NV ENERGY

Nevada Dynamic Pricing Trial Final Report

An evaluation of NV Energy's Choose When You Use Program

October 2015

This report is a final evaluation of NV Energy's two-year Nevada Dynamic Pricing Trial. It details the recruitment, reenlistment and transition of the program from March 2013 to February 2015. This project is based upon work supported by the Department of Energy under Project Number DE-OE0000205.

Nevada Dynamic Pricing Trial
Final Report

The NDPT demonstrates that voluntary time-of-use rates delivered savings to participants and load-shifting benefits to all customers

Executive Summary

This report covers analysis and results of the Nevada Dynamic Pricing Trial (NDPT) operations from its formal inception of recruiting in January 2013 through the close of the two-year program on February 28, 2015.

The NDPT was a set of research experiments jointly sponsored by NV Energy and the federal Department of Energy (DOE) as required by the terms of the Smart Grid Investment Grant (SGIG) that the DOE awarded to NV Energy. The NDPT design was approved by NV Energy, the DOE and by the Public Utilities Commission of Nevada (PUCN), as described in the original and subsequently amended NDPT Consumer Behavior Study Plan.

NV Energy conducted the NDPT as a program for single-family residential customers called Choose When You Use. NV Energy enrolled volunteer households, and then supplied them with new time-varying rates, digital and print energy education and programmable thermostats. Every participating household had previously been on standard flat rate pricing and received either a time-of-use (TOU) rate or a TOU rate with Critical Peak Pricing (CPP) events as part of the Choose When You Use program. Some households received digital and print energy education in addition to the rate and some households also received programmable thermostats. The intent of the NDPT was to monitor and understand the household changes in electricity use that may occur in response to these treatments.

The NDPT investigated four hypotheses discussed later in this report.

The primary NDPT findings are these:

1. **Customers responded to the NDPT by addressing their electricity use.**
   Customers rapidly volunteered for the program in large numbers; within six weeks, overall enrollment reached 99% of maximum recruitment targets. A strong majority of participants (85%) who completed the first year reenlisted in the program for a second year. Many participants opted-in to similar TOU rates after the program ended. Choose When You Use participants' new habits of electricity use appeared to persist generally throughout the program, and afterwards for the 43% of participants who transitioned to Optional-TOU rates.
2. **Customers responded to the TOU and CPP rates by shifting their electricity use substantially.**
   During summer periods, participants shifted their electricity use out of more expensive rate

periods between 19 and 36% in the South, and between 7 and 39% in the North. NDPT participants shifted more than 3 MWH of electricity use out of more expensive rate periods during the two years of the program. Choose When You Use proved to be a shifting program.

3. **Customers did not respond to the TOU and CPP rates by reducing their overall electricity use.** Participants North and South generally did not respond to any of the treatments or combinations of treatments by reducing their electricity use significantly. Choose When You Use proved not to be an energy-conservation program.
4. **Customer responses to the NDPT treatments differed over time and among segments of customers.**
   Specifically, Choose When You Use results were concentrated in peak periods, but distributed across many types of customers.
5. **Combinations of the NDPT treatments yielded levels of customer response similar to those provided by the TOU and CPP rates on their own.**
   Participants appreciated receiving the education and technology treatments, and they used them, but adding education and technology treatments to the TOU and CPP rate treatments delivered little incremental change in overall electricity use. In the South during peak periods, and among engaged participants, these treatments did have modest incremental effects. But Choose When You Use results were largely delivered as a result of time-varying rates, with or without other treatments.
6. **Customer responses to the NDPT treatments were associated with customer attitudes of energy ownership.**
   Participants initially perceived Choose When You Use primarily as a new kind of money-saving opportunity. Saving money is a very strong example of psychological ownership. Most Choose When You Use participants learned how to save money by developing new habits of electricity use at different times. Over the course of the two years of the program, NDPT participants saved a net of $1,528,177.91 in total.
7. **Customer responses to the NDPT treatments were associated with customer satisfaction with energy ownership.**
   Some participants saved a substantial amount of money through Choose When You Use, but many did not. However, participants became attached to the new habits of electricity use they developed, even if the savings that resulted were modest. Choose When You Use participants were generally satisfied with the combination of their modest savings, their status as savers, and their prospects for saving in the future.

The NDPT demonstrates that voluntary time-varying electric rates in Nevada should be pursued, and that they can deliver a satisfactory level of savings to customers and substantial load-shifting benefits to NV Energy and all its customers.

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Introduction to NV Energy

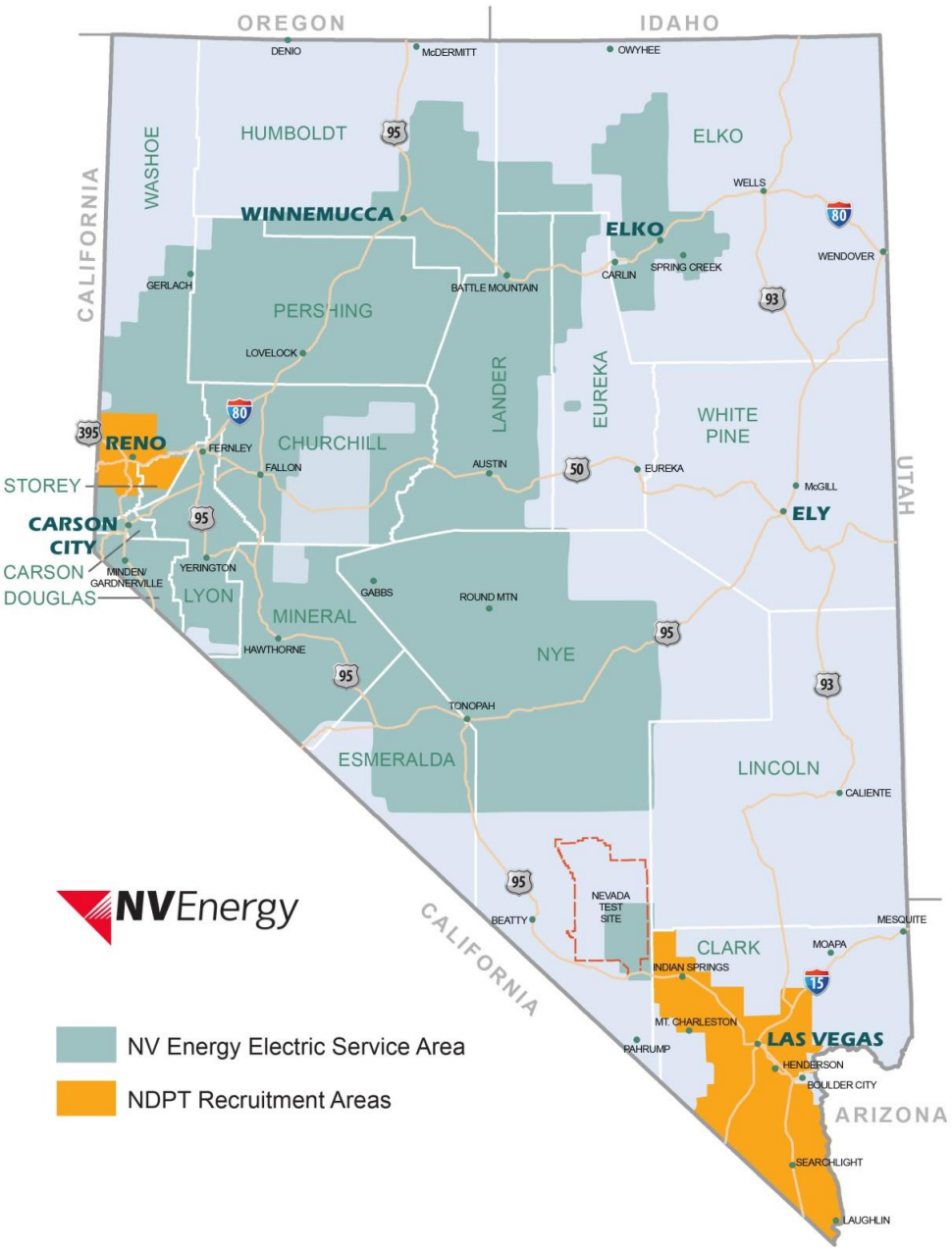
NV Energy, a MidAmerican Energy Holdings Company, has provided Nevada with power for more than a century. NV Energy has served citizens in northern Nevada for over 150 years beginning as Sierra Pacific Power (SPPC), and southern Nevada since 1906 as Nevada Power (NPC). The companies merged in 1999 and began doing business as NV Energy in 2008. NV Energy was acquired by Berkshire Hathaway Energy in 2013.

Today NV Energy provides electricity to 1.3 million customers and a state tourist population of over 40 million annually. It's nearly 46,000-square-mile service territory stretches north to south from Elko to Laughlin. The company also provides natural gas to more than 155,000 citizens in the Reno-Sparks area.

The Advanced Metering Infrastructure (AMI) project known as NVEnergize began after NV Energy was awarded the Smart Grid Investment Grant (SGIG) on December 24, 2009. The first smart meter was installed in southern Nevada in September 2010 and since then smart meters have been installed at

homes throughout the state, giving NV Energy the opportunity to provide customers with options to manage their energy use through enhanced technology, tools and programs.

Figure 1: Nevada Map with NDPT Service Area



The Nevada map in Figure 1 shows all areas that NV Energy offers service and highlights in gold the areas where the NDPT was offered – the greater Reno-Sparks area in the North and the greater Las Vegas area and Henderson in the South.

Research Hypotheses

After consultation with the Public Utilities Commission of Nevada (PUCN), the NDPT was proposed as a compliance item in NV Energy's application for a federal Smart Grid Investment Grant (SGIG).

Once the federal grant was awarded to NV Energy, the NDPT team drafted the 2010 NDPT Consumer Behavior Study Plan (CBSP), which was approved by NV Energy, the U.S. Department of Energy as represented by Lawrence Berkley National Laboratories (LBNL), and the PUCN.

The NDPT CBSP identified the following hypotheses to be tested:

1. Customers will respond to
    a. The time of use (TOU) and critical peak pricing (CPP) rates
    b. The customer education, and
    c. The enabling technology provided

    by addressing, reducing, and shifting energy usage (i.e., by managing their energy use).
2. Customer energy management responses to the rates, education and technology treatments will differ significantly over time and among segments of customers.
3. Combination of rates, education and technology treatments will yield customer energy management responses that differ from the sum of the individual responses to those elements over time and among segments.
4. The extent and persistence of customer energy management responses to rates, education and technology treatments are significantly correlated with customer attitudes of
    a. Energy ownership, and
    b. Satisfaction with energy ownership.

These four hypotheses were chosen based on the new opportunities available to Nevadans and to utilities, through the customer experience of the Smart Grid. Evaluating these hypotheses would be feasible because of the NVEnergize Smart Meter deployment which was funded in part through the federal SGIG.

Even before the Smart Grid arose, NV Energy had a strong and successful demand response program, based on supplying programmable thermostats, load control devices and incentive payments to customers. The utility recognized that not only would the Smart Grid make such technology-based programs more attractive and economical, the Smart Grid would also make time-based rates and customer energy education more feasible.

The NDPT was designed to provide different sets of customers with different combinations of these experimental treatments (i.e., rates, education and technology), and then to examine the newly available hourly household meter data to assess the impact these treatments had on household electricity use across the year[1] before the trial began and the two years of the trial. Based on the NDPT,

[1] Due to smart meter installation delays, some Program Year 0 electricity usage was unavailable.

NV Energy can understand how its customers managed their energy use with the help these treatments provided.

NV Energy's interest in energy ownership and customer satisfaction arose from the utility's conviction that its customer-oriented programs should be based on well-informed customer choice. NV Energy believed that customers who were pleased to take charge of their own energy management would make the best choices about how and when to use energy. So while NV Energy aimed the NDPT to help understand the statewide opportunity for time-varying rates, education and technology programs, the utility's interest was always to design better programs and to learn how to help more customers choose among its programs more wisely.

NDPT Program Design

The NDPT was a controlled randomized experimental design established to support objectives, test hypotheses and support the development of deliverables.

The NDPT had a fixed population from which to draw samples and to which NV Energy could market. The population was limited due to smart meter installations and the data that would be available.

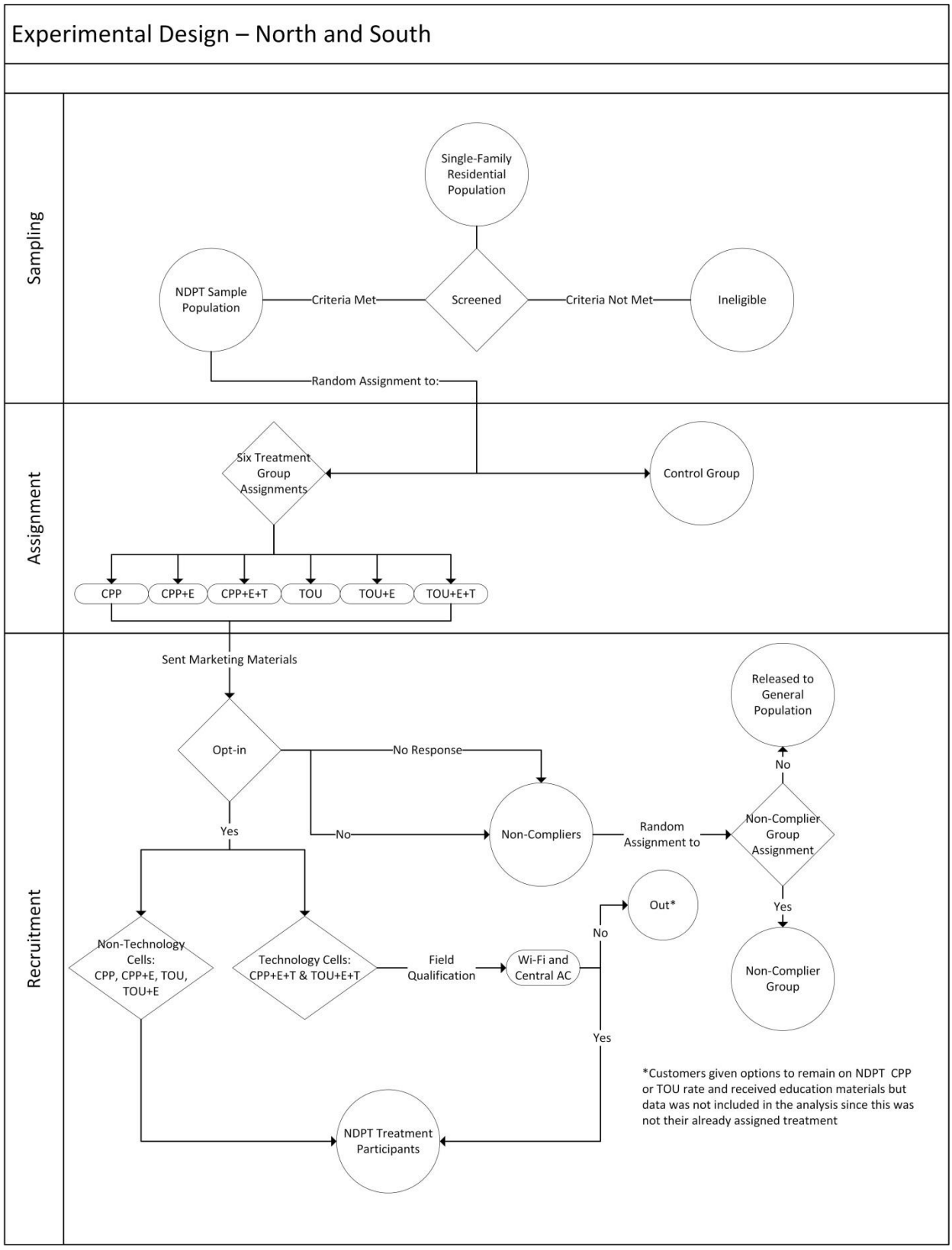
After the eligible population had been defined by service territory, customers were assigned to the control and treatment groups. The control group was populated at ten times the minimum number of participants for the largest treatment, and then the remaining population was split across the six treatment groups as those who would be solicited for participation.

It was assumed that different treatments could be more or less appealing to customers and these differences could lead to different acceptance rates.

Evidence from similar research around the country led NV Energy to assume that an acceptance rate of approximately 3% should be achievable. Because the rate-only treatment was assumed to be a relatively less-attractive program, since it only included a rate, the expected acceptance rate for these targeted participants was set at 2%. Rate coupled with education was expected to be a more attractive program so the acceptance rate was set at the median value of 3%. Lastly, rate with both education and technology was assumed to be the most popular because of its three elements and the installation of the thermostat, so its acceptance rate was set at 4%.

Figure 2 shows how the process of the NDPT sampling, assignment and recruitment worked for customers and what steps the customer experienced.

Figure 2: NDPT Experimental Design North and South



Target Population

The NV Energy territory is divided into two smaller service territories: the North and the South. Only customers on the single-family residential rate class were eligible to participate in the NDPT. At the time of selection and recruitments, there were approximately 211,000 customers in the single-family residential class in the North, and 499,000 in the South.

Despite the relatively large numbers of customers in the class both North and South, the number eligible for the NDPT was substantially less due to multiple inclusion criterions:

- Customers had to have been in their home and had a smart meter installed prior to the start of the 2012 summer in order to have adequate summer pretrial data (June 1, 2012 at NPC; July 1, 2012 at SPPC)
- Customers could not be participating in any demand response program (e.g. NPC's existing ACLM program, Cool Share), net metering, Standby or existing optional TOU rate
- Customers could not be an employee of the Utility or be part of its load research sample
- Customers had to previously be taking service under the flat rate and could not be part of a master-metered mobile home park
- Geographic bounds limited the northern trial to just the greater Reno/Sparks area known as Truckee Meadows (i.e., no outlying districts such as Fernley or Elko)

A single wave recruitment strategy was used due to time constraints, and eligible participants were marketed to for only their assigned treatment. Participants did not get to choose their rate or treatment groups.

Sampling

Smart meters began installation earlier in southern Nevada than northern Nevada, which led to a larger percentage of smart meter population from which to draw a sample population. After taking into account all inclusion criterions, 150,371 customers were eligible to participate in the NDPT in the South and 52,897 were eligible in the North.

Treatments

The NDPT elected to test two rate offerings: a simple Time-Of-Use (TOU) rate and a TOU rate that included Critical Peak Pricing (CPP) events on select days. NV Energy includes two territories, South and North, so the NDPT tested four new rates. Each of the four is notably different from one another in pricing levels and structure. Every NDPT participant received one of the four rate structures but only some received the additional education and technology combinations.

Table 1 describes the breakdown of the rate and treatment combinations by region.

Table 1: NDPT Cells by Region

NDPT Cells by Region						
North	TOU	TOU+E	TOU+E+T	CPP	CPP+E	CPP+E+T
South	TOU	TOU+E	TOU+E+T	CPP	CPP+E	CPP+E+T

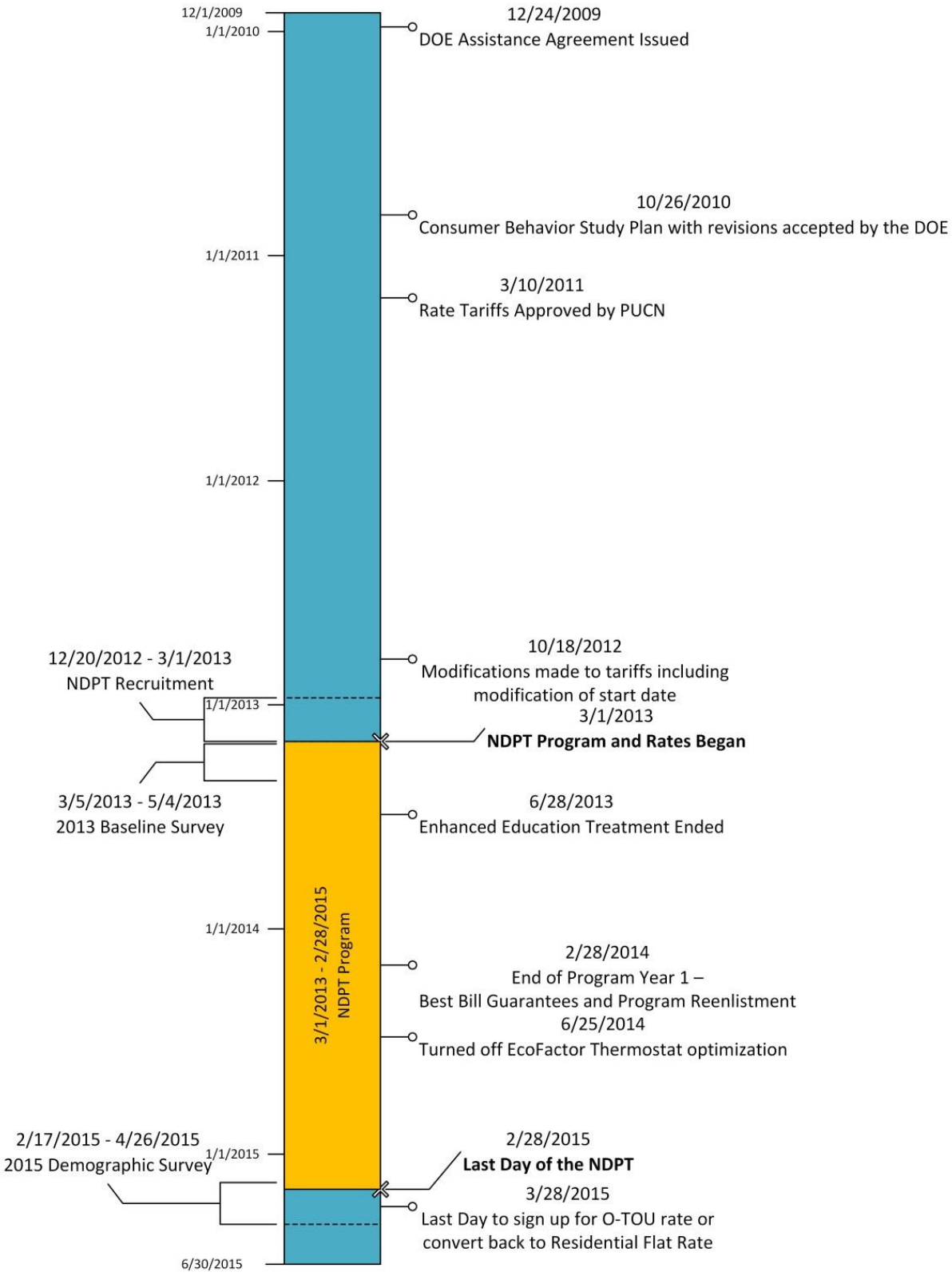
Legend
TOU: Time-of-Use rate treatment
CPP: Critical Peak Pricing rate treatment
E: Education treatment
T: Technology treatment

Timeline

Planning and implementation for Choose When You Use began in December 2009 with the DOE Assistance Agreement issued. From there, the design of the program through the Consumer Behavior Study Plan (CBSP) was drafted, revised and accepted. There was a fourteen month delay in starting the program from the original plan due to a delay in smart meter installation. Both territories and all treatments began on March 1, 2013. Program Year 1 ended February 28, 2014 and the entire program ended on February 28, 2015.

Figure 3 outlines the major dates throughout the entire NDPT from inception through completion.

Figure 3: NDPT Timeline



Recruitment

Customers were first contacted by mail through two separate mailings as a program announcement and notice that they had a time-limited choice to either enroll as a participant in the particular treatment offered or continue taking service under the default flat rate. Recruitment for the twelve treatments was broken down into three waves: rates with education and technology, rate only, and rate with education. This approach was taken in order to avoid overwhelming the call center with inbound calls of everyone receiving the enrollment packets on the same day. The mailings for each treatment were spread across a week's time.

Each customer was given the choice to participate or decline, and could enroll by returning the mail postcard, calling into the dedicated NDPT customer service line (inbound calls), enrolling on the website, or responding to an outbound solicitation call. Table 2 shows the final enrollment numbers by territory and treatment.

Table 2: Final Enrollment by Territory and Treatment

	North	South	Total
TOU	435	430	865
TOU+E	296	323	619
TOU+E+T	150	317	467
CPP	334	914	1,248
CPP+E	300	731	1,031
CPP+E+T	322	703	1,025
Totals	**1,837**	**3,418**	**5,255**

Customers who enrolled in the program were called immediately after the program started and asked to take a survey. From early March 2013 to early May 2013, customers were surveyed for basic energy use questions about the household habits and demographic information. This baseline survey was administered by the University of Nevada, Las Vegas Cannon Survey Center and Active TeleSource (ATS) over the phone. A second similar survey was later administered in 2015 to see the impacts of the program. Below are the number of customers who participated in the survey by location and treatment.

Table 3: Enrolled Customers Participating in 2013 Baseline Survey

	North	South	Total
TOU	229	230	459
TOU+E	154	171	325
TOU+E+T	103	188	291
CPP	193	477	670
CPP+E	151	352	503
CPP+E+T	196	399	595
Totals	**1,026**	**1,817**	**2,843**

Rate Treatment

All of the NDPT rates were designed to follow two principles: better cost alignment and customer choice. First, given the current two-part rate structure, all of the NDPT rates were designed to better align the costs customers pay with the true costs of providing service. When electricity is cheaper to provide, it costs the customer less (off-peak) and when it's more expensive to provide, it costs the customer more (mid-peak and on-peak). Second, all of the NDPT rates included a best bill guarantee for the first year of the program, and permitted participants to elect the Equal Payment Plan (EPP) as an option to mitigate potentially high bills.

