CONSORTIUM for BUILDING ENERGY INNOVATION

REPORT

Title: The Corner Store Retail AER Packaged Retrofit and Utility Incentive Program Final Findings

Report Date: April 27, 2016

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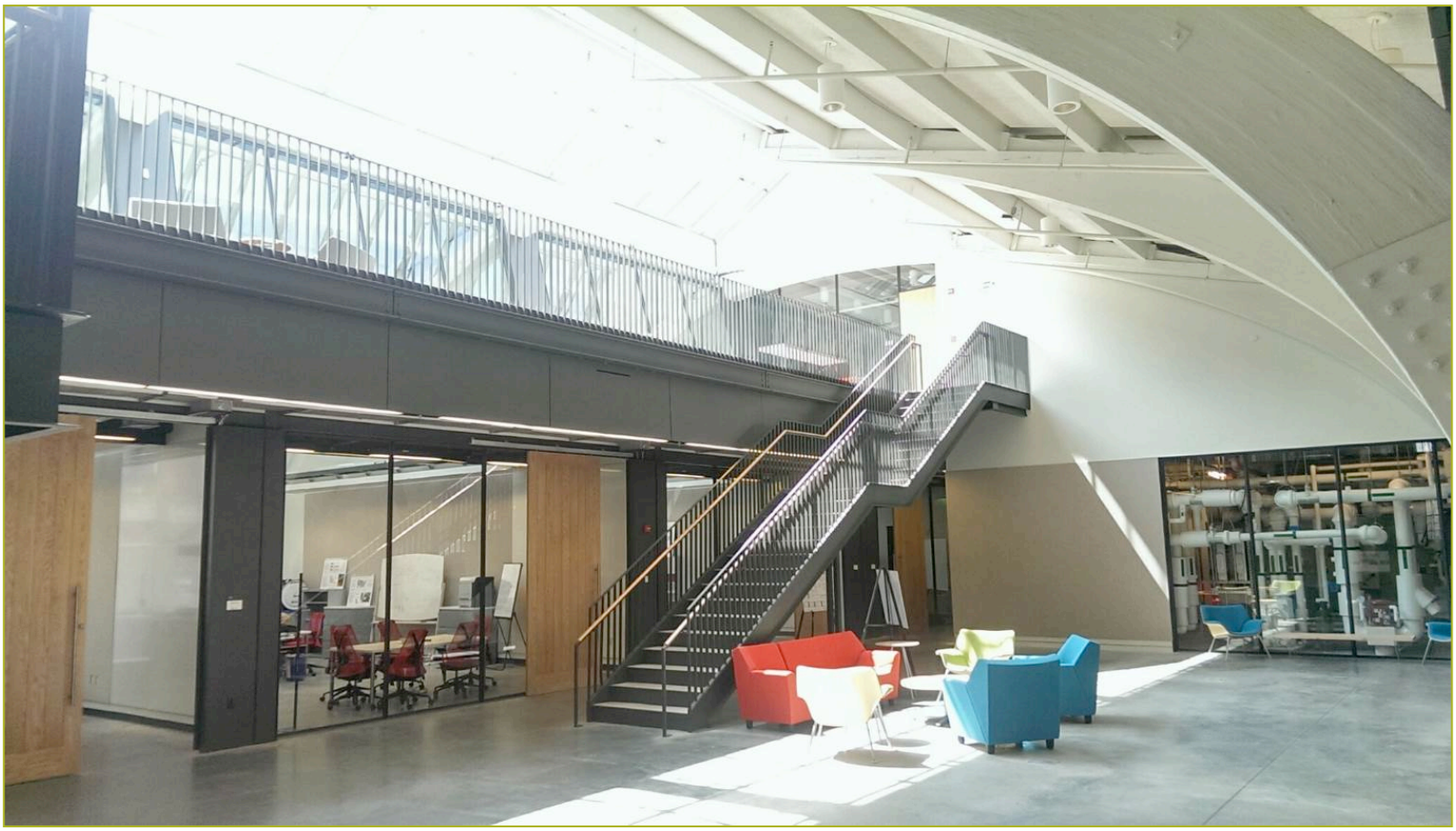

Funded by U.S. DOE

Corner Grocery Store Energy Project Final Findings

About this report

The purpose of this report is to highlight the main project findings from the The Corner Store Retail AER Packaged Retrofit and Utility Incentive Program in a way that is accessible to the utility, policy, and energy efficiency services stakeholders the project is designed to support and inform. If the reader has inquiries related to the research or the content within, he or she can reach out to the Principal Investigator, Leslie Billhymer, at leslieab@upenn.edu. This research was funded by the Department of Energy Building Technologies Office.

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Project Introduction

"These findings are valuable to the Office of the Small Business Advocate, because they offer data-supported technical solutions that may increase kilowatt and kilowatt-hours savings projects achieved through Act 129 small business direct install energy efficiency programs"
- John Evans, PA PUC Office of the Small Business Advocate

Introduction

Grocery stores are highly energy consumptive no matter what their size. Food service and food sales are first and third in ranking of building types that are the most energy consumptive according to the Commercial Building Energy Consumption Survey. Small grocery stores (<10,000 ft2) are both highly consumptive and are members of the smallest and most populous size class of US buildings. Commercial buildings that are less than 10,000 FT2 in size account for 73% of all buildings.1 The Corner Grocery Store Energy Project is a Consortium for Building Energy Innovation initiative directed with U.S. Department of Energy funding during 2015 and 2016. The project assesses direct install (DI) energy efficiency programs and their work in independently owned and operated small commercial grocery stores.

Small Grocery Barriers to Retrofit

The well-documented barriers that hold members of this market segment back from pursuing deep energy efficient retrofits are important to note. This project focused on grocery stores that fit the following profile: these are grocery stores that both occupy small buildings and are small businesses, where the owner is often busy keeping the store open and running basic operations: he or she is managing the cash register, accepting shipments and stocking shelves, or cooking behind the deli counter. Many utility contractors do not often have a specific mandate to reach profile businesses. They just have a mandate to implement energy efficiency in small buildings, and they can go to larger businesses with several locations that have the capacity to consider energy efficiency as a strategic financial investment. Second, these businesses do not have the human resources to devote to considering energy efficiency. These factors combined reveal how the incentive for energy contractors lies in reaching chain store businesses due to the economy-of-scale available, where contractors can execute one transaction and touch several buildings at once. Second, small businesses often develop a distrust of a large market of enterprises that sell various services, not all of them legitimate. This issue arises in markets where energy is deregulated; consumers who changed providers were soon surprised by exceptionally high peak demand charges. For example, as of 1997 Pennsylvania is a deregulated electricity market. In 2010, rate caps that were passed in 1997 expired. As a result, a host of businesses cropped up that offered customers low off-peak demand charges with high peak demand charges. These high peak demand charges were buried in the fine print of these contracts, and during the peak demand periods, the electricity prices rose to punishingly exorbitant heights. Several stores the investigators visited experienced this and spoke of extremely high monthly electricity bills under past providers. Pennsylvania is one of 46 states with partial or full energy market deregulation. Third, the transactional complexity of an energy retrofit, at both the "sell" and "follow-through" phases, is often daunting to a small business owner. And fourth, a lack of available capital for energy efficiency investment in severely capital constrained organizations makes even small projects off-limits. Research in the field of small business energy efficiency has identified that DI projects are the only type of rebate and incentive program that consistently impact the small commercial grocery market vertical.

Image Source: The Food Trust

Project Partners

Based in Philadelphia, Pennsylvania, the project worked with The Food Trust's Healthy Corner Store Initiative to conduct outreach to area small grocery store owners for research project participation. The project surveyed regional small business DI programs through two aspects. First, assess the technical packages implemented through DI programs with an eye toward offering alternatives that exceed current versions' energy efficiency while meeting cost-benefit requirements. For the first aspect, the project aimed to expand the technical package recommendations for the corner stores beyond those currently offered through DI programs to include additional systems and comprehensive system measures. Second, the project aimed to offer best practice outreach methods used to recruit and identify new customers for the DI incentive programs.

Special Thanks

This project would not have been possible without the generous support in the form of client identification, energy audits, energy efficiency measure recommendations, cost-benefit analysis, energy modeling, utility bill data analysis, and industry knowledge that was provided on a volunteer basis by the following regional organizations: The Food Trust, The Enterprise Center, The Tri-State Light & Energy, National Resource Management, and CBEI partners PennState University, UTRC, and Carnegie Mellon.

2 CHANNEL PARTNERS

100 STORES VISITED

12 STORES PARTICIPATING

Details of work of the project and accomplishments

The Corner Grocery Store Project was led by investigators from the University of Pennsylvania on behalf of the CBEI in Philadvelphia, Pennsylvania. The area of research was the city of Philadelphia for the small grocery store energy audits and analysis and the states of Pennsylvania, Maryland, New Jersey, and New York for the small business DI program comparison analysis.

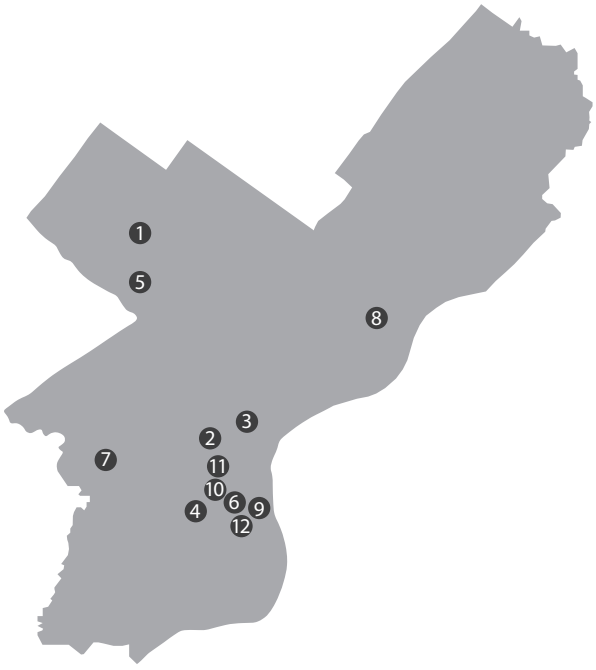
Participating Stores

The corner store visits were conducted under the guidance of The Food Trust program managers. In addition, several of the store owners who signed up for the energy audit and analysis also participate in The Food Trust Healthy Corner Store Initiative (insert link here). The project visited small commercial grocery stores across the city with concentrated efforts in the following areas: Center City's Old City and Rittenhouse neighborhoods, West Philadelphia's Baltimore Ave. and 52nd Street, and Lancaster Ave. corridors, and the South Philadelphia, Germantown, Fairmount, Chinatown, and Chestnut Hill neighborhoods. Altogether, almost 100 stores received an in-person visit and description of the project, 12 stores agreed to participate in the study, and five stores received comprehensive system energy audits from partnering contractors. The contractors put together energy efficiency measure recommendations and cost-benefit analysis for five stores.

