TEP Power Partners Project

Final Report

DOE Data Access

Power Partners Project

2012-2013 EE Pilot

Submission Date: February 6, 2014

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Contents

1. Executive Summary

The Arizona Governor's Office of Energy Policy, in partnership with Tucson Electric Power (TEP), Tendril, and Next Phase Energy (NPE), formed the TEP Power Partners pilot project to demonstrate how residential customers could access their energy usage data and third party applications using data obtained from an Automatic Meter Reading (AMR) network.

The project applied for and was awarded a Smart Grid Data Access grant through the U.S. Department of Energy. The project participants' goal for Phase I is to actively engage 1,700 residential customers to demonstrate sustained participation, reduction in energy usage (kWh) and cost ($), and measure related aspects of customer satisfaction.

This Demonstration report presents a summary of the findings, effectiveness, and customer satisfaction with the 15-month TEP Power Partners pilot project. The objective of the program is to provide residential customers with energy consumption data from AMR metering and empower these participants to better manage their electricity use. The pilot recruitment goals included migrating 700 existing customers from the completed Power Partners Demand Response Load Control Project (DRLC), and enrolling 1,000 new participants.

Upon conclusion of the project on November 19, 2013:

- 1,390 Home Area Networks (HANs) were registered.
- 797 new participants installed a HAN.
- Survey respondents' are satisfied with the program and found value with a variety of specific program components.
- Survey respondents report feeling greater control over their energy usage and report taking energy savings actions in their homes after participating in the program.
- On average, 43 % of the participants returned to the web portal monthly and 15% returned weekly.
- An impact evaluation was completed by Opinion Dynamics and found average participant savings for the treatment period[1] to be 2.3% of their household use during this period.[2] In total, the program saved 163 MWh in the treatment period of 2013.

2. Overview

The Power Partners Project utilized a combined goal of 700 existing portal users from a previously completed pilot and 1,000 new users. The participants from the previous program are referred to as "DRLC participants" and the new users are referred to as the "EE participants" throughout the report.

The program kicked off with a portal migration for existing 724 DRLC participants. New users were emailed and notified of the new web portal functionality and benefits. In addition to the existing

[1] Treatment periods differ across participants, beginning as early as December 2012 through March 1 of 2013. This means that a participant could have participated in the program for five to eight months.

[2] Opinion Dynamics did not provide an annual savings estimate for this program effort because of the large seasonal variation in Tucson's climate. As such, extrapolating our findings beyond the analysis period (January-July, 2013) is not supported.

presentation of 15-minute meter reads, bill history and pricing program information, the portal introduced a community aspect, expert service, weekly challenge, energy saving actions and other customer engagements.

After migration to the new portal, we initiated an email marketing campaign to recruit 1,000 new participants. Three emails were sent to a segmented and non-segmented group of TEP customers.

Participants were randomly chosen for a self-installation or a professional installation. Installations were scheduled and completed, or kits were shipped, upon acceptance into the program. All new participants received a Tendril Translate Bridge, Tendril Transport Gateway and access to the Tendril Tendril Energize Portal. The Translate and Transport collected 15-minute meter reads, which were displayed, on the users Tendril Energize Portal in near-real time, which allows users to understand where energy is used within the home. The Tendril Energize Portal gave participants the ability to view usage by month, day or year, participate in a weekly challenge, sign up for and complete energy saving actions, view pricing program details, set energy saving goals, and view anticipated usage in cost and kWh.

The following table summarizes six month and to-date milestones.

SUMMARY	As of 2/28/13 (6-month reporting milestone)	As of 7/30/13	As of 11/19/2013
Email Marketing –unique emails sent	18,593	18,593	18,593
Enrolled	940	1,254	1,245
Accepted	417	840	861
Rejected	270	355	355
New Installs (Self & Professional)	335	733	797
Registered Home Area Network (including roll over accounts)	1039	1340	1390
Opted Out (after Installation)	18	54	54

All data in this report are as of July 30, 2013 unless otherwise noted.

3. Project Timeline

Actual project dates are as follows:

Task	Project Dates
Project Award	8/27/12
Contracting	8/28/12 – 9/16/12
Project Set Up	9/17/12 – 12/9/12
Marketing Launch	12/10/12
Installation	12/10/12 –10/3/13
Participant Survey	6/25/13 – 7/17/13
Demonstration Report	8/21/13
Project Closure	11/19/13
Final Report	2/6/2014

4. Equipment

The Power Partners Project was launched on Tendril Energize Portal 3.6. The hardware for the 1,000 new EE Participants included the following:

Hardware	Qty
Tendril Transport Gateway	1000
Tendril Translate Bridge	1000

Tendril Energize Portal

Tendril Transport Gateway

Tendril Translate Bridge

- Tendril Translate Bridge – lets homes participate in the Power Partners program by providing communication between an AMR electric meter and smart energy devices.
- Tendril Transport Gateway – a communications device that sends and receives energy-related information, to and from the electric utility company, over a secure Internet connection.

- Tendril Energize Portal creates a place on the internet where customers can manage their energy usage. The portal includes a customer's dashboard, energy use data, and ways to save energy, a pricing plan, and expert advice.

In addition to the hardware mentioned above, the DRLC group had Programmable Thermostats, In-Home Displays and/or Load Control Switches attached to their air conditioner compressor as part of their participation in the earlier pilot.[3] These included:

- Tendril Insight In-Home Display (IHD) – shows information about a home's energy consumption, including present energy use (kW), cost per hour, and period-to-date usage. The IHD software lets customers set alerts to indicate when their cost and consumption exceeds a limit that they define.
- Tendril Set Point thermostat (TSTAT) – a smart, programmable thermostat that works with the Tendril Home Area Network (HAN) to help understand and manage the energy usage in homes.
- Tendril Load Control Switch (LCS) – attached to their air conditioner compressor as part of their participation in demand response events.

5. Marketing

The Power Partners project initiated three marketing efforts: 1) Email Marketing, 2) Newspaper Article and 3) Green Community Outreach. Each is described below.

Email Marketing

Marketing approaches were designed to achieve a goal of installing 1,000 residential participants.

Segmentation

TEP provided a master marketing list from TEP that included 35,996 customers to be used for recruitment and control groups.

The pilot also leveraged 10,120 TEP customers that had been segmented during the DRLC program (see above). These customers had not received any marketing for the DRLC program, and were therefore eligible for marketing. Due to budget limitations, additional segmentation was not completed on the remaining customers.

Customers were segmented into the following Experian Mosaic groups:

[3] This switch allows TEP to cycle a participant's air conditioner on and off during peak periods when TEP requires load reduction. Customers are compensated for their participation in this cycling.

Segmentation Group	Total List	Emailed
Group E: American Diversity	2,127	2,127
Group B: Upscale America	2,055	2,055
Group F: Metro Fringe	1,095	1,095
Group H: Aspiring Contemporaries	900	900
Group A: Affluent Suburbia	1,567	1,567
Group J: Struggling Societies	426	256
Group C: Small Tow Contentment	576	576
Group K: Urban Essence	389	389
Group G: Remote America*	220	131
Group D: Blue-Collar Backbone*	507	332
Group I: Rural Village & Farms*	145	84
Group L: Varying Lifestyles*	13	10
Non- Segmented*	25,976	18,593
Total	35,996	18,593

*Email was sent however email creative that was sent, was not based on segmentation.

In order to achieve 1,000 residential enrollments, Tendril engaged all segmentation and non-segmented groups. The final marketing list included 18,593 customers, with 7,881 held in reserve to serve as a control group. Note that the reserve group did not receive any marketing.

Email

Tendril delivered segmented emails to each of the targeted segmentation groups. These emails contained information that outlined the goals of the TEP Power Partners Project and emphasized the following benefits to participants:

- Free, personalized energy management portal
- Learn how to manage energy use
- View energy use in near real time
- Compare billing periods and similar homes energy usage
- Make informed decisions that can results in real savings on monthly bills
- Tips and tricks to help save energy

The email also provided highly visible images and links that encouraged the recipient to sign-up for a chance to participate in the TEP Power Partners Project.

The following four images were used in email blasts for recruitment:

Group 1 Email: Upscale America, Aspiring Contemporaries, and Small-Town Contentment -

TEP wants to help you save money on your monthly energy bill.

TENDRIL

TEP
Tucson Electric Power

The TEP Power Partners Project puts the power in your hands.

Sign up now and receive access to a free, personalized, energy management portal.

"I like being able to track my energy usage in real time."
– Power Partners Project participant

Tucson Electric Power together with its partner Tendril, a leader in energy management solutions, is expanding the highly successful TEP Power Partners Project. It's a program that will help you manage your energy usage. We'd like you to join us!

The TEP Power Partners Project started over two years ago as a pilot program with more than 700 residential customers participating. This two year project helped customers like you better manage their energy use and helped TEP learn ways to improve how electricity is delivered and used throughout our community. Now it's your turn!

Here's how it works

TEP will give you access to a state-of-the-art home energy management portal that will let you see your energy usage in near real-time. You'll have the ability to compare your usage to previous billing periods or even to similar homes in your area. There are also valuable tips and tricks to help you save energy without sacrificing comfort. All this valuable information will help you make smarter decisions that can result in real savings on your monthly bill.
Learn More.

Don't miss the opportunity to become a part of this exciting program. Put the power in your hands. Start managing your energy usage and make a difference.

APPLY NOW!

Group 2 Email: American Diversity and Affluent Suburbia

Managing your monthly energy bill just got easier.

TENDRIL

TEP Tucson Electric Power

The TEP Power Partners Project puts the power in your hands.

Sign up now and receive access to a free, personalized, energy management portal.

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Learn More.

Don't miss the opportunity to become a part of this exciting program. Put the power in your hands. Start managing your energy usage and make a difference.

APPLY NOW!

Group 3 Email: Metro Fringe

TEP wants to help you save money on your monthly energy bill.

TENDRIL

TEP Tucson Electric Power

The TEP Power Partners Project puts the power in your hands.

Sign up now and receive access to a free, personalized, energy management portal.

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Learn More.

Don't miss the opportunity to become a part of this exciting program. Put the power in your hands. Start managing your energy usage and make a difference.

APPLY NOW!

Group 4 Email: Struggling Societies and Urban Essence

Managing your monthly energy bill just got easier.

TENDRIL

TEP
Tucson Electric Power

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Learn More.

Don't miss the opportunity to become a part of this exciting program. Put the power in your hands. Start managing your energy usage and make a difference.

APPLY NOW!

Email Results

Four email blasts were completed with average click through rates of 5%, within an industry standard of 3-5%. Email recruitment started 12/11/13 and was completed over a 2-month period.

Click Through Rates by Segmentation

Installation Rate by Segementation

	Delivered	Opened	Open Rate	Clicked	Click Thru Rate
Email #1 (12/11/121)					
Group #1_H	876	367	42%	33	4%
Group #2_E_A	3,488	2,410	69%	298	9%
Group #3_F_K	1,427	615	43%	72	5%
Group #4_B_C	2,504	1,688	67%	204	8%
EMAIL #1 TOTAL	8,295	5,080	61%	607	7%
Email #2 (1/8/13)					
Group #1_H	868	277	32%	15	2%
Group #2_E_A	3,412	2,104	62%	190	6%
Group #3_F_K	1,410	511	36%	40	3%
Group #4_B_C	2,454	1,383	56%	131	5%
EMAIL #2 TOTAL	8,144	4,275	52%	376	5%
Email #3 (1/15/13)					
Group #1_H	866	210	24%	10	1%
Group #2_E_A	3,369	1,602	48%	142	4%
Group #3_F_K	1,399	406	29%	24	2%
Group #4_B_C	2,428	1,060	44%	99	4%
Group#2_Non Segmented	4,800	1,750	36%	121	3%
Group#4_Non Segmented	13,705	7,450	54%	767	6%
EMAIL #3 TOTAL	26,567	12,478	47%	1,163	4%
Email #4 (1/28/13)					
Group#2_Non Segmented	13,579	8,456	62%	526	4%
Group#4_Non Segmented	4,766	1,371	29%	87	2%
EMAIL #4 TOTAL	18,345	9,827	54%	613	3%
Average per email blast	**15,338**	**7,915**	**54%**	**690**	**5%**
Total	**61,351**	**31,660**	-	**2,759**	-

Enrollments to Installation per Segmentation Group

The following chart summarizes enrollments to installation per segmentation group. The "Independent" group were enrollees that did not receive direct marketing and were word of mouth enrollments. Affluent Suburbia had the highest enrollment rate of 4% and installation rate of 86% (excluding groups with less than 20 customers who enrolled in the program).

Segmentation Group	Emails Sent	Enrolled	Enrollment Rate	Accepted	Acceptance Rate (from enrollment)	Installed	Installation Rate (from enrollment)
Group E: American Diversity	2127	68	3%	45	66%	42	62%
Group B: Upscale America	2,055	80	4%	63	79%	65	81%
Group F: Metro Fringe	1.095	22	2%	16	73%	13	59%
Group H: Aspiring Contemporaries	900	16	2%	9	56%	8	50%
Group A: Affluent Suburbia	1,567	63	4%	54	86%	54	86%
Group J: Struggling Societies	526	2	0%	2	100%	2	100%
Group C: Small Tow Contentment	576	11	2%	5	45%	4	36%
Group K: Urban Essence	389	6	2%	0	0%	0	0%
Group G: Remote America	220	2	1%	1	50%	1	50%
Group D: Blue-Collar Backbone	507	4	1%	2	50%	2	50%
Group I: Rural Village & Farms	145	3	2%	3	100%	3	100%
Group L: Varying Lifestyles	13	0	0%	0	0%	0	0%
Not Segmented	25,914	337	1%	214	64%	205	61%
Independent	n/a	649	n/a	447	69%	398	61%
Total/Average	**34,940**	**1263**	**4%**	**861**	**68%**	**797**	**63%**

Email Acceptance, Rejection & Waitlist

Enrollment data was shared with TEP for program acceptance or denial based on factors determined by TEP.