The NDPT tested two different kinds of rates. The first was a time-of-use (TOU) rate similar in design to NV Energy's existing optional TOU rate, but more closely tracking the cost of providing service hour by hour and season by season. The second NDPT rate was a critical peak pricing (CPP) rate, using the NDPT's TOU rate design as a basis, but added a fixed number of designated pricing events across certain hours on certain summer days.

Northern Nevada

The TOU period definitions in the North TOU schedule were split into two seasons: summer and winter. Winter (October through June) on-peak was 5 p.m. to 9 p.m. daily and off-peak was 9 p.m. to 5 p.m. daily. Summer (July through September) on-peak was 1 p.m. to 6 p.m. weekdays and mid-peak was 10 a.m. to 1 p.m. and 6 p.m. to 9 p.m. weekdays. Summer off-peak was all other hours in July through September, including all weekend hours.

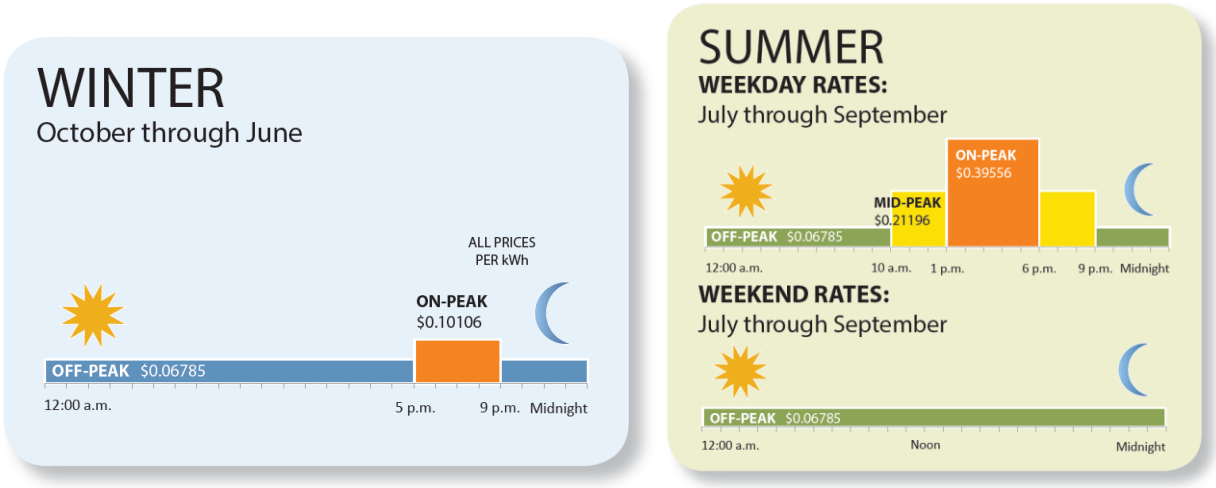
For the CPP rate schedule in the North, the Critical Peak costs and rates are separated from the summer on-peak period, with one summer season and one critical peak rate. The Critical Peak periods in the North were the last four hours, 2 p.m. to 6 p.m., during the summer on-peak period for 16 non-holiday weekday events called by the company. During each summer of the NDPT in the North, NV Energy called 14 events between July and August and two in September.

Table 4: Northern Nevada TOU Rate Periods

	Winter		**Summer**		
	October through June		July through September		
	On-Peak	Off-Peak	On-Peak	Mid-Peak	Off-Peak
Northern Nevada	5:00 p.m. to 9:00 p.m. daily	9:00 p.m. to 5:00 p.m. daily	Weekdays 1:00 p.m. to 6:00 p.m.	Weekdays Early: 10:00 a.m. to 1:00 p.m. Late: 6:00 p.m. to 9:00 p.m.	All Weekend hours and Weekdays 9:00 p.m. to 10:00 a.m.

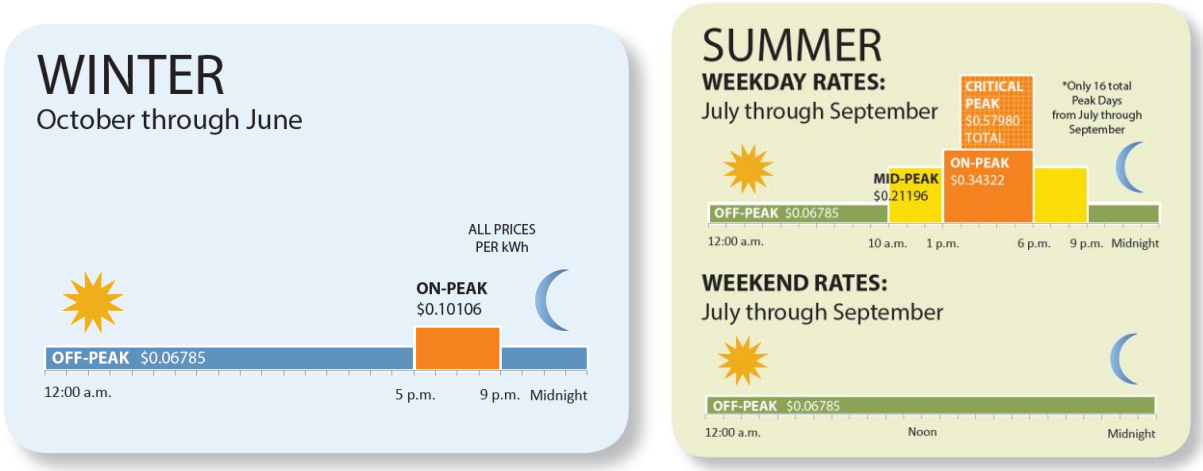
Customers in the North TOU cells received the following graphics in their recruitment materials to help them understand the rate structure:

Figure 4: North Time-Of-Use Rate Graphics



And customers in the North CPP cells received the following graphics in their recruitment materials:

Figure 5: North Critical Peak Pricing Rate Graphics



Southern Nevada

In the South, the NDPT TOU definitions separated the summer season into two periods for the TOU rate structure: core and shoulder. The core summer was July and August, and the shoulder summer was June and September. Winter was the balance of October through May. The core and shoulder summer on-peak periods were both from 2 p.m. to 7 p.m. These changes provided TOU periods that were reflective of system costs across the year.

The Critical Peak Pricing (CPP) rate schedule for southern Nevada used the same period definitions as the TOU schedule but added another element: 72 very high cost on-peak hours allocated across 18 Critical Peak events, each four hours long, from 3 p.m. to 7 p.m. during non-holiday weekdays.

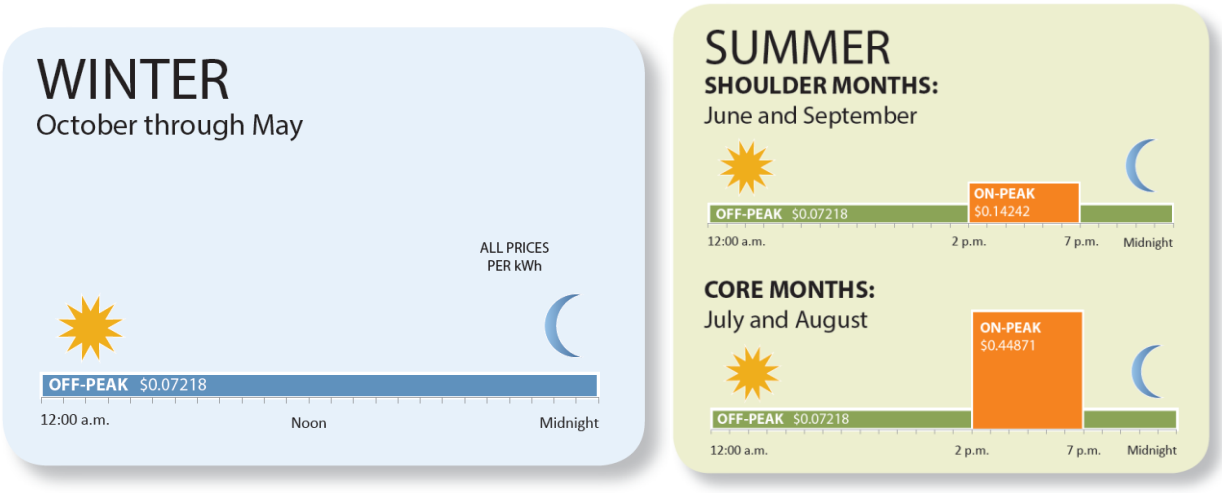
For the NDPT in the South, four of the 18 Critical Peak Events each year were called in June and September and the remaining 14 were called during July and August.

Table 5: Southern Nevada TOU Rate Periods

	Winter	Summer Core		Summer Shoulder	
Southern Nevada	October through May	July and August		June and September	
	Off-Peak	On-Peak	Off-Peak	On-Peak	Off-Peak
		2:00 p.m. to 7:00 p.m. daily	7:00 p.m. to 2:00 p.m. daily	2:00 p.m. to 7:00 p.m. daily	7:00 p.m. to 2:00 p.m. daily

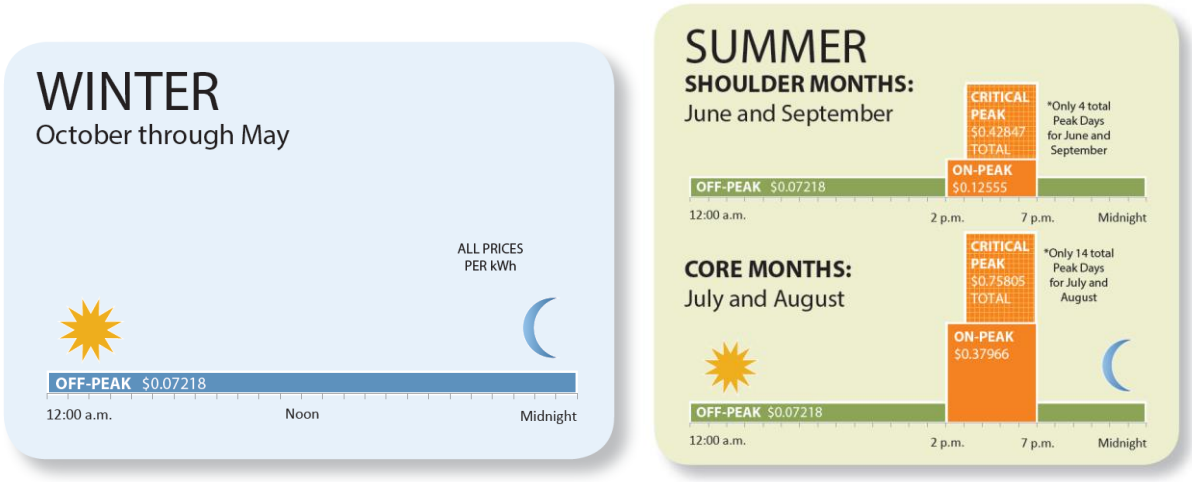
Customers in the South TOU cells received the following graphics in their recruitment materials to help them understand the rate structure:

Figure 6: South Time-Of-Use Rate Graphics



And customers in the South CPP cells received this rate card graphics in their recruitment materials:

Figure 7: South Critical Peak Pricing Rate Graphics



Rate Design

Rates were developed based upon the reconciled marginal costs for the otherwise applicable flat rate schedules. The rates were revenue neutral, such that the average consumer would pay the same amount as they would have on the flat rate, assuming no changes in consumption behavior. The rates were approved in March 2011 and updated quarterly when all rates were changed as a result of a change in a component of the total rate.

The NDPT rates were designed so that participating customers who changed their consumption behavior to reduce usage during higher cost hours would lower costs and save money as a result. Those participants who had higher usage and higher costs would pay more. Rates for both companies were attenuated somewhat from full cost-based rates, but the NDPT rates were more reflective of full costs than the rates participants would have experienced in the past with two-part flat rates. TOU period definitions in each region varied due to different costs at each company.

For each NDPT rate class, on-peak rates and the Critical Peak Period rates were calculated from the same on-peak period marginal generation and energy costs as the TOU rates, but these marginal costs were split between the two periods. For the CPP rates, marginal transmission and distribution costs per kWh for both the Critical Peak Periods and the on-peak periods were the same as the marginal cost per kWh identified by the on-peak rate calculations for the TOU rates.

During NDPT rate development, the summer on-peak days with the highest marginal generation and energy costs per kWh were identified separately as the CPP rate periods. This separation established the Critical Peak Period rate as higher than the corresponding summer on-peak rate and caused the on-peak CPP rate (for non-critical peak hours) to be less than the corresponding on-peak TOU rate for all non-

Critical Peak hours. The lower on-peak rate balances against the fact that the rate for CPP participants during critical peak hours was much greater than the on-peak TOU rate. [2]

Critical Peak Period Events

While the number of CPP events differed in the North and South (18 in the South, 16 in the North), many of the rules around the events did not. In both regions there were no more than nine events in one month and no more than five events in a row on eligible days. Events were only called on non-holiday weekdays. The event times differed but were consistent across the events in each region (South: 3 – 7 p.m. and North: 2 – 6 p.m.)

CPP Event Nomination

CPP events were elected by utilizing a forward cascading model that took into account how many days still needed to be nominated versus the eligible days remaining in the month. The model nominated days based on seasonal and weekly forecasts of system demand. Each morning, the seven day forecast was inserted into the model and run to decide if the next business day should be nominated for an event by evaluating if that next day would be one of the highest forecasted demand days left in the month, assuming there were days left to nominate. For example, if there was a need to select three more events in July, the next day would be an event if it was at least the third highest forecasted day remaining in the month, in terms of system demand. Because the north and south trials were separate, events were nominated independently for each territory. Customers were notified of the event the day prior to an event by 4 p.m. through their selected communication channel[3]: text message, voice calls or email. Notifications were also posted on NV Energy's online customer portal, MyAccount.

The following figures highlight the days CPP events were called in each year:

Figure 8: NDPT North CPP Event Days Summer 2013

July 2013						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August 2013						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September 2013						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

[2] Customers had the option of being on the Equal Payment Plan in addition to the NDPT to average customers' bills over a 12-month period to help reduce costs and budget finances.

[3] An investigation and analysis was conducted after summer 2013 and NV Energy determined that some CPP customers were not receiving their CPP Event Notifications. As a result, NV Energy issued a one-time bill credit in December 2013 for the amount of energy consumed in kWh for the event in which notification wasn't received, multiplied by difference between the critical peak rate and the applicable on-peak rate. More information about the CPP Notification refund can be found in the interim report found in the resource library of smartgrid.gov.

Figure 9: NDPT North CPP Event Days Summer 2014

July 2014						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August 2014						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September 2014						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Figure 10: NDPT South CPP Event Days Summer 2013

June 2013						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July 2013						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August 2013						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September 2013						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Figure 11: NDPT South CPP Event Days Summer 2014

June 2014						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

July 2014						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August 2014						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September 2014						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Best Bill Guarantee

Both TOU and CPP NDPT rates included a best bill guarantee for the first year in which participants were held harmless from paying more annually on the dynamic rates than they would have had they been billed on the otherwise applicable flat rate. At the end of the first year, if customers paid more on the dynamic rate than they would have on the flat rate, a bill credit was issued to their account. The bill guarantee went away for the second year since customers had enough experience to determine if they should continue on with the program or not. Of those customers who completed Program Year 1, 339 (11%) participants in the South and 754 (41%) in the North, received a refund. The full results are in the following tables.

Table 6: NDPT Participants Receiving a Best Bill Guarantee Refund - North

	Eligible Participants (#)	Participants Refunded (#)	Average Refund ($)
TOU	420	186	81.57
TOU+E	273	141	96.89
TOU+E+T	136	74	77.01
CPP	318	93	83.25
CPP+E	284	147	85.61
CPP+E+T	303	113	64.32
All North	1,734	754	82.40

Table 7: NDPT Participants Receiving a Best Bill Guarantee Refund – South

	Eligible Participants (#)	Participants Refunded (#)	Average Refund ($)
TOU	375	98	75.77
TOU+E	290	76	75.56
TOU+E+T	290	63	70.30
CPP	833	53	39.44
CPP+E	643	39	35.69
CPP+E+T	651	10	20.83
All South	3,082	339	62.79

Education Treatment

The NDPT was designed to test treatments that potentially could be introduced once the program's research was complete and also would be capable of providing the data required for an assessment of the treatment's impacts on electricity usage.

NV Energy selected Vergence Entertainment LLC (Vergence) to design and deliver the education treatment component of the NDPT. Vergence worked with partners in rich media development, incentive programs, research and instructional design to develop a multi-media education treatment that included print, email, SMS (Short Message Service), IVR (Interactive Voice Response), video and website development.

The NDPT elected to use a different kind of education treatment based on the Vergence Entertainment Ringorang® engagement system. Vergence piloted this innovative game approach with Puget Sound Energy to train utility employees in technical content through online and mobile game play. The repetition, competition and entertainment of the game experience led to player learning. The NDPT team reasoned that a similar application could be developed for consumer energy education and Vergence created it for the program.

Eight of the twelve NDPT cells included the education treatment in combination with a rate treatment. Four of the eight cells also included the technology treatment. After recruitment, the NDPT included an initial cohort of 3,142 NDPT participants in all education treatments. As shown in the following table, 2,870 education treatment participants completed Program Year 1 and were widely distributed across the eight cells, North and South.

Table 8: NDPT Education Treatment Participants Enrolled at End of Program Year 1

NDPT Treatment Group	Initial Program Enrollment			End of Program Year 1		
	North	South	Totals	North	South	Totals
TOU+E	296	323	619	273	290	563
TOU+E+T	150	317	467	136	290	426
CPP+E	300	731	1,031	284	643	927
CPP+E+T	322	703	1,025	303	651	954
Totals	1,068	2,074	3,142	996	1,874	2,870

Play Learn Win

The main component of the NDPT education treatment operating system was Play Learn Win (PLW), an online game application developed for the NDPT by Vergence Entertainment and made available either on a computer (Apple or Windows systems) or over a mobile telephone (Apple, Android or Blackberry systems). PLW players received questions about energy usage that were pushed to them at different times of the day. Considerable effort was expended to ensure that the NDPT education treatment would be equally available across a number of technical platforms and devices. Curriculum learning elements were incorporated into teaching modules that spanned print, online and mobile channels, each capable of delivering the curriculum learning element multiple times through multiple formats.

The education treatment required online remote installation of the PLW software, which meant that education treatment participants had to understand that the software was related to their Choose When You Use program. Participants then had to take the time to install the application and become familiar with the game-playing routine. Because the education treatment communications were remote (mail, email, and telephone), considerable effort was taken to establish contact with recruited participants and confirm that they had successfully downloaded the PLW software onto their computers or mobile devices.

The installation effort began immediately after recruitment in February 2013, when participants were sent a Welcome Kit. Just before the formal beginning of the NDPT in March 2013, education treatment participants were sent a second copy of the Welcome Kit along with a deck of 56 playing cards that contained curriculum elements and energy-saving tips referenced in subsequent PLW games. The education treatment was administered until August 28, 2013, when the last prize was awarded.

The following figures are examples of the Welcome Kit, playing cards and the Ringorang® game.

Figure 12: Education Treatment Welcome Kit

Figure 13: Examples from the Education Treatment Deck of Playing Cards

Figure 14: Education Treatment Ringorang® Interface

Participation

Play Learn Win and the other components of the NDPT education treatment were all developed as a new customer service element specifically for the NDPT. Engaging customers required continual effort during the recruitment and application installation process and that did not stop once the game started. Sixty-nine percent of education treatment participants engaged with the treatment in some way. Nearly 24% of education treatment participants answered 50% or more of the PLW questions posed to them. And over 21% of education treatment participants responded through text or IVR to the mailings – an average of 2.87 responses each. Despite efforts to engage customers, 31% of education participants neither downloaded the PLW game nor responded to the mailings.

Technology Treatment

The NDPT was designed to be a pricing study and to be focused on the roles that education and technology may have when employed in addition to new rates. The NDPT did not include rate plus technology cells since NV Energy already had considerable experience through its demand response program and studies of home energy displays. Therefore, the technology treatment for the NDPT was only provided to participants who also received the new rate and education treatment.

The NDPT was designed to test treatments feasible to introduce once the program's research was complete, and that were capable of providing the data required to assess the treatments' impacts on electricity usage. The EcoFactor system had been tested previously at NV Energy and had been deployed in the NV Energy demand response program. Applying the EcoFactor system in the NDPT was a natural extension of these previous activities.

The EcoFactor NDPT technology treatment consisted of one or more new programmable thermostats with online connections linking the participant, NV Energy and EcoFactor. The EcoFactor website provided the participant with the ability to program the thermostats online, through a computer or mobile telephone. The online connection also enabled the utility and EcoFactor to program and reprogram the thermostats remotely. During the NDPT, NV Energy did not program or reprogram participant's thermostats, but during Program Year 1 EcoFactor did regularly reprogram participants' thermostats as part of an optimization feature.

Installation

To receive the NDPT technology treatment, the participants needed to schedule and attend the field installation of their new thermostats, which included the establishment of a communications link between the thermostats and EcoFactor. At installation, installers walked the participant through programming their thermostats according to the participants' preferences. NDPT staff monitored some NDPT field installations of EcoFactor technology for compliance with specified procedures and for an understanding of the customer experience.

After installation, the EcoFactor technology treatment required little customer interaction, although several sources were available. Participants continued to have access to the web portal that allowed them to reprogram their thermostat through a scheduling wizard tool. This tool helped participants program the thermostats based on their desired set points. NDPT technology treatment participants had three channels to access the EcoFactor thermostat or customer service: online, via a smartphone application or through the customer service center.

The EcoFactor technology treatment could also intervene in the participants' experiences through an optimization function. The optimization function was designed to provide participants with a more economical experience than they had programmed. By evaluating the programming and operating conditions, it could automatically adjust the participants' programming to nudge them to be more energy efficient. This occurred without any specific notification of the individual adjustments to the participant or without any specific authorization by the participant. Optimization was turned off in Program Year 2.

As part of the NDPT, 2,217 EcoFactor thermostats were installed in 1,380 homes in the North and South trials. Most installations were completed between January and March 2013. Table 9 details the installed thermostats throughout the program and Figures 15 through 17 show the thermostat, web portal and mobile application for adjusting the thermostat.

Table 9: EcoFactor Device Installations by Territory and Treatment Class throughout NDPT

NDPT Treatment Group	Devices Installed			Participating Households[4]			Final Completed Program Year 2		
	North	South	Totals	North	South	Totals	North	South	Totals
TOU+E+T	152	433	585	136	290	426	103	221	324
CPP+E+T	400	1,232	1,632	303	651	954	205	534	739
Totals	552	1,665	2,217	439	941	1,380	308	755	1,063

Figure 15: EcoFactor Two-Way Communicating Thermostat

[4] These numbers differ slightly from Table 32 in Volume 1 of the Interim Report, as there were a few corrections made to the files containing enrollment and terminations after Program Year 1.

Figure 16: EcoFactor Web Portal

Figure 17: EcoFactor Mobile Application

NDPT Operations

The NDPT Interim Report was accepted and approved by the DOE on August 5, 2015. Those interested in reading the report can find it on smartgrid.gov within the Resource Library.

Billing

Standard NV Energy billing spreads residential customers across many billing cycles. This makes it harder to present customers the same information at the same time, as they are billed at different times throughout the month. As a result, the NDPT tariffs had a special condition that allowed NV Energy to move anyone participating in the NDPT to calendar month billing from their current billing cycle[5].

On March 1, 2013, the first day of the rate treatment, all participating customers were final billed on the flat rate for the number of days they were into their billing cycle. At the same time, they were moved to calendar month billing and placed on the new time-of-use rate. This brought all NDPT participants into the same billing cycle.

Tariffs

The NDPT was regulated by four different tariffs for the two service territories and two dynamic rates: North TOU, South TOU, North CPP and South CPP that were originally filed in Nevada Public Utilities Commission Docket Nos. 10-08014 and 10-08015. Those tariffs were then modified through advice letter filings in Docket Nos. 12-10020 and 12-10021 which modified the dates of the NDPT, modified language regarding the technology package and removed the requirement to physically sign an acknowledgement to participate in the trial.

Participants in the NDPT were also subject to various other tariffs, like all residential customers, including Miscellaneous Charges, Deferred Energy Accounting Adjustment, Energy Efficiency rate and Renewable Energy Program Rate, as well as all the approved rules that apply to customers.

The Statement of Rates contains the actual price per kilowatt that customers are charged for energy by component. This tariff is updated as rates change for all classes, which is at least quarterly as energy prices are modified to reflect changes in the BTER (Base Tariff Energy Rate).

Customer Service

The NDPT decided to use an outsourced call center for recruitment and enrollment that is used by the company for peak seasons, high volume and overflow, to ensure that NDPT customers were assisted personally and as quickly as possible. The NDPT program relied on specialized support systems such as the Demand Response Management System (DRMS) to manage enrollment and technology installations and required the NDPT Customer Service Representatives (CSRs) to have specialized skills not required by typical in-house personnel.

The dedicated NDPT customer service team allowed the program to conduct special training sessions to give CSRs in depth knowledge of the NDPT advanced time-of-use rates, education and technology treatments. The NDPT customer service team was given specialized training on HVAC systems, energy

[5] Note that customers were still allowed to pick their payment due dates, pursuant to Rule 5.

management devices and equipment installation. This team was able to provide all customer support for the education treatment including the ability to reset passwords, resend materials and enrollment emails and diagnose connectivity and device issues.