Presentations to utility, contractor, and policy stakeholders

These findings, the cost-benefit analysis and recommendation for five of the 12 stores above, were compiled early on to maximize the short one-year project span. These findings were shared in the form of in-person or virtual presentations and discussion with relevant stakeholders, beginning in early fall 2015, as soon as the first cost-benefit analyses were available to the team. The following table captures the types of organizations that have received a findings presentation to date. While the study captures the regional context, there was an emphasis on engaging Pennsylvania utilities in discussion, the PA Public Utility Commission, and contractors, because during this year PA was organizing for the third phase of their 2008 Act 129 legislation. This presented the opportunity to have utilities incorporate new priorities into the program design for the 2016-2021 cycle. These presentations emphasized the technical findings related to measure package recommendations as relevant to the organization's relationship to one or more policy-driven DI program(s). These organizations will also receive this final findings report.

Participating Philadelphia Small Grocery Stores



Project Presentations in Region

presentation audience	PA	NJ	MD	NY
utilities	4	-	-	-
contractors	2	2	3	2
government	2	-	-	-
conferences	2	1	1	1

Small Grocery Market

153,886

FOOD SALES STORES IN THE US UNDER 10,000FT

This is an important market vertical to address for the retrofit industry, and CBECS data confirms this. The average US grocery store spends just under $4 per square foot on energy bills per year, with electricity accounting for $3.70 of that cost, or 92.5% of that cost. This electricity cost is three to four times the money spent on average for electricity by commercial office space. CBEI collected and analyzed store energy consumption data from 12 small grocery stores in the city of Philadelphia, finding a wide range of annual electricity energy expenditure levels, from $4 to $13 a square foot. From small grocery, to convenience stores, to bakeries, to meat markets, these businesses are more numerous than might be expected in urban, suburban, and rural communities in the US. According to CBECS, there are 153,886 Food Sales buildings that are less that 10,000 FT2 in size, and this represents 2.7% of the commercial building population, a proportion consistent with regional data at 2.5%. In the states studied here, stores >2500 FT2 comprises approximately 30% of the small food store market, and those >10,000 FT2 comprise 65% of the food store market.

The US convenience store market is fragmented; the top 50 companies control only 40% of industry sales in the US (First Research 2012), and therefore there is a large market of small, independently owned grocery stores. There is a relatively low cost to establish a new business or buy an existing one in this vertical, so there are low barriers to enter the industry and this makes it attractive for first time business owners. Of national convenience stores that do not include gasoline sales, 68% of businesses have five or fewer employees and a 1.4% average profit margin (IBISWorld2015). Therefore, cost control is a priority in order to thrive in the small grocery store business sector.

In addition to cost control, there is a strong public benefit to energy efficiency, especially in neighborhoods in need of increased levels of economic activity. Jerrold Oppenheim is the former Attorney General of Massachusetts and New York, and he writes about the positive economic impacts of energy efficiency activity in the economy through the concept of a multiplier in a 2008 article titled Energy Efficiency Equals Economic Development: The Economics of Public Utility System Benefit Funds. The logic is that different investments cascade or "multiply" through the economy differently, by creating jobs, which in turn create income, which in turn create measurable economic activity and growth. He argues that the multiplier of energy efficiency investment is 2.7 times that of new investment in manufacturing using data from the Department of Commerce Bureau of Economic Analysis.

Food Stores in Region of Study (Reference USA, 2016)

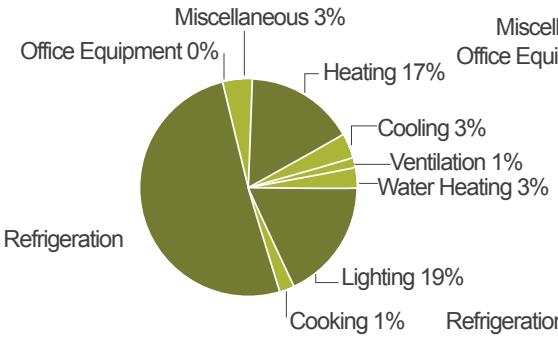
	Food Stores (<2,500 SF)	Food Stores (<2,500 SF)/ Food Stores	Food Stores (<10,000 SF)	Food Stores (<10,000 SF)/ Food Stores	All (all sizes)	Food Stores (<10,000 SF) % of small businesses
MD	1134	16%	3608	51%	7085	2%
NJ	6861	50%	10705	78%	13809	3%
NY	6244	21%	19167	64%	30048	3%
PA	5552	31%	11111	62%	17783	2%
Averages		31%		65%		3%

This project has partnered with The Food Trust (TFT), a Philadelphia-based organization that has been instrumental in helping recruit small grocery participants. They have gained national recognition for their Healthy Corner Store Initiative, a program funded by the Philadelphia Department of Public Health that helps hundreds of small grocery stores and convenience stores provide healthy unprocessed foods in neighborhoods with high rates of obesity and diabetes.2

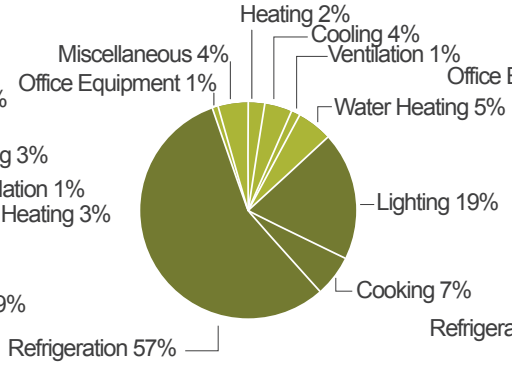
By being the first to map the relationship between proximity to access to fresh, healthy food and income level in Philadelphia neighborhoods, The Food Trust has developed a set of public health programs to address this "grocery gap" phenomenon. A "grocery gap" occurs where urban communities lack a full-service grocery store, a key finding for those who study nutrition and public health. With the Healthy Corner Store Initiative, The Food Trust is working to address systemic public health issues on a store-by-store basis. They offer incentives for selling healthy foods and promoting healthy food sales; recently they launched a store certification that continues to mature with the program.

Grocery Store Load Distribution Averages by Climate Zone

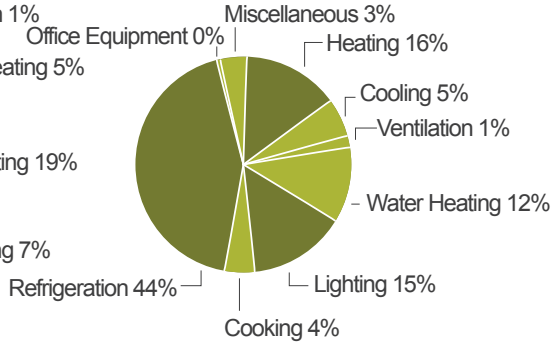
Climate Zone 1



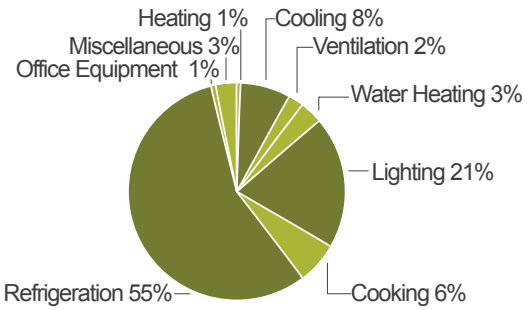
Climate Zone 2



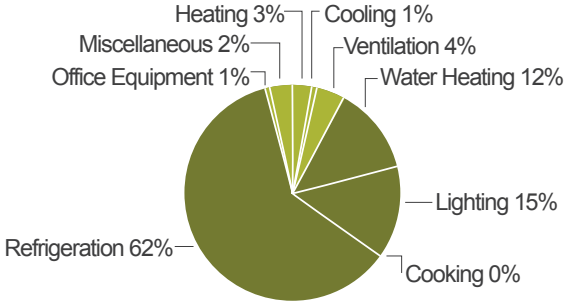
Climate Zone 3



Climate Zone 4



Climate Zone 5



Small Grocery Energy Consumption Profile

1.47 HIGHEST SAMPLE EUI

.28 LOWEST SAMPLE EUI

.75 MEDIAN SAMPLE EUI

Load Distribution Characteristics Across The US

Across all climate zones, the most consumptive systems in grocery stores in descending order are refrigeration, lighting, heating and cooling, and hot water. In four of five climate zones, refrigeration and lighting are the largest loads in these grocery stores, in one, heating and cooling are within 1% of lighting. Refrigeration is by far the largest load in the grocery market vertical, consuming between 44% in climate zone three to 62% in climate zone five. The following graphics have been adapted from National Grid's report on supermarket energy consumption, which includes small commercial grocery, showing average load consumption profiles across climate zones.