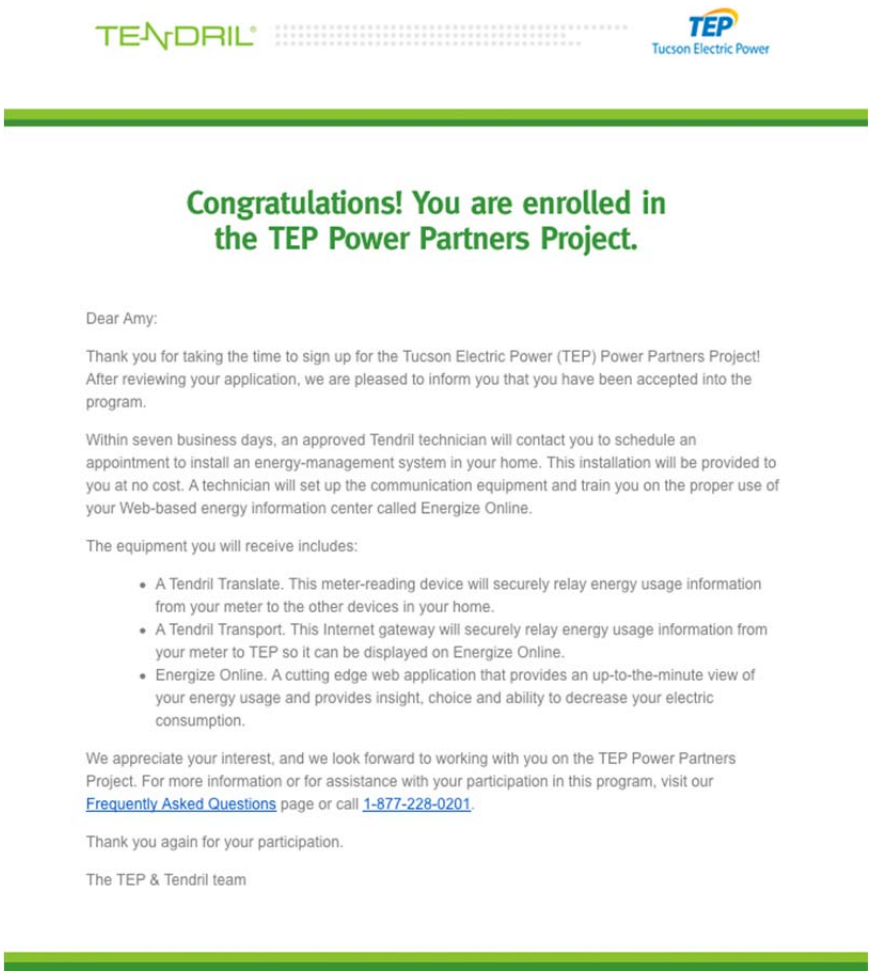
Acceptance

861 customers were accepted by TEP for program participation. AMR meters were a requirement for program participants and in most cases a meter swap was needed prior to installation. Once the meter swap was completed, TEP notified Tendril of their status and Tendril sent out an acceptance email.

Participants were randomly designated for a self-install or a professional install and notified accordingly through email.

The following acceptance emails were sent by Tendril, to the participant; depending on which group they were assigned to:

Acceptance Email – Professional Install



TENDRIL

TEP Tucson Electric Power

Congratulations! You are enrolled in the TEP Power Partners Project.

Dear Amy:

Thank you for taking the time to sign up for the Tucson Electric Power (TEP) Power Partners Project! After reviewing your application, we are pleased to inform you that you have been accepted into the program.

Within seven business days, an approved Tendril technician will contact you to schedule an appointment to install an energy-management system in your home. This installation will be provided to you at no cost. A technician will set up the communication equipment and train you on the proper use of your Web-based energy information center called Energize Online.

The equipment you will receive includes:

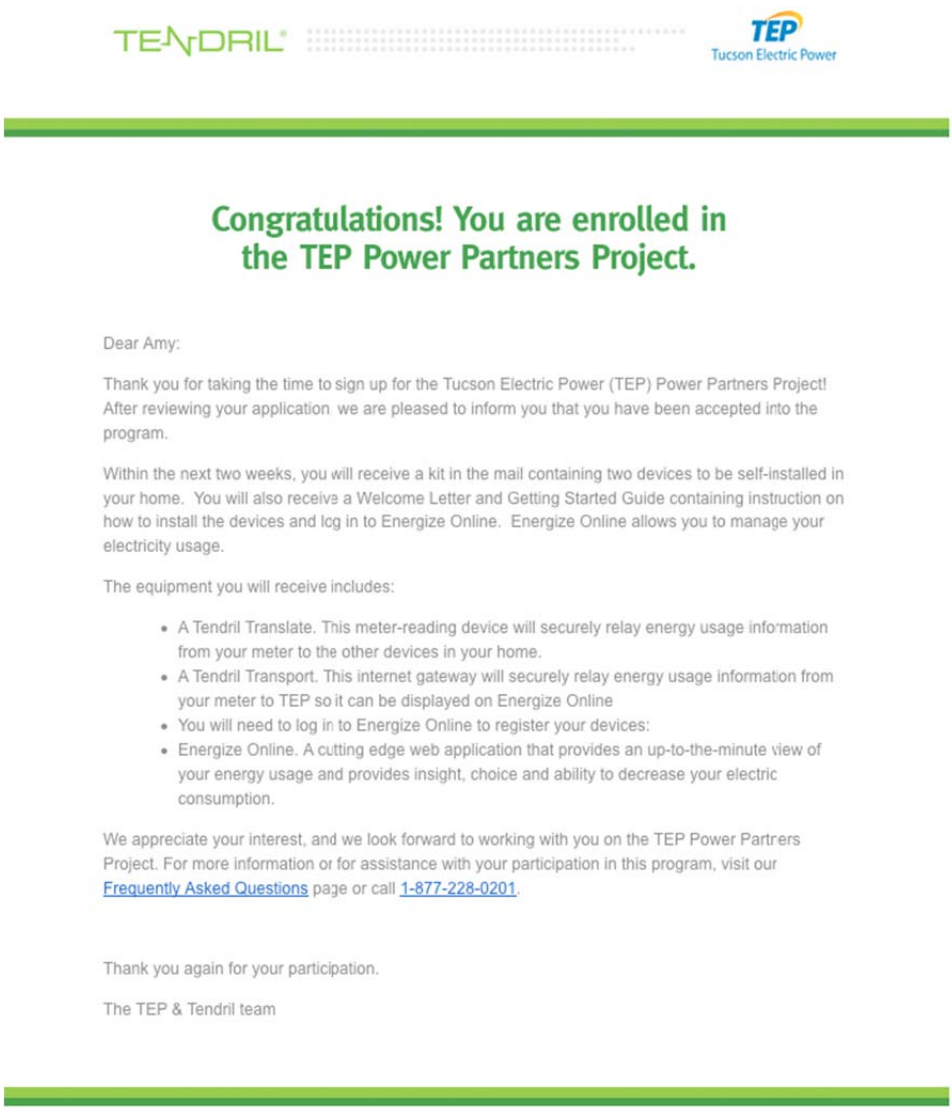
- A Tendril Translate. This meter-reading device will securely relay energy usage information from your meter to the other devices in your home.
- A Tendril Transport. This Internet gateway will securely relay energy usage information from your meter to TEP so it can be displayed on Energize Online.
- Energize Online. A cutting edge web application that provides an up-to-the-minute view of your energy usage and provides insight, choice and ability to decrease your electric consumption.

We appreciate your interest, and we look forward to working with you on the TEP Power Partners Project. For more information or for assistance with your participation in this program, visit our Frequently Asked Questions page or call 1-877-228-0201.

Thank you again for your participation.

The TEP & Tendril team

Acceptance Email – Self-Install



TENDRIL

TEP Tucson Electric Power

Congratulations! You are enrolled in the TEP Power Partners Project.

Dear Amy:

Thank you for taking the time to sign up for the Tucson Electric Power (TEP) Power Partners Project! After reviewing your application we are pleased to inform you that you have been accepted into the program.

Within the next two weeks, you will receive a kit in the mail containing two devices to be self-installed in your home. You will also receive a Welcome Letter and Getting Started Guide containing instruction on how to install the devices and log in to Energize Online. Energize Online allows you to manage your electricity usage.

The equipment you will receive includes:

- A Tendril Translate. This meter-reading device will securely relay energy usage information from your meter to the other devices in your home.
- A Tendril Transport. This internet gateway will securely relay energy usage information from your meter to TEP so it can be displayed on Energize Online
- You will need to log in to Energize Online to register your devices:
- Energize Online. A cutting edge web application that provides an up-to-the-minute view of your energy usage and provides insight, choice and ability to decrease your electric consumption.

We appreciate your interest, and we look forward to working with you on the TEP Power Partners Project. For more information or for assistance with your participation in this program, visit our Frequently Asked Questions page or call 1-877-228-0201.

Thank you again for your participation.

The TEP & Tendril team

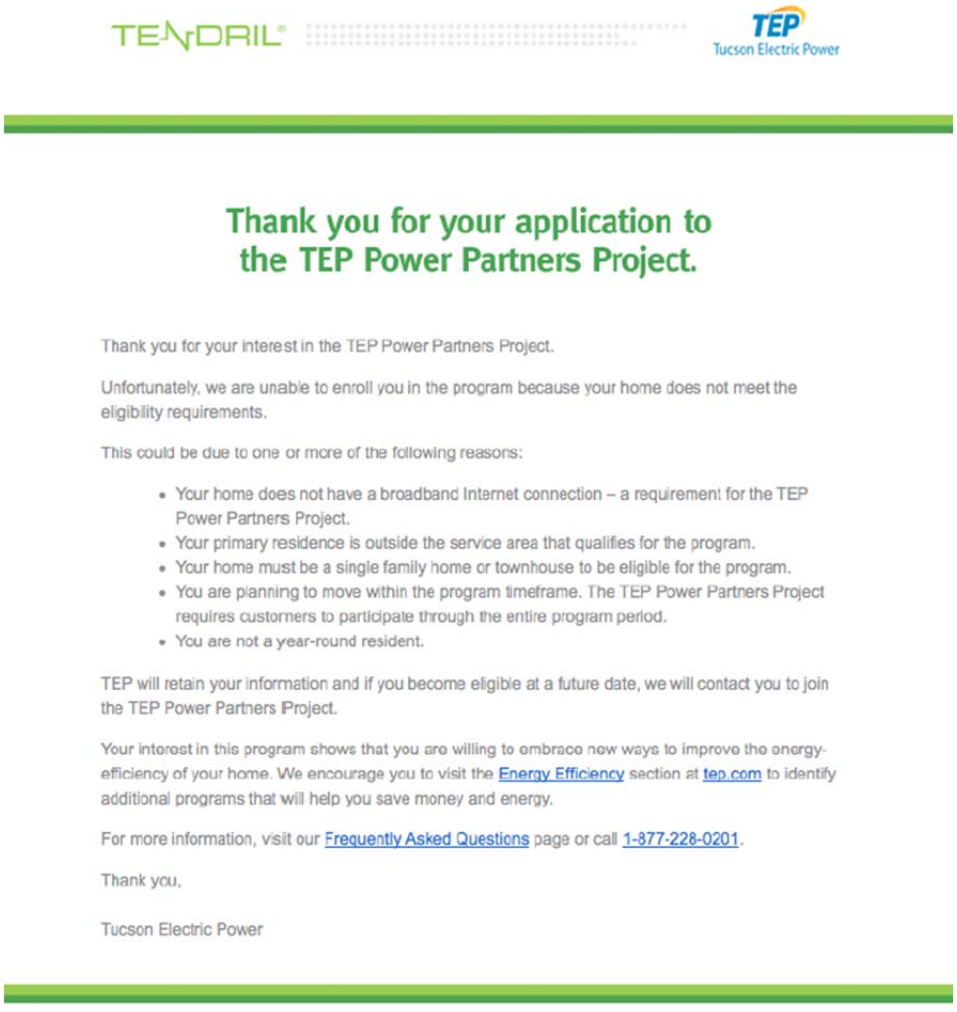
Rejection

Rejections occurred in one of two ways: the first opportunity for rejection was upon completion of the enrollment questionnaire. If applicants failed to meet one or more of enrollment criteria, they were automatically rejected and immediately sent an email notification of their enrollment status. There were 237 customers who were automatically rejected based on their enrollment application. In some cases, there were two disqualifying factors. The following chart is a breakdown of enrollment rejections:

Enrollment Disqualification	Count
No Broadband Internet	35
Dwelling Type: Apartment	53
No router	73
No open port on router	41
Moving in 2 years	48
Not primary residence	32

The second opportunity for rejection occurred after the customer enrolled and had met all enrollment criteria. TEP reviewed these accounts and provided a list of accepted or rejected customers. 118 customers were rejected by TEP for program participation. Rejections were based on account status of; bankruptcy, post-petition account, ACC complaint, deceased, legal assignment, master meter MHP, access PIN, threatening customer, and smart meter opt out.

Rejection Email



TENDRIL

TEP Tucson Electric Power

Thank you for your application to the TEP Power Partners Project.

Thank you for your interest in the TEP Power Partners Project.

Unfortunately, we are unable to enroll you in the program because your home does not meet the eligibility requirements.

This could be due to one or more of the following reasons:

- Your home does not have a broadband Internet connection – a requirement for the TEP Power Partners Project.
- Your primary residence is outside the service area that qualifies for the program.
- Your home must be a single family home or townhouse to be eligible for the program.
- You are planning to move within the program timeframe. The TEP Power Partners Project requires customers to participate through the entire program period.
- You are not a year-round resident.

TEP will retain your information and if you become eligible at a future date, we will contact you to join the TEP Power Partners Project.

Your interest in this program shows that you are willing to embrace new ways to improve the energy-efficiency of your home. We encourage you to visit the Energy Efficiency section at tep.com to identify additional programs that will help you save money and energy.

For more information, visit our Frequently Asked Questions page or call 1-877-228-0201.