Participant Communications

The NDPT was rich with customer interactions and communication channels. Starting with the recruitment materials, customers received information directed specifically to them. Monthly summaries allowed the customer to see where they stood each month with their savings and could make choices to adjust their behavior. CPP event notifications, summer reminder letters and interactions with the customer service team helped shape a unique experience for those participating in the NDPT.

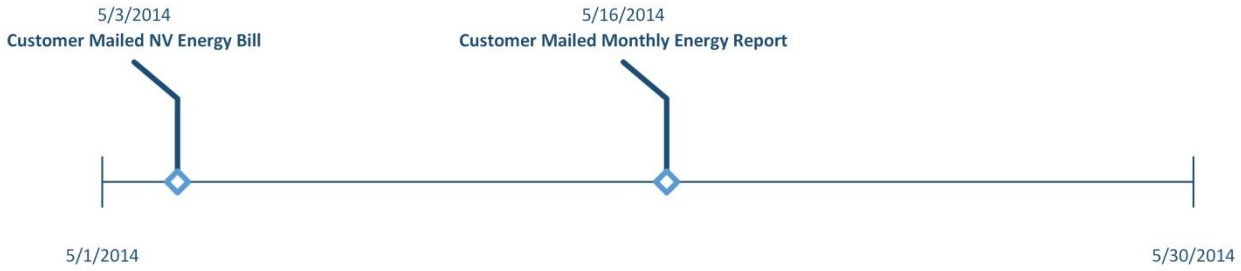
Monthly Bill Statements

Before the trial began, customers were used to receiving a monthly bill statement outlining their kilowatt usage, current rate price and associated fees either through physical U.S. mail or as a paperless bill through their email. Approximately 14% of all NV Energy customers receive their monthly bill statement online. The customer's preference of receipt did not change when the trial began as all billing dates changed to align all NDPT participants on the same schedule.

Monthly Energy Reports

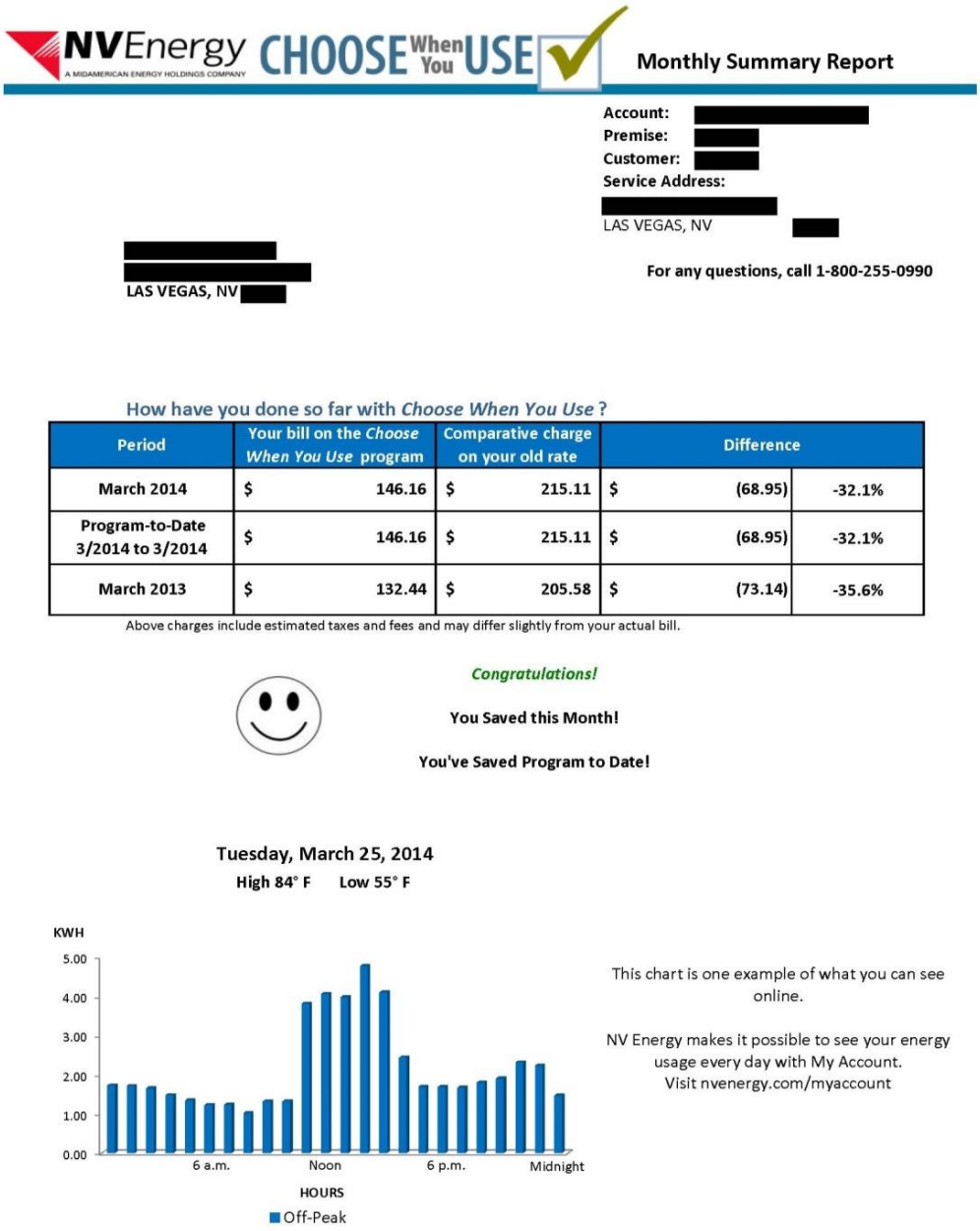
In addition to monthly bills, monthly energy reports were sent to customers to help track how they are using energy and the resulting charges compared to the flat rate. Energy saving tips and important information were included within each report along with the direct NDPT customer service phone number for any questions. The first summaries were sent in May 2013 for the month of April. No summary was sent for February 2014 because the Year 1 True Up letter was sent at the same time and both would contain similar information.

Figure 18: Typical Monthly Customer Communications Timeline



Customers received at least two communication pieces from the company each month. Around the 3rd of the month, customers were mailed their monthly bill. It was received within approximately three to five days, excluding holidays. For customers who chose to receive their bill online, the bill was available the day after the bill date. The bill included kWh usage for the past month, rates and fees. Between the 16th and 20th of each month, the customer was mailed their Monthly Energy Report. As shown in Figure 18, this report showed the customer what their bill looked like compared to what they would have paid on the flat rate and compared their usage to the same month a year prior. Customers were then shown a smiley face if they saved during that month or over the program year. If they lost money that month, there was a statement encouraging different electricity use behaviors. After a graph of a sample day's usage, the back of the report included a rate graphic as a reminder of the program days and rates. It also included any important information the customer should be aware of and energy tips to help customers save money and reduce usage on the NDPT.

Figure 19: NDPT Home Energy Report Example



NVEnergy A MIDAMERICAN ENERGY HOLDINGS COMPANY CHOOSE When You USE

Monthly Summary Report

Account: [redacted]
Premise: [redacted]
Customer: [redacted]
Service Address:
[redacted]
LAS VEGAS, NV [redacted]

[redacted]
[redacted]
LAS VEGAS, NV [redacted]

For any questions, call 1-800-255-0990

How have you done so far with *Choose When You Use* ?

Period	Your bill on the *Choose When You Use* program	Comparative charge on your old rate	Difference	
March 2014	$ 146.16	$ 215.11	$ (68.95)	-32.1%
Program-to-Date 3/2014 to 3/2014	$ 146.16	$ 215.11	$ (68.95)	-32.1%
March 2013	$ 132.44	$ 205.58	$ (73.14)	-35.6%

Above charges include estimated taxes and fees and may differ slightly from your actual bill.

Congratulations!

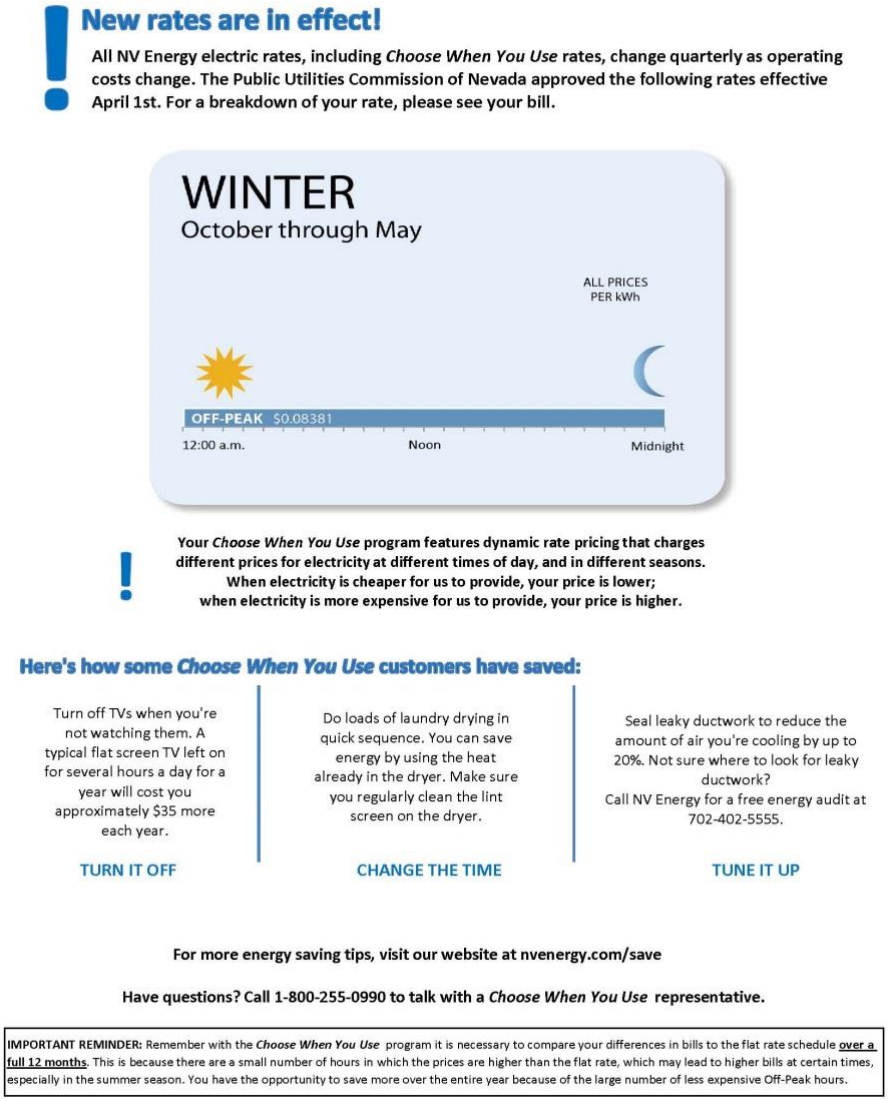
You Saved this Month!

You've Saved Program to Date!

Tuesday, March 25, 2014
High 84° F Low 55° F

This chart is one example of what you can see online.

NV Energy makes it possible to see your energy usage every day with My Account.
Visit nvenergy.com/myaccount



New rates are in effect!

All NV Energy electric rates, including *Choose When You Use* rates, change quarterly as operating costs change. The Public Utilities Commission of Nevada approved the following rates effective April 1st. For a breakdown of your rate, please see your bill.

WINTER
October through May

ALL PRICES
PER kWh

OFF-PEAK $0.08381

12:00 a.m. Noon Midnight

Your *Choose When You Use* program features dynamic rate pricing that charges different prices for electricity at different times of day, and in different seasons. When electricity is cheaper for us to provide, your price is lower; when electricity is more expensive for us to provide, your price is higher.

Here's how some *Choose When You Use* customers have saved:

Turn off TVs when you're not watching them. A typical flat screen TV left on for several hours a day for a year will cost you approximately $35 more each year.

TURN IT OFF

Do loads of laundry drying in quick sequence. You can save energy by using the heat already in the dryer. Make sure you regularly clean the lint screen on the dryer.

CHANGE THE TIME

Seal leaky ductwork to reduce the amount of air you're cooling by up to 20%. Not sure where to look for leaky ductwork?
Call NV Energy for a free energy audit at 702-402-5555.

TUNE IT UP

For more energy saving tips, visit our website at nvenergy.com/save

Have questions? Call 1-800-255-0990 to talk with a *Choose When You Use* representative.

IMPORTANT REMINDER: Remember with the ***Choose When You Use*** program it is necessary to compare your differences in bills to the flat rate schedule **over a full 12 months**. This is because there are a small number of hours in which the prices are higher than the flat rate, which may lead to higher bills at certain times, especially in the summer season. You have the opportunity to save more over the entire year because of the large number of less expensive Off-Peak hours.

Customers always have the option of visiting nvenergy.com or obtaining their account information through MyAccount. Both can be accessed through the NV Energy website. In addition to logging on to MyAccount, customers can find tips to conserve energy and resources to help teach their children about the importance of using energy wisely through games and other outside links. When first visiting the website, customers are greeted with timely utility information and programs that they are able to sign up for. If the customer needs utility service assistance such as starting, stopping or transferring service, reporting an outage, signing up for paperless billing and more, the website will direct them to the information that they need.

Participant Surveys

The NDPT conducted two major surveys of customers to get to know their household, how they use energy and what changed because of the program. Both surveys were administered by the University of Nevada, Las Vegas Cannon Survey Center and by Active TeleSource (ATS) over the phone.

The 2013 Baseline Survey was conducted from March 2013 to May 2013. The Baseline Survey was approximately 70 items that asked customers a series of questions to determine their willingness to spend time evaluating their energy use, prior program knowledge and gather some demographic information. This helped the NDPT get an idea of who the NDPT customers were and the information would help during analysis stages to help understand the NDPT customer.

The 2015 Demographic Survey was conducted from February 2015 to April 2015 and surveyed NDPT participants and members of the control group. The Demographic Survey was between 78 and 110 questions depending on the group being called and also focused on energy use, household habits and demographic information. For NDPT participants, questions were asked specifically about actions taken and habits formed during the pricing trial. The surveys are a major part of the program analysis since it takes the average customer's actions and reactions to the program in account. The survey was taken by 412 NDPT participants in the North and 818 in the South. Those who completed the survey were put into a drawing for a $1,000 American Express gift card. The winner was drawn at the close of the survey in April 2015.

Customer Focus Groups

NDPT participants were invited to participate in focus groups in the north and south during both years of the program, and after the program ended. During the first year, three sets of focus groups were completed (18 North and 18 South); during the second year of the program an additional two sets (eight North and eight South) were held. After the program, one set of focus groups was completed (four North and four South). Groups held during the program were recruited by cell, some later groups were recruited across cells by savings status or transition status.

Focus groups were conducted according to a research protocol in each case. All focus groups were transcribed. Some direct comments from the focus group comments are included in this report. Attendees were assured of their anonymity in subsequent review, reporting, and analysis of the focus group research.

In-Home Interviews

After the close of the program, NDPT participants were also invited to participate in in-home interviews. A total of 20 such interviews were conducted, ten in the North and ten in the South. Each interview consisted of a 30-90 minute conversation with one or more members of an individual participating household.

In-home interviews were conducted according to a research protocol in each case, but participants' responses ranged widely. Attendees were assured of their anonymity in subsequent review, reporting, and analysis of the in-home research.

NDPT Databases

As the NDPT progressed through recruitment, Program Year 1 and Program Year 2, different databases were created to track customer decisions, collect meter data and comply with DOE requirements. The following is a list of databases that were created and used throughout the program and during analysis work.

- Master file: all customer data coded by a unique NDPT ID to protect customer information
- 2013 Baseline Survey files
- Education Survey files: administered during the education treatment to determine learning
- 2015 Demographic Survey files
- EPP Customer lists: used to identify customers choosing EPP for a Report to PUCN
- Program Year 1 Savers/Non-Savers list: customer letters at the end of Program Year 1 were sent using this list
- End of Program Savers/Non-Savers list: identification for analysis
- Education Treatment files: a list of active education treatment participants
- Focus Group Transcripts: used to document information from focus group participants for Hypothesis 4 analysis
- Focus Group Videos: used to create transcripts
- Thermostat installation files
- Meter Data files: used for analysis
- Recruitment files: all materials sent during recruitment
- End of Program Year 1 files: all materials sent during reenlistment
- End of Program Transition: all files sent at the end of the program
- All Department of Energy required files: determined from SGIG Guidance Document #10

These files were used throughout the analysis.

Program Transition

The state of Nevada is a very diverse area that boasts something for everyone to enjoy with its outdoor recreation, gaming and farming industries. Each of these brings many people to the area each year, which creates a unique problem for NV Energy to overcome in providing energy and collecting bill payments as the move-in and move-out numbers change. This contributed to the attrition the program saw during both years of the trial.

Program Year 1 Attrition

The NDPT experienced three types of attrition during Program Year 1, resulting in 439 participants, or approximately 8% of the starting population, leaving the NDPT from March 1, 2013 to February 28, 2014.

- Move-outs: These are customers who moved out of the residence they occupied at the time of enrollment. Per the tariffs and CBSP, customers were not allowed to take their enrollment with

them to a different residence, nor were the new occupants allowed to take over the prior tenant's trial participation. The NDPT experienced 344 total move-outs in Program Year 1. Move-outs accounted for 78% of attrition.

- Exempted: Despite the tariff specifically stating that customers could not leave the program until the end of the first year of participation, NV Energy made exceptions in order to foster better customer service by allowing some customers to leave during Program Year 1. NV Energy exempted 81 participants during Year 1. Exemptions accounted for 18% of attrition.
- Other: For disqualifying actions, 14 customers were removed from the pricing trial, including switching to net metering after installing renewable generation, having their smart meter removed and taking service under the existing optional TOU. Miscellaneous removals accounted for 3% of attrition.

Table 10: NDPT Program Year 1 North Starting Population and Attrition

Treatment	Started	Moved	Exempted	Other	Retained
TOU	435	13	1	1	420
TOU+E	296	18	5	0	273
TOU+E+T	150	14	0	0	136
CPP	334	15	1	0	318
CPP+E	300	14	2	0	284
CPP+E+T	322	16	3	0	303
Totals	**1,837**	**90**	**12**	**1**	**1,734**

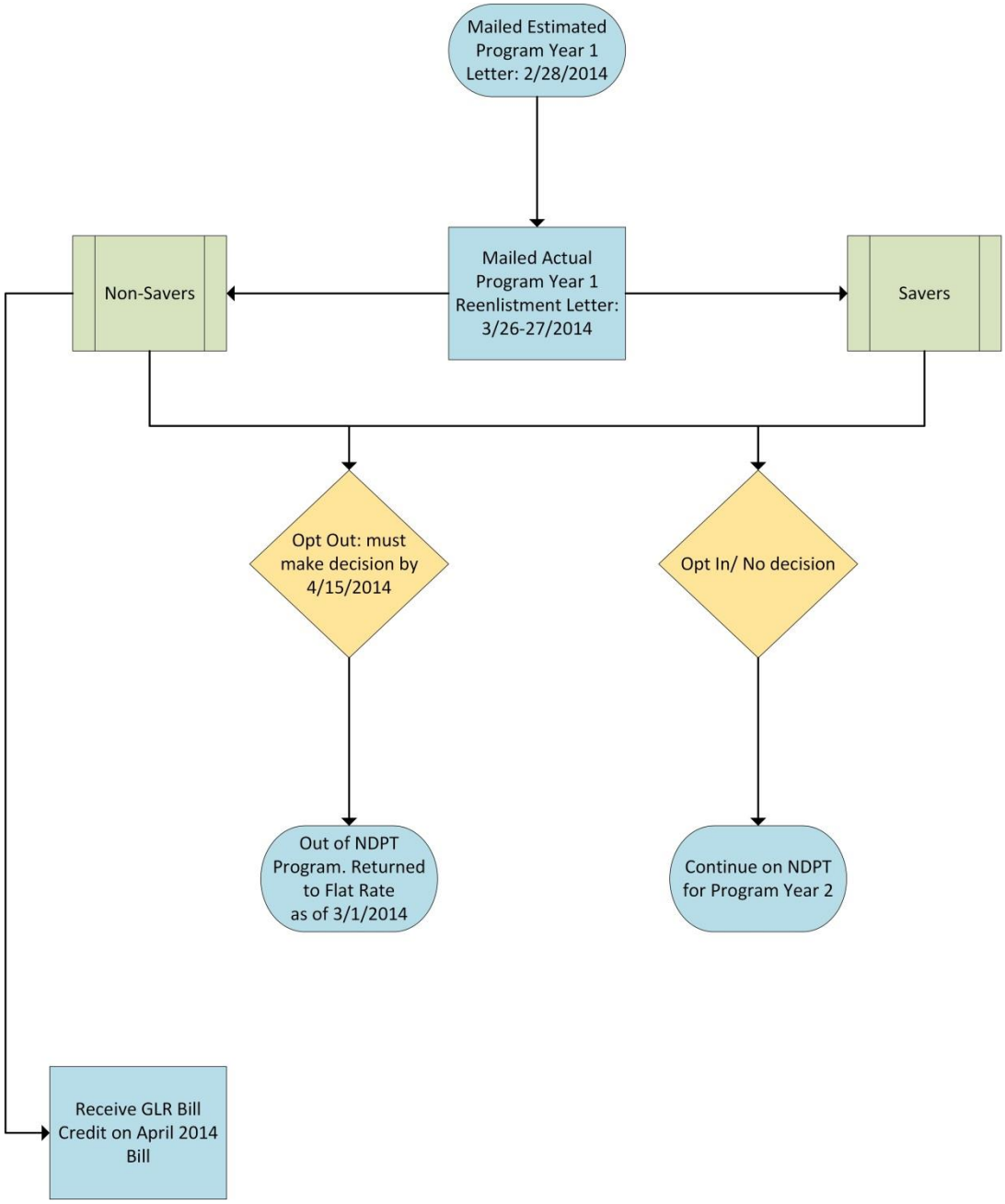
Table 11: NDPT Program Year 1 South Starting Population and Attrition

Treatment	Started	Moved	Exempted	Other	Retained
TOU	430	41	12	2	375
TOU+E	323	26	6	1	290
TOU+E+T	317	16	9	2	290
CPP	914	63	16	2	833
CPP+E	731	62	21	5	643
CPP+E+T	703	46	5	1	651
Totals	**3,418**	**254**	**69**	**13**	**3,082**

Program Year 1 Reenlistment

Tables 11 and 12 indicate the NDPT participants who completed Program Year 1 and were eligible to decide whether or not to participate in Program Year 2. The NDPT included a first year Guaranteed Lowest Rate (GLR) or Best Bill Guarantee that expired after the first year of the program meaning that participants who elected to remain in the program proceeded without the potential of any additional reimbursements.

Figure 20: End of Program Year 1 Reenlistment



The NDPT had a defined period of time in which customers were presented results of their performance during Program Year 1 and provided an opportunity to opt-out. On February 28, 2014, NV Energy mailed customers a summary of their performance in Year 1, using an estimate for the last five days in February. The letter indicated whether the customer was estimated to save or lose money by being on the dynamic rate and the level of savings or loss. The letter also provided contact information for the

NDPT customer service team to answer opt-out or other questions and provided information about changes in Program Year 2, such as the removal of the GLR.

On March 26-27, 2014, NV Energy mailed customers a final summary of their performance in Program Year 1, taking into account the last five days in February. The letter reiterated the deadline to opt-out and provided information on when the customer would receive their bill credit, if they lost money by being on the NDPT rate compared to the otherwise applicable flat rate. Those bill credits were included on the February usage bill, which was received in the first part of March.

The original window to opt-out was from March 1, 2014 to March 31, 2014 and subsequently stretched to April 15, 2014 to account for any delays in the mail processing, vacations, etc. Within the six week window, 735 customers opted not to participate in the second year of the pricing trial. The results are outlined in Table 12.

Table 12: NDPT Program Year 1 Reenlistment Opt Out Numbers

Cell	North	South
TOU	74	56
TOU+E	62	57
TOU+E+T	23	35
CPP	67	96
CPP+E	87	69
CPP+E+T	66	43
Totals	**379**	**356**

It is important to note that customers who saved money did not necessarily stay in the program for a second year, just as those who lost money during the first year did not all opt out of the program. Approximately 49% of customers who opted out of Program Year 1 saved money, while approximately 15% of customers who continued to Program Year 2 lost money in Program Year 1.

Figure 21: Program Year 1 Non-Saving Reenlistment Letter

NVEnergy

DATE

Account Number:
[account number]

NAME
ADDRESS
CITY, STATE ZIP

Service Address:
[ADDRESS]
[CITY], [STATE] [ZIP]

Final Bill Comparison Report: Year 1

Thank you for participating in the NV Energy *Choose When You Use* program. The first year of the program has come to an end and this letter includes the final comparison of what you paid in Year 1 on your *Choose When You Use* rate with what you would have paid on the standard flat rate. Throughout the last year we sent you monthly energy reports, and earlier this month you should have received an estimated bill comparison for the first year. Because this Final Bill Comparison Report is based on complete usage information, it may differ slightly from those.

Below is a monthly comparison of your electric charges:

Charge Date:	On your new rate you paid:	On your old rate, you would have paid:	Difference:
4/3/213	$44.89	$60.60	$15.71
5/2/2013	$40.87	$55.72	$14.85
6/4/2013	$39.14	$51.95	$12.81
7/3/2013	$94.57	$79.38	-$15.19
8/2/2013	$193.32	$107.46	-$85.86
9/5/2013	$183.22	$93.64	-$89.58
10/3/2013	$81.10	$52.72	-$28.38
11/2/2013	$34.77	$46.19	$11.42
12/5/2013	$54.28	$73.38	$19.10
1/3/2014	$60.99	$82.20	$21.21
2/4/2014	$56.40	$76.81	$20.41
3/4/2014	$53.22	$71.87	$18.65
Total:	**$936.77**	**$851.92**	**-$84.85**

You'll receive a bill credit!

