DTE Energy®

SmartCurrents℠

DYNAMIC PEAK PRICING PILOT

Interim Evaluation Report

SGIG Project No. 10OE000146 January 13, 2014

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1. Executive Summary

DTE Electric (electric subsidiary of DTE Energy and formerly known as Detroit Edison) is conducting a two-year Consumer Behavior Study (CBS) to learn the best ways to induce residential consumer energy efficiency and demand response behaviors while providing opportunities for customers to save on their energy bills with the help of dynamic peak pricing, enabling technologies, and customer education. DTE Energy (DTE) is conducting this study as part of the SmartCurrents^{SM} pilot program funded in part by a grant from the U.S. Department of Energy (DOE). The DOE sponsored Technical Advisory Group (TAG) assigned to oversee and support this study has provided invaluable contributions to the design, implementation, and evaluation of results.

This interim report describes the program background, overview, design, implementation, and analysis methodology, and provides preliminary results based on the data collected during the first two event days. Specifically, the interim report covers analysis of data for approximately 2,035 randomly assigned treatment and control group customers for the event days that occurred on August 16, 2012 and on May 30, 2013. The study will provide DTE a means to leverage Advanced Metering Infrastructure (AMI) along with enabling technologies to not only offer new pricing options but to evaluate corresponding customer acceptance, satisfaction, and behavior changes, to offer a platform for better customer energy management, and also to give DTE an ability to evaluate customer acceptance and satisfaction.

The Dynamic Peak Pricing (DPP) rate being studied during the pilot program consists of a three-tiered time-of-use rate for weekdays overlaid by a Critical Peak Pricing (CPP) rate ($1/kWh) on a maximum of 20 event days per year; the event days are announced to the customers a day in advance via various communication means. For the interim reporting period, only two CPP event days were called; as a result this report focuses mostly on hourly impact analysis of the first two event days.

Customer recruiting began in late January 2012 and continued through June 30, 2012, and involved contacting approximately 149,000 eligible customers. The customers were further surveyed, narrowed down and randomly allotted to various study groups. Along with education initiatives – monthly eNewsletter, web portal, targeted eBlasts and Play-Learn-Win game described in 3.a.ii. Treatments -- and dynamic pricing, some customers were provided two different enabling technologies, with the effects of each studied separately and in combination. There are four main treatment groups, based on type of technology received, as follows:

- T1 Group: Education + Dynamic pricing rate
- T2 Group: Education + Dynamic pricing rate + In-home display (IHD)
- T3 Group: Education + Dynamic pricing rate + Programmable communicating thermostats (PCT)
- T4 Group: Education + Dynamic pricing rate + In-home display + Programmable communicating thermostats

All the customers can view their hourly energy consumption via an online web portal. Sixty customers have withdrawn during the program for various reasons; however, following TAG's recommendation their data is still being included for analysis. Further, four customers have been dropped from the T2 group for analysis purposes to reduce the high usage bias existing in the T2 group. Although the study was randomized, the hourly load impact analysis has revealed that for certain customer groups, the matched control group had lower hourly means during the pretreatment period (even though they passed the ANOVA tests[1]), possibly masking the impacts of the pilot. Specifically, the T2 group faces this issue.

The first half of DTE's consumer behavior study can be deemed successful. There have been few customer withdrawals in response to the rate and the feedback from focus groups have been mostly favorable towards the DPP Rate. Also, despite experiencing some issues with the treatment and control groups and using a simple impact calculation methodology, the preliminiary results show kWh reductions during the the first two event days. This encourages DTE that with a full summer of data analysis, more concrete results will be revealed in support of this hypothesis.

2. Introduction

This is an interim evaluation report of DTE's two year SmartCurrents[SM] pilot program, a residential consumer behavior study based on the AMI installations and an experimental three-tier TOU rate with a CPP overlay. The DOE sponsored TAG assigned to oversee and support this study provided invaluable contributions to the design, implementation, and evaluation of results. The design of the pilot program was coordinated among DTE, Ernst & Young, and the TAG, and is documented in DTE's Consumer Behavior Study Plan, originally dated September 10, 2010, and revised on February 4, 2011. Energy & Environmental Resources Group, LLC (E2RG) was retained by DTE to assist first in the DOE build metrics, and subsequently to evaluate results.

2.a. Project Background

Detroit Edison Company (now known as DTE Electric) is an Investor Owned Utility (IOU) and subsidiary of DTE Energy. DTE Electric generates, transmits, and distributes electricity to 2.1 million customers in southeastern Michigan. Founded as Detroit Edison in 1903, DTE Electric is the largest electric utility in Michigan and one of the largest in the nation. The SmartCurrents program application was submitted under the DOE Smart Grid Investment Grant (SGIG) topic area for "Integrated and/or Crosscutting Systems." For the purpose of both this interim report and the final report, the Company will be referenced as DTE instead of Detroit Edison.

1 Analysis of Variance or ANOVA, is a statistical model used to analyze the differences between group means. In the typical application of ANOVA, the null hypothesis is that all groups are simply random samples of the same population. This implies that all treatments have the same effect (perhaps none). Rejecting the null hypothesis implies that different treatments result in altered effects.

2.b. Project Overview

The SmartCurrents pilot will provide DTE with information about the best ways to integrate dynamic pricing rates, enabling technologies, information feedback, and customer education to:

- Induce a change in residential consumer energy efficiency and demand response behaviors, and
- Open up opportunities for customers to save on their energy bills.

The SmartCurrents pilot deployments are split into two different types of experiments, described separately in the document:

1. A **<u>quantitative cause and effect</u>** experimental design with a Control Group to analyze usage and bill impacts from the different intervention approaches; and

2. A **<u>qualitative informational</u>** design to understand why and how customers react to pre-pay billing and smart home appliances.

The DTE quantitative experimental study is focused on testing the differences in behavior resulting from changes in pricing, enabling technology type, and educational information. One of DTE's main objectives for the informational pilot, including dynamic pricing and pre-pay billing approaches, is to create real opportunities for customers to reduce their energy spending by matching their consumption behaviors to electricity supply conditions. A major goal of the pilot is to offer innovative education and technology programs that increase customer engagement and satisfaction.

The quantitative or experimental design group is the focus of this interim report. The qualitative or informational design group and detailed marketing analysis will be covered in detail in the final report.

2.c. Expected Benefits

The SmartCurrents pilot provides customer service approaches such as dynamic pricing, remote meter connect and disconnect, web-based customer energy usage presentation, load control, and pre-payment options. The anticipated benefits of the SmartCurrents pilot are to provide the following:

- A platform to promote customer energy management, including energy waste reductions, energy cost savings, as well as customer control, choice, and flexibility using interactive in-home technology. With the DPP rate coupled with a web-based shadow rate comparison, customers will learn more about real-time supply conditions, how to change their usage patterns, and how to save money and environmental impacts by changing their usage patterns;
- Capability to leverage AMI to offer and evaluate new customer options, such as dynamic pricing, pre-pay billing, and enabling technologies;
- Capacity to leverage AMI to conduct research to learn about customer behavior and acceptance of pricing and enabling technology, as well as the recruitment strategies;
- Opportunity for customer control of HVAC applications and smart appliances, ability to respond to price signals, peak load management, and lower costs on appliance operation; and
- Ability to evaluate customer acceptance and satisfaction.

2.d. Research Questions and Hypotheses

DTE's SmartCurrents Pilot explores research questions in three areas: pricing, technology, and informational feedback. DTE will experiment with the following feedback attributes:

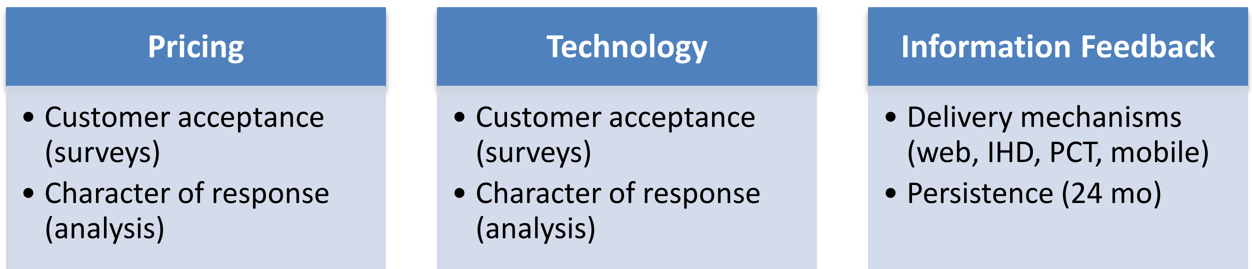

Figure 1: The Transforming Capabilities of AMI

For the experimental treatment groups, the overall project objective is to understand both customer acceptance (use of technologies and educational materials) and customer character of response (load shifting and energy efficiency). DTE will focus on research questions and hypotheses around usage impacts, but will examine customer satisfaction and acceptance through surveys, focus groups, and marketing research.

DTE is attempting to understand if DPP rates will support a measurable and persistent load shift, while also enabling customers to save money by allowing them to manage when they use electricity. DTE would further like to determine the "minimum viable" education and enabling technology approach that will achieve persistent demand response.

Table 1 depicts the Treatment Cells along with the overall research objectives of each cell as reflected in DTE's CBS. Please note, as shown in Table 7, the actual control and treatment groups recruited for this study were less than originally projected in the CBS.

Table 1: Research Objectives[2]

Research Objective	Existing Rate	DPP Rate
Education only/Existing rate: Determine cost-effectiveness of education only by comparing Control Group (CTE) that does not receive education with Treatment Group (TE) that receives education, and both groups remain on the existing rate.	Control Group CTE, (N=1,200), and Treatment Group TE (N=1,200)	N/A
Education only: Determine cost-effectiveness of DPP rate supported with only education compared to technology-enabled approaches.	Control Group CT1, (N=375)	T1, (N=375)
Education +IHD: Explore the extent that real-time information, learning by doing, and alert features engage customers to action.	Control Group CT2, (N=375)	T2, (N=375)
Education +PCT: Explore the extent that automation based on customer preferences engages customers to action.	Control Group CT3, (N=375)	T3, (N=375)
Education +IHD +PCT: Explore the additive (or subtractive effect) of near real-time feedback combined with air conditioning/load automation.	Control Group CT4, (N=375)	T4, (N=375)
Total N = 5,400	N = 3,900	N = 1,500

DTE would like to understand if an education approach alone (on the existing Residential Service rate) would induce customer energy efficiency and demand response behaviors. In addition, DTE would like to test the effectiveness of a DPP rate supported by education with and without IHD and PCT enabling technologies. Through the experiments, DTE will examine whether dynamic pricing impacts complement or compete with the impact of the various enabling technologies. The DTE research will incorporate the following questions and hypothesis:

1. Can a targeted and behaviorally-focused education and outreach program in itself be an effective customer engagement strategy?

   H1a: A well designed education and outreach program based on individual and social behavioral leading practices on top of the existing inverted rate could induce customer energy efficiency and demand response behavior (cell TE).

   H1b: A DPP rate and program with education, outreach, and pricing (i.e., financial consequences to the call to action) (cell T1) should achieve higher levels of demand response than the existing rate (cell C1).

[2] Note, throughout this report control group CT1 is referred to as C1; control group CT2 is referred to as C2. DTE did not recruit for control groups CT3 and CT4. As discussed later in this report, control group C1 was compared to treatment groups T1 and T2, and control group C2 was compared with treatment groups T3 and T4.

2. What are the changes in energy usage by time period (on, off, mid, and critical-peaks)?

   H2: A DPP rate with an IHD and a PCT (feedback and automation enabling technologies) will result in the greatest levels of demand response and energy efficiency (cell T4).

The DTE enabling technology question will primarily be analyzed from experimental cells T2, T3, and T4 and include the following questions with resulting hypotheses:

3. What is the impact of different enabling technology combinations? What mixture of enabling technologies and pricing results in the greatest levels of demand response and energy efficiency? Which achieves the most cost effective source of demand response and energy efficiency?

   H3a: DPP supported by an educational approach alone could result in customer energy efficiency and demand response (T1).

   H3b: DPP supported by education and enabling technologies approach could result in customer energy efficiency and demand response (T2, T3, T4).

   H3c: A DPP rate with a PCT will result in the greatest level of demand response (T3),

   H3d: A DPP rate with IHD will result in the greatest level of energy efficiency (T2).

   H3e: A DPP rate with IHD and PCT will result in the greatest level of energy efficiency and demand response (T4).

3. Project Description

3.a. Design Elements

3.a.i. Target population

In theory, the target population for the study was all residential customers who would be interested in a rate option that would allow them to "know their own power" and to save energy and save money. In practice, the target population for the study was single family households on the standard residential inverted (moderately inclining) block rate, with AMI meter, 12 months of monthly consumption data, and at least 3-6 months[3] of AMI interval data regardless of geographic location. Internet access was a requirement for the enabling technology treatment cells. Customers with other elective discounted rates such as Interruptible Air Conditioning, Block water heating, Plug-In Electric Vehicle, Senior Citizen, net metering, etc., were excluded per the requirements of the Experimental DPP Rate. At the time lists were drawn for recruitment, AMI had been installed in the following areas: Grosse Isle, Harsens Island, and Metro Detroit (select ZIP codes/read routes); installation activity was then heavily concentrated in the Oakland County area. Thus the bulk of the operational target audience was in Oakland County,

[3] It was later determined that the potential population with at least 3-6 months of AMI interval meter was insufficient to meet the desired project enrollment levels. With TAG approval, the interval meter data requirement was reduced to 3 months.

where approximately 449,000 AMI meters (excluding Interruptible Air Conditioning) were installed as of December 2011.

3.a.ii. Treatments

Rates

DTE's pilot program focuses on a critical peak pricing tariff. All customers in the Treatment Groups were placed on the DPP Rate as approved by the Michigan Public Service Commission (MPSC) that includes time-differentiated energy-only charges as follows:

1. On-Peak: All kWh used only from 3 p.m. to 7 p.m. Monday through Friday, excluding holidays, are charged at 12¢ per kWh;

2. Mid-Peak: All kWh used from 7 a.m. to 3 p.m., and from 7 p.m. to 11 p.m., Monday through Friday, excluding holidays, are charged at 7¢ per kWh;

3. Off-Peak: All kWh used from 11 p.m. to 7 a.m. Monday through Friday, and all weekend and holiday hours are charged at 4¢ per kWh; and

4. Critical-Peak: All kWh used during critical event hours, which will replace the full on-peak time period from 3 p.m. to 7 p.m. when announced in advance, are charged at $1.00 per kWh. Critical Peak Events are limited to a maximum of 20 per year, or 80 hours total.

The weekday DPP power supply costs are shown graphically in Figure 2. It should be noted that while customers did not see this particular graphical depiction of the power supply charges, all references to the rate – both written and verbal – were in the context of power supply charges only. The monthly customer charge, distribution and surcharges were acknowledged as part of the total billed charge; but the repeated emphasis was on the component customers could control: power supply cost.

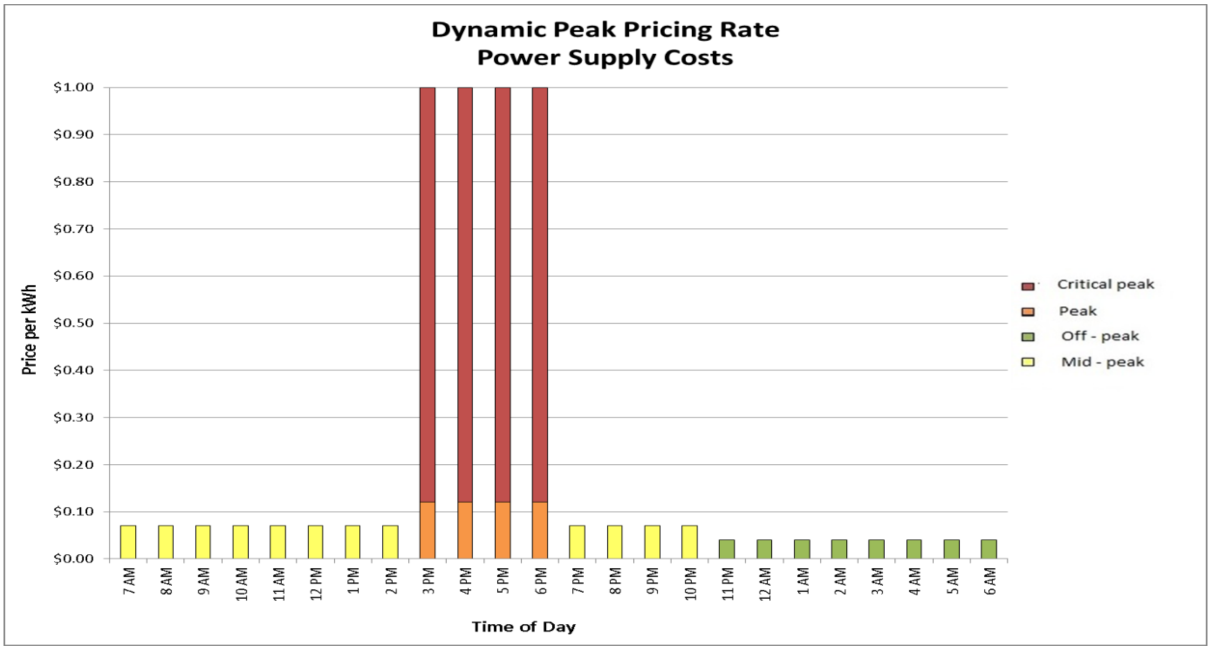

Figure 2: Dynamic Peak Pricing Rate – Power Supply charges

Collateral materials emphasizing the DPP power supply charges are listed here and shown in the Education and Marketing appendices:

- Invitation to the Pilot – FAQs
- Welcome Kit – insert on DPP rate
- Nucleus Software – dashboard and IHD
- eNewsletters articles on DPP rate
- Pilot participant Web Portal pages – How the Rate Works

To better understand the effect of the DPP rate, DTE will compare the DPP customers' response to that of the Control Group customers on the existing rate, D1 – Residential Service Rate. This rate is a moderately inverted (moderately inclining) block rate with the energy-only power supply charges described below:

- 6.912¢ per kWh for the first 17 kWh per day, where daily usage is averaged across the 30 billing days based on monthly usage, and
- 8.257¢ per kWh for excess over 17 kWh per day

The DPP and Standard Residential tariff sheets are included for reference in Appendix B and summarized in Table 2.