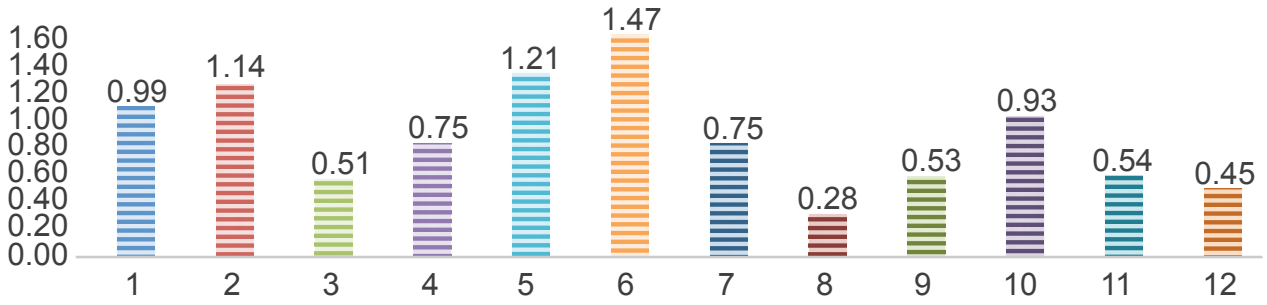
Small, Independently Owned Grocery Store Recruitment

The Corner Grocery Store Energy Project recruited and examined energy and systems data for a sample of small grocery stores (12) in the city of Philadelphia. These stores are situated in a variety of neighborhoods across the city. It is reported that many of these stores are renting spaces, in the study sample set, seven of the 12 stores are building owner occupied. A logical conclusion draws from the building energy efficiency industry's long validated knowledge of the split incentive issue: store owners who also own the building are naturally more invested in the energy efficiency of the property from a long-term investment standpoint whereas renters are not. This could by why more owners than renters opted to participate in the research.

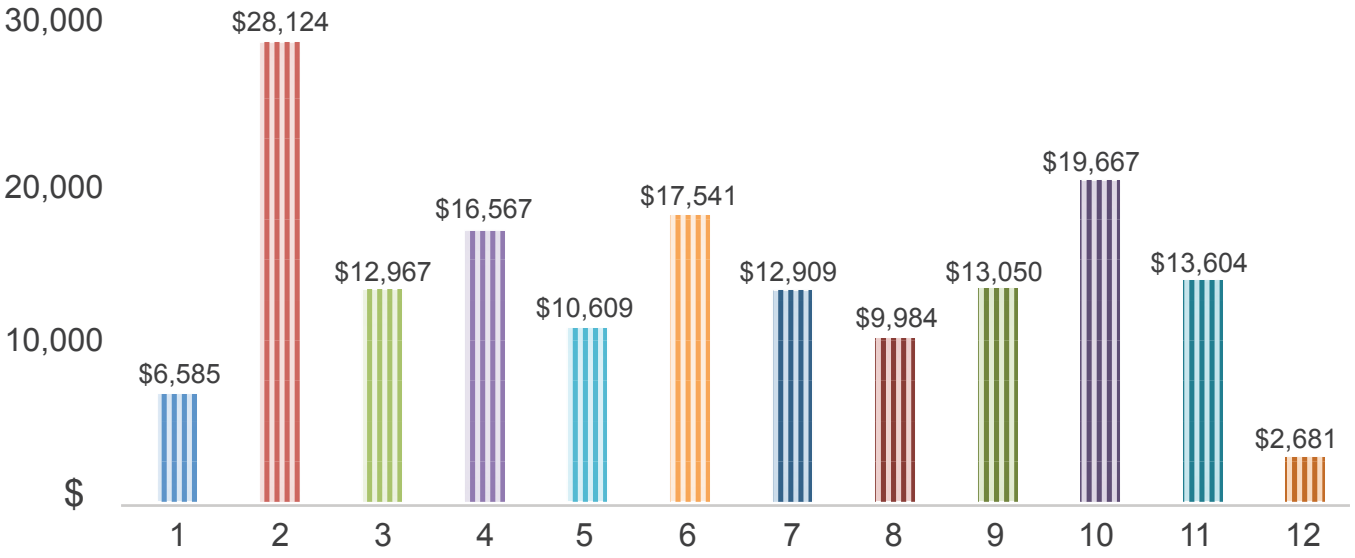
Store and System Condition Highlights

As highlighted earlier, the project investigators visited over 100 stores and studied 12 in-depth. Over the course of this market surveying, the

Size and Operating Hours Normalized Electric Usage (kWh/SF/HR)



Annual Electricity Cost for Participating Stores



team gleaned some insights about the building and systems conditions across these buildings, highlighted below. This list is not extensive and could be more extensive and detailed. But it does suggest several reasons why these stores' energy costs are so much higher than the national sector average.

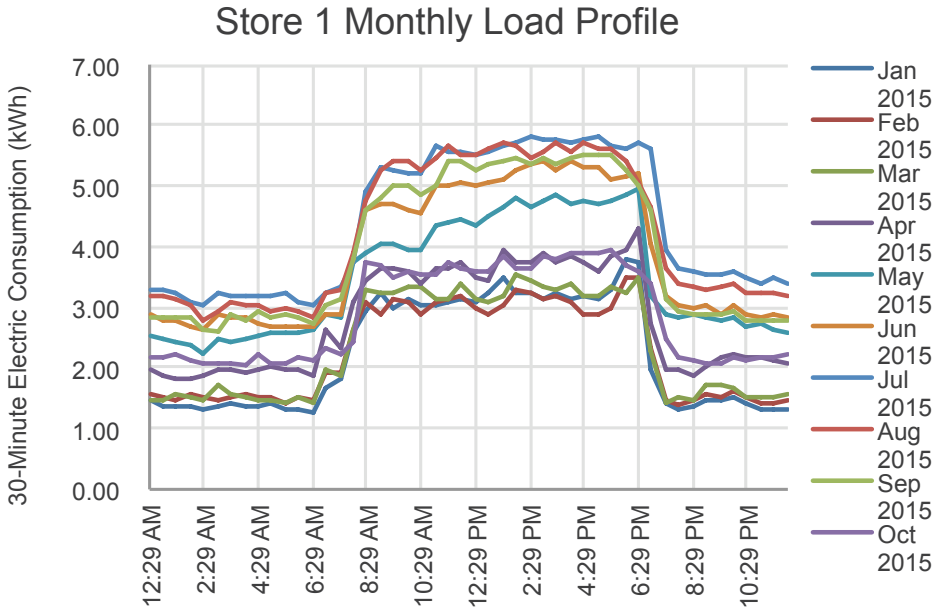
- Owners are often renters of a building or part of a building and have limited control of the HVAC systems
- Store owners are often compelled to purchase their own stop-gap HVAC equipment to supplement failing full-building systems
- Their HVAC and refrigeration equipment is often poor-performing, second hand, and at or beyond end-of-life
- Interior, exterior, and refrigeration case equipment is often very old, demonstrating that even tackling single system retrofits would yield a considerable benefit to store owners.
- Building electrical wiring is old, overloaded with equipment, and not up-to-code
- The building envelope is in poor condition, which, depending on the season, can stress building HVAC and refrigeration equipment

Small Grocery Building Energy Consumption

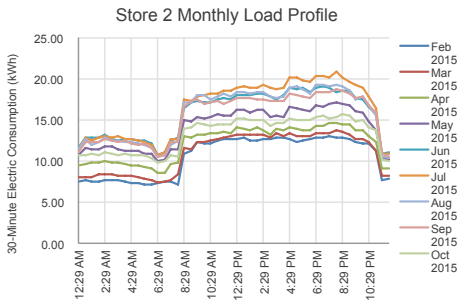
The data analysts estimated the annual energy spend for the sample stores, using a regional estimate for kWh price of 12 cents, and $.95 per therm. These amounts are not normalized for store area or operating hours, which are two of the most important factors in energy consumption across commercial buildings. But they do show the range of the cost of doing business for the stores in the sample.

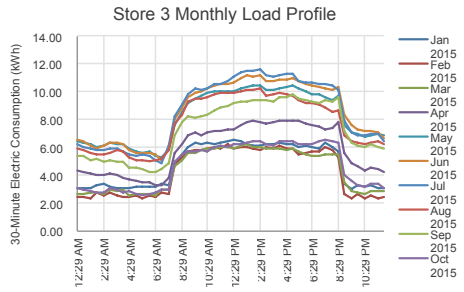
This next comparison is a common performance metric for buildings. Energy Use Intensity (EUI) is the metric that measures a building's energy use as a function of its size or other characteristics. For most property types in Portfolio Manager, the EUI is expressed as energy per square foot per year. EUI is calculated by dividing the total energy consumed by the building in one year (measured in kBtu or GJ) by the floor area of the building.3 The floor area of the small grocery stores was used for this analysis, and these measurements excluded the basement areas. To obtain EUI averages for commercial properties, analysis steps include normalizing building energy data for common characteristics shared by a sample of buildings. The process of normalizing data allows

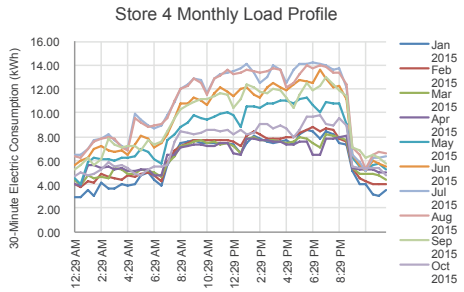
Interval Data Analysis

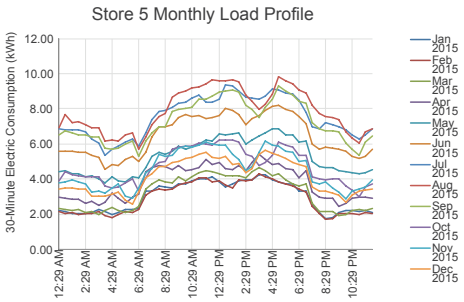


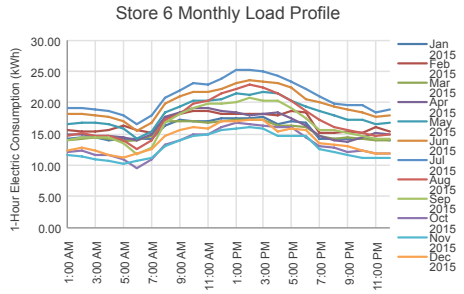
Store 1 shows normal interval data curves, where energy use consistently increases during operating hours. This data shows how summer month electric energy consumption is higher than peak and winter months. Store 1 has case heat service.