You decided to try a program that included a first-year No-Risk Bill Protection Guarantee and you ended the year with a credit of $84.85 under that guarantee. This credit will be applied to your March bill that is sent in April. Please look for this credit on your bill.

The *Choose When You Use* program is a two-year program and will continue until February 28, 2015. Staying in the program gives you another chance to save. However, **if you choose not to participate, please let us know by Monday, March 31 by** calling 1-800-255-0990. If we don't hear from you by then, you will automatically continue in the second year without the ability to leave the program. We would also like to remind you that the second year of the program does not include a No-Risk Bill Protection Guarantee or associated bill credit.

The *Choose When You Use* program gives you the opportunity to decide when to use electricity and the ability to shift usage to less expensive times of day. If you decide to stay for the second year of the program, you will continue to receive monthly energy reports along with tips on how to save more.

Thank you for being a part of the first year of the *Choose When You Use* program. If you have any questions, please contact us at 1-800-255-0990 and we'll be happy to help.

We appreciate the opportunity to serve you,

Your NVEnergize *Choose When You Use* team

P.O. BOX 98910, LAS VEGAS, NEVADA 89151-0001 6226 WEST SAHARA AVENUE, LAS VEGAS, NEVADA 89146
P.O. BOX 10100, RENO, NEVADA 89520-0024 6100 NEIL ROAD, RENO, NEVADA 89511 **NVEnergy.com**

Figure 22 Program Year 1 Saving Reenlistment Letter

NVEnergy

DATE

Account Number:
[Account Number]

[NAME]
[ADDRESS]
[CITY], [STATE] [ZIP]

Service Address:
[ADDRESS]
[CITY], [STATE] [ZIP]

Final Bill Comparison Report: Year 1

Thank you for participating in the NV Energy *Choose When You Use* program. The first year of the program has come to an end and this letter includes the final comparison of what you paid in Year 1 on your *Choose When You Use* rate with what you would have paid on the standard flat rate. Throughout the last year we sent you monthly energy reports, and earlier this month you should have received an estimated bill comparison for the first year. Because this Final Bill Comparison Report is based on complete usage information, it may differ slightly from those.

Below is a monthly comparison of your electric charges:

Charge Date:	On your new rate you paid:	On your old rate, you would have paid:	Difference:
4/3/2013	$74.12	$118.00	$43.88
5/2/2013	$90.00	$142.95	$52.95
6/4/2013	$136.03	$216.06	$80.03
7/3/2013	$296.04	$375.11	$79.07
8/2/2013	$617.31	$447.48	-$169.83
9/5/2013	$444.13	$374.46	-$69.67
10/3/2013	$216.20	$287.27	$71.07
11/2/2013	$119.46	$187.65	$68.19
12/5/2013	$101.73	$159.81	$58.08
1/3/2014	$120.56	$189.39	$68.83
2/4/2014	$123.99	$192.18	$68.19
3/4/2014	$105.13	$162.95	$57.82
Total:	**$2444.70**	**$2853.31**	**$408.61**

Congratulations on your savings!

You worked hard this year to change your energy habits to make this new rate work for you and you saved $408.61.

The *Choose When You Use* program is a two-year program and will continue until February 28, 2015. Staying in the program gives you a chance to save even more. However, **if you choose not to participate, please let us know by Monday, March 31** by calling 1-800-255-0990. If we don't hear from you by then, you will automatically continue in the second year without the ability to leave the program. We would also like to remind you that the second year of the program does not include a No-Risk Bill Protection Guarantee.

The *Choose When You Use* program gives you the opportunity to decide when to use electricity and the ability to shift usage to less expensive times of day. If you decide to stay for the second year of the program, you will continue to receive monthly energy reports along with tips on how to save more.

Thank you for being a part of the first year of the *Choose When You Use* program. If you have any questions, please contact us at 1-800-255-0990 and we'll be happy to help.

We appreciate the opportunity to serve you,

Your NVEnergize *Choose When You Use* team

P.O. BOX 98910, LAS VEGAS, NEVADA 89151-0001 6226 WEST SAHARA AVENUE, LAS VEGAS, NEVADA 89146
P.O. BOX 10100, RENO, NEVADA 89520-0024 6100 NEIL ROAD, RENO, NEVADA 89511 **NVEnergy.com**

Figure 23: Average Savings and Loss for North Customers at the End of Program Year 1

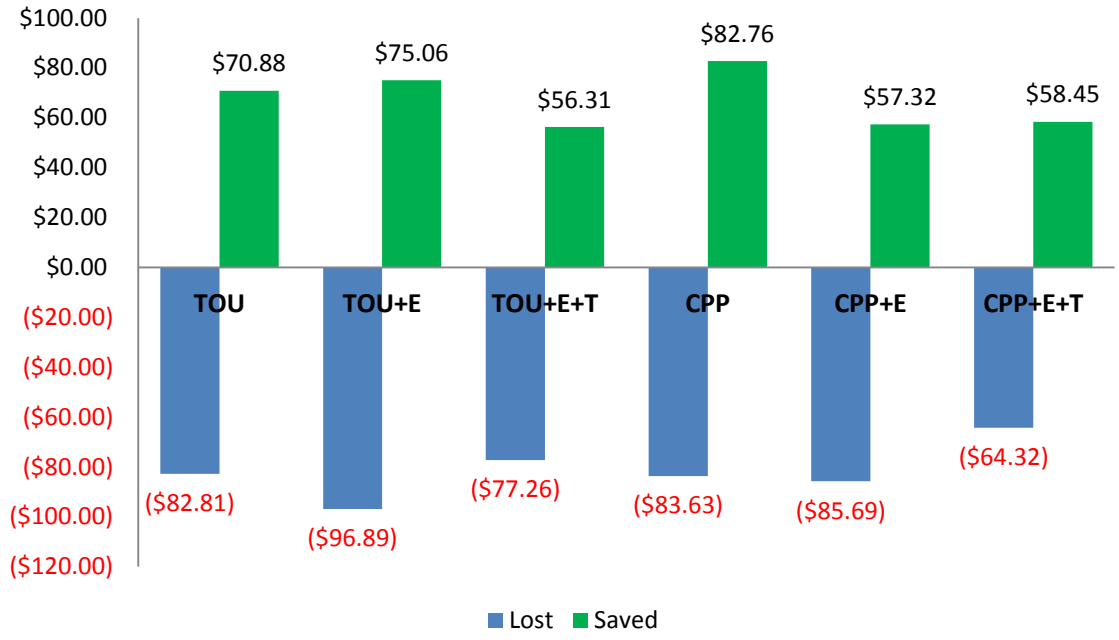


Figure 24: Average Savings and Loss for South Customers at the End of Program Year 1

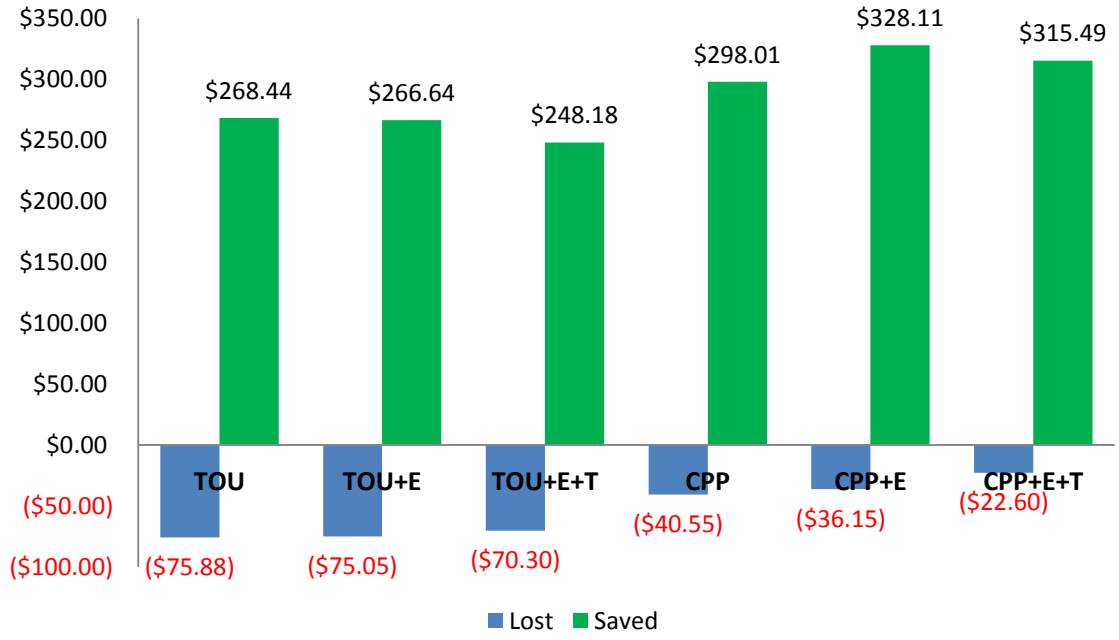


Table 13: Difference in North NDPT Starting Population, Program Year 1 and End of Program

Treatment	Started NDPT	End of Program Year 1	End of Program Year 2
TOU	435	420	319
TOU+E	296	273	194
TOU+E+T	150	136	103
CPP	334	318	232
CPP+E	300	284	167
CPP+E+T	322	303	205
Totals	1,837	1,734	1,220

Table 14: Difference in South NDPT Starting Population, Program Year 1 and End of Program

Treatment	Started NDPT	End of Program Year 1	End of Program Year 2
TOU	430	375	284
TOU+E	323	290	199
TOU+E+T	317	290	221
CPP	914	833	656
CPP+E	731	643	504
CPP+E+T	703	651	534
Totals	3,418	3,082	2,398

End of Program Transition

At the end of the NDPT, customers were sent materials to choose their rate program starting March 1, 2015. The brochure outlined that they could choose to return to the Residential Flat Rate they were on prior to starting the NDPT, or they could go on to the Optional Time-Of-Use program that was similar to the rate structure they had participated in for two years. NDPT Participants had until March 28, 2015 to make a decision on a new program or to be automatically placed back on the Residential Flat Rate for their March 2015 statement.

Figure 25: End of NDPT Decision Process

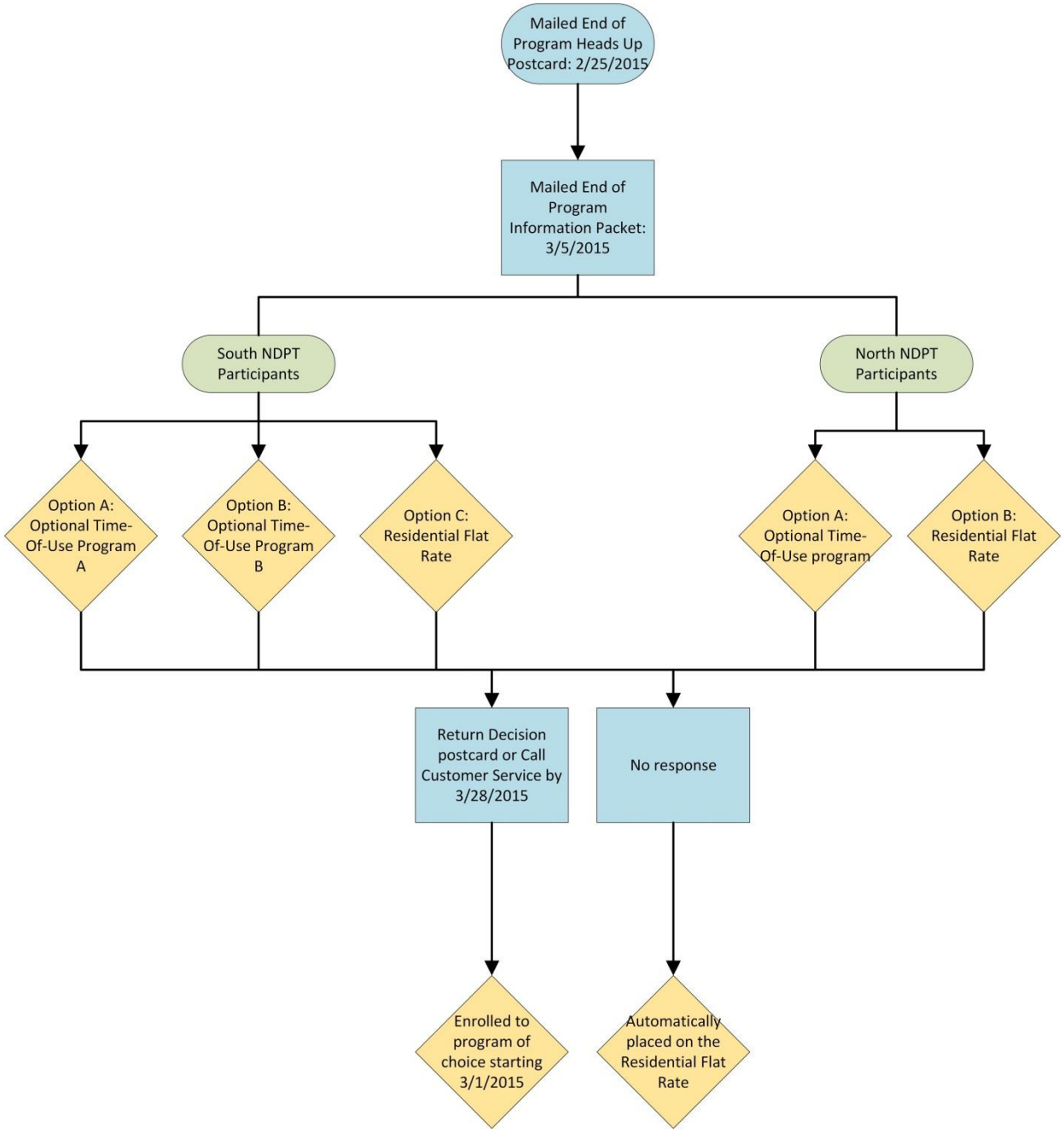


Figure 26: Average Savings and Loss for North Customers at the End of Program Year 2

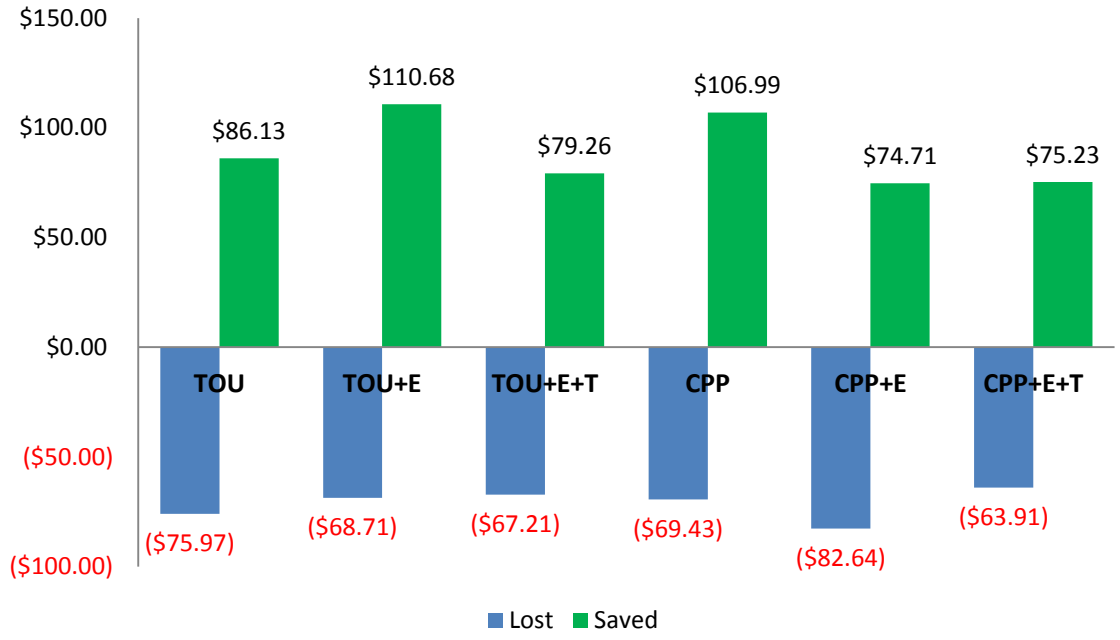
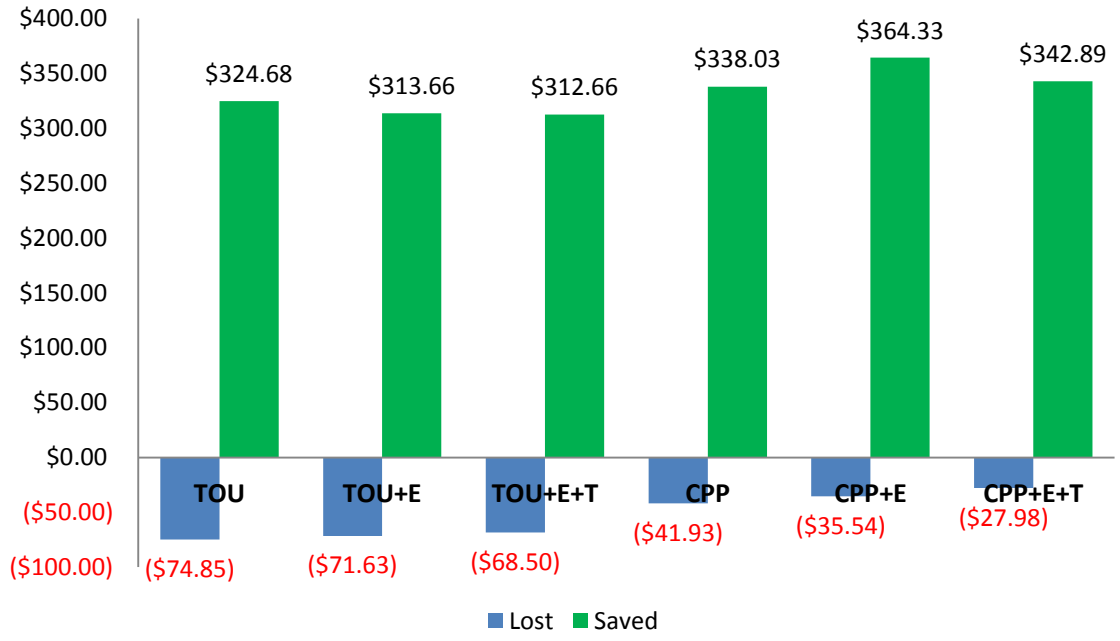


Figure 27: Average Savings and Loss for South Customers at the End of Program Year 2



After receiving the transition materials, customers made a decision about their rate program. Some chose to go back to the flat rate while others chose the Optional Time-Of-Use program. Just as in the reenlistment phase at the end of Program Year 1, some customers who lost money on the NDPT chose the Optional Time-Of-Use rate while some of those who saved money on the program, decided to go

back to the Residential Flat Rate. Tables 15 and 16 detail the transitions by cell. Table 17 explains the customers who chose to go to the mPowered program.

Table 15: North End of Program Rate Transition[6]

NDPT Treatment	Residential Flat Rate	Optional Time-Of-Use	Other[7]	Total
TOU	196	123	0	319
TOU+E	136	58	0	194
TOU+E+T	68	35	0	103
CPP	135	97	0	232
CPP+E	119	48	0	167
CPP+E+T	130	74	1	205
Totals	**784**	**435**	**1**	**1,220**

Table 16: South End of Program Rate Transition[8]

NDPT Treatment	Residential Flat Rate	Optional Time-Of-Use Program A	Optional Time-Of-Use Program B	Other[4]	Total
TOU	182	83	19		284
TOU+E	114	63	21	1	199
TOU+E+T	117	88	16		221
CPP	337	250	67	2	656
CPP+E	265	193	46		504
CPP+E+T	262	225	46	1	534
Totals	**1,277**	**902**	**215**	**4**	**2,398**

Table 17: North and South NDPT to mPowered Program Transition[9]

Treatment	North	South
TOU	11	16
TOU+E	15	14
TOU+E+T	20	56
CPP	9	62
CPP+E	8	40
CPP+E+T	64	181
Totals	**127**	**369**

[6] Rate transition as of June 1, 2015.
[7] Other includes Net Metering and Optional TOU HEV
[8] Rate transition as of June 1, 2015
[9] mPowered transition numbers as of June 30, 2015. NDPT to mPowered program transitions after June 30 are not included.

Analysis Methodology

The NDPT was designed to test customers' electricity consumption response to different combinations of experimental treatments (i.e., dynamic rates, education and technology) as detailed previously. The overall objective of the NDPT analysis is to describe how NDPT customers managed their electricity use with the help of the treatments provided.

This portion of the NDPT Final Report is divided into two sections. The first section details the methods that are used to quantify the results of the NDPT. There are three broad categories of methods that are employed in this report: statistical analysis methods (including load impacts and customer responsiveness metrics), survey methods and direct research techniques. These are the analytical tools that will be used to address the four NDPT hypotheses. The second section will consider each of the four hypotheses in turn, using the analytical methods described in the first section to address each of the hypotheses. The analysis in this section includes all of the anticipated metrics from the CBSP in conjunction with discussions with LBNL regarding DOE required metrics.

Data

For NDPT trial participants and control group members, NV Energy collected data for the year before the trial began (Program Year 0) and the two years in which the NDPT trial rates were in effect (Program Years 1 and 2). NV Energy collected 15-minute interval meter data via their advanced metering infrastructure (AMI). The 15-minute interval observations were then aggregated to hourly observations by taking the mean 15-minute usage across each hour and multiplying that value by four. This method is preferred to summing across the 15-minute intervals for the hour because it controls for that fact that an interval in the time series may be missing.

As mentioned previously, there were delays in the roll-out of smart meter installations, limiting data availability for the NDPT. In order to maximize the number of NV Energy customers that were eligible to participate in the NDPT in the North, all participants who had meters installed before July 2012 were included in the trial. As a result, there were a number of Program Year 0 hourly consumption observations for which 15-minute interval data was not available. In order to have a complete Program Year 0 time series for each of the 3,618 participants who finished the trial, monthly consumption data from individual billing data and load shapes were used to impute missing values.

Unless otherwise noted, all analysis in this report is based on the 3,618 NDPT participants (1,220 in the North, 2,398 in the South) who completed both Program Year 1 and Program Year 2 of the NDPT. Program Year 1 analysis in this report may differ from analysis in the interim report[10] because it is calculated based on the set of participants who completed the trial, while the interim report analysis was based on the set of participants who completed Program Year 1. The NDPT was designed to provide customers with an offer to participate in a voluntary program, typical of what NV Energy might offer.

[10] Available on smartgrid.gov within the Resource Library.

All analysis, unless otherwise noted, is calculated for the two regions separately. As discussed previously, there are differences in the rates, time periods and seasons in the NDPT between the North and South which necessitate separate analysis. The regions are clearly identified throughout the analysis and in all applicable tables and figures.

Load Impacts

Load impact metrics are calculated in order to measure how electricity usage changed for households exposed to the time-of-use rates (TOU) and time-of-use rates with a critical peak pricing period (CPP) tested in the NDPT. In order to understand and quantify these changes in electricity use, we examine the behavior of participants as compared to the control group members using difference-in-differences (DiD) analysis.[11] The NDPT was designed to test how different combinations of experimental treatments (i.e., dynamic rates, education and technology) affected electricity usage for participating households, and this analysis allows us to understand whether any of the treatments caused a statistically significant change in electricity used between participants and the control group.

The regression equation for this analysis is shown in Equation 1. The households included in the DiD analysis include all NDPT participants and all control group members.

$$load_{iP} = \beta_0 + \beta_1 T_i + \beta_2 R_P + \beta_3 T_i * R_P + \varepsilon_{iP} \quad (1)$$

The variables in Equation 1 are defined as follows.

- $load_{iP}$ is electricity use in kWh for customer *i* in period P. The six treatment groups in the NDPT incorporated a number of rates at different times. In some cases the load impact is measured at the hourly level, and other times at the period level (i.e., during a 4-hour Critical Peak Pricing period). The analysis period and treatment group are clearly described in each model specification.
- T_i is a dummy (indicator) variable for identifying whether a customer is a NDPT participant or a control group customer. T_i = 1 for NDPT participants, and zero otherwise.
- R_P is a dummy (indicator) variable for the NDPT program period. R_P = 1 for the time period in which the NDPT rates were in effect (Program Year 1, Program Year 2, or the average of the two program years). R_P = 0 for the period before NDPT rates were in effect (i.e., PROGRAM YEAR 0).
- $T_i * R_P$ is an interaction term that identifies customers in the NDPT participant group in the period when NDPT rates were in effect (i.e., T_i*R_P = 1 for customers in the Treatment group in Program Years 1 and 2, and zero otherwise).

[11] In line with guidance from LBNL, we also analyzed NDPT data using methodology intended for experiments structured as a Randomized Encouragement Design (RED). However, the size of the overall NDPT non-complier group (a total of 190,324 customers, with 48,580 in the North and 141,744 in the South), limited the ability of the RED to detect reasonable effect sizes. In a RED design, having a large percentage of non-compliers compared to participants can result in treatment effects that are understated, as well as Type II errors (failing to reject the null hypothesis that there is no statistically significant treatment effect when it is false). Analysis of NDPT data using the RED approach found these problems to be present. To avoid these problems, and to accurately determine the effect of the NDPT treatments on participating households, we calculate load impacts for the NDPT using a difference in differences framework.