Thank you,

Tucson Electric Power

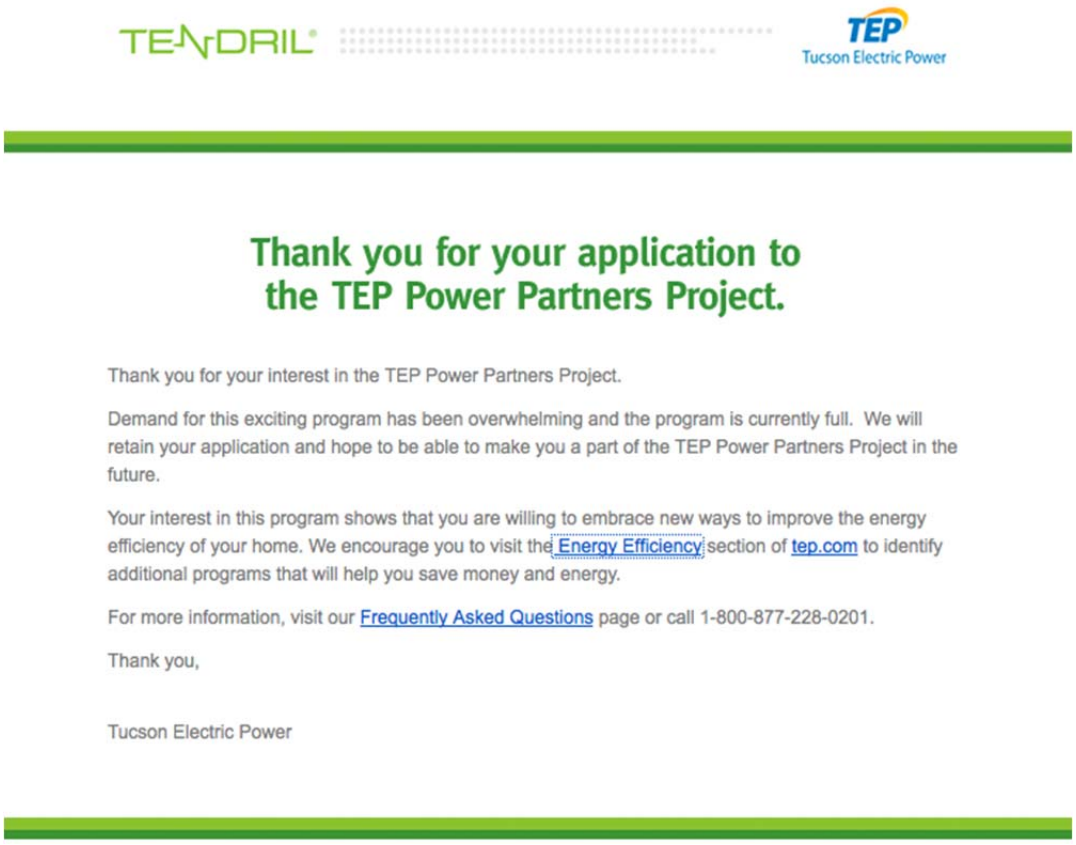
Waitlist

If a customer enrolled after the installation period concluded, the program sent the customer a waitlist email in order to capture interest for future programs.

There were zero customers who were placed into a waitlist.

The waitlist email was developed by Tendril, however none were sent to any customers.

Waitlist Email



TENDRIL

TEP Tucson Electric Power

Thank you for your application to the TEP Power Partners Project.

Thank you for your interest in the TEP Power Partners Project.

Demand for this exciting program has been overwhelming and the program is currently full. We will retain your application and hope to be able to make you a part of the TEP Power Partners Project in the future.

Your interest in this program shows that you are willing to embrace new ways to improve the energy efficiency of your home. We encourage you to visit the Energy Efficiency section of tep.com to identify additional programs that will help you save money and energy.

For more information, visit our Frequently Asked Questions page or call 1-800-877-228-0201.

Thank you,

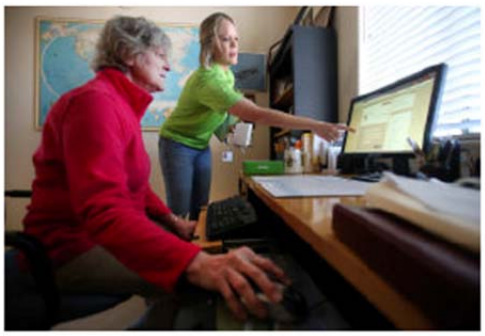
Tucson Electric Power

Newspaper article

The second marketing effort included a newspaper article. TEP featured an article in the Arizona Daily Star on 2/18/13. The goal of the newspaper article was to increase enrollments. Tendril received 304 enrollments on 2/18/13, 76 enrollments on 2/19/13 and 18 enrollments on 2/20/13. The newspaper article was very successful and boosted enrollments.

Track your power use, lower your Tucson Electric Power bill

TEP monitor system to help 1,700 do that in consumption test



FEBRUARY 18, 2013 12:00 AM • DAVID WICHNER ARIZONA DAILY STAR

Tucson Electric Power Co. residential customers can learn how to cut their power bills by joining a free program that allows customers to closely track their power usage.

Through the new TEP Power Partners Project, advanced monitoring equipment is installed at the customer's meter by program partner Tendril Inc. and used to capture energy-consumption data from customer meters at least every 15 minutes.

That data is analyzed and used to prepare personalized energy-saving strategies, and participants will be able to use Web and mobile dashboards at any time to see how and where energy is being used in their homes.

Participating customers can receive goal-setting and performance-tracking tools, personalized energy-efficiency suggestions and expert advice, TEP says.

The new TEP Power Partners Project is being funded through a $500,000 U.S. Department of Energy Smart Grid Data Access Award and administrative funding from the Governor's Office of Energy Policy, with matching funding from TEP and Colorado-based Tendril.

Initially, TEP and Tendril will seek participation from 700 customers who were part of an earlier Power Partners initiative, plus 1,000 additional customers. TEP customers can sign up for the program by visiting tep.com

The utility has about 400 to 500 openings remaining, TEP spokesman Joe Barrios said.

The DOE-awarded program follows a pilot "demand response load control" program TEP launched in 2010 and concluded successfully in October.

Participants in the pilot program were able to monitor and adjust the temperature of their home or business remotely, and allowed TEP system operators to cycle off a customer's air conditioner or adjust the customer's thermostat during periods of peak electric demand, to help the utility manage the load.

More than 750 customers participated in the program, for which each got a $50 billing credit at

the program's end, TEP's Barrios said.

TEP exercised its load controls eight times during the program last year, on 100-degree-plus days in June, July, August and September.

Most surveyed participants were positive about the program, Barrios said.

"It was successful, because we demonstrated the technology works, and people were willing to participate," he said. "The thinking is, there is a lot of untapped potential in behavioral programs."

Power Partners signup and details

• To sign up for TEP's Power Partners Project or to view more information, go to enroll.teppowerpartners.com

• Up to 1,700 residential TEP customers will be enrolled in the free program, which is scheduled to last for about 15 months.

• Participants must be TEP customers with broadband Internet access who plan to stay in their homes for at least one year. Other conditions may apply.

• Once eligible participants complete an online application and are approved to participate in the program, TEP's contractor, Tendril Inc., will make arrangements to install energy-management equipment in the customer's home. Some customers will be sent self-installation kits.

• Participants will be provided with equipment including a Tendril "Translate" device that transmits data about current consumption levels and a Tendril "Transport" device, which establishes a single-purpose home area network (HAN) that connects TEP and the customer.

Contact Assistant Business Editor David Wichner at dwichner@azstarnet.com or 573-4181.

Green Community Outreach

A third marketing effort included Green Community Outreach. For this effort, Next Phase Energy sent out emails to the University of Arizona Sustainability Office, University of Arizona Honors College, Sun City and the Metropolitan Energy Commission.

Timeline

Enrollments were originally planned to take 2 ½ months. Due to lower than anticipated enrollment, they were open approximately 8 months.

6. Home Area Network Installations

This section summarizes the Home Area Network (HAN) installation.

Overview

733 new participants were installed from December 2012 through October 2013.

Installed HANs

The following chart illustrates HAN registrations by month.

Professional Installations

Dec 2012	**10**
Jan	133
Feb	192
Mar	207
Apr	37
May	10
Jun	11
Jul	10
Aug	51
Sept	7
Oct	6
Total	**674**

Self-Installations

Mar 2013	**99**
Apr	12
May	0
Jun	2
Total	**123**

Installations

Professional Installation

Next Phase Energy installed, registered and trained the customer on the Home Area Network (HAN), which included a Tendril Translate Bridge, Tendril Transport Gateway, and Tendril Energize Portal. Next Phase Energy left behind the following documents for the customer upon completion of installation: a customized Welcome Letter, Getting Started Guide, and signed Installation Checklist.

Self-Installation

Self-installation kits were shipped to 123 participants. Participants were randomly chosen for self-installation however in a few cases participants requested self-installation kits. They were mailed via FedEx and the kit included a Welcome Letter, Self-Installation Guide, Tendril Translate Bridge and Tendril Transport Gateway. Although 123 kits were mailed to participants, only 78 participants registered their equipment. Emails were sent out to these participants encouraging registration and participation.

Installation Documents

Customer installation documents were created for TEP. See Appendix for content.

- Welcome Letter
- Installation Checklist
- Scheduling and Installation Scripts (for the installer)
- Self-Installation Guide

Customers Denied Participation –Installation

Upon acceptance into the program, some participants were disqualified or opted out prior to installation. The majority of these customers were no longer interested at the time of installation. In most cases, this was known by phone screening done by Next Phase Energy.

Installation Disqualification	Count
No longer interested	12
No broadband connection	1
No router	1
No free ports in router	3
Total	17

Timeline

Installations began in December 2012 and completed October 2013. Installation completion was later than anticipated due to enrollment rate and meter swap availability.

7. Attrition

In some cases, participants chose to opt-out of the program after installation was completed. Between 12/10/12 – 11/19/13, 54 participants opted out of the program. Reasons for opt outs vary. A participant may be moving, temporarily locating to a seasonal residence, needing the port on the router for other in home devices, device frustration and/or other personal reasons.

8. Average Duration in Program

The average duration in the program for registered participants was 301 days.

The average duration for the participants who de-enrolled at some point during the project was 105 days.

9. Customer Satisfaction Survey

This section describes the results of the online participant survey conducted from June through July 2013. Much of the process evaluation findings were provided in the Demonstration Report released in July 2013.[4] Overall, respondents are satisfied with the program and found value with a variety of specific program components. In addition, respondents report feeling greater control over their energy usage and report taking energy savings actions in their homes after participating in the program. We structure our survey results into four categories: 1) program satisfaction, 2) program

[4] TEP Power Partners Project Demonstration Report, DOE Data Access Power Partners Project 2012-2013 EE Pilot, August 2013.

engagement, 3) energy savings actions, and 4) changes to energy use knowledge and attitudes. We summarize our findings below.

Participant Survey

Opinion Dynamics coordinated with Tendril to conduct an online survey of Tucson Electric Power's Power Partners Program participants as well as selected non-participants matched on pre-baseline energy consumption. Opinion Dynamics sent survey respondents an email requesting their participation. These emails all included a link to the survey online. Our participant survey was fielded from June 25 to July 17, 2013. The table below shows our final population sizes and response rates for the survey.

Table 1. Population Size and Response Rate

	Participant Survey
Total sample frame	952[a]
Total ineligible	32
Total completes	413
Response rate[b]	45%

[a] Total sample frame includes participants through February, 2013. Participant respondents totaled 510.
[b] AAPOR Response Rate 1.

Opinion Dynamics fielded the online survey of participants to collect information regarding customer satisfaction, as well as to learn more about the types of actions taken by participants during the program period.

The survey was a good representation of program participants. Below we provide an overview of the match between survey respondents and participants in the program.

Table 2. Participant Groups, Population versus Sample

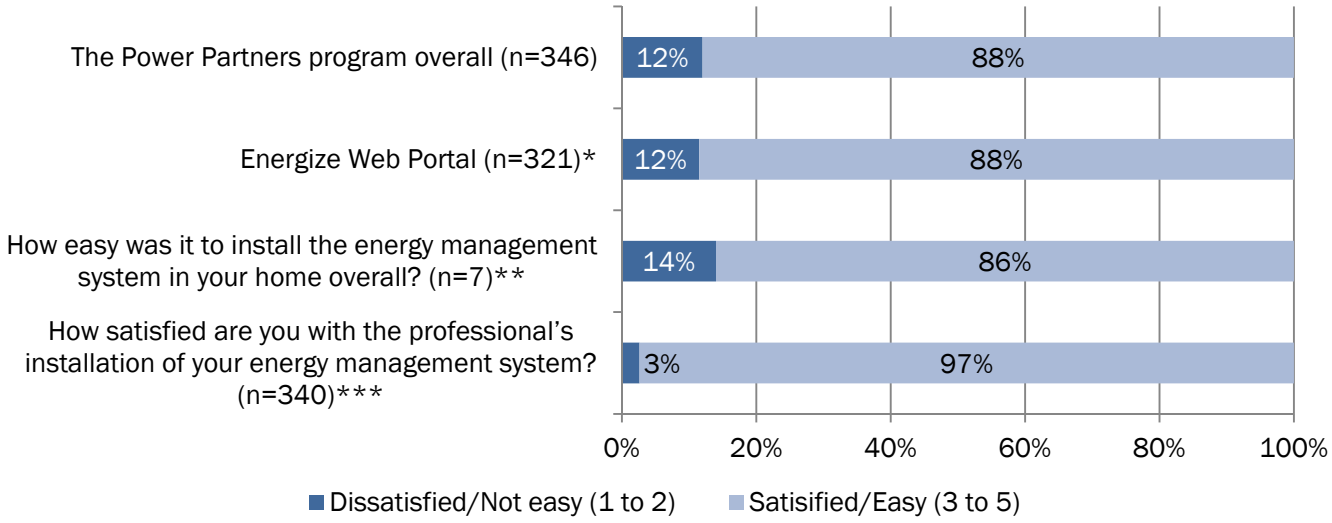
Participant Group	Population*	Population %	Sample	Sample %
EE Participants	313	33%	149	36%
DRLC Participants	639	67%	264	64%
In-Home Display Recipients	160	17%	79	19%
Programmable Thermostat Recipients	411	43%	183	44%
Total Participants	952	100%	413	100%

Note: no statistically significant differences at 95% confidence between the population and sample.
*Population of participants as of February 2013.

Program Satisfaction

Overall, 88% of respondents are satisfied with the program and the Tendril Energize Portal (Figure 1). In addition, over 86% of respondents are satisfied with the ease of installation or the professionalism of the person installing the energy management system.