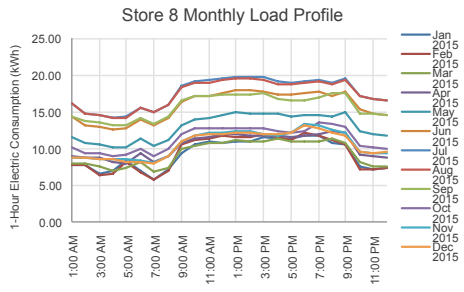




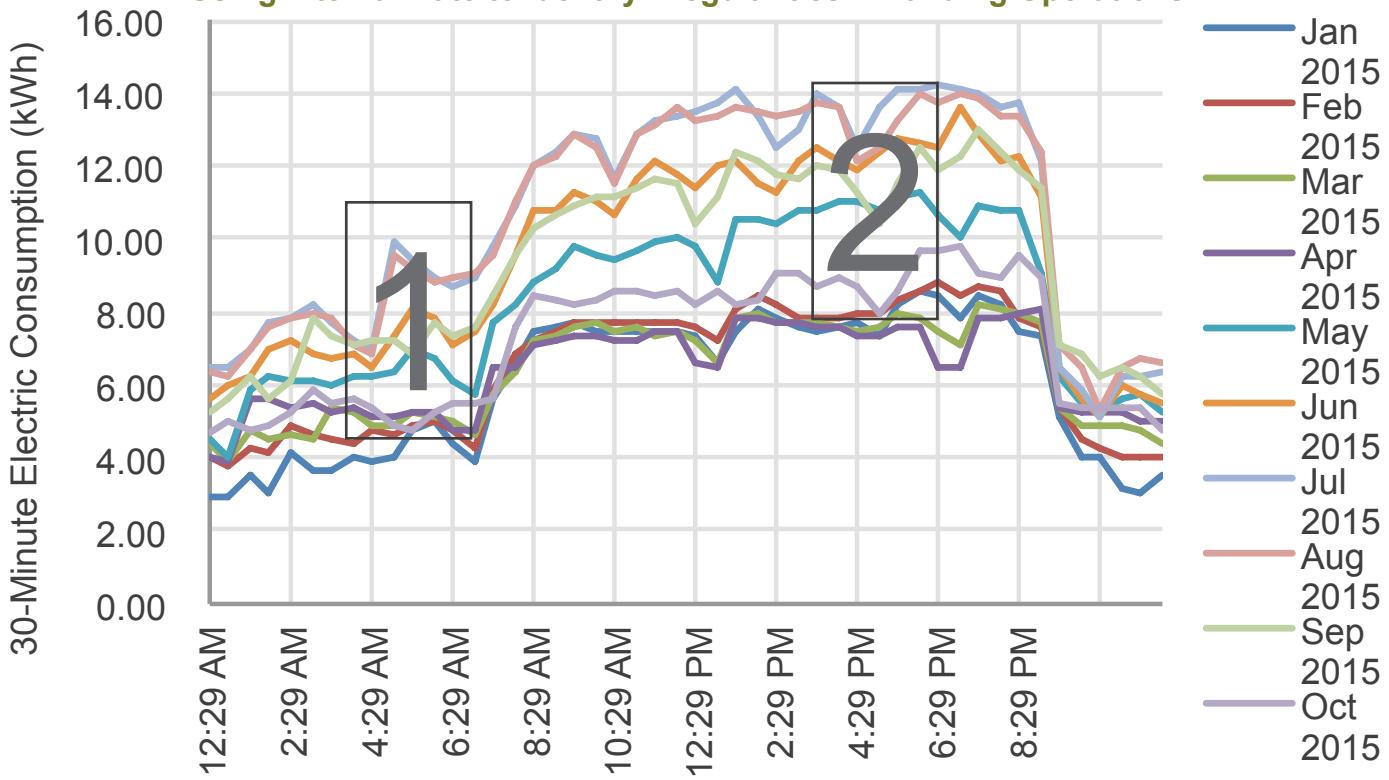








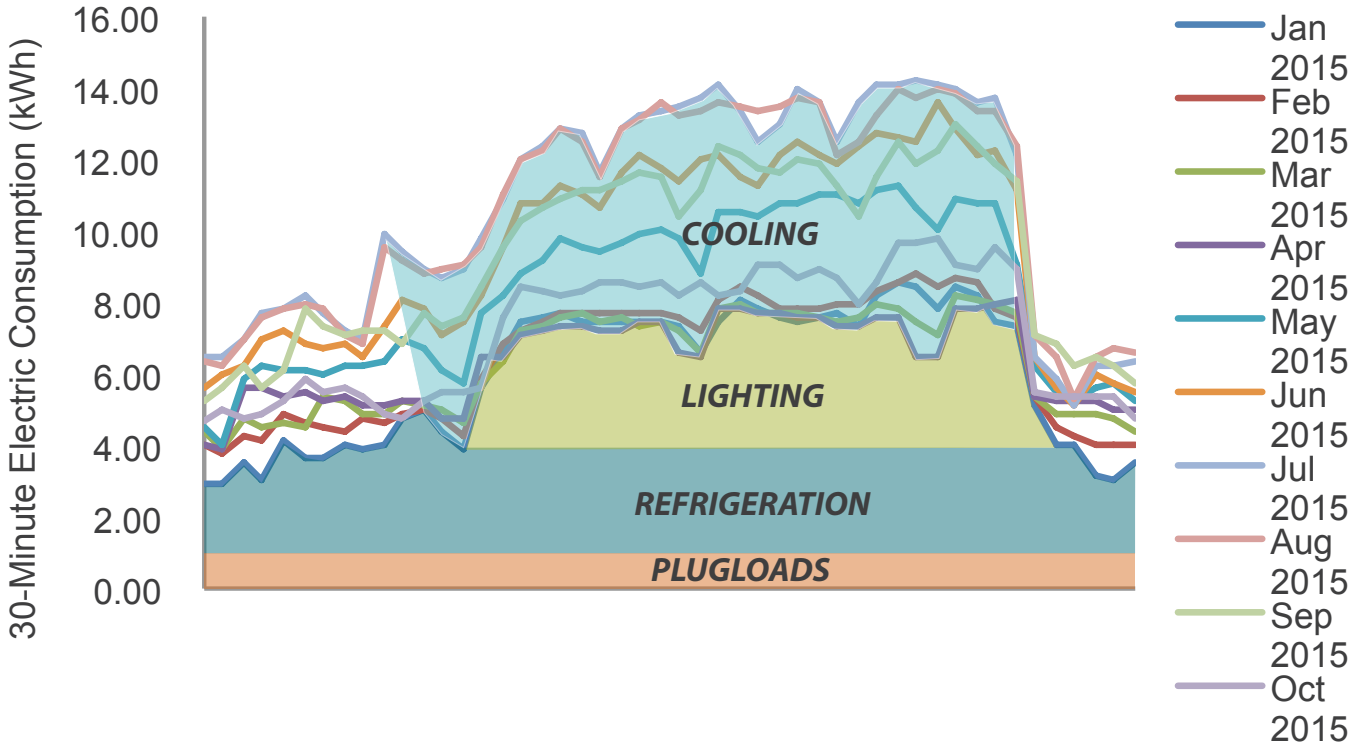
Using Interval Date to Identify Irregularities inBuilding Operations



1. Area 1 energy profile curves spike. This fluctuation suggests that there is improperly programmed HVAC equipment or that refrigeration equipment is cycling instead of coasting

2. Area 2 looks like there is a demand response energy consumption drop, but this is happening all year round. There is possibly refrigeration equipment on a timer.

Using Interval Data to Estimate Loads within a Store Using Area Under th Curve Calculations



for data to be compared in a way that eliminates the effects of certain gross influences. For this small grocery store analysis, the data is normalized by size and operating hours to account for high variation for each of these factors. For instance, some of the stores operate according to a typical business day schedule, from 8 am to 6 pm in the evening for Monday thru Friday with shorter weekend hours. Other stores are open between 12 and 14 hours a day every day of the week. To compare stores that fit both profiles as our sample does without normalizing them for operating hours would distort the results; stores that are open longer would appear to have comparatively high energy consumption without that step.