- ε_{iP} is the error term associated with the observation for $load_{iP}$, robust and clustered at the household level.

β_3 is the coefficient of interest in equation 1. This estimated coefficient provides the measure of the change in kWh usage associated with being in the NDPT participant group during the NDPT time period under consideration, relative to the control group.

In this report, the analysis is performed for Program Year 1 (PY1) vs. Program Year 0 (PY0) and Program Year (PY2) vs. Program Year 0 for each of the treatment groups. These calculations use regression analysis, with standard errors calculated using individual households as clusters.[12]

In order to accurately calculate load impacts during CPP periods, it is important to use days in Program Year 0 that are comparable to CPP event days during the NDPT. NV Energy's mPowered demand response program was in effect in summer 2012, and uses similar decision rules as the NDPT to determine which summer days are designated as event days. In this analysis, we use the CPP hours in each region (2 – 6 p.m. in the North, 3 – 7 p.m. in the South) during the mPowered event days in 2012 as the Program Year 0 comparison periods for calculating the load impacts during CPP periods. The mPowered event days for the North and South in 2012 are shown in the following figures.

Figure 28: mPowered Event Days, North 2012

July 2012						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

August 2012						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

September 2012						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

[12] This method of calculating standard errors accounts for serial correlation across observations within each household.

Figure 29: mPowered Event Days, South 2012

June 2012						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

July 2012						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

August 2012						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

September 2012						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

The DiD approach does not explicitly incorporate adjustments for changes in conditions from Program Year 0 to Program Year 1 and to Program Year 2 (e.g., weather, changes in the economy that affect electricity usage, etc.). The implicit assumption for this analysis is that a change in electricity use in response to a change in conditions would be the same for the control group and the treatment group in the absence of the treatment. While these assumptions cannot be tested, we can at least examine whether the treatment and control groups were similar during the pre-treatment period, and so we compared electricity use in Program Year 0 between the treatment and control groups. The average hourly electricity use was calculated for each month for both groups.

In the South, we find that there is not a statistically significant difference in Program Year 0 usage between NDPT participants and the control group. In the North, we find that there is a marginally significant (p=0.043) difference in Program Year 0 monthly usage between NDPT participants and the control group. However, upon further examination we find that the difference between these groups in Program Year 0 is solely due to a lower average hourly usage level for participants than for control group members in March 2012.[13]

Customer Responsiveness Metrics

In addition to load impact metrics, we also examine the variation in participant responsiveness to the NDPT at the individual household level by using within subject regression analysis and calculating

[13] As discussed previously, there was a delay in smart meter roll-out in the North. As a result, there were many participants in the North who were missing meter data in the single month of March 2012 and had data imputed for that month. This difference in March 2012 should have minimal effects on our analysis, but may have resulted in slight overstatements of winter load impact in the North.

elasticity metrics. This analysis is undertaken in order to understand heterogeneity in individual responses to the NDPT. Each of these methods will be discussed in greater detail next.

Individual Household Impact Metrics

Household level load impact metrics are calculated using within subject regression analysis. The results of these regressions are used to understand the heterogeneity in individual electricity reducing or shifting behavior, as well as to understand characteristics of groups who decreased or shifted electricity use more or less than other groups.

The regression equation for this analysis is shown in Equation 2, and will be described further next.

$$load_t = \beta_0 + \beta_1 POST_1 + \beta_2 WV_t + \varepsilon_t \quad (2)$$

The variables in Equation 2 are defined as follows.

- $load_t$ is electricity use in kWh for each household in hour t.
- $POST_1$ is a dummy (indicator) variable for identifying whether the kWh observation during hour t occurred during the NDPT (PY1 and/or PY2) or in the baseline year (PY0). $POST_1$ = 1 for all hours during PY1 and/or PY2 of the NDPT, and zero for hours during PY0.
- WV_t = weather variable values (described in detail next) per hour during hour t.
- ε_t is the error term associated with the observation for $load_t$.

Weather variables are included in the regression specifications in order to control for weather effects on electricity usage. For these variables, we use the same variables that the NV Energy load forecasting team uses to control for hourly weather variation on the system energy. These variables are calculated as heating degree days (HDD) and cooling degree days (CDD) with different base temperature levels. Heating degree day variables are used to control for the effect of external temperature on the amount of electricity used to heat a building. For example, HDD65 indicates a heating degree day variable with a base temperature of 65°F. For any external temperature of 65°F or greater, this variable takes on a value of zero. For any external temperature of less than 65°F, this variable takes on a value equal to the difference between the external temperature and 65°F.

A cooling degree day variable is calculated in a similar manner, except that cooling degree day variables are used to control for the effect of external temperature on the amount of electricity used to cool a building. For example, CDD65 indicates a cooling degree day variable with a base temperature of 65°F. For any external temperature of 65°F or lower, this variable takes on a value of zero. For any external temperature of greater than 65°F, this variable takes on a value equal to the difference between the external temperature and 65°F. These variables are calculated on an hourly basis based on observations from the closest National Weather Service meteorological observation site to each household (KRNO for customers in the North, KLAS for customers in the South)[14].

For customers in the South, our analysis employs the values of HDD55, CDD60 and CDD75, and in the North our analysis employs the values of HDD40, HDD55, CDD60 and CDD70. These variables were

[14] Any missing weather observations from these station were filled with data from nearby stations. These included Reno-Stead (KRTS) in the North, and North Las Vegas (KVGT) and Nellis Air Force Base (KLSV) in the South.

chosen based on analysis that the NV Energy load forecasting team, in conjunction with Itron Inc., performed on historical load and temperature data. Multiple temperature variables are used to control for non-linearities in electricity usage at different temperatures in each region. This vector of weather variables is denoted as WV_t in the regression equation.

β_1 is the coefficient of interest in equation 2. This estimated coefficient indicates the difference in average hourly kWh usage during the NDPT as compared to the baseline year for the particular rate period or year of interest. Separate regressions are run for each individual household for Program Year 1 and Program Year 2 of the NDPT as well as both years together compared to usage in Program Year 0. This provides a separate estimate for each NDPT participant household for each of these time periods in order to categorize household saving behavior. In addition, separate regressions are run for each rate period for each individual household for Program Year 1 and Program Year 2 of the NDPT, as well as both years together compared to usage in Program Year 0. This provides a separate estimate for each NDPT participant household for each rate period in order to categorize household shifting behavior.

Elasticity Metrics

Elasticity measures are used in order to understand the responsiveness of individual households to the TOU and CPP rates tested in the NDPT. Elasticity metrics are calculated using regression analysis at the individual household level for each rate period and season.

Own Price Elasticity of Demand

This metric is intended to measure the responsiveness of each customer's demand for a good given a change in its price. More specifically, for the NDPT this is a measure that may indicate the percentage change in the quantity of electricity used by a participant in a particular period, given a 1% change in the price of electricity in that period. We use a log-linear demand model specification to calculate own price elasticity, where Q_{tm} is the hourly electricity demand for each customer. The regression equation for this metric is shown in Equation 3, and will be described further next.

$$ln\, Q_{tm} = \beta_0 + \beta_1\, ln\, Tariff_t + \beta_2\, ln\, Bill_{m-1} + \beta_3 EnergyReport_{m-1} + \beta_4\, ln\, WV_t + \beta_5\, HIGHAQI_t + \varepsilon_{tm} \quad (3)$$

In focus group discussions and customer interviews, participant testimony indicated attention to three different types of communications. These communications included their electricity tariffs, as described in the recruiting materials, their monthly bills and their monthly energy reports. A standard calculation of own price elasticity of demand would include the tariff as the only price measure. However, these discussions with participants indicated that other price measures may have been influential as well. In order to account for this, we include three price variables in Equation 3: 1) the electricity price ($/kWh) experienced by customers at the time of usage (*Tariff*$_t$), 2) the customers' bills ($) from the previous month (*Bill*$_{m-1}$), and 3) the monthly energy reports that customers received comparing their bills under the NDPT rates to what their bills would have been on the current NV Energy flat rate tariff (*EnergyReport*$_{m-1}$)[15]. *EnergyReport*$_{m-1}$ is a dummy variable and is equal to one if the customer's bill was

[15] The elasticity metrics reported here may not be directly comparable to elasticity metrics reported in other studies.

lower under NDPT rates than it would have been on the flat rate in the previous month, and zero otherwise.

Weather variables (as described previously) are included in the regression equation, and denoted as WV_t. In addition, indicator variables are included in order to account for the effects of unusual events, such as days with unhealthy air quality which may have affected electricity usage. On these days, customers who might typically open windows during cooler hours may have chosen to use air conditioning instead. For example, there were several periods during the NDPT when air quality reached the unhealthy range in either the northern or southern Nevada areas where the NDPT customers lived.[16] To account for the effects of such occurrences, a dummy variable is added to the estimating equation that takes the value of 1 for the hours in any data where the AQI is in the unhealthy ranges and 0 for all others.[17] This dummy variable is denoted as HIGHAQI_t in equation 3.

Elasticity of Substitution

This metric is often used as an indicator of how readily an individual will substitute one good for another good. In the case of the NDPT trial, intra-day elasticity of substitution is a measure of the percentage change in the ratio of electricity usage during one rate period to the electricity usage in another rate period correlated with a 1% change in the ratio of the prices of electricity in the two periods. For purposes of discussion here, we consider two rate periods, designated as peak and off-peak. In the analysis, we consider different combinations of rate periods, which are clearly described in each model specification.

A regression model as specified in Equation 4 allows estimation of intra-day elasticity of substitution. This equation expresses the peak to off-peak quantity ratio as a function of the ratio of peak price to off-peak price. The weather term included represents the difference in a vector of weather variables (as described previously) between the peak and off peak periods.

$$\ln\left(\frac{Q_p}{Q_{op}}\right) = \alpha + \sigma \ln\left(\frac{P_p^*}{P_{op}^*}\right) + \delta\left(WV_p - WV_{op}\right) + \varepsilon \quad (4)$$

[16] In northern Nevada, unhealthy days occurred in 2013 and 2014 as follows:

- In August 2013 there were large scale fires in the Sierra Nevada that resulted in a heavy incursion of smoke into the Reno area where the bulk of the northern NDPT participants reside. There were seven days in August where the Air Quality Index (AQI) registered either Unhealthy for Sensitive Groups (USG), three days, or Unhealthy, four days.
- In December 2013, there were nine days where the AQI registered in the USG range.
- In September 2014, there were three days where the AQI registered USG and three days Unhealthy.

For southern Nevada, unhealthy air quality days were spread throughout the year.

- In 2013, there were ten days in the USG range and one day in the Unhealthy range.
- In 2014, there were five days in the USG range and one day in the Unhealthy range.

[17] The commonly used Air Quality Index grades air quality into six categories: Good, Moderate, Unhealthy for Sensitive Groups (USG), Unhealthy, Very Unhealthy, and Hazardous. For purposes of analysis, we consider air quality to be unhealthy if the AQI for a day (hour) falls into any of the last four categories.

where

Q_p = electricity use per hour in the peak rate period (kWh)

Q_{op} = electricity use per hour in the off-peak rate period (kWh)

σ = elasticity of substitution between peak and off-peak electricity use

P_p^* = household's price of electricity during peak rate period ($/kWh)

P_{op}^* = household's price of electricity during off-peak rate period ($/kWh)

δ = measure of weather sensitivity

WV_p = weather variable values (as described previously) per hour during peak rate period

WV_{op} = weather variable values (as described previously) per hour during off-peak rate period

ε = error term

Survey Methodology

NDPT participants and control group subjects were surveyed at the beginning of the program, and again at the close of the program. The telephone surveys were conducted by the University of Nevada, Las Vegas Cannon Center, a specialized research organization. The surveys aimed to collect demographic, psychographic, and attitude information.

Table 18: Survey Responses

Survey	Group	Number of Completed Surveys
2013 Baseline Survey	Participants	2,795
2013 Baseline Survey	Control	1,021
2015 Demographic Survey	Participants	1,131
2015 Demographic Survey	Control	628

Participant survey respondents' electricity usage results (i.e., meter data) were compared to those of the participant set as a whole, and the two sets of respondents were shown to be similar.

The survey was designed to include content resembling typical residential appliance saturation surveys, and residential surveys of conservation and efficiency measures. As a result, the surveys were lengthy, and required callbacks in many instances. The typical time control subjects spent on the telephone completing the final survey was 45 minutes; participants averaged 58 minutes.

All survey results were captured in a database. Attendees were assured of their anonymity in subsequent review, reporting, and analysis of the survey research.

Direct Research Techniques

Direct research techniques employed in the NDPT included focus groups and in-home interviews. A total of sixty focus groups (30 North and 30 South) and twenty in-home interviews (10 North and 10 South) were completed, both during and after the program.

Focus groups and in-home interviews were conducted according to a research protocol in each case. All focus groups were transcribed with some focus group comments cited in this report. In-home interviews were not transcribed. All participants were assured of their anonymity in the subsequent review, reporting, and analysis of the focus groups and in-home research.

Hypotheses Exploration

As discussed previously, the NDPT was designed to test these four hypotheses:

1. Customers will respond to a) the time of use (TOU) and critical peak pricing (CPP) rates, b) the customer education, and c) the enabling technology provided by addressing, reducing, and shifting electricity usage (i.e., by managing their electricity use).

2. Customer electricity management responses to the rates, education, and technology treatments will differ significantly over time, and among segments of customers.

3. Combinations of rates, education, and technology treatments will yield customer electricity management responses that differ from the sum of the individual responses to those elements over time and among segments.

4. The extent and persistence of customer electricity management responses to rates, education, and technology treatments are significantly correlated with customer attitudes of a) energy ownership, and b) satisfaction with energy ownership.

Each one in turn will be described further in the following sections.

In order to address the hypotheses being tested, it is important to define some important terms that will be used throughout the analysis. The first hypothesis indicates that customers will respond to the NDPT by addressing, reducing and shifting electricity use. These terms are discussed further next.

- **Addressing electricity use:** In the NDPT, we define addressing electricity use as an individual making a choice to focus attention or behavior on their electricity use, as evidenced by a customer's statements or behavior.
- **Reducing electricity use:** In the NDPT, we define reducing electricity use as the action of using less electricity during all time periods overall, compared to behavior before the NDPT.
- **Shifting electricity use:** In the NDPT, we define shifting electricity use as the action of using less electricity during more expensive time periods (i.e. on-peak, mid-peak and CPP rate periods), using more electricity during less expensive periods (i.e. off-peak rate periods), or both, as compared to behavior before the NDPT.

Hypothesis 1

Hypothesis 1 states that customers will respond to TOU and CPP rates, education and technology provided by addressing, reducing and shifting use. We will now focus on each component of Hypothesis 1 in turn.

Addressing Electricity Use

All Participants addressed electricity use at some level

In the NDPT, the decision to address electricity use is indicated in a number of ways. First, the NDPT was an entirely opt-in program, so all participants made a choice to participate in the program and took action to sign up for the NDPT. The motivations behind the decision to participate in the NDPT were varied, but the action of enrolling in the NDPT indicates that all participants addressed their electricity use at some level.

The decision to reenlist in the program after the first year is another indication that participants in the addressed their electricity use. As described previously, participants who completed Program Year 1 could decide whether or not to participate in Program Year 2. The NDPT included a first year Guaranteed Lowest Rate (GLR) that expired after the first year[18], so participants who elected to remain in the program did so without the potential of any additional reimbursements. The choice to remain in the NDPT for the second year is an action that indicates NDPT participants addressed their electricity use.

Finally, NDPT participants had an opportunity to address their electricity use at the completion of the NDPT. As described previously, at the end of the NDPT customers could choose to return to the Residential Flat Rate they were on prior to starting the NDPT, or they could choose to transition to the Optional Time-Of-Use program. This choice is another example of how NDPT participants addressed their electricity use.

All NDPT participants addressed their electricity use to some degree, by initially choosing to participate in the NDPT. In addition, the participants who remained after Program Year 1 and who completed both years of the NDPT further addressed their electricity use. These findings support Hypothesis 1.

[18] Customers understood this as a bill guarantee that ensured that any losses they incurred in the first year due to the program would be reimbursed.

Reducing Electricity Use

Participants did not necessarily reduce electricity use

Next we will focus on reducing electricity use, the second assertion in Hypothesis 1. We look at whether NDPT participants decreased electricity overall during the course of the NDPT. All load impacts in Tables 19 through 22 are calculated using the DiD approach indicated in regression equation 1.

First, we look at overall electricity use in each year of the NDPT compared to electricity use in the baseline year. For Table 19, the regression equation includes all hours of Program Year 1 or Program Year 2 compared to all hours of Program Year 0. The impact (kWh) metric indicates the difference in the average hourly kWh usage for all NDPT participants compared to the average hourly kWh usage for all control group members for the NDPT year indicated (PY1 or PY2) compared to Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in each region.

Table 19: Hourly Load Impacts by Region

	PY1					
Region	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	0.017	1.52	0.010	0.074	21,374,037	1,220
SOUTH	-0.041	-1.93	0.010	0.000	42,012,855	2,398
	PY2					
Region	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	0.028	2.49	0.013	0.028	21,374,037	1,220
SOUTH	0.051	2.42	0.013	0.000	42,012,857	2,398

In Table 19 we see that NDPT participants in the North did not have a statistically significant change in overall electricity use in Program Year 1, and used 0.028 kWh more electricity on average in Program Year 2 compared to the baseline year. In the South, we find that NDPT participants used 0.04 kWh less electricity on average in Program Year 1. However, this decrease in electricity reversed in Program Year 2, and NDPT participants in the South used 0.05 kWh more electricity on average during the second year of the program. Averaging the two years together, we find that NDPT participants in the North used 0.02 kWh (p=0.03) more electricity overall, and NDPT participants in the South did not have a statistically significant change in their overall electricity use over the course of the NDPT. This finding does not support the hypothesis that NDPT participants would decrease electricity consumption overall.

Next, we look at overall load impacts by cell in order to determine whether this result was consistent across treatment groups. For Tables 21 and 22, the regression equation includes all hours of Program Year 1 or Program Year 2 compared to all hours of Program Year 0. The impact (kWh) metric indicates the difference in the average hourly kWh usage, by region, for each NDPT treatment group compared to the average hourly kWh usage for all control group members for the NDPT year indicated compared to Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in each treatment group.

Table 20: Hourly Load Impacts by Treatment (North)

		Program Year 1					
Region	**Treatment**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	**TOU**	0.020	1.76	0.012	0.103	5,588,520	319
	TOU+E	0.039	3.28	0.029	0.177	3,398,880	194
	TOU+E+T	0.006	0.50	0.019	0.753	1,804,559	103
	CPP	0.021	1.87	0.018	0.239	4,064,639	232
	CPP+E	0.003	0.31	0.016	0.832	2,925,840	167
	CPP+E+T	0.005	0.46	0.015	0.730	3,591,599	205
		Program Year 2					
Region	**Treatment**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	**TOU**	0.016	1.44	0.016	0.310	5,588,520	319
	TOU+E	0.051	4.31	0.048	0.284	3,398,880	194
	TOU+E+T	0.037	3.16	0.022	0.092	1,804,559	103
	CPP	0.029	2.57	0.019	0.124	4,064,639	232
	CPP+E	0.014	1.28	0.019	0.460	2,925,840	167
	CPP+E+T	0.030	2.79	0.017	0.070	3,591,599	205

Table 20 breaks down the overall load impact results by treatment cell in the North. We find that there is no statistically significant decrease in electricity use in any treatment group during either Program Year 1 or Program Year 2, indicating that the NDPT was not an electricity usage reduction program for participants in the North. Next, we look at overall load impacts by treatment cell in the South.

Table 21: Hourly Load Impacts by Treatment (South)

		Program Year 1					
Region	**Treatment**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
SOUTH	**TOU**	-0.052	-2.27	0.025	0.036	4,975,582	284
	TOU+E	-0.061	-2.71	0.026	0.018	3,486,480	199
	TOU+E+T	-0.055	-2.64	0.024	0.024	3,871,918	221
	CPP	-0.035	-1.70	0.016	0.026	11,493,120	656
	CPP+E	-0.050	-2.29	0.018	0.006	8,830,077	504
	CPP+E+T	-0.019	-0.98	0.017	0.254	9,355,678	534
		Program Year 2					
Region	**Treatment**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
SOUTH	**TOU**	-0.012	-0.54	0.030	0.675	4,975,582	284
	TOU+E	-0.032	-1.40	0.037	0.396	3,486,480	199
	TOU+E+T	0.035	1.69	0.029	0.216	3,871,920	221
	CPP	0.070	3.37	0.020	0.000	11,493,120	656
	CPP+E	0.051	2.33	0.022	0.019	8,830,077	504
	CPP+E+T	0.099	5.12	0.020	0.000	9,355,678	534

In the South during Program Year 1, we find there are statistically significant decreases in electricity use across all treatment groups except CPP+E+T. However, this result does not persist in Program Year 2, with no statistically significant decreases in electricity use in any group and a statistically significant increase in electricity use in all CPP groups. These results provide more insight into the aggregate impacts in Table 19. We find that the aggregate level decrease in electricity use in the South in Program Year 1 is not associated with one particular treatment group, but was spread broadly across all treatment groups except CPP+E+T. However, in Program Year 2 we find that the increase in aggregate electricity use is the result of statistically significant increases in electricity use by the CPP treatment groups. In the load shifting section we will explore how this result is related to usage in different rate periods.

Next we focus on electricity usage impacts by season in order to understand whether there was a statistically significant decrease in electricity usage during different times of the year. For Table 22, the regression equation is subset to include all hours during each season in Program Year 1 or Program Year 2, compared to all hours in the corresponding season during Program Year 0. For example, the North Summer Program Year 1 DiD regression equation includes all hours for all NDPT participants and control group members in the North during the months of July through September in Program Year 1 and Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the indicated season and year for NDPT participants compared to the average hourly kWh usage during the same season and year for all control group members, compared to the corresponding season in Program Year

0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated season.

Table 22: Hourly Load Impacts by Season

		Program Year 1					
Region	**Season**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	**Summer**	-0.050	-3.84	0.015	0.001	5,387,518	1,220
	Winter	0.023	2.11	0.009	0.015	15,986,519	1,220
SOUTH	**Summer Core**	-0.110	-3.23	0.020	0.000	7,136,445	2,398
	Summer Shoulder	-0.118	-4.17	0.016	0.000	6,906,240	2,398
	Winter	-0.010	-0.60	0.009	0.279	27,970,170	2,398
		Program Year 2					
Region	**Season**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	**Summer**	-0.059	-4.58	0.015	0.000	5,387,518	1,220
	Winter	0.038	3.56	0.014	0.005	15,986,519	1,220
SOUTH	**Summer Core**	-0.082	-2.40	0.022	0.000	7,136,445	2,398
	Summer Shoulder	-0.069	-2.44	0.019	0.000	6,906,240	2,398
	Winter	0.082	5.09	0.012	0.000	27,970,172	2,398

We find that there are statistically significant decreases in electricity use in the summer seasons across both regions in both years. In the North during the summer season, NDPT participants decreased electricity use by 3.8% in Program Year 1 and 4.6% Program Year 2. In the South during both summer seasons, NDPT participants decreased electricity use by a greater percentage in Program Year 2 than Program Year 1. We also see statistically significant increases in winter electricity use in both years in the North, and Program Year 2 in the South. We will investigate these findings further as we break down these effects by rate period.

We do not find evidence to support the assertion in Hypothesis 1 that NDPT participants would reduce overall electricity consumption during the NDPT. In the North there was an increase in electricity use over the course of the NDPT, and in the South there is an insignificant change during the average of the two years, with the decrease in electricity use in Program Year 1 offset by an increase in electricity use in Program Year 2. We find that participants decreased overall electricity use in the summer months in both regions, but increased use in winter months by more than the decreases in summer electricity use. We now focus on electricity usage by rate period in order to determine whether NDPT participants changed electricity usage compared to behavior before the NDPT.

Load Shifting Impacts

Participants did shift electricity use

In this section we turn our attention to load shifting impacts in order to understand whether NDPT participants used less electricity during more expensive time periods (i.e., on-peak, mid-peak and CPP rate periods) used more electricity during less expensive periods (i.e., off-peak rate periods), or both, as compared to pre-NDPT behavior. This definition of load shifting does not necessarily capture all load shifting that occurred during the NDPT. Individuals may have shifted usage within rate periods, between days in the same rate period, or in other ways. However, these metrics capture the load shifting behaviors that the NDPT intended to produce.

All electricity shifting load impacts are calculated using the DiD approach indicated in regression equation 1. Similar to the analysis of decreases in electricity use in the previous section, the load shifting analysis begins with a high-level, aggregate analysis, then is subset by different time periods and segments.

In Table 23, the regression equation is subset to include all hours during each rate period in Program Year 1 or Program Year 2, compared to all hours in the corresponding rate period during Program Year 0. For this aggregate level analysis, we group all hours in all rate periods not designated as Off-Peak into a single group, designated as PEAK. In the North, this includes all hours during On-Peak periods in the summer and winter, as well as Mid-Peak and CPP rate periods. In the South, this includes all hours during On-Peak and CPP rate periods, which occur during both summer seasons. For example, the North PEAK Program Year 1 DiD regression equation includes all hours for all NDPT participants and control group members in the North during all On-Peak, Mid-Peak and CPP rate periods in Program Year 1 and Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the designated rate period and year for all NDPT participants compared to the average hourly kWh usage for all control group members, as compared to the corresponding rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region and rate period.