Table 2: Standard and Pilot Rate Structures

Rate Component	Standard Residential Rate – D1	DPP – D1.8
Monthly Charge	$6.00 per month	$6.00 per month
Power Supply Charges	• 6.912¢/kWh for the first 17 kWh/day* • 8.257¢/kWh for excess over 17 kWh/day* * *where daily usage is averaged across the 30 billing days based on monthly usage*	• On-Peak 3-7pm M-F (excluding holidays): 12¢/kWh • Mid-Peak 7am-3pm & 7pm-11pm M-F: 7¢/kWh • Off-Peak * 11pm – 7am M-F*: 4¢/kWh • Critical Peak 3-7pm M-F, when announced: $1.00/kWh * *plus weekends and all designated holidays*
Delivery Charges	5.003¢/kWh	4.195¢/kWh
Surcharges and Credits	As approved by MPSC	As approved by MPSC

At the time of final Consumer Behavior Plan filing in February 2011, the DPP Rate and the existing Standard Residential Rate featured an identical $6.00/month service charge, a 4.195¢/kWh delivery charge, and applicable surcharges; only power supply charges differed. Since then, the standard residential rate has experienced slight rate increases resulting from DTE's general rate case (U-16472) approved in December 2011. The Experimental DPP Rate, approved in September 2010, was not part of this general rate case increase. In its next general rate case filing, DTE will adjust the delivery rate for DPP to equal that of its standard residential rate (D1).

Critical Peak Price events

The Company is authorized to implement Critical Peak Pricing for no more than 80 hours per year, for evaluation of the tariff based on several factors including but not limited to economics, system demand, or capacity deficiency.

CPP Events are triggered primarily at the SmartCurrents program level. Events may be called for any of the following conditions:

- Forecast day-ahead temperatures ≥ 85°
- Forecast Relative Humidity ≥ 65% or heat index of ≥ 90°
- Economic Dispatch Criteria: Average Day Ahead Peak Price ≥ $60.00 for MISO Michigan Hub
- Back-to-back events will be called when forecast heat/humidity is expected to span several days. If indicated, 3 or more consecutive event days will be called.

Customers are notified by 6:00 p.m. the day before critical hours are expected to occur. In practice, notification is typically delivered by 3:00 p.m. the prior day. The notifications process was modified to run earlier in the day to help ensure that notifications are delivered by the 6:00 p.m. deadline, as stated in the tariff sheet. This process improvement was made in response to system issues that impacted the first event called in August 2012.

Notification is made using stated customer preferences: automated telephone message, text message, and/or e-mail. Customers are required to have at least two of these three automated notification preferences. While message length varies by notification type (text is shortest), all receive the same base information:

> *"Your DTE Energy account at 123 Main Street is enrolled in Dynamic Peak Pricing. Tomorrow August 16th, from 3 pm to 7 pm will be a critical peak day."*

DTE is not utilizing the message capability of the devices (IHD and/or PCT) for a combination of financial and practical reasons. While the GE devices were "message capable," adding this functionality to the Demand Response Management (DR1000) system for deployment, was considered a system enhancement at additional cost. More importantly, T1 customers with rate and education only had no devices, so DTE's standard communication method was already required.

Targeted messaging and preferred communication media are being used in an attempt to maximize customer CPP engagement. In May 2013, in advance of the summer cooling season, a specific communication was sent to all pilot customers advising that event activity for the year will be greater than last year, and recommending they review and update notification preferences. In addition, periodic CPP discussions are included in the monthly e-newsletter.

As of the close of this Interim Report Period, DTE has called two events:

Table 3: Event Day List and Details

Event	Date	Conditions	Comments
1	8/16/2012	Average Temp. during Peak: 79° Average Relative Humidity: 72%	Partial success—Not all customers were notified
2	5/30/2013	Average Temp. during Peak: 78° Average Relative Humidity: 74%	Success—Notification issue fixed and sent to all customers with valid notification methods

DTE recognizes that neither event appears to meet the dispatch criteria as described earlier. Dispatch criteria was solidified in Spring 2013, in response to TAG's inquiries about how DTE would achieve a minimum of 10 CPP events. The day ahead forecast high of 90° for Event 1 simply did not materialize. For Event 2, the forecast high of 88° with 60% relative humidity (suggesting a heat index of 95°) was within the dispatch criteria. Heat index calcuations used the National Weather Service heat index calculator (http://www.hpc.ncep.noaa.gov/html/heatindex.shtml).

DTE Energy is planning to call approximately 10-15 CPP events in summer 2013.

Treatments

DTE's SmartCurrents Pilot Program is comprised of four treatments or "offers" and three control groups:

Table 4: Treatment Cells

Treatment Cell	Control Group	Description	Blind/Opt-in	Study
	CE	Standard Residential Rate	Blind (no direct customer contact)	Statistical
T1	C1	DPP + Education	Opt-in; randomization	Statistical
T2		DPP + Education + IHD	Opt-in; randomization	Statistical
T3	C2	DPP + Education + PCT	Opt-in; randomization	Statistical
T4		DPP + Education + IHD + PCT	Opt-in; randomization	Statistical

As briefly noted in 2.d. Research Questions & Hypotheses, actual control and treatment groups recruited for the study were less than originally projected in the CBS. In December 2011, DTE requested TAG approval to eliminate the Education only cells (T1 and C1) as well as the TE and CE, which were higher level education treatments. This request was made because the target population mail file was deemed insufficient to yield the desired enrollment quantities.

In a December 9, 2011 email, TAG approved the request, with the recommendation that DTE "retain the CE 1200 point sample and draw it from the installed meter population, without exclusions for "arrears" or "load control" customers. The purpose of this sample is to collect load data only to be used to compare and benchmark the populations for the remaining treatment cells. No demographic survey data collection is required; consequently none of the 1,200 points will require any direct customer contact.

Based on TAG's guidance, DTE eliminated the TE "blind" education group and filled the CE group for comparison purposes only. Over the course of the enrollment term, customer acceptance/qualification activity suggested T1 could be supported, and it was added back into the study. Control Groups were reduced from four (C1-C4) to two groups: C1 for comparison to T1 and T2 (central air conditioning not required) and C2 for comparison to T3 and T4 (central air conditioning required).

Education

SmartCurrents Education was designed in three phases. The first two phases – AMI Meter Installation Communications and Pilot Recruitment Communications - are intrinsic to pilot infrastructure and operations, and the third – Pilot Customer Education – is where the bulk of the educational content is implemented.

Phase 1: AMI Meter Installation Communications, which prepare the customer for the installation and provide information on the benefits of smart metering. These include an advance notification letter and brochure as well as door hanger left on installation day. The entire AMI installation population receives these communications.

Phase 2: Pilot Recruitment, which includes key communications and customer touch points related to invitation, qualification survey, and installation of devices (where relevant). In addition, in the fall of 2011 (several months ahead of the start of formal recruitment), a special email blast was sent to the target population. This e-blast gave an overview of AMI benefits and pointed out the new capability to see detailed energy usage online at dteenergy.com. The intent of the communication was to "pave the way" for recognition when the recruiting effort began. These communications were received both by pilot participants and those who were invited but declined to participate.

Phase 3: Pilot Customer Education, which consists of customer touch points and communications related to the Dynamic Peak Pricing rate, energy efficiency and energy waste management, enabling-technology operations, and other key educational components necessary to empower customers in the pilot program.

All participants in the T1 to T4 treatment groups have access to a variety of feedback and educational materials and tools presented through multiple channels. Some materials are accessed with a "pull," meaning that customers must take a voluntary action to access them (such as a website or "paging through" the IHD), while other material is made accessible by a "push", meaning that customers automatically receive the materials (such as email, direct mail and event alerts). Core tools include:

- Monthly e-newsletter
- Customer web portal that presents a wide variety of energy information, and is updated monthly
- Suite of hard copy educational materials (Welcome Kit)
- SmartCurrents program support and GE Technical Support
- Play-Learn-Win energy education game

Monthly e-newsletter

Pilot participants received a monthly e-newsletter with energy efficiency tips, DPP rate discussions, DPP savings strategies, etc. Content was tailored to the specific treatment cells, and included links to the web portal for additional insight and information. Focus Groups conducted in fall of 2012 indicated participants felt the content was lengthy, too generic, and they wanted more program specific information. Beginning in January 2013, content was streamlined and more pilot-focused, generally limited to a main feature and secondary topic. Tech Tips were added, providing answers to common questions such as how to rebind a device and how to verify Nucleus communication status. "Submit your Story" features also were introduced, inviting participants to share their energy saving/shifting strategies for a chance to win a gift card if their story was featured in a subsequent newsletter. Ten stories were submitted: six from T2 participants, and two each from T1 and T4 participants.

Overall readership (open rate) for the interim report period is 62 percent. While this may seem low, "open rate" tracks only customers who viewed the email with its images. A more likely open rate is one to five percent higher – 63 to 67 percent – to account for recipients who viewed text only or used the preview pane. The average click through rate for the report period was 14.5 percent. This represents unique individuals who click on one or more links in the email, expressed as a percentage of the total tracked opens. The links include: SmartTrivia, Submit a Story, and various websites customers can access for more information such as energy saving tips and SmartCurrents web content. See Appendix D for readership statistics.

Web Portal

DTE offers all customers the opportunity to view key energy usage data, and other relevant information and analytics, online through a computer or mobile phone internet browser.

Pilot customers have access to a special web portal that provides the following:

- Rate comparison tool that allows comparison between their new DPP rate and their prior residential rate
- Energy Use Analysis charts
- Energy education content customized by treatment cell

This specialized content is restricted to pilot participants, and is accessed when they login to their accounts on dteenergy.com and pilot participation status is detected.

The rate comparison tool allows participants to become familiar with DPP rate impacts, and understand how they might benefit from the DPP rate by performing rate comparisons between their new DPP rate and previous Standard Residential rate. It is intended to help participants become familiar with DPP rate impacts, and enable them to understand how they might benefit from the DPP rate, based on levels of behavior change (i.e., none, slight, moderate or significant). Usage of this tool was not as high as anticipated, with a total of 216 users over the period June 2012 through May 2013.

The portal also provides hourly and daily usage information and pricing information presented graphically to help users understand their usage trends. Energy Use Analysis screen shots are shown in Figure 3 for Standard Residential Rate (left) and DPP rate (right).

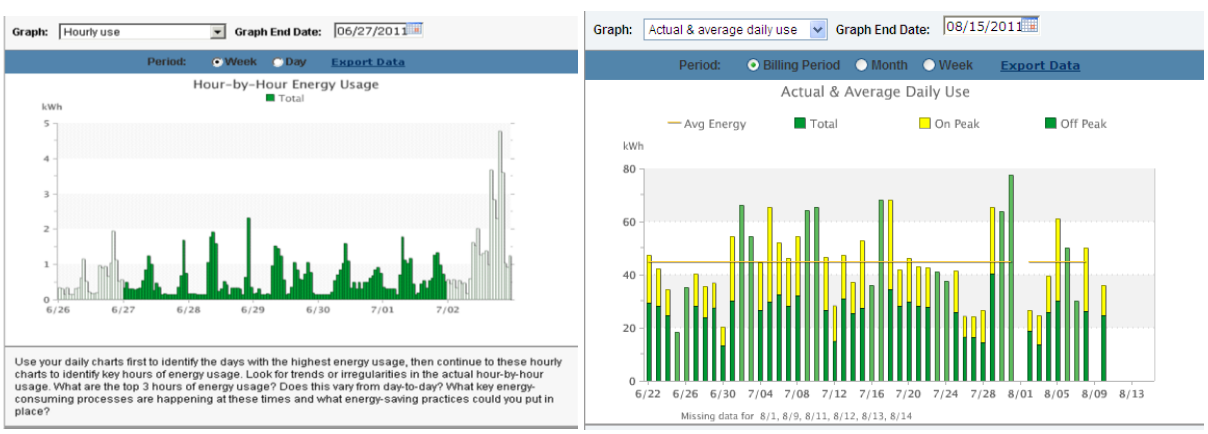

Figure 3: ACLARA Energy Use Analysis Web Portal

Finally, the portal provides energy education content customized by treatment cell. For example, content for T3 and T4 was tailored to understanding and maximizing the PCT, while T1 and T2 content was focused on the benefits of programmable thermostats, and provided links to rebates. This content changes monthly, and participants are directed here from links in the monthly e-newsletter. This portal is presented in the context of the existing DTE Energy website (www.dteenergy.com), which offers a wide range of content and services to help DTE customers better understand energy and energy savings, including energy calculators, energy saving tips, energy efficiency videos, rebates, and special offers.

SmartCurrents web page views for the period August 2012 through June 2013 totalled 4,813 views. The averge monthly view count was 437.5. The highest view count was March 2013, with 712 views and the lowest view count was September 2012 with 134 views. SmartCurrents web page views and rate comparison calculator usage are shown in Appendix D.

Hard Copy Educational Materials

The Welcome Kit, sent upon pilot enrollment (and therefore included in Appendix E. Marketing Materials), was the primary hard copy educational material. Customized by treatment cell, it featured a "Getting Started" page, DPP rate sheet, and IHD and/or PCT device sheets as applicable, in a branded pocket folder. A SmartCurrents Pilot Program magnet listing DTE and GE Support phone numbers and hours of operation also was included. In addition, customers who received Nucleus with IHD and/or PCT also received "Before You Begin - Installation Tips for GE Nucleus" in the box with the device/s. This information sheet described initial installation using the Ethernet cable provided as well as steps to add Nucleus to their home's WiFi network later in the installation process. Steps for connecting devices also were provided.

In April 2013, pilot participants received a hard copy letter reminding them of the Critical Peak Event component of the DPP rate, advising them to confirm their preferences for day-ahead event notifications, and announcing a system test in advance of summer "CPP" season. This communication was intentionally designed as a mail piece to help ensure timely readership, as fall Focus Groups had indicated participants receive but may not read every SmartCurrents program email. A follow-up letter was subsequently sent to 45 customers whose notifications failed during test. The letter reiterated the importance of up-to-date notification preferences, displayed current preferences with delivery failure reasons, and reminded them to call to update. All but seven customers responded and updated their notification preferences. When system testing was complete, customers were notified that the system was working properly and that all future CPP Notifications would be for real events and not testing.

SmartCurrents Program and GE Technical Support

DTE Customer Support Representatives were trained to handle initial program questions and enrollment as well as provide support to pilot participants who may call for various reasons, including but not limited to:

- Seeking more information about the DPP rate and/or what they have learned from the portal
- Looking for answers to questions about the pilot or technology
- Providing feedback about pilot experience,
- Understanding their bill
- Contemplating dropping the rate and withdrawing from the program

The GE Customer Support staff was trained to respond to enrolled customer calls for ordering, set up and system operation questions, including but not limited to:

- Fulfilling enrolled customer IHD and PCT "orders" based on master list of customers by treatment cell,
- Scheduling PCT installations,
- Nucleus password resets,
- Binding devices to Nucleus,
- Explaining how PCT responds to price signals

The Customer Support phone numbers and hours of operation for both GE and DTE are provided on portal pages, emails, and all relevant pilot educational materials.

Play-Learn-Win

Vergence Entertainment's "Play-Learn-Win: Learn a Little. Save a Lot" (PLW) program was introduced in April 2013, with a goal to test customer acceptance and engagement with a novel "gamification" approach, and provide education with energy-saving information and action items. PLW was offered in addition to the monthly e-newsletter and web portal updates which had been in place since summer 2012.

Pilot participants were invited to subscribe to PLW via email invitations, as well as featured items in SmartCurrents e-newsletters and through presence on the web portal. PLW participation was incentivized with prizes from the local communities (including Qdoba restaurant giftcards, Arthur Murray dance lessons, DTE Music Theatre tickets and more) and designed for various purposes: to incentivize PLW mobile and computer app downloads, achievement, persistence and daily engagement.

Game questions focused on core pilot program information: Energy efficiency, energy waste, Dynamic Peak Pricing and demand response. Through the end of this interim report period, eight weeks of game play (out of 17) had been completed. The delivery of curriculum began with the mailing of a welcome kit to all pilot participants, which included a welcome letter and a deck of playing cards branded to the SmartCurrents program and designed with 52 energy saving actions on the faces of the cards. These cards served functionally as the entirety of the PLW curriculum, with the intention to provide the answers in advance of the "test." In this way, pilot participants who did not download the computer or mobile app could still receive the PLW curriculum elements; and for those who downloaded the PLW app by Ringorang® the deck of cards was designed to serve as a reference point. Questions delivered through the app offered the player opportunity to click through to a customized website where the image of the correlating card in the deck could be seen.

Additionally, all pilot participants received monthly print mailers where game challenges relating to the PLW curriculum appeared in the form of questions and puzzles. On these mailers, participants were encouraged to either text message (SMS) or call by phone to an IVR system to answer the questions presented. Participants who provided answers in this way were enrolled in a sweepstakes to win packages of prizes.

The initial invitation email attracted 325 subscribers to PLW, or 24.3% of the 1,336 pilot participants in treatment cells T1 – T4 as of the April game introduction. During the reporting period, that number of PLW subscribers rose to 334, or 25% of pilot participants. All PLW subscribers were invited to download the app; and 56% downloaded it initially. During the reporting period, the percentage of subscriber downloads rose to 73.6%, suggesting that the periodic email reminders were effective in gradually inciting the desired action from subscribers. The total number of downloads started at 184 and increased to 246 in the reporting period. Of the app downloads, 45% were to Windows computers, followed by 33% iPhones, 17% Android phones, 4% Mac computers, and only one participant downloading to a Blackberry phone as of June 9.

