

**BPA Cooperative Grant Award #56061**  
Starbucks Commercial Pilot – IBBE  
Phase I Final Report

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# Executive Summary

## Introduction

This small commercial behavior based energy efficiency (BBEE) pilot program tested an innovative approach to energy efficiency in 10 Starbucks Coffee Company stores in Snohomish County. Snohomish County PUD (SnoPUD), in collaboration with Starbucks, PECL, Lucid, and Puget Sound Energy (PSE), designed and implemented the pilot to test whether energy feedback and competition can produce persistent and measurable energy savings in the fast-paced retail sector. The pilot paired a 30-day competition among 10 Starbucks locations with real-time energy-use information delivered via an Energy Information System (EIS) to affect behavior change through information, employee engagement, and focused energy savings strategies.

The pilot was funded, in part, by a grant from the Bonneville Power Administration, with the goals of:

- Demonstrating employee behavior change driven energy savings in the small commercial environment
- Identifying key program components and drivers for persistence
- Developing a replicable, scalable program design
- Piloting a M&V approach for behavior based efficiency in small commercial buildings

## Results Overview

This BBEE pilot successfully designed, deployed, and measured impacts of a behavior based energy efficiency program for the retail sector. The design process effectively leveraged the extensive energy efficiency, occupant engagement and retail sector experience of the project team. Within a tight project timeline the team put in play an effective quasi-experimental pilot design, deployed an innovative EIS, collected valuable data and insights, pioneered an M&V approach, and provided a positive experience for more than 100 Starbucks store employee participants.

Many of the participating store employees did change their energy use behavior during the 30-day competition, and the M&V approach indicated overall electric energy saving of four percent (4%) for the participant group, or two percent (2%) when controlling for the trend indicated by the control group. When measured on an individual basis, the stores' electric savings ranged from a low of -1.8 percent to a high of 9 percent. Gas savings were more difficult to measure given the overall low and sporadic gas use during the August competition. Two stores were found to have statistically significant gas savings of 4.8 and 9.2 percent.

Following the competition, the pilot left the EIS dashboards in place and tracked the stores' energy use for an additional four months to assess the persistence of the energy savings. The measurement of persistence proved difficult as the test continued into months with markedly cooler temperatures than were captured during the pre-intervention baseline period. There is no evidence to indicate that the energy savings persisted beyond the competition, though this may very well be due to the weakness of the baseline rather than the absence of persistence.

Most store employees showed interest and enthusiasm for the project. 100 responses were received to the pre-competition survey. In these responses many employees shared their own ideas for saving energy and water in their stores. Immediately prior to and during the 30 day competition the stores used the two-way communication features of the EIS eighteen (18) times to interact with the project team, asking questions and providing feedback. The stores that saved the most energy were also the most active communicators through the EIS. The post-competition survey had a much lower response rate, with only

21 respondents, but among those respondents there was a strong increase in awareness of the sustainability component of the Starbucks mission and in reported energy saving behavior.

## Key Lessons Learned

Clear predictors of store success were supportive management, a strong in-store champion, and active communication with the project team. In an effort to extend the baseline monitoring period the project team waited until just one week prior to the competition before engaging store managers. Dedicating additional front-end time and effort to bringing those key stakeholders onboard would likely lead to greater energy savings.

A baseline of 15-minute interval data that covered most of the annual temperature range was not adequate for the full implementation timeline, as many of the cooler intervals occurred at night when the stores were not operating. Those cool nighttime intervals were not useful predictors of energy use during the cool daytime intervals that occurred during the persistence period.

The EIS relied on off-the-shelf hardware for speed of deployment and ease of installation. Nonetheless, considerable testing was required to ensure that the components were compatible and functioned well in the challenging store environment. Ultimately, the Obvius hardware, Android tablet, and Lucid BuildingDashboard performed superbly. However, the team still learned the lesson that equipment in employee areas is easily disrupted, such as occurs when employees inadvertently unplug equipment.

The focus on a short competition period seems to have detracted from the message about long term persistence. Employees seemed to think that the engagement was over after the 30 day competition, even though ongoing supportive messages and performance updates were being delivered through the EIS.

## Recommendations for future pilots/scaled programs

1. Allow time to bring managers onboard and become fully engaged. Fully educate managers as to the logic and goals of the program. Also provide them an opportunity to voice their concerns and make sure those concerns are addressed by the program design.
2. Make a concerted effort to recruit an energy champion in each facility. Provide that champion with the background and tools that will help her excel in that role. Also allow opportunities for feedback that can be used to continuously improve the program.
3. Allow time for a baseline that collects operating period (i.e. daytime) performance data for the full annual range of expected temperatures during operating periods.
4. Either use a simplified EIS equipment set-up or educate occupants on the basics of the EIS installation. Occupants should know, for example, that if they unplug a certain wireless router then their EIS dashboard service will be interrupted.
5. Strengthen messaging about the ongoing nature of the program goals, and decrease emphasis on competition. As time progresses, integrate the program into daily routines and existing reports and communications to ensure continuity.

# Introduction

## Pilot Overview

This innovative behavior based energy efficiency pilot program targeted behavior change in the small commercial sector. The program used an Energy Information System (EIS) with integrated communication capabilities, displayed on an in-store dashboard, to inform and empower Starbucks employees. After the EIS was installed, the 10 pilot stores engaged in a 30 day competition to motivate and empower employees to change behavior and save energy. During a four month period after the competition, the program offered ongoing support and encouragement to the stores while monitoring the persistence of the energy savings achieved during the competition. The figure below illustrates the key activities in the pilot.

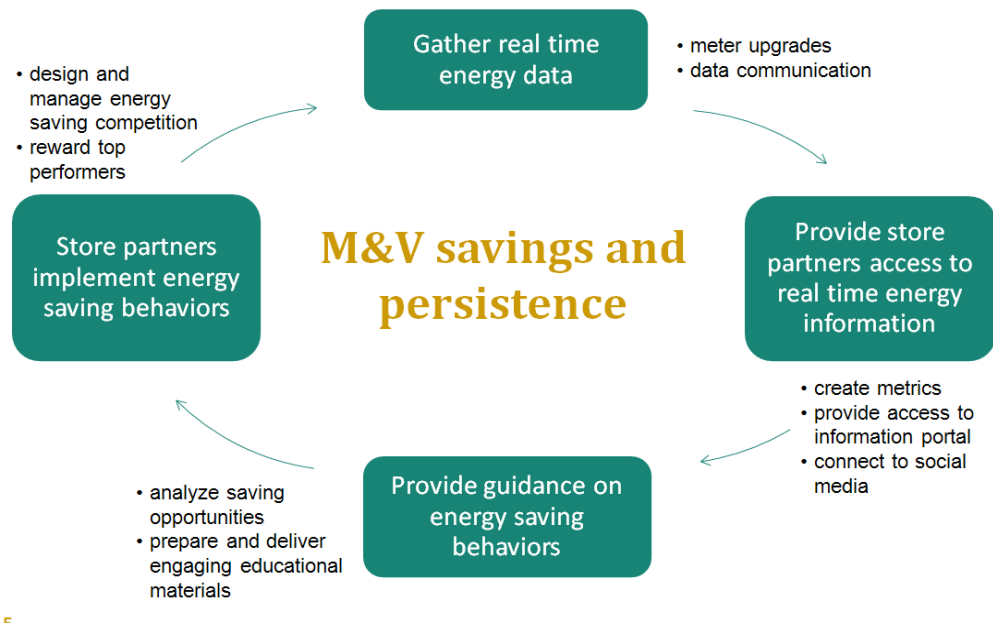


Figure 1. Pilot model, key activities

The pilot began in March 2012 with a project team kickoff and drafting of Operational and Measurement & Verification (M&V) plans. Selection of the participant group of stores began at the same time and by May a group of 12 candidate stores had been identified. SnoPUD quickly upgraded the billing meters of all 12 stores to begin collecting 15-minute interval usage data to provide the longest baseline possible. PSE verified that daily interval gas data was available for all 12 stores. Starbucks, intending to install water usage interval meters, surveyed the plumbing upgrade costs for each of the 12 stores. The final group of 10 participant stores was decided in early June with input and buy-in from Starbucks district management.

In parallel with the store selection, the project team completed a detailed design of the EIS integration architecture. The project team researched several data collection and communication hardware options before deciding on an in-store solution using an Obvius AcquiSuite and Obvius ModHoppers. The team then tested in-store dashboard options, considering various all-in-one PCs and tablets, before deciding on an Acer tablet running the Android operating system. After the final participant stores were identified in June, the in-store data gathering and communication hardware were tested at one store before being deployed to all 10 stores. The tablet PCs were not installed in June, thus the store employees still had no knowledge of the coming competition.

The detailed design of the competition also began in earnest in May. Members of the project team examined the operations of Starbucks stores and developed energy saving tips. Lucid collaborated with other members of the

project team to customize the BuildingDashboard to meet the requirements of this project. PECl readied documents and presentations describing what became known as the Green Store Challenge, and Starbucks scheduled a launch meeting with the participant stores' managers for July 23<sup>rd</sup>.

During the pilot launch meeting the store managers were informed of the Green Store Challenge goals, the structure of the competition and the resources they'd be given. They were also encouraged to designate in-store champions to lead their teams' efforts. Two days later, PECl installed the dashboards in the stores, which displayed the stores' energy use and information about the upcoming competition. One week later, on the first of August, the competition began.

Over the course of the 30 day competition the stores received energy and water saving tips through the dashboard every other day. On the dashboard they could also see their rank in the competition and view displays showing the stores' real time 15-minute electricity use and daily gas use. They gave feedback, asked questions and received responses through communication tools embedded in the dashboard. At the end of the 30 days, a clear winner had emerged. The winner was rewarded with a plaque and a pizza party.

Following the competition, the EIS remained in the stores for four months, but the frequency of updates declined. Real time electricity data continued to stream through the dashboard, but gas data was updated only weekly and tips only semi-weekly. During that time the project team measured the energy savings achieved during the competition and their persistence.

## Program Logic

As part of designing the pilot, the project team developed a logic model describing how energy savings would be achieved. The mechanism that was defined consisted of the four parts below.

1. **Energy Use Feedback:** Provide an in-store dashboard for store partners to view real-time energy data. The dashboard gives store partners visibility into energy consumption and provides a source of feedback on their behaviors.
2. **Energy Saving Tips:** Use the social media features of the dashboard to communicate tips on energy saving behaviors to the store partners. For some partners, the availability of the information and tips combine with their own motivations to drive them to adopt energy saving behaviors.
3. **Competition:** An inter-store energy saving competition initiates engagement and provides further motivation, driving a larger number of store partners to become consumers of the information and tips and to adopt energy saving behaviors. Dashboards provide a point of comparison of energy consumption between participating stores.
4. **Establish Norms:** Social networking allows the most motivated store partners to themselves suggest energy saving tips and to promote norms of energy saving behaviors within their store. These norms are reinforced through ongoing communications after the competition to drive persistence.

This pre-implementation program logic is shown in greater detail on the following page in the form of a logic model. The actual program implementation differed slightly from this design. As installation of the EIS progressed, it proved impractical to use the social networking features of the Lucid Dashboard. After considerable testing and deliberation, the project team determined that those features would have been too difficult to navigate on a touch screen display and would have required individual employees to log in and out. Instead, the dashboard itself was modified to serve as a vehicle of communication within and among stores and the project team.