Table 23: Overall Load Shifting Impacts

		Program Year 1					
Region	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	**PEAK**	-0.062	-4.04	0.014	0.000	4,422,440	1,220
	Off-Peak	0.031	3.00	0.009	0.001	16,951,597	1,220
SOUTH	**PEAK**	-0.932	-20.15	0.034	0.000	2,925,558	2,398
	Off-Peak	0.024	1.27	0.010	0.011	39,087,297	2,398
		Program Year 2					
Region	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	**PEAK**	-0.057	-3.68	0.017	0.001	4,422,440	1,220
	Off-Peak	0.042	4.11	0.012	0.001	16,951,597	1,220
SOUTH	**PEAK**	-1.092	-23.62	0.039	0.000	2,925,558	2,398
	Off-Peak	0.128	6.66	0.012	0.000	39,087,299	2,398

We find there was statistically significant load shifting from more expensive PEAK hours to less expensive off-peak hours during both years of the NDPT in both the North and South. In the South, NDPT participants decreased electricity usage during PEAK hours by over 20% in both years, while participants in the North decreased electricity usage during all PEAK hours by 4% in Program Year 1 and 3.7% in Program Year 2.[19]

Next we consider the load impacts for each specific rate period, as well as those for each season. In Tables 24 and 25, the regression equation is subset to include all hours during each particular rate period in Program Year 1 or Program Year 2, compared to all hours in the corresponding rate period during Program Year 0. For example, the North On-Peak Program Year 1 DiD regression equation includes all hours for all NDPT participants and control group member in the North during On-Peak rate periods in Program Year 1 and the corresponding hours during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the indicated rate period and year for NDPT participants compared to the average hourly kWh usage for all control group members, as compared to the corresponding rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region and rate period.

[19] The quantitatively smaller impacts in the North may be partially explained by presence of on-peak hours during the winter months in the North. In the North, winter on-peak hours were $0.10 kWh compared to summer mid-peak hours at $0.21 kWh and summer on-peak hours at $0.40. In the South, all hours during the winter months were off-peak. We will explore seasonal differences in shifting behavior in order to better understand the impact of these different price signals.

Table 24: Hourly Load Shifting Impacts by Rate Period (North)

		Program Year 1					
	Rate Period	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	**On-Peak**	-0.043	-2.79	0.013	0.001	3,386,208	1,220
	On-Peak (Summer)	-0.292	-16.49	0.026	0.000	1,199,795	1,220
	On-Peak (Winter)	0.003	0.18	0.012	0.826	2,664,420	1,220
	CPP	-0.604	-32.22	0.042	0.000	77,312	604
	Mid-Peak 1	-0.080	-7.40	0.018	0.000	479,460	1,220
	Mid-Peak 2	-0.151	-7.42	0.024	0.000	479,460	1,220
	Off-Peak	0.031	3.00	0.009	0.001	16,951,597	1,220
	Off-Peak (Summer)	0.019	1.71	0.013	0.151	3,629,498	1,220
	Off-Peak (Winter)	0.026	2.67	0.009	0.004	13,322,099	1,220
		Program Year 2					
	Rate Period	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Observations (n)**	**# of Unique NDPT IDs (N)**
NORTH	**On-Peak**	-0.032	-2.10	0.017	0.054	3,386,208	1,220
	On-Peak (Summer)	-0.302	-17.04	0.028	0.000	1,183,365	1,220
	On-Peak (Winter)	0.016	1.08	0.017	0.342	2,664,420	1,220
	CPP	-0.730	-38.95	0.045	0.000	77,312	604
	Mid-Peak 1	-0.074	-6.86	0.019	0.000	479,460	1,220
	Mid-Peak 2	-0.173	-8.46	0.027	0.000	479,460	1,220
	Off-Peak	0.042	4.11	0.012	0.001	16,951,597	1,220
	Off-Peak (Summer)	0.009	0.81	0.014	0.508	3,629,498	1,220
	Off-Peak (Winter)	0.042	4.27	0.013	0.001	13,322,099	1,220

In the North during Program Year 1, we find statistically significant decreases in electricity use in all on-peak, mid-peak and CPP periods, except during winter on-peak hours. We find the same results in Program Year 2, except that there is not a statistically significant decrease in overall on-peak use during the year. This result relates to an increase in on-peak winter use in Program Year 2, rather than an increase in summer on-peak use. CPP participants decreased electricity use during the CPP rate periods, with a 32% decrease in Program Year 1 and a 39% decrease in Program Year 2, compared to use in Program Year 0.

By separating the on-peak and off-peak hours by season, we observe important differences in seasonal shifting. Looking at the differences in on-peak usage between summer and winter, we find that prices during summer on-peak hours had a much larger effect on electricity usage than prices during winter on-peak hours. On-peak use in the summer declined by 16.5% in Program Year 1 and 17% in Program Year 2, while there was no statistically significant change in electricity use during on-peak winter hours. For off-peak periods, we find that there was no statistically significant increase in off-peak summer usage, but there was a statistically significant increase in winter off-peak use in both years. These results support the assertion in Hypothesis 1 that NDPT participants would shift electricity use. In Table 26 we look at the same metrics for the South.

Table 25: Hourly Load Shifting Impacts by Rate Period (South)

		Program Year 1					
	Rate Period	Impact (kWh)	Percentage (%)	SE	p-value	# of Observations (n)	# of Unique NDPT IDs (N)
SOUTH	On-Peak	-0.958	-20.71	0.033	0.000	2,803,590	2,398
	On-Peak (Summer Core)	-1.032	-21.22	0.038	0.000	1,303,806	2,398
	On-Peak (Summer Shoulder)	-0.808	-18.69	0.031	0.000	1,343,936	2,398
	CPP	-1.501	-30.80	0.051	0.000	277,816	1,694
	Off-Peak	0.024	1.27	0.010	0.011	39,087,297	2,398
	Off-Peak (Summer Core)	0.148	4.93	0.019	0.000	5,649,687	2,398
	Off-Peak (Summer Shoulder)	0.053	2.19	0.015	0.000	5,467,440	2,398
	Off-Peak (Winter)	-0.010	-0.60	0.009	0.279	27,970,170	2,398
		Program Year 2					
	Rate Period	Impact (kWh)	Percentage (%)	SE	p-value	# of Observations (n)	# of Unique NDPT IDs (N)
SOUTH	On-Peak	-1.087	-23.51	0.038	0.000	2,803,590	2,398
	On-Peak (Summer Core)	-1.134	-23.30	0.042	0.000	1,303,806	2,398
	On-Peak (Summer Shoulder)	-0.981	-22.69	0.037	0.000	1,343,936	2,398
	CPP	-1.759	-36.10	0.055	0.000	277,816	1,694
	Off-Peak	0.128	6.66	0.012	0.000	39,087,299	2,398
	Off-Peak (Summer Core)	0.223	7.45	0.022	0.000	5,649,687	2,398
	Off-Peak (Summer Shoulder)	0.161	6.60	0.018	0.000	5,467,440	2,398
	Off-Peak (Winter)	0.082	5.09	0.012	0.000	27,970,172	2,398

In the South, we find statistically significant decreases in electricity use in all on-peak and CPP periods in both years. On-peak usage dropped between 18.7% and 22.7% on average, and CPP period usage decreased by 30.8% in Program Year 1 and 36.1% in Program Year 2. Across all on-peak and CPP periods, we find larger decreases in electricity use in Program Year 2 than in Program Year 1. During off-peak periods, we find statistically significant increases in electricity use, except during the winter in Program Year 1. We find that participants did not change their electricity use in the winter of Program Year 1 compared to Program Year 0. However, this behavior did not persist in the winter of Program Year 2, with a 5% increase in winter electricity use compared to Program Year 0. Similar to our findings in the North, these results support the assertion in Hypothesis 1 that NDPT participants would shift electricity use.

Next, we consider decreases in use during CPP events in both regions. Table 27 portrays load impacts during each hour of CPP events, as well as the two hours prior to and the two hours following CPP events. In the following table, the four hours of CPP events are designated as Event 1 through 4, with Event 1 corresponding to the first hour of a CPP event period. The two hours prior to CPP events are designated as Pre-event 1 and 2, with Pre-event 2 indicating the hour immediately prior to CPP events. Similarly, the two hours following CPP events are designated as Post-event 1 and 2, with Post-event 1 indicating the hour immediately following CPP events. As discussed in the Load Impacts section, CPP

periods during mPowered event days in 2012 for the North and South are used as the Program Year 0 comparison periods for this analysis.

For this table, the regression equation is subset to include the indicated hour of all CPP events in Program Year 1 or Program Year 2, compared to the corresponding hour on mPowered event days during Program Year 0. For example, the North Event 1 Program Year 1 DiD regression equation includes kWh usage for all CPP treatment group participants and all control group member in the North during the first hour of all CPP Events in Program Year 1 and the corresponding hour during mPowered event days in Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the designated period and year for NDPT participants compared to the average hourly kWh usage for all control group members, compared to the corresponding time period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all CPP treatment group participants in the indicated time period.

Table 26: CPP Events

		Program Year 1					Program Year 2				
	Rate Period	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**
North	**Pre-event 1**	-0.302	-22.24	0.037	0.000	604	-0.321	-23.63	0.039	0.000	604
	Pre-event 2	-0.191	-15.77	0.033	0.000	604	-0.203	-16.79	0.035	0.000	604
	Event 1	-0.516	-33.55	0.041	0.000	604	-0.593	-38.55	0.045	0.000	604
	Event 2	-0.617	-34.79	0.043	0.000	604	-0.750	-42.24	0.048	0.000	604
	Event 3	-0.656	-32.57	0.047	0.000	604	-0.814	-40.44	0.051	0.000	604
	Event 4	-0.628	-28.85	0.046	0.000	604	-0.765	-35.17	0.050	0.000	604
	Post-event 1	-0.269	-12.37	0.044	0.000	604	-0.340	-15.60	0.047	0.000	604
	Post-event 2	-0.184	-8.96	0.038	0.000	604	-0.215	-10.43	0.044	0.000	604
South	**Pre-event 1**	-1.166	-25.15	0.054	0.000	1,694	-1.371	-29.57	0.056	0.000	1,694
	Pre-event 2	-0.102	-2.35	0.044	0.021	1,694	0.071	1.63	0.051	0.166	1,694
	Event 1	-1.729	-35.44	0.056	0.000	1,694	-1.956	-40.09	0.058	0.000	1,694
	Event 2	-1.634	-32.94	0.055	0.000	1,694	-1.910	-38.51	0.059	0.000	1,694
	Event 3	-1.441	-29.16	0.054	0.000	1,694	-1.730	-35.00	0.058	0.000	1,694
	Event 4	-1.199	-25.47	0.050	0.000	1,694	-1.440	-30.58	0.054	0.000	1,694
	Post-event 1	0.467	10.55	0.043	0.000	1,694	0.646	14.60	0.050	0.000	1,694
	Post-event 2	0.626	14.96	0.040	0.000	1,694	0.768	18.36	0.045	0.000	1,694

In the North, the average temperature during NDPT CPP event hours was 92°F. We find statistically significant and quantitatively large (29-42%) decreases in electricity usage during all CPP event hours

across both years. In the two hours prior to the CPP events, we find statistically significant decreases in electricity usage compared to Program Year 0, although they are not on the magnitude of the decreases during CPP events. We find a similar result in the two hours following CPP events. However, it is important to note that these hours occurred during the mid-peak rate periods, and were still elevated rate periods for NDPT customers.

In the South, the average temperature during NDPT CPP event hours was 103°F. Again we find statistically significant and quantitatively large (25-40%) decreases in usage in all event hours in both years. Two hours before CPP events start there is still a large and statistically significant decrease in electricity use, despite the fact that this was an off-peak hour for all participants in the South. In the hour before the CPP event started, electricity use decreased to a lesser degree. These results would be consistent with some participants pre-cooling their homes in the hour prior to the start of CPP events. We find that electricity use increased during the two hours after CPP events in the South. This may indicate a post-event cooling effect. Overall we find that CPP events had a statistically significant and quantitatively large effect on electricity usage patterns before, during and after these events in the South.

We do not find evidence to support the assertion in Hypothesis 1 that NDPT participants would reduce overall electricity consumption during the NDPT. In the North there was an increase in electricity use over the course of the NDPT, and in the South there is an insignificant change during the average of the two years, with the decrease in electricity use in Program Year 1 more than offset by an increase in electricity use in Program Year 2.

All NDPT rates were designed based on cost causation principles, preserving revenue neutrality with the otherwise applicable flat rates. NDPT rates were not created based on customer preferences. However, we find evidence that the NDPT rate designs did result in shifting electricity use with statistically significant decreases in use during more expensive periods and statistically significant increases in use during less expensive rate periods. In the next section, we explore how responses to the NDPT differed over time and between different segments.

Hypothesis 2

Participant responses differed over time and among segments

Hypothesis 2 asserts that participant responses to the rates, education and technology treatments will differ significantly over time and among segments. We now focus on each component of Hypothesis 2 in turn.

First, we look at how participant responses varied over time during the NDPT. As shown in the previous section, we found that there were differences in saving and shifting behavior between Program Year 1 and Program Year 2 in both regions. In Table 27, we look at load impacts by both season and rate period

in order to better understand how electricity shifting behavior varied between seasons. We group all hours in all rate periods not designated as Off-Peak into a single group, designated as PEAK. We will continue this technique throughout the analysis.

The regression equation is subset to include all hours for the indicated rate period and season for all NDPT participants and the control group in Program Year 1 or Program Year 2, compared to all hours in the corresponding rate period and season during Program Year 0. For example, the North Summer PEAK Program Year 1 DiD regression equation includes all hours for all NDPT participants and all control group members in the North during all On-Peak, Mid-Peak and CPP rate periods in July through September in Program Year 1, and the corresponding hours during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the designated season, rate period and year compared to the average hourly kWh usage for all control group members, compared to the corresponding season and rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region, season and rate period.

Table 27: Load Shifting Impacts by Season

			Program Year 1			
Region	**Season**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**
NORTH	**Summer**	**PEAK**	-0.193	-11.60	0.021	0.000
		Off-Peak	0.019	1.71	0.013	0.151
	Winter	**PEAK**	0.003	0.18	0.012	0.826
		Off-Peak	0.026	2.67	0.009	0.004
SOUTH	**Summer Core**	**PEAK**	-1.090	-22.02	0.039	0.000
		Off-Peak	0.148	4.93	0.019	0.000
	Summer Shoulder	**PEAK**	-0.767	-17.88	0.031	0.000
		Off-Peak	0.053	2.19	0.015	0.000
	Winter	**PEAK**	-	-	-	-
		Off-Peak	-0.010	-0.60	0.009	0.279
			Program Year 2			
Region	**Season**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**
NORTH	**Summer**	**PEAK**	-0.204	-12.29	0.023	0.000
		Off-Peak	0.009	0.81	0.014	0.508
	Winter	**PEAK**	0.016	1.08	0.017	0.342
		Off-Peak	0.042	4.27	0.013	0.001
SOUTH	**Summer Core**	**PEAK**	-1.242	-25.08	0.043	0.000
		Off-Peak	0.223	7.45	0.022	0.000
	Summer Shoulder	**PEAK**	-0.940	-21.91	0.037	0.000
		Off-Peak	0.161	6.60	0.018	0.000
	Winter	**PEAK**	-	-	-	-
		Off-Peak	0.082	5.09	0.012	0.000

In the North, we find statistically significant decreases in electricity use during all on peak periods in the summer, with decreases of 11.6% in the Program Year 1 and 12.3% in Program Year 2. We do not find evidence of statistically significant increases in use during summer off-peak periods in either year. In the winter, there is a statistically significant increase in off-peak electricity use in both years, with increases of 2.7% in Program Year 1 and 4.3% in Program Year 2. We do not find statistically significant decreases in winter on-peak use in either year. This seasonal variation in responses to on-peak and off-peak rates supports Hypothesis 2.

In the South, we find statistically significant shifting from more expensive to less expensive rate periods in the summer seasons during both years. Participants decreased on-peak electricity use by more in the Summer Core season than in the Summer Shoulder season, with decreases of 22% vs. 17.9% in Program Year 1 and 25.1% vs. 21.9% in Program Year 2. We also find that participants increased off-peak electricity use by more in the Summer Core season than in the Summer Shoulder season, with increases of 4.9% vs. 2.2% in Program Year 1 and 7.5% vs. 6.6% in Program Year 2. In the winter season in the South, we find that participants did not change electricity use in Program Year 1, but increased use by 5.1% overall in Program Year 2. Overall, we find that participant responses vary in magnitude and significance by season, a finding which supports Hypothesis 2.

Next, we focus on whether participant responses varied between weekdays and weekends. In Table 29, we look at load impacts by both day type and rate period in order to understand how electricity shifting behavior varied between Weekdays (Monday – Friday) and Weekends (Saturday and Sunday). As in Table 28, we group all hours in all rate periods not designated as Off-Peak into a single group, designated as PEAK. The regression equation is subset to include all hours for the indicated rate period and day type for all NDPT participants and the control group in Program Year 1 or Program Year 2, compared to all hours in the corresponding rate period and day type during Program Year 0. For example, the North Weekday PEAK Program Year 1 DiD regression equation includes all hours for all NDPT participants and all control group members in the North during all On-Peak, Mid-Peak and CPP rate periods Monday – Friday in Program Year 1, and the corresponding hours during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the designated day type, rate period and year compared to the average hourly kWh usage for all control group members, compared to the corresponding day type and rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region, day type and rate period.

Table 28: Load Shifting Impacts by Day Type (Weekday & Weekend)

			Program Year 1				
Region	**Day Type**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**
NORTH	**Weekday**	**PEAK**	-0.078	-5.04	0.015	0.000	1,220
		Off-Peak	0.027	2.79	0.009	0.003	1,220
	Weekend	**PEAK**	0.007	0.46	0.013	0.594	1,220
		Off-Peak	0.035	3.10	0.010	0.000	1,220
SOUTH	**Weekday**	**PEAK**	-0.978	-21.53	0.034	0.000	2,398
		Off-Peak	0.022	1.14	0.010	0.023	2,398
	Weekend	**PEAK**	-0.821	-17.01	0.034	0.000	2,398
		Off-Peak	0.031	1.58	0.010	0.002	2,398
			Program Year 2				
Region	**Day Type**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**
NORTH	**Weekday**	**PEAK**	-0.075	-4.81	0.017	0.000	1,220
		Off-Peak	0.039	4.01	0.012	0.002	1,220
	Weekend	**PEAK**	0.020	1.30	0.017	0.253	1,220
		Off-Peak	0.046	4.03	0.013	0.000	1,220
SOUTH	**Weekday**	**PEAK**	-1.115	-24.55	0.039	0.000	2,398
		Off-Peak	0.127	6.67	0.012	0.000	2,398
	Weekend	**PEAK**	-1.029	-21.34	0.040	0.000	2,398
		Off-Peak	0.129	6.64	0.013	0.000	2,398

We find that participants in the North decreased PEAK use on weekdays by 5% in Program Year 1 and 4.8% in Program Year 2. It is important to note that in the North there were no on-peak rate periods during weekends in the summer season, but there were on-peak periods during weekends in the winter season. We find that there was not a statistically significant decrease in weekend on-peak electricity use in either year. We find that North participants increased off-peak use by similar magnitudes during both weekdays and weekends each year. In Program Year 1, weekday off-peak use increased by 2.8% and weekend off-peak use increased by 3.1%; in Program Year 2 off-peak electricity increased by 4% during both weekdays and weekends.

In the South, we find that weekday and weekend on-peak use decreased in both years.[20] There were larger decreases during on-peak periods on weekdays than on weekends in both years. In Program Year 1 there was a 21.5% decrease in weekday on-peak use compared to a 17% decrease in weekend on-peak use. In Program Year 2 we see a 24.6% decrease in weekday on-peak use compared to a 21.3% decrease

[20] In August 2014, a billing programming error was discovered that affected the South CPP cohort of participants. For the four summer months of 2013, the ten hours of on-peak usage each weekend (five hours each Saturday and Sunday) was mistakenly billed at the off-peak rate, rather than the on-peak rate. This mistake resulted in these 2,127 customers being under-billed for the four summer months.

in weekend on-peak use. Similar to our finding in the North, we find that participants in the South increased off-peak use by similar magnitudes during both weekdays and weekends each year. In Program Year 1, weekday off-peak use increased by 1.1% and weekend off-peak use increased by 1.5%; in Program Year 2 off-peak electricity increased by 6.7% during weekdays and 6.6% during weekends.

Next, we turn our attention to understanding how electricity shifting behavior varied between segments of NDPT participants. As discussed previously, a survey was administered to NDPT participants and control group members at the conclusion of Program Year 2. In the following tables, we compare load shifting behavior between NDPT participants and control group members who participated in the survey. The segments that we consider in this report are categories that would typically be considered for analysis of demographic segments.

Table 29 examines load impacts by income segment, looking at the different load shifting responses of participants who responded that they earned more than $40,000/year (Higher Income) and participants who responded that they earned equal to or less than $40,000/year (Lower Income). The regression equation is subset to include all hours for the indicated rate period in Program Year 1 or Program Year 2, for all NDPT participants and control group members who answered this particular question, compared to all hours in the corresponding rate period during Program Year 0 for the same individuals. For example, the North Higher Income PEAK Program Year 1 DiD regression equation includes all hours for all Higher Income NDPT participants and all Higher Income control group members in the North in Program Year 1, and the corresponding hours during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the designated income group, rate period and year compared to the average hourly kWh usage for all control group members who answered the income survey question, compared to the corresponding rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region, income segment and rate period.

Table 29: Load Shifting Impacts by Income Segment

			Program Year 1				
Region	**Income**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**
NORTH	**Higher Income**	**PEAK**	-0.043	-2.87	0.061	0.485	219
		Off-Peak	0.072	7.26	0.048	0.138	219
	Lower Income	**PEAK**	-0.015	-1.23	0.081	0.851	65
		Off-Peak	0.066	7.67	0.052	0.205	65
SOUTH	**Higher Income**	**PEAK**	-1.129	-26.01	0.183	0.000	397
		Off-Peak	0.047	2.66	0.062	0.447	397
	Lower Income	**PEAK**	-0.782	-20.60	0.174	0.000	100
		Off-Peak	-0.028	-1.81	0.051	0.590	100
			Program Year 2				
Region	**Income**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**
NORTH	**Higher Income**	**PEAK**	0.041	2.74	0.077	0.596	219
		Off-Peak	0.131	13.34	0.053	0.013	219
	Lower Income	**PEAK**	0.033	2.69	0.092	0.718	65
		Off-Peak	0.093	10.77	0.060	0.121	65
SOUTH	**Higher Income**	**PEAK**	-1.379	-31.77	0.189	0.000	397
		Off-Peak	0.148	8.39	0.079	0.060	397
	Lower Income	**PEAK**	-0.722	-19.02	0.168	0.000	100
		Off-Peak	0.066	4.29	0.058	0.256	100

In the North during Program Year 1 we find that there are no statistically significant differences in shifting behavior between the two income groups. However, in Program Year 2 we find that Higher Income households increased electricity use by 13.3% in off-peak hours; the 10.8% increase in off-peak use by Lower Income households was not statistically significant.

In the South during both program years, we find that Higher Income households shifted electricity usage out of PEAK hours by a greater percentage than Lower Income households. In addition, we find that Higher Income households increased electricity use by more in off-peak hours than Lower Income households. These findings suggest that Higher Income households in the South shifted electricity use to a greater degree than Lower Income households. Overall, the variation in the response and differences in significance between groups provides support for Hypothesis 2.

Table 30 examines load impacts by household type, looking at the different load shifting responses of Adult households (under 65), Adult with Children households and Senior Adult (over 65) households. The regression equation is subset to include all hours for the indicated rate period in Program Year 1 or Program Year 2, for all NDPT participants and control group members who answered this particular question, compared to all hours in the corresponding rate period during Program Year 0 for the same individuals. For example, the North Adult with Children PEAK Program Year 1 DiD regression equation

includes all hours for all NDPT participants and all control group members in the North who responded that both adults and children under 18 lived in their household, during all On-Peak, Mid-Peak and CPP rate periods in Program Year 1, and the corresponding hours during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the designated household type, rate period and year compared to the average hourly kWh usage for all control group members who answered this survey question, compared to the corresponding household type and rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region, household type and rate period.

Table 30: Load Shifting Impacts by Household Type

			Program Year 1				
Region	**Income**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**
NORTH	**Adult**	**PEAK**	0.056	4.00	0.061	0.355	101
		Off-Peak	0.105	11.03	0.047	0.026	101
	Adult with Children	**PEAK**	0.085	4.80	0.075	0.262	100
		Off-Peak	0.146	12.93	0.056	0.010	100
	Senior Adult	**PEAK**	-0.105	-7.95	0.052	0.043	140
		Off-Peak	0.012	1.37	0.036	0.742	140
SOUTH	**Adult**	**PEAK**	-1.329	-30.26	0.155	0.000	270
		Off-Peak	0.054	2.98	0.048	0.256	270
	Adult with Children	**PEAK**	-1.267	-24.48	0.156	0.000	235
		Off-Peak	0.035	1.70	0.051	0.487	235
	Senior Adult	**PEAK**	-0.792	-20.67	0.162	0.000	172
		Off-Peak	0.015	0.87	0.046	0.753	172
			Program Year 2				
Region	**Income**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**
NORTH	**Adult**	**PEAK**	0.079	5.64	0.075	0.289	101
		Off-Peak	0.118	12.38	0.051	0.021	101
	Adult with Children	**PEAK**	0.239	13.53	0.106	0.025	100
		Off-Peak	0.272	24.09	0.072	0.000	100
	Senior Adult	**PEAK**	-0.080	-6.08	0.058	0.164	140
		Off-Peak	0.046	5.29	0.042	0.273	140
SOUTH	**Adult**	**PEAK**	-1.317	-29.97	0.156	0.000	270
		Off-Peak	0.213	11.76	0.060	0.000	270
	Adult with Children	**PEAK**	-1.383	-26.73	0.169	0.000	235
		Off-Peak	0.198	9.51	0.061	0.001	235
	Senior Adult	**PEAK**	-0.889	-23.21	0.209	0.000	172
		Off-Peak	0.112	6.77	0.066	0.091	172

In the North during both program years, we find that Adult and Adult with Children households did not reduce PEAK electricity use on average. Adult with Children households increased Program Year 2 PEAK usage by 13.5% on average. In addition, both of these household types increased off-peak electricity use in both years. Seniors Adult households decreased electricity use in PEAK periods by 8% on average in Program Year 1; the 6% decrease in PEAK use in Program Year 2 is not statistically significant. Seniors Adult households in the North did not significantly change electricity use during off-peak periods in either year.