In the period from the April 2013 game start to close of report period in June 2013 a total of 97 questions were delivered through the PLW app. Of the 246 downloaded participants, 222 (90% of downloads, representing 16% of total pilot population) played at least one question over the eight weeks as shown. The median percentage who played at least one question in any given weekly game was 57.7%. A median 38.1% played every question delivered through the app in any of the eight weekly games played in this reporting period.

Table 5: Play Learn Win participation by Treatment Cell

Treatment Cell	Pilot Population	Total Subscribed	Total Downloads	Players who played 1+ Questions	% of Treatment Cell who played 1+ Questions
T1	249	28	19	15	6.02%
T2	390	108	83	74	18.97%
T3	328	95	68	64	19.51%
T4	369	103	76	69	18.70%
Total	1336	334	246	222	16.62%

Weekly results suggest that information is being retained by participants, as review modules show an increase in correct answers compared to the averages of the content modules they review. The summary games entitled “Connecting: Part 1” and “Connecting: Part 2” delivered repeat questions derived from the preceding three games respectively. The average participant scores for the first summary game were 8.1% higher than those of the related games, and 8.4% higher for the second summary game over its related games. Program images and “Game Statistics Report” are shown in Appendix E.

Technology

Three of the four treatment cells under study were provided with enabling technology. Qualified customers were randomly selected to receive an In Home energy Display (IHD), a Programmable Communicating Thermostat (PCT) or both IHD and PCT. The IHD and PCT are “powered” by GE Nucleus, a Home Energy Management (HEM) Hardware system that acts as the gateway for monitoring electrical usage and controlling energy consumption within the home in real time. The Nucleus communication and storage device plugs into a standard 120 volt electrical outlet, and works in combination with desktop client software to create the home area network. It interfaces with the AMI meter to show real-time (kW) and long-term (kWh) data on power consumption. Daily/monthly/yearly historical trends can be seen over a span of three years, via the desktop client or smart phone.

After Nucleus is bound to the AMI meter, compatible smart devices such as the IHD and/or PCT are added to the home energy management network. Meter usage and price and load control signals received by Nucleus are transmitted to IHD and PCT to allow customers to determine how appliances or devices can best help control energy costs. IHD and PCT rely on Nucleus for usage and price signals; thus all IHD and/or PCT users utilize Nucleus. No customers received Nucleus only.

The IHD is a counter top device that receives and displays information from the Nucleus. Key features of the IHD include:

- Display that allows consumers to closely track their energy consumption in near real time energy usage in kW or $
- Historical energy usage - month, day, hour – kWh or $
- Usage display to three decimal points
- Energy analysis tools – Spyglass and Stopwatch
- Show Time-of-Use (TOU) Power Supply rates: $0.04/kWh offpeak; $0.07/kWh midpeak; $0.12/kWh onpeak and $1.00/kWh Critical Peak

A screen shot of Nucleus device and desktop display with IHD is shown in Figure 4.

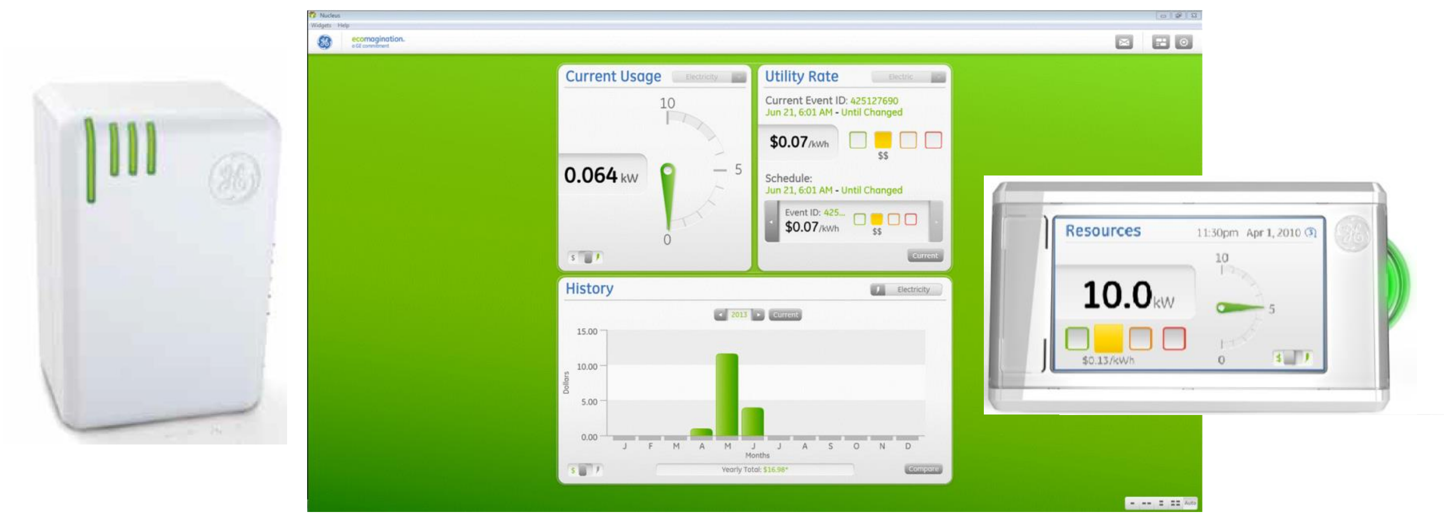

Figure 4: GE Nucleus & IHD – T2 & T4

The GE PCT is a full featured programmable communicating thermostat that provides four degree temperature offset during critical peak events to provide energy management for the period. The GE system sends two signals for events: the $1.00 price signal and the demand response signal which activates the temperature offset. Event override by the customer is possible. Operating as a 3 heat/2 cool universal thermostat, it has a touch screen/button interface, filter replacement reminder and is programmable at the wall or through the Nucleus interface. Key Design Specifications of the PCT include:

- ZigBee® Smart Energy Profile Thermostat
- Full 7 day program with 4 set points per day

- Programmable energy savings setback
- Screen selection
  - $ or KWh Usage
  - Instantaneous KWh
  - Instantaneous $ Pricing

In addition to these features, Nucleus allows users to program and/or change the PCT settings. The PCT can also be accessed by an iPhone app. Nucleus with PCT widget and PCT is shown in Figure 5.

Figure 5: GE Nucleus & PCT – T3 & T4

Qualified customers who called to begin the enrollment process had their rate changed from Residential to DPP, and were then transferred to the GE Order Line to order their devices and arrange for installation of a PCT if necessary. Nucleus, IHD and/or PCT were shipped via UPS and generally arrived within five days. PCT installations were completed by GE Factory Service after the appointment was scheduled by the customer. Nucleus software was self-installed by the customer, with the final step being binding to the meter after any required installations were complete. A customer's pilot program enrollment was considered "complete" when the meter binding established communication. The master list of referrals to GE was utilized for enrollment completion tracking. Outbound calls were made to customers who did not call the binding hotline within two to three weeks.

3.a.iii. Randomization and assignment method

The study design is a randomized controlled trial (RCT) with denial of treatment for the control group. A simple random sample of AMI-metered residential customers in the service territory who met certain eligibility criteria (as described in section 3.a.i, Target Population) received an invitation to opt in to the study where participating customers could receive one of several treatments, with the understanding that this treatment is limited in supply.

With a variety of enabling technologies, customers who opted in were screened (i.e., owned their home; were not employed by DTE or a GE competitor; and had a forced air heating system) and surveyed to ensure qualification to potentially receive a treatment. Targeted customers were given the option of completing qualification and baseline survey online, or beginning the process with a printed Business Reply (BR) qualification questionnaire. Respondents who chose the BR response method were subsequently invited to complete the online baseline survey.

Those who qualified and self-identified as having central air conditioning were randomly assigned either to a control group or to receive an offer to opt in to one of four studies, each of which takes service under DPP with CPP overlay and includes an offer of: no technology, an IHD only, a PCT only, or both PCT and IHD.

Those who qualified and self-identified as not having central air conditioning were randomly assigned either to a control group or to receive an offer to opt in to one of two studies, each of which take service under DPP with CPP overlay and include an offer of either no technology or an IHD.

Figure 6 on the following page depicts a high level overview of this randomization and assignment process.

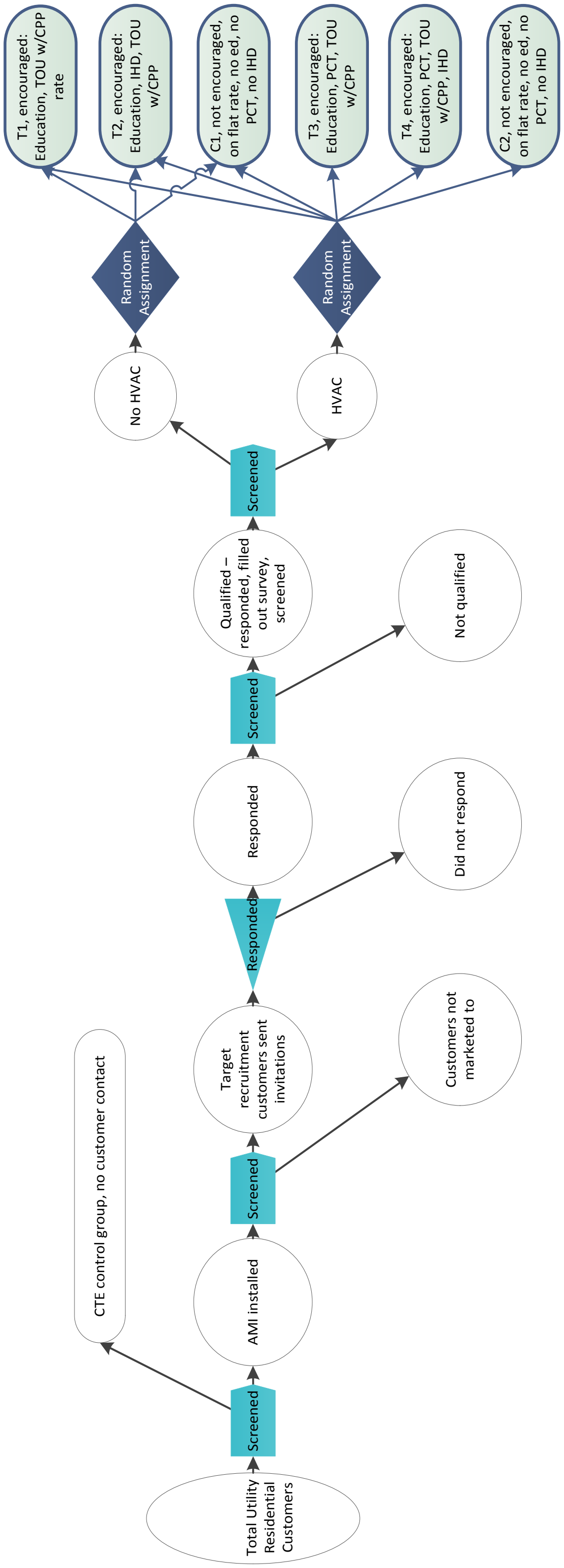

Figure 6. High Level Randomization and Assignment Process

3.b. Implementation

3.b.i. Project schedule

Key Milestones for the DTE pilot program are shown below, reflecting completed recruit/enroll activity and listing remaining deliverables.

Table 5: Key Milestones for the DTE Pilot Program

Date	Milestone
January 24, 2012	First wave of mailings sent out
April 9, 2012	Outbound calling begins
May 7, 2012	Second wave of mailings sent out
June 13, 2012	Reminder Post Card sent out
June 30, 2012	Last day to call to enroll
June 30, 2012	Last day to order from GE
July 27, 2012	Last day for GE PCT installations
August 10, 2012	Last day to bind Nucleus to meter
August 13, 2012	Pilot Observation begins
June 11, 2013	Data cut off for Interim Report
Fall 2013	Interim Report filing
December 31, 2013	Pilot Observation ends
Spring 2014	Final Report filing

3.b.ii. Recruitment and customer retention approach

Recruitment was designed to utilize two waves of invitation mailings and follow-up via reminder post card and outbound calling as necessary. On the advice of DTE's direct mail consultant Dziurman Dzign, the recruiting invitation was a personal letter in a #10 standard DTE envelope. The letter inviting customers to "join us in shaping the future of energy use" was signed by the SmartCurrents Program Manager. A four-color, glossy insert was included, featuring a message from Steve Kurmas, then President and COO, DTE Energy, and showing the energy display and thermostat that qualified candidates might be randomly selected to receive. To create an urgency to act, a deadline to respond was highlighted. Prospects could begin the enrollment qualification process online or by returning the survey registration form in a Business Response (BR) envelope.

When the SmartCurrents Pilot Program recruiting began, there were approximately 449,000 electric AMI meters installed and reading remotely with a 95% or better accuracy. That population was screened to exclude customer profiles described earlier (interruptible air conditioning, net metering, etc.). Based on direct mail estimated response rates, the direct mail consultant selected 149,307 customers to target. A larger mailing was not contemplated out of concern for driving interest that could not be satisfied due to fixed quantities of the enabling technologies.

Recruiting began in late January 2012 and was intended to be complete by end of May 2012, as shown in the recruitment plan below.

Table 7: Recruitment Plan

Target Date	Planned Recruitment Activity
January 24, 2012	First wave of mailings
February 6, 2012	Second wave of mailings
February 29, 2012	Follow-up Postcard as needed
March 20, 2012	Outbound calling as needed
May 1, 2012	Last day to call to enroll & order from GE
May 30, 2012	Last day to bind Nucleus to meter
June 1, 2012	Pilot Observation begins

The first wave of invitation letters were sent to 100,585 customers mid-January 2012. With a variety of enabling technologies available for study, the qualification survey further screened potential participants for eligibility. They were given the option of completing a qualification and baseline survey online, or beginning the process with a printed BR qualification questionnaire. Respondents who chose the BR response method would subsequently be invited to complete the online baseline survey. Initial BR response was swift and plentiful, leading to the decision to postpone the February mailings out of concern for generating demand that could not be met. The actual rate of BR qualification was extremely low, however, because these customers did not follow through with the online demographic survey, which was a requirement for qualification.

Qualified responses were pooled and held until "critical mass" was achieved with at least 1,200 candidates to randomize and begin to populate the cells. Randomization was performed by Market Strategies International (MSI), which designed and hosted the online qualification site noted above. At such point, they were randomized into treatment and control groups based on presence of central air conditioning and appropriate heating system. Randomization of the T and C cells was an automated process. The end result of every randomization was to have roughly the same number of cases in the T and C cells. For each event, the process was generally as follows:

1. Confirm total number of qualified (T0) cells to be randomized.
2. Based on the total number of cases, determine roughly how many should fall into each of the T and C cells.
3. T1, T2 and C1 groups: Customers reporting they did not have central air (based on qualification baseline survey QMA3: "Does your home have central air conditioning?") could only fall into one of these three cells. These records were assigned to T1, T2 or C1 at random.

4. T1, T2, C1, T3, T4 and C2 groups: The remaining records to be randomized should now all have central air,). These records could fall into any T or C cell. Records were assigned to either quota cell at random (where only the difference to get to the amount determined in step 2 was needed for the T1, T2 or C1 groups).

After treatment cells were opened in March 2012, randomization was conducted whenever the “pool” accumulated at least 100 qualified prospects. During the last eight weeks of recruiting, randomization was a weekly activity, as a result of the enrollment push noted below.

Upon randomization, candidates received an email with link to a customer agreement (T1-T4) and phone number to call to enroll. Customers randomized into control groups received a letter saying “Sorry you weren’t selected,” and enclosing an Entertainment® Dining Dollars gift card as our way of saying “Thank you for your interest.”

Outbound calling began April 9 and ran through May 7. Outbound calls were made to customers who had not responded at all, and customers who had qualified, but had not yet called to enroll, or had not yet completed enrollment. This effort yielded 235 enrollments.

The second mailing, sent May 7, was modified to eliminate the BR option and provide online qualification only. In addition, it included the offer of an Entertainment® Dining Dollars gift card for those who completed enrollment. A “Last Chance” reminder post card was mailed June 13, emphasizing that the enrollment period was coming to a close, and that June 20th was the last day to qualify to enroll. Over 900 customers enrolled as a result of the entertainment card offer and post card reminder.

Customers who elected to begin the enrollment process were sent a SmartCurrents Welcome Kit (shown in Appendix E), which included helpful information on their new DPP rate, technology set up tips, etc. For customers without technology (T1), enrollment was complete at rate change and meter configuration from 60 to 15-minute intervals. For customers with technology, complete enrollment meant binding the GE Nucleus software to the AMI meter.

The period from June 30 to August 10 was dedicated to assuring that customer devices were shipped and received, PCT installations were scheduled and installed, and meters were bound (enrollment completion). While five weeks may seem overly generous for completing these tasks, the time was well spent; nearly 350 meter binding/enrollment completions were accomplished for the T2-T4 treatment cells.

A detailed flow chart of enrollment activity is shown in at the end of Appendix E.

3.b.iii. Recruitment and customer retention numbers

Overall, the recruiting effort yielded a six percent response rate. Seventy percent of respondents qualified, and twenty percent of those qualified completed enrollment. Overall recruitment rate based on mailed population was five percent.