Figure 1. Satisfaction with Program



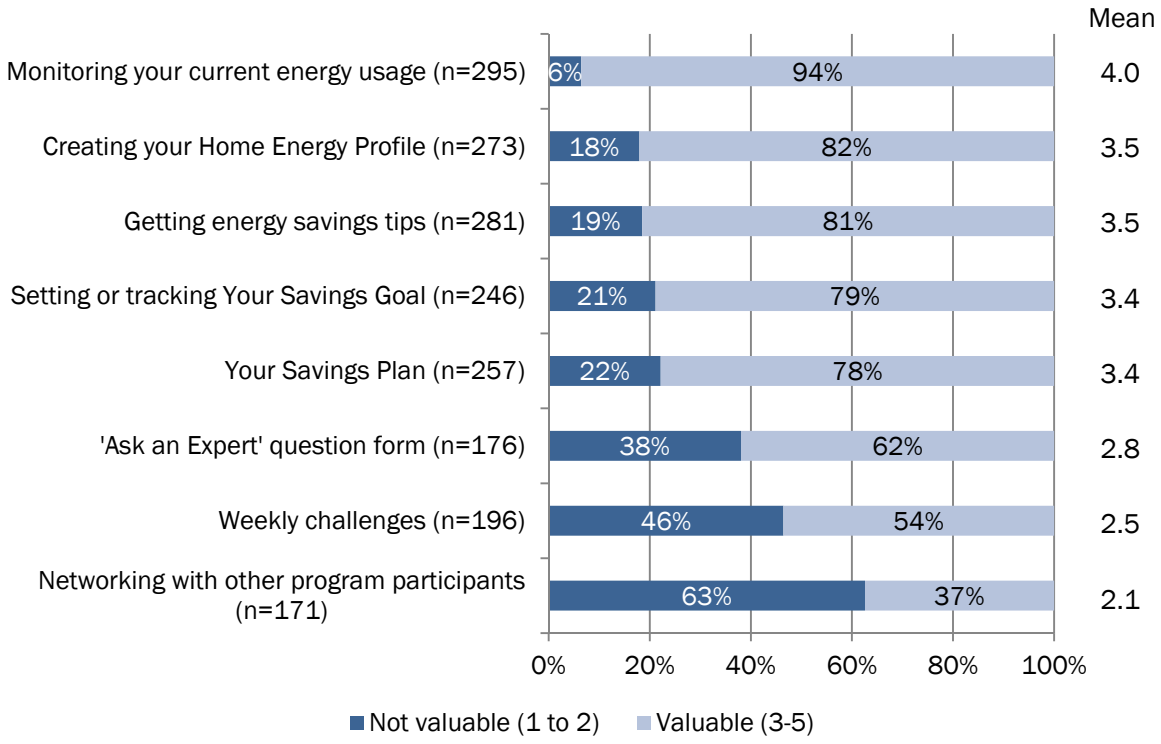
*Base: Those who recall using the Tendril Energize Portal.
**Base: Those who self-installed the energy management system.
***Base: Those who had the energy management system professionally installed.

We also asked respondents why they felt the program was valuable. Respondents indicated that the program provides a lot of information, they can see when their usage is high (often in real-time) (12%), and they can identify ways to save energy (12%). However, some respondents indicated that they had technical problems (12%), that the information provided through the program wasn't new to them (11%), or that they didn't know what to do to save energy (11%).[5] These findings align with findings from similar programs offered in other jurisdictions.

In terms of the value of specific program components, over three-quarters of respondents indicated that tracking and monitoring energy usage was valuable (94%), followed by creating a Home Energy Profile (82%) and getting energy savings tips (81%) are valuable aspects of the program (Figure 2).

[5] Percent's are derived from a total of 346 respondents.

Figure 2. Value of Components of Power Partners Energy Efficiency Program Platform

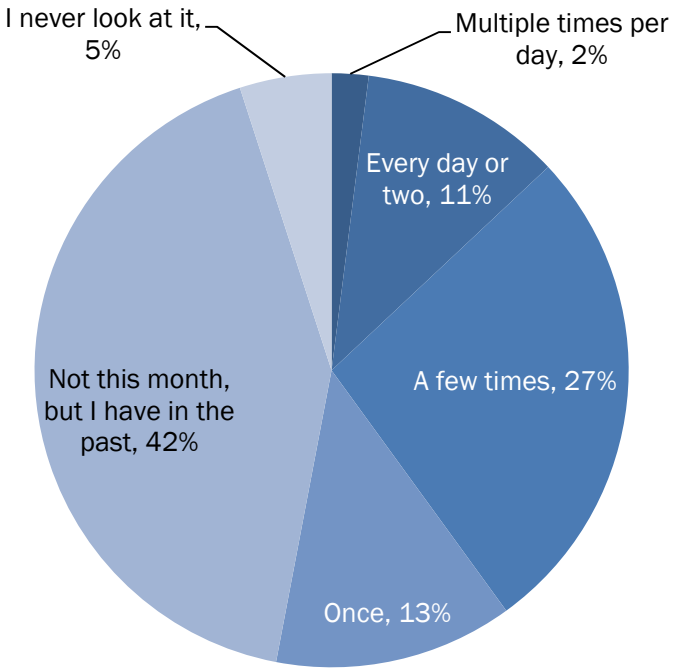


*Note that responses are based on respondent recall of specific program components.

Program Engagement

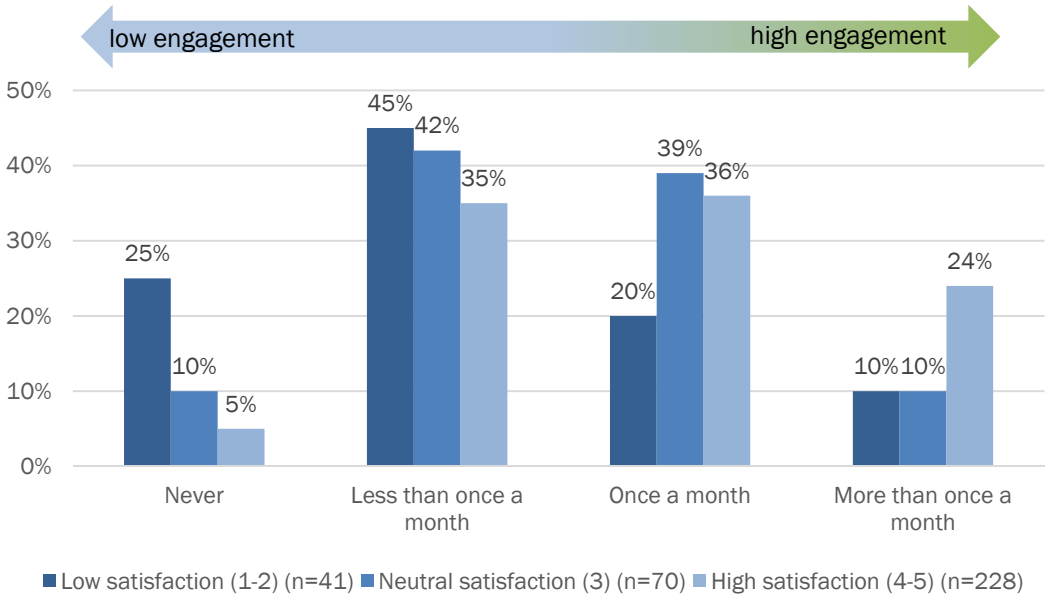
Slightly than half of respondents engage with the Tendril Energize Portal monthly. Respondents who engage with the Web Portal more frequently tend to be more satisfied with the program. Just under half (40%) have looked at the website more than once in the last month while 13% of customers looked at the portal more frequently (i.e., they look every day or two or look multiple times per day).

Figure 3. How Often Participants Looked at Tendril Energize Portal in Past Month (n=321)



While the data is not different statistically, we identified a trend related to engagement and satisfaction. Respondents who logged into their account over a few times a month tended to be more satisfied with the program, while those logged into their account once per month or less frequently tended to be less satisfied (Figure 4).

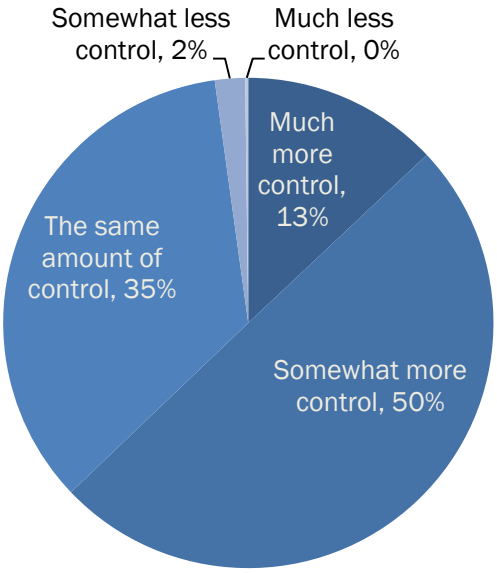
Figure 4: Satisfaction by Online Account Engagement



Energy Savings Actions

The majority of respondents feel that they have more control over their home's energy use since signing up for the program (63%), and that over half of respondents indicate taking at least one energy savings action (Figure 5).

Figure 5. Changes in Perceived Control over Home Energy Use since Signing Up For the Program (n=364)



We asked respondents whether they had taken actions to save energy in their homes after participating in the program, as well as whether they had plans to take action within the next six months. We provided respondents with a series of actions grouped into high-cost, low-cost and behavioral actions that corresponded to tips provided to participants through the Power Partners program. For example, a high cost action might involve replacing an air conditioner or appliance with an energy efficient model. An example of a low-cost action is having your central air conditioner serviced or putting outdoor lights on motion detectors or timers. Behaviors included reducing usage of lights or reducing the energy used by your home electronics.

Since participating in the program, over half of the respondents took a low cost action (53%) or a behavioral action (55%), while over a third (35%) took a high cost action (Table 3). Furthermore, over half of all survey respondents plan to take a low cost action in the first six months.

Table 3. Actions and Behaviors Taken by Respondents (Multiple Response)

Action Type (n=413)	Took Action Since Participating	Plans to Take Action in the First Six Months
High-Cost Action	35%	28%
Low-Cost Action	53%	53%
Behaviors	55%	15%

We provide details regarding high-cost, low-cost and behavioral actions taken or planned by respondents since participating in the program below.

Table 4. High Cost Actions (Multiple Response)

High Cost Action	% who took action since participating	% who plan to take action in the first six months
ANY high-cost actions (n=413)	**35%**	**28%**
Replaced a television with an energy efficient model (n=244)	30%	9%
Replaced a refrigerator or freezer with an energy efficient model (n=247)	13%	13%
Replaced a water heater with an energy efficient model (n=248)	13%	13%
Replaced a dishwasher with an energy efficient model (n=234)	12%	15%
Replaced an air conditioner with an energy efficient model (n=259)	11%	8%
Replaced a heater with an energy efficient model (n=243)	7%	6%
Insulated walls, attic, basement, ceilings, floors, etc. (n=280)	7%	10%
Other high-cost action (n=413)	8%	2%

Base: The sample size changes for each action as it reflects customers who are able to take the action (i.e., they own specific equipment or have the ability to influence other actions such as insulation).

The most common low-cost actions taken since participating were servicing central air conditioners and enabling energy management on the computer. The most frequent planned low cost actions included cleaning refrigerator coils and sealing leaky doors and windows (Table 5).

Table 5. Low Cost Actions (Multiple Response)

Low Cost Action	% who took action since participating	% who plan to take action in the first six months
ANY low-cost actions (n=413)**	**53%**	**53%**
Have your central air conditioner serviced (n=234)	46%	29%
Enable energy management on your computer (n=275)	43%	18%
Put outdoor lights on motion detectors or timers (n=192)	29%	20%
Clean refrigerator coils (n=276)	25%	47%
Seal leaky doors or windows (n=241)	24%	35%
Other low-cost action (n=413)	11%	2%

Base: The sample size changes for each action as it reflects customers who are able to take the action (i.e., they own specific equipment or have the ability to influence other actions such as insulation).
**Note totals to more than 100% due to multiple responses.

The most common behavioral changes since participating were reducing usage of lights and energy used by home electronics. Respondents also reported increasing the frequency of their conservation behaviors since participating, with 31% increasing the frequency with which they reduced their usage of lights. The most frequent planned behavioral actions were to reduce energy used by home electronics (Table 6).

Table 6. Behavior Changes (Multiple Response)

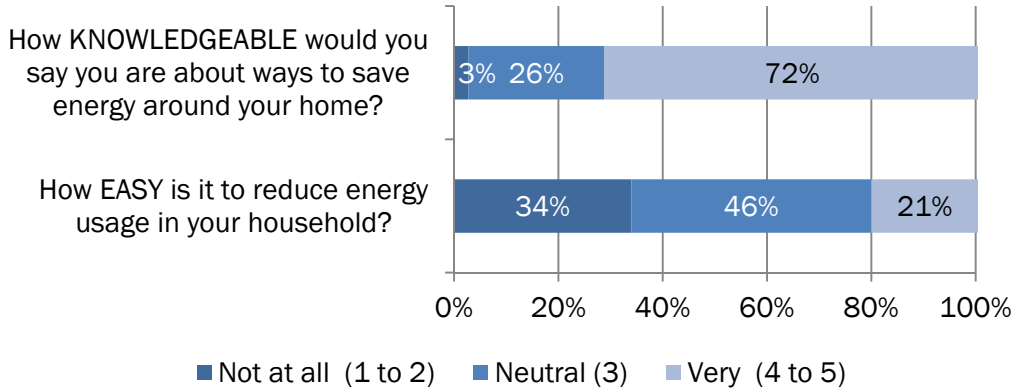
Low Cost Action	% who started behavior since participating	% who increased frequency of behavior since participating	% who plan to start behavior in the first six months
ANY behavior change (n=413)**	**55%**	**31%**	**15%**
Reduce usage of lights (n=271)	45%	28%	5%
Reduce the energy used by your home electronics (n=308)	39%	13%	10%
Reduce usage of dishwasher (n=265)	32%	16%	6%
Air dry your laundry (n=324)	11%	7%	3%
Unplug second refrigerator or freezer (n=204)	7%	1%	5%
Other behavior change (n=413)	18%	2%	1%

Base: The sample size changes for each action as it reflects customers who are able to take the action (i.e., they own specific equipment or have the ability to influence other actions such as insulation).
**Note totals to more than 100% due to multiple responses.

Energy Use Knowledge and Attitudes

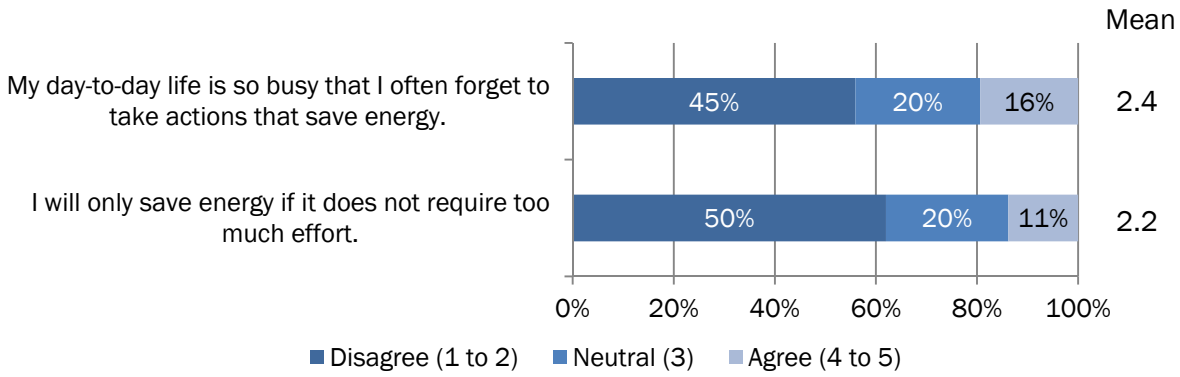
Approximately three quarters of the survey respondents indicated that they were very knowledgeable about ways to save energy in the home (Figure 6). However, over one third of respondents indicated that it was “not easy” to reduce energy in their households. These findings suggest that despite having a high degree of perceived knowledge about ways to save, many respondents find reducing their energy usage difficult.

