energy consumption.

[4] For 2,000 C Stores using approximately 364,000 kWh per year, the total usage is equivalent to 2,000 x 364,000 or 725 GWh per year.

The study also looked at the energy use index and compared that to the CBECS benchmark of 49.4 kWh/ft^2. The CBECS benchmark was significantly less than the study average of 94 kWh/ft^2. As can be seen in Figure 4 below, only five participants were below the CBECS benchmark. They were below that benchmark because they did not fit the profile of a typical modern day convenience store. They did not have any refrigeration equipment (one store), or the square footage was almost twice the average (three stores), or were located in a small town and only open 18 hours a day with much of the exterior lighting off at night (one store).

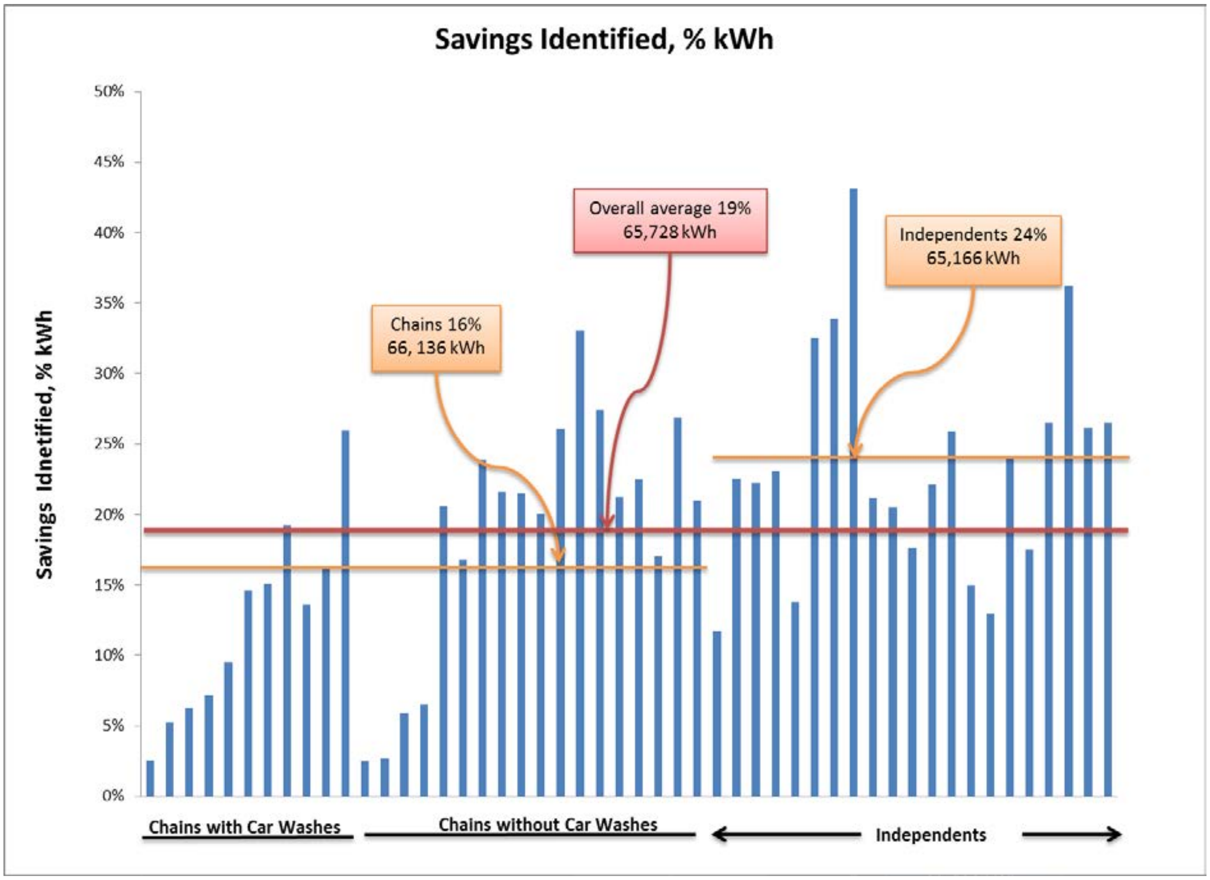
FIGURE 4: ENERGY USE INDEX, KWH/FT^2



Energy Savings Potential and Opportunities

The overall energy savings potential for all 50 stores in the study was 19% of overall annual electric use. The average for independents was 24% and the average for chain stores was 16%. Some opportunities were evenly distributed in all the stores. Examples include occupancy sensors, converting 32-watt to 25- or 28-watt T8 lamps, converting shaded pole or permanent split capacitor motors to electrically commutated (ECM) motors, installing anti-sweat heater controls, or general maintenance issues (such as cleaning evaporator and condenser coils or replacing door gaskets). Typically independently owned stores lagged behind chain stores in implementing new technologies, such as the conversion from T12 lighting, using LED exit signs, using LED light strips in glass door reach-ins, or converting exterior lighting to LED. Therefore, while independent stores used less energy than chains, they had more opportunities for saving energy.

FIGURE 5: POTENTIAL SAVINGS IDENTIFIED FOR CONVENIENCE STORES



As part of the audit process, various efficiency measures were tracked to determine market penetration. The overall summary of these findings is included in Appendix A3. Each measure was categorized as either an opportunity, an existing best practice, or not applicable. For capital projects the payback had to be 5 years or less for it to be considered an opportunity, with the exception of T12 lighting. T12 lighting was tracked as an opportunity even though the paybacks were over 9 years, in order to inform owners that T12s were phased out as of June 2012 and that they should plan for a retrofit. Many maintenance activities, such as coil cleaning or door gasket replacement, were identified as an opportunity even if the associated payback was greater than 5 years because failure to address these items could result in equipment failures and downtime, costs which were not included in the payback analysis.

This market sector has many opportunities for energy savings. Table 7 lists the opportunities that were identified in over 50% of the businesses. Some discussion of these opportunities follows in the next few paragraphs.

TABLE 6: HIGH FREQUENCY OPPORTUNITIES

Low/Med Cost	# of Stores	% Opportunity	Observations
Install Strip Curtains	41	82%	employees don't like them
Reduced Wattage: 32W T8 to 28 /25W T8 Lamps	34	68%	concerned of inadequate lighting
Clean Evaporator Coils	26	52%	can be ignored - tough to inspect
Clean Condenser Coils	26	52%	can be ignored - tough to inspect
Occupancy Sensors	44	88%	common opportunity in all businesses
High Cost	**# of Stores**	**% Opportunity**	**Observations**
Floating head pressure	32	64%	best for at least 5 hp compressor size
Anti-sweat heater controls	41	82%	many businesses not aware of this
EC fan motors	37	74%	many businesses not aware of this
Exterior Building Lighting - MH to LED	36	72%	not much market penetration at all
Gas Canopy Lighting: MH to LED	43	86%	most common exterior lighting retrofit

Strip curtains for walk-in coolers are unpopular among employees, but there are some improvements available so they may gain acceptance by employees (Photo 3).

PHOTO 3: TRADITIONAL STRIP CURTAINS ON LEFT (PHOTO NOT FROM C STORE) AND NEW GATE STYLE CURTAINS ON RIGHT

It is understandable how evaporator coils are ignored because the employees usually have to move a lot of boxes to gain access to them. The same goes for condenser coils, which are typically located on the roof or in an attic space and difficult to access.

The floating head pressure controller is a ne w technology for this market sector. At current market prices and estimated rebate amounts, it is best if the compressor has at least a 5 hp motor. Anti-sweat heater controls (Photo 5) seem to be on the verge of making more market penetration, however it was difficult to assess whether stores had anti-sweat heater opportunities because the controller box was often hidden, non-descript, or pre-installed and owners/managers may not know they have the equipment. Since it is a controls technology the change is not as obvious as LED lighting, so it may take more education to gain market acceptance. Electronically commutated (EC) motors are another technology of which C Store owners were not generally aware.

LED lighting was probably the most popular opportunity among this group of store owners. Since measures were only identified as an opportunity if the simple payback was less than 5 years, the number of opportunities will increase as the price of installation decreases. This was especially true for exterior wall pack and parking pole LED lighting as well as floating head pressure controls. Occupancy sensor opportunities are prevalent in all businesses, but may be a tough sell because of a lack of understanding of the technology.

There is some education needed around the 32-watt to 25-watt conversion for T8 lighting in Greater Minnesota which may improve acceptance of these bulbs. It appears that some contractors or store owners feel they will have “inadequate” lighting if they use the 25- or 28-watt bulbs.

Some energy efficiency opportunities have made significant market penetration. Table 7 lists the best practices that were observed in over 50% of the businesses. Items such as LED exit signs, door closers on walk-in coolers, and photo sensors for exterior lights were common. If there were T12 bulbs in the facility they were only observed in one or two fixtures in a back storage room. Items such as adjusting refrigeration temperature set points or adjusting the defrost time clocks are difficult to make recommendations for because settings are product and equipment specific. Some items such as cycling evaporator fans were tough to recommend financially.