Table 8: Recruitment Effort Summary

Wave	Mailed	Responded	Percent	Qualified	Overall Rate
1	100,585	5,361	5%	3,602	4%
2	48,722	4,342	9%	3,192	7%
Total	149,307	9,703	6%	6,794	5%

The final enrollment numbers as observation officially began on August 13, 2012, were:

Table 9: Final Enrollment Numbers

Treatment Cell	Control Group		Description
	CE	1,212	Standard Residential Rate
T1 (N=249)	C1	347	DPP + Education
T2 (N=390)			DPP + Education + IHD
T3 (N=328)	C2	356	DPP + Education + PCT
T4 (N=369)			DPP + Education + IHD + PCT
1,336		**1,915**	**Total enrolled Treatments & Controls**

Final enrollment numbers under study are slightly less than enrollment numbers indicated in the recruitment flowchart in Appendix D. This difference is the result of Load Research group's enrollment validation review, wherein disqualifying customer characteristics were observed, such as: not receiving AMI meter data; different or inactive customer; addition of an incompatible product such as Interruptible Air Conditioning rate or net metering (solar), etc.

From observation start through close of the interim report period, June 11, 2013, a total of 60 customers, or approximately four and a half percent have withdrawn from the pilot, fairly equally across treatment cells.

Table 10: Dropped Customer Summary

Withdrawals through 6-11-2013	Total
T1	17
T2	16
T3	13
T4	14
Grand Total	60

Customers are withdrawn from the pilot by deliberately calling to withdraw, or when prescribed account activities occur that violate program participation rules. For example, nine participants called to advise they are moving; another 30 system-generated withdrawals were processed as a result of service disconnects, force-outs (new buyer calls to start service before current customer calls to end it), addition of an incompatible product such as Interruptible Air Conditioning, etc. Withdrawal reasons are itemized in Table 10. In summary, withdrawals to date are driven more by forces beyond program control than by customers actively opting out for other reasons. When considering elective withdrawals only, less than two percent have deliberately chosen to exit the program.

Table 11: Withdrawal Reasons

Withdraw Reason	Total
System generated: Disconnects, etc.	30
*MOVING	9
*DPP RATE TOO HIGH	4
*EQUIPMENT PROBLEMS	9
*INCONVENIENT TO SHIFT USE	1
*NOT SEEING THE BENEFIT	7
*PROGRAM TOO CONFUSING	1
Grand Total	60

3.b.iv. Survey approach

Baseline Demographics

DTE selected Market Strategies International (MSI) to conduct the qualification and baseline demographic survey requirements. Both surveys were conducted together during the recruiting and enrollment process to ensure 100% completion of the baseline survey to comply with DOE requirements.

Because qualification to continue the enrollment process required completion of the baseline survey, this data is available for not only 100 percent of the enrolled pilot population, but also for those C1 and C2 control groups and qualified customers who did not complete the enrollment process, regardless of reason.

Customer focus group discussions

Consumer Insights (CI) conducted a series of focus group studies among program participants in October 2012 to assess the initial stages of the program. This qualitative study answered issues surrounding six key questions:

- What were participants’ motivations for joining the pilot program?
- How well did DTE and GE execute the initial installation and “launch” phase of the study from a customer perspective?
- What behavioral changes have occurred among participants because of DPP?
- Have the equipment and other tools provided to participants impacted behavior and consumption patterns?
- How do participants feel about the level of customer support they have received to date from DTE and GE?
- If DTE expands DPP, how can it improve the process for future participants?

Methodology and Sample

This study consisted of focus group discussions with approximately seven percent of the pilot program population. Discussions were 90 to 120 minutes in duration, and were conducted at Consumer Insights’ Troy, Michigan, facility between October 23 and 30, 2012.

Pilot program customers were initially invited to participate in discussions by email, with follow-up phone calls completed for cells with smaller potential respondent pools or low initial response rates. In general, cooperation rates were very high. Respondents were paid $100.00 for their participation.

Groups were segregated based on the level of equipment provided during the pilot. Two groups were conducted among each of the “cells” as defined by equipment:

T1: DPP and education

T2: DPP, IHD, and education

T3: DPP, PCT, and education

T4: DPP, IHD, PCT, and education

Findings

Most participants have reported favorable interactions with both DTE and GE. Customers have learned to use the tools provided to shift a significant portion of their energy consumption into non-peak periods. In fact, on a self-reported basis, respondents estimate their energy savings so far at 10-20% per month. Learning curves have been short and steep, and optimal behaviors have been sustained; virtually all respondents indicated they would continue in the program if DTE extends it beyond the two-year pilot because DPP provides them a way to actively manage electrical consumption and costs.

As of fall 2012, the most optimal equipment combination for driving concerted customer efforts to avoid peak and near peak electrical consumption appeared to be T4 because T4 provides the monitoring tools but leaves it up to the homeowner to figure out the best ways to shift consumption[4]. At the same time, the T1 customers who have been provided with nothing other than an education of the new rate structure indicated they were accomplishing 75-85% of the energy savings of the more technologically endowed counterparts based on behavior changes and manual shifting of appliance operating times.

[4] Treatment group T4 includes a PCT, which can be set by the customer and thus DTE has no direct load control capabilities.

Interim SmartCurrents experiential surveys

As discussed earlier, CI conducted a series of focus group studies among program participants in October 2012 to assess the initial stages of the program. CI then used the information gathered from those groups to guide the research questions for the interim web-based surveys:

- What were participants' motivations for joining the pilot program?
- What behavioral changes have occurred among participants because of DPP?
- Have the equipment and other tools provided to participants impacted behavior and consumption patterns?
- How well have the various pieces of hardware provided to participants (e.g., displays, appliances) performed?
- Has DTE effectively communicated relevant program and billing information?

Methodology and sample

- Email invitations to participate in an online survey were sent to all 1,336 customers enrolled in the program. Of that group, 800 respondents, or 59 percent, completed the survey. The survey took approximately 18 minutes to complete, and was fielded between December 6 and December 20, 2012. Respondents were paid $25 for their participation.

- All conclusions are drawn from differences observed in the data that are statistically significant at the 95% confidence level.

- Respondents were recruited from each of the four levels of treatment participation:

    - T1: DPP and education (n=113)
    - T2: DPP, IHD, and education (n=235)
    - T3: DPP, PCT, and education (n=212)
    - T4: DPP, IHD, PCT, and education (n=240)

Findings

Nearly all respondents from each treatment cell, including T1 (education only), indicated that they made at least one behavior change to minimize energy usage after joining the program. This would seem to indicate that education alone will have some impact on curtailing usage during peak hours. However, the presence of the additional technology pieces made available to higher level respondents (T2-T4) led to more energy saving behaviors and an increase in the duration of those behaviors.

Behavior Changes Since Joining SmartCurrents

= sig. higher/lower than T1	Total (n=838)	T1 (n=113)	T2-T4 (n=687)
Minimize all electricity usage between 3 pm and 7 pm	68%	66%	67%
Run washer and dryer on the weekends, avoiding weekdays	53%	44%	55%
Run dishwasher between 11 pm and 7 am	41%	33%	41%
Set thermostat to raise AC temperature between 3 pm and 7 pm	40%	26%	43%
Better management of "vampire" sources of electric consumption	33%	29%	34%
Run dishwasher between 7 am and 3 pm OR between 7 pm and 11pm	31%	30%	31%
Switched from traditional to CFL and LED bulbs (since joining the program)	31%	33%	30%
Run washer and dryer between 7 am and 3 pm OR between 7 pm and 11pm	30%	28%	29%
Set thermostat to lower AC temperature before 3 pm to "pre-cool" the house	21%	16%	22%
Run washer and dryer between 11 pm and 7 am	16%	12%	16%
None	5%	9%	5%

SmartCurrents Participant Web Study Report

Q14. Since joining SmartCurrents, have you changed any of your behavior when it comes to the electricity consumption in your household?

Figure 7: Participant-Reported Behavior Changes

Generally speaking, respondents with the PCT, IHD, or both (T2-T4) were more likely to engage in several efficiency behaviors than those with only education (T1). Further, T2-T4 respondents were more aware of and responsive to Critical Peak Events than T1 respondents. It should be noted that this web survey fielded in December 2012, four months after the one imperfect event on August 16. Furthermore, of the nearly 400 notification failures in August 2012, 37 percent of failures were to the T1 group, as discussed further in 6.c. Process Evaluation – Event Dispatch and Notification.

Program experiences

The primary reason survey respondents joined SmartCurrents was the opportunity to save money on their energy bills. Although some "lip-service" was paid to environmental benefits, when pushed to select the single most important reason for joining, financial benefit was by far the strongest reason for joining.

SmartCurrents participants have higher satisfaction with DTE overall, which may stem from positive interactions with the program or be an artifact of the self-selection process for joining the pilot. Although the SmartCurrents staff received high marks, both DTE and GE received slightly lower grades for follow-up communications. For DTE, this assessment centered on communication of the Critical Peak Event. Less than half of all respondents had a full understanding of Critical Peak Events prior to reading about them in the survey, even though there was a verbal review of the rate during enrollment, and the Welcome Kit included an informational enclosure entitled "DPP -- Understanding Your New Electricity Rate." To address this shortcoming, the project team has incorporated CPP discussions in the monthly newsletters, and used special pre-season messaging to remind customers about this rate feature. For GE, the assessment centered on the PCT installation, and the technicians' lack of SmartCurrents program knowledge. Installers' lack of program knowledge was more difficult to address, since specific GE Factory Service Technicians were not dedicated to this effort.

Most survey respondents had used the Nucleus PC software tools, and found them to be useful. Use of Nucleus software tools is not tracked by the software, so survey data is the best available indicator of customer use and evaluation.

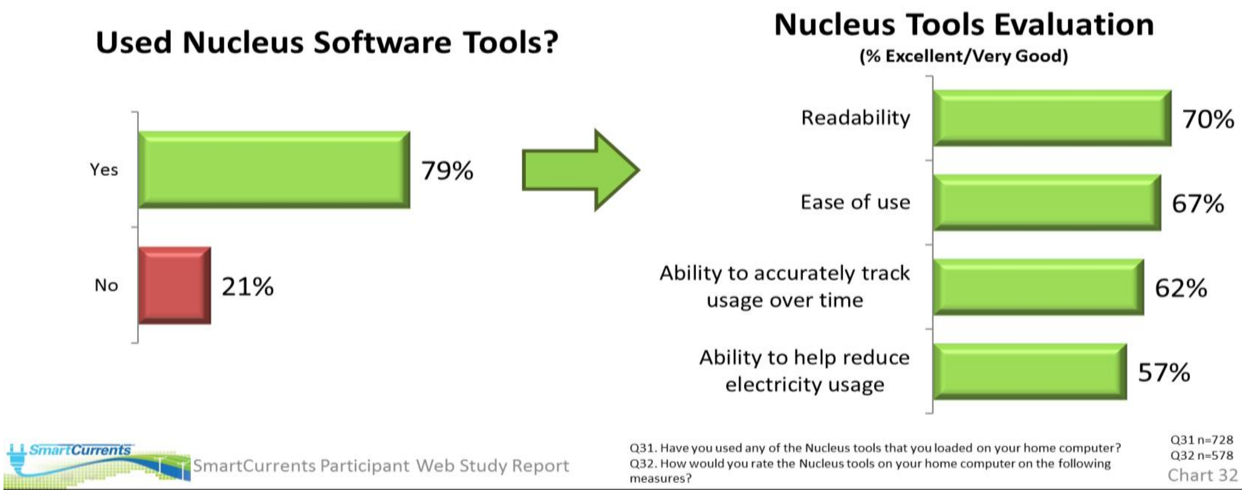

Figure 8: Participant-Reported Nucleus Software Use

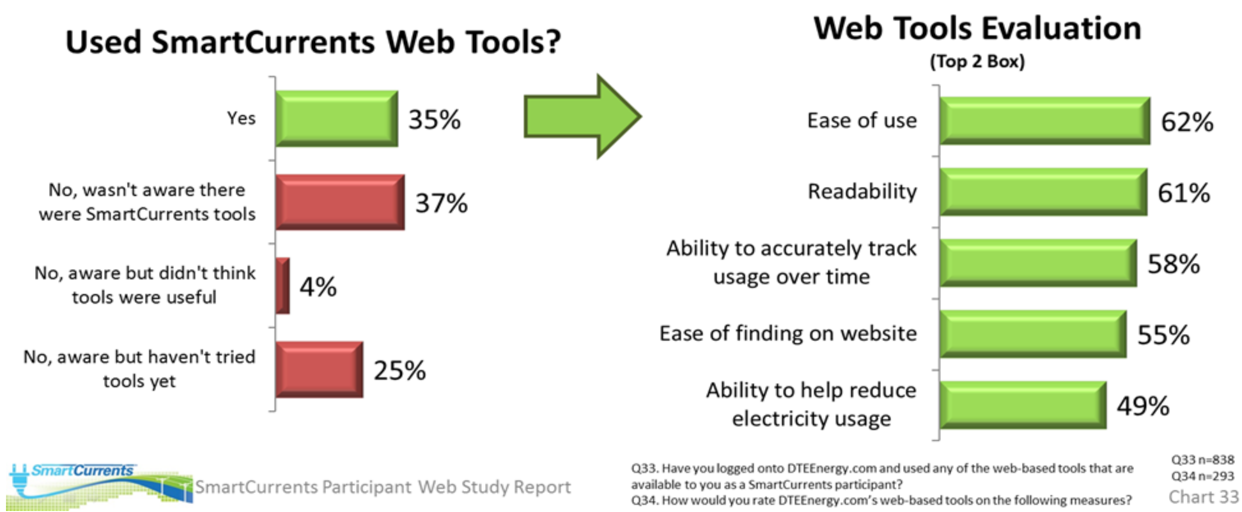

Figure 9: Participant Reported SmartCurrents Web Tool Use

Only about a third of survey respondents used the SmartCurrents web tools. This was not surprising, given that web tools were the primary tools provided for T1 participants. T2-4, on the other hand had their choice of near-real time Nucleus or the web tools that provided information through the previous day. Further, in order to access the web tools, customers must login to their dteenergy.com accounts, navigate to the energy use charts link and then select and change chart views as desired. Accessing Nucleus tools generally does not require as many clicks.

Hardware experiences

Over two-thirds of respondents experienced at least temporary connectivity issues with their home Nucleus, and a quarter had difficulties with their in-home display.

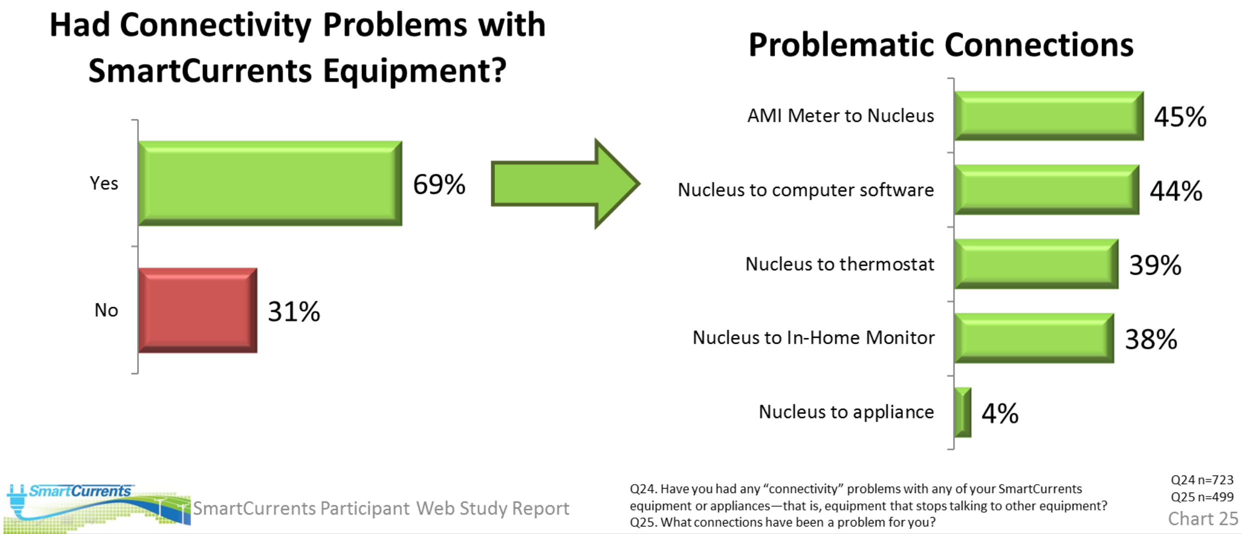

Figure 10: Participant-Reported Connectivity Problems

Although nearly all participants attempted to fix these problems, not all were successful, indicating a potentially serious problem for mass adoption of the technology.

Connectivity Problem Resolutions

	Attempted to Fix Problem	Contacted DTE/GE	Problem Fixed
AMI Meter to Nucleus	91%	75%	76%
Nucleus to thermostat	97%	68%	83%
Nucleus to In-Home Monitor	92%	53%	73%
Nucleus to computer software	97%	60%	75%

SmartCurrents Participant Web Study Report

Q26. All of the connectivity problems you noted are shown in the table below. Tell us a little more about each issue by answering the three questions to the right.

Chart 26

Figure 11: Participant-Reported Connectivity Problem Resolution

If respondents continue to encounter difficulties with the program hardware, they are more likely to abandon using that hardware and subsequently will be unable to benefit from information it offers. The survey respondents mentioned that including clear instructions on how to address common Nucleus/hardware issues in the program welcome package could be helpful. "Tech Tips" are now being incorporated in program communications.

Selected survey question responses by treatment cell are shown in Appenix A. Survey Instruments.

3.b.v. Experience with enabling technology

Technologies were shipped to customer homes after they called to start the enrollment process and their rate was changed to DPP. Nucleus software and IHD were customer-installed; PCTs were installed by trained GE Factory Service Technicians. “Binding” or establishing communication with the meter was accomplished by having the customer call the DTE “Binding Hotline” after installing the software.

Communication with the Smart Meter

Establishing and maintaining Nucleus communication with the meter has presented its share of challenges: During the enrollment period, 266 meters dropped their Nucleus connection; 208 (78 percent) were able to rebind and complete enrollment. Of the remaining 58, connectivity was resolved for 39 by replacing the meter or the meter & nucleus combination, and enrollment was completed. In 19 cases, connectivity could not be achieved at all. The total of 25 unresolved cases noted below (representing less than two percent of the total enrolled population) never completed enrollment and thus are not part of the study.