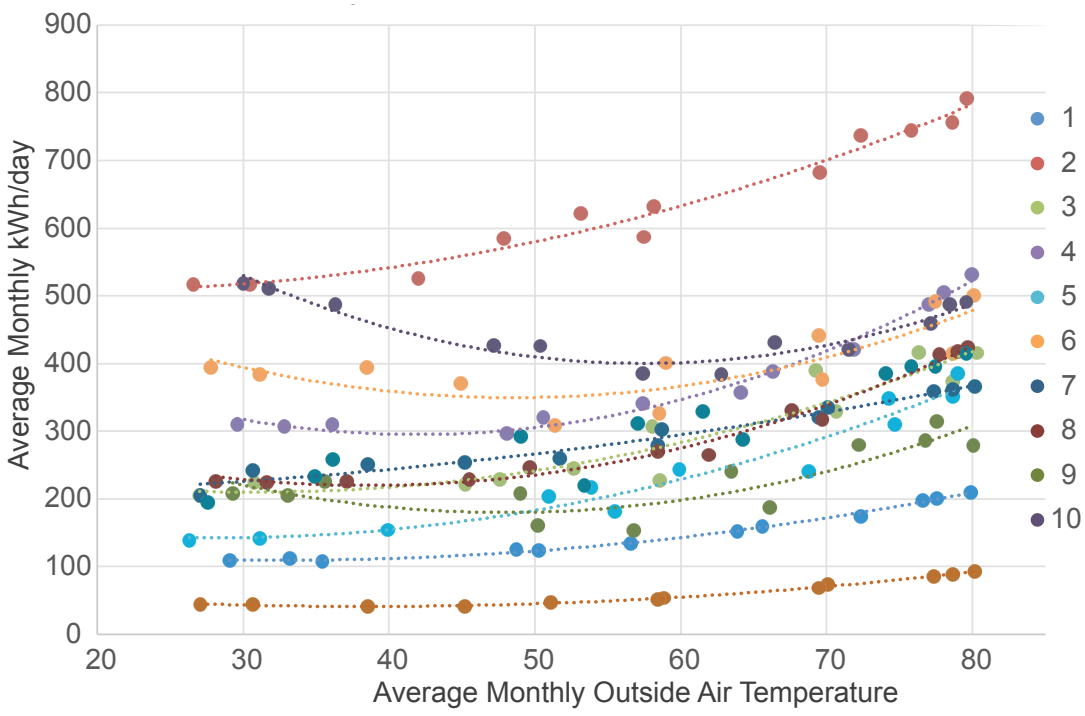
EUIs can be determined from monthly energy consumption data, the type that is included in a store's monthly bill. In the data gathered through PECO on the 12 participating stores, the EUIs range from .28 kWh/FT2/HR to 1.47 kWh/FT2/HR, showing the range of intensity of energy use in these stores. Stores number, one, two, five, six, seven, eight, nine, and eleven all have walk-in refrigerators and/or freezers. These are known to consume a great deal of energy. Store eight's low intensity is due to the fact that it is larger than most of the other stores, spreading the energy use of its systems over more area. This is the difficulty with only relying on energy use intensity measurements as indicators of retrofit potential. This store still has significant potential for energy efficiency, as there is old refrigeration equipment and CFL lighting, but one wouldn't discern that from this EUI comparison. Store ten has gone to great lengths to implement energy efficiency measures: there is LED lighting on the interior, several refrigerator LEDs, HVAC duct wrapping, and new combined heating and cooling heat pump system. This store has lots of business with a kitchen that makes hot food consistently throughout the day. The data suggests that this store EUI would be much higher without the measures that have already been installed. While there are several factors that determine EUI in small grocery stores, the amount and type of refrigeration equipment, the lighting equipment, and the amount and type of equipment that creates heat within the stores (that the refrigeration then needs to counteract) are the three most important factors.

The participating stores all fall within PECO and PGW distribution territory. By installing smart meters and joining the Green Button Initiative, PECO provided the building energy data infrastructure to accomplish a deeper energy analysis on the participating stores than monthly data would enable. The Green Button Initiative is a program that allows utility customers to download their own detailed energy usage information in a common electronic format in order to reduce their usage and costs. Project investigators were able to analyze 30-minute interval data for most of the 12 stores in the sample, which can reveal a great deal about building and equipment operations.

In the curves here, there is a clear relationship between the hours the store is open and the energy consumption, where in most cases, the energy consumption more than doubles during operating hours. One can imagine why this is the case. When a store opens, the lights go on, the space conditioning starts, the refrigerator doors start opening, etc. Another behavior to observe from these electricity consumption curves is how the consumption of shoulder months, April through mid-June, and September through October, is half of the peak consumption months of July, August, December, January, and February.

Weather regression analysis reveals how energy consumption is to weather. In these plots, the stores are normalized to each other, as the

Weather Driven Electric Consumption



Store	R^2
1	0.9955
2	0.9682
3	0.8824
4	0.9882
5	0.9444
6	0.6527
7	0.9646
8	0.9829
9	0.7345
10	0.9166
11	0.8775
12	0.9973

Survey of Regional DI Programs

4 STATES IN SURVEY

14 PROGRAMS IN SURVEY

3 PENNSYLVANIA DI PROGRAMS

analysis covers the same time period in the same city, where all stores experienced the same weather conditions. The R Squared value measures how close the data are fitted to the regression line, where a higher value indicates a closer fit of data to the line. Generally speaking, all of the stores in the sample have a high R Squared Value, revealing a predictable relationship between energy consumption and the climatic conditions.

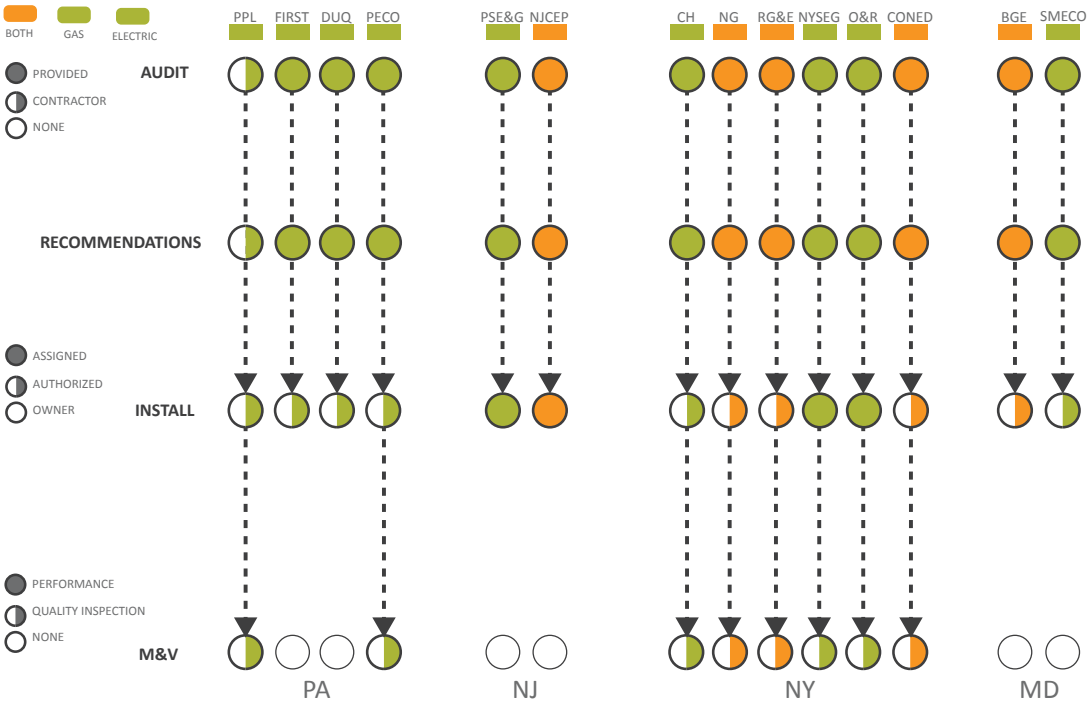
DI Program Availability to the Target Population

The purpose of this project is to evaluate the access small grocery stores have to comprehensive retrofit through DI program providers, these are one of the only channels available to these businesses for retrofit. This section introduces some of the basic attributes of the programs studied and further sections delve deeper into them. Small businesses receive the benefit of DI programs in less than half of the area studied. However, DI programs do serve the largest cities in the area studied which include New York, Philadelphia, Pittsburgh, and Baltimore, suggesting that areas with the densest occurrence of small grocery are served. The programs with the higher thresholds capture a greater number of potential clients, which means that very small grocery stores might not meet program savings targets in those markets. Programs with lower thresholds might be more likely to serve a small grocery through a DI program. One can compare the program thresholds to the energy consumption statistics in other sections to see where the stores from this project fall among the various program thresholds. For instance, by summing the kW loads for the equipment from the two stores in the previous section, one can estimate the kW load at peak demand.

DI Program Process

The DI project process is dramatically different from a basic equipment incentive program model, because it provides service for the full lifecycle of the retrofit process compared to rebates and incentives that cover part or all of the cost of the new equipment. This is a common definition, and there is room for variation within that. Program administrators exert different levels of control and oversight at the four different stages of a project, building audit, retrofit recommendations, installation, and measurement and verification (M&V). A DI retrofit where the audit is "Provided" and the installed measures are "Assigned" represent a program with more centralized control by the utility or other type of authority responsible for capturing the energy savings. For M&V, a program that measures performance after the installation demonstrates more oversight than a program that inspects completed projects for installation quality. Great-

Direct Install Project Process for Study Programs

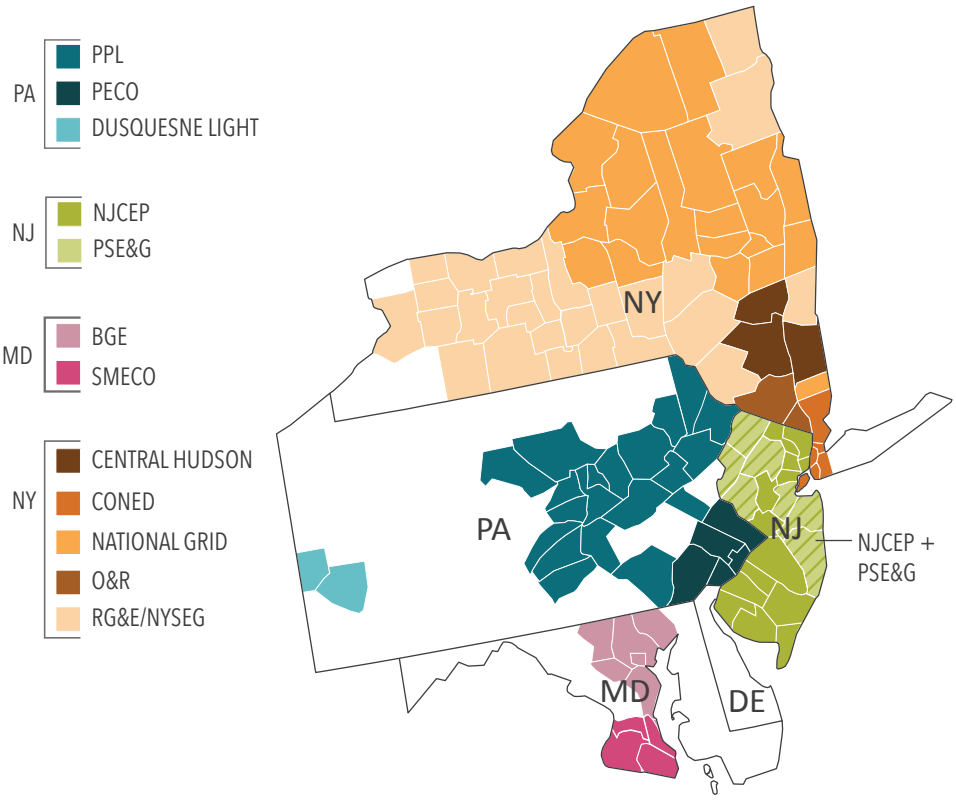


er follow through in the operational stages of DI retrofit mean that energy efficiency programs can continuously improve how they ensure consistent and increasing energy efficiency levels.