TABLE 7: EXISTING BEST PRACTICE IN C STORES

Low/Med Cost	# of Stores	% Opportunity	Observations
Adjust Refrigeration Temperature Set Points	36	72%	Assumption these were adequate
Adjust Defrost Cycle	41	82%	Assumption these were adequate
Install Door Closers	40	80%	
Door Gaskets	36	72%	
LED Exit Signs	35	70%	
High Cost	**# of Stores**	**% Opportunity**	**Observations**
Timeclock/Photosensor	34	68%	Many still shut lights off manually
Replace T12 lamps with T8 lamps	30	60%	Limited in number and in storage rooms
Case Lighting: LED strip lamps	28	56%	may be in areas where rebate is low

Two key factors affected the ultimate paybacks the businesses would see on their potential retrofit or maintenance measures: hours of operation and rebate level. For most of the lighting measures, the payback depended on whether the store was open 24 hours a day or closed at midnight because most lights, other than security lighting, were shut off when the store was closed. There also is some variability in the wattage rating of the LED lighting. The wattage rating of a LED light can be 3 – 6 times less than the wattage rating of the metal halide (MH) lights they are replacing. This can cut the payback period in half. Since the refrigeration equipment runs 24 hours a day, the saving estimates are independent of store operating hours. The other significant factor was the rebate provided by the utility serving the business.

The effect of these two factors provides the starkest contrast for the canopy lighting, as shown in Table 8 below. The rebate can vary from $200 to $3,500 depending on which utility serves the C Store and the payback from 1.6 to 4.3 years. The case lighting and anti-sweat heater controls are other measures that had a high variability in rebate levels. Additionally, chain stores have some advantage over the independents because they are able to buy down the install prices for new technologies by bulk purchasing, which in some instances can cut the payback time in half.

TABLE 8: RECOMMENDED ENERGY EFFICIENCY MEASURES FOR PROFILE C STORE

Capital Investments/Retrofits										
Efficiency Measures /Action	**Rebates[1]**		**kW**	**kWh Savings**			**$ Savings[2]**		**Payback, years**	
Lighting	**High**	**Low**	**Savings**	**24 hrs.**	**18 hrs.**	**Cost**	**Max**	**Min**	**Max**	**Min**
Total of 4 Wall Packs, 250W MH to 59W LED	$300	$40	0.9	4,100	2,100	$960	$360	$240	1.8	3.9
Total of 4 Parking Lot Luminaires, 400W MH to 100W LED	$700	$40	1.4	6,200	6,200	$2,600	$540	$540	3.4	4.6
Total of 20 Gas canopy lights, 400W MH to 100W LED	$3,500	$200	7.1	31,100	15,500	$7,800	$2,700	$1,800	1.6	4.3
Total of 136 Store T8 lamps - 32W 4'T8s to 25W 4'T8	$70	$70	1.4	11,900	7,900	$680	$900	$650	0.7	0.9
Case Lighting 9 coolers and 4 freezers - 107 W T12 to 20 W LED	$1,300	$130	1.5	13,000	13,000	$2,900	$960	$960	1.7	2.9
Controls										
Occupancy Sensors for 2 restrooms and 2 storage rooms	$120	$60	0.0	2,800	1,900	$440	$170	$110	1.9	3.4
Anti-sweat Htr controls - 8 coolers @ 0.85 and 3 freezer @ 1.3 amp	$660	$0	1.0	10,200	10,200	$2,300	$730	$730	2.2	3.1
Motors										
EC Motors for 4 freezer and 4 cooler evap fans @ 1/20 hp	$560	$0	0.7	6,000	6,000	$2,200	$450	$450	3.6	4.9
Refrigeration										
Floating Head Pressure Control - 4 hp walk-in freezer comp. moto	$240	$0	0	5,500	5,500	$2,100	$340	$340	5.5	6.2
Retrofit Measures Total	**$7,450**	**$540**	**14.0**	**90,800**	**68,300**	**$21,980**	**$7,150**	**$5,820**	**2.0**	**3.7**
Maintenance Measures										
Install strip curtains	$0	$0	0	570	570	$80	$30	$30	2.3	2.3
Clean 2 Condenser Coils (4 hp freezer/3 hp cooler)	$160	$0	0.2	1,600	1,600	$400	$120	$120	3.3	4.8
Clean 2 Evaporator Coils (4 hp freezer/3 hp cooler)	$160	$0	0.2	1,600	1,600	$400	$120	$120	2.0	4.8
Maintenance Measures Total	**$320**	**$0**	**0.4**	**3,770**	**3,770**	**$880**	**$270**	**$270**	**2.1**	**3.3**
Overall Totals	**$7,770**	**$540**	**14.4**	**94,570**	**72,070**	**$22,860**	**$7,420**	**$6,090**	**2.0**	**3.7**
Note 1: The table lists the highest and lowest rebates observed in the 12 Minnesota utility territories in the study										
Note 2: Maximum savings were based on 24 hr. operation with highest rebate and lowest savings were based on 18 hr. operation with lowest rebate										

Based on the 50 stores audited in the study a profile business is described below. Table 8, above, provides a savings profile for that average store in this market sector in Minnesota.

Profile C Store

Typical C Store profile from this study:

Hours of Operation: Open 7 days per week

- Open either 18 or 24 hours per day

Size: 4,400 ft^2
Annual Electricity Usage: 360,000 kWh
Annual Electricity Cost: $32,725

Savings Opportunity: $6,000 / year
Savings Ratio: 19% reduction in usage
Investment Cost: $23,000
Simple Payback (before rebates): 3.8 years

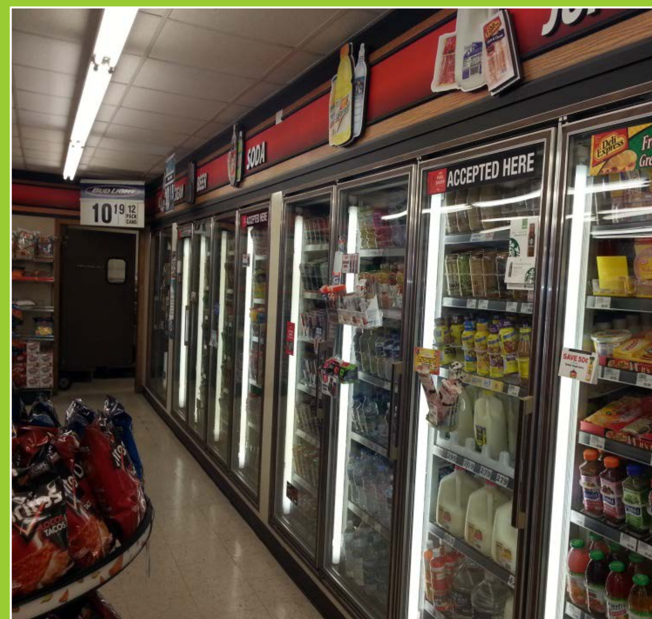


PHOTO 5: C STORE INTERIOR

Key Equipment:

Lighting: 4 wall packs, 4 parking lot luminaires, 20 gas canopy lights, 136 4-foot T8 fluorescent lamps, 4 areas needing occupancy sensors

Refrigeration: 8 door walk-in cooler and 3 door walk-in freezer

Efficiencies from Operating Practices

Even the mundane and common practice of not setting the thermostat higher (or lower) than required for the season can help with energy efficiency in C Stores. A list of recommended practices for operations includes:

1. Keep the space thermostat set point as low (winter) or as high (summer) as possible for customer comfort and staff efficiency.
2. For stores with some shut down time, reduce the space temperature (winter) or raise the temperature (summer) as much as feasible during the downtime.
3. Keep the coolers and freezers as warm as proper food conditions will allow. This minimizes refrigeration operations.
4. Do a daily check of lighting and other equipment that is turned on during daylight hours. Is it needed or can it be turned off? And repeat at night. Is only the required lighting and equipment on? – If more is turned on, then turn off what is possible.
5. Minimize operation of defrost cycles. If defrosts are manually controlled with a time clock, reset the defrost times at least seasonally in response to the humidity in the

outside air. As the outside air is drier (fall/winter/spring), the number and time of defrost cycles can be reduced. Watch the evaporator coils to judge how much defrost is needed.

Store HVAC

An early stage of research included some in depth study of convenience store HVAC systems, to determine what types of energy efficiency measures might be possible. One goal was to provide the framework for an HVAC maintenance program. One such program that is already in use by several utilities is called CheckMe!, provided by Proctor Engineering Group. A description of the program from the Proctor Engineering website follows:

> *CheckMe!® was developed as a result of over 20 years of studies by Proctor Engineering Group. These studies found three main problems with air conditioners: incorrect refrigerant level, low airflow through the indoor coil, and duct system air leakage. CheckMe is a computerized diagnostic, verification, and quality assurance system that has been used by thousands of HVAC service technicians to detect and correct these problems on over a quarter of a million systems nationwide. Over the years, CheckMe has evolved to also identify under-performing air conditioners that are ideal candidates for replacement with a new high efficiency air conditioner.*

The CheckMe! process was tested on several C stores in Minnesota. The primary issues identified through the process were incorrect refrigerant charges and low airflow across the evaporator coil. Refrigerant charges were simple to remedy, however, airflow proved more difficult. In all the cases, the speed of the fan was changed to its maximum setting and the units were still deficient in airflow. A redesign of the duct work would likely be necessary to fully solve the airflow issues. This fell outside of the scope of what was deemed maintenance, so was not pursued further. The energy savings attributed to the tune-up averaged about 450 kWh for a four ton unit. This equates to about $45 a year in energy savings. The CheckMe! process costs about $250 per unit, which gives the CheckMe! process a simple payback of about 5.5 years. Because of the long payback period, this process was not recommended for use in convenience stores.