# BPA Light Commercial BBEE Pilot: Phase I

INPUTS AND ASSUMPTIONS:  
Staff, Funding, Partnerships with Snohomish PUD, Starbucks, Lucid, and Puget Sound Energy

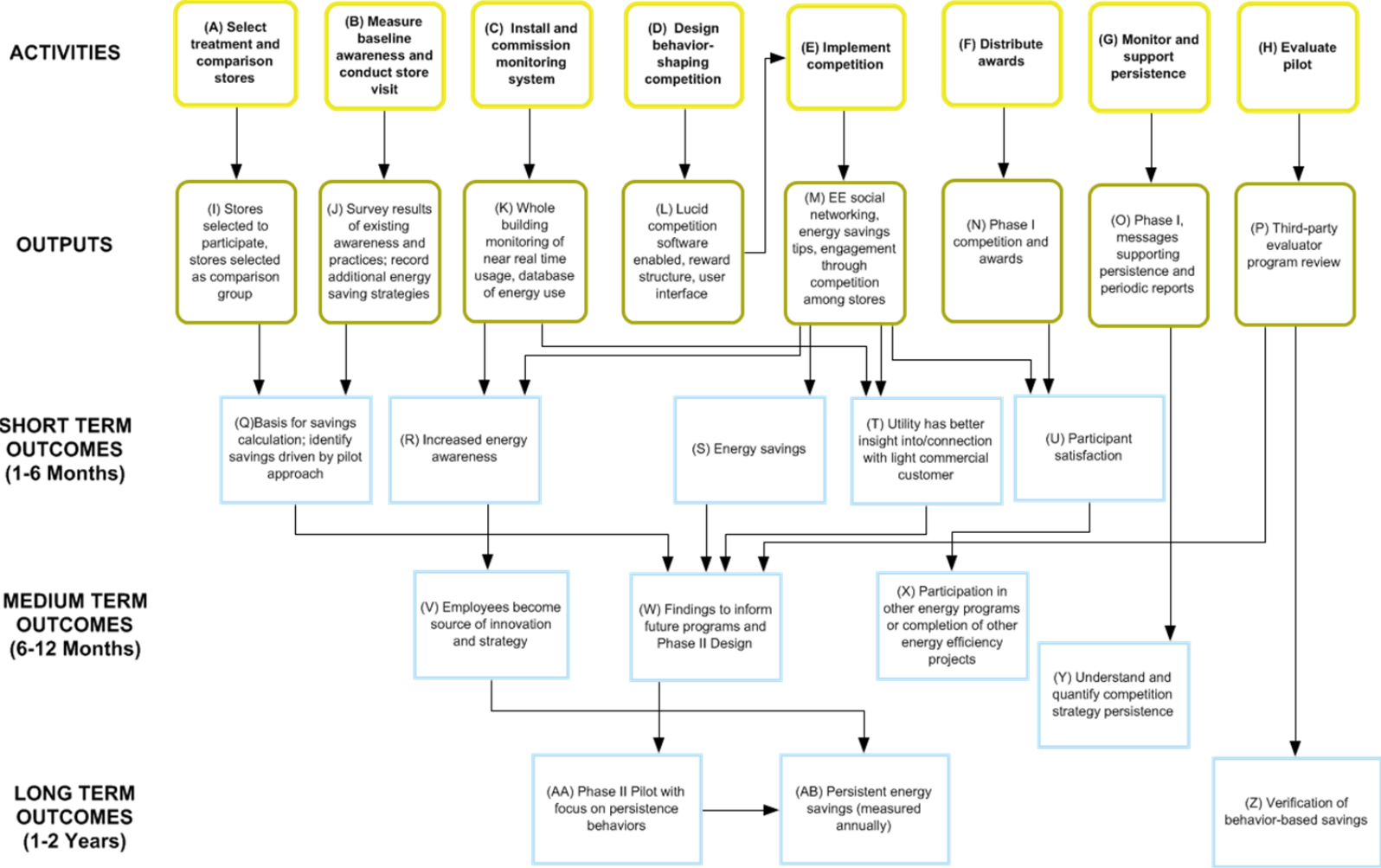


Figure 2. Program logic model

## Pilot Goals

In 2009, PECl began researching EIS tools and their potential applications for enabling energy efficiency. BPA released a funding opportunity announcement in late 2011 with the stated goal, “to enable, validate and increase the amount and persistence of energy savings achieved through BBEE programs in the Northwest.” This goal aligned closely with a program concept that PECl had developed, and PECl approached Snohomish PUD to further define the program in response to BPA’s funding opportunity. Starbucks, PSE, and Lucid joined the team, and together the project team defined goals for the pilot program in terms of energy and non-energy benefits.

### Energy savings

Demonstrating energy savings, both electric and natural gas, through behavior change was a primary goal of the pilot. The Project Team set a savings goal of 5% for the competition period based on a preliminary assessment of how much of a store’s energy use employees could influence without impacting the store’s core business operations. Having no impact on core business operations was judged essential if the savings were to persist.

Initially, the project team’s planned approach to persistence was to simply measure the persistence of savings from the competition. However, most members of the group agreed that persistence of benefits was unlikely without some sustained interaction. So, as will be described later in the report, a low level of support was provided following the competition to aid persistence. The goal was then to measure some persistence of the energy savings, but a specific target level was not defined.

As a necessary compliment to the energy savings and persistence goals, the project team also set the goal of designing and testing a process for estimating energy savings from behavior based interventions in the small commercial market. Such a M&V process would support the needs of this pilot and would certainly further BPA’s goals of enabling and validating behavior based energy efficiency in the Northwest.

### Non-energy benefits

The secondary goals of the pilot were to achieve water savings through changes in store employee behavior and to improve employees overall engagement with Starbucks’s energy and resource goals. Water savings were planned to be both supported and measured by new communicating interval meters to be installed in the stores. However, extensive investigation found installation of such water meters to be time and cost prohibitive for this pilot. Therefore direct measurement of water savings was not possible. Both water savings and store partners’ engagement were evaluated on the basis of pre- and post-intervention surveys.

## Quasi-Experimental Design

The project team initially considered a randomized controlled trial for this pilot, but ultimately selected a quasi-experimental design. The team recognized that non-random selection of the control and intervention groups would make measurement of savings more difficult. However, two practical considerations made a quasi-experimental design seem a preferable approach. First, Starbucks had a desire to guide the selection to avoid conflict with other initiatives ongoing in stores. Second, costs could be dramatically reduced by leveraging existing metering infrastructure. Thus, the program selected two observation groups:

- A “participant” group (n=10) of Starbucks stores in SnoPUD service territory that received the EIS and participated in the energy reduction competition.
- A control group (n=44) of Starbucks stores in PSE electric service territory that received no intervention from this program.

The processes used to select these two groups and the characteristics of each group are described below.

## Intervention Store Selection

In the first stage, a pool of eligible participant stores was drawn at random from stores in SnoPUD's service territory, but with the stipulation that the mix of store characteristics in the draw should include a mix of store types (café and drive thru), building vintages, store size, and store energy use. In the second stage, SnoPUD and Starbucks narrowed to the final 10 stores by eliminating stores that had difficult to reach or modify meters and stores that were engaged in other, potentially conflicting initiatives. The characteristics of the final participant group are shown in the figures below.

Figure 3. Intervention store characteristics



The selection of the intervention control group took longer than anticipated. Additional time was required for two reasons. First, the project team went to great lengths to investigate whether water meters could be installed in the stores. In the process, Starbucks arranged for site surveys to estimate the plumbing costs and potential store disruptions. Those surveys took more than a month to schedule and execute. Second, there were many stakeholders involved in the selection process. Informing those stakeholders and obtaining approvals, where needed, took additional time. The project schedule initially allowed about one month for store selection, and the process required just over two months.

## Control Store Selection

The control group was selected from PSE service territory, in an area adjacent to the participant stores. The purpose of the control group was to determine if there were factors, outside the intervention, causing stores' energy use in the region to increase or decrease, and if so, to control for that influence when estimating the energy savings of the intervention group. The project team selected stores from PSE service territory due to the availability of advanced metering infrastructure (AMI) data and the similar weather and environment between PSE and SnoPUD service territory.

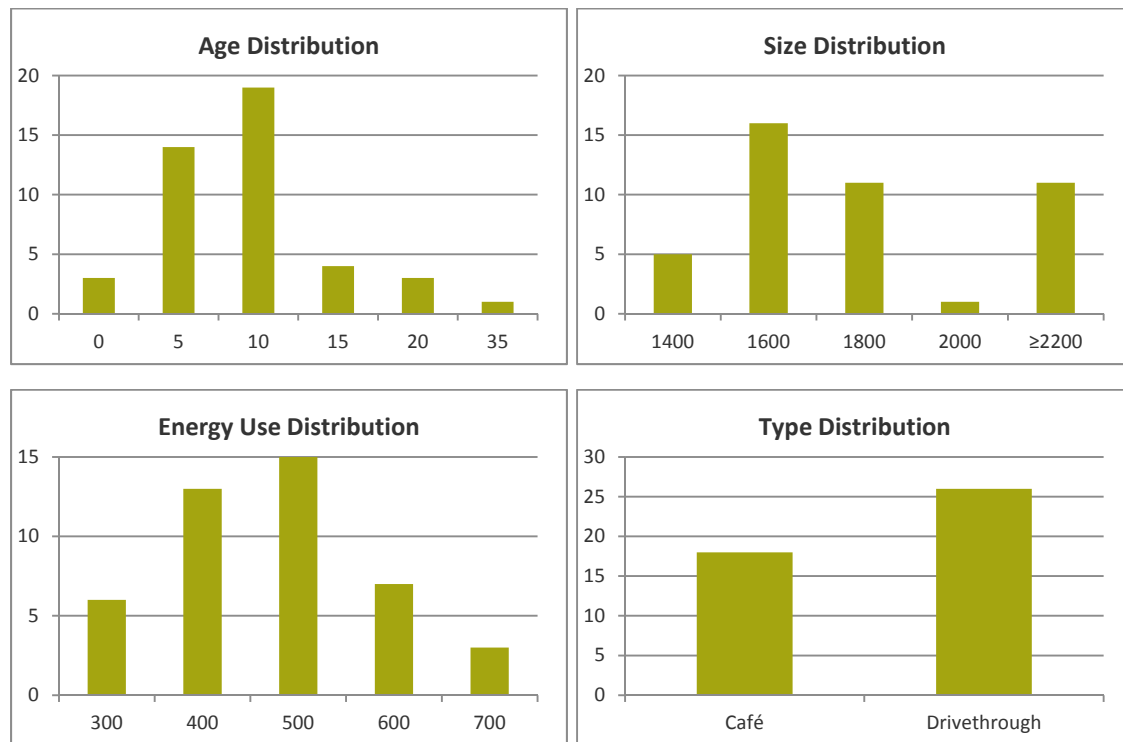
Initially, the project team selected a control group by drawing a sample of stores from Starbucks' database that had characteristics matched to those of the intervention group. Once this selection was made, PSE then provided



meter data for the selection. In reviewing the data that this yielded, the project team identified many inconsistencies and gaps in the data, such as would occur when the interval recording feature of a meter was switched on or off. Numerous such data problems were identified in this initial draw, and thus a new selection process was defined that was essentially the reverse of the first.

The new control group selection process had two stages. The first stage was to identify stores with complete utility data during the baseline and intervention periods. This was not a trivial task. One utility account can cover multiple stores, or an individual store may have multiple utility accounts, and many accounts and stores include multiple meters. The second stage was to randomly eliminate control stores until their distribution of characteristics was similar to those of the intervention group. The characteristics of the final control group are shown in the figures below.

Figure 4. Control store characteristics



## EIS Integration

The EIS integration pulled electricity use data from SnoPUD’s electric meters and provided it to Lucid’s servers, which displayed the information using the customized Lucid BuildingDashboard on an Android tablet computer in the back room of the participating stores. The interval between when the actual electric usage occurred and when the usage showed up on the dashboard was about 15 minutes. This near real time EIS was accomplished by upgrading SnoPUD’s billing meters and installing new communications hardware.

At the outset of the project, SnoPUD intended to enable the existing billing meters to transmit interval usage data by adding a pulse output relay. However, as the project progressed, SnoPUD decided to replace their existing meters with interval meters that recorded 15-minute consumption as well as add the pulse output relay. By upgrading the 12 final candidate intervention stores with meters that could record 15-minute consumption, SnoPUD allowed the program to begin collecting baseline data even before the final intervention group was selected. This was an important time saving measure given the slower than anticipated store selection process.

The meter upgrades also provided redundancy for the data that was ultimately collected in the BuildingDashboard database.

After the new meters were installed, SnoPUD's metering staff equipped each with a wireless transmitter to collect and transmit the pulses produced by the meter. The specific transmitter used was an Obvius ModHopper. A technician then installed a matched wireless receiver, again a ModHopper, in the back room of the store to receive the pulse data sent from the meter. The interior ModHopper was hard-wired to an Obvius AcquiSuite data manager that converted the pulse data to energy use using a multiplier that was determined on a meter-by-meter basis. Once connected to the existing network router in the store, the data manager could then transmit the energy data to Lucid's servers. The list below summarizes the equipment used and its function. The electric data integration architecture is then shown in Figure 5 below.