Table 12: Smart Meter & Nucleus Set up Challenges

Problem	Total	Rebound	Meter Replaced	Meter & Nucleus Replaced	Unresolved
Defective Meter	7		3	2	2
Never Connected	4				4
Dropped Connection	266	208	5	34	19
Totals	277	208	8	36	25

In most instances, the meters bound successfully to Nucleus on first try, and are generally able to re-bind if necessary. Successful re-bindings were not tracked. Meter binding activity was expected to last only through enrollment, and DTE did not anticipate the need to maintain the Meter Binding Hotline beyond that period. However, recurring meter/Nucleus connectivity issues have necessitated maintaining the binding hotline through the term of the pilot, although activity is low, averaging a handful of calls per week at most. A Nucleus update from v27 to v34 resolved some issues with meter connections (and corrected an issue with the iPhone app so it would work outside a customer’s home network). Nucleus compatibility with the Itron firmware in the meters also was investigated but no firm conclusions could be drawn.

Maintaining communication between the meter and Nucleus, as well as connected devices, is an on-going activity. GE provides a weekly “Heartbeat” report indicating connectivity, or Nucleus communication with the meter. The following summary from October 2012 is representative of meter/Nucleus communication status during the interim report period:

Table 13: Heartbeat Report

Maintaining Communication with the Smart Meter	T2	T3	T4	Total
Active Participants	375	318	380	1073
Did not heartbeat since yesterday	60	54	53	167
Did not heartbeat since the last week	51	44	39	134
Did not heartbeat since before Oct 1	21	13	12	46

GE's weekly report is a snapshot in time and an attempt to show "aging" by length of time. A variety of factors can cause Nucleus to stop "heartbeating," or communicating, including but not limited to: customer's internet service interruption; computer crash; wireless router problem; or power outage. The communication problem may be between Nucleus and the meter or Nucleus and wireless router. Some of these "outages" self-correct; for example, internet connection is reestablished.

In an effort to increase connectivity, both DTE and GE have initiated ongoing proactive customer communications indicating "our records show your system is not communicating" and providing instructions for power cycling Nucleus as well as GE Tech Support contact information. In some cases, individual devices are losing connection to Nucleus, and require removal from Nucleus and re-binding. This effort has been made both in a targeted fashion (specific email messages to 20 or 30 customers at a time) and globally (via email blast to the entire non-communicating population). Overall, these efforts have helped maintain communication levels, but have not generated significant increases from week to week.

Demand Response & Price signals

DR1000 is the GE Demand Response system that sends price signals and CPP events to customers. Besides sending this information, it also sends collects customer participation during those events. As such, price signals are sent by the GE server, not the DTE AMI meter. Since pilot commencement, intermittent problems have occurred with sending price signals. This has resulted in customer complaints and confusion, requiring the SmartCurrents program team to send email blasts recognizing the problem and reminding customers that their billing is not affected because the DTE billing system stores the correct rates and pricing tiers. GE has instituted multiple internal resolutions including price signal monitoring.

Demand Response signals to the PCTs are "firing," (i.e., being generated and sent) without incident. However, like the "Heartbeat" report, the Event Participation Report has gaps where no signal status – completed, rejected, etc. – is provided. GE Energy Management is investigating the root cause and will advise DTE of its corrective solution. As part of the final report analysis, DTE will assess the impact of connectivity issues on the character of customer response.

General usability

In spite of online qualifications and survey activity, a portion of the pilot population required "hand-holding" with set up of the Nucleus software. While "Installation Tips for GE Nucleus" were included with all device shipments, some customers had great difficulty with the router connection, reportedly because they do not interact regularly with the router past initial set up. Others had difficulty understanding the base 16 numbering system for MAC address and install code. Much of this difficulty is attributed to the small font size in the documentation, making it difficult to distinguish between some letters and numbers. Many software set-up questions were actually answered by the DTE binding team, in the course of the binding phone call.

In spring 2013, IHD software had a bug that caused a constant restart. This again led to customer calls and complaints. An update provided by GE eventually resolved the issue.

4. Data Description

Interval data is collected and stored at the meter level and then retrieved by DTE's Meter Data Management (MDM) System and stored in the MDM. DTE's Load Research Department specifies which meters' data is to be brought into the Load Research Data Management (LRDM) System for analysis. All the treatment group and control group customers' interval data is loaded into the LRDM. This data is brought into the LRDM in 15 minute intervals which is then aggregated to hourly intervals for analysis. If a meter cannot be communicated with or reports a missing value, the reading is flagged and the MDM system attempts to retrieve the missing interval for the next five days. If after five days, the interval has not been recovered, the MDM system stops attempting to retrieve the interval and the reading is marked as missing and remains a blank value in the MDM system. The LRDM is designed to query the MDM for selected meters' previous day's data late in the afternoon to assure that the data has been loaded into the MDM which occurs during the early morning hours. After 10 days, the LRDM queries the MDM again in an attempt to recover any missing intervals that were not available in the MDM during the first query.

Any other values are used "as is" for analysis. No data is modified, validated or edited in the LRDM. Any validation of the data occurs at the customer level and then is edited at the billing level if needed. Editing intervals is very rare as DPP customers are the only residential customers who are billed on interval readings. Residential customers are billed on start and end readings regardless if they have an AMI meter and interval readings are available. DTE's AMI meters currently are reading with above 95% accuracy making incorrect readings a very rare occurrence. To date, DTE has not received any calls from customers on the DPP rate questioning their interval usage since the start of the pilot program.

As discussed in 3.a.1, Target Population, an existing AMI meter was a requirement of the program. Pretreatment data was collected prior to the January 2012 mailings, before any of the potential pilot participants became aware of the new rate. Interval data available prior to September 1, 2011 was found to be of poor quality as the data systems were still in the early stages of set up and configuration. As a result, DTE felt it was best to use September 1, 2011 through December 31, 2011 as the pretreatment period. While formal pilot observations did not start until August 13, 2012, selection of pretreatment data was constrained by customer awareness of the rate on one end (January 2012) and data quality (earlier than September 2011) on the other. A more detailed discussion regarding the enrollment process appears previously in section 3.

Through qualification and demographic survey questions each DPP pilot participant was required to answer, DTE collected data related to housing type, household income, and the existence of central air.

In addition, DTE categorized each DPP pilot customer using customer billing data into two usage groups, medium (3,960 kWh to 12,000 kWh per year) and high (>12,000 kWh per year). DPP pilot customers were placed into multiple groups or "cohorts" for their respective treatment and control group and are listed in Appendix G. Cohorts represent a group of customers with a combination of one or more like demographics.

DTE's AMI rollout is geographically based, meaning that the AMI meter population available cannot be representative of the entire service area until the rollout is complete. The AMI meter population from which the target population was drawn has a greater proportion of high-income residents and a smaller proportion of lower income residents compared to DTE's entire service territory. It is further hypothesized, although the calculations are not yet completed to support it, that customers in the AMI population use higher amounts of discretionary energy usage, creating a proportionately greater opportunity to effect change than may exist for all DTE customers as a whole. This causes the external validity of the study to be questioned.

The sixty customers who have chosen to leave the study and return to the electric rate they used prior to the pilot remain in the study and in the appropriate treatment group to which they were originally assigned. Consistent with DOE's Guidance Document #6, and confirmed in conversations with DTE's TAG, their usage data will continue to be collected and will be analyzed with their original assigned treatment group.

As discussed in more detail in Section 5, DTE removed four customers from the T2 treatment group. Data for these customers was removed from the study since their 24 hour pretreatment average usage was greater than three times the standard deviation of the entire T2 group. These study participants were deemed "outliers," and although they remain in DTE's DPP rate, their data is not being analyzed. The removed customers are not aware that they are no longer being analyzed.

5. Analytical Methodology

For the interim report, DTE felt it was most appropriate to use the comparison of means methodology. Despite its simplicity, the comparison of means approach can be very useful in calculating the effect of a treatment on a group of customers if the control and treatment groups are considered to be from the same population. More information about the ANOVA process to determine the "likeness" of the groupings will be discussed later in this section.

Formal regression models tend to be more useful when estimating load impacts than the comparison of means methodology as they can account for any unobserved effects that may be affecting a customer's energy consumption. Unfortunately, at the time of this report, DTE did not have software capable of doing advanced regression models. In order to be able to include some preliminary results, DTE chose the comparison of means methodology as a way to analyze data for the interim report because of its simplicity and the software that is needed to complete the calculations was readily available within DTE's Load Research Department.

The period covered in this interim report contains two partial summers which included two event days; one of which a portion of the customers did not receive any advanced notification and the other when the forecasted weather never materialized. Demand modeling will be used to calculate load impacts for the final report when the effects of a full summer and more event days can be analyzed. DTE, with the help of Lawrence Berkley National Laboratories, is exploring various statistical software programs to assist with the demand modeling.

The impact of the underlying time-of-use rate on treatment group customers is not addressed in the interim report for the aforementioned reasons. DTE did not see any benefit in sharing the preliminary results from the TOU rate for a period that did not include a full summer, since summer tends to be the focus of the DPP studies. The results of the TOU rate analysis will be included in the final report.

In order for the comparison of means to provide any useful information about how the DPP rate affects energy consumption, the treatment group must prove to be from the same population as the control group. In order to determine if the control group is indeed a counterfactual load of the treatment group, each control group and treatment group combination (C1-T1-T2 and C2-T3-T4) must pass an ANOVA analysis. Because the treatment group customers were placed on the DPP rate at different times during enrollment, in order for the ANOVA analysis to be accurate, the data used must be before the treatment group customers were made aware of the DPP rate. The pretreatment data used for the ANOVA analysis was from September 1, 2011 through December 31, 2011. An ANOVA analysis was not performed on the demographic cohorts, only the treatment and control groups as a whole.

The first step in in the ANOVA analysis was to calculate the hourly mean for each hour of each day of the pretreatment period for the control and treatment groups. From there, each hour was averaged to get 24 unique values for each treatment and control group for the entire pretreatment period (not including weekends and holidays). The equations to calculate the 24 unique hourly values are as follows:

Average kWh usage for customers in experimental group *g* in hour *h* of day *d*

$$kWh_{g,d,h} = \frac{\sum_{i \in g} kWh_{i,d,h}}{I_g}$$

Average kWh usage for customers in experimental group *g* in hour *h* (across all days)

$$kWh_{\boldsymbol{g},\boldsymbol{h}} = \frac{\sum_{\boldsymbol{d}} kWh_{g,d,h}}{D}$$

Where:

$kWh = Electricity\ usage$

$g = Experimental\ group\ (T1, T2, T3, T4, C1, C2)$

$i = Customer\ i\ in\ experimental\ group\ g$

$I_g = Total\ number\ of\ Customers\ in\ group\ g$

$h = Hour\ of\ the\ day\ (1 - 24)$

$d = Day\ of\ the\ pretreatment\ period\ (excluding\ weekends\ and\ holidays)$

$D = Total\ number\ of\ days$

Once average hourly means were calculated for each treatment and control group, an ANOVA analysis with a 95% confidence level was performed in Microsoft Excel but can be performed using any standard statistical analysis software. If the F value is smaller than the F critical value, one can fail to reject the null hypothesis that the means are equal, which is the desired outcome of the ANOVA. If for some reason, the F value is larger than the F critical value, one must reject the null hypothesis that the means are equal. Rejecting the null hypothesis would mean that the control group cannot be considered a counterfactual load of its' paired treatment groups.

As discussed in 3.b.ii. Recruitment, MSI randomized the customers after they qualified for the program and once critical mass was reached. Because the target population was from the same county in Michigan (Oakland), it was believed that all the participants would have approximately the same usage patterns and levels and that randomization would produce comparable groups. This was not the case. At the recommendation of the TAG, ANOVA was performed on the control and treatment groups which indicated that the null hypothesis could not be accepted for the C1-T1-T2 grouping (i.e. these groups did not have equivalent loads and were deemed inappropriate for use in comparison studies). In hindsight, the ANOVA analysis should have been performed on the randomized groups before customers were notified of their acceptance or denial. This would have allowed for re-randomization to address the issue. However, there was no reason to believe that the groups would be different.

Through further analysis and graphing of each group's pretreatment data, it was determined that the ANOVA was returning an F value much larger than the F critical value for the C1-T1-T2 grouping as a result of the T2 group having abnormally high hourly usage when compared to the T1 and C1 groups. Once it was learned why the ANOVA was failing for this grouping, DTE had discussions with their consultant about different ways to proceed with the analysis to fix the high usage bias by the T2 group. The first method that was explored was propensity score matching[5]. However, this method was quickly ruled out as it was determined DTE did not have sufficient data.

Upon examination of the individual groups, it was observed that the demographics of the T2 treatment group were much different than the C1 and T1 groups. Table 14 shows the disproportion of high usage customers, high income customers (>$75K) and households with central air conditioning between the C1 control group and the T1 and T2 treatment groups. The disproportion between these three demographics seemed to explain why the C1-T1-T2 ANOVA failed.

Table 14: Percentages of Demographics of C1-T1-T2

[5] Propensity score matching involves matching customers who are not in the treatment with customers who are in the treatment based on similar characteristics.

	C1	T1	T2
Income >$75K	52.74%	58.63%	62.05%
High Usage	25.07%	26.51%	32.05%
With Central A/C	71.18%	82.73%	81.79%

A “trimmed down” methodology was explored to better “equalize” the demographics across the C1-T1-T2 groups. This was done through a randomization process which resulted in 558 customers being removed from the analysis portion of the study. While this approach resulted in all the groupings passing the ANOVA, the method was not fully endorsed by the TAG due to the large amount of customer data that would not be analyzed. It was subsequently determined that the best way to improve comparability, was to reduce the average kWh usage by the T2 group. This “outlier methodology” resulted in removing four T2 customers from the analysis whose 24 hour pretreatment usage was greater than three times the standard deviation of the entire T2 treatment group. The outlier methodology is based on the characteristics of a normal distribution where 99.87% of the data appear in this range. This approach yielded a C1-T1-T2 grouping that was no longer statistically different from one another. It should be noted that the four customers who have been removed from analysis are still on the DPP rate and their data is still being collected; however, for purposes of the analysis presented in this report, their data will not be included.

Once the groupings (C1-T1-T2, C2-T3-T4) pass the ANOVA analysis, the treatment and control groups can be considered counterfactual loads of each other. In being considered a counterfactual load, at any time during the pretreatment phase of the study (September 1, 2011 – December 31, 2011), the treatment and control groups would have the same average customer kWh usage. Any change in behavior since the inception of the DPP program by the treatment groups can be attributed to the change in their electric rate. The comparison of means approach can calculate the magnitude of this change by subtracting the average customer hourly load for the control group from the average customer hourly load for the treatment group. This difference between the two average means is considered the impact metric. The control group is subtracted from the treatment group to show a kWh reduction as a negative number. The formulas to calculate the load impact is as follows:

Average kWh usage for customers in experimental group *g* in hour *h* of event day *d*

$$kWh_{g,d,h} = \frac{\sum_{i \in g} kWh_{i,d,h}}{I_g}$$

Where:

$kWh = Electricity\ usage$

$g = Experimental\ group\ (T1, T2, T3, T4, C1, C2)$

$i = Customer\ i\ in\ experimental\ group\ g$

$I_g = Total\ number\ of\ Customers\ in\ group\ g$

$h = Hour\ of\ the\ day\ (1-24)$

$d = Event\ day\ of\ the\ treatment\ period$

Comparison of means

$$Y_{g\in T,d,h} = kWh_{g\in T,d,h} - kWh_{g\in C,d,h}$$

$T = Experimental\ treatment\ group\ (T1, T2, T3, T4)$

$C = Experimental\ control\ group\ (C1, C2)$

To construct the 95% confidence interval around the load impact, DTE used the pooled estimate of the common standard deviation. In using the pooled estimate of the common standard deviation to calculate confidence intervals, the confidence interval will provide a range of values of the difference between the control and treatment group during any given time on an event day. The formula for the pooled estimate of the common standard deviation is as follows:

$$Sp_t = \sqrt{\frac{(Count_{c,t}-1){s_{c,t}}^2 + (Count_{d,t}-1){s_{d,t}}^2}{Count_{c,t} + Count_{d,t} - 2}}$$

Where:

$Sp_t = Pooled\ estimate\ of\ common\ standard\ deviation\ at\ time\ t$

$Count_{c,t} = Number\ of\ successful\ control\ group\ meter\ reads\ at\ time\ t$

$Count_{d,t} = Number\ of\ successful\ treatment\ group\ meter\ reads\ at\ time\ t$

$s_{c,t} = Standard\ deviation\ of\ the\ control\ group\ kWh\ meter\ reads\ at\ time\ t$

$s_{d,t} = Standard\ deviation\ of\ the\ treatment\ group\ kWh\ meter\ reads\ at\ time\ t$

Once the pooled estimate of the common standard deviation is available, the confidence interval around the impact metric is calculated with the following formula:

$$CI_t = Y_t +/- ZSp_t\sqrt{\frac{1}{Count_{c,t}} + \frac{1}{Count_{d,t}}}$$

Where:

$CI_t = Confidence\ Interval\ at\ time\ t$

$Y_t = Impact\ metric\ at\ time\ t$

$$Z = Z\ score\ at\ desired\ confidence\ level$$

$$Sp_t = Pooled\ estimate\ of\ common\ standard\ deviation\ at\ time\ t$$

$$Count_{c,t} = Number\ of\ successful\ control\ group\ meter\ reads\ at\ time\ t$$

$$Count_{d,t} = Number\ of\ successful\ treatment\ group\ meter\ reads\ at\ time\ t$$

If the calculated confidence interval does not include zero, the impact metric is said to be statistically significant. With the impact metric being statistically significant, DTE can specify the direction of the effect (DPP rate), whether it be positive and customers increase their energy use or negative and customers decrease their energy use. Hours that are considered statistically significant are indicated by an asterisk next to the hour in tables that appear in section 6.a.