Figure 6. Respondent Ratings on Household Energy Usage (n=413)



Many TEP program participants seem to have positive attitudes towards savings energy. Only 16% percent of respondents agreed that their "day-to-day life is so busy that they often forget to take actions that save energy", and 11% of respondents agreed that they will "only save energy if it does not require too much effort" (Figure 7).

Figure 7. Participant Attitudes toward Saving Energy (n=413)



Differences by Baseline Consumption

We segmented survey respondents into three groups; low, medium and high baseline energy consumption[6], to see if there were any key differences in terms of their experience with the program. Overall, we identified statistically significant differences across these groups in terms of attitudes towards saving energy (Table 7).

Table 7. Differences by Baseline Consumption

Percent of respondents that agree that... [a]	Low Baseline Consumption (a)	Medium Baseline Consumption (b)	High Baseline Consumption (c)
their day to day life is too busy to save energy (n=413)	13%	24% (a)	22% (a)

[6] We developed tertiles of baseline energy consumption, low baseline energy consumption ranged from an average of 7 to 26 kWh per day, medium ranged from an average of 27 to 40 kWh per day, and high ranged from an average of 41 to 167 kWh per day.

Percent of respondents that agree that... [a]	Low Baseline Consumption (a)	Medium Baseline Consumption (b)	High Baseline Consumption (c)
they will only save energy if it does not require too much effort (n=413)	11%	11%	19% (ab)
the information they received from the program caused them to think differently about their energy usage (n=413)	51%	52%	61% (ab)
the information provided through the program caused them to change the way they use energy in their home (n=413)	45%	52%	66% (ab)

Note: Differences are statistically significant at a 90% confidence level.
[a] Agreement is a response of 4 or 5 on a 1 to 5 scale, where 1 means the respondent disagrees and 5 means the respondent agrees.

We took these survey findings and looked to see if the differences in attitudes related to energy use and saving energy presented here between high, medium and low baseline energy consumers translate into differences in energy savings as shown by an impact analysis. We found that for the EE group baseline energy consumption was not significant in terms of predicting energy savings, however for the DRLC group baseline energy consumption was significant and changed the energy savings results.

10. Impact Evaluation

Summary of Results

The objective of the Energy Efficiency Power Partners Program (Program) is to provide residential customers not served with AMI[7] meter data with energy consumption data to empower participants to manage their electricity use better. Tendril designed their Tendril Energize Portal suite to enable a customer to be an active steward of the customer's home energy usage, providing personalized experiences, and education to attempt to engage customers to take energy savings actions. Engagement can occur through many mechanisms, including personalizing the system (answering a short series of questions), taking a home energy audit, setting a personal savings goal, providing personalized recommendations that conform to the individual household footprint, or comparing their performance to similar households. Further, the program also provides social support and performance recognition events through social forums, posting content, energy snapshots and personal stories.

Tendril recruited customers into the Program from two distinct cohorts – a set of customers already participating in an existing TEP demand response pilot (DRLC cohort) and new customers (EE

[7] AMR technology collects electrical energy consumption and transfers that data from the electric meter on the home to the utility (one-way communication). AMI or Smart meters measure and capture electricity use at varying times during the day, and communicate information between the utility company and the consumer (two-way communication).

cohort). The program recruited 1,317 customers from January to March 2013, and ultimately registered 1,134 participants.[8]

Opinion Dynamics was contracted to conduct an impact evaluation for the Program. This report provides impact evaluation results for the treatment period, which is defined as the date of enrollment in the program through July 2013.[9] Results indicate that average participant savings for the treatment period are 2.3% of their household use during this period.[10] The savings seen are typical of programs with similar designs. In total, the program saved 163 MWh during the treatment period of 2013.

Table 8. TEP Power Partners Program Impacts

Cohort Name	Modeled Average Daily Usage (kWh)	Net Savings per H.H.%	Total Evaluated Participants (N)*	Total Program Net Savings: Evaluated Period (MWh)
Demand Response Cohort	36.7	3.1	626	130.3
Energy Efficiency Cohort	43.8	1.2	508	33.1
Overall	**39.9**	**2.3**	**1,134**	**163.4**
* The impact models were built for 1,074 participants with sufficient billing data.				

The percentage savings may increase over time. Opinion Dynamics has found ramp up of electric savings for similar programs in other service territories over time. That is, we have seen that energy savings results in similar programs continue to increase in program year 2 from program year 1. A meta-evaluation of 28 studies that included some component of residential energy feedback, indicated that 73% of programs had either persistent or an increase in savings between years.[11]

Notably, we see a difference in energy savings between DRLC participants and EE cohorts, where DRLC participants have higher savings on average than the EE cohort. We expect that participants who have participated in an earlier pilot effort and over a longer period would have greater engagement with utility programs. DRLC participants also have additional enabling technologies such as In-Home Displays and Programmable Thermostats that provide further opportunities to engage with energy usage information.

[8] We conducted our evaluation for customers who enrolled prior to March 1, 2013 given the timing of the evaluation effort. The evaluation effort excluded 183 participants who did not register for the program after enrolment.

[9] Treatment periods differ across participants, beginning as early as December 2012 through March 1, 2013. This means that a participant could have participated in the program for five to eight months.

[10] We do not provide an annual savings estimate for this program effort because of the large seasonal variation in Tucson's climate. As such, extrapolating our findings beyond the analysis period (January-July, 2013) is not supported.

[11] Ehrhardt-Martinez, Karen, (2010). The Persistence of Feedback-Induced Energy Savings. http://www.stanford.edu/group/peec/cgi-bin/docs/behavior/research/Ehrhardt-Martinez%202011%20-%20Feedback%20and%20Persistence%20Paper.pdf

Evaluation Overview

In this section, we provide an overview of the evaluation activities conducted for the program. Within each subsequent chapter, we provide a more detailed discussion of the methods.

The primary focus of this impact evaluation effort was to estimate program savings for the treatment period, which is defined as the date of enrollment in the program through July 2013.[12] We conducted survey efforts to support impact estimates as well as provide information regarding customer satisfaction, engagement and energy actions taken.

Data Sources and Analytical Methods

Data sources for evaluating the Power Partners program include:

- Information on key program efforts and dates gathered through interviews with implementation and program staff, and review of program materials
- Program tracking databases
- Electric and gas billing usage data for participant and comparison groups
- Participant and comparison group survey responses
- Secondary data on participant and comparison group households
- Weather data sourced from Tucson International Airport (KTUS)

Table 9 provides a summary of the evaluation methods used for the evaluation.

Table 9. Summary of Evaluation Methods

Activity	Details	Relevant Chapter
Interviews with program managers and implementers	Interviewed program staff from TEP and Tendril to better understand program theory and implementation.	n/a
Comparison Group Selection	To establish a counterfactual (e.g., what would have happened in the absence of the program), we generated a matched comparison group drawing on energy usage history to develop a one-to-one match on for each program participant.	Appendix A
Participant and Comparison Group Surveys	Opinion Dynamics conducted an online survey of participants to collect information regarding customer satisfaction, as well as to learn more about the types of actions taken by participants during the program period.	Section 9
Billing Analysis	Conducted a billing analysis to quantify the changes in energy use among the treatment and comparison group members. Our linear fixed effects model used an average treatment effect on the treated approach that examines	Section 10

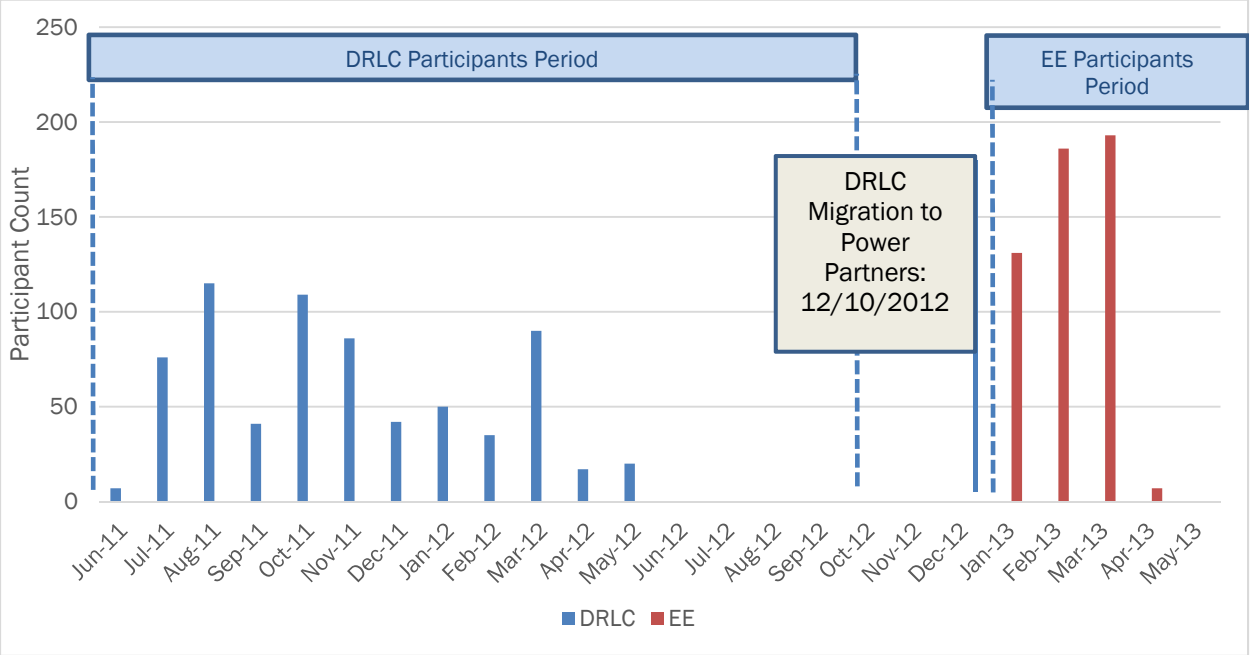
[12] Treatment periods differ across participants, beginning as early as December 2012 through March 1 of 2013. This means that a participant could have participated in the program for five to eight months.

Activity	Details	Relevant Chapter
	participant savings over the post-period using the comparison group as a control.	

Participant Enrollment

The program is an opt-in program involving two groups of customers: DRLC registered participant households (N=626) that entered the DRLC pilot from June 2011 to May 2012 and were switched to the Tendril Energize Portal in December 2012, and Energy Efficiency registered participant households (N=508) that entered the pilot on the Tendril Energize Portal from January through April 2013. Figure 8 shows the pilot enrollment for the DRLC and EE participants over time.

Figure 8: Power Partners Program Participant Enrollment Dates



NOTE: Figure includes two participants who enrolled in early April 2013.

Final Sample

The billing analysis excludes customers with less than 12 months of billing records in the pre-program period to ensure sufficient billing records. There was no limitation on the number of treatment period months (i.e., months when participants received treatment). We excluded 183 participants from the analysis. The table below shows the number of participant and potential comparison group customers excluded from the billing analysis.

Table 10: Billing Analysis Drops[13]

	Unique Customer/Premise Combinations			
	Total	DRLC	EE	Comparison
Initial #	50,630	782	535	49,313
# removed due to no post period data	94	87	7	-
# after	50,536	695	528	49,313
# removed due to low usage: <.25	1,980	-	-	1,980
# after	48,556	695	528	47,333
# removed due to low usage: pre-usage >= .25 & post-usage > .25	5	4	1	-
# after	48,551	691	527	47,333
# removed because "unregistered"	84	65	19	-
Final #	48,467	626	508	47,333
% Removed	**4.3%**	**19.9%**	**5.1%**	**4.0%**

Model Specification

Opinion Dynamics performed a billing analysis to compare monthly billing records before program participants began interacting with the program (pre-treatment period) to the monthly billing records after the interaction started (treatment period), for both the treatment and comparison groups. As stated previously, the inclusion of the matched comparison group allows us to evaluate the counterfactual, "What would the participants' average daily energy consumption (ADC) have been in the absence of the program?" The differences in energy consumption between the participants' weather adjusted usage in the treatment period and the participants' weather adjusted usage in the treatment period under the counterfactual are the savings attributable to the program.

This billing analysis models ADC using a linear fixed effects regression (LFER) which automatically corrects for time-invariant differences between households. LFER is able to do this by calculating a household-specific term for each household in the model. In this way, the effect on ADC of variables like house square footage, orientation, occupancy and all other variables that remain fixed throughout the pre-treatment and treatment periods are corrected for by the household-specific intercept.

We assessed many models for fit to the billing data and relative simplicity. In the end, we selected one model that contains weather correction as weather may vary between the pre-treatment and treatment periods and a correction for ADC during the pre-treatment period. Opinion Dynamics selected this model based on the accuracy and sensitivity of the ADC estimates.

[13] A more detailed table of billing analysis drops is in the Appendix.

Equation 1: Model Equation

$$ADC_{it} = \alpha_i + \beta_1 Post_t + \beta_2 Treatment_i \cdot Post_t + \beta_3 hdd_t + \beta_4 cdd_t + \beta_5 Post_t \cdot hdd_t + \beta_6 Post_t \cdot cdd_t + \beta_7 Post_t \cdot PreADC_i + \varepsilon_{it}$$

Where:

ADC_{it}= Average daily consumption (kWh) for household i at time t

α_i= Household-specific intercept

β_1= Coefficient for the change in consumption between pre- and post-periods for all customers

β_2= Coefficient for the change in consumption for the treatment group in the post-period compared to the pre-period, and to the comparison group. This is the basis for the net savings estimate.

β_3= Coefficient for the change in consumption associated with a one-unit increase in hdd

β_4= Coefficient for the change in consumption associated with a one-unit increase in cdd

β_5= Coefficient for the change in consumption associated with a one-unit increase in hdd in the post-period

β_6= Coefficient for the change in consumption associated with a one-unit increase in cdd in the post-period

β_7= Coefficient for the change in consumption in the post-period associated with a one-unit increase in average daily consumption in the baseline period (PreADC)

e_{it}= Error term

The average daily treatment effect is β_2.