1. Electric meter – This is the utility's billing meter. In the case of the pilot participants these were upgraded by SnoPUD to MV90 compatible interval recording meters.
2. Pulse output relay – This is a device added to the billing meter that emitted a signal every time a defined unit of energy use was recorded by the meter. For example, the pulse output relay may have emitted a signal for each incremental 100 Watt-hours of consumption.
3. Obvius ModHopper – This is a wireless communication device that records and transmits/receives data using the Modbus protocol. In this architecture, one ModHopper recorded pulses from the pulse output relay and transmitted the data to a second ModHopper inside the store.
4. Obvius AcquiSuite – This is a data management device that receives, stores, and transmits data using multiple formats. In this architecture, the AcquiSuite received data transmitted by the ModHoppers using the Modbus protocol, translated that data to energy consumption using a user-defined conversion factor, stored the consumption in flash memory and then transmitted the consumption across the network at a user-defined interval.
5. Internet service – This is the modem and router combination that provided internet service to the store.
6. Wireless router – This is a standard wireless broadband router that provided secure wireless communication between the tablet computer and the internet service.
7. Acer Iconia tablet – This is a tablet computer using the Android 3.0 operating system. The tablet had internet access through the wireless router, however that access was restricted to the BuildingDashboard website using the SiteKiosk™ software.

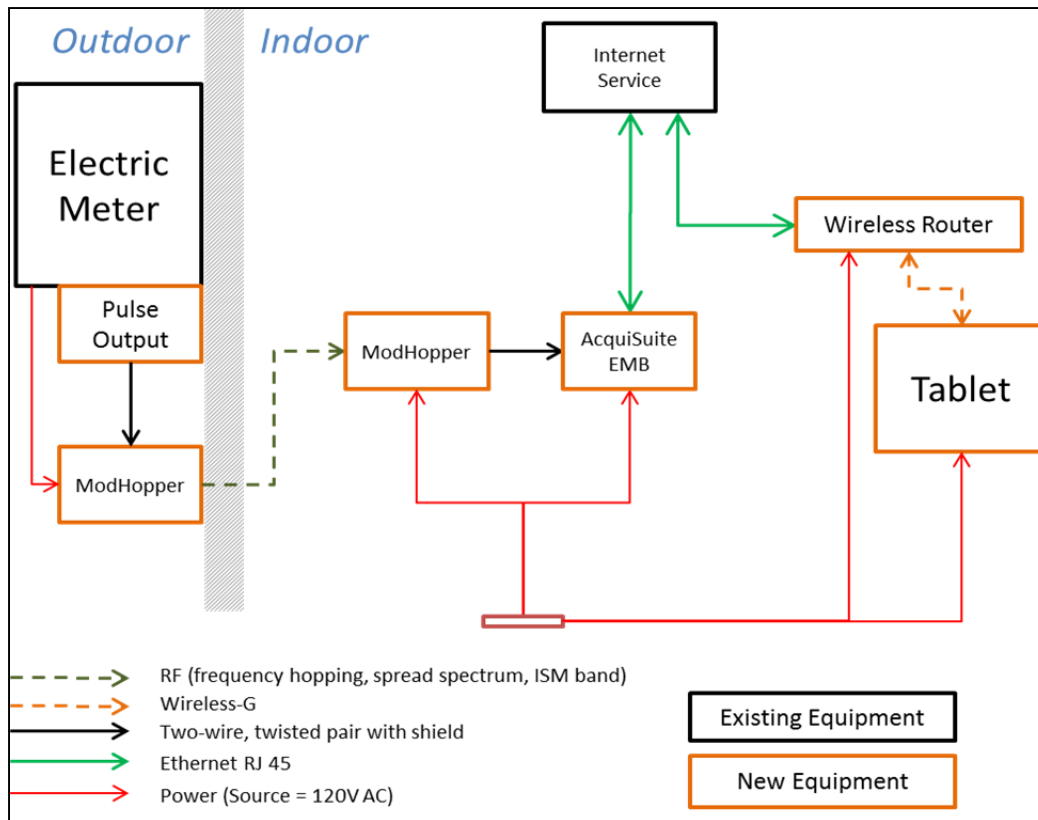


Figure 5. EIS architecture

Nine of the participant stores receive natural gas service from PSE. One store had no natural gas service. As part of the store selection process, PSE tested that the stores' natural gas AMI billing meters were communicating properly. Some reprogramming of the meters was required to establish proper communication for the participating stores. PSE was then able to collect and provide daily gas data for the participant stores. The data was then uploaded to BuildingDashboard through Lucid's online management portal.

During the competition, the stores were supplied with new gas data each day, Monday through Friday. This process presented gas data on the BuildingDashboard website 2 to 3 days after usage occurred. After the competition, during the persistence period, data was uploaded once per week.

Automated collection and delivery of water was investigated but proved to be cost-prohibitive. Instead, the participant stores' water usage was collected from bi-monthly bills and uploaded to Lucid's servers. Billed water usage was only available for five stores. For the other five stores, water was included in the store lease and not billed separately.

## Lessons

Upgrading electric billing meters to interval meters on the potential participant stores to begin collecting baseline usage allowed for thoughtful finalization of store selection and data integration.

Real-time electric use infrastructure, in the absence of smart meters, was expensive, particularly when the upgrades involved work inside the stores.

Quoted at more than \$3,000 per store, installation of customer side pulse-capable water metering was significantly more costly than the project team estimated during pilot proposal development.

Obtaining, interpreting, and processing usage data from multiple utilities requires frequent communication and coordination.

Manual data transfer and upload processes would be challenging to scale; they were difficult to maintain even for just 10 stores.

Equipment installed in employee areas is easily disrupted. The root cause of several interruptions in the flow of data from stores over the course of the project was in-store equipment that had been unplugged.

## Dashboard Design and Creation

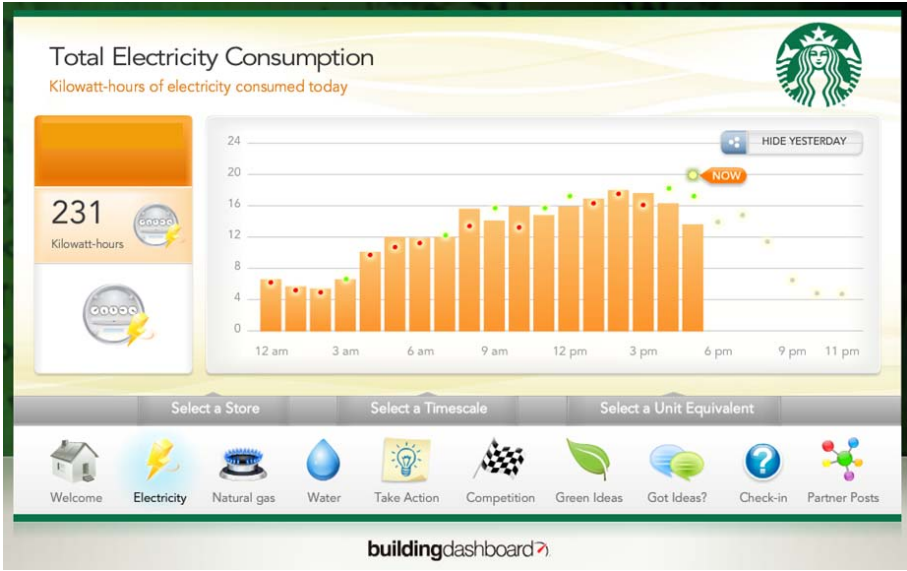
The design of the in store dashboard evolved considerably between the original pilot proposal and the competition. The evolution may be best considered as changing from maximum feature set to maximum ease of use. The Starbucks store environment is fast paced and space is at a premium. So employees weren't likely to sit at a desktop or laptop computer and navigate through an elaborate website. A wall-mounted tablet PC configured as an informative and interactive kiosk was ultimately judged more appropriate.

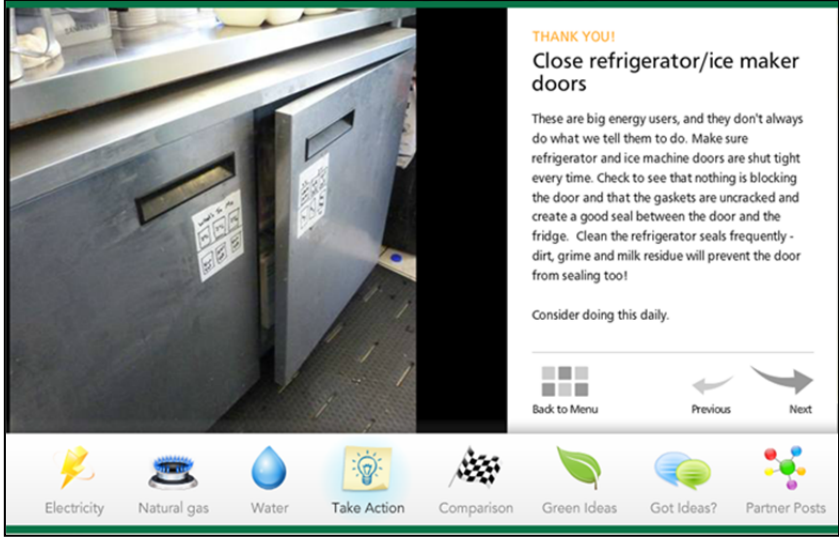
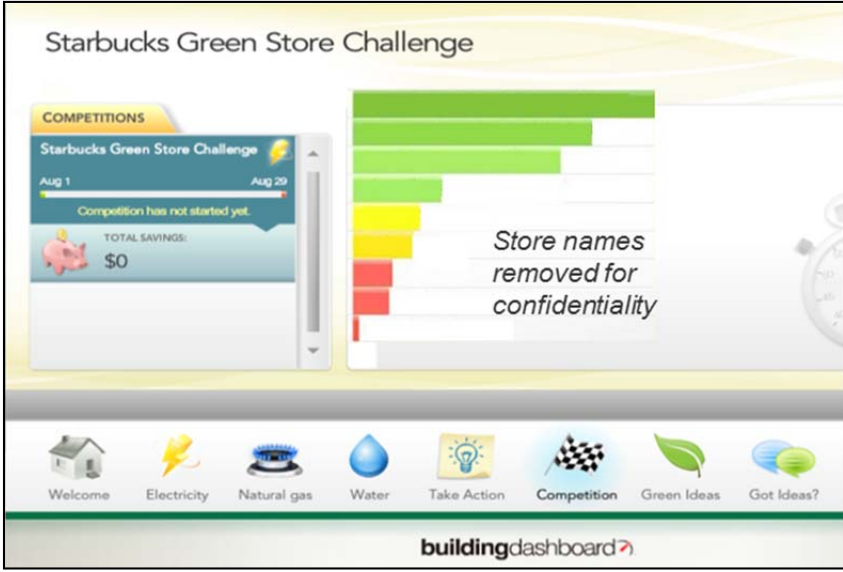
Lucid offers both a standard version of their BuildingDashboard software for a desktop or laptop computer and a kiosk version that is more appropriate for touch-screen tablets. The native communication features of the kiosk version are much more limited than those of the standard version. The social media integration and related messaging capabilities are not present in the kiosk version, and the project team thus devised an original approach to enable the needed communication between the project team and store employees and amongst store employees. We used Cvent, a customizable survey website, to augment the kiosk version of BuildingDashboard with a few new features. Those features are identified by a \* in the table below.

A store-specific version of the BuildingDashboard was provided to each store. BuildingDashboard is essentially a website, and providing a separate version with a unique URL for each store allowed us to control the content that was visible and presented by default to each store. The table on the following page describes the content that was presented on each store's BuildingDashboard. Each of the different "Modules" was a screen that a store employee could view by clicking on an icon at the bottom of the screen. If the screen was not touched for a minute, it would begin to progress automatically through Modules one through six in a "movie mode," pausing on each screen for approximately 15 seconds.

Use of the tablets was restricted to the BuildingDashboard. SiteKiosk™, commercially available software, was installed on each tablet. This software allowed the project team to configure the tablets so, upon start up, they would enter immediately into BuildingDashboard and users could only navigate within the BuildingDashboard. This restriction provided certainty that the tablets would be fully dedicated to support of the pilot program.