Other HVAC projects were considered, such as rooftop unit replacement and night setback thermostat controls. These were typically not included as projects for the convenience stores since many stores operate 24 hours a day, making the possibility of using any sort of night setback scheme impractical. Replacing rooftop units will save energy, but the cost to do so does not yield a favorable payback. It is often best to purchase a high efficiency unit at the end of equipment life, rather than replacing a working unit. One technology that would be highly beneficial to convenience stores is an air side economizer. Economizers allow the use of cooler outdoor air to provide cooling instead of running the AC units. It is likely that most rooftop units have the capability to run an economizer cycle. However, some stores use split system air conditioners, which less frequently have economizer capability.

Management Survey Results

Of the 50 convenience stores across the state of Minnesota that participated in this study, 36 of their owners/managers agreed to answer an informational survey after their energy assessment report had been presented to them. The goal of the survey was to better understand the perspectives of business owners in the convenience store business and their attitudes towards energy efficiency and conservation. Of the 36 businesses that participated in the survey, 15 are independently owned stores and 21 are corporately owned chain stores. The survey was completed by the owners of the independent stores and the facility operation managers in the case of the chain stores. The survey consisted of four questions. For each question, responders were given a series of possible answers and asked to rank each of the answers from 1 to 5, with 5 indicating that the answer was very accurate for this business, and 1 indicating that the answer was not accurate for this business. The results are summarized in Figure 9.

Chain stores have about twice as many energy maintenance practices in place than independently owned stores.

The first question in the survey asked why they agreed to participate in this study. The most frequent reason given for participation is the need to reduce and control energy costs and the need for information on how to best achieve energy efficiency and conservation. When this answer is split into separate groups for independents and chains, independent store owners were also concerned with expected increases in energy costs.

The second question asked in the survey was what energy management practices they currently do. The most frequently chosen description of current energy management across all the C Stores is that they “pay their bills and turn things off.”

However, when the results to this question are split between the chains and the independents, the chains responded that every measure was an accurate description of what they are currently doing to manage energy costs including: monitor and track bills and use; watch for, evaluate and install new technologies; watch for waste, fix, train employees; adjust temperatures, pressures, times, etc.; compare operations with other stores; and planned preventive maintenance. This response from the chain stores means that they are almost twice as likely to have a specific energy management practice in place when compared to an independently owned store. [5] This might be due to the likelihood that chain stores have at least one dedicated energy manager on staff, whereas in independent stores that role is left to the owner.

[5] One issue with the survey is that the only two chain store managers were surveyed on behalf of the 21 stores they manage. That results in less diversity of response from the chain stores.

The third question asks what their preferred financial criteria are when making decisions on investing in energy efficiency. Across all the stores surveyed, the best description for financial criteria for investment in energy efficiency was a simple payback of about 2.7 years.

However, here again was a stark contrast between chains and independents. Chains considered net present value calculation as the best criteria for financial investment, closely followed by a cash flow calculation and their simple payback requirement was 2.2 years on average. Independently owned stores on the other hand generally preferred a simple payback analysis and were open to longer paybacks of 3.6 years.

The last question asked what needs or requirements C Stores may have before deciding to implement energy efficiency and conservation measures. For this question, both chains and independently owned C Stores would like proof that other stores are installing specific technologies and having good results from using it. Plus, references to other users doing energy efficiency and conservation measures would be appreciated. Independently owned C Stores were also interested in project management assistance including: references to contractors, help gathering bids and verification of energy savings claims.

Loans and financing were not frequently mentioned as barriers. The stores either had capital on hand to self finance improvements or they had an existing relationship with a financial partner, so getting funding wasn't a hindrance to implementing an energy project.

For independent store owners there is a need for information. Store owners found the report helpful, and appreciated the recommendations for technology. Some independent store owners mentioned hesitation to invest in their business if they were considering selling the business. Participants generally agreed to implement some energy efficiency and conservation measures after reviewing the reports.

A summary of the survey results can be found in Figure 9 below. A full copy of the survey results is available in Appendix A5.

FIGURE 9: SUMMARY OF SURVEY RESULTS

Motivation to Study and Implement Energy Measures	All Stores	Independents	Chains
Rank 5 - 1; 5 = best description and 1 being least	Average	Average	Average
1. Why did you participate in this study?			
a. Energy cost are too high	2.3	3.3	1.5
b. Energy costs are growing / likely to grow?	2.9	4.1	2.0
c. Want to reduce/control energy costs – need information?	4.4	4.0	4.8
d. Competition – internally or external?	1.2	1.4	1.0
e. New technologies – would they work for us?	1.9	2.9	1.2
f. Other ___Utility Referral_______________________________________			
2. What energy management do you do now?	4.1	2.8	5.0
a. Pay the bills and turn things off?	4.8	4.4	5.0
b. Monitor and track the bills and use?	4.0	2.6	5.0
c. Watch for new technologies, evaluate and install when appropriate?	4.1	2.9	5.0
d. Watch for waste / fix / train employees?	4.2	3.0	5.0
e. Adjust temperatures, pressures, times etc....	3.9	2.3	5.0
f. Compare your operations with other similar stores?	3.8	1.8	5.0
g. Planned preventive maintenance e.g. with contractor?	4.1	2.8	5.0
h. Other____			
3. Do you have financial criteria for investment in energy efficiency?			
a. Simple payback – Cost/Savings = Payback	3.6	3.8	3.5
i. What is your general PB requirement? (in Years)	2.7	3.6	2.2
b. Return on Investment type calculation	2.3	2.7	2.0
c. Present Value calculation	3.5	1.5	5.0
d. Cash generation calculation	3.5	2.7	4.0
e. Other ______see notes______________________			
4. Are there other needs or requirements you have before deciding to implement energy conservation measures?			
a. Financing?	1.5	2.3	1.0
b. Low interest rate?	1.5	2.3	1.0
c. Project management assistance? (specifications, bidding, verification?)	1.9	2.7	1.2
d. Trust in engineering and contractor?	1.9	2.5	1.5
e. Evidence of other stores installing, using and having good results?	4.1	2.8	5.0
f. References to other users?	4.1	2.8	5.0
g. Other ___Less Red Tape with Utilities____________________________			

Program Recommendations

A major purpose of this Grant is to develop an outline of a CIP Program that a utility could use to approach and engage C Stores in energy conservation for their stores. This is a challenging assignment because of the wide diversity of C Stores and utilities around the State. Utilities serving larger population centers will have more C Stores in their service areas and more resources to use in design, support, operation and management of programs. Utilities with smaller service areas may have only a few C Stores and few resources to use for programs. With these extremes, it is clear that one size won't fit all and the program will need to be flexible and scalable to fit the particular circumstances of the utility.

The program design recommendations have several features which come from observations and interactions with the owners/managers of the stores and utility representatives. The program should include the following components:

1. Should begin with energy benchmarking to identify stores with a high potential for energy savings. This assessment is not a full ASHRAE Level II audit, but rather a targeted evaluation of refrigeration and lighting systems, which are the most common opportunities for the C Store market.
2. The energy assessment should be provided at no upfront cost to the participant business. Payment for an audit or assessment is a major barrier to participation.
3. The energy assessment report should be created during the initial site visit so engagement with the business owner can occur immediately.
4. The program should be accessible to qualified trade allies. Trade allies need to be knowledgeable in the available retrofit technologies and qualified to install them.
5. Energy savings and estimated costs should be easily verified through a spreadsheet calculator and should use Minnesota CIP Deemed Savings as much as possible. Training should be provided to make sure the spreadsheet is used properly.
6. The program should incent comprehensive implementation of C Store measures for appropriate systems and equipment. Offering larger rebates in exchange for the business' commitment to implement comprehensively is recommended.
7. Documentation should be simple for the customer while providing the data necessary for programmatic calculations, certainty and verification.

There are two major areas of savings for the C Stores – lighting and refrigeration. Multiple smaller opportunities are also usually identified with an audit. However, current practice is to rebate a specific technology, so stores choose to implement the measures with the lowest payback and none of the others. This results in missed opportunity of additional energy savings.

Current Practice: "Per Measure" Conservation

The current practice is to rebate a specific technology (typically directly to the customer) at a level that incents a business owner to select that measure as a rational choice. This practice has its strengths. Primarily, it is flexible and easy for utilities to operate. In this way utilities exercise a degree of influence over the market conditions by using rebates to reduce first costs and increase the cost-effectiveness of a measure to a customer, and customers respond by choosing to install the measure (or not). If utilities want more participation in a specific measure, they can choose to increase the rebate amount within regulated cost-effectiveness limits. Rebates also have the advantage that businesses can choose to work with whomever they want to get the information needed to install a rebated measure. For example, if a chain of stores has a corporate energy manager, that person might be able to do “in house” energy audits, rather than the need to hire an outside consultant to perform them. Measures identified as a result of an audit are typically only implemented if they meet a specific payback threshold.

The drawback of the existing paradigm is that it encourages cherry picking the measures with the best paybacks and it doesn’t challenge businesses to work towards comprehensive energy efficiency. Furthermore, for some businesses, the rebates do not amount to enough of an incentive to complete an upgrade.