Note that we ran two separate models, one for each cohort using the same estimating equation. For the EE cohort, the preADC coefficient was not statistically significant, so we set that coefficient (β_7) to zero.

The "post" variable is set to 1 for all months after Power Partners equipment was installed or migrated in the home- i.e. the post-period does not include the month of installation. The post variable is set to zero for all months before equipment installation. The month of installation is removed from the model, as there may be some treatment effect for part of the month, which would bias savings estimates toward lower savings if the month were included in the "pre" period.

To assign analogous post-period indicators to comparison group customers, we assigned the participant's installation date to the matched household from the comparison group.

Estimating Program Savings

We calculated program impact by evaluating the model equation for each participant. Once we estimate the model coefficients using all available participants and comparison group data, we use those coefficients to estimate the usage for each participant in the treatment period. Then using the same coefficient estimates, we set the treatment variable to zero and estimate the participant usage under non-participation conditions. The savings for each participant is the second of these two values minus the first. This estimate, divided by the non-participation usage prediction, produces the estimate of the proportional reduction in usage attributable to the program. The total program savings is the sum of average daily savings multiplied by the number of days of participation for all participants.

Billing Analysis Results

This section presents electric savings results from the billing analysis conducted with TEP Power Partner program participants and a matched group of comparison customers. We performed separate billing analyses on the two groups within the program – those coming through the DRLC existing pilot and those within the EE group.

The linear fixed effects regression (LFER) model results indicate that the DRLC participants achieved 3.1% savings from December 2012 through July 2013, resulting in 1.04 kWh average daily savings. This results in 130 MWh savings per participant for the treatment period. The EE cohort achieved 1.2% savings from January through July 2013, resulting in 0.5 kWh average daily savings. This results in 33 MWh savings over the treatment period.

Table 11. Electric Billing Analysis Results

Metric	DRLC Cohort	EE Cohort	Program
Average Participant Daily Savings (kWh)	1.04	0.5	0.8
Percent Savings	3.1%	1.2%	2.3%
Number of Participants	626	508	1134
Estimated MWh Total Program Savings	130.3	33.1	163.4

The following figures provide a visual representation of pre- and post- average daily consumption by cohort. The savings for both cohorts is small enough that the difference between participant and comparison is difficult to see.

Figure 9: DRLC Pre and Post Period Average Daily Consumption

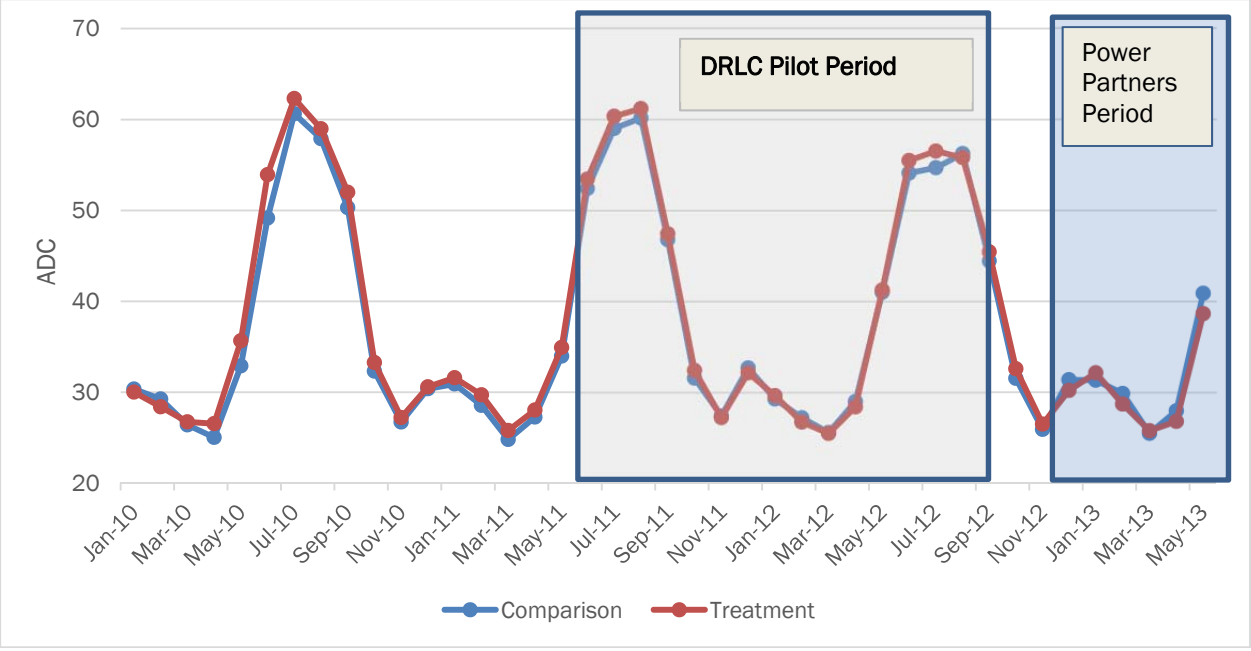
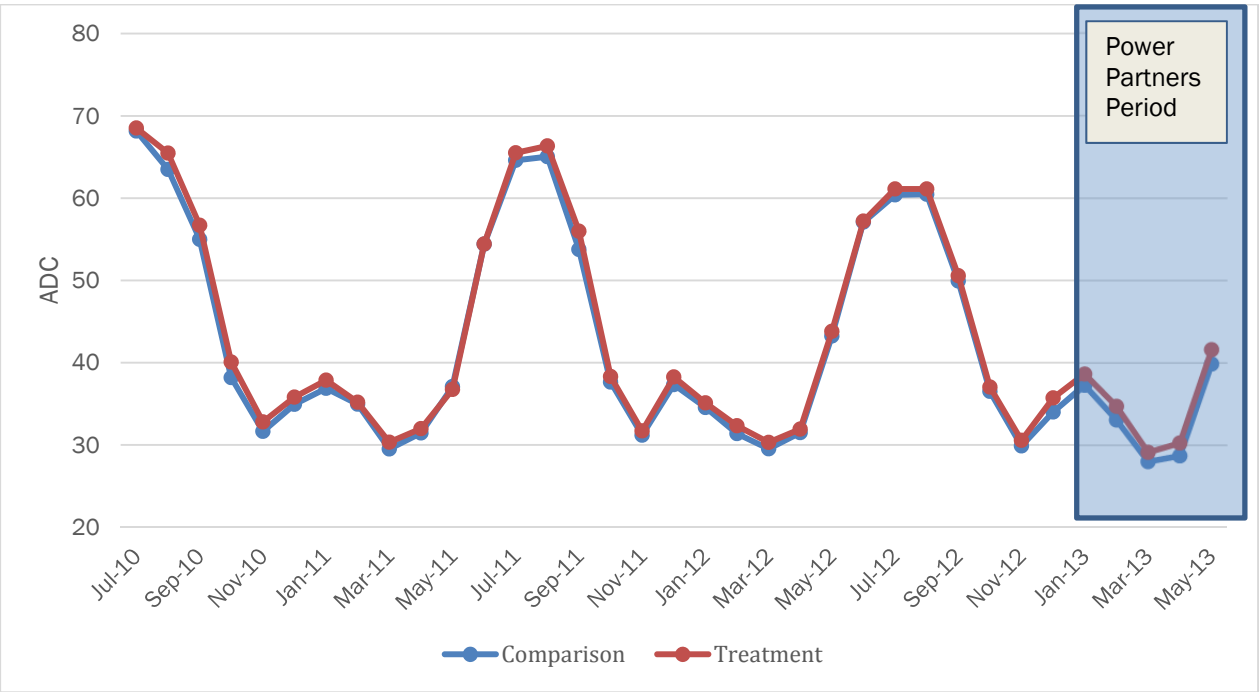


Figure 10: EE Pre and Post Period Average Daily Consumption



Discussion of Results

These results indicate that within a half-year of program treatment both EE and DRLC participant cohorts achieved energy savings. We note that the results presented in this report cover up to eight months of treatment, depending on the date of enrollment and post-period billing records available. Those months represent the cooler months in TEP's service territory. In most service territories, the summer months offer the most potential for electric savings, but further analysis is required to confirm this effect for Tucson, especially as September can continue to have very warm temperatures in Tucson (i.e., with 24 out of 30 days having temperatures over 90 degrees F).[14]

The percentage savings may also increase over time. Opinion Dynamics has found ramp up of electric savings for similar programs in other service territories over time. That is, we have seen that energy savings results in similar programs continue to increase in program year 2 from program year 1. A meta-evaluation of 28 studies that included some component of residential energy feedback, indicated that 73% of programs had either persistent or an increase in savings between years.[15]

Notably, we see a difference in energy savings between DRLC participants and EE cohorts, where DRLC participants have higher savings on average than the EE cohort. This makes intuitive sense as DRLC participants have participated in some pilot effort for a longer period of time, which is highly correlated with energy savings. Furthermore, we expect that participants who have participated in an earlier pilot effort and over a longer period would have greater engagement with utility programs, particularly a demand response program. In this case, DRLC participants are a select group that may have a higher tolerance for achieving energy efficiency at an uncomfortable threshold. DRLC participants also have additional enabling technologies such as In-Home Displays and

[14] http://www.climate-zone.com/climate/united-states/arizona/tucson/

[15] Ehrhardt-Martinez, Karen, (2010). The Persistence of Feedback-Induced Energy Savings. http://www.stanford.edu/group/peec/cgi-bin/docs/behavior/research/Ehrhardt-Martinez%202011%20-%20Feedback%20and%20Persistence%20Paper.pdf

Programmable Thermostats that provide further opportunities to engage with energy usage information.

11. Engagement

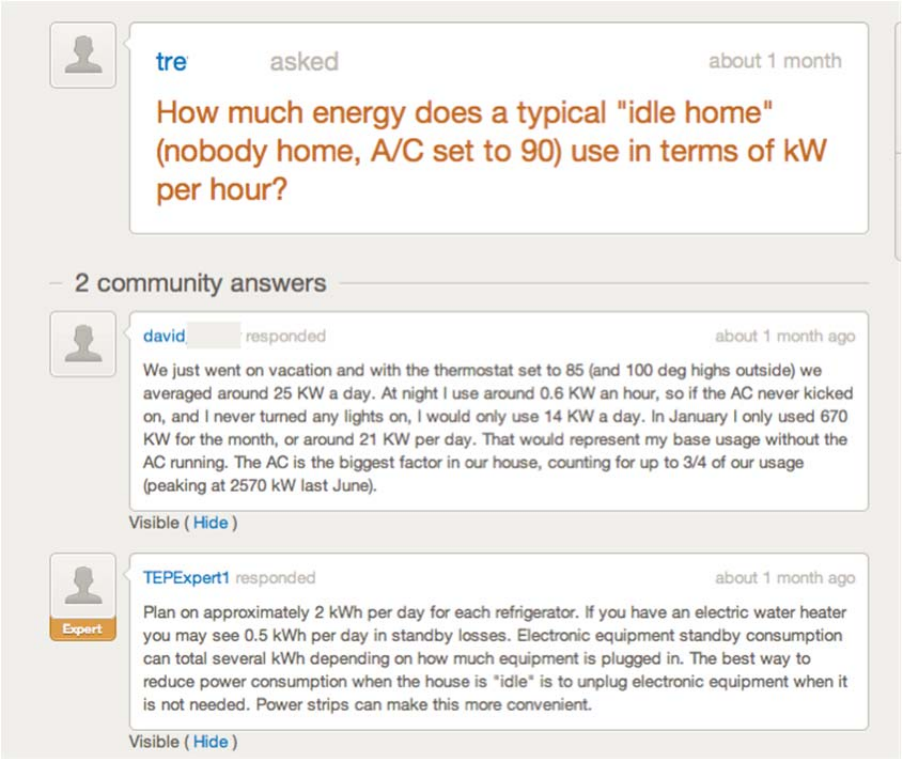
The Tendril Energize Portal engages and informs participants on energy usage and energy saving tips. The following three features are examples of user engagement on the Web Portal as well as aggregate analytics on participant usage.

Ask the Expert

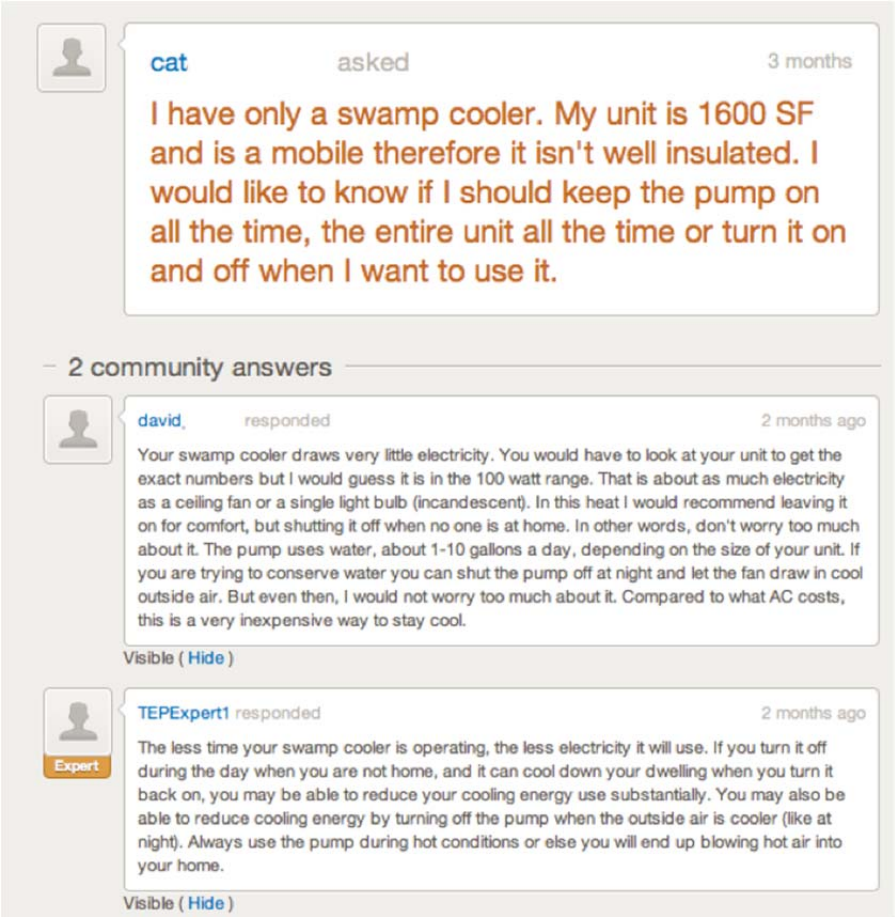
Participants have the opportunity to ask and receive answers on the Ask the Expert forum. The forum is moderated and questions are approved before they are posted. Questions vary from energy related recommendations, product enhancement requests and user specific questions which are forwarded on to Tendril Technical Support.