Trade Ally and Qualified Contractor Models in DI

For programs that use a trade ally model, there is a broad network of registered organizations that are qualified to administer retrofits through the DI program. Trade allies are system contractors that have a regular customer base in a given territory. If a program adopts this model, they have many system contractors working to implement the program at any one time. If a qualified contractor model is used, contractors go through a rigorous screening program during program launch or renewal cycles and the contract is awarded to a small set of those, many fewer than under the trade ally model. Industry professionals agree that there are benefits and drawbacks to each model. For the purpose of this discussion, it is important to note that those organizations practicing under a trade ally model do not experience the challenge of generating leads for retrofit because there are many contractors in the field operating on behalf of the DI program at any one time. The qualified contractor model programs that pre-certify a single or a small set of system-specific contractors for a DI program give those contractors responsibility for generating all leads of the program and likely experience some challenges without the benefit of a broad network of on-the-ground organizations talking to businesses. These programs can experience challenges identifying program customers, a factor that increases the acquisition cost. Acquisition cost is the cost of delivering a unit of energy efficiency through an energy efficiency program.

As the market profile suggests, there is a strong public benefit and business economic argument for these stores to participate in energy efficiency programs. DI project models create "one-stop shops" with the directive and capacity to usher small business owners through the several lifecycle steps of a retrofit project- initiation, audit, measure recommendations, installation, and measurement and verification. Over a decade or more of data from energy efficient program work shows how only the "turnkey" or "one-stop shop" comprehensive models have meaningful success with very small commercial energy customers.4 The caveat is that program reach remains limited for capacity-limited small businesses that fit one of the two profiles, 1) are tenants in a larger building, or 2) only own the building their business occupies. A set of well-documented factors contributes to this: small business energy customers do not have basic knowledge and expertise about energy efficient retrofits, the time to solicit services, or the available capital to complete projects. The issue of trusting energy service providers is also a pronounced issue in deregulated energy markets where small businesses have switched providers and experienced exorbitant peak demand charges. These factors make traditional marketing approaches ineffective with small business energy customers, creating an opportunity to improve means of marketing and access so that these ratepayers can benefit from DI program offerings.



This study addresses marketing methods with regional energy efficiency program managers; all but one are run through utilities. The questions for program managers were designed to collect information on the means of outreach the utilities and program managers used to identify potential customers of the programs. The findings indicate there are common ways the different DI programs generate leads as well as key differences.

By focusing on the ways energy efficiency program managers generate DI program leads within and beyond their paid contractor networks, this project suggests new ways DI programs conduct outreach to reduce marketing costs. Table data encodes this work; in the row titled "Outside Org. Lead Generation", the data reveals how programs in Pennsylvania, New Jer-

Survey of DI Marketing Approaches

7
CRM SOFTWARE USERS

7
TRADE ALLY MODELS

2009
OLDEST SMALL BUSINESS DI PROGRAM

sey, and New York have gone outside the utility and program contractors to generate projects. PP&L's territory is a combination of urban and suburban areas outside of Pennsylvania's largest population center, Philadelphia. Their DI program contractors worked with local chambers of commerce to publicize the DI incentive program to their small business owner members; though, as discussed previously, they did not experience challenges in meeting program targets, largely due to their contractor model.

NJCEP, their program manager, TRC Companies, Inc, and their small business DI program contractors worked with Sustainable New Jersey (SNJ), a state-wide program that provides tools, training and financial incentives to support communities as they pursue sustainability programs. SNJ has developed a municipal certification program that currently includes 80% of New Jersey jurisdictions.5 NJCEP and SNJ collaborated to promote enrollment in the DI small business program across New Jersey's patchwork of small town and city jurisdictions by offering points towards municipal certification for two categories of activities: first, for conducting an outreach campaign to the local business community to promote the small business DI energy efficiency program, and second, for achieving a target increase in local business participation in DI energy efficiency program uptake. By incentivizing municipalities to mobilize small businesses to complete energy efficiency retrofit, it created two layers of benefit for completing DI projects: one at the store level and one at the municipality level. Within the SNJ framework of incentives, the program piloted different types of outreach campaigns. One notable effort worked to address one of the main barriers to uptake by small business, the wariness in small business owners to trust unknown service providers who are approaching them to sell energy projects and other services. This effort piloted a program where the mayor sent mailers encouraging them to participate in the NJCEP and retrofit their businesses. Through programs like this within the SNJ framework, the contractors learned to partner with municipal governments to recruit businesses to reach their energy efficiency program targets.

These energy efficiency programs are costly for utility ratepayers and expensive to administer; in most cases, the programs are funded directly through an upcharge through utility bills. Public Utility Commissions are sensitive to this fact, and acquisition costs continue to drop across the country, a dynamic that forces energy efficiency programs to achieve more energy efficiency with less money. Marketing or marketing-related activities can

DI Program Attributes for Study Area

Utility	PECO	DL	PP&L	NJCEP	BGE	SMECO	Central Hudson	Coned	National Grid	NYSEG	O&R	RGE
Start Year	2013	2014	2011	2009	2009	2009	2010	2009	2010	2010	2013	2010
Trade Ally	N	Y	Y	N	N	N	Y	N	Y	Y	Y	Y
Customer Financing	Y	N	N	Y	N	N	Y	Y	Y	Y	Y	Y
Program Threshold	<100 kW Peak Demand	<300 kW Peak Demand	<100,000 kW per year	<200 kW Peak Demand	<60 kW Peak Demand	<60 kW Peak Demand	<110 kW Monthly Demand	<110 kW Peak Demand	<110 kW Monthly Demand	<110 kW Monthly Demand	<110 kW Peak Demand	<110 kW Monthly Demand

DI Program Marketing Approaches Attributes for Study Area

Utility	PECO	DL	PP&L	NJCEP	BGE	SMECO	Central Hudson	Coned	National Grid	NYSEG	O&R	RGE
CRM	Y	Y	N	Y	N	N	Y	Y	Y	Y	N	N
Door to Door Canvassing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Outside Org. Lead Gen.	N	N	Y	Y	N	N	Y	N	Y	Y	Y	Y
Passive marketing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

account for a large portion of a program budget. These activities involve the time and effort of utility, contractor, and sometimes, external consultants. They often involve travel to events and presentations. There are also costs for advertising collateral and materials, such as for direct mailings or buying space in printed media, for digital media on the web, television, or radio. As some contractors have discussed over the course of this project, the project recruitment work is based on door-to-door canvassing of neighborhoods. Generating a first project within a given district can serve as an influential sales point for other small businesses to decide to participate. Depending on the level of the DI incentive, these activities combined can cost up to 25% of a program's total budget. This level has been recorded for DI programs that provide a 60% customer reimbursement. The higher the incentive level per customer, the lower the portion of project resources go to marketing; data records that at a 100% incentive level, approximately 7% of the budget is dedicated to marketing. 6 Cost-benefit analysis shows that a systems or more comprehensive approach to improving energy efficiency increase realized energy savings while reducing program costs. These benefits also are expected to hold true in the small grocery market vertical. To summarize, this program suggests that by working with organizations like The Food Trust to educate customers on DI program benefits, identify leads, and initiate retrofit projects, utilities and their contractors can reduce their effort in the marketing phases of a project and used saved resources in later phases, such as the measure implementation phases.

DI Program Technical Packages for Small Grocery

1 HVAC PROGRAM

10 REFRIGERATION PROGRAMS

14 LIGHTING PROGRAMS

Survey of the approaches for technical retrofit in stores

Energy efficiency programs in commercial buildings are moving to develop comprehensive solutions in order to achieve increasing energy efficiency targets and decreasing acquisition costs. DI programs are usually the most expensive program type, in terms of dollars per unit of energy efficiency achieved; for the region studied, the systems story is that the more developed programs are completing comprehensive lighting and comprehensive refrigeration retrofits (and in one case HVAC), while others have not yet moved into refrigeration. Within both refrigeration and lighting, there is a wide variety of measures covered across programs, with some programs implementing limited sets of measures within the two systems and some more comprehensive sets of measures (see accompanying graphics). In lighting, some programs have not yet brought in LEDs at scale; in refrigeration, some programs, like PECO's, only offer Electrically Commutated Motors and Door Heater Controls, while others, like BGE and SMECO offer more comprehensive refrigeration retrofits. The data this study has collected from a sample of small grocery stores in Philadelphia, PA reveal that expanding programs to first, move from Florescent to LED installations and second, to include a more comprehensive approach to refrigeration retrofits will lead to dramatic improvements in the energy efficiency achieved for these businesses. Please see the accompanying tables for a record of the measure types these programs currently cover as of May, 2016.

With a project designed to explore comprehensive system options for retrofit, the team enlisted the help of separate refrigeration, lighting, plug load, HVAC, and envelope contractors and manufacturers to provide energy efficiency measure options that could have been installed in the stores examined here. All of the measures specified by the contractors are approved by the Pennsylvania state-level Technical Resource Manuals, the document which determines which energy efficiency measures are eligible for implementation through utility or state-funded energy efficiency programs. Please see the accompanying list of measures and cost benefit analysis compiled for retrofit one small grocery stores, store 4 from our anonymized data set. This provides a sense of the cost-benefit across all systems.