Alternative Practice: “Comprehensive” Conservation

An alternative program structure might be useful to encourage deeper retrofits from businesses. This deeper program approach, combined with the larger rebates discussed in the following section, could be effective at capturing more energy savings. This alternative approach is characterized by participants with significant potential to save energy (pre-qualified to verify and benchmark their energy use) committing to reduce their energy use to a targeted goal. By making that commitment, businesses would receive an audit and rebates at a special, more attractive rate.

Eligibility for participating in the program is done by pre-screening stores’ energy use using a basic benchmark of their annual energy use and hours of operation. This pre-screening is critical to maintain program cost-effectiveness and energy savings. Based on this project’s research, possible criteria for pre-screening might be:

Stores open more than 18 hours/day: Minimum annual energy usage = 350,000 kWh/yr

Stores open 18 hours/day or less: Minimum annual energy usage = 225,000 kWh/yr

A key component to the success of this approach is the store’s commitment to reduce their energy use by a set amount. Based on this project’s research, a suggested target would be 20% or any projects with an individual payback of less than 5 years after the rebate is applied. That is ambitious enough to justify the larger rebates, while still being technically feasible.

The actual auditing and implementing would behave in a similar fashion to the existing paradigm, except that the stores will need to implement more than just the low hanging fruit in order to meet their reduction goal.

A rebate package is calculated using a lifetime kWh calculation (see following section). The key is that the rebate needs to be significant enough to bring the paybacks down on a package of comprehensive retrofits so that all measures in the package are implemented. Stores are only eligible for the larger lifetime kWh rebate because they make a commitment to reduce their energy use by the targeted amount.

TABLE 10: PROGRAM FLOW COMPARISON

	Current Practice	Recommended Alternative
	"Per Measure"	**"Comprehensive"**
Step One	No pre-screening	Store is Prequalified and Benchmarked
Step Two	No commitment from business	Store formally agrees to work towards energy reduction target (in return getting higher rebates)
Step Three	Information Gathering Variety of information sources: energy audits, employee knowledge, contractor recommendations	Information Gathering Utility funded Energy Assessment
Step Four	Implementation Store selects measures with best payback and selects a contractor to install the measures	Implementation Store implements multiple measures in order to reach their energy savings target
Step Four	Rebates available on specific technologies, rates vary based on many factors	Rebates paid out, calcuated at higher lifetime kWh rate available only to businesses that commit to reaching their reduction target

Rebates Based on Lifetime Savings

Setting rebate levels will be dependent on the financial situation of each utility and the perceived values of conservation and load control to the utility. Each utility has an interest in getting the measure installed at the lowest rebated cost, such that the measure is operationally and economically attractive.

Since each utility has its own financial and operational conditions, rebate levels cannot be prescribed, but an approach that provides some parameters for consideration in setting the rebates can be suggested. The authors suggest the "lifetime cost of energy saved" as a simple calculation and data point for consideration.

This concept of the "lifetime energy savings" as the basis of calculating rebates is offered here without exhaustive study and analyses and was not within the scope of the project. Its advantages and disadvantages have not been studied, but the concept is recommended for further study. In a more exhaustive study other factors, such as the time-value of money, should be included, but are not included in this summary for simplicity's sake.

Assumptions About Utility Costs

For this example, some assumptions were made about utility costs. The retail rate was assumed to be \$0.08/kWh, and profit, indirect and direct costs were calculated to determine the portion of that retail rate attributable to power supply under the scenarios of a utility generating 100% of power, distributing 100% purchased power, and a 50/50 split of those two.

TABLE 11: COST OF UTILITY POWER

	Utility Cost Breakout					
	Profit	Indirect	Direct	Wholesale	Customer Rate	**Cost to Utility of Power Supply**
	10%	50%	40%			
Generating Utility	$ 0.008	$ 0.040	$ 0.032	$ -	$ 0.08	**$ 0.032**
	10%	30%	0%	60%		
Distribution Only Utility	$ 0.008	$ 0.024	$ -	$ 0.048	$ 0.08	**$ 0.048**
	10%	40%	25%	25%		
50% Generation/ 50% Distribution	$ 0.008	$ 0.032	$ 0.020	$ 0.020	$ 0.08	**$ 0.040**

As Table 11 shows, the cost to a utility to supply power might range from $0.03 to $0.05 cents depending on their business model. Conservation has the benefit of avoiding that $0.03 to $0.05 cost per kWh for each year during the measure lifetime. A rebate of $0.01/kWh saved needs to be compared to the potential cost avoided for the utility.

To illustrate this concept, consider the replacement of 20 gas canopy MH lights to LED lights. That measure will save 355,000 kWh during its 11.4 year lifespan. That energy savings creates a simple lifetime avoided cost to a 50% generation/50% distribution utility of $14,200. At a rebate level of $0.01/lifetime kWh, this measure would receive a rebate of $3,550. Although this rebate model needs further analysis, on the surface level it seems like this approach could deliver higher rebates to the customer while still providing a financially attractive approach to conservation for utilities.

Setting the Rebate

Based the experience of this pilot research, it is recommended that utilities increase the rebate amount to increase energy efficiency improvements in the sector. The suggestion of a $0.01 per lifetime kWh calculation in an intriguing way to justify that increased rebate level. This $0.01 rebate is larger than most currently available rebates, but it is validated as reasonable by the fact that some rebates are currently at about the $0.01 per lifetime kWh level, for instance the canopy light rebate. A rebate cap of 75% of installed cost is recommended in order to ensure customer commitment and deter abuse of the rebate program.

Ultimately, the $0.01 rebate is a negotiable amount, which will need to be determined by the utility. This level is based on this study's evidence of what might be needed to move the market sufficiently to achieve deep energy savings. Table 12 show the proposed $0.01/lifetime kWh rebate amount compared to the highest (best) rebates presently offered in Minnesota.

TABLE 12: LIFETIME COST ANALYSIS REBATE COMPARISON

	Equipment Lifetime Yr	Lifetime Savings kWh/Meas	"Best" Rebate $/Measure	"Best" Rebate $/ Lifetime kWh	Proposed Rebate @ $0.01/ Lifetime kWh
Lighting					
Wall Packs, street and Canopy Lighting (MH to LED)					
4 Wall Packs, 250W to 59W	22.8	94,406	$ 300	$ 0.003	$ 944
4 Parking Lot Luminaires, 400W to 100W	22.8	142,009	$ 700	$ 0.005	$ 1,420
20 Gas canopy lights, 400W to 100W	11.4	355,000	$ 3,500	$ 0.010	$ 3,550
136 - 32W 4'T8s to 25W 4'T8 lamps	3.0	36,268	$ 68	$ 0.002	$ 363
Case Lighting 9 coolers and 4 freezers - 85 to 20 watt	11.4	148,836	$ 1,300	$ 0.009	$ 1,488
Controls					
Occupancy Sensors for 2 restrooms and 2 storage rooms	15.0	42,015	$ 120	$ 0.003	$ 420
Anti-sweat Htr controls for 8 cooler @ 0.85 and 3 freezer @ 1.3 amps/dr	12.0	122,136	$ 660	$ 0.005	$ 1,221
Motors					
EC Motors for 4 freezer and 4 cooler evap fans @ 1/20 hp	15.0	89,760	$ 560	$ 0.006	$ 898
Refrigeration					
Floating Head Pressure Control - 4 hp walk-in freezer compressor motor	10.0	55,050	$ 180	$ 0.003	$ 551
Maintenance Measures					
Install strip curtains	3.0	1,713	$ -	$ -	$ 17
Clean 2 Condenser Coils (4 hp freezer/3 hp cooler)	3.0	4,845	$ 160	$ 0.033	$ 48
Clean 2 Evaporator Coils (4 hp freezer/3 hp cooler)	3.0	4,797	$ 160	$ 0.033	$ 48
Totals		**1,096,835**	**$ 7,708**	**$ 0.007**	**$ 10,968**

Of even greater significant, this higher rebate could be used to leverage additional buy-in and deeper energy retrofits from C Store owners in order to access this level of rebate. Table 13 shows how the proposed $0.01 per kWh rebate brings the overall package of recommendations to an attractive payback of 1.6 years. That kind of investment is likely to be appealing to any C Store owner.

TABLE 13: PROPOSED REBATE PROGRAM

Example	Store usage		415,000	kWh/yr				
Higher Use Store	Store operations		24	hr/day			**With Proposed Rebates**	
	Qualify for program?		Yes					
	Avg Elec Rate		$ 0.0789	per kWh				
	Annual Energy		$ 32,744	per year				
	En Svg Target	20%	83,000	kWh/yr				
			Annual	**Annual**	**Lifetime**	**Proposed**		**Annual**
Measures from Audit		**$ Capital**	**kWh Savings**	**$ Savings**	**kWh Savings**	**Rebate**	**Simple PB**	**Cum % Savings**
	Lighting	$ 14,925	66,405	$ 5,480	776,519	$ 7,765	1.3	16%
	Controls	$ 2,750	12,979	$ 902	164,151	$ 1,642	1.2	3%
	Motors	$ 2,200	5,984	$ 450	89,760	$ 898	2.9	1%
	Refrigeration	$ 2,125	5,505	$ 340	55,050	$ 551	4.6	1%
		$ 22,000	90,873	$ 7,172	1,085,480	$ 10,855	1.6	22%

The financial criteria for installing conservation measures in C Stores varied mostly depending on the ownership type for the C Store. Corporate owners required a 2.2 year payback or less on average to move ahead, while private entity's requirements were varied; some were willing to do all recommended projects and others were only willing to do O&M projects requiring no capital investment. The average payback requirement was 3.6 years for independent stores. The overall average payback requirement was 2.7 years.