In the South, we find that all three household types decreased electricity use during PEAK periods in both years. Adult households had the greatest decreases in use during PEAK periods of the three household types, using 30.2% less electricity in Program Year 1 and 30% less in Program Year 2. Senior Adult households had the lowest decreases in use during PEAK periods of the three household types, using 20.7% less electricity in Program Year 1 and 23.2% less in Program Year 2. During off-peak hours in Program Year 1, we do not find that any of the household types increased electricity use. However, in Program Year 2 we find that Adult and Adult with Children households increased off-peak electricity use by 11.8% and 9.5% respectively. These findings support the assertion in Hypothesis 2 that responses to the NDPT would vary by segment.

Next, we examine load impacts by economic outcome in Program Year 2. Table 32 compares load shifting between households that saved money in Program Year 2 on the NDPT compared to the flat rate tariff and households that lost money in Program Year 2 on the NDPT compared to the flat rate tariff. The regression equation is subset to include all hours for the indicated rate period for all NDPT participants in the specified group and all control group members in Program Year 2, compared to all hours in the corresponding rate period during Program Year 0. For example, the North Saved $ PEAK Difference in Difference regression equation includes all hours for all NDPT participants who saved money on the NDPT in Program Year 2 compared to the flat rate tariff and all control group members in the North, during all On-Peak, Mid-Peak and CPP rate periods in Program Year 2, and the corresponding periods during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage for all NDPT participants compared to the average hourly kWh usage for all control group members, for the economic outcome and rate period indicated compared to Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated economic outcome, household type and rate period.

Table 31: Load Shifting Impacts by Economic Outcome

			Program Year 2				
Region	**Saved or Lost $ in Program Year 2**	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**# of Unique NDPT IDs (N)**
NORTH	**Saved $**	**PEAK**	-0.068	-4.67	0.020	0.001	831
		Off-Peak	0.054	5.28	0.015	0.000	831
	Lost $	**PEAK**	-0.034	-1.93	0.020	0.091	389
		Off-Peak	0.016	1.57	0.012	0.196	389
SOUTH	**Saved $**	**PEAK**	-1.184	-25.36	0.040	0.000	2221
		Off-Peak	0.129	6.55	0.013	0.000	2221
	Lost $	**PEAK**	0.060	1.48	0.068	0.377	176
		Off-Peak	0.111	8.91	0.021	0.000	176

In the North, we find that households that saved money in Program Year 2 decreased PEAK use by 4.7% on average throughout the year, and increased off-peak usage by 5.3% on average. In comparison, households that did not save money in Program Year 2 did not decrease their PEAK usage or increase their off-peak usage. In the South, households that saved money in Program Year 2 on the NDPT compared to the flat rate tariff decreased PEAK electricity use by 25.4% on average, and increased off-peak usage by 6.6% throughout the year. We find that households that lost money in Program Year 2 did not reduce electricity use during PEAK periods and increased electricity use in off-peak periods by 8.9%.

In short, the households that saved money on the NDPT compared to the flat rate were those who shifted electricity use out of more expensive periods; the households that did not save money, did not shift. The differences in responses to the NDPT between these groups provides support for Hypothesis 2.

Individual Level Variation in Response

Responses of individual customers differed substantially

Underlying the aggregate level results, there is substantial variation in how customers responded to the NDPT. When distributions are as broad as those seen in the following figures, it is extremely difficult to apply generalizations to participant behavior. Figures 30 through 33 are intended to illustrate the variation in individual behavior between regions, rate periods and seasons. These figures are created by using the household level load impact metrics, which are calculated using within subject regression analysis (as described in equation 2).

These figures show the frequency distributions of the individual household load impacts, by year, region, season and rate period. The vertical axes indicate the number of participant households in each category. The horizontal axes indicate the values for the household level impacts. The horizontal axes indicate the magnitude of the difference in average hourly kWh usage during the NDPT as compared to the baseline year for the particular rate period, season or year of interest.

Household load impacts with a value of zero are shown in orange. The orange columns indicate that, on average, those households did not change electricity use during the NDPT rate period, season or year of interest compared to electricity use in the same period during Program Year 0. Household load impact values greater than or less than zero are indicated in blue. Negative values (to the left of the orange bar) indicate a decrease in electricity usage and positive values (to the right of the orange bar) indicate an increase in electricity usage during the NDPT rate period, season or year of interest compared to electricity usage in the same period during Program Year 0. First, we look at individual level distributions in the North during Program Year 1 and Program Year 2.

Figure 30: NDPT Participant Individual Level Load Impact Distributions (North, Program Year 1)

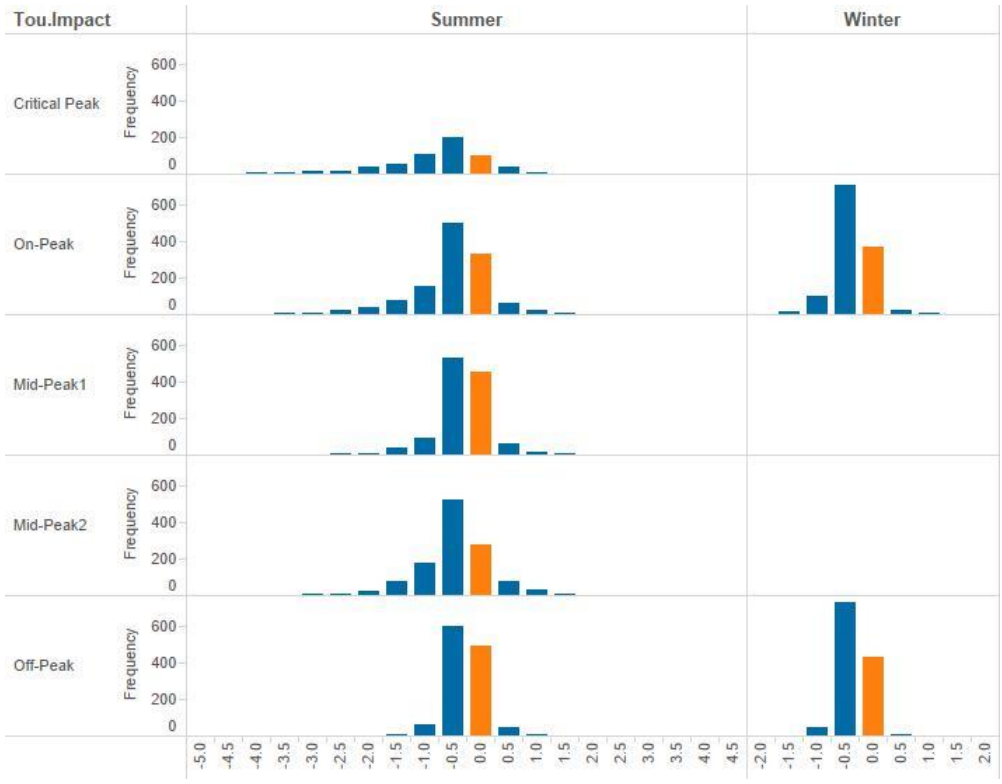
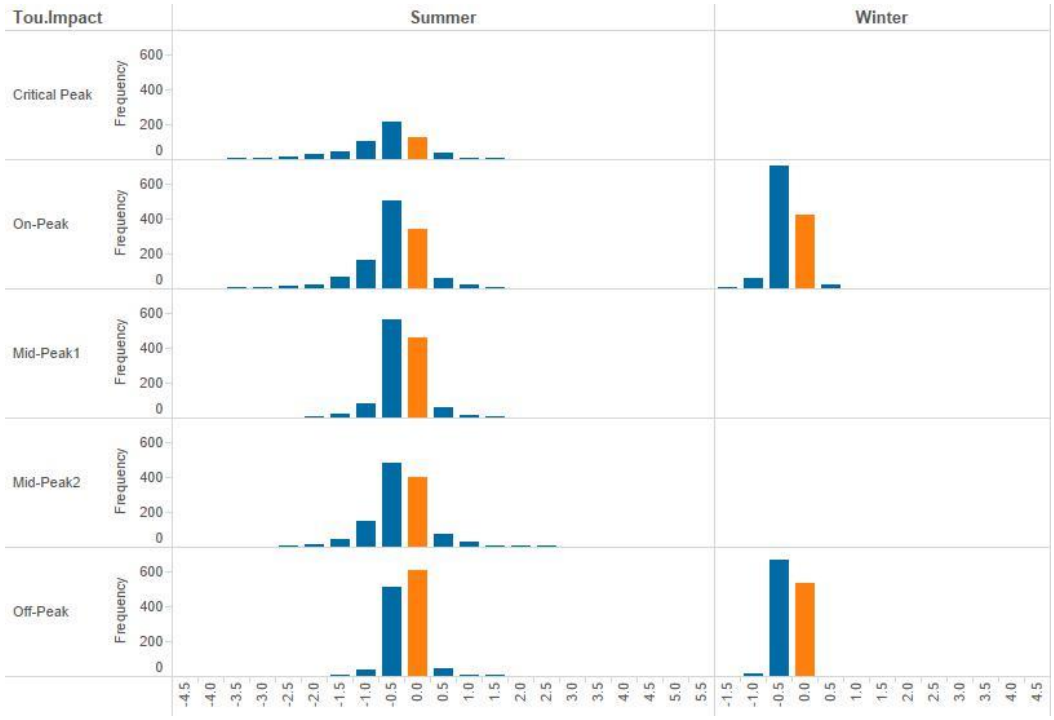


Figure 31: NDPT Participant Individual Level Load Impact Distributions (North, Program Year 2)



In the North, we see substantial variation in household responses across rate periods in both years. During on-peak and CPP periods, most households decreased electricity usage; there are some households that decreased usage by large amounts, as well as some households that increased overall usage. Next, we look at individual level distributions in the South during Program Year 1 and Program Year 2.

Figure 32: NDPT Participant Individual Level Load Impact Distributions (South, Program Year 1)

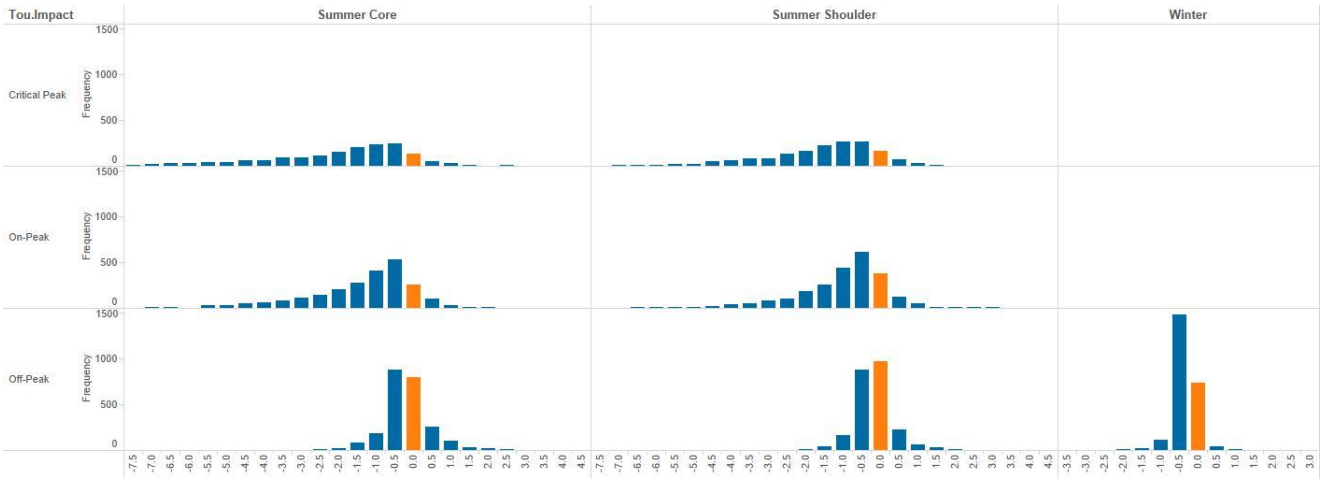


Figure 33: NDPT Participant Individual Level Load Impact Distributions (South, Program Year 2)

In the South, we see even greater variation in household responses across rate periods in both years. Most households decreased use during on-peak and CPP periods, but there is a wide range of individual level responses. Particularly in CPP periods we find evidence that some households reduced usage by much more than the average. Off-peak usage is more tightly distributed, indicating there were fewer households that changed behavior considerably more or less than the average.

The household level own price elasticity of demand and elasticity of substitution metrics also demonstrate the variation in customer responses to NDPT rates. We find substantial variation in the own price elasticity of demand values by individual household. On average, we find own price elasticity of demand values between -3.4 and 0.78, depending on the rate period, season, treatment groups and regions considered[21].

In addition, we find differences in the significance of the three price signals (the electricity tariff at the time of use, the previous month's bill and the previous month's energy report) between individuals, regions and seasons considered. On average, we find that the tariff was statistically significant in 67% of the elasticity specifications for customers in the North and 77% in the South, the monthly bill was statistically significant in 40% of the elasticity specifications for customers in the North and 57% in the South, and the energy report was statistically significant in 18% of the elasticity specifications for customers in the North and 50% in the South.

We also find substantial variation in the elasticity of substitution values by individual household. On average, we find elasticity of substitution values between 0.00 and -0.36, depending on the rate periods, season, treatment groups and regions considered[22].

Overall, we find there is substantial variation in how customers chose to respond to the treatments in the NDPT. The aggregate level results mask a complex story of how individuals responded by rate period, time of day, season, year and many other factors. Any specific rate design should be tested in its own right, and not rely solely on the aggregate conclusions in this report.

Post NDPT Period Preliminary Analysis

In order to understand whether electricity usage behavior adopted during the NDPT persisted after the trial completed, we also perform DiD analysis on kWh usage for trial participants vs. the control group from March through July 2015. We refer to this time period as the Post NDPT Period. This analysis provides a preliminary look at the data, but it is based on an incomplete year of data and should not be used for major conclusions. All DiD analysis of Post NDPT Period data is calculated by comparing the indicated month(s) to the corresponding month(s) in Program Year 0, with standard errors robust and

[21] The own price elasticity of demand metrics reported here are based on the electricity price experienced by customers at the time of usage (Tariff). We find substantial variation in the own price elasticity of demand values by region, season, rate period and treatment group. For example, we find an average elasticity of demand value of -0.04 for the North CPP groups during CPP hours, but the values range from a minimum of -3.98 to a maximum of 10.0. In comparison to the same group in the South, we find an average elasticity of demand value of -0.42 for the South CPP groups during CPP hours, but the values range from a minimum of -7.8 to a maximum of 11.9. Individual by individual customer reactions vary from sensitive to insensitive to the included price measures.

[22] We find substantial variation in the elasticity of substitution values by region, season, treatment group and combination of rate periods. For example, we find an average elasticity of substitution value of -0.20 for the North CPP groups for CPP periods compared to off-peak periods, but the values range from a minimum of -5.6 to a maximum of 4.2. In comparison to the same group in the South, we find an average elasticity of demand value of -0.28 for the South CPP groups for CPP periods compared to off-peak periods, but the values range from a minimum of -1.8 to a maximum of 0.9.

clustered at the household level. It is important to note that for all of this analysis, we are designating on-peak and off-peak periods using the rate periods from the NDPT. The TOU rates that participants transitioned to following the NDPT do not have the same rate design as the NDPT.

In Table 32, we look at load impacts by season, rate period and rate choice in order to better understand how electricity usage behavior changed following the NDPT. The regression equation is subset to include all hours for the indicated rate period and months in the Post NDPT Period for all NDPT participants in each rate group and the control group, compared to all hours in the corresponding rate period and months during Program Year 0. For example, the North Summer On-Peak Flat DiD regression equation includes all NDPT participants who transitioned to the flat rate following the NDPT and all control group members in the North during all on-peak hours in July 2015, and the corresponding on-peak hours during July 2012.

The impact (kWh) metric indicates the difference in the average hourly kWh usage for all NDPT participants in each rate group during the indicated month(s) and rate period compared to the average hourly kWh usage for all control group members, compared to the corresponding month(s) and rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region, rate group season and rate period.

Table 32: Load Shifting Impacts by Season and Rate Choice in Post NDPT Period

				POST NDPT			
Region	**Season**	**Rate Period**	**Rate Choice**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**
NORTH	**Summer** (July)	**On-Peak**	**Flat**	-0.043	-2.15	0.048	0.373
			TOU	-0.097	-6.17	0.050	0.050
		Off-Peak	**Flat**	0.020	1.62	0.034	0.559
			TOU	0.101	9.68	0.024	0.000
	Winter (March - June)	**On-Peak**	**Flat**	0.155	11.25	0.035	0.000
			TOU	0.080	6.40	0.029	0.006
		Off-Peak	**Flat**	0.106	11.53	0.030	0.000
			TOU	0.099	11.40	0.020	0.000
SOUTH	**Summer Shoulder** (June)	**On-Peak**	**Flat**	0.081	1.74	0.055	0.140
			TOU	-0.666	-14.69	0.063	0.000
		Off-Peak	**Flat**	0.186	7.21	0.033	0.000
			TOU	0.380	14.60	0.034	0.000
	Summer Core (July)	**On-Peak**	**Flat**	0.014	0.28	0.054	0.801
			TOU	-1.103	-23.09	0.066	0.000
		Off-Peak	**Flat**	0.202	6.83	0.035	0.000
			TOU	0.430	14.46	0.034	0.000
	Winter (March - May)	**Off-Peak**	**ALL**	0.113	6.84	0.017	0.000

In the North, we find that participants in both rate groups used more electricity in both on-peak and off-peak periods from March to June 2015 compared to the same months in Program Year 0. Participants who transitioned back to the flat rate used approximately 11% more electricity in both on-peak and off-peak winter hours compared to usage in Program Year 0. Participants in the North who transitioned to the TOU rate shifted electricity use in the Post NDPT Period, using 6.2% less electricity during summer on-peak rate periods and 9.7% more in summer off-peak periods.

In the South, participants used 6.8% more electricity on average during the winter months compared to the same months in 2012. Shifting behavior persisted for participants who transitioned to the TOU rate, with these households reducing on-peak electricity use by 14.7% on average in June and 23.1% in July compared to the same months in Program Year 0. This group also increased off-peak use by approximately 14% in both of these months. The participants who transitioned to the flat rate did not reduce use during on-peak periods, but did use more electricity in off-peak periods compared to Program Year 0.

In general, we find that participants who transitioned to the TOU rates did continue shifting behavior in both on-peak and off-peak periods. As noted, this analysis provides a very preliminary look at the data and should not be used for major conclusions.

Conclusion

On the whole, we find evidence to support Hypothesis 2. We find substantial differences in participant responses to rates, education and technology treatments over time and among segments. In particular, we find differences in participant responses to the NDPT in the summer seasons as compared to the winter seasons, with the stronger price signals in the summer seasons resulting in greater participant shifting. We find that there were differences in the levels of shifting between income groups and household types in the North and the South, but there were not consistent patterns across both regions. Importantly, in both regions we find that the households that saved money on the NDPT compared to the flat rate were those who shifted electricity use out of more expensive periods to a greater degree.

In addition to differences in responses over time and among segments, we also find that there is substantial variation in the individual responses to the NDPT. Within the aggregate level results, we find that there are many different individual responses to the rates, education and technology treatments tested. In the next section, we will explore how the combinations of these treatments impacted participant responses.

Hypothesis 3

Responses for the combinations of treatments differed significantly from the individual responses

NDPT Hypothesis 3 asserts that combinations of rates, education and technology will have responses that differ from the sum of the individual responses to these treatment elements.

In Tables 33 and 34, we look at load impacts by cell and rate period in order to understand how electricity shifting behavior varied across treatment groups. On-peak and off-peak rate periods are broken down by season, as we have found important differences in responses to the different price signals. The regression equation is subset to include all hours for the indicated treatment group and the control group during each particular rate period in Program Year 1 or Program Year 2, compared to all hours in the corresponding rate period during Program Year 0. For example, the North TOU On-Peak (summer) Program Year 1 DiD regression equation includes all hours for all TOU treatment group participants and all control group members in the North during all Summer On-Peak rate periods in Program Year 1, and the corresponding hours during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage in the indicated rate period, season and year for each treatment group compared to the average hourly kWh usage for all control group members, compared to the corresponding rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for each treatment group in the indicated region, rate period and season.

Table 33: Load Shifting Impacts by Treatment and Rate Period (North)

		Program Year 1				Program Year 2			
Treatment	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**p-value**	**# of Unique NDPT IDs (N)**	**Impact (kWh)**	**Percentage (%)**	**p-value**	**# of Unique NDPT IDs (N)**
TOU	**On-Peak (Summer)**	-0.187	-10.74	0.000	319	-0.220	-12.60	0.000	319
	On-Peak (Winter)	-0.011	-0.76	0.528	319	-0.022	-1.49	0.323	319
	CPP*	-0.250	-13.19	0.000	319	-0.330	-17.40	0.000	319
	Mid-Peak 1	-0.061	-5.73	0.018	319	-0.059	-5.56	0.061	319
	Mid-Peak 2	-0.091	-4.70	0.014	319	-0.159	-8.23	0.000	319
	Off-Peak (Summer)	0.019	1.71	0.341	319	0.000	-0.04	0.982	319
	Off-Peak (Winter)	0.025	2.47	0.033	319	0.027	2.74	0.084	319
TOU+E	**On-Peak (Summer)**	-0.154	-8.21	0.007	194	-0.238	-12.70	0.000	194
	On-Peak (Winter)	0.008	0.53	0.789	194	0.030	1.96	0.596	194
	CPP*	-0.134	-6.52	0.046	194	-0.314	-15.29	0.000	194
	Mid-Peak 1	-0.025	-2.25	0.595	194	-0.034	-2.99	0.446	194
	Mid-Peak 2	-0.088	-4.15	0.115	194	-0.195	-9.21	0.000	194
	Off-Peak (Summer)	0.052	4.62	0.193	194	0.030	2.65	0.378	194
	Off-Peak (Winter)	0.039	3.66	0.132	194	0.067	6.25	0.223	194
TOU+E+T	**On-Peak (Summer)**	-0.339	-16.60	0.000	103	-0.275	-13.45	0.000	103
	On-Peak (Winter)	-0.007	-0.44	0.810	103	0.050	3.31	0.111	103
	CPP*	-0.252	-11.45	0.001	103	-0.246	-11.15	0.001	103
	Mid-Peak 1	-0.118	-10.67	0.001	103	-0.091	-8.18	0.022	103
	Mid-Peak 2	-0.186	-8.27	0.001	103	-0.156	-6.92	0.013	103
	Off-Peak (Summer)	-0.008	-0.69	0.761	103	-0.017	-1.45	0.589	103
	Off-Peak (Winter)	0.023	2.28	0.202	103	0.055	5.45	0.009	103
CPP	**On-Peak (Summer)**	-0.208	-14.56	0.000	232	-0.203	-14.24	0.000	232
	On-Peak (Winter)	-0.005	-0.35	0.811	232	0.006	0.42	0.808	232
	CPP	-0.434	-28.21	0.000	232	-0.554	-36.00	0.000	232
	Mid-Peak 1	-0.055	-5.44	0.076	232	-0.049	-4.80	0.114	232
	Mid-Peak 2	-0.088	-5.26	0.035	232	-0.062	-3.69	0.158	232
	Off-Peak (Summer)	0.028	2.77	0.238	232	0.019	1.86	0.381	232
	Off-Peak (Winter)	0.022	2.14	0.188	232	0.031	3.01	0.096	232
CPP+E	**On-Peak (Summer)**	-0.528	-26.99	0.000	167	-0.562	-28.70	0.000	167
	On-Peak (Winter)	0.031	2.23	0.134	167	0.045	3.21	0.074	167
	CPP	-0.643	-29.25	0.000	167	-0.885	-40.31	0.000	167
	Mid-Peak 1	-0.102	-8.92	0.005	167	-0.143	-12.51	0.000	167
	Mid-Peak 2	-0.240	-10.48	0.000	167	-0.318	-13.86	0.000	167
	Off-Peak (Summer)	-0.017	-1.41	0.516	167	-0.007	-0.55	0.820	167
	Off-Peak (Winter)	0.024	2.63	0.088	167	0.040	4.45	0.017	167
CPP+E+T	**On-Peak (Summer)**	-0.532	-29.71	0.000	205	-0.454	-25.37	0.000	205

	On-Peak (Winter)	0.009	0.67	0.641	205	0.031	2.17	0.211	205
	CPP	-0.766	-38.37	0.000	205	-0.804	-40.31	0.000	205
	Mid-Peak 1	-0.152	-14.18	0.000	205	-0.100	-9.33	0.004	205
	Mid-Peak 2	-0.288	-12.78	0.000	205	-0.189	-8.41	0.000	205
	Off-Peak (Summer)	0.021	1.75	0.389	205	0.019	1.60	0.417	205
	Off-Peak (Winter)	0.026	2.82	0.043	205	0.050	5.51	0.002	205

*__Note:__ TOU groups were not exposed to CPP rates. This category is used to show what TOU groups did during the CPP periods, in order to understand the marginal effect during CPP rate periods.