Table 1. Dashboard overview

Module Number	Module Name	Description
<i>Modules 1 – 6 automatically presented in movie mode</i>		
1	Welcome	Described the program and the purpose of the dashboard. Alternative contact information – phone and email – for assistance with the Dashboard or questions about the Challenge was also presented here.
2	Electricity	<p>Displayed the store’s near real time electricity use. The default view was the store’s hour-by-hour electricity use, but the three “Select” buttons at the bottom of this screen allowed a user to explore different views, including different time periods (this week, last week, this month, last month), other stores’ electricity use, and comparison against another store or the average store electricity use. Users could also choose to view either gross kWh usage or kWh per square foot to normalize their consumption as related to other stores.</p> 
3	Natural Gas	Displayed the store’s natural gas use. Similar to the Electricity Module, the default view was the store’s daily gas use, but the three “Select” buttons at the bottom of this screen allowed a user to explore different views, including different time periods, other stores’ natural gas use, and comparison against another store or the average store gas use. The one all-electric store did not have this module.
4	Water	Displayed the store’s water use. The default display was the store’s monthly water use for the year to date. Again, the “Select” buttons could be used to change views. Only the five stores with water billing data had this module.

5	Take Action	<p>Provided a focused energy or water saving tip. This Action message was updated by the project team every two days. The full set of energy and water saving tips was available in the Green Ideas module, but this Take Action module focused on one for a short period and was automatically displayed in the kiosk's movie mode.</p> 
6	Competition	<p>Shown how the stores were ranked in the energy saving competition. We have the best data for electricity, so stores were ranked based on which had achieved the highest percentage electricity savings since the start of the competition.</p> 

Modules 7 – 10 not presented in movie mode		
7	Green Ideas	Provided a library of all tips for saving energy and water in the stores store. The tips were grouped by the equipment they affected. Here, an employee could at any time click through the tips to find ideas for saving energy and water in their store.
8	Got Ideas?*	Linked to an email form where store employees were invited to share their ideas and opinions or to ask questions. The project team responded to all such inquiries using the Partner Posts module.
9	Check-in*	Linked to a short survey to provide the project team with feedback on how the store was doing. A Take Action message was displayed once per week during the competition that asked the employees to Check-in using this survey.
10	Partner Posts	Here, the project team posted photos and text responding to store employees' questions or comments. A decision was made to post all responses to all stores so each store could learn from the others.

\* New communication features added to BuildingDashboard kiosk for this program.

## Lessons

- The compatibility of technologies must be rigorously tested. The version of BuildingDashboard that the project team planned to use was not compatible with the tablet computers and using the tablet-compatible version required some adjustments to the program design.
- Determining the final in-store competition interface while balancing cost and software capabilities with store needs and hardware availability was more time and discussion intensive than expected.

## Energy Saving Tips to Inform Behavior Change

The energy saving opportunities that ultimately appeared to store employees as Take Action tips originated from opportunities that Starbucks had previously documented and from the project team's in-store observation of equipment and employee behaviors.

At the outset of the program, the project team reviewed energy and water saving best practices that had been previously identified by Starbucks but were reported to be infrequently implemented. We also reviewed equipment-focused audit reports, which helped to identify the major energy end uses where behavior changes might make a significant impact. From those existing resources, we developed our preliminary list of energy and water saving activities.

Several members of the program team then spent an evening and a morning shadowing store partners to verify opportunities on the preliminary list and to identify additional opportunities. Some of the additional opportunities were suggested by the store partners who were shadowed, and others were directly observed by the program team. This shadowing was not conducted in participant or control stores to avoid disrupting the baseline energy use data that was being collected at the time.

The program team then made simple estimates of the energy savings associated with each of the energy saving opportunities. These were combined with a summary of the employee behavior change tip and the expected impact on store operations. It was clear from the outset that the amount of time employees could dedicate to the effort was modest, so opportunities were selected judiciously and generally the expected impact on store operations was negligible. The opportunities were then presented to Starbucks for approval. After Starbucks

finalized the list, the exact text, graphics and timing of each Take Action tip was defined in collaboration with Starbucks. A summary of the final list of tips is shown in the table below. Additional detail was given in the tip messages provided to store employees.

Table 2. Summary of energy and water saving tips

<b>Category</b>	<b>Tip Message Summary</b>
Tune-Up	Set the proper temperature on your water heater to save energy
Tune-Up	Enable Power Management on the store’s laptop and monitors
Tune-Up	Confirm thermostat settings are aligned with Starbucks standards
Tune-Up	Check for and report any water leaks
Tune-Up	Confirm that indoor and outdoor signage is on the correct schedule
Lights	Turn off lamps when sun is out
Lights	Lower lighting during opening and closing
Lights	Turn off most lights for the night
Water	Turn off faucets completely between uses
Champion action	Spread the word; get your colleagues involved
Champion action	Snap a photo showing your participation and share it
Champion action	Rally your team
Air Conditioner	Use window shades to keep cool
Air Conditioner	Close windows when it's hot
Air Conditioner	Rely on standard A/C settings
Hot Water	Turn on the sanitizer with the first load of dishes
Hot Water	Only run the sanitizer when full
Hot Water	Use cool water to rinse items
Refrigerator	Close refrigerator and ice maker doors
Refrigerator	Perform routine maintenance activities
Refrigerator	Clean coils and ensure that vents are not blocked
Refrigerator	Keep refrigerated pastry cases full
Other/Oven	Turn off the second oven



## Lessons

- Retail employees have an abundance of responsibilities and must manage a large volume of instructions and standards; to be actionable, tips must be short, simple and ideally should be presented only when and where applicable.
- Within the Starbucks organization, and likely within many others, there is a wealth of information on energy and water saving opportunities; mining that information, for example by talking to employees and reviewing past works, can provide tips that need only to be highlighted and prioritized to support a behavior based energy efficiency program.
- Providing clear statements of expected impacts on store operations and connecting tips to existing standards were useful practices for gaining stakeholder support.

## Competition

This was a 10 store energy and water saving competition that began on August 1<sup>st</sup> and ended on August 29<sup>th</sup>. The winner of the competition was the store that reduced its baseline energy consumption by the greatest percentage during the competition. For the purposes of measuring and reporting the winner to the stores (not to be confused with the program M&V), the team relied on Lucid's integrated measurement algorithm. This algorithm compared the competition period energy use directly to energy use during a July 1 to July 21 baseline period, without adjustment. The incentive for winning the competition was recognition with a team spirit award and a pizza party.

One week before the competition began, store managers participated in kick-off conference call with the program team. Store managers were also mailed Green Store Challenge introductory collateral and pre-competition surveys that arrived to them just before the kickoff call. Included in the introductory materials were:

- 1-page overview of the Challenge stating the goals, rewards, and details (e.g. start and end dates) of the competition.
- 1-page strategy recommendations document that suggested seven tactics that would help a store be successful. Those strategies for success included recruiting an employee champion to lead the stores' efforts and implementing as many of the energy and water saving tips as possible.
- Pre-competition surveys to be completed by store employees prior to the competition start and returned to PECL.
- A guide showing step-by-step how to use the many features of the dashboard and troubleshoot when necessary.

During the kickoff call, the program team described the project background and then reviewed the competition overview and strategy recommendations. During the call the project team requested that all stores complete and send back the pre-competition surveys. The remainder of the call was dedicated to explaining the purpose and features of the dashboard and answering store manager questions.

Following the call, store managers had the week before the competition to explain the competition to partners, recruit champions, introduce the dashboard, and distribute and collect pre-competition surveys. The tablet dashboard was installed in the stores on July 25<sup>th</sup>, allowing the employees some time to familiarize themselves with its use prior to the August 1<sup>st</sup> start.

On August 1<sup>st</sup>, the first day of the competition, a Take Action message was used to announce the start of the competition and the Competition module began tracking and ranking the stores. The project team's activities during the ensuing competition are summarized in the table below.

Table 3. Project team activities during the competition

Frequency	Activity
<b>Daily</b>	Upload latest gas data
<b>Daily</b>	Check for messages from store employees
<b>Daily</b>	Confirm proper data transmission and dashboard operation
<b>Every other day</b>	Upload new Take Action message
<b>Weekly</b>	Post message on Take Action screen highlighting leading and most improved stores
<b>Weekly</b>	Prepare summary report for project team showing latest savings and communications
<b>As needed</b>	Monitor and respond to communications from stores
<b>As needed</b>	Troubleshoot problems of data transmission or dashboard operation

### Interactions with the Stores

The pilot provided the stores with three channels of communication with the project team. The primary channel was the dashboard. Stores were encouraged to submit questions and comments through the dashboard at any time, and to complete a brief survey through the dashboard at least once per week. The two other communication channels were a dedicated email address and an 800 phone number. The email address and phone number were listed in the dashboard and supporting collateral, but they were never used by the stores.

Communication from the stores varied considerably among the stores and also by week of the competition. The figure below shows the total number of communications received from each store through the dashboard. The store that won the competition was the store that communicated most.

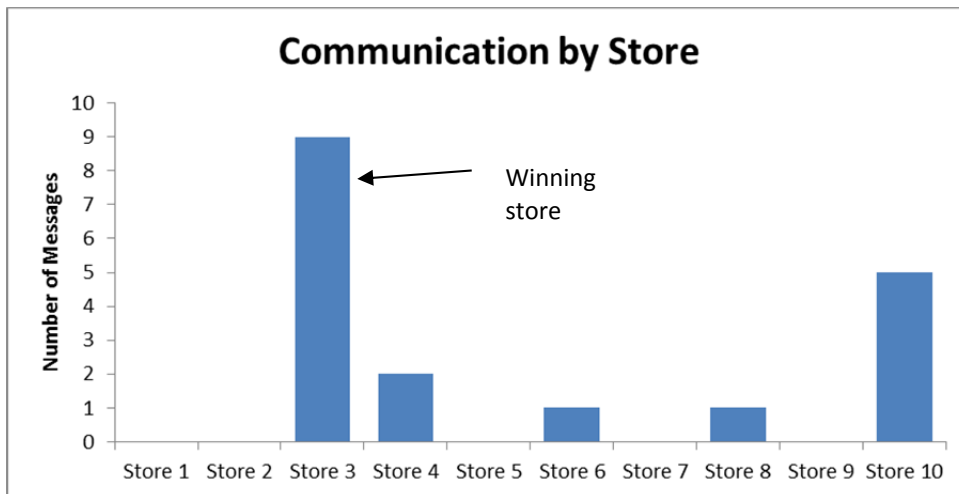


Figure 6. Communication received through the dashboard, by store

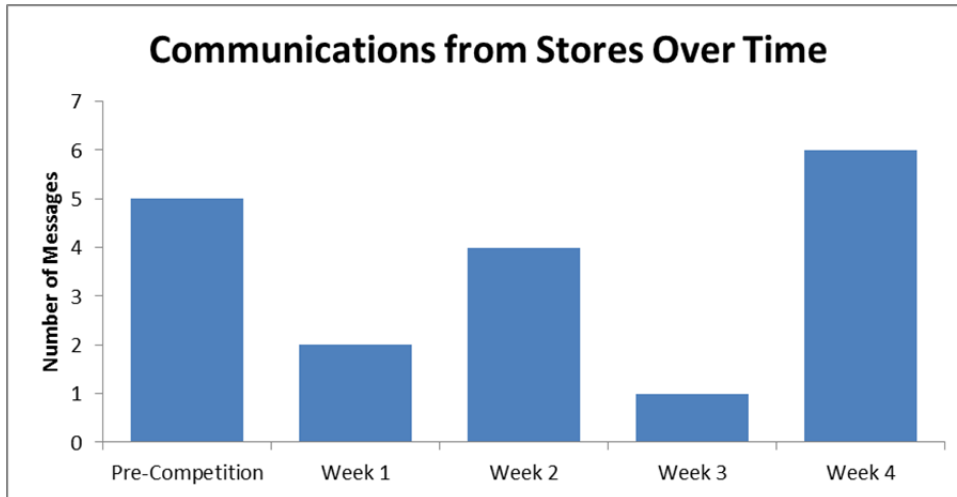


Figure 7. Communication received from through the dashboard over time (all stores)

On August 30<sup>th</sup>, the program team posted a message through the dashboard identifying the winning store and congratulating all stores on their participation. All stores were asked to continue saving energy and water, noting that the competition had ended but that the challenge to save energy and water in their stores was ongoing. The winning store received their award and pizza party in September.