Store Four Completed a DI Retrofit

Project investigators worked to understand how current technical approaches could be improved, and the analysis benefitted from including a small grocery store that pursued a

DI Program Systems Convered in Study Area

	PECO	DL	PP&L	NJCEP	BGE	SMECO	Central Hudson	Coned	National Grid	NYSEG	O&R	RGE
Lighting	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Refrigeration	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y
HVAC				Y								
Plugload												
Hot Water												
Cooking												
Envelope												

DI Program Lighting Systems Convered in Study Area

Lighting	PECO	DL	PP&L	NJCEP	BGE	SMECO	Central Hudson	Coned	National Grid	NYSEG	Orange & Rockland	RGE
Lighting Controls		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y
LED Lighting		Y		Y	Y	Y		Y		Y	Y	Y
Lamps	Y	Y	Y	Y	Y	Y	Y		Y			Y
Ballasts		Y		Y	Y	Y						Y
Fixtures	Y	Y	Y	Y	Y	Y		Y		Y	Y	Y
Flourescent Lighting	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lamps	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ballasts	Y	Y		Y	Y	Y						Y
Fixtures	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

DI Program Refrigeration Systems Convered in Study Area

Refrigeration	PECO	DL	PP&L	NJCEP	BGE	SMECO	Central Hudson	Coned	National Grid	NYSEG	Orange & Rockland	RGE
Evaporator Fan Control				Y	Y	Y		Y				
Evaporator Fan					Y	Y						
Anti-Sweat Control	Y			Y	Y	Y		Y				
Venting Machine												
Night Covers				Y	Y	Y	Y		Y	Y	Y	Y
Strip Curtains					Y	Y						
Door Gaskets							Y	Y	Y	Y	Y	Y
Door Closers												
Motors				Y	Y	Y	Y		Y	Y	Y	Y
ECM	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y
Suction Pipe Insulation												
Appliances												
Refrigerator LED				Y	Y	Y		Y				

retrofit through PECO's DI program in 2014. This store received an interior lighting retrofit that enabled an average energy savings of approximately 10% annually. This example is helpful as a benchmark when compared to the comprehensive packages specified and cost-analyzed by project investigators.

Comprehensive System Measure Recommendations

The data show that even though this project took place, there is ample opportunity remaining there for additional energy efficiency through a comprehensive, deeper approach to DI retrofit. Just by taking a comprehensive approach to LED lighting and refrigeration measures- measures that typically don't require landlord involvement, this store could save 25% of its energy consumption (see accompanying systems analysis). The energy efficiency measures behind these estimates are included, indicating the benefit of including each additional measure. It doesn't take large increases in budget per store to include new measures to achieve significant incremental steps in energy efficiency.

The project findings suggest a clear set of program expansions to best serve this important market vertical and rapidly increase the energy efficiency of DI implementations. First, DI programs should embrace comprehensive lighting and comprehensive refrigeration retrofit measures, even if it means recruiting a specialty refrigeration contractor in the process. Lighting programs should immediately start implementing cost-effective LED lighting solutions.

If programs consider expansion to other systems, findings suggest that there might be some opportunity to expand to HVAC measures with large energy efficiency benefits. There have been several measures selected that work on the physical tightness of the air delivery system that would benefit these stores even before buying a new piece of equipment or further instrumenting an existing one.

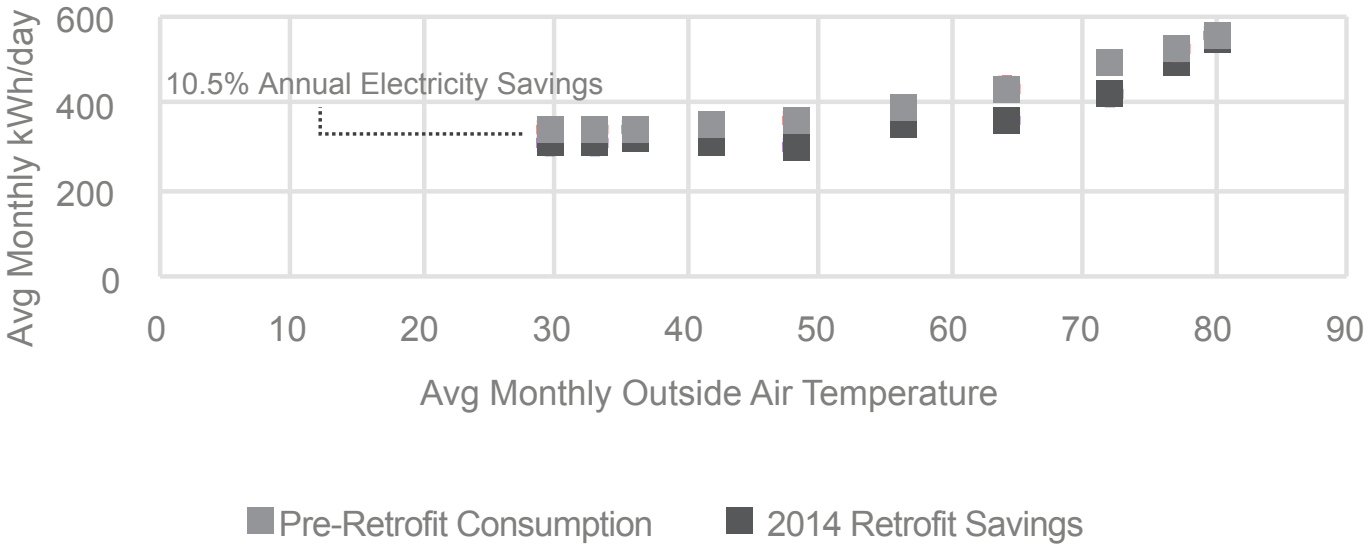
Recommended Comprehensive Technical Measure and Savings Analysis for Small Commercial Grocery (n=5)

Measures	Average kW Savings	Average kWh Savings	Average CCF Savings (Gas)	Average Cost	Average Annual Cost Savings
Lighting					
Interior LED Lighting	1.76	9312		$6,297.27	$942.39
Exterior LED Lighting	0.73	3562		$1,527.56	$383.75
Refrigeration					
Door Heater Controls (DHC)	0.37	4878		$3,488.65	$585.30
Cycling Evaporator Fans	0.13	w/ DHC		w/ DHC	w/ DHC
Electrically Commutated Motors (ECM) Motors	0.16	1754		$1,181.00	$210.48
Night Covers	N/A	w/ DHC		w/ DHC	w/ DHC
Case LEDs	0.30	9121		$3,001.00	$1,094.46
HVAC					
Ductwork extension	N/A	733	25	$250.00	$87.93
Variable Frequency Drive (VFD)	0.2	3298		$3,212.00	$395.70
Advanced Economizer	w/ VFD	351		w/ VFD	$210.48
Cool Demand Side Ventilation (DSV)	w/ VFD	216	79	w/ VFD	$25.92
Envelope					
10" Foam Insulation-ceiling	N/A	5823	209	$6,416.00	$104.50
Basement air sealing	N/A	*w/ Insulation*	15	$185.00	$7.50
Basement rim joist	N/A	*w/ Insulation*	7	$390.83	$3.50
Duct sealing	N/A	500	25	$170.00	$60.00
Basement door	N/A	59	2	$300.00	$7.03
Plugload					
Advanced Power Strips	N/A	216	N/A	$120.00	$25.92

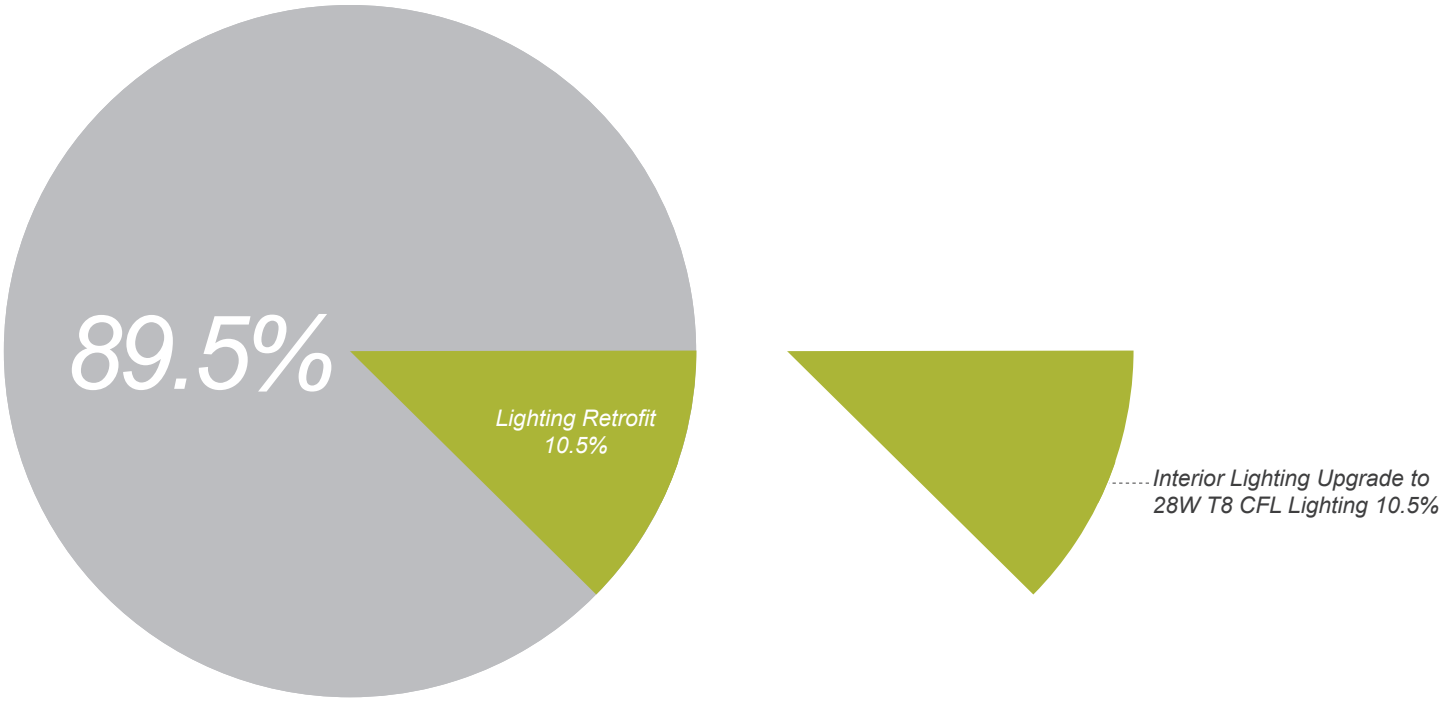
One Store Example (Store 4) System Characteristics