Within a myopic perspective, the above cost calculations show utilities could afford to buy energy efficiency far more cheaply than to buy and/or generate the energy. However, this strategy begins to affect the indirect costs and margins and hence the viability of the organization. Although, given the margin of cost savings, utilities could afford a rebate to encourage the customers to install efficiency projects on a scale that doesn't affect organizational viability.

A rebate based on $/kWh lifetime savings has good logic in approach and can be applied to many different technologies. For C Stores, it appears that a rebate level of $0.01 per lifetime kWh saved would be a good starting point. Table 13 above provides an example of how this comprehensive rebate program might appear for a C Store that meets the screening requirement suggested earlier. The qualifying measures are those described in Table 8 presented earlier in this report. With this comprehensive approach, the customer is required to implement the longer payback technologies, such as EC motors or floating head pressure controls, in addition to the shorter payback items like LED lights and anti-sweat heater controls. Of course, changes to rebate levels and creating new programs do take time, Investor Owned Utilities (IOUs) would need to file an Amended CIP Plan to get the regulatory approval for such a program, but good energy savings in the C Store sector may merit the labor of amending the plan.

Conclusion

In conclusion, it is clear that convenience stores are a compelling market sector to focus targeted energy conservation efforts. The uniformity of their conservation opportunities and the ubiquitous nature of C Stores mean that most every utility in Minnesota could stand to benefit from energy reduction. Table 14 shows the energy savings potential from the measures identified in this study. Statewide savings from an effective program could approach 120 GWh/year and save over 7 million dollars annually.

TABLE 14: POTENTIAL SAVINGS STATEWIDE

Potential Savings across existing 2,000 C-Stores Statewide (50% open 24 hrs and 50% open 18 hrs)							
Efficiency Measures /Action	**Store**	**kWh Savings**		**%**	**Statewide**	**Statewide**	**Statewide**
Lighting	**kW Savings**	**24 hrs.**	**18 hrs.**	**Opportunity**	**MW Savings**	**GWh Savings**	**$ Savings**
4 Wall Packs, 250W to 59W	0.9	4,135	2,067	72%	1.35	4.47	$275,531
4 Parking Lot Luminaires, 400W to 100W	1.4	6,220	6,220	38%	1.08	4.73	$291,679
20 Gas canopy lights, 400W to 100W	7.1	31,098	15,549	86%	12.21	40.12	$2,475,303
136 - 32W 4'T8s to 25W 4'T8 lamps	1.4	11,914	7,942	68%	1.85	13.50	$833,097
Case Lighting 9 coolers and 4 freezers - 85 to 20 watt	1.5	13,038	13,038	56%	1.67	14.60	$900,994
Controls							
Occupancy Sensors for 2 restrooms and 2 storage rooms	0.0	2,801	1,868	88%	0.00	4.11	$253,508
Anti-sweat Htr controls for 8 cooler @ 0.85 and 3 freezer @ 1.3 am	1.0	10,178	10,178	82%	1.69	16.69	$1,029,908
Motors							
EC Motors for 4 freezer and 4 cooler evap fans @ 1/20 hp	0.7	5,984	5,984	74%	1.01	8.86	$546,445
Refrigeration							
Floating Head Pressure Control - 4 hp walk-in freezer compressor	0.0	5,505	5,505	64%	0.00	7.05	$434,763
Retrofit Measures Total	**14.0**	**90,873**	**68,351**		**20.9**	**114**	**$7,041,228**
Maintenance Measures							
Install strip curtains	0.0	571	571	82%	0.00	0.94	$57,778
Clean 2 Condenser Coils (4 hp freezer/3 hp cooler)	0.2	1,615	1,615	52%	0.19	1.68	$103,633
Clean 2 Evaporator Coils (4 hp freezer/3 hp cooler)	0.2	1,599	1,599	52%	0.19	1.66	$102,606
Maintenance Measures Total	**0.4**	**3,785**	**3,785**		**0.37**	**4**	**$264,018**
Overall Totals	**14.4**	**94,658**	**72,136**		**21.2**	**118**	**$7,305,246**

Especially compelling are the opportunities to reduce energy in lighting and refrigeration. Technologies like floating head pressure controls and anti-sweat door heater controls show promise for refrigeration savings; while LED lighting, especially in gas canopies, offers significant savings. The average store could stand to reduce their energy use by about $5,000 per year – savings that would go directly to store profit margin.

What is needed now is for utilities to offer a compelling program that will provide rebates large enough to motivate installation of equipment in combination with the quicker payback measures they are currently likely to install.

Assessing the value over the lifetime of the equipment offers one such approach. Creating a conservation program that offers those larger rebates in exchange for the business' commitment to reduce their energy use could strike a mutually beneficial bargain and make strides towards reducing energy use statewide.

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Appendix A1: New Federal Refrigeration Standards

Code of Federal Regulations

For New Refrigeration Equipment

431.306 Energy conservation standards and their effective dates.

Effective: Tuesday, November 01, 2011

1) Each walk-in cooler or walk-in freezer manufactured on or after January 1, 2009, shall—
   a) Have automatic door closers that firmly close all walk-in doors that have been closed to within 1 inch of full closure, except that this paragraph shall not apply to doors wider than 3 feet 9 inches or taller than 7 feet;
   b) Have strip doors, spring hinged doors, or other method of minimizing infiltration when doors are open;
   c) Contain wall, ceiling, and door insulation of at least R–25 for coolers and R–32 for freezers, except that this paragraph shall not apply to glazed portions of doors nor to structural members;
   d) Contain floor insulation of at least R–28 for freezers;
2) For evaporator fan motors of under 1 horsepower and less than 460 volts, use—
   a) Electronically commutated motors (brushless direct current motors); or
   b) 3-phase motors;
3) For condenser fan motors of under 1 horsepower, use—
   a) Electronically commutated motors (brushless direct current motors);
   b) Permanent split capacitor-type motors; or
   c) 3-phase motors; and
4) For all interior lights, use light sources with an efficacy of 40 lumens per watt or more, including ballast losses (if any), except that light sources with an efficacy of 40 lumens per watt or less, including ballast losses (if any), may be used in conjunction with a timer or device that turns off the lights within 15 minutes of when the walk-in cooler or walk-in freezer is not occupied by people.
5) Each walk-in cooler or walk-in freezer with transparent reach-in doors manufactured on or after January 1, 2009, shall also meet the following specifications:
   a) Transparent reach-in doors for walk-in freezers and windows in walk-in freezer doors shall be of triple-pane glass with either heat-reflective treated glass or gas fill.
   b) Transparent reach-in doors for walk-in coolers and windows in walk-in cooler doors shall be—
      i) Double-pane glass with heat-reflective treated glass and gas fill; or
      ii) Triple-pane glass with either heat-reflective treated glass or gas fills.
   c) If the walk-in cooler or walk-in freezer has an anti-sweat heater without anti-sweat heat controls, the walk-in cooler and walk-in freezer shall have a total door rail, glass, and frame heater power draw of not more than 7.1 watts per square foot of door opening (for freezers) and 3.0 watts per square foot of door opening (for coolers).
   d) If the walk-in cooler or walk-in freezer has an anti-sweat heater with anti-sweat heat controls, and the total door rail, glass, and frame heater power draw is more than 7.1 watts per square foot of door opening (for freezers) and 3.0 watts per square foot of door opening (for coolers), the anti-sweat heat controls shall reduce the energy use of the anti-sweat heater in a quantity corresponding to the relative humidity in the air outside the door or to the condensation on the inner glass pane.