### Implementation Adjustments

In the first week of August, the temperatures in the region reached into the 90s Fahrenheit. Naturally, the stores began to use more energy to provide more cooling. This influence was filtered out of the measurement of savings by statistical methods for the pilot M&V, but for the immediate reporting of progress to stores it presented a problem. The store rankings in the BuildingDashboard were calculated simply as a comparison of a store's average demand (kW) since the start of the competition against the store's average demand during the three weeks beginning July 5, 2012. Hence, soon after the start of the competition, the dashboard showed the stores were increasing energy use.

The project team met and decided that adjusting the baseline value used in dashboard to reflect the unexpected heat wave would have a positive impact on store morale and would not compromise the validity of the study. This adjustment was justified because the stores' energy consumption is weather dependent, and the average daily high temperature to date during the competition had been 5 degrees warmer than during the selected three week baseline period. Based on an analysis of the stores' weather dependence, the project team estimated that on average the stores' daily energy use increased by 0.57% for each degree increase in daily high temperature. Based on this analysis, the baseline consumption of all stores was increased by 2.85%. This adjustment only impacted the dashboard display and did not impact the later M&V analysis and measurement of energy savings.

The adjustment was made on August 16<sup>th</sup>, and it was accompanied by an explanatory message to stores posted on the dashboard. The text of the message was as follows:

*Your store's energy use is influenced by the weather. In hot weather, like we've been having lately, stores use more energy. So we've just updated the baseline that the competition's savings are measured against to reflect the hot weather. This will give you a more accurate picture of the savings that you're achieving. The adjustment did not change the competition rankings. As always, please let us know if you have any questions.*

## Lessons

- Use of a non-weather-adjusted baseline and competition scoring process in the dashboard presented a challenge; even though measurement and verification could later provide the necessary weather-adjustment to calculate correct savings values, the immediate need to provide a reasonably accurate and understandable measure of progress led the team to manually adjust the dashboard baseline.
- Clear documentation of responsibilities for tracking, performing and approving daily and weekly competition support activities was essential for smooth operation of the competition.
- Providing the store managers with background and an understanding of the project's rationale from a Starbucks perspective was an important step and one week's prior-notice should be considered a bare minimum; more advance notice may have allowed the managers more opportunity to inform and prepare employees.

## Competition Results

After the intense planning and deployment period, the project team was rewarded with a smooth and successful competition. The EIS and dashboard performed well and store employees were engaged. Given the innovative nature of the approach, this in itself was a success. Furthermore, the project team developed a new and thorough approach for measuring energy savings, which has shown significant energy savings resulting from the intervention.

### Energy Savings

The project team measured the competition's energy savings using three approaches. The first approach, known as an avoided energy use analysis, compared participating stores against their pre-intervention performance, with adjustments to reflect post-intervention weather. The second approach, a pooled analysis, grouped together the energy use data of all stores and estimated the influence of the intervention on the entire group. The third approach, known as a difference-in-differences analysis, adds in comparison to the control group to adjust for factors other than this program and weather that may have influenced store energy use during the competition period.

#### Avoided energy use analysis

The avoided energy use analysis begins by building a baseline model of an individual stores energy performance. Energy use is the model's dependent variable, and various other possible drivers of energy use may be evaluated as independent variables. After considering multiple independent variables, we identified the following independent variables as the most significant indicators of store energy use:

1. Outside air temperature, and
2. Occupancy (a binary variable indicating whether the store was open or closed)

An ordinary least squares regression was performed for each store, using data from the baseline period, to estimate the coefficients for each of the independent variables. The resulting model was then driven with the air temperature and occupancy that occurred during the period of analysis (either the competition or persistence period) to estimate the store's baseline energy performance. Subtracting the actual energy use from that baseline energy use gives an estimate of the store's energy savings.

## Pooled analysis

The pooled analysis uses the energy use data of all participant stores, both prior to and during the intervention, in a single regression model. With that energy use as the dependent variable, several potential drivers of energy use were considered as independent variables. Ultimately, we selected the following independent variables:

1. Outside air temperature
2. Occupancy (a binary variable indicating whether the store was open or closed)
3. Average baseline energy use, and
4. Pre/post indicator variable

As shown above, in addition to the temperature and occupancy variables in the avoided energy use analysis we controlled for the variation in stores' baseline energy consumption by including an additional independent variable for average baseline energy. A binary indicator of whether the energy use occurred in the baseline (pre) or intervention (post) period is the final independent variable. Upon estimating the model's coefficients using an ordinary least squares regression, it is the coefficient on that final pre/post indicator variable that provides the estimate of energy savings.

## Difference-in-differences analysis

The approach of the difference-in-difference analysis is similar to that of the pooled analysis, but it corrects for one weakness of that analysis. In the pooled analysis, it is possible that an unobserved influence, unrelated to the intervention of the pilot, is responsible for some portion of the change in energy use. An example of such an influence is a region-wide change in energy prices, which could broadly influence energy use. The difference in differences analysis controls for those possible external influences by comparing the performance of the intervention group to that of a control group.

The difference-in-differences analysis uses the energy use data of participant and control stores, both prior to and during the intervention, in a single regression model. PSE's daily electric energy use data was found to be more complete than the 15-minute interval data, so a daily model was used. With daily energy use as the dependent variable, several potential drivers of energy use were considered as independent variables. Ultimately, we selected the following independent variables:

1. Outside air temperature
2. Average baseline energy use
3. Pre/post indicator variable
4. Control/intervention indicator
5. Interaction between control/intervention and pre/post

Two independent variables are added to those of the pooled analysis. One is a binary indicator of whether the energy use occurred at a control store or intervention store. The other is an indicator of the interaction between the pre/post and the control/intervention variables. Upon estimating the model's coefficients using an ordinary least squares regression, it is the coefficient on that final interaction variable that provides the estimate of the intervention stores' energy savings, controlling for any changes that occurred in the control stores as well.

## Results

Without comparison to the control group, the pooled analysis provided an estimate of the participant stores' electric energy savings during the competition of 4.0%. This was consistent with the results of the avoided energy use analysis, which showed individual store electric energy savings ranging from -1.8% to 9.0%.

The difference-in-differences analysis yielded a lower estimate of the participant stores' electric energy savings, at 2.1%. There are several possible explanations for this analysis. The first possible explanation is that, as intended, the analysis filtered out an overall regional trend towards lower energy consumption. In this case, the best estimate of the energy savings for participation in the pilot would indeed be 2.1%. However, a second possible explanation is that the control stores were for some reason not directly comparable to the intervention stores. This could occur, for example, if maintenance and equipment upgrades in the control group for some reason occurred at a greater rate than in the participant stores. In fact, the facilities team overseeing the participant stores was instructed to delay optional tasks until after the competition. This made sense for the avoided energy use analysis, but may have inadvertently biased the control versus intervention analysis.

The questionable comparability of the control and intervention groups is the principal challenge of a quasi-experimental design as opposed to a truly experimental design. An experimental design would have been preferable, but as mentioned in the discussion of store selection it was not feasible in this pilot. Based on the available information and M&V analyses conducted, the electric energy savings of this pilot probably lie between the pooled estimate of 4% and the difference-in-differences estimate of 2.1%.

Savings were also estimated for natural gas, but the results are less clear. Natural gas use was very low during the competition. This was not surprising, given that the average hourly temperature was 63 degrees Fahrenheit (min 51°F and max 88°F)<sup>1</sup> during the August competition. The low and sporadic gas use complicated the measurement of savings. Using the avoided energy use analysis resulted in significant estimates of gas savings for only two stores. Those stores saved an estimated 4.8% and 9.2%. Pooled and difference-in-differences analyses were not conducted for natural gas energy savings.

The tables below show the electric and gas energy savings estimates for all stores. Additional details on the analysis used to arrive at these results are provided as an appendix.

Table 4. Energy savings estimates

Store*	Electric		Gas		Surveys	
	% Whole Building Savings	95% Confidence Interval	% Whole Building Savings	95% Confidence Interval	Pre	Post
Store 1	0.1%	+/- 1.2%			Yes	
Store 2	5.2%	+/- 1.2%			Yes	Yes
Store 3	9.0%	+/- 1.4%	9.1%	+/- 2.7%	Yes	Yes
Store 4	-1.8%	+/- 1.2%	-3.3%	+/- 5.1%		
Store 5	2.5%	+/- 1.3%	0.1%	+/- 7.2%	Yes	
Store 6	0.6%	+/- 0.7%	4.8%	+/- 2.5%		
Store 7	3.9%	+/- 1.2%			Yes	
Store 8	4.5%	+/- 1.4%			Yes	Yes
Store 9	2.2%	+/- 1.2%	5.9%	+/- 10.4%		
Store 10	3.7%	+/- 1.5%	-1.1%	+/- 6.2%	Yes	
<b>Pooled Store Savings</b>	<b>4.0%</b>					
<b>Participant vs Control Estimate of Savings</b>	<b>2.1%</b>					

\*Store numbers are the same as those presented in the figure "Communication by Store"

<sup>1</sup> Weather station location: SNOHOMISH CO (PAINE FD) AP (24222)

## Non-Energy Benefits

In addition to the direct energy benefits of the program, the project team set out to identify non-energy benefits, such as water savings and increased engagement in sustainability initiatives by the store employees.

### Water Savings

As discussed in the section on EIS integration, water data was limited and it was not possible to estimate water savings with so little data.

### Employee Awareness and Attitudes

All employees in participating stores were asked to complete a survey during the week before and during the week after the competition. 100 employees responded to the pre-competition survey and 21 responded to the post-competition survey. As shown in the table above, the three stores where employees responded to the post-competition survey were the three stores that performed best during the competition. It is unclear whether the stores that performed less well did not complete surveys because they were discouraged by the results or if their lower results and lack of survey response were both symptoms of their disengagement. In any case, the pre-post analysis of the surveys is skewed toward the best performers.

The figure below shows a comparison of the pre-competition survey responses to a question of employees' attitudes toward energy and water conservation in their store. The three best performing stores are shown separately from the other stores. There is a clear tendency for employees in what turned out to be the most successful stores to see energy and water conservation as part of their duties and something they already engaged in. There is also simply a higher survey response rate for the best performers.

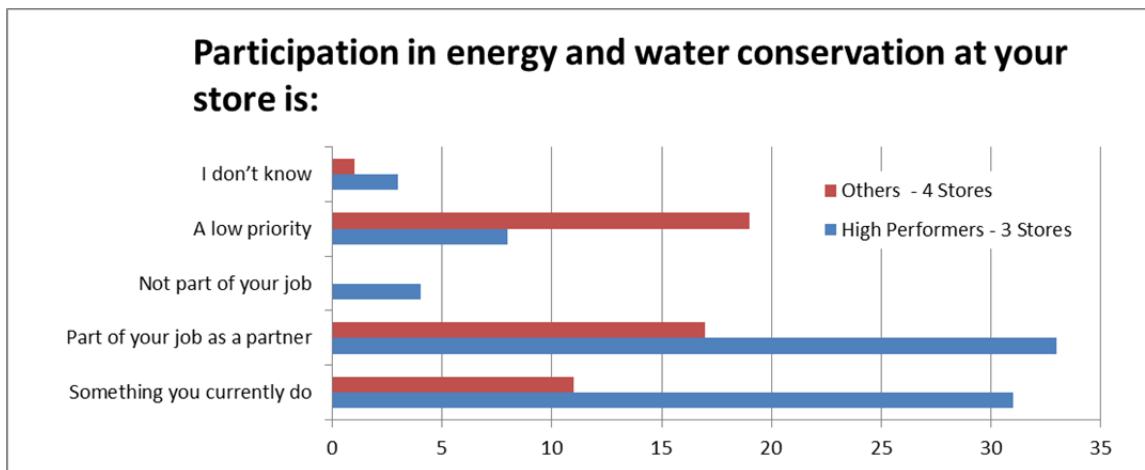


Figure 8. Pre-competition engagement in energy and water conservation

The next set of figures shows pre and post-competition survey responses for only the three best performing stores (these are the only stores that provided post-competition responses). Note that two of the figures only have post-competition responses because there were no corresponding pre-competition survey questions. These responses indicate that employees became more aware of the sustainability component of Starbucks' mission and more actively engaged in conservation activities as a result of the program. Moreover, they planned to continue their newly adopted behaviors and roughly half had carried some behaviors home from the workplace.