Participants asked 191 questions in the Ask the Expert Forum. Below are 3 examples of the forum questions and answers:

Example 1



Example 2



cat asked 3 months

I have only a swamp cooler. My unit is 1600 SF and is a mobile therefore it isn't well insulated. I would like to know if I should keep the pump on all the time, the entire unit all the time or turn it on and off when I want to use it.

2 community answers

david responded 2 months ago

Your swamp cooler draws very little electricity. You would have to look at your unit to get the exact numbers but I would guess it is in the 100 watt range. That is about as much electricity as a ceiling fan or a single light bulb (incandescent). In this heat I would recommend leaving it on for comfort, but shutting it off when no one is at home. In other words, don't worry too much about it. The pump uses water, about 1-10 gallons a day, depending on the size of your unit. If you are trying to conserve water you can shut the pump off at night and let the fan draw in cool outside air. But even then, I would not worry too much about it. Compared to what AC costs, this is a very inexpensive way to stay cool.

Visible (Hide)

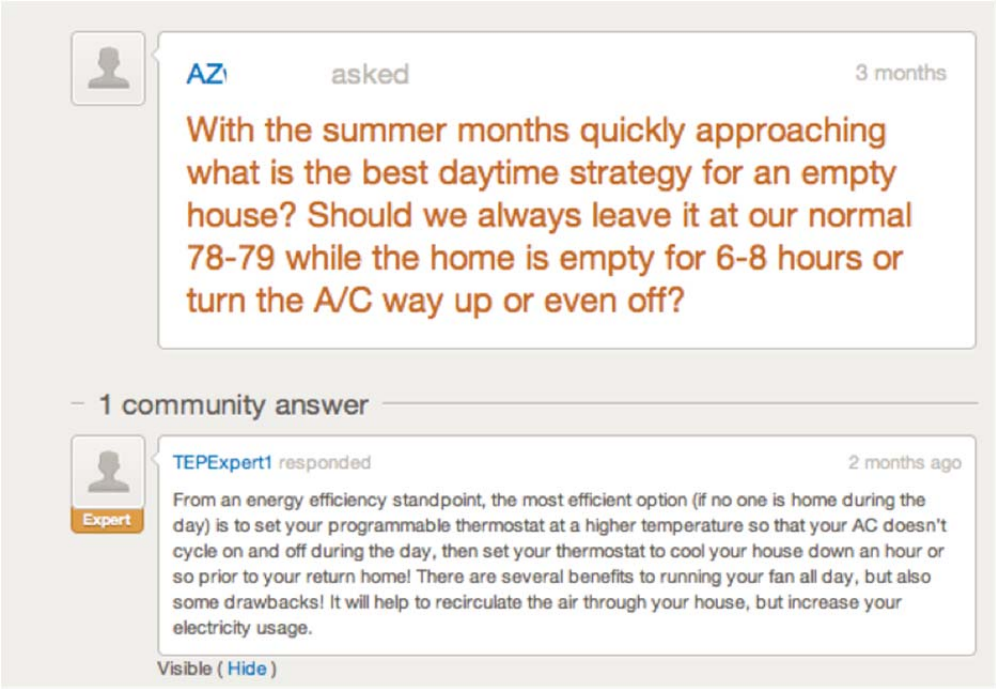
Expert

TEPExpert1 responded 2 months ago

The less time your swamp cooler is operating, the less electricity it will use. If you turn it off during the day when you are not home, and it can cool down your dwelling when you turn it back on, you may be able to reduce your cooling energy use substantially. You may also be able to reduce cooling energy by turning off the pump when the outside air is cooler (like at night). Always use the pump during hot conditions or else you will end up blowing hot air into your home.

Visible (Hide)

Example 3



Weekly Challenges

A weekly challenge was published each week to encourage participants to revisit the portal, learn about energy saving ideas, and complete the challenge. Users receive points for completing challenges. The program featured the following 19 challenges. The 3 most popular challenges were;

- **Make Sense of Sensors:** Check if your outdoor lights have timers or motion sensors.
- **Be a Full Double-Racker:** How full was your dishwasher the last time you ran it?
- **Stop Spying on Your Oven:** Keep your oven door shut while you cook.

Energy Saving Actions

If participants add an energy saving action to their plan, it indicates a commitment to saving energy, saving money, reducing carbon footprint and/or reducing waste. Commonly the major motivation is saving money. Points are given to users for adding points to their personal plan.

The 3 top actions added to savings plans by participants were:

1. Be thoughtful about your oven cooking habits
2. Maintain your fridge for peak performance

3. Reduce standby power used by battery chargers

What we can infer from analysing actions taken is that participants believe the potential savings are worthwhile, and more importantly, feel confident that they can make the change.

Tendril Energize Portal Analytics

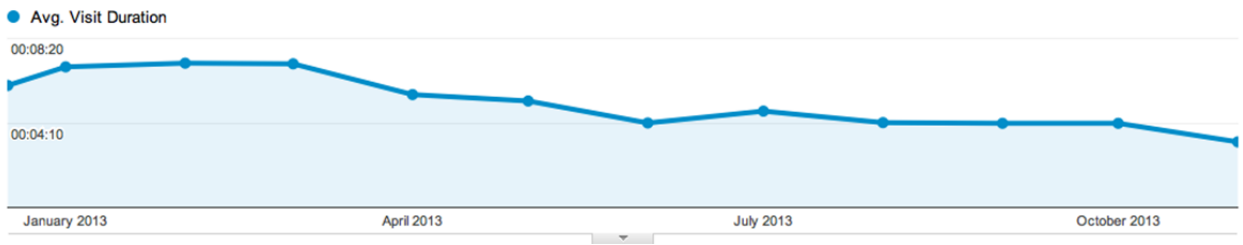
Introduction

Customer engagement is a lead indicator to increased customer satisfaction. These key measures of engagement are the amount of time a visitor spends on the portal, the volume of, and frequency of returning visitors.

How Much Time Are People Spending on the Portal?

People spend time doing things that interest them, therefore the amount of time users spend on the portal is a common measure of engagement and a point of comparison with other channels, web sites and on-line applications.

The average log in time was 5 minutes and 19 seconds.



Given the US customer on average spends around seven minutes a year[16] interacting with their energy provider (often regarding an issue). These initial results indicate a strong improvement in engagement and are in line with Tendril's expectations at this point in the program.

The decrease in time spent in March compared to January and February is mainly due to an increased proportion of returning visitors who, unlike new visitors do not undertake the first time login process and have already familiarized themselves with the portal. The expectation is that the amount of time people spend on the portal per month will continue to reduce.

How Many People Returned to the Portal?

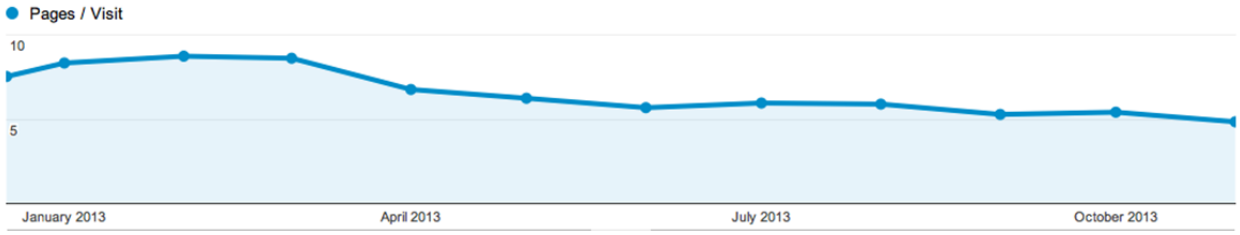
The number of people returning to the portal in a period indicates to what extent people have an interest in the visiting the portal. The portal averaged approximately;

[16] Actionable Insights for the New Energy Consumer, Accenture, 2012

- 6% of the participants returning daily
- 20% of the participants returning weekly
- 44% of the participants returning monthly

How Many Pages Did Participants View?

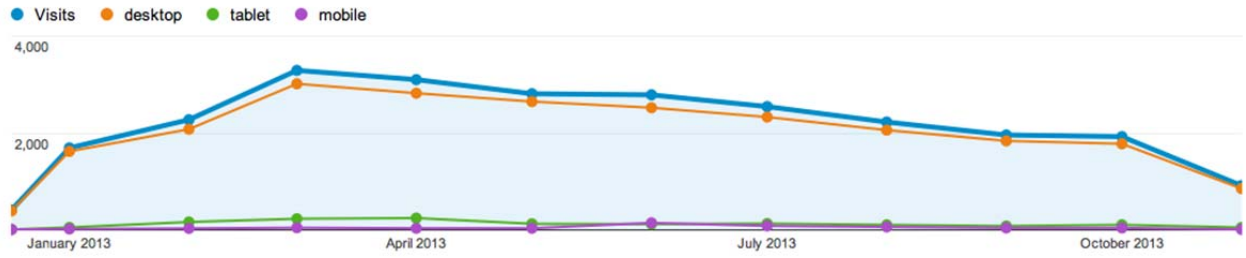
The average user visited 6.68 pages while logged into the portal. The March drop off was due to a high number of installations. The most popular pages were Energy Use, Dashboard, Home Energy Profile, Actions and Expert Questions.



Device Usage

Usage of smart mobile devices is a fast growing trend that makes it more convenient for users to utilize online services “on the go”. Monitoring mobile device usage can indicate changing user preferences.

Desktop usage was most common however the most common mobile and tablet devices were iPad, iPhone and Google Nexus. They attributed to 8% of total visits.



12. Appendix

Impact Evaluation Methodology

In this section, we detail the evaluation activities conducted for the evaluation of TEP's Power Partners program, along with the methods.

Data Preparation

The data used in the billing analysis comes from two primary sources:

- Monthly billing data from January 2010 to July 2013
- Program launch date specific to each customer (treatment and control)

To develop the dataset used for the statistical analysis, the evaluation team conducted the following data processing steps:

- Separated out the monthly billing data by each of the two program cohorts
- Removed observations and customers within each cohort based on the following criteria:
    - Duplicate entries
    - Customers flagged as not being a part of the test group
    - Unavailable first report date
    - Out-of-range usage data
    - Insufficient pre-treatment or post-treatment usage data
    - Very low usage data
    - Customer flagged as moving out of state
- Determined the usage on a calendar month basis for each customer based upon their read cycle
- Linked the usage with the customer-specific program start date

The following table shows the results of the data cleaning effort for the billing analysis.

Table 12. Data Cleaning Results

	Unique Customer/Premise Combinations	Observations

	Total	DRLC	EE	Comparison	Total	DRLC	EE	Comparison
Initial #	50,630	782	535	49,313	1,577,756	31,611	20,181	1,525,964
# removed due to complete duplicate usage data	-	-	-	-	51,281	1,006	150	50,125
# after	50,630	782	535	49,313	1,526,475	30,605	20,031	1,475,839
# removed of partial duplicates by estimated/actual read	-	-	-	-	20	-	-	20
# after	50,630	782	535	49,313	1,526,455	30,605	20,031	1,475,819
# removed partial duplicates by keeping the higher usage	-	-	-	-	788	-	-	788
# after	50,630	782	535	49,313	1,525,667	30,605	20,031	1,475,031
# of removed overlapping reads	-	-	-	-	22	-	-	22
# after	50,630	782	535	49,313	1,525,645	30,605	20,031	1,475,009
# collapsed due to overlap in month variable	-	-	-	-	25,574	816	368	24390
# after	50,630	782	535	49,313	1,500,071	29,789	19,663	1,450,619
# removed if bill days > 75	-	-	-	-	2	-	-	2
# after	50,630	782	535	49,313	1,500,069	29,789	19,663	1,450,617
# removed due to no post period data	94	87	7	-	2,014	1,861	153	-
# after	50,536	695	528	49,313	1,498,055	27,928	19,510	1,450,617
# removed due to low usage: <.25	1,980	-	-	1,980	63,557	-	-	63,557
# after	48,556	695	528	47,333	1,434,498	27,928	19,510	1,387,060
# removed due to low usage: pre-usage >= .25 & post-usage > .25	5	4	1	-	572	507	65	-
# after	48,551	691	527	47,333	1,433,926	27,421	19,445	1,387,060
# removed due to “unregistered” participants	84	65	19	-	3,256	2,585	671	-
Final #	48,467	626	508	47,333	1,430,670	24,836	18,774	1,387,060
% Removed	**4.3%**	**19.9%**	**5.0%**	**4.0%**	**9.3%**	**21.4%**	**7.0%**	**9.1%**

Model Coefficients

The table below presents model coefficients for the DRLC and EE models. The "post" variable indicates that the billing record in the post-installation period was assigned to the matched comparison group customers according to their matched participant's program start date.

Table 13. Billing Analysis Model Coefficients

Regression Variable	Metric[1]	EE Cohort Estimate	DRLC Cohort Estimate
Post	*b*	-1.94	3.013
	se	0.561	0.573
Post X Treatment	*b*	-0.497	-1.044
	se	0.6	0.383
HDD	*b*	1.62	1.438
	se	0.045	0.036
CDD	*b*	2.30	2.198
	se	0.044	0.033
Post X HDD	*b*	-0.084	0.047
	se	0.078	0.026
Post X CDD	*b*	-0.177	-0.118
	se	0.032	0.025
Post X PreADC	*b*	0	-0.129
	se	0	0.014
Constant	*b*	11	8.491
	se	0.636	0.486

Comparison Group Selection Approach

The comparison group provides information on the counterfactual, i.e., what would have occurredin the absence of the program. To obtain a valid estimate of savings, it is essential that the program participants and comparison group match to the best of our ability. This section describes the approach for selecting a matched comparison group of residential customers for the program. We first summarize background information on program design and program participants relevant for understanding the comparison group. We then describe the selection approach. Finally, we discuss the match results and quality.

Comparison Group Considerations

In this impact evaluation, we estimate savings with an average treatment effect, in which we compare the change in energy consumption for participant households before and after entering the program to the change in consumption for comparison households across the same time-period. This method assumes that comparison households can account for the counterfactual energy use of participant households—the energy use of participant households in the absence of the program. This requires that the comparison group be a good match to the participant group in both baseline energy usage and in how their energy usage changes in response to outside events.

The program savings estimate is only unbiased when matched comparison households accurately represent the behaviors that program participants would have had in the absence of the program.