Appendix A2: Summary of Participating Stores

City	ID Number	Electric Utility Name	Implementing?	Square Feet	hr/day	Days/Wk	Hr /Year	Base Year kWh	Elec Cost @ 0.09/kWh [2]	EUI, kWh/ft2	Indp (I) or Chain (C)?	Car Wash?	Savings Identified, kWh	Monthly Savings, kW	Savings, $	Savings Identified, % kWh
Albert Lea	C19	Alliant	Yes	4,185	24	7	8,760	425,160	$38,264	102	C	Yes	10,676	0.00	$659	3%
Lewiston	C25	Alliant	Yes	3,520	20	7	7,300	228,629	$20,577	65	C	Yes	12,001	0.26	$771	5%
Albert Lea	C17	Alliant	Yes	4,185	24	7	8,760	499,040	$44,914	119	C	Yes	31,124	5.47	$2,566	6%
Eagan	C04	Xcel[1]	Yes	4,751	24	7	8,760	577,680	$51,991	122	C	Yes	41,371	6.28	$3,294	7%
Apple Valley	C01	Xcel[1]	Yes	4,591	24	7	8,760	672,440	$60,520	146	C	Yes	63,794	10.44	$5,169	9%
Shakopee	C16	Xcel[1]	Yes	6,394	24	7	8,760	436,480	$39,283	68	C	Yes	63,794	10.44	$5,169	15%
Shakopee	C14	Xcel[1]	Yes	5,168	24	7	8,760	557,600	$50,184	108	C	Yes	84,246	16.89	$7,192	15%
Minneapolis	C10	Xcel[1]	Yes	4,047	24	7	8,760	572,000	$51,480	141	C	Yes	109,972	15.64	$8,632	19%
Prior lake	C13	Xcel[1]	Yes	5,267	24	7	8,760	547,200	$49,248	104	C	Yes	74,228	13.17	$6,135	14%
Bemidji	C49	Ottertail Power		5,544	11	7	4,015	552,149	$49,693	100	C	Yes	90,235	13.77	$7,193	16%
Cottage Grove	C03	Xcel[1]	Yes	5,383	24	7	8,760	531,360	$47,822	99	C	Yes	138,148	19.30	$10,803	26%
Dassel	C43	Xcel		2,720	24	7	8,760	386,688	$34,802	142	C	No	9,553	0.65	$666	2%
Winsted	C42	Xcel		3,750	24	7	8,760	356,809	$32,113	95	C	No	9,553	0.65	$666	3%
Stewartville	C23	Alliant	Yes	2,864	24	7	8,760	329,960	$29,696	115	C	No	19,454	3.12	$1,569	6%
Chatfield	C22	Alliant	Yes	3,060	24	7	8,760	411,300	$37,017	134	C	No	26,631	3.31	$2,034	6%
Chanhassen	C02	Xcel[1]	Yes	3,982	24	7	8,760	373,440	$33,610	94	C	No	76,797	10.41	$5,968	21%
Shakopee	C15	Xcel[1]	Yes	3,920	24	7	8,760	384,080	$34,567	98	C	No	64,477	11.67	$5,356	17%
Eagan	C05	Xcel[1]	Yes	3,920	24	7	8,760	373,920	$33,653	95	C	No	89,218	15.66	$7,354	24%
Eagan	C06	Xcel	Yes	4,084	24	7	8,760	295,120	$26,561	72	C	No	63,683	12.10	$5,358	22%
Otsego	C11	Xcel[1]	Yes	6,928	24	7	8,760	492,400	$44,316	71	C	No	105,695	14.75	$8,263	21%
Edina	C07	Xcel	Yes	3,930	24	7	8,760	319,440	$28,750	81	C	No	63,989	8.20	$4,916	20%
Pine City	C12	Xcel[1]	Yes	3,400	18	7	6,570	306,620	$27,596	90	C	No	79,987	10.00	$6,116	26%
Stewartville	C31	Alliant		2,400	17	7	6,205	353,440	$31,810	147	C	No	116,773	15.35	$9,017	33%
Maple Plain	C09	Xcel[1]	Yes	3,635	19	7	6,935	317,680	$28,591	87	C	No	87,169	11.14	$6,694	27%
Garrison	C08	Xcel[1]	Yes	5,286	24	7	8,760	485,520	$43,697	92	C	No	103,182	14.78	$8,112	21%
Ramsey	C38	GRE/Connexus		2,376	18	7	6,570	328,840	$29,596	138	C	No	73,881	10.97	$5,854	22%
Blaine	C39	GRE/Connexus		1,800	18	7	6,570	296,720	$26,705	165	C	No	50,556	6.71	$3,912	17%
Rochester	C24	RPU		2,376	18	7	6,570	291,920	$26,273	123	C	No	78,400	11.30	$6,172	27%
Olivia	C40	MMPA		2,376	24	7	8,760	378,108	$34,030	159	C	No	79,347	10.62	$6,150	21%
Bemidji	C48	Ottertail Power		3,400	18	7	6,570	222,940	$20,065	66	I	Yes	26,165	3.21	$1,993	12%
Coon Rapid	C37	Connexus Energy		5,000	18	7	6,570	480,560	$43,250	96	I	Yes	108,234	18.51	$8,864	23%
St. Cloud	C36	Xcel		5,000	18	7	6,570	419,876	$37,789	84	I	Yes	93,420	18.38	$7,934	22%
Bemidji	C47	Ottertail Power		4,200	17	7	6,205	355,300	$31,977	85	I	Yes	82,053	12.35	$6,521	23%
Le Roy	C29	Alliant	Yes	2,750	17	7	6,205	283,920	$25,553	103	I	Yes	39,124	6.51	$3,183	14%
Albert Lea	C18	Alliant	Yes	3,595	18	7	6,570	293,740	$26,437	82	I	Yes	95,483	11.95	$7,302	33%
Austin	C32	SMMPA	No	2,400	17	7	6,205	171,080	$15,397	71	I	Yes	57,955	9.00	$4,639	34%
Albert Lea	C20	Alliant	Yes	700	18	7	6,570	89,120	$8,021	127	I	Yes	38,419	7.28	$3,230	43%
Minnetonka	C34	Xcel	Yes	6,500	17	7	6,205	361,680	$32,551	56	I	Yes	76,622	8.85	$5,773	21%
Albert Lea	C21	Alliant	Yes	2,400	18	7	6,570	287,220	$25,850	120	I	Yes	58,920	7.60	$4,533	21%
Spring Valley	C44	Municipal		1,500	16	7	5,840	148,995	$13,410	99	I	Yes	26,221	3.51	$2,032	18%
Fon Du Lac	C46	Minnesota Power		7,800	17	7	6,205	494,640	$44,518	63	I	Yes	109,442	14.72	$8,491	22%
Buffalo	C35	Municipal		5,473	17	7	6,205	300,400	$27,036	55	I	No	77,845	12.38	$6,265	26%
Walnut Grove	C28	Alliant	Yes	3,875	15	7	5,475	101,495	$9,135	26	I	No	15,226	2.52	$1,237	15%
Austin	C33	SMMPA	No	10,500	24	7	8,760	616,500	$55,485	59	I	No	79,726	12.15	$6,354	13%
Le Center	C27	Alliant	Yes	8,640	18	7	6,570	338,800	$30,492	39	I	No	81,332	10.53	$6,262	24%
Cloquet	C45	Minnesota Power		3,000	18	7	6,570	239,320	$21,539	80	I	No	41,905	7.11	$3,425	18%
Windom	C26	CMMPA	Yes	1,145	17	7	6,205	105,953	$9,536	93	I	No	28,079	4.12	$2,219	27%
Austin	C30	SMMPA	No	6,000	17	7	6,205	257,198	$23,148	43	I	No	93,063	9.12	$6,819	36%
Pelican Rapids	C41	GRE		8,892	11	7	4,015	365,840	$32,926	41	I	No	95,659	9.41	$7,013	26%
Bemidji	C50	Ottertail Power		9,600	10	6	3,120	164,240	$14,782	17	I	No	43,586	9.46	$3,806	27%
Average		**Total**		**4,364**	**20**	**7**	**7,282**	**363,611**	**$32,725**	**94**			**65,728**	**9.63**	**$5,193**	**19%**
Max				**10,500**	**24**	**7**	**8,760**	**672,440**	**$60,520**	**165**			**138,148**	**19.30**	**$10,803**	**43%**
Min				**700**	**10**	**6**	**3,120**	**89,120**	**$8,021**	**17**			**9,553**	**0.00**	**$659**	**2%**
Count				**50**	**50**	**50**	**50**	**50**	**50**	**50**			**50**	**50**	**50**	**50**
Average		**Chain**		**3,995**	**22**	**7**	**8,093**	**416,612**	**$37,495**	**109**			**66,136**	**9.76**	**$5,233**	**16%**
Count				**29**	**29**	**29**	**29**	**29**	**29**	**29**			**29**	**29**	**29**	**29**
Average		**Independent**		**4,875**	**17**	**7**	**6,162**	**290,420**	**$26,138**	**72**			**65,166**	**9.46**	**$5,138**	**24%**
Count				**21**	**21**	**21**	**21**	**21**	**21**	**21**			**21**	**21**	**21**	**21**
Average		**Chain with Carwash**		**4,821**	**22**	**7**	**8,196**	**509,067**	**$45,816**	**107**			**65,417**	**10.15**	**$5,235**	**12%**
Count				**11**	**11**	**11**	**11**	**11**	**11**	**11**			**11**	**11**	**11**	**11**

Notes:

1. Xcel rebate program assumed

2. Average cost of $0.09/kWh based on energy cost of $0.617/kWh and demand of $9.84/kW

Appendix A3: Summary of Energy Opportunities

		Opportunity		Existing		Not Applicable		C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25
Refrigeration	**Refrigeration: Low Cost**	#	%	#	%	#	%																									
	Adjust Refrigeration Temperature Set Points	13	26%	36	72%	1	2%	E	E	O	O	E	E	O	O	O	E	O	E	E	E	E	E	E	E	E	E	E	O	O	E	E
	Adjust Defrost Cycle	5	10%	41	82%	4	8%	E	E	O	E	E	E	E	E	E	E	E	E	E	E	E	E	E	X	E	X	O	E	E	E	E
	Install Display Case Shields	4	8%	2	4%	44	88%	X	X	X	X	X	X	X	E	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Install Strip Curtains	41	82%	6	12%	3	6%	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	E	O	E	O	O	E	E	O	E
	Install Door Closers	8	16%	40	80%	2	4%	E	E	E	E	E	E	E	O	E	E	E	O	E	E	E	E	E	E	E	E	E	E	E	O	E
	Refrigeration: Medium Cost																															
	Clean Evaporator Coils	26	52%	23	46%	1	2%	E	O	O	E	E	E	O	O	O	O	O	O	E	E	E	E	E	O	E	E	O	E	E	O	E
	Clean Condenser Coils	26	52%	23	46%	1	2%	E	O	O	E	O	O	O	O	O	O	O	O	O	E	E	E	E	O	E	O	O	E	E	O	O
	Suction Line Insulation	5	10%	43	86%	2	4%	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	O	O	E	E	E	E	E	E	O
	Door Gaskets	13	26%	36	72%	1	2%	E	O	E	E	E	E	E	O	O	E	O	O	E	E	E	E	E	E	E	E	E	E	E	O	E
	Refrigeration: High Cost																															
	Install floating head pressure	32	64%	0	0%	18	36%	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	X	O	X	X	O	O	O	O
	Install anti-sweat heater controls	41	82%	4	8%	5	10%	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	E	O	O	O	O	O	E	O	E
	Install efficient fan motors	37	74%	6	12%	7	14%	O	O	O	O	O	O	O	O	O	O	O	X	X	O	O	X	E	O	E	X	O	O	E	O	E
	Install energy management system (Einstein)	12	24%	23	46%	15	30%	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	X	E	O	O	E	E	O	E
	Total Refrigeration	**214**	**39%**	**237**	**43%**	**99**	**18%**																									
Lighting	**Lighting: Low Cost**																															
	Reduced Wattage: 32W T8 to 28 /25W T8 Lamps	34	68%	14	28%	2	4%	E	E	O	O	O	O	O	O	O	O	E	E	E	O	O	E	E	O	E	X	X	E	E	O	E
	Lighting: Medium Cost																															
	Occupancy Sensors	44	88%	6	12%	0	0%	O	E	E	O	O	O	O	O	O	E	O	O	O	O	O	O	O	O	O	O	O	E	E	O	O
	Timeclock/Photosensor	11	22%	34	68%	5	10%	E	E	E	E	E	E	E	E	E	O	E	E	E	E	E	E	E	X	E	X	X	E	E	X	E
	LED Exit Signs	12	24%	35	70%	3	6%	E	E	E	E	E	E	E	O	E	E	E	E	O	E	E	E	E	E	E	O	O	E	E	E	E
	Replace T12 lamps with T8 lamps	19	38%	30	60%	1	2%	E	E	E	E	E	E	O	E	E	E	E	E	O	E	O	E	E	E	E	O	O	E	E	E	E
	Lighting: High Cost																															
	Case Lighting: LED strip lamps	18	36%	28	56%	4	8%	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	O	O	E	E	O	E
	Exterior Building Lighting - MH to LED	36	72%	6	12%	8	16%	O	E	O	E	O	O	O	O	O	O	O	O	O	O	O	O	X	O	E	O	O	X	X	O	E
	Area /Street Lighting: MH lamps to LED	19	38%	7	14%	24	48%	O	O	O	E	X	X	E	O	O	O	O	O	X	X	X	X	X	X	X	X	X	X	X	X	E
	Gas Canopy Lighting: MH lamps to LED	43	86%	7	14%	0	0%	O	O	O	E	O	O	O	O	O	O	O	O	O	O	O	O	O	O	E	O	O	O	O	O	E
	Total Lighting	**236**	**52%**	**167**	**37%**	**47**	**10%**																									
							% In Place	59%	55%	41%	64%	50%	50%	41%	32%	36%	45%	41%	41%	45%	55%	50%	59%	68%	27%	77%	23%	18%	64%	73%	23%	77%
							% Opportunity	36%	41%	55%	32%	41%	41%	55%	68%	59%	50%	55%	50%	41%	36%	41%	27%	18%	45%	14%	45%	59%	23%	14%	64%	18%
							% Not Applicable	5%	5%	5%	5%	9%	9%	5%	0%	5%	5%	5%	9%	14%	9%	9%	14%	14%	27%	9%	32%	23%	14%	14%	14%	5%

	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35	C36	C37	C38	C39	C40	C41	C42	C43	C44	C45	C46	C47	C48	C49	C50
Refrigeration: Low Cost																									
Adjust Refrigeration Temperature Set Points	E	E	E	E	E	E	E	E	O	E	O	E	E	E	E	E	E	E	E	O	E	E	O	O	X
Adjust Defrost Cycle	X	E	E	E	E	E	E	E	O	E	E	E	O	O	E	E	E	E	E	E	E	E	E	E	X
Install Display Case Shields	X	X	X	X	O	X	X	X	X	O	X	O	X	X	X	X	X	X	X	X	X	E	O	X	X
Install Strip Curtains	O	O	X	O	O	O	O	E	O	O	O	O	O	O	O	O	O	O	X	O	O	O	O	O	X
Install Door Closers	E	E	E	E	O	E	E	E	E	E	E	E	E	E	O	O	E	E	X	E	E	O	O	E	X
Refrigeration: Medium Cost																									
Clean Evaporator Coils	O	O	O	O	O	E	O	O	O	E	E	O	E	E	O	O	E	E	O	O	E	O	O	E	X
Clean Condenser Coils	E	O	E	E	E	E	E	O	O	O	E	E	O	O	O	O	E	E	O	O	E	E	E	E	X
Suction Line Insulation	E	E	E	E	E	E	E	E	O	E	E	E	E	E	E	E	E	E	X	E	E	O	E	E	X
Door Gaskets	E	E	E	E	O	E	O	E	E	E	E	E	O	O	O	O	E	E	E	E	E	O	E	E	X
Refrigeration: High Cost																									
Install floating head pressure	X	O	O	X	O	O	X	X	X	X	X	X	X	X	O	X	O	O	X	X	X	O	O	O	X
Install anti-sweat heater controls	O	O	O	O	O	O	O	X	O	O	O	X	X	O	O	O	O	O	O	X	O	O	E	O	X
Install efficient fan motors	O	O	O	O	O	O	O	O	O	O	O	O	X	O	O	X	E	E	O	O	O	O	O	O	X
Install energy management system (Einstein)	X	X	X	X	O	X	X	O	X	O	O	X	O	O	O	X	E	E	X	X	X	O	X	O	X
Total Refrigeration																									
Lighting: Low Cost																									
Reduced Wattage: 32W T8 to 28 /25W T8 Lamps	O	O	O	O	O	O	O	O	E	O	O	O	O	O	O	O	E	E	O	O	O	O	O	O	O
Lighting: Medium Cost																									
Occupancy Sensors	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	E	O	O	O	O
Timeclock/Photosensor	E	E	E	E	O	O	E	X	O	E	E	E	O	O	O	O	E	E	O	E	O	E	E	E	O
LED Exit Signs	O	O	O	O	X	O	O	O	E	E	E	E	E	E	E	X	E	E	X	E	O	E	E	E	E
Replace T12 lamps with T8 lamps	E	E	O	O	O	E	X	O	O	O	O	E	O	O	O	O	E	E	O	E	E	E	E	O	O
Lighting: High Cost																									
Case Lighting: LED strip lamps	O	O	E	O	O	O	O	X	O	O	O	E	X	O	O	X	E	E	O	O	O	O	E	E	X
Exterior Building Lighting - MH to LED	X	O	O	O	O	O	O	O	O	O	O	X	O	O	O	O	E	E	O	O	X	O	O	X	X
Area /Street Lighting: MH lamps to LED	X	O	O	O	X	O	X	E	O	O	O	O	X	X	X	X	E	E	O	X	X	X	E	O	O
Gas Canopy Lighting: MH lamps to LED	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	E	E	E	O	O	O	E	O	O
Total Lighting																									
% In Place	32%	32%	36%	32%	18%	36%	27%	32%	18%	36%	36%	45%	23%	23%	18%	14%	77%	77%	18%	32%	41%	32%	50%	41%	5%
% Opportunity	41%	59%	50%	55%	73%	55%	50%	45%	68%	59%	55%	36%	50%	64%	73%	55%	18%	18%	50%	45%	36%	64%	45%	50%	27%
% Not Applicable	27%	9%	14%	14%	9%	9%	23%	23%	14%	5%	9%	18%	27%	14%	9%	32%	5%	5%	32%	23%	23%	5%	5%	9%	68%

Measures identified as “opportunities” or “existing” in 50% of more of the businesses are highlighted pink or green respectively. Measures are marked with a “E” to indicate it was “Existing” or in place at the time of the audit, an “O” to indicate an “Opportunity” and an “X” if the measure was “Not Applicable”.

MichaelsEnergy

Energy Efficiency in Convenience Stores

Site Information

Gas Express Stop, 200 Main Street, Hometown, MN

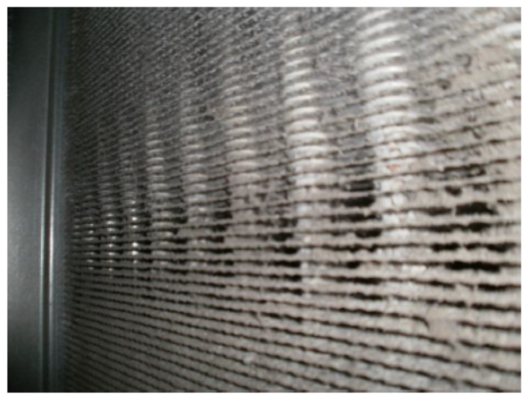

Table 1: Benchmark

Your Store	Area, ft^2	4,200	Energy Star Energy Use Index	Your Store
	Electric Use (2011)	KWh 355,300	kWh /ft2 52.5	kWh /ft2 84.6
	Electric Cost $ (2011)	$0.08 /kWh $26,648	$ /ft2 4.73	$ /ft2 6.34

Executive Summary

Gas Express Stop located at 200 Main Street, Hometown, is open 18 hours a day, 7 days per week. A site visit was conducted in April, 2013.