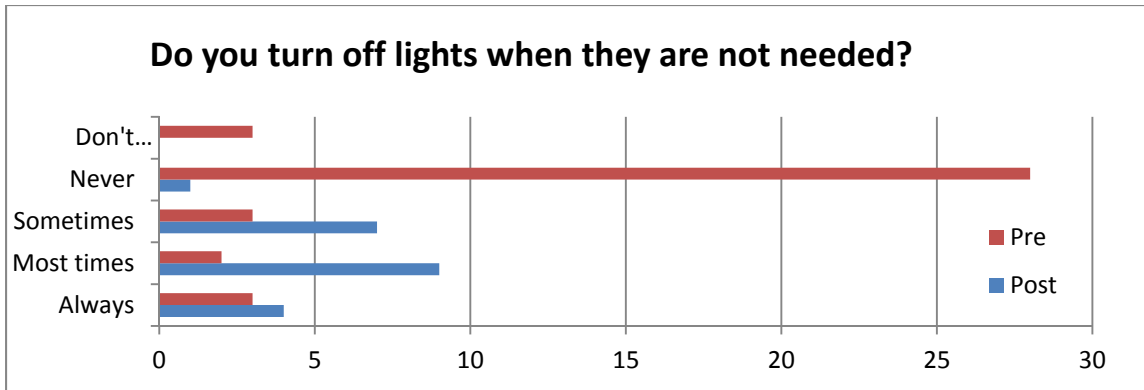


Figure 9. Pre and post energy saving activity for top performing stores

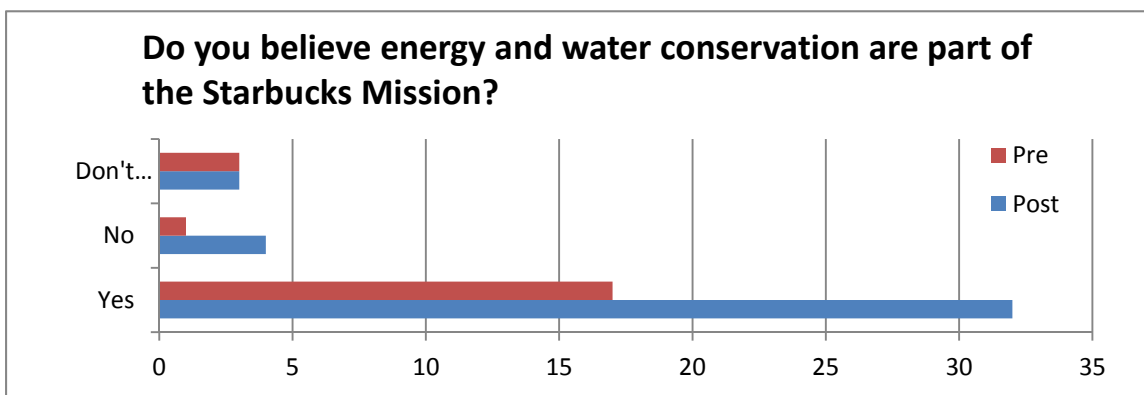


Figure 10. Pre and post engagement in the Starbucks mission at the top performing stores

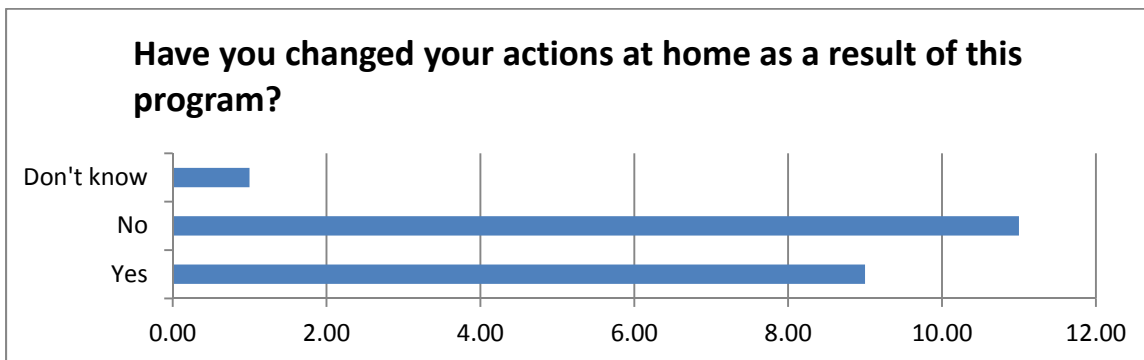


Figure 11. Impact on behaviors outside of work (top performing stores)



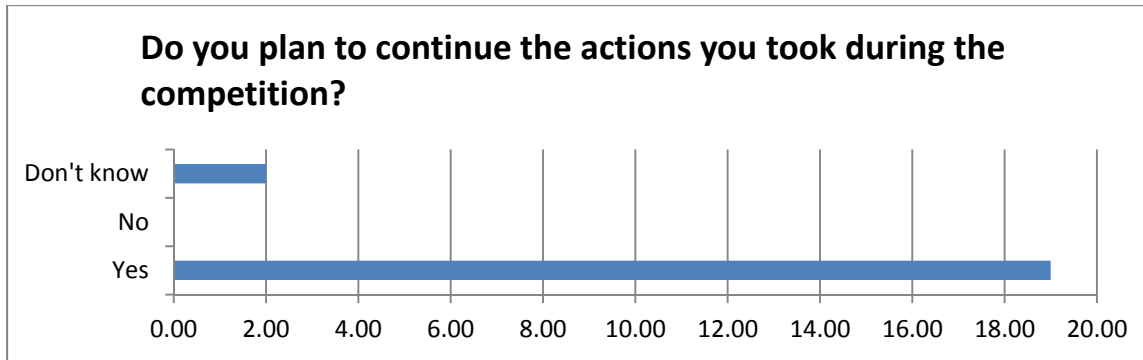


Figure 12. Expectation of continuing energy saving behavior (top performing stores)

## Lessons

- Overall the intervention proved successful in saving energy in the stores, though individual store performance covered a wide range; finding ways to better engage the lower performers would significantly boost program savings.
- Individual store analysis of energy savings using the avoided energy use method produced similar results to the pooled analysis. To save resources, future programs could omit the individual store analyses.
- Absent a truly experimental design, which was not feasible in this pilot, the difference-in-differences estimate of energy savings may have been biased by differences between the control and intervention groups that were not directly related to the behavioral intervention. The pooled and difference-in-differences analyses together provide a useful estimate of the range of likely energy savings.
- A greater than anticipated amount of time was required to gather, interpret and process the various data streams for the analysis. Time must be allocated to match meters and accounts to stores, and clearly documenting processes will save time for repeated analyses.
- Post-implementation surveys responses may be difficult to obtain. Recognizing this difficulty upfront, it may be possible to incorporate the surveys in a scheduled wrap-up activity, to integrate the survey in routine communications, or to incentivize responses in a way that would increase the post-implementation response.

During the four months following the competition, the dashboards remained in the stores and the program team provided ongoing support and encouragement, albeit at a reduced level than during the competition. The program team’s activities during the persistence period are summarized in the table below.

Table 5. Project team activities during the persistence period

Frequency	Activity
<b>Weekly</b>	Upload latest gas data
<b>Daily</b>	Check for messages from store employees
<b>Weekly</b>	Confirm proper data transmission and dashboard operation
<b>Semi-weekly</b>	Upload new Take Action message
<b>As needed</b>	Monitor and respond to communications from stores
<b>As needed</b>	Troubleshoot problems of data transmission or dashboard operation

On a monthly basis, the program team also uploaded a scorecard to the dashboards to show the stores how their performance compared to their achievement during the competition. A sample scorecard is shown below.



Figure 13. Sample score card for the persistence period

As the persistence period progressed, it became increasingly difficult to report to the stores on their performance. By October, the weather experienced by the stores was much cooler than during the August competition and at the low end of the temperatures seen during the stores’ June-July baseline period (see figure below). So, while the energy savings estimation methodology adjusts for changes in weather, our baseline models incorporated very little information about how the stores performed in cooler temperatures.

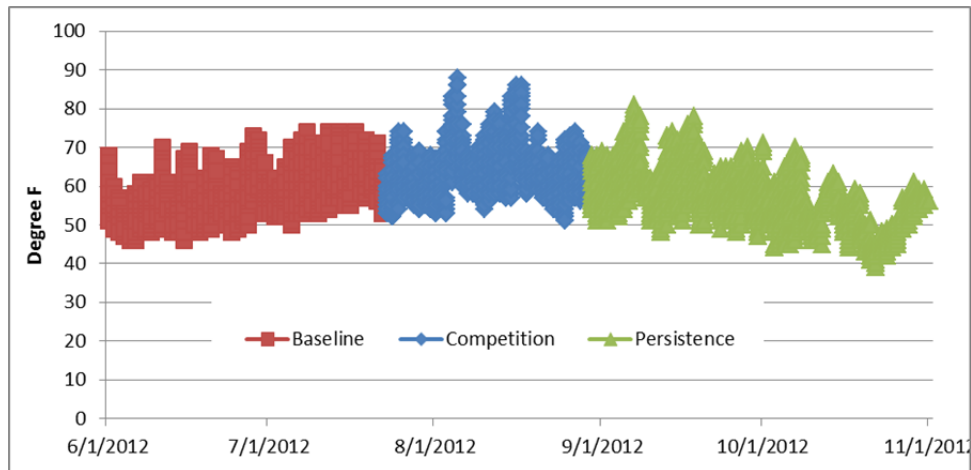


Figure 14. Temperatures observed over the course of the pilot

The weakness of the models under low temperature conditions made it difficult to discern whether the stores' energy saving behaviors were being abandoned or whether the store was increasing energy use in response to cooler weather. So we decided to set the floor of percentage savings reported back to stores at 0%, rather than showing the negative values (energy use increases) that we actually calculated for some stores.

The lower temperatures also complicated the analysis required to report on the overall persistence of the energy savings achieved by the program during the competition. The analyses used to estimate persistence was an extension of the previously described difference-in-differences analysis. We believed that including the control stores in the analysis would adequately compensate for the cooler weather, but we suspect that it did not. The analysis of persistence following the competition indicated a statistically significant increase in electric energy use of 3.7% by the participant stores. Full details of this analysis are provided as an appendix.

Given the lack of cold weather in the baseline data, the team cannot establish if the estimated increase in participant store energy use during the persistence was due to temperature effects or due to store employees' behavior. We suspect that it was due to temperature effects. There is no direct evidence indicating, or other reason to believe, that employees' behavior after the competition was more energy consuming than before the competition.

Several store partners and store managers were interviewed near the end of the persistence period. Most indicated that they believed the program had ended with the end of the August competition, and since then they had paid little, if any, attention to the dashboard. One implication of those reports is that the aforementioned decisions on how to present data in the score cards had little impact. The other, more important implication is that the intended ongoing nature of the behavior changes may not have been effectively communicated to employees, and that may have contributed to low persistence. By the time the dashboards were removed in early January it appeared that few employees were still viewing them.

## Lessons

- Allow time for a baseline that collects operating period (i.e. daytime) performance data for the range of expected temperatures during operating periods.
- Strengthen message about the need for maintaining behavior changes over the long term in order to increase the likelihood of persistence.

# Third-Party EM&V

In October 2012 SnoPUD drafted and released a Request for Proposals (RFP) for third-party evaluation of the pilot. The RFP was reviewed by BPA prior to release. Proposals were received from three consulting firms. The evaluation proposals were reviewed and scored by a team that included representatives from SnoPUD, BPA, and PECL. The review team selected Cadmus for the evaluation based on the completeness of their proposed approach to the requested tasks and the strength of their experience evaluating similar programs.