The best match for a particular participant household is the household from the comparison pool whose monthly energy consumption most closely matches the participant household's during the twelve-month pre-program period. Households with energy consumption closely matched over twelve months demonstrate that they respond the same way to the many exogenous factors—weather in particular—that drive energy consumption. Matching in this way ensures that the annual energy use is similar and that each month's energy use will match.

Comparison Group Sample Frame

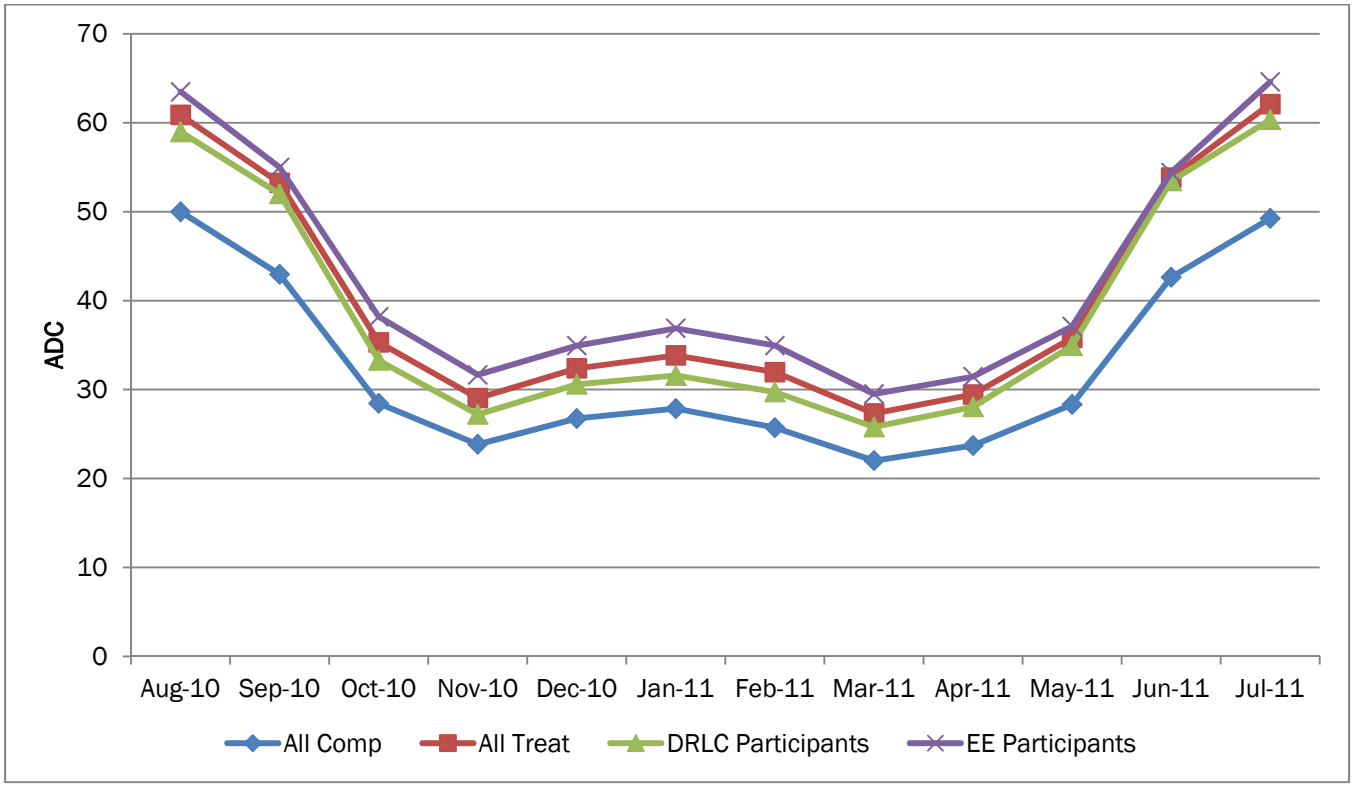
The program recruited 1,317 customers from January to March 2013, and ultimately registered 1,134 participants.[17] As a starting point for selecting a comparison group, we requested pre-program billing data for residential customers who Tendril had identified as eligible for program participation (7,842). Tendril had identified a group of eligible customers similar in key demographics to potential participants at the beginning of the program, but reserved these customers and did not market the program to them. The evaluation team reviewed the billing data provided and identified a mismatch in terms of energy usage related to selecting a comparison group from the 7,842 eligible customers. Eligible customer billing records compared with program participant billing records indicated substantial differences in the pre-billing period. Eligible customers used about 21.3% less energy on average than the participant group. Opinion Dynamics then requested billing data for January 2010 through March 31, 2013 for an additional 41,471 residential customers to include in the comparison pool.

We compared the eligible comparison pool to the participant group by calculating average daily consumption for each month during the pre-participation period (August 2010 through July 2011)[18] for customers with sufficient billing records. Figure 11 shows the average daily consumption for the eligible customers compared to that for participants in this 12-month pre-period. The figure also shows that EE program participants have higher pre-period consumption on average than DRLC participants.

[17] We conducted our evaluation for customers who enrolled prior to March 1, 2013 given the timing of the evaluation effort. The evaluation effort excluded 183 participants who did not register for the program after enrolment.

[18] The pre-period for EE participants extends past July 2011, but we chose a single pre-period to show comparable differences for both DRLC and EE participant cohorts.

Figure 11. Electricity Consumption of Participants and Non-Participants in 2011 (Year Before DRLC Pilot)



Comparison Group Selection Process

The matching method used to develop the comparison group is the following:

- We assigned all billing data to a billing month, based on the month in which the majority of billing days occurred.
- For program participants, electric consumption in each of the twelve months before program enrollment was compared to *all 49,313 TEP* residential customers in the comparison pool with billing data over the same twelve months.
- We calculated the sum of squared deviations (SSD) in monthly kWh for each potential comparison customer, and for each program participant, the non-program residential customer account with the lowest SSD was chosen as a match.

Opinion Dynamics used this matching method to select a one-to-one matched comparison group. Each participant had a distinct pre-period based on their data of enrollment into either the Program (for EE group) or the DRLC pilot (for DRLC group), and the comparison group was matched based upon those 12 prior months. The evaluation team compared baseline usage between the treatment and comparison groups for each cohort. We examined the average daily energy consumption for the entire pre-program period for each cohort.

Table 14. Average Daily Consumption by Cohort, Treatment v. Comparison

Metric	Statistic	DRLC Cohort		EE Cohort	
		Participants	Comparison	Participants	Comparison
Total Number of Customers	N	782	NA	535	NA

Metric	Statistic	DRLC Cohort		EE Cohort	
		Participants	Comparison	Participants	Comparison
Customers in Billing Analysis	n	626	586	508	488
Average Daily Consumption in all pre-program months available by participant	Mean (kWh)	38.6	37.8	42.2	43.1
	Std. Err. (kWh)	0.2	0.2	0.2	0.3
Number of billing records in pre-program period	count	12,491	20,677	16,117	16,688

Our matching effort worked well as shown by the figures below, which present average daily consumption per month during the pre-program period for all participant and matched comparison customers by participant cohort (DRLC, EE). For both cohorts, average daily consumption differs from their matched comparison group by only 0.2 to 1.4 kWh. Compared to their matched comparison group, the EE cohort comparison group has higher, and the DRLC cohort has lower, average daily consumption in the pre-period. This difference could have introduced some bias between the matched comparison group and participants. Our model controls for this bias by including baseline consumption, likely making this bias negligible.

Figure 12. Comparison of the average daily consumption per month of DRLC households and their 12-month matches in the months before program enrollment

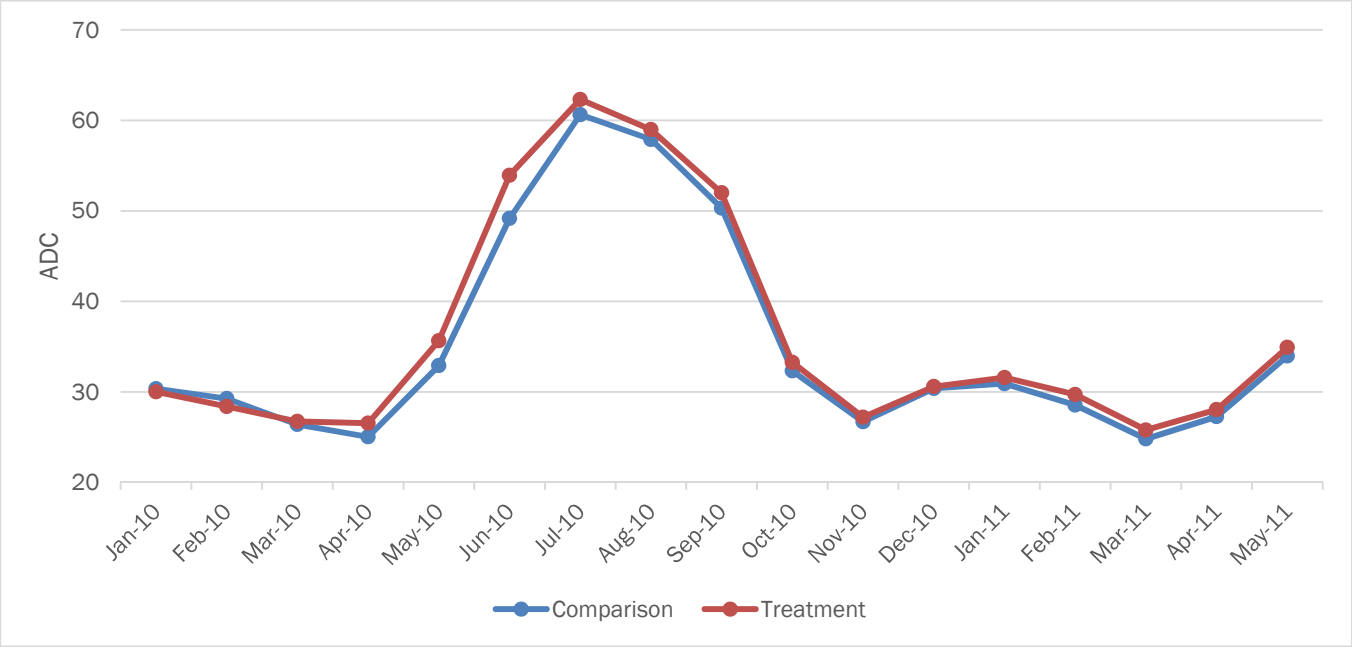
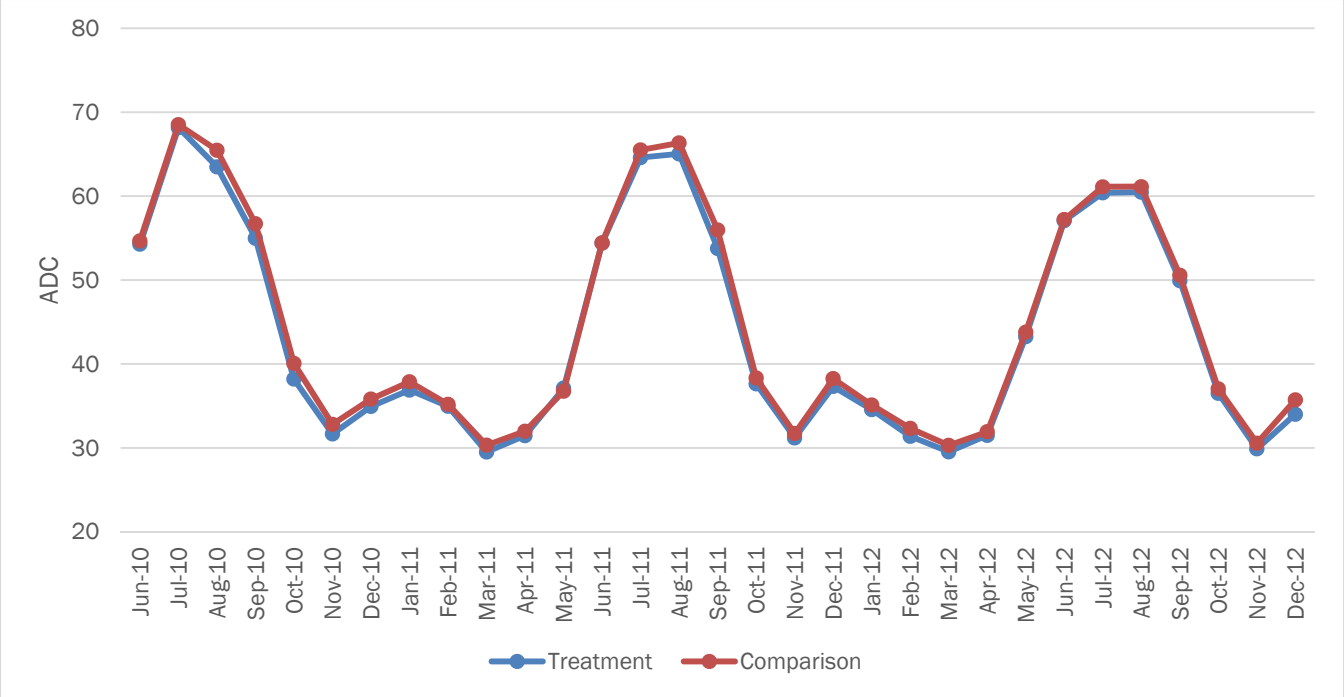


Figure 13. Comparison of the average daily consumption per month of EE households and their standard matches in the months before program enrollment



Customer Satisfaction Survey Demographics

Below we provide key demographics of the survey respondents.

Table 15: Respondent Age

Demographics	% of respondents (n=413)
Age	
18 to 24	0.2%
25 to 34	8%
35 to 44	14%
45 to 54	14%
55 to 64	23%
65 to 74	23%
75 and older	8%
Refused	10%

Table 16. Number of People in Home

Demographics	% of respondents (n=413)
Number of people in home	
1	17%
2	48%
3	14%
4	10%
5	4%
6 or more	2%
Refused	5%

Table 17. Number of Children in Home

Demographics	% of respondents (n=413)
Number of children under 18 in the home	
0	70%
1	10%
2	13%
3	4%
4 or more	1%
Refused	2%

Table 18. Changes in Occupancy

Demographics	% of respondents (n=413)

Demographics	% of respondents (n=413)
Change in occupancy level in the last year	
Yes, increase	7%
Yes, decrease	7%
No change	85%
Refused	2%

Table 19. Education

Demographics	% of respondents (n=413)
Education	
Less than high school	0.2%
High school graduate or equivalent	4%
Some college, no degree	16%
Associate's degree	7%
Bachelor's degree	29%
Graduate or professional degree	42%
Refused	3%