6. Results

6.a Impact Evaluation Results

CPP days or "events" are described previously in Section 3.a.ii. The first event DTE called was on August 16, 2012. The forecast for that day indicated a high near 90°F. However, this high temperature never materialized. The average temperature for this day was 73° F, with a high of 83° F, and average temperature of 79° F during the event period (HE 16-HE 19). After the event, it was learned that nearly a third of the customers in the treatment groups did not receive any sort of signal informing them of the event day. DTE later determined that T1 and T2 groups were most affected by the notification failures, with nearly 40 percent of T1 and nearly 25 percent of T2 not receiving notice. The analyses for the four treatment groups were all performed using the data as it was received. Customers who did not get notified were still included in the event day analysis.

Table 15: C1-T1 Demands (Event Day 1 – All Hours)

C1-T1 Demands - Event Day 1 - All Hours						
Hour Ending	C1 Demand	T1 Demand	Impact	Impact %	Lower Bound	Upper Bound
1	1.095	1.164	0.069	6.31%	(0.106)	0.244
2	0.986	1.002	0.016	1.63%	(0.142)	0.174
3	0.911	0.925	0.014	1.57%	(0.132)	0.160
4	0.851	0.869	0.018	2.17%	(0.104)	0.141
5	0.822	0.842	0.021	2.51%	(0.094)	0.136
6	0.885	0.874	(0.011)	-1.27%	(0.135)	0.113
7	1.001	0.941	(0.059)	-5.91%	(0.195)	0.077
8	1.001	0.943	(0.057)	-5.73%	(0.189)	0.074
9	0.983	0.967	(0.016)	-1.62%	(0.153)	0.121
10	0.967	1.029	0.063	6.48%	(0.089)	0.215
11	1.041	1.127	0.086	8.30%	(0.088)	0.261
12	1.133	1.216	0.082	7.28%	(0.109)	0.273
13	1.170	1.256	0.085	7.29%	(0.112)	0.282
14	1.194	1.280	0.086	7.20%	(0.111)	0.283
15	1.209	1.317	0.108	8.92%	(0.100)	0.316
16	1.262	1.304	0.042	3.35%	(0.165)	0.250
17	1.389	1.424	0.035	2.53%	(0.197)	0.267
18	1.461	1.527	0.066	4.51%	(0.179)	0.311
19	1.467	1.589	0.122	8.35%	(0.125)	0.248
20	1.523	1.629	0.106	6.98%	(0.136)	0.349
21	1.631	1.688	0.057	3.51%	(0.187)	0.302
22	1.666	1.721	0.055	3.30%	(0.189)	0.299
23	1.480	1.691	0.211	14.26%	(0.028)	0.450
24*	1.209	1.418	0.209	17.27%	0.083	0.335
Total Energy*	**28.336**	**29.746**	**1.410**	**4.97%**	**1.251**	**1.568**

Table 15 displays the hourly demands for the C1 customers compared to the T1 customers. By looking at the hourly demands, it appears that the T1 group did not adjust their energy consumption in reaction to the first event. The only hour that shows a statistically significant difference from the control group, is HE 24. On average, the T1 customers use statistically significant more energy during this hour, so the increase in demand for HE 24 is likely not a direct cause of the event and more likely attributed to the underlying TOU rate. As previously discussed, nearly 30% of T1 customers did not get notified that an event day was taking place which would result in no energy reduction occurring during the critical peak time by those customers. The notification errors are likely the rationale for no observable behavior change by the T1 group on the first event day. T1 customers have no technology to aid them in reducing their load, which may have had and influence on their event day behavior, or lack thereof. More analysis will need to be performed to determine whether or not the education only group (T1) can make meaningful changes in their energy usage.

Table 16: C1-T2 Demands (Event Day 1 – All Hours)

C1-T2 Demands - Event Day 1 - All Hours						
Hour Ending	C1 Demand	T2 Demand	Impact	Impact %	Lower Bound	Upper Bound
1	1.095	1.247	0.152	13.90%	(0.005)	0.310
2	0.986	1.059	0.074	7.46%	(0.061)	0.208
3	0.911	0.974	0.063	6.94%	(0.061)	0.188
4	0.851	0.916	0.065	7.65%	(0.047)	0.177
5	0.822	0.874	0.053	6.40%	(0.053)	0.158
6	0.885	0.909	0.024	2.75%	(0.092)	0.141
7	1.001	1.009	0.009	0.87%	(0.111)	0.128
8	1.001	1.084	0.084	8.37%	(0.042)	0.209
9	0.983	1.074	0.091	9.24%	(0.039)	0.221
10	0.967	1.072	0.105	10.83%	(0.033)	0.242
11	1.041	1.169	0.128	12.31%	(0.032)	0.289
12	1.133	1.284	0.151	13.31%	(0.032)	0.333
13*	1.170	1.413	0.242	20.71%	0.042	0.442
14	1.194	1.384	0.190	15.91%	(0.010)	0.390
15	1.209	1.365	0.156	12.91%	(0.037)	0.350
16	1.262	1.228	(0.034)	-2.73%	(0.210)	0.141
17	1.389	1.361	(0.028)	-2.02%	(0.224)	0.168
18	1.461	1.339	(0.122)	-8.33%	(0.315)	0.072
19*	1.467	1.354	(0.113)	-7.70%	(0.300)	(0.018)
20	1.523	1.528	0.005	0.31%	(0.193)	0.203
21	1.631	1.704	0.073	4.45%	(0.131)	0.277
22	1.666	1.800	0.134	8.02%	(0.080)	0.348
23*	1.480	1.719	0.239	16.16%	0.019	0.459
24*	1.209	1.525	0.316	26.11%	0.216	0.416
Total Energy*	**28.336**	**30.391**	**2.055**	**7.25%**	**1.905**	**2.205**

Table 16 shows the hourly demands for the T2 group compared to the C1 group during the first event. There are still questions concerning how representative the C1 control group is of the T2 treatment group even with the outliers removed. Because of this, the true impact of the event day could be being masked by the treatment group having higher hourly usage than the control group, despite passing the ANOVA test. It appears that there is some attempt at a load reduction by the T2 group in HE 16 through HE19 as the group did not follow what would be thought of as a normal load pattern during the event hours as can be seen in Figure 12. Between the known communication errors that affected the T2 customers' receipt of day ahead notification, and the high usage bias that exists within the T2 group, DTE does not believe that there is enough credible information to make a conclusion about the behavior of the T2 customers on an event day. There is a change in the load curve during the event period but it cannot be determined to what extent.

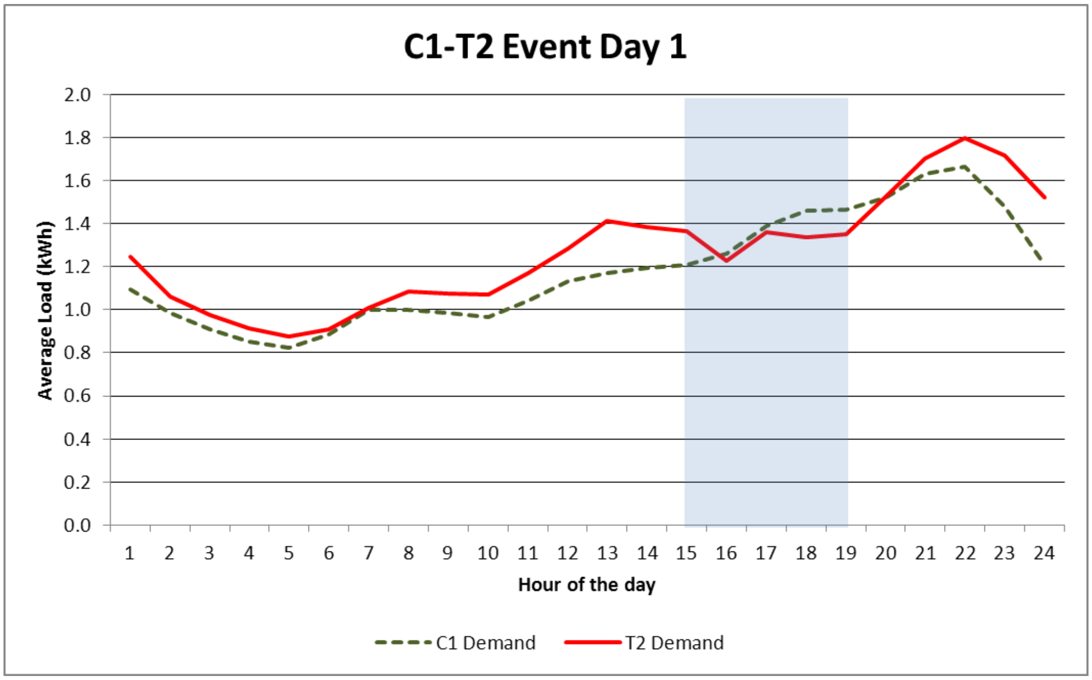

Figure 12: T2 Event Day 1

Table 17: C2-T3 Demands (Event Day 1 – All Hours)

C2-T3 Demands - Event Day 1 - All Hours						
Hour Ending	C2 Demand	T3 Demand	Impact	Impact %	Lower Bound	Upper Bound
1	1.140	1.202	0.061	5.39%	(0.088)	0.211
2	1.019	1.034	0.015	1.48%	(0.122)	0.152
3	0.923	0.934	0.012	1.26%	(0.106)	0.130
4	0.855	0.844	(0.012)	-1.37%	(0.115)	0.092
5	0.832	0.788	(0.044)	-5.33%	(0.138)	0.050
6	0.869	0.895	0.026	3.03%	(0.080)	0.133
7	0.932	0.971	0.039	4.13%	(0.079)	0.156
8*	1.045	0.858	(0.187)	-17.93%	(0.304)	(0.071)
9*	1.065	0.878	(0.187)	-17.59%	(0.319)	(0.056)
10*	1.125	0.917	(0.208)	-18.50%	(0.355)	(0.061)
11*	1.253	0.983	(0.270)	-21.55%	(0.442)	(0.099)
12*	1.403	1.111	(0.292)	-20.83%	(0.500)	(0.085)
13*	1.494	1.151	(0.343)	-22.97%	(0.557)	(0.130)
14*	1.472	1.152	(0.320)	-21.75%	(0.520)	(0.120)
15*	1.385	1.135	(0.249)	-18.01%	(0.434)	(0.065)
16*	1.512	0.952	(0.560)	-37.03%	(0.740)	(0.380)
17*	1.657	1.048	(0.609)	-36.73%	(0.809)	(0.408)
18*	1.714	1.093	(0.622)	-36.25%	(0.817)	(0.426)
19*	1.810	1.111	(0.699)	-38.64%	(0.904)	(0.595)
20*	1.815	1.562	(0.252)	-13.90%	(0.479)	(0.025)
21*	1.798	1.561	(0.237)	-13.18%	(0.442)	(0.032)
22*	1.858	1.589	(0.269)	-14.46%	(0.474)	(0.063)
23*	1.782	1.466	(0.316)	-17.74%	(0.512)	(0.120)
24	1.518	1.487	(0.030)	-2.00%	(0.162)	0.102
Total Energy*	**32.275**	**26.721**	**(5.554)**	**-17.21%**	**(5.732)**	**(5.377)**

The T3 group reduced their total energy usage by an average of 5.554 kWh or 17.2% on the event day as indicated in Table 17. These customers began reducing their load beginning in HE 8 and maintained a statistically significant reduction until HE 23. The table further exemplifies that the T3 group has reduced their overall daily load. During off-peak hours (HE 24 – HE 7), when the energy charge is the lowest, the T3 group is always within 100 kWh of the control group. Once the price increased, during the on peak hours, they reduced their hourly energy usage (compared to the C2 group) an average of 261 kWh (not including the event hours). Even during the "payback period" immediately following the event, the T3 group did not increase their load to levels equal to or above the C2 group. This behavior gives the indication that the T3 group is experiencing some energy conservation as a result of the underlying TOU rate. The T3 group reduced their load during the event hours by 37.2% when compared to the C2 control group. The event period can be seen in Table 18.

Table 18: C2-T3 Demands (Event Day 1 – Event Hours)

C2-T3 Demands - Event Day 1 - Critical Peak Hours				
Hour Ending	C2 Demand	T3 Demand	Impact	Impact %
16*	1.512	0.952	-0.560	-37.03%
17*	1.657	1.048	-0.609	-36.73%
18*	1.714	1.093	-0.622	-36.25%
19*	1.810	1.111	-0.699	-38.64%
Total	**6.693**	**4.204**	**-2.489**	**-37.19%**

Once the event concluded, the T3 group increased energy usage during HE 20 and then for the last four hours of the day resumed its normal load shape. This increase in load was expected to occur after the event period but for a longer period of time. This shows that the customers in this treatment group delayed energy usage activities until after the event ended and then started and maintained those activities until hour 20 where again normal activities occurred. Also, this group did not seem to increase their load before the event period started. Figure 13 shows the T3 load curve compared to the C2 load curve.

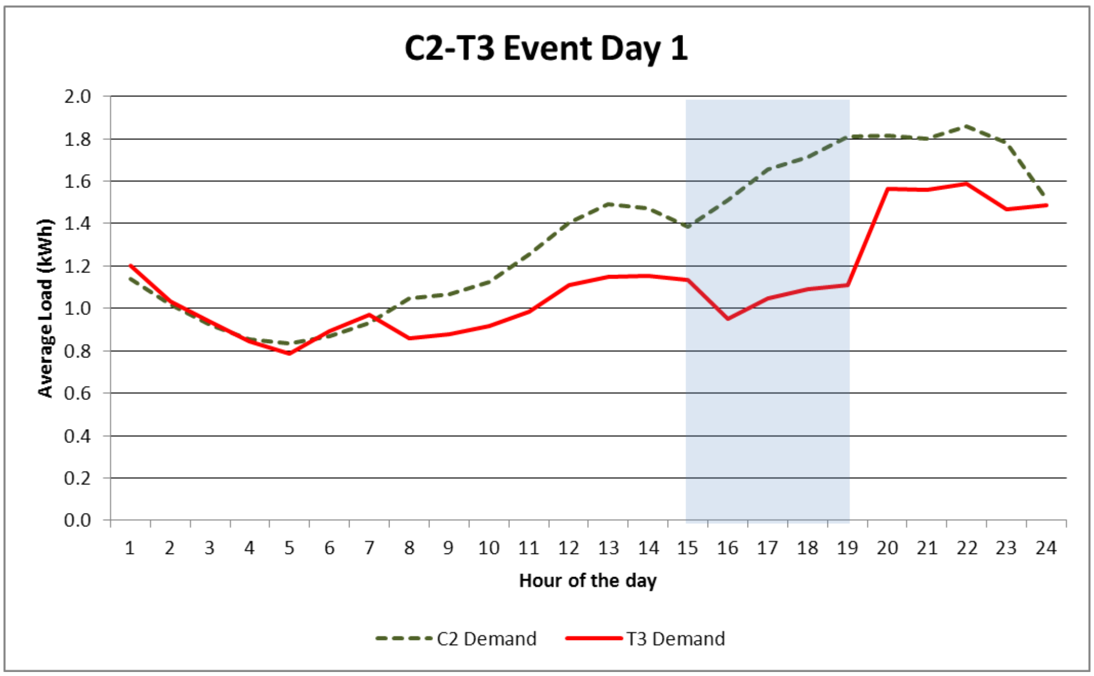

Figure 13: C2-T3 (Event Day 1)

Table 19: C2-T4 Demands (Event Day 1 – All Hours)

C2-T4 Demands - Event Day 1 - All Hours						
Hour Ending	C2 Demand	T4 Demand	Impact	Impact %	Lower Bound	Upper Bound
1	1.140	1.229	0.088	7.76%	(0.055)	0.232
2	1.019	1.040	0.021	2.04%	(0.111)	0.153
3	0.923	0.902	(0.021)	-2.24%	(0.132)	0.090
4	0.855	0.829	(0.027)	-3.11%	(0.126)	0.073
5	0.832	0.784	(0.048)	-5.79%	(0.140)	0.043
6	0.869	0.856	(0.013)	-1.46%	(0.114)	0.089
7	0.932	0.989	0.057	6.13%	(0.060)	0.174
8	1.045	0.965	(0.081)	-7.71%	(0.197)	0.035
9	1.065	0.975	(0.090)	-8.41%	(0.223)	0.044
10*	1.125	0.957	(0.168)	-14.89%	(0.313)	(0.022)
11*	1.253	0.984	(0.270)	-21.52%	(0.434)	(0.105)
12*	1.403	1.023	(0.380)	-27.07%	(0.572)	(0.187)
13*	1.494	1.171	(0.322)	-21.59%	(0.539)	(0.106)
14*	1.472	1.219	(0.253)	-17.17%	(0.457)	(0.049)
15	1.385	1.205	(0.180)	-12.97%	(0.375)	0.015
16*	1.512	0.967	(0.545)	-36.03%	(0.720)	(0.370)
17*	1.657	0.985	(0.672)	-40.56%	(0.856)	(0.488)
18*	1.714	1.098	(0.616)	-35.95%	(0.808)	(0.424)
19*	1.810	1.158	(0.652)	-36.02%	(0.855)	(0.549)
20	1.815	1.611	(0.204)	-11.24%	(0.420)	0.012
21	1.798	1.698	(0.100)	-5.57%	(0.304)	0.104
22	1.858	1.728	(0.129)	-6.97%	(0.335)	0.076
23	1.782	1.678	(0.104)	-5.84%	(0.303)	0.094
24	1.518	1.622	0.104	6.88%	(0.019)	0.228
Total Energy*	**32.275**	**27.673**	**(4.602)**	**-14.26%**	**(4.791)**	**(4.413)**

The customers in the T4 group reduced their load a total of 14.3% during the event day when compared to the C2 control group, as shown in Table 19. A statistically significant reduction in load began during HE 10 and was maintained until HE 14. While there was a reduction that occurred in HE 15 by the T4 group, it is not considered statistically significant. Once the event period began, the T4 group again reduced their load a statistically significant amount and sustained that reduction through the entire four hour event. Early indications from the reduction in energy consumption throughout the day, are that the T4 customers have modified their behavior to reduce their total energy load throughout the day, not just during the on-peak hours. The event hours do see the biggest reduction compared to the C2 load, with total load reduction during the four hour span of 37.1%.