## EM&V Tasks

SnoPUD contracted with Cadmus to address these questions related to the pilot electric and gas savings estimates as well as the pilot implementation:

- Are the individual store and difference-in-differences modeling methodologies sufficient and appropriate for estimating electricity savings? Natural gas savings?
- What are the net electricity savings due to the BBEE pilot?
- How can the reliability and accuracy of behavior-based energy-savings estimates be improved?
- What factors can explain the differences in savings between successful, neutral, and unsuccessful stores?
- How can the program be improved to increase participant engagement and energy savings?

## EM&V Results Summary

Overall, Cadmus' review of the pilot's M&V approach and implementation processes was positive. Cadmus found that none of the identified opportunities for improving the M&V were significant enough to question the energy-saving estimates. Cadmus agreed with the project team's assessment of the issues with evaluating savings using the identified control group as well as estimating persistence. Cadmus' conclusions around process improvements were generally in agreement and alignment with those that the project team had already identified.

Cadmus presented their findings to the Project Team and BPA staff on April 15, 2013. The complete Cadmus evaluation report was provided to BPA with this final pilot report.

## **Attachments:**

Challenge Overview

Challenge Strategy

Pre-Competition Survey

Post-Competition Survey

M&V Approach Descriptions

## Starbucks Green Store Challenge – Overview

### About Green Store Challenge

Welcome to the Starbucks Green Store Challenge, a friendly competition between 10 area stores, all battling to see who can save the most energy and water. The Global Energy & Resource Management and Facilities Teams are sponsoring this contest. Participating stores will receive touchscreen dashboards to track progress and view their place in the standings. Dashboards will also be equipped with information and tips for creating a more sustainable workplace.

### Challenge Goals

1. Being a force for positive action is essential to the Starbucks mission. Saving energy and water are ways we can continue to lead. Our goal is to reduce energy and water use by 25% in all stores by 2015. Your store can make a big contribution by **aiming for 5% energy and water savings during the challenge.**
2. A 5% reduction during a one-month contest won't be easy, but we think you can do it. A winning strategy – try to **implement all of the energy- and water-saving tips provided on the dashboard.**

### Challenge Rewards

1. Green Store Challenge bragging rights.
2. Be recognized by your region as a leader in delivery on Starbucks' commitment to the community.
3. A pizza party for the store with the greatest percentage in energy savings.

### Challenge Details

- Green Store Challenge begins Wednesday, August 1 and ends Wednesday, August 29.
- The winner will be the store with the greatest percentage in energy savings after the four-week contest.
- Each store will have a touchscreen dashboard installed. The dashboard will:
  - Display your store's energy and water performance, as well as that of your competitors
  - Deliver information and tips for saving energy and water in your store
  - Allow you to share feedback with the Facilities team - tell us what's working or what's not working. Or use it as a message board and have some fun with the other stores - send a message or photo of your team practicing an energy- or water-saving tactic and we'll make sure the other stores see it!
- We suggest you assign or elect a Green Store Challenge Leader to spearhead your store's efforts to win.
- Consider James Bogert, Facilities Services Manager, your coach for this competition. He can answer your questions and address just about any Green Store Challenge issue. The dashboard will provide several options for contacting James.

## Starbucks Green Store Challenge – Strategy

### Green Store Challenge Leader

Designating a Green Store Challenge Leader is a good way to get your store moving fast off the starting line. Think of the Challenge Leader as a team captain, making sure everyone stays focused, works together, and plays with a winning strategy. The following tactics will help the Challenge Leader guide the team to victory.

### 7 Winning Tactics

- 1. Distribute and collect surveys.** This one may not help you win, but it'll help us better understand your feelings about the competition, and will help Starbucks reach our greater sustainability goals.
- 2. Explore the dashboard.** Go ahead and click on all the tabs. Here's what you'll find:
  - **WELCOME** – Describes the competition and the purpose of the dashboard. You can also find contact information here.
  - **ELECTRICITY** – Displays store's electricity use. The default view is your store's hour-by-hour electricity use, but the three "Select" buttons at the bottom of this screen allow you to explore different views.
  - **NATURAL GAS** – Displays store's natural gas use. The default view is your store's daily natural gas use.
  - **WATER** – Displays store's water use. Water meters record monthly use, so information here is limited.
  - **TAKE ACTION** – Provides focused, energy- or water-saving tips to help empower your team. This action message will change every two days.
  - **COMPETITION** – Shows how you're ranked against the competition. We have the best data for electricity, so stores will be ranked based on their electricity savings percentage.
  - **GREEN IDEAS** – A library of all tips for saving energy and water in your store. These tips are grouped by the equipment they affect.
  - **GOT IDEAS?** – Links to an email form – Challenge Leaders and partners are invited to share ideas and opinions, or to ask questions.
  - **CHECK-IN** – Links to short surveys, allowing you to provide feedback on Challenge activities. This survey will change each week.
  - **PARTNER POSTS** – Holds photos that stores may provide and is where we'll post responses to your questions or comments.
- 3. Check the dashboard often.** The dashboard shows your store's progress and will supply you with energy- and water-saving tips to share with your team. Read the tips and spread the word.
- 4. Give your store a Tune-up.** On the "Green Ideas" tab, you'll find suggestions under, "Tune-up." These tips can have a big impact on store performance. Unlike the other tips, these only need to be performed once. We suggest you do a *tune-up* at the start of the competition.
- 5. Provide feedback.** You're leading a brand new Starbucks initiative, so we'd like to hear from you at least once a week. Check in with us using the weekly electronic surveys (see **Check-In** tab). You can also send emails (see **Got Ideas?** tab) or leave a voicemail at any time, and we'll get back to you as soon as possible.
- 6. Get creative.** You know your store best; there may be ways to save energy and water that we missed. Please share your ideas and we'll help you get them approved.
- 7. Have fun.** The surveys, feedback and savings are important, but this is a contest and is meant to stir a little friendly competition. Most importantly, we hope you gain a fresh perspective on conservation and the simple things you can do to make a difference.

Snohomish PUD would like to hear your thoughts about energy and water conservation at work. This survey is anonymous and your honest opinion is valued.

Please select the option(s) that best fits your answer. You're welcome to include your comments as well. Thank you for your participation.

**1. Do you believe energy and water conservation are part of the Starbucks mission?**

- Yes
- No
- I don't know

*Optional – Describe why or why not.*

**2. In your opinion, participation in energy and water conservation at your store is (check all that apply):**

- Something you currently do
- Part of your job as a partner
- Not part of your job
- A low priority
- I don't know

**3. What would motivate you to conserve energy and water at work?**

Please rank from #1 (most motivating) to #7 (least motivating)

- |   |  |
|---|--|
| ___ Knowing it's good for the environment | ___ Knowing it's a job requirement               |
| ___ A reward for you                      | ___ Knowing that your actions have a real impact |
| ___ A reward for your team                | ___ Knowing it's good for your store's finances  |
| ___ Other: _____                          |  |

**4. Do you turn off lights when they are not needed, like in the back room when no one is in there?**

- \_\_\_ Always    \_\_\_ Most times    \_\_\_ Sometimes    \_\_\_ Never    \_\_\_ I don't know

*Optional – Describe why or why not.*

**5. Do you only use cool water to rinse dishes?**

- \_\_\_ Always    \_\_\_ Most times    \_\_\_ Sometimes    \_\_\_ Never    \_\_\_ I don't know

*Optional – Describe why or why not.*

**6. What other actions can you take to save energy and water in your store?**



Snohomish PUD would like to hear your thoughts about energy and water conservation at work, following the energy- and water-saving competition. This survey is anonymous and your honest opinion is valued.

You're welcome to include your comments as well. Thank you for your participation.

**1. Do you believe energy and water conservation are part of the Starbucks mission?**

- Yes  
 No  
 I don't know

*Optional – Describe why or why not.*

**2. Do you turn off lights when they are not needed?**

\_\_\_ Always \_\_\_ Most times \_\_\_ Sometimes \_\_\_ Never \_\_\_ I don't know

*Optional – Describe why or why not.*

**3. Do you only use cool water to rinse dishes?**

\_\_\_ Always \_\_\_ Most times \_\_\_ Sometimes \_\_\_ Never \_\_\_ I don't know

*Optional – Describe why or why not.*

**4. How did you participate in the competition? (Check all that apply)**

- \_\_\_ I viewed the dashboard                      \_\_\_ I reminded my co-workers of tips  
 \_\_\_ I applied water-saving tip(s)              \_\_\_ I learned something about my store's energy and water use  
 \_\_\_ I applied energy-saving tip(s)            \_\_\_ I did not participate in the Challenge  
 \_\_\_ Other: \_\_\_\_\_

**5. Do you plan to continue your energy- and water-saving behavior?**

- Yes  
 No  
 I don't know

*Optional – Describe why or why not.*

**6. Have you changed any of your energy or water behavior at HOME, as a result of the Challenge?**

- Yes  
 No  
 I don't know

*Optional – Describe why or why not.*

## Starbucks Green Store Challenge – Survey 2

7. Resources have been provided to aide in the Challenge. We'd like to know what you're finding "Useful" or "Not Useful." (You may add additional items in the blank rows.)

Resource	Useful	Not Useful	Comments (if any)
<i>(example) Pencil</i>		X	<i>It wasn't sharpened.</i>
Tips to save energy			
Tips to save water			
Ability to ask questions or comment			
Ability to receive responses (via Partner Posts tab)			
Competition with other stores			
Tablet computer			
Dashboard/online software (the website shown on the tablet computer)			
New action message every-other-day			

8. What has been your favorite part of the Challenge?

9. Please share any additional comments.

## **M&V Approach Descriptions**

## **Difference-in-Differences (Control vs. Intervention) Analysis**

This document describes the process used by PEI to estimate the energy saving impact of the August 2012 competition, by comparing the performance of the 10 participating Starbucks stores against a control group in neighboring PSE territory. As in the pooled analysis, the reported value is the per store energy savings that can be expected if SnoPUD runs this competition (same design and length) for the larger population of Starbucks stores in SnoPUD territory. This analysis uses daily data and begins with the full set of stores in PSE territory as an eligible control group.

### **Data Processing**

1. Import data
2. Excluded 24 accounts with two meters where we might not have data for both meters
3. Eliminated accounts which did not have a corresponding store in the Starbucks database
4. Merge PSE data and SBUX data based on account # to get store # and info into data set
5. Eliminated stores that have 2 PSE statement accounts, but not both account numbers have made it through analysis so far
6. Analyzing good vs. estimated reads
  - a. 58 stores have reads that are “estimates” instead of “good” reads.
  - b. Excluded stores because too many estimates (more than 2 percent of observations estimated)
7. Calculated total Daily consumption
  - a. Merged in based on account number the multiplier
  - b. Multiplied read status by multiplier for each account number
8. Combined stores with multiple accounts into 1 daily consumption per store
9. Exclude stores that were distant from the intervention group
10. Exclude all electric stores, based on data supplied by Starbucks
11. Exclude stores with too high readings (in thousands of kWh – indicates a shared meter)
12. Excluded some cafes to get the right mix of café vs drive thru to match intervention stores
  - a. PSE mix was 51% vs. 49%, want it to be 33% vs. 67%
  - b. Ranked stores high to low use and excluded roughly every 3<sup>rd</sup>

### **Savings analysis:**

1. Key dates
  - a. Baseline period: May 22 or June 6 – July 15, 2012. Two stores’ meters were not activated until June 6. Store managers were emailed the details of a competition kickoff conference call on July 16<sup>th</sup>.
  - b. Competition period: July 23, 2012 – August 29, 2012. Store managers were informed of the competition in a conference call on July 23<sup>rd</sup>.
2. Added potential independent variables:
  - a. Daily weather data (from NOAA, station SNOHOMISH CO (PAINE FD))
    - i. Averaged hourly readings over full day

- b. Weekday/weekend
    - i. 0= weekday
    - ii. 1 = weekend
  - c. Control/intervention store
    - i. 0= control
    - ii. 1= intervention
  - d. Pre/post
    - i. 0 = pre (until 7/15)
    - ii. 1 = post (7/23-8/29)
  - e. Normalized for differences in store size based on pre-competition average hourly usage for each store:
    - i.  $\frac{\sum \text{Hourly usage in baseline period}}{\sum \# \text{ hours in baseline period}}$
3. Regression model created
- a. Using the following independent variables:
    - i. Control/intervention
    - ii. Dry Bulb Fahrenheit
    - iii. Pre/post
    - iv. Normalization factor
    - v. Interaction between control/intervention and pre/post
  - b. Results
    - i. Overall model statistically significant
    - ii. The difference in difference variable (intervention/control\*pre/post) statistically significant at 95% confidence
    - iii. Sign of difference in difference variable indicates savings
4. Savings results: 274 kWh/store
- a. Difference in difference variable\*#of days in competition

## Avoided Energy Use (Electric) Analysis Documentation

This document describes the process used by PECl to estimate the electric energy saving impact of the August 2012 competition for each of the participant stores. An avoided energy use method is used, wherein each stores' hourly performance during the competition is compared against a model of that stores' baseline hourly energy use.