The highest savings will be achieved by retrofitting the canopy lighting to LED units, retrofitting the lighting in the reach-in units to LED, installing anti-sweat heater controllers on the glass door reach-in coolers and freezers, and installing efficient EC motors for the walk-in evaporator fan units. The quickest payback is achieved by installing 25 or 28 watt bulbs in the T8 fixtures.

Most of these measures qualify for prescriptive and custom rebates with Alliant Energy to help pay the initial cost of implementation. Additional savings can be achieved by implementing a preventive maintenance to keep equipment running efficiently such as cleaning the refrigeration condenser coils.

Annual savings for all these measures is approximately $5,700 per year.

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Retrofits

Key	Not Applicable	X	Existing	E	Opportunity	O

Table 2: Retrofit Measures Energy Assessment

Efficiency Measures /Action	Status	Monthly kW Savings	kWh Savings	Savings $	Rebate $	Final Cost $	Payback
Store Lighting	E	0.00	0	$0	$0	$0	0.00
Reduced Wattage T8s	O	0.88	5,485	$443	$530	$150	0.34
Case Lighting	O	1.49	13,038	$980	$1,300	$1,625	1.66
Canopy Lighting	O	7.10	15,549	$1,798	$4,260	$3,540	1.97
Exterior Building Lighting	O	0.94	2,067	$239	$566	$354	1.48
Astronomical time clock	E	0.00	0	$0	$0	$0	0.00
Exit Signs	E	0.00	0	$0	$0	$0	0.00
Occupancy Sensors	O	0.00	1,869	$115	$120	$320	2.78
Parking Area Lighting	O	1.42	6,220	$551	$852	$1,708	3.10
Anti-sweat Heater Controls	O	1.05	10,164	$751	$550	$1,760	2.34
Install Efficient Fan Motors	O	0.64	5,603	$421	$320	$1,880	4.46
Install Floating Head Pressure	O	0.00	4,129	$255	$180	$1,945	7.64
Total Retrofit Measures		**13.52**	**64,124**	**$5,553**	**$8,679**	**$13,281**	**2.39**

Operations and Maintenance

Table 3: Preventive Maintenance Measures Energy Assessment

Efficiency Measures /Action	Status	Monthly kW Savings	kWh Savings	Savings $	Rebate $	Final Cost $	Payback
Insulate Refrigerant Suction Line	E	0.00	0	$0	$0	$0	0.00
Clean Condenser Coils	O	0.13	1,153	$87	$0	$400	4.61
Clean Evaporator Coils	O	0.13	1,142	$86	$160	$240	2.79
Adjust Refrig Temp Set points	E	0.00	0	$0	$0	$0	0.00
Install New Seals	E	0.00	0	$0	$0	$0	0.00
Adjust Defrost Cycle	E	0.00	0	$0	$0	$0	0.00
Cycle Evaporator Fans	X	0.00	0	$0	$0	$0	0.00
Display Case Shields	E	0.00	0	$0	$0	$0	0.00
Total PM Measures		**0.26**	**2,296**	**$173**	**$160**	**$640**	**3.71**

Total All Measures		**13.79**	**66,420**	**$ 5,726**	**$ 8,839**	**$ 13,921**	**2.43**

MichaelsEnergy

Energy Efficiency in Convenience Stores

Financial Impact

FREE'd Cash from Energy Savings

To Invest in Energy Savings or Not ??

Investment and Escalation	
Investment of	$ 13,921
Energy Price Escalation	5%
Percent Savings (Scenario #1)	21%
Percent Savings (Scenario #2)	0%

Annual Energy Costs	
Electricity	$ 26,648
Natural Gas	
Propane	
Other	
Total	$ 26,648

Scneario #1 Make Energy Improvements

Year	Cost of Improvements	Energy Spend	Savings
0	$ 13,921	$ 26,648	
1		21,968	6,012
2		23,066	6,313
3		24,219	6,629
4		25,430	6,960
5		26,702	7,308
6		28,037	7,673
7		29,439	8,057
8		30,911	8,460
9		32,456	8,883
10		34,079	9,327
Totals	**$ 13,921**	**$ 276,306**	**$ 75,621**

NET Cost #1 $ 290,228

Scenario #2 Do Nothing

Year	Cost of Improvements	Energy Spend	Savings
0	$ -	$ 26,648	
1		27,980	-
2		29,379	-
3		30,848	-
4		32,390	-
5		34,010	-
6		35,710	-
7		37,496	-
8		39,370	-
9		41,339	-
10		43,406	-
Totals	**$ -**	**$ 351,928**	**$ -**

NET Cost #2 $ 351,928

10 Year FREE'd Cash Flow $ 61,700

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

Motivation to Study and Implement Energy Measures	C33	C30	C32	C17	C19	C22	C23	C25	C18	C29	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C34	C27	C36	C28	C26	C35	C47	C48	C41	C37	All Stores	Independents	Chains
Rank 5 - 1; 5 = best description and 1 being least	Indp	Indp	Indp	Chain	Chain	Chain	Chain	Chain	Indp	Indp	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Chain	Indp	Indp	Indp	Indp	Indp	Indp	Indp	Indp	Indp	Indp	Average	Average	Average
1. Why did you participate in this study?																																							
a. Energy cost are too high	3	3	5	3	3	3	3	3	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	2	3	3	1	2	5	2	4	2	2.3	3.3	1.5
b. Energy costs are growing / likely to grow?	3	5	4	5	5	5	5	5	4	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	2	5	5	3	3	5	5	5	4	2.9	4.1	2.0
c. Want to reduce/control energy costs – need information?	5	3	2	4	4	4	4	4	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	2	4	5	5	5	4	4	5	5	4.4	4.0	4.8
d. Competition – internally or external?	1	4	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1.2	1.4	1.0
e. New technologies – would they work for us?	1	1	3	2	2	2	2	2	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	5	5	4	3	3	5	3	1.9	2.9	1.2
f. Other ___Utility Referral_______________________________________																												5		5	5		5						
2. What energy management do you do now?																																					4.1	2.8	5.0
a. Pay the bills and turn things off?	1	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	3	5			5	5	5	5	4.8	4.4	5.0
b. Monitor and track the bills and use?	1	1	5	5	5	5	5	5	2	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	4	4	4		2	3	4	2	1	4.0	2.6	5.0
c. Watch for new technologies, evaluate and install when appropriate?	1	1	2	5	5	5	5	5	5	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	4	1	5		5	3	3	3	2	4.1	2.9	5.0
d. Watch for waste / fix / train employees?	5	2	3	5	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	4		4		4	2	5	3	3	4.2	3.0	5.0
e. Adjust temperatures, pressures, times etc….	5	3	3	5	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	2	1		1	1	3	2	1	3.9	2.3	5.0
f. Compare your operations with other similar stores?	1	3	1	5	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	4	5	1			1	1	3	1	3.8	1.8	5.0
g. Planned preventive maintenance e.g. with contractor?	3	2	1	5	5	5	5	5	4	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	1	5		3	1	4	4	4	4.1	2.8	5.0
h. Other____																																							
3. Do you have financial criteria for investment in energy efficiency?																																							
a. Simple payback – Cost/Savings = Payback	5	1	5	5	5	5	5	5	1	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5	1	4	5	2	3	5	5	5	5	3.6	3.8	3.5
i. What is your general PB requirement? (in Years)	3		4	3	3	3	3	3		2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3		3	5		3	4	5	5	2	2.7	3.6	2.2
b. Return on Investment type calculation	4	1	4	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	3	5	1	2	4	1	2	3	4	2.3	2.7	2.0
c. Present Value calculation	1	1	2	5	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	3	1	1	2	2	1	2	1	2	3.5	1.5	5.0
d. Cash generation calculation	1	5	3	1	1	1	1	1	3	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	1	2	2	5	3	2	4	3	3.5	2.7	4.0
e. Other _____see notes____________________																															5			5					
4. Are there other needs or requirements you have before deciding to implement energy conservation measures?																																							
a. Financing?	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	5	1	1	1	2	3	1	5	1.5	2.3	1.0
b. Low interest rate?	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	1	4	4	2		2	2	1	4	1.5	2.3	1.0
c. Project management assistance? (specifications, bidding, verification?)	2	1	2	2	2	2	2	2	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	2	3	5	5	3	5	2	1.9	2.7	1.2
d. Trust in engineering and contractor?	1	1	5	3	3	3	3	3	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	5	3	4	3	1	1	3	1.9	2.5	1.5
e. Evidence of other stores installing, using and having good results?	1	5	4	5	5	5	5	5	1	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	1	1	1	5	3	4	5	4	1	4.1	2.8	5.0
f. References to other users?	1	4	3	5	5	5	5	5	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	1	3	1	5	2	4	5	4	1	4.1	2.8	5.0
g. Other ___Less Red Tape with Utilities_________________________________											5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5													