Table 20: C2-T4 Demands (Event Day 1 – Event Hours)

C2-T4 Demands - Event Day 1 - Critical Peak Hours				
Hour Ending	C2 Demand	T4 Demand	Impact	Impact %
16*	1.512	0.967	-0.545	-36.03%
17*	1.657	0.985	-0.672	-40.56%
18*	1.714	1.098	-0.616	-35.95%
19*	1.810	1.158	-0.652	-36.02%
Total	**6.693**	**4.208**	**-2.485**	**-37.13%**

The total reduction during the on peak hours was 2.485 kWh. What is interesting about this T4 group is that after the event period completed, the load increased (while still staying below the C2 counterfactual load) until hour 22 and then for the last two hours of the day, load decreased somewhat but not to this group's normal load pattern. This increase in load, the payback period, was expected to occur after the event period but this group maintained the increase in load for a longer time period than expected. Figure 14 displays the C2 and T4 load curves for the first event day.

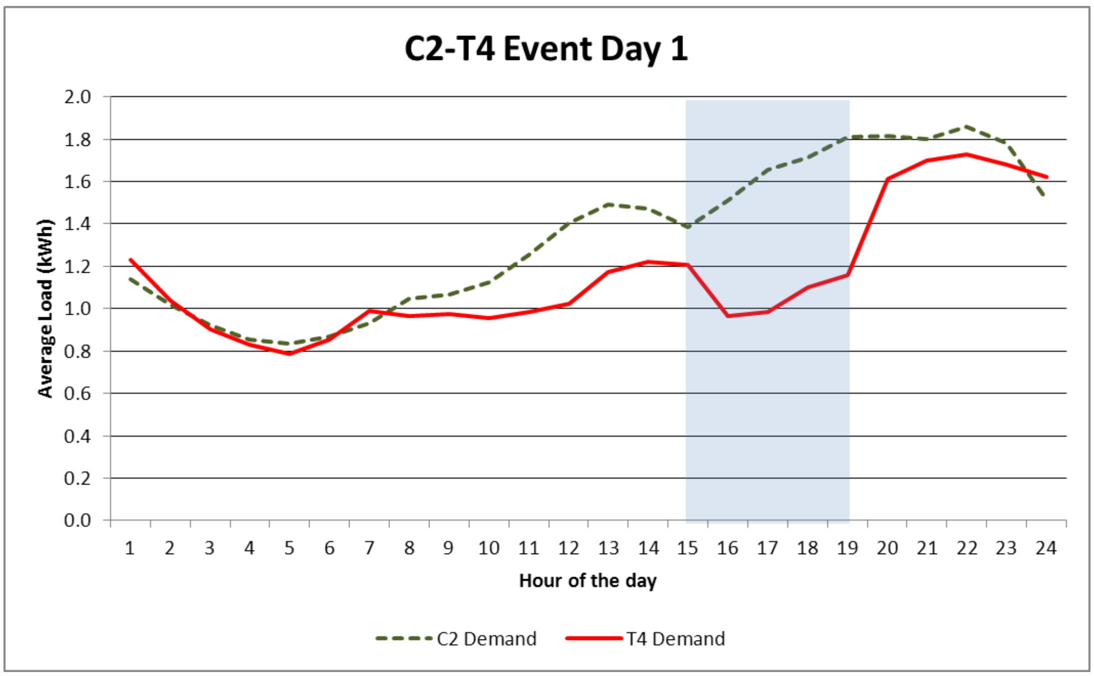

Figure 14: C2-T4 (Event Day 1)

Event 2 (5-30-2013)

The second CPP event day took place on May 30, 2013. The average temperature for the day was 75° F, with a high of 88° F, and an average of 77° F during the event period. Unlike the first event day, DTE did not experience any issues with customers not receiving day-ahead notifications.

Table 21: C1-T1 Demands (Event Day 2 – All Hours)

C1-T1 Demands - Event Day 2 - All Hours						
Hour Ending	C1 Demand	T1 Demand	Impact	Impact %	Lower Bound	Upper Bound
1	1.066	1.123	0.057	5.33%	(0.120)	0.234
2	0.894	0.936	0.042	4.75%	(0.111)	0.196
3	0.823	0.821	(0.002)	-0.25%	(0.138)	0.133
4	0.780	0.805	0.025	3.19%	(0.112)	0.162
5	0.772	0.786	0.014	1.86%	(0.112)	0.140
6	0.817	0.839	0.022	2.66%	(0.107)	0.151
7	0.943	0.960	0.017	1.78%	(0.133)	0.167
8	0.927	0.990	0.064	6.86%	(0.074)	0.201
9	0.896	0.987	0.090	10.09%	(0.057)	0.238
10	0.932	0.962	0.029	3.15%	(0.128)	0.187
11	1.060	1.004	(0.056)	-5.27%	(0.233)	0.121
12	1.136	1.119	(0.017)	-1.48%	(0.213)	0.179
13	1.214	1.337	0.122	10.08%	(0.101)	0.346
14	1.304	1.505	0.200	15.36%	(0.049)	0.449
15	1.377	1.465	0.088	6.38%	(0.163)	0.338
16	1.411	1.290	(0.121)	-8.55%	(0.367)	0.126
17	1.615	1.394	(0.221)	-13.66%	(0.492)	0.051
18	1.720	1.454	(0.267)	-15.50%	(0.538)	0.005
19*	1.742	1.516	(0.226)	-12.98%	(0.499)	(0.087)
20	1.728	1.699	(0.029)	-1.70%	(0.290)	0.231
21	1.772	1.695	(0.078)	-4.38%	(0.330)	0.174
22	1.784	1.750	(0.034)	-1.91%	(0.280)	0.212
23	1.597	1.623	0.026	1.60%	(0.205)	0.256
24	1.357	1.398	0.041	3.03%	(0.156)	0.238
Total Energy*	**29.669**	**29.457**	**(0.212)**	**-0.71%**	**(0.410)**	**(0.014)**

Table 21 shows that the T1 customers behaved much like they did during the first event day despite the higher incidence of notification success. Only during one hour (HE 19) did they use a statistically significant lower amount of energy. By looking at the confidence intervals, DTE can speculate that the majority of T1 customers did react to the event as the confidence intervals tend to mostly reside on the negative side of zero during HE 16 – HE 19. Despite only one hour showing a statistically significant reduction in energy consumption, T1 did use 212 kWh less energy than the C1 group during the entire event day, a number that is statistically significant. In Table 22, it can be seen that the T1 customers used 0.834 kWh less energy than the C1 customers during the critical peak period on the second event day, but again, this is not a statistically significant finding during the event hours.

Table 22: C1-T1 Demands (Event Day 2 – Event Hours)

C1-T1 Demands - Event Day 2 - Critical Peak Hours				
Hour Ending	C1 Demand	T1 Demand	Impact	Impact %
16	1.411	1.290	-0.121	-8.55%
17	1.615	1.394	-0.221	-13.66%
18	1.720	1.454	-0.267	-15.50%
19*	1.742	1.516	-0.226	-12.98%
Total	**6.488**	**5.654**	**-0.834**	**-12.85%**

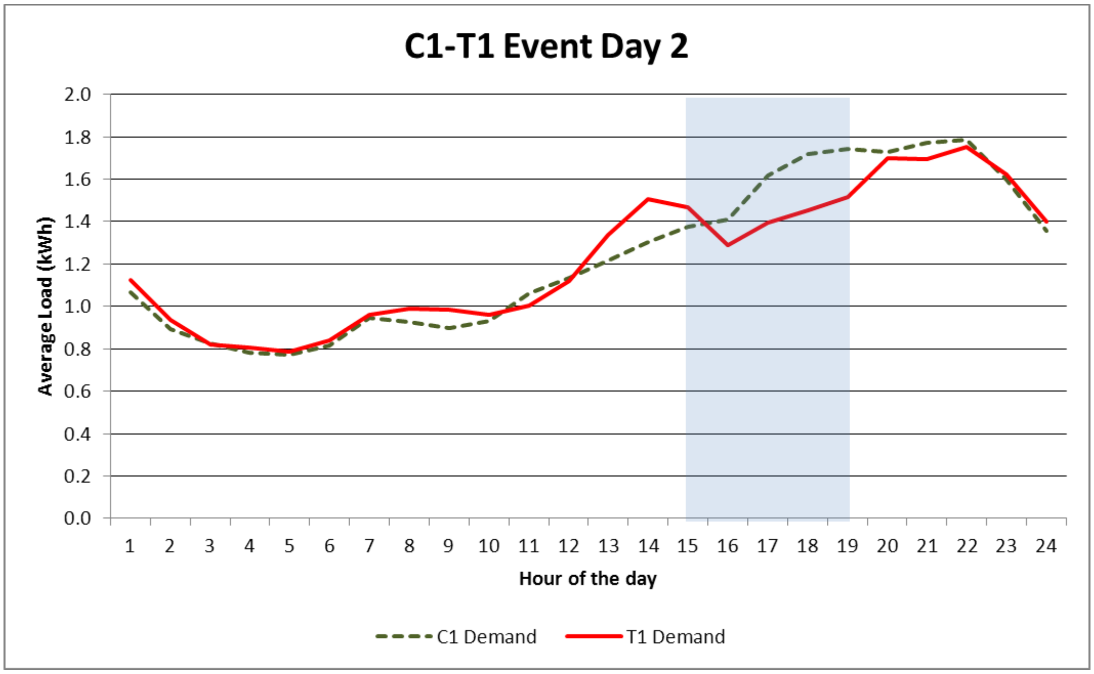

Figure 15: C1-T1 (Event Day 2)

Figure 15 shows the load curves from the C1 and T1 groups during the second event day. The T1 curve indicates an increase in energy consumption before the event and then a reduction at the beginning of the event. After the first hour of the event, the curve starts trending up until it returns to T1's normal load shape. So while all indications are that the T1 customers are attempting to reduce their load by shifting their energy use to before the event (as evident by the large increase in energy consumption in the hours directly preceding the event), their reductions during the event are not statistically significant.

Table 23: C1-T2 Demands (Event Day 2 – All Hours)

C1-T2 Demands - Event Day 2 - All Hours						
Hour Ending	C1 Demand	T2 Demand	Impact	Impact %	Lower Bound	Upper Bound
1	1.066	1.182	0.116	10.89%	(0.043)	0.275
2*	0.894	1.045	0.151	16.87%	0.007	0.294
3*	0.823	0.959	0.135	16.43%	0.005	0.265
4	0.780	0.868	0.089	11.36%	(0.028)	0.205
5	0.772	0.859	0.087	11.32%	(0.029)	0.204
6	0.817	0.890	0.073	8.92%	(0.043)	0.189
7	0.943	1.012	0.069	7.31%	(0.053)	0.191
8*	0.927	1.067	0.140	15.08%	0.018	0.262
9	0.896	0.969	0.073	8.15%	(0.048)	0.194
10	0.932	1.069	0.137	14.71%	(0.015)	0.289
11	1.060	1.171	0.111	10.47%	(0.062)	0.284
12	1.136	1.286	0.150	13.21%	(0.039)	0.339
13*	1.214	1.454	0.239	19.72%	0.026	0.453
14*	1.304	1.558	0.253	19.43%	0.024	0.483
15	1.377	1.519	0.142	10.29%	(0.080)	0.363
16	1.411	1.297	(0.114)	-8.07%	(0.329)	0.102
17	1.615	1.430	(0.185)	-11.43%	(0.432)	0.063
18	1.720	1.491	(0.230)	-13.34%	(0.473)	0.014
19*	1.742	1.501	(0.241)	-13.83%	(0.476)	(0.121)
20	1.728	1.896	0.168	9.74%	(0.079)	0.416
21	1.772	1.963	0.190	10.74%	(0.059)	0.439
22	1.784	1.970	0.185	10.38%	(0.051)	0.421
23	1.597	1.771	0.174	10.91%	(0.036)	0.385
24*	1.357	1.491	0.134	9.88%	0.009	0.259
Total Energy*	**29.669**	**31.718**	**2.049**	**6.90%**	**1.842**	**2.255**

Table 23 shows the hourly demands for the T2 and C1 groups for the second event day. Much like the T1 group, there appears to be some effort by the T2 customers to reduce their load during the critical peak period, but the reductions are not statistically significant outside of HE 19. It also appears that the T2 group used a statistically significant amount of more energy on the event day than did the C1 group, which is more than likely attributed to the existing high usage bias as there does not seem to be a correlation between a TOU price structure and an increase in daily energy consumption.

Table 24: C1-T2 Demands (Event Day 2 – Event Hours)

C1-T2 Demands - Event Day 2 - Critical Peak Hours				
Hour Ending	C1 Demand	T1 Demand	Impact	Impact %
16	1.411	1.290	-0.121	-8.55%
17	1.615	1.394	-0.221	-13.66%
18	1.720	1.454	-0.267	-15.50%
19*	1.742	1.516	-0.226	-12.98%
Total	**6.488**	**5.654**	**-0.834**	**-12.85%**

T2 appears to have used 0.834 kWh less than the C1 group during the event hours, but this reduction is not statistically significant. This data point simply allows DTE to speculate that there was some sort of effort made by the T2 customers to reduce their energy consumption during the event.

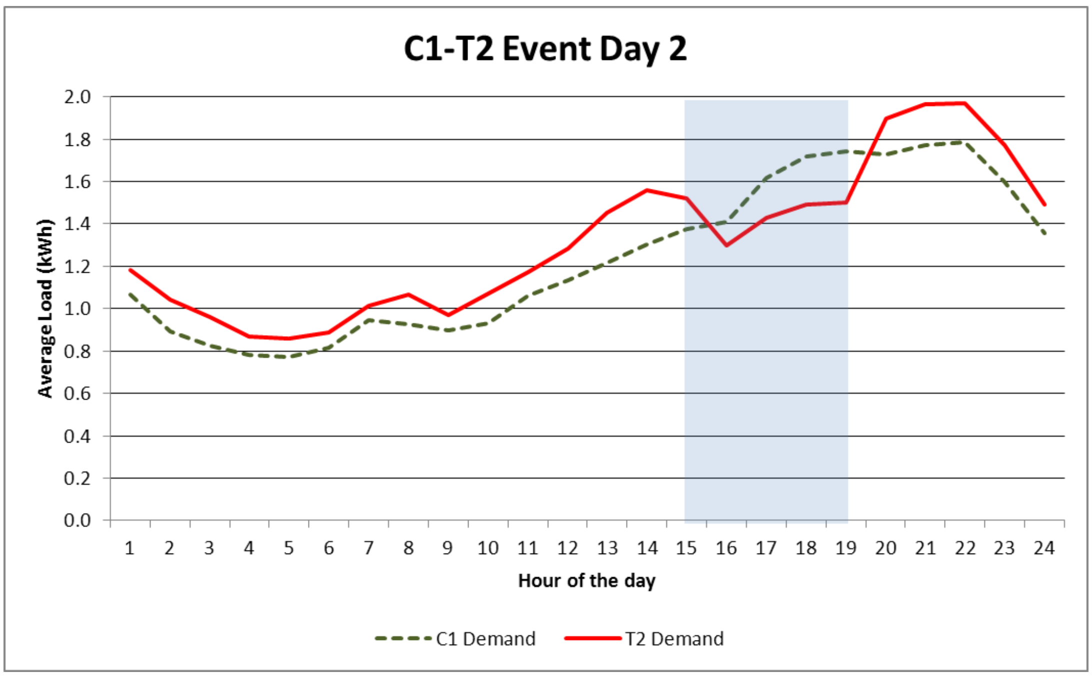

Figure 16: C1-T2 (Event Day 2)

By looking the load curves in Figure 16, T2 does reduce their load from their normal load pattern during the event hours. One might speculate that the reductions during this period are not statistically significant because of the high usage bias that exists within the T2 group. It can be seen above that the T2 curve is consistently above the C1 control curve in all the non-event hours. Much like the first event day, DTE does not believe there is enough credible information to draw conclusions about the T2 group's behavior on the second event day. For the final report, more analytical approaches will be explored that reduce this bias and provide DTE with valuable information about these customers.

Table 25: C2-T3 Demands (Event Day 2 – All Hours)

C2-T3 Demands - Event Day 2 - All Hours						
Hour Ending	C2 Demand	T3 Demand	Impact	Impact %	Lower Bound	Upper Bound
1	1.093	1.179	0.086	7.90%	(0.074)	0.247
2	0.900	1.010	0.110	12.25%	(0.024)	0.245
3	0.813	0.870	0.057	7.00%	(0.059)	0.173
4	0.785	0.787	0.003	0.33%	(0.101)	0.106
5	0.745	0.766	0.021	2.76%	(0.071)	0.112
6	0.785	0.810	0.026	3.27%	(0.068)	0.119
7	0.984	0.965	(0.020)	-1.99%	(0.149)	0.110
8	1.007	0.925	(0.082)	-8.12%	(0.207)	0.044
9	1.003	0.891	(0.112)	-11.15%	(0.236)	0.012
10	1.020	0.927	(0.092)	-9.06%	(0.227)	0.043
11	1.116	1.040	(0.076)	-6.81%	(0.248)	0.096
12*	1.267	1.068	(0.199)	-15.69%	(0.396)	(0.002)
13*	1.445	1.172	(0.273)	-18.91%	(0.494)	(0.052)
14*	1.585	1.250	(0.336)	-21.17%	(0.558)	(0.113)
15	1.505	1.337	(0.169)	-11.20%	(0.381)	0.044
16*	1.577	1.076	(0.501)	-31.75%	(0.707)	(0.294)
17*	1.803	1.182	(0.621)	-34.46%	(0.845)	(0.397)
18*	1.867	1.197	(0.669)	-35.85%	(0.880)	(0.458)
19*	1.948	1.257	(0.690)	-35.44%	(0.912)	(0.577)
20	1.899	1.672	(0.227)	-11.97%	(0.456)	0.001
21	1.748	1.726	(0.022)	-1.26%	(0.234)	0.190
22	1.838	1.758	(0.079)	-4.31%	(0.300)	0.142
23	1.661	1.617	(0.044)	-2.66%	(0.248)	0.160
24*	1.359	1.670	0.311	22.86%	0.188	0.433
Total Energy*	**31.752**	**28.153**	**(3.599)**	**-11.34%**	**(3.810)**	**(3.388)**

Table 25 shows that the T3 group reduced their total energy load by 3.599 kWh, or 11.3% on the May 30 event day. A statistically significant reduction occurred between HE 12 through H14 and again between HE 16 and HE 19. During the event period, the T3 group shed 2.481 kWh or 34.5% when compared to the C2 group.