Source	Systems	Characteristic/Equipment	Store 4
Architectural	General		
		Area (SF)	1945
		Attached (Y/N/Semi)	Semi
		Vacant Above	Y
		Age	Ca. 1900
	Envelope		
		% Glazed In Occupied Space	21.9%
		Envelope Irregularities	1. 2 Defunct Wall Units not in use, still in exterior walls 2. Door access for delivery (sealed) 3. Addition to E and N sides of building
		Single/double glazing	Single
		Unducted plenum	Y
		Roof Type	Flat- BUR
Electric	Refrigeration		
		Freezers (#types, range of ages)	2 Hussman Horizontal Closed Reach-in (both 1995), 1 Russell Vertical Closed Reach-in (2 doors) (1991), 1 Deep Freezer (age unknown)
		Coolers (#types, range of ages)	1 Open Reach-In (1994), 2 Closed Reach-in (6 doors) (1995), 1 Leader Refrigerated Prep Table
	Lighting		
		Main Indoor Lighting	T8 28W
		Main Exterior Lighting	T12 60W
	HVAC		
		Heating	N/A
		Cooling	60,000 btu/hr central system (include years old?)
		Ventilation	Combined with A/C
	Hot Water		
		N/A	N/A
	Plugloads		
		Additional Equipment draws	Lotto Machine, Fan, Dietz and Watson light-up sign, Deli Meat Slicer
Gas	Space Heating		
		Furnace (year of	120,000 btu/hr 78 AFUE (1994)
	Hot Water		
		Water Heater	50 Gallon (approx. 2009)
	Cooking		
		N/A	N/A

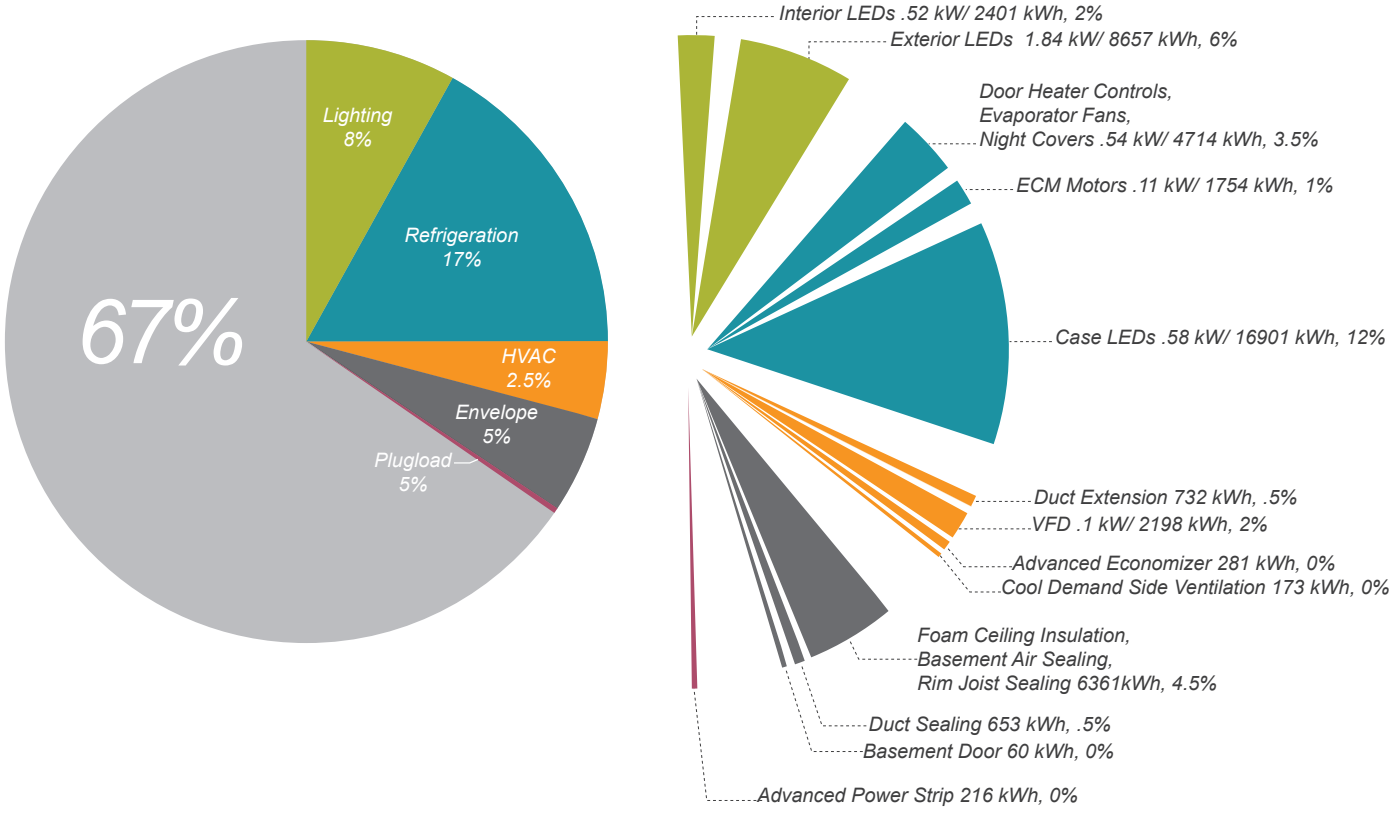
Weather Driven Savings Estimate from Participation in DI Program in August, 2014



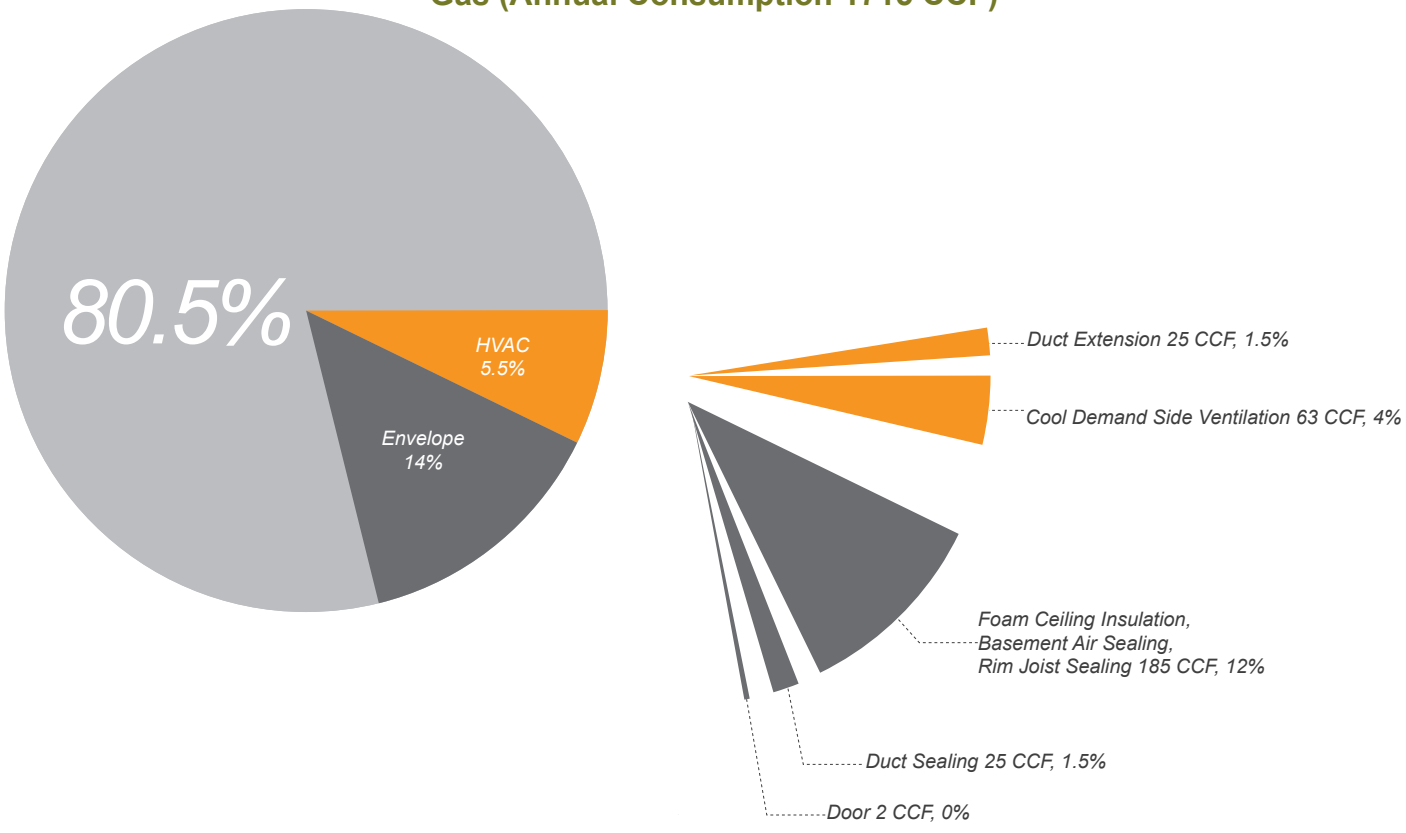
One Store Example (Store 4) Weather Driven Savings Estimate from Participation in DI Program in August, 2014



One Store Example (Store 4) of Comprehensive Retrofit Savings Analysis: Electric (Annual Consumption 138599 kWh)



One Store Example (Store 4) Comprehensive Retrofit Savings Analysis: Gas (Annual Consumption 1715 CCF)



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