### Data processing

1. 5 of the participant stores have two MV90 meters. Combined 2 meters according to table provided by SnoPUD
2. Used 15-min. electric interval data for the savings analysis
3. Key dates
  - a. Baseline period: first day of full day of meter data (May 22 or June 6) – July 15, 2012. Two stores' meters were not activated until June 6. Store managers were emailed the details of a competition kickoff conference call on July 16<sup>th</sup>.
  - b. Competition period: July 23, 2012 – August 29, 2012. Store managers were informed of the competition in a conference call on July 23<sup>rd</sup>. The actual competition began on Wednesday, August 1<sup>st</sup> and ended on Wednesday, August 29<sup>th</sup>.
4. Added potential independent variables:
  - a. Hourly weather data (from NOAA, station SNOHOMISH CO (PAINE FD))
    - i. Averaged readings where there was greater than 1 reading per hour
  - b. Occupancy schedule according to store hours provided by Starbucks. As analysis was done on an hourly basis opening times on the ½ hour were rounded down (i.e. 4:30AM was considered open at 4:00AM) and closing times were rounded up (8:30 PM closed at 9:00).
    - i. 0 = closed
    - ii. 1 = open
  - c. Weekday/weekend
    - i. 0 = weekday
    - ii. 1 = weekend
5. Selecting model variables: Used an R-squared analysis method
  - a. Selected Occupancy & Dry Bulb Temperature
6. Baseline regression model created for each store using the baseline period dates and occupancy and dry bulb temperature as the independent variables.
  - a. Model R<sup>2</sup>, Standard Error, distribution of residuals, and influence diagram assessed
  - b. Sign and significance of variables checked

### Savings Analysis – Avoided energy use method

1. Pre-Competition Baseline Adequacy Analysis
  - a. Found that the baseline NOAA data captured the range of temperatures expected during the competition period.

- b. Expected savings of 5% was  $\geq 2x$  baseline SE
  - c. NOAA data also captured the expected upper range of temperature
  - d. Findings a-c, above, combined with customer-side project timeline constraints, led to a “go” decision with the shorter baseline period.
  - e. However, we observed that NOAA data did not capture the lower range of temperatures that may be experienced during the persistence period. We expected to be able to measure persistence by comparison against the control stores.
2. Savings estimation methodology
    - a. Actual occupancy and DB from the post-period used in the baseline regression model to create an adjusted baseline
    - b. Actual consumption in post-period subtracted from adjusted baseline for each hour
    - c. Hourly savings summed for entire competition period to get store savings for the post-period
  3. Checked for autocorrelation with hourly data (measure of the extent to which an observation is correlated with its immediate successor)
    - a. Methodology - Followed AHSRAE GL 14 procedure, pg. 108.
      - i. “The coefficient  $\rho$ , which is usually at time lag 1, is easily deduced by duplicating the time series data of model residuals onto another column of your worksheet with the time stamp displaced by one time interval. The square root of the R2 value between both these data streams is the coefficient  $\rho$ .”
      - ii. If  $\rho < 0.5$  the effect of autocorrelation in the regression model residuals can be ignored
    - b. 3 stores showed some autocorrelation. Determined it didn’t warrant adjusting our approach especially as the daily analysis was not good (discussed below).

#### **Daily Analysis of baseline data:**

1. Used same data as above, but rolled interval meter data into daily
2. Independent variables:
  - a. Daily weather data (from NOAA, station SNOHOMISH CO (PAINE FD))
    - i. Averaged hourly readings over full day
  - b. Weekday/weekend
    - i. 0 = weekday
    - ii. 1 = weekend
  - c. Store sales/transaction data provided by Starbucks
3. Selecting model variables: Used an R-squared analysis method
  - a. Selected sales/transaction data & Dry Bulb Temperature
4. Regression results
  - a. Sales/transaction data was not statistically significant.
  - b. Regression results were significantly worse (much lower  $R^2$ , much higher error) than hourly results.
  - c. Given a & b the decision was made to use hourly results for savings analysis.

## Avoided Energy Use (Gas) Analysis Documentation

This document describes the process used by PECl to estimate the natural gas energy saving impact of the August 2012 competition for each of the participant stores. An avoided energy use method was used, wherein each stores' daily performance during the competition was compared against a model of that stores' baseline daily energy use.

### Data processing

1. Used daily gas pulse data supplied by PSE.
2. Converted ccf to therms:  $\text{therms} = 1.031 * \text{ccf}$
3. Key dates
  - c. Baseline period: May 1, 2012 – July 15, 2012. Store managers were emailed the details of a competition kickoff conference call on July 16<sup>th</sup>.
  - d. Competition period: July 23, 2012 – August 29, 2012. Store managers were informed of the competition in a conference call on July 23<sup>rd</sup>. The actual competition began on Wednesday, August 1<sup>st</sup> and ended on Wednesday, August 29<sup>th</sup>.
4. Added potential independent variables:
  - a. Daily weather data (from NOAA, station SNOHOMISH CO (PAINE FD))
    - i. Averaged hourly readings over full day
  - e. Store sales/transaction data provided by Starbucks
  - f. Weekday/weekend
    - i. 0 = weekday
    - ii. 1 = weekend
5. Selecting model variables: Used an R-squared analysis method
  - g. Selected Occupancy & Wet Bulb Temperature
6. Two Baseline regression models created for each store using the baseline period dates:
  - a. Wet bulb temperature as the independent variable
  - h. Wet bulb temperature and sales/transaction data as the independent variables
  - i. Model  $R^2$ , Standard Error, distribution of residuals, and influence diagram assessed
  - j. Sign and significance of variables checked

### Savings Analysis – Avoided energy use method

1. Methodology
  - a. Actual WB or WB and sales/transaction data from the post-period used in the baseline regression model to create an adjusted baseline
  - b. Actual consumption in post-period subtracted from adjusted baseline for each day
  - c. Daily savings summed for entire competition period to get store savings for the post-period



## Pooled Analysis Documentation

This document describes the process used by PECl to estimate the pooled energy saving impacts of the August 2012 competition among 10 Starbucks stores. The pooled impact is the per store energy savings that can be expected if SnoPUD runs this competition (same design and length) for the larger population of Starbucks stores in SnoPUD territory.

1. Used 15 min electric interval data prepared for the store savings analysis.
2. Combined all the data into one file
3. Key dates
  - a. Baseline period: first day of full day of meter data (May 22 or June 6) – July 15, 2012.  
Two stores' meters were not activated until June 6. Store managers were emailed the details of a competition kickoff conference call on July 16<sup>th</sup>.
  - b. Competition period: July 23, 2012 – August 29, 2012. Store managers were informed of the competition in a conference call on July 23<sup>rd</sup>.
4. Added potential independent variables:
  - a. Hourly weather data (from NOAA, station SNOHOMISH CO (PAINE FD))
    - i. Averaged readings where there was greater than 1 reading per hour
  - b. Occupancy schedule according to store hours provided by Starbucks. As analysis was done on an hourly basis opening times on the ½ hour were rounded down (i.e. 4:30AM was considered open at 4:00AM) and closing times were rounded up (8:30 PM closed at 9:00).
    - i. 0 = closed
    - ii. 1 = open
  - c. Weekday/weekend
    - i. 0= weekday
    - ii. 1 = weekend
  - d. Sales/transaction data (for daily analysis) provided by Starbucks
  - e. Pre/post
    - i. 0 = pre (until 7/15)
    - ii. 1 = post (7/23-8/29)
  - f. Normalized for differences in store size based on pre-competition average hourly usage for each store:
    - i. 
$$\frac{\sum \text{Hourly usage in baseline period}}{\sum \# \text{ hours in baseline period}}$$
5. Regression model created using the baseline period dates and occupancy, dry bulb, pre/post, and the pre average hourly usage.
  - a. All variables were statistically significant.
  - b. Sign of pre/post coefficient in the correct direction to indicate savings.
6. Calculated savings
  - a. Pooled savings = pre/post coefficient \* # hours in competition

## Difference-in-Differences Persistence Analysis

This document describes the process used by PECl to estimate the persistence of energy savings following the August 2012 competition, by comparing the performance of the 10 participating Starbucks stores against a control group in neighboring PSE territory. As in the competition versus intervention analysis, the reported value is the per store energy savings that can be expected if SnoPUD runs this competition (same design and length) for the larger population of Starbucks stores in SnoPUD territory. This analysis uses daily data and begins with the full set of stores in PSE territory as an eligible control group. The persistence analysis has one significant weakness: the lack of cold weather data in the baseline period. We expect that the baseline period does not well represent the stores' energy performance during the colder months, November and December, included in the persistence period.

### Data Processing

13. Import data
14. Excluded 24 accounts with two meters where we might not have data for both meters
15. Eliminated accounts which did not have a corresponding store in the Starbucks database
16. Merge PSE data and SBUX data based on account # to get store # and info into data set
17. Eliminated stores that have 2 PSE statement accounts, but not both account numbers have made it through analysis so far
18. Analyzing good vs. estimated reads
  - a. 58 stores have reads that are "estimates" instead of "good" reads.
  - b. Excluded stores because too many estimates (more than 2 percent of observations estimated)
19. Calculated total Daily consumption
  - a. Merged in based on account number the multiplier
  - b. Multiplied read status by multiplier for each account number
20. Combined stores with multiple accounts into 1 daily consumption per store
21. Exclude stores that were distant from the intervention group
22. Exclude all electric stores, based on data supplied by Starbucks
23. Exclude stores with too high readings (in thousands of kWh – indicates a shared meter)
24. Excluded some cafes to get the right mix of café vs drive thru to match intervention stores
  - a. PSE mix was 51% vs. 49%, want it to be 33% vs. 67%
  - b. Ranked stores high to low use and excluded roughly every 3<sup>rd</sup>

### Savings analysis:

5. Key dates
  - a. Baseline period: May 22 or June 6 – July 15, 2012. Two stores' meters were not activated until June 6. Store managers were emailed the details of a competition kickoff conference call on July 16<sup>th</sup>.
  - b. Persistence period: August 30 – December 27, 2012. The competition ended on August 29<sup>th</sup>.

6. Added potential independent variables:
  - a. Daily weather data (from NOAA, station SNOHOMISH CO (PAINE FD))
    - i. Averaged hourly readings over full day
  - b. Weekday/weekend
    - i. 0= weekday
    - ii. 1 = weekend
  - c. Control/intervention store
    - i. 0= control
    - ii. 1= intervention
  - d. Pre/post
    - i. 0 = pre (until 7/15)
    - ii. 1 = post (8/30-12/27)
  - e. Normalized for differences in store size based on pre-competition average hourly usage for each store:
    - i. 
$$\frac{\sum \text{Hourly usage in baseline period}}{\sum \# \text{ hours in baseline period}}$$
7. Baseline regression model created
  - a. Using the following independent variables:
    - i. Control/intervention
    - ii. Dry Bulb Fahrenheit
    - iii. Pre/post
    - iv. Normalization factor
    - v. Interaction between control/intervention and pre/post
  - b. Results
    - i. Overall model statistically significant
    - ii. The difference in difference variable (intervention/control\*pre/post) statistically significant at 95% confidence
    - iii. Sign of difference in difference variable indicates savings
8. Results: increased usage of 12 kWh/store-day relative to the baseline period; compared to decreased usage of 7 kWh/store-day during the competition period. The dissimilar weather during the baseline and persistence periods may explain much of this change. However, we must conclude that there is no evidence to indicate persistence of the energy savings.