Table 26: C2-T3 Demands (Event Day 2 – Event Hours)

C2-T3 Demands - Event Day 2 - Critical Peak Hours				
Hour Ending	C2 Demand	T3 Demand	Impact	Impact %
16*	1.577	1.076	-0.501	-31.75%
17*	1.803	1.182	-0.621	-34.46%
18*	1.867	1.197	-0.669	-35.85%
19*	1.948	1.257	-0.690	-35.44%
Total	**7.195**	**4.713**	**-2.481**	**-34.49%**

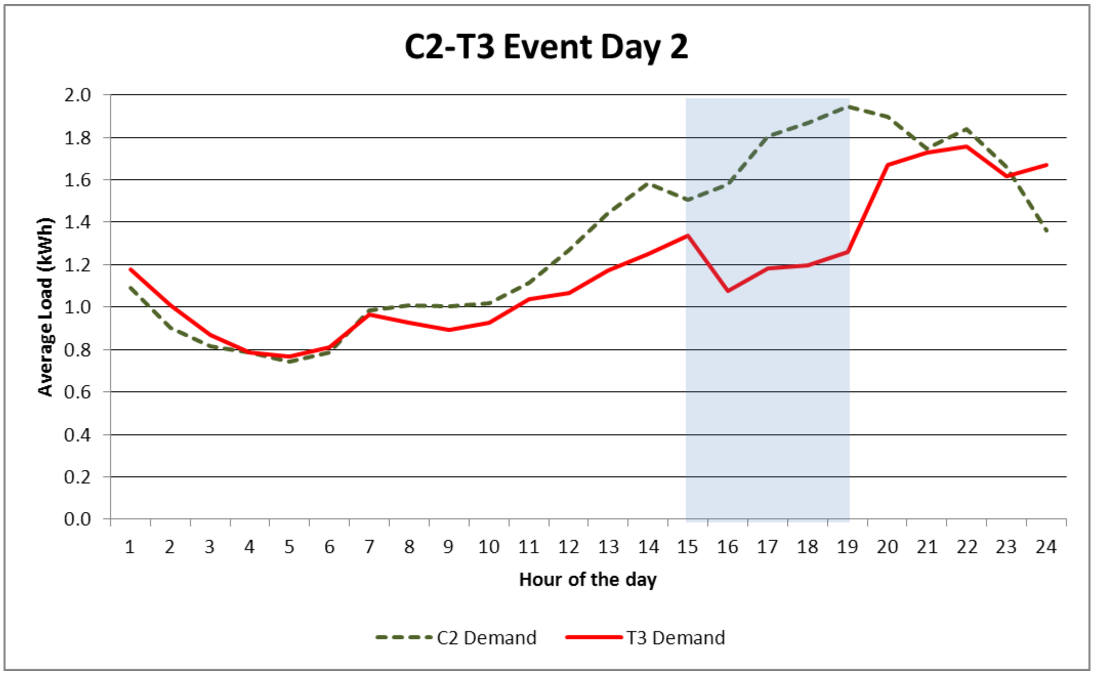

Figure 17: C2-T3 (Event Day 2)

Figure 17 shows that both the T3 and the C2 groups increased their load in the hours leading up to the event. However, T3 increased their load at a slower rate, which could be a result of the TOU pricing. Once the event began, T3 reduced load while the C2 group increased load, and the difference between the kWh used during this hour, along with the other critical peak hours, is statistically significant. Once the event concluded, T3 increased energy consumption, while the C2 group reduced. This is evidence that the T3 group waited until the conclusion of the event to begin energy using activities. It took until HE 24 for the T3 group to use more energy than the C2 group.

Table 27: C2-T4 Demands (Event Day 2 – All Hours)

C2-T4 Demands - Event Day 2 - All Hours						
Hour Ending	C2 Demand	T4 Demand	Impact	Impact %	Lower Bound	Upper Bound
1	1.093	1.144	0.051	4.69%	(0.104)	0.206
2	0.900	0.943	0.043	4.80%	(0.086)	0.172
3	0.813	0.849	0.036	4.44%	(0.079)	0.152
4	0.785	0.763	(0.021)	-2.70%	(0.124)	0.082
5	0.745	0.695	(0.050)	-6.77%	(0.133)	0.032
6	0.785	0.769	(0.015)	-1.97%	(0.101)	0.070
7	0.984	0.881	(0.103)	-10.45%	(0.219)	0.014
8	1.007	0.957	(0.050)	-4.98%	(0.162)	0.062
9*	1.003	0.867	(0.136)	-13.55%	(0.256)	(0.016)
10*	1.020	0.854	(0.166)	-16.25%	(0.294)	(0.037)
11*	1.116	0.907	(0.209)	-18.75%	(0.365)	(0.054)
12*	1.267	1.038	(0.230)	-18.12%	(0.411)	(0.048)
13*	1.445	1.213	(0.232)	-16.08%	(0.448)	(0.017)
14*	1.585	1.257	(0.328)	-20.70%	(0.541)	(0.115)
15	1.505	1.360	(0.145)	-9.65%	(0.355)	0.064
16*	1.577	1.050	(0.528)	-33.46%	(0.721)	(0.335)
17*	1.803	1.091	(0.712)	-39.49%	(0.915)	(0.510)
18*	1.867	1.177	(0.690)	-36.95%	(0.890)	(0.489)
19*	1.948	1.181	(0.767)	-39.38%	(0.978)	(0.660)
20*	1.899	1.643	(0.256)	-13.49%	(0.486)	(0.026)
21	1.748	1.840	0.091	5.22%	(0.135)	0.317
22	1.838	1.952	0.114	6.22%	(0.112)	0.341
23	1.661	1.631	(0.029)	-1.77%	(0.229)	0.171
24*	1.359	1.546	0.187	13.78%	0.072	0.302
Total Energy*	**31.752**	**27.607**	**(4.145)**	**-13.05%**	**(4.366)**	**(3.924)**

As indicated by Table 27, the T4 group shed 4.145 kWh or 13% of their total energy load when compared to the C2 group during the entire event day. Energy reduction began in HE 4 with a statistically significant reduction beginning in HE 9 and extending beyond the event period to HE 20, with HE 15 being the only hour during this period that a statistically significant reduction did not occur. DTE can speculate that during HE 15, many customers were engaged in an increased amount of energy consuming activities (i.e. precooling, etc.) in anticipation of the event, preventing the 0.145 kWh load shed during this hour to have statistical significance. During the event period, the T4 group used 37.5% less energy than the comparable C2 group.

Table 28: C2-T4 Demands (Event Day 2 – Event Hours)

C2-T4 Demands - Event Day 2 - Critical Peak Hours				
Hour Ending	C2 Demand	T4 Demand	Impact	Impact %
16*	1.577	1.050	-0.528	-33.46%
17*	1.803	1.091	-0.712	-39.49%
18*	1.867	1.177	-0.690	-36.95%
19*	1.948	1.181	-0.767	-39.38%
Total	**1.899**	**1.643**	**-0.256**	**-13.49%**

Figure 18 shows that T4 increased their demand until the beginning of the event, and then reduced load for the entire duration. Once the event concluded, there was a spike in demand by the T4 group (the payback period) to which their demand actually surpassed that of the C2 group. Much like the T3 group, there is a statistically significant increase in demand over the C2 group during HE 24. Unlike the T3 group, during the payback period, the T4 group consumed more energy than the C2 group, though not statistically significant.

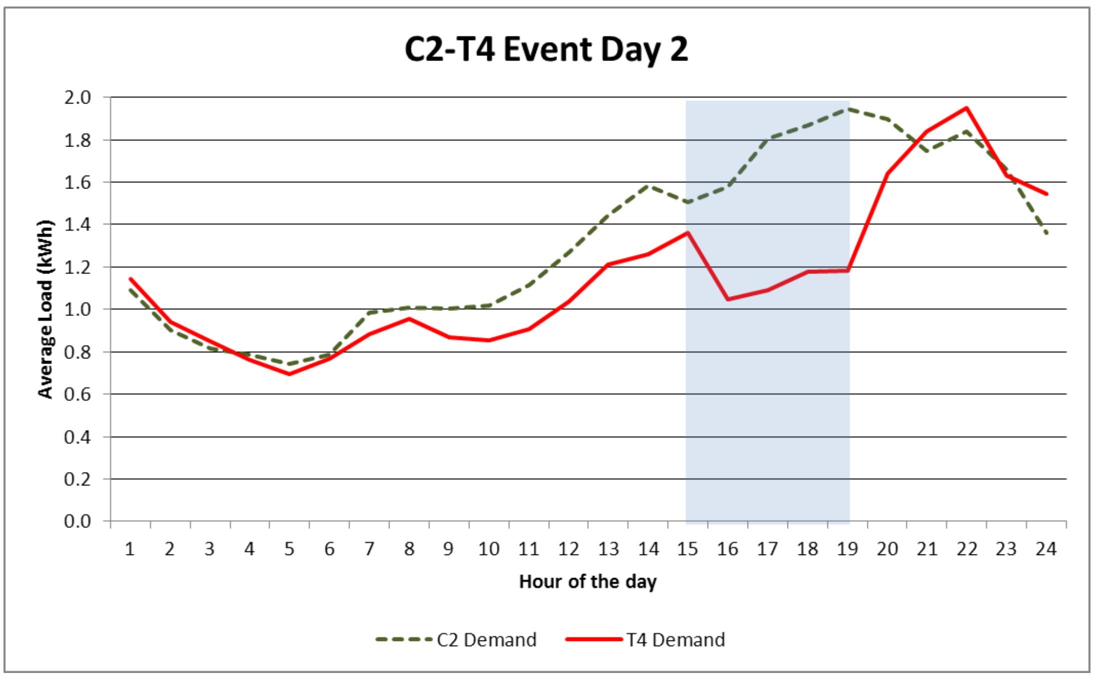

Figure 18: C2-T4 (Event Day 2)

6.b Process Evaluation Results

Customer recruitment

The recruitment process utilized dual response methods of online and Business Reply mail for initial interest and qualification; a link to the required baseline demographic survey was subsequently sent to customers who responded by mail. BR was offered on the advice of the direct mail consultant preparing our recruiting materials, based on demonstrated past successes with the vehicle. Online was offered as a potential indicator of program participation success. Since technology was a key component of all but one treatment cell, it was theorized that willingness to qualify online would help weed out the "technically challenged or insecure." While the BR responses were swift and plentiful, these candidates overwhelmingly failed to take the next step of completing the baseline survey online when they received the follow up email and link.

The recruitment process also was challenged by the variety and incidence of incompatible heating systems in target population homes including: boiler, baseboard, and geothermal. As a result, the second mailing was modified to eliminate BR, fine-tune qualification questions to better screen for the desired forced air heating system, and incentivize enrollment with an Entertainment® discount card. This combination of changes resulted in enrollment activity that nearly equaled enrollment activity from the first mailing; a notable improvement, since mailing #2 was half the quantity of mailing #1.

Enrollment was considered complete when the customer bound Nucleus to the meter and established communication. Many customers started the enrollment process (changed rate) but did not follow up with GE or if they did get devices, did not bind. Follow up phone calls, not originally part of process design, were instituted to address this lag, and yielded some success. Interestingly, many of these "AWOL" customers remain on the DPP rate to this day, and without benefit of the educational tools that the program provides. As an "unofficial" pseudo T1 treatment cell—DPP without education—analysis of this population might provide insight into the "minimum level of education" if these customers are responding well to the CPP events.

AMI and technology installations

At the time recruiting began, AMI deployment had been in process for several years, and nearly 500,000 AMI electric meters with six months of AMI interval data were in place. However, internal screening to eliminate incompatible rates and account characteristics reduced the target population significantly, leading to concern that based on projected response rates, the mail quantity would be insufficient. With TAG approval, the six month interval data requirement was relaxed to three months in order to achieve the appropriate mail quantity.

As noted previously, the incidence of meter/Nucleus incompatibility was not anticipated, and became a program enrollment challenge. Approximately 60 meter/Nucleus replacements were done, but they were time consuming, and ill-timed during the heavy enrollment push. This would pose a significant challenge in a wider scale program.

Information technology vendors

During the course of the pilot, Nucleus software has undergone numerous iterations to correct both functionality and ease of customer use. In addition, in August 2012 Nucleus was adversely impacted by an Adobe Air Update that required many customers to reconfigure their Nucleus clients. Periodic Adobe Updates continue to "annoy" customers and create concern about their impact on Nucleus. In general, customers have been slow to act on software updates, necessitating both DTE and GE outbound communications reminding them to install the updates. Even with gentle reminders, some customers still are not using the latest software version.

Customers expected technology to be set up for them, particularly those with PCTs. GE Factory Service technicians installed the PCTs, and many customers expressed disappointment that the technicians not only would not help with software and set up, but were not well informed on the pilot program, generally or specifically. Customers did not appreciate that the factory service technicians were from a different GE organization. In their minds, "GE is GE." Despite DTE providing program talking points, it is difficult to ensure that a regional factory service organization utilizes a dedicated support team for a project such as this, and that those installers learn the program specifics.

Finally, the pilot program launched using GE DR1000 version 1.5, GE's Demand Response system that sends price and Demand Response signals. It also tracks customer interaction with the PCT during events, such as over-ride, reject, etc. While version 2.0 addresses a number of the DTE concerns about the DR features and participation reports, it was deemed impractical to push an upgrade during the enrollment process, as it would impact every connected device. Therefore, the pilot will run to completion on version 1.5. If final evaluation supports a software solution going forward, that would be the optimal time to upgrade.

Event dispatch and notification

During the enrollment process, customers were asked to provide up to three preferences for CPP event notification. These customer preferences were stored in the enrollment system, and subsequently transferred to the DTE notifications system that interfaces with the third party Varolii messaging service. Data issues in the transfer file were discovered in the dispatch of the August event, when approximately one third of participants did not receive the notification. Of the 379 message failures, 37 percent were T1, 25 percent were T2, 19 percent were T3 and 20 percent were T4. This has been resolved and confirmed via system testing in May 2013. To date, notifications for all 2013 events have gone out successfully. The few notifications failures seen from event to event are the result of customers failing to keep preferences current. These are addressed as identified by Varolii message status reports and customer calls, in addition to a general message in the monthly e-newsletter reminding customers to keep preferences up to date. Call center staff has been instructed to make notification preference updates a part of every customer call. A small population of customers has neglected to update notification methods in spite of email reminders and CPP charges incurred; personal letters have been mailed to them, indicating the contact method on file and notification failure reason.

For the period covered by the interim report, CPP event dispatch in the GE DR1000 has been uneventful, with events starting and ending within a few minutes of the defined parameter. The participation reports, as noted earlier, are being reviewed by GE Energy Management team for more detail.

Customer service

Due to the number and variety of treatment cells, or "offers," customers have a variety of paths for customer service calls. Enrollment and routine account transactions were handled by DTE's third party call center, APAC. Agents were already skilled to take DTE Customer Care calls, and are held to the same high standards for call quality. APAC agents continue to take pilot customer calls. During the enrollment phone call, customers with technology were transferred to the GE call center for ordering devices and PCT installation if applicable. The order line has since been discontinued. Questions about devices and/or technical issues continue to be handled by GE Tech support. Binding calls continue to be handled by DTE personnel.

Overall, post-enrollment customer service call volume has been lower than anticipated, for both the DTE call center and GE Tech support. However, the incidence of continuing calls to re-bind was not anticipated. DTE staff members dedicated to binding during enrollment now have other non-pilot additional responsibilities, and this continuing need to bind is sometimes necessarily handled on a call-back basis. A larger scale deployment of this type would require additional binding line resources.

7. Conclusions

DTE hesitates to make any firm conclusions about customer response to the DPP rate with its Critical Peak Events; however it does appear that the T3 and T4 customer groups have internalized it the best. On both event days they were able to reduce their energy consumption a statistically significant amount during the event hours. Not all of the T1 and T2 customers received proper notification on the first event day which may have prevented those two groups from experiencing energy reductions as a whole. On the second event day, there appeared to be a minimal reduction by the T1 and T2 groups. With more event days in summer of 2013, DTE expects data analysis will provide better conclusions about customer response to the rate.

A new calculation methodology is being explored for the final report. While the comparison of means methodology used in this report can provide some valuable results, it does not take into consideration other variables that can affect energy consumption. The comparability issue encountered with the C1-T1-T2 grouping can also be addressed in order to provide better results with a different calculation methodology.

The summer of 2013 is expected to provide at least 10-12 event days, providing substantially more data for analysis and thus will allow for stronger conclusions about events. Also, a full year will allow study of the effects of the time-of-use rate on the treatment groups. While the first summer provided some preliminary results that can be deemed positive, the summer of 2013 will provide better results and a better impact calculation methodology that will allow for more concrete conclusions.