In the North, we find that the relationship with rates, education and technology is not simply additive. For example, in Program Year 2 on-peak summer use in the CPP group decreased by 14.2% and by an even greater 28.7% in the CPP+E group. However, use decreased by 25.4% in the CPP+E+T group, which is lower than the impact in the CPP+E group. We find a similarly puzzling result in the TOU groups. In Program Year 1, participants in the TOU group decreased electricity use in all on-peak periods to a greater extent than participants in the TOU+E group.

We do find statistically significant and quantitatively large load shifting during CPP periods in both years for all groups in the North. CPP treatment groups decreased electricity use by 28 – 40% during these periods, while TOU treatment groups decreased use between 6 – 17%. The differences in electricity use between these groups are statistically significant. In Table 34 we look at the same metrics for the South.

Table 34: Hourly Load Shifting Impacts by Treatment and Rate Period (South)

		Program Year 1				Program Year 2			
Treatment	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**p-value**	**# of Unique NDPT IDs (N)**	**Impact (kWh)**	**Percentage (%)**	**p-value**	**# of Unique NDPT IDs (N)**
TOU	**On-Peak (SS)**	-0.588	-13.47	0.00	284	-0.738	-16.92	0.00	284
	On-Peak (SC)	-0.723	-14.53	0.00	284	-0.903	-18.15	0.00	284
	CPP	-0.660	-13.67	0.00	284	-0.897	-18.57	0.00	284
	Off-Peak (SS)	0.002	0.08	0.95	284	0.025	1.03	0.50	284
	Off-Peak (SC)	0.033	1.10	0.47	284	0.079	2.60	0.09	284
	Off-Peak (Winter)	-0.022	-1.17	0.36	284	0.014	0.74	0.62	284
TOU+E	**On-Peak (SS)**	-0.570	-13.30	0.00	199	-0.804	-18.75	0.00	199
	On-Peak (SC)	-0.812	-16.26	0.00	199	-1.012	-20.26	0.00	199
	CPP	-0.655	-13.62	0.00	199	-0.945	-19.67	0.00	199
	Off-Peak (SS)	0.049	2.02	0.27	199	0.067	2.73	0.20	199
	Off-Peak (SC)	0.058	1.91	0.28	199	0.089	2.91	0.16	199
	Off-Peak (Winter)	-0.046	-2.56	0.04	199	-0.016	-0.90	0.67	199
TOU+E+T	**On-Peak (SS)**	-0.740	-17.71	0.00	221	-0.962	-23.03	0.00	221
	On-Peak (SC)	-1.011	-20.95	0.00	221	-1.219	-25.25	0.00	221
	CPP	-0.866	-18.41	0.00	221	-1.194	-25.39	0.00	221

	Off-Peak (SS)	0.058	2.47	0.15	221	0.171	7.25	0.00	221
	Off-Peak (SC)	0.148	5.07	0.01	221	0.242	8.28	0.00	221
	Off-Peak (Winter)	-0.038	-2.35	0.03	221	0.052	3.22	0.03	221
CPP	**On-Peak (SS)**	-0.862	-19.24	0.00	656	-1.059	-23.62	0.00	656
	On-Peak (SC)	-1.105	-22.00	0.00	656	-1.230	-24.48	0.00	656
	CPP	-1.504	-29.90	0.00	656	-1.798	-35.74	0.00	656
	Off-Peak (SS)	0.068	2.80	0.00	656	0.205	8.40	0.00	656
	Off-Peak (SC)	0.153	5.02	0.00	656	0.235	7.69	0.00	656
	Off-Peak (Winter)	0.001	0.04	0.96	656	0.109	7.13	0.00	656
CPP+E	**On-Peak (SS)**	-0.929	-20.31	0.00	504	-1.066	-23.32	0.00	504
	On-Peak (SC)	-1.164	-23.05	0.00	504	-1.183	-23.44	0.00	504
	CPP	-1.466	-28.79	0.00	504	-1.781	-34.98	0.00	504
	Off-Peak (SS)	0.041	1.56	0.15	504	0.163	6.27	0.00	504
	Off-Peak (SC)	0.179	5.70	0.00	504	0.250	7.94	0.00	504
	Off-Peak (Winter)	-0.016	-1.00	0.26	504	0.084	5.12	0.00	504
CPP+E+T	**On-Peak (SS)**	-0.881	-22.27	0.00	534	-1.025	-25.91	0.00	534
	On-Peak (SC)	-1.133	-25.80	0.00	534	-1.133	-25.80	0.00	534
	CPP	-1.529	-34.21	0.00	534	-1.689	-37.79	0.00	534
	Off-Peak (SS)	0.074	3.22	0.00	534	0.207	9.00	0.00	534
	Off-Peak (SC)	0.206	7.36	0.00	534	0.304	10.87	0.00	534
	Off-Peak (Winter)	0.016	1.09	0.29	534	0.131	9.01	0.00	534

SS: Summer Shoulder; **SC:** Summer Core

***Note:** TOU groups were not exposed to CPP rates. This category is used to show what TOU groups did during the CPP periods, in order to understand the marginal effect of the CPP prices.

In the South, we find that for all treatment groups there is statistically significant shifting out of on-peak and CPP rate periods in both years. In addition, we see a higher level of shifting in Program Year 2 than in Program Year 1 for all groups, indicating that participants were more familiar with the program during the second year and made fewer mistakes.

Similar to the results in the North, we find that the relationship with education and technology is not simply additive. For example, in Program Year 1 participants in the TOU group decreased electricity use during all on-peak periods by a similar level to participants in the TOU+E group. We find the same result in Program Year 2 between the CPP group and the CPP+E group. These examples show that there is not a simple additive relationship between these treatments and their impacts on participant behavior.

As in the North, we find a statistically significant and quantitatively large load shifting during CPP hours in both years for all groups, with CPP treatment groups reducing electricity use by 29 – 38% and TOU treatment groups reducing electricity use by 14 – 25% during these periods. Next, we examine whether

the responses of treatment groups to the rates, education and technology treatments provided were different from one another.

In order to test whether there were statistically significant differences in the responses between groups, difference-in-differences analysis was performed between all treatment groups for each rate period in both Program Year 1 and Program Year 2. For example, to test whether there was a statistically significant difference between the responses of the North TOU and TOU+E groups to On-Peak and Mid-Peak rates, DiD regression analysis was performed in which the TOU+E group was designated as the treatment group and the TOU group was designated as the control group. Tables 35 and 36 indicate which treatment groups had statistically significant different responses to particular rate periods in each year. We designate $p<0.05$ as the level of significance for these tables.

Table 35: North – Statistically Significant Differences between Treatment Group Load Impacts

On-Peak + Mid-Peak

Program Year 1						Program Year 2					
TOU	**TOU+E**	**TOU+E +T**	**CPP**	**CPP+E**	**CPP+E+ T**	**TOU**	**TOU+E**	**TOU+E +T**	**CPP**	**CPP+E**	**CPP+E+ T**
CPP+E+ T	CPP+E+T		CPP+E+ T		CPP TOU TOU+E	NO STATISTICALLY SIGNIFICANT DIFFERENCES BETWEEN TREATMENT GROUPS.					

Off-Peak

Program Year 1						Program Year 2					
TOU	**TOU+E**	**TOU+E +T**	**CPP**	**CPP+E**	**CPP+E+ T**	**TOU**	**TOU+E**	**TOU+E +T**	**CPP**	**CPP+E**	**CPP+E+ T**
NO STATISTICALLY SIGNIFICANT DIFFERENCES BETWEEN TREATMENT GROUPS.						NO STATISTICALLY SIGNIFICANT DIFFERENCES BETWEEN TREATMENT GROUPS.					

CPP Periods

Program Year 1						Program Year 2					
TOU	**TOU+E**	**TOU+E +T**	**CPP**	**CPP+E**	**CPP+E+ T**	**TOU**	**TOU+E**	**TOU+E +T**	**CPP**	**CPP+E**	**CPP+E+ T**
CPP CPP+E CPP+E+ T	CPP CPP+E CPP+E+T	CPP CPP+E CPP+E+ T	CPP+E CPP+E+ T TOU TOU+E TOU+E +T	CPP TOU TOU+E TOU+E +T	CPP TOU TOU+E TOU+E +T	CPP CPP+E CPP+E +T	CPP CPP+E CPP+E +T	CPP CPP+E CPP+E+ T	CPP+E CPP+E+ T TOU TOU+E TOU+E +T	CPP TOU TOU+E TOU+E +T	CPP TOU TOU+E TOU+E +T

Next, we look at the same analysis for treatment groups in the South.

Table 36: South – Statistically Significant Differences between Treatment Group Load Impacts

On-Peak

Program Year 1						Program Year 2					
TOU	**TOU+E**	**TOU+E+T**	**CPP**	**CPP+E**	**CPP+E+T**	**TOU**	**TOU+E**	**TOU+E+T**	**CPP**	**CPP+E**	**CPP+E+T**
CPP CPP+E CPP+E+T	CPP CPP+E CPP+E+T		TOU TOU+E	TOU TOU+E	TOU TOU+E	CPP CPP+E CPP+E+T			TOU	TOU	TOU

Off-Peak

Program Year 1						Program Year 2					
TOU	**TOU+E**	**TOU+E+T**	**CPP**	**CPP+E**	**CPP+E+T**	**TOU**	**TOU+E**	**TOU+E+T**	**CPP**	**CPP+E**	**CPP+E+T**
CPP+E+T	CPP+E+T				TOU TOU+E	CPP CPP+E CPP+E+T	CPP CPP+E CPP+E+T TOU+E+T	CPP+E+T TOU+E	TOU TOU+E	TOU TOU+E	TOU TOU+E TOU+E+T

CPP Periods

Program Year 1						Program Year 2					
TOU	**TOU+E**	**TOU+E+T**	**CPP**	**CPP+E**	**CPP+E+T**	**TOU**	**TOU+E**	**TOU+E+T**	**CPP**	**CPP+E**	**CPP+E+T**
CPP CPP+E CPP+E+T	CPP CPP+E CPP+E+T	CPP CPP+E CPP+E+T	TOU TOU+E TOU+E+T	TOU TOU+E TOU+E+T	TOU TOU+E TOU+E+T	CPP CPP+E CPP+E+T	CPP CPP+E CPP+E+T	CPP CPP+E CPP+E+T	TOU TOU+E TOU+E+T	TOU TOU+E TOU+E+T	TOU TOU+E TOU+E+T

By looking at whether or not there were statistically significant differences between the treatment groups, we find evidence to support Hypothesis 3. Combinations of rates, education and technology had responses that differed from the sum of the individual responses to these treatment elements. Combinations of treatments, and treatments on their own, provided different effects from one another. These different effects themselves varied between regions and between years. For example, participants in the North CPP+E+T group used less electricity during on-peak and mid-peak hours in Program Year 1 than participants in the CPP group. However, this difference did not persist in Program Year 2.

During CPP periods, there are statistically significant differences between all TOU groups and all CPP groups, with CPP participants decreasing electricity use by more than TOU participants during those periods. In the North during CPP periods in both years, we find statistically significant differences

between the CPP and CPP+E groups, as well as the CPP and CPP+E+T groups. However, in the South we do not find a statistically significant difference in the response between these groups in CPP periods.

In short, we find that the addition of education and technology to NDPT rates changed electricity use in ways that were complex and would be difficult to predict accurately. Next, we look further into how different engagement levels with the education and technology treatments impacted participants' shifting behavior.

Education Treatment

As discussed previously, there was substantial variation in the engagement level of education treatment participants with the education materials, and with the mobile game in particular. In this section we look at whether there were differences in load shifting behavior between individuals who were engaged with the PLW game compared to those who were not engaged. For this analysis, we define an engaged education participant as someone in the education treatment groups (TOU+E, TOU+E+T, CPP+E or CPP+E+T) who downloaded the PLW game and answered at least one question. A non-engaged education participant is someone in one of those treatment groups who either did not download the game or downloaded the game but did not answer any questions.

Table 37 examines load impacts of engaged vs. non-engaged education treatment participants. The regression equation is subset to include all hours for the indicated rate period in Program Year 1 or Program Year 2, for all NDPT education treatment participants, compared to all hours in the corresponding rate period during Program Year 0 for the same individuals. For example, the North PEAK Program Year 1 DiD regression equation includes all hours for all NDPT education treatment participants in the North, during all On-Peak, Mid-Peak and CPP rate periods in Program Year 1, and the corresponding hours during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage between engaged and non-engaged education treatment participants in the indicated rate period and year, compared to the corresponding rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region, education engagement group and rate period.

Table 37: Load Shifting Impacts within Education Treatment Participants

		Program Year 1					
Region	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**Treatment # of Unique NDPT IDs (N)**	**Control # of Unique NDPT IDs (N)**
NORTH	**PEAK**	-0.015	-0.99	0.028	0.578	415	254
	Off-Peak	0.010	1.03	0.018	0.560	415	254
SOUTH	**PEAK**	-0.374	-8.16	0.077	0.000	880	578
	Off-Peak	-0.006	-0.34	0.018	0.725	880	578
		Program Year 2					
Region	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**Treatment # of Unique NDPT IDs (N)**	**Control # of Unique NDPT IDs (N)**
NORTH	**PEAK**	0.009	0.60	0.034	0.781	415	254
	Off-Peak	0.033	3.35	0.027	0.214	415	254
SOUTH	**PEAK**	-0.376	-8.21	0.086	0.000	880	578
	Off-Peak	0.031	1.62	0.023	0.175	880	578

In the North, there were 415 participants who engaged with the education treatment compared to 254 who did not engage with the treatment. On average, we find that there were not statistically significant differences in PEAK or off-peak electricity usage between NDPT participants in the North who did and did not engage with the PLW game.

In the South, there were 880 participants who were engaged with the education treatment compared to 578 participants who were not. We find that there were statistically significant differences in PEAK usage between participants in the South who were and were not engaged with the education treatment. The engaged participants in the South used 8% less PEAK electricity than non-engaged participants in the South in both years. We find that there were not statistically significant differences in off-peak electricity usage between the groups. Although the PLW game was only active for the first six months of Program Year 1, we find that the decreases in PEAK usage for those who engaged with the treatment persisted for both years of the NDPT.

Technology Treatment

In this section we will look at whether there were differences in load shifting behavior between individuals who were engaged with the programmable thermostat that was provided to technology treatment participants compared to those who were not engaged. As discussed previously, technology treatment participants were able to manually override the thermostat program. Overriding a thermostat setting required a participant to actively intervene in the technology treatment's operations, whether to reduce, increase, or confirm particular settings. Overriding a thermostat was not the only type of engagement available to participants who received the technology treatment, but it was the most familiar and distinct type. Participants who overrode their thermostat settings were not following a 'set

it and forget it' protocol. They were reacting to circumstances in their lives at particular moments by engaging with the treatment.

The median technology participant manually overrode the thermostat 2.05% of time. For this analysis, we define an engaged technology participant as someone in the technology treatment groups (TOU+E+T or CPP+E+T) who overrode the thermostat more than the median. A non-engaged education participant is someone in one of those treatment groups who overrode the thermostat less than the median.

Table 38 examines load impacts of engaged vs. non-engaged technology treatment participants. The regression equation is subset to include all hours for the indicated rate period in Program Year 1 or Program Year 2, for all NDPT technology treatment participants, compared to all hours in the corresponding rate period during Program Year 0 for the same individuals. For example, the North PEAK Program Year 1 DiD regression equation includes all hours for all NDPT technology treatment participants in the North, during all On-Peak, Mid-Peak and CPP rate periods in Program Year 1, and the corresponding hours during Program Year 0.

The impact (kWh) metric indicates the difference in the average hourly kWh usage between engaged and non-engaged technology treatment participants in the indicated rate period and year, compared to the corresponding rate period in Program Year 0. The percentage (%) metric is calculated by dividing the impact (kWh) metric by the average hourly Program Year 0 kWh use for all NDPT participants in the indicated region, technology engagement group and rate period.

Table 38: Load Shifting Impacts within Technology Treatment Participants

		Program Year 1					
Region	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**Treatment # of Unique NDPT IDs (N)**	**Control # of Unique NDPT IDs (N)**
NORTH	**PEAK**	0.029	2.00	0.038	0.437	189	113
	Off-Peak	0.015	1.60	0.020	0.450	189	113
SOUTH	**PEAK**	0.391	8.49	0.104	0.000	332	412
	Off-Peak	0.010	0.54	0.024	0.665	332	412
		Program Year 2					
Region	**Rate Period**	**Impact (kWh)**	**Percentage (%)**	**SE**	**p-value**	**Treatment # of Unique NDPT IDs (N)**	**Control # of Unique NDPT IDs (N)**
NORTH	**PEAK**	-0.023	-1.55	0.043	0.592	189	113
	Off-Peak	0.017	1.81	0.024	0.477	189	113
SOUTH	**PEAK**	0.350	7.59	0.119	0.003	332	412
	Off-Peak	0.006	0.32	0.030	0.836	332	412

In the North, we find that there were not statistically significant differences in all PEAK or off-peak electricity usage between NDPT participants who did and did not override the thermostat more than the median.

In the South, we find that there were statistically significant differences in PEAK usage between participants in the South who did, and participants in the South who did not engage with the thermostat. The engaged participants in the South used 8.5% more PEAK electricity in Program Year 1 and 7.6% more PEAK electricity Program Year 2 than non-engaged participants in the South. We find that there were not statistically significant differences in off-peak electricity usage between the groups. We find that the increases in PEAK usage for those who overrode the program persisted for both years of the NDPT.

Overall, we find evidence to support Hypothesis 3. In the NDPT, combinations of rates, education and technology had responses that differed from the sum of the individual responses to these treatment elements. At times, and during some rate periods, there are statistically significant effects from the combination of education or education + technology elements with the rate only treatments. However, we find that these relationships are complex and would be difficult to predict. In the NDPT, providing participants with education or education and enabling technology did not necessarily mean that participants shifted electricity usage more than they did when provided with the rate alone.

Hypothesis 4

Participants displayed attitudes of energy ownership, and satisfaction with energy ownership

NDPT Hypothesis 4 states that the extent and persistence of customer energy management responses to rates, education and technology treatments are significantly correlated with attitudes of (a) energy ownership, and (b) satisfaction with energy ownership. To address Hypothesis 4 we utilize the results of customer surveys, focus groups and in-home interviews[23].

Direct research is an excellent source of testimony and gives customers the opportunity to share their perceptions, recollections and reflections. However, there are limitations as a research technique that focus groups consist of small groups of people that provide a limited sample of their personal experiences and are susceptible to influence by other focus group attendees. As a result of these strengths and limitations, direct research testimony is best used to suggest hypotheses about the participants' experiences that can be substantiated by further research.

[23]Analysis of 2015 survey results indicated that the shifting responses of survey respondents were similar to the shifting responses of non-respondents, indicating that in that respect survey respondents can be taken as representative of NDPT participants. However, focus groups and in-home interview attendees were volunteers who may not have been representative of all NDPT participants. Therefore, the views of these attendees should be seen as anecdotal. The 2015 survey also included a control group of NV Energy residential customers who had not been part of the NDPT. Analysis indicates that the set of control subjects and the set of NDPT participants who responded to the survey were similar in many respects but not all. Thus control/participant comparisons are not definitive. We offer them merely as a contrast to the participant metrics.

The direct research information is from 1,759 complete 2015 surveys, focus groups across the two-year program and twenty in-home interviews.

The NDPT research indicates that participants displayed reliable, persistent, and substantial changes in their electricity use under a variety of conditions. The research also indicates that NDPT participants displayed attitudes of energy ownership[24]. These exploratory findings provide support for the fourth NDPT hypothesis and indicate that it could be useful to consider the role of energy ownership in utility program design.

The Role of Energy Ownership

The NDPT investigated energy ownership in a search for more effective methods of achieving customer change[25]. Many utilities would prefer that their residential customers change their habits by using less electricity during peak periods than they do now. Utilities seek reliable, persistent, and substantial changes in these customer habits. To meet these goals, residential customers have to be motivated to make changes, and stick to them.

The NDPT hypothesized that the additional impetus from energy ownership would lead many customers to overcome resistance to change. Therefore, the NDPT oriented many of its key communications to foster energy ownership[26], and then looked for energy ownership to reveal itself in participant behaviors and statements. If successful in fostering energy ownership, NDPT energy owners would see themselves as competent and effective in situations involving electricity use at home, and would see owning their electricity use as significant and rewarding[27].

Overview of Energy Ownership

The ownership drive expresses itself in attitudes, and it also expresses itself in a distinctive set of behaviors. Aiming to achieve ownership, we seek control, in-depth knowledge, or ways we can invest ourselves in a situation. If and when these behaviors succeed, we are satisfied because the moment is ours: we own it. We experience ownership when we sense we belong or fit into a situation, we identify with it, and we are competent or effective within it.

[24] The NDPT was not designed to test whether or not the treatments caused energy ownership, or vice versa. The NDPT was not designed to assess energy ownership in the control group, or to estimate the potential, costs, or preferred approach to establishing energy ownership across NV Energy's residential customers. The NDPT was only designed to indicate the presence and strength of energy ownership among participants.

[25] In identifying the presence of energy ownership at the close of the NDPT, and associating that presence with NDPT participants' shifting and saving of electricity usage during the NDPT, we are not claiming that participants' energy ownership was caused by the NDPT and its treatments. Participants may have had energy ownership prior to the NDPT, or developed energy ownership during the NDPT due to other factors.

[26] Recruiting materials, energy reports, and treatment communications were framed around changing behavior to save money.

[27] While it might have been useful to measure the attitude of energy ownership directly, the NDPT was a field trial rather than a formal test of attitudes. There were no proven survey instruments available to measure energy ownership, and it was not an objective of the NDPT to develop research instruments.

Energy ownership is one example of psychological ownership[28]. The energy owner seeks control, knowledge, and self-identity through experiences of energy use. The attitude of energy ownership colors the energy owner's experiences, highlighting opportunities for ownership, and nudging behaviors. Energy ownership may be a deliberate and mindful attitude. Or, energy ownership can be an unconscious and automatic attitude. In either case, like any attitude, energy ownership may strengthen or weaken over time as the energy owner's experience varies.

Saving Money and Energy Ownership

Energy ownership was neither a strong nor a common attitude among newly-recruited NDPT participants. As the program began, participants reported relatively neutral attitudes about their electricity use at home.[29] Participants reported that prior to the NDPT, they hadn't attended much to electricity use, apart from paying bills, enduring outages, and occasionally contacting utility customer service. Participants recalled childhood memories about being told to turn lights off and they recalled shopping for appliances or light bulbs. They were aware of the amounts of their electric bills, in general terms. A few participants had participated in NV Energy programs from time to time.

Achieving energy ownership was not a specific objective for these recruits. Nor did many NDPT recruits begin the program with plans in mind[30]. They did not join Choose When You Use in order to develop a new attitude about electricity use. Instead, most NDPT recruits indicated that they had joined the program to save money.

The NDPT recruiting materials sparked the recruits' ambition to save money by offering a time-varying rate. Choose When You Use suggested that participants might save money if they used electricity at different times than they had before. Even though the program's recruiting materials didn't promise a specific level of savings in exchange for specific changes in behavior, NDPT recruits reported that they signed up for the program just on the chance that they might save money[31]. The strong and common attitude motivating NDPT recruitment was an attitude toward saving money, not an attitude toward electricity use.

Saving money had a powerful appeal to NDPT recruits; the opportunity to manage electricity use through time-varying rates was a new route to save money. NDPT participants had experience trying to save money, so they knew where to begin (e.g., distinguish expensive from inexpensive opportunities to consume, apply self-control to consumption behavior, and keep track of costs). The time-varying

[28] Psychological ownership is an established construct within the discipline of psychology, in both theory and research.

[29] The NDPT was not designed to assess participants' energy ownership at its outset, but direct NDPT research early in Program Year 1 indicated participants' attitudes toward electricity use tended to be shallow and lacking conviction.

[30] There were exceptions: some participants kept careful track of their electric bills, and others had technical knowledge about energy management.

[31] The recruiting materials warned that participants might lose money instead of save, if they failed to change their behaviors. However, the NDPT first-year bill guarantee also reassured many participants that they 'couldn't lose' as they tried to save money during the program's first year.

electricity rates within the NDPT made these familiar principles relevant to electricity use. Shifting electricity use from one time period to another was an unfamiliar practice, but shifting consumption from one time to another was a familiar concept.

It is important to note that there were some NDPT participants who indicated another reason for joining the program. These participants joined the NDPT to help save their community, or save the planet. This attitude is generally described as stewardship. Only a few NDPT recruits reported stewardship as a primary motivation for joining Choose When You Use, although many noted it as a secondary motivation. NDPT participants with the attitude of stewardship were asserting ownership beyond saving money for themselves or their household; they sought to 'do *their* part' for the 'greater good.' Doing their part meant shifting and reducing electricity use, because many of these participants had concluded that shifting and reducing behaviors might help reduce the need for new power plants and might help prevent brownouts. The attitude of stewardship and the attitude of energy ownership are not the same, but in the NDPT they were well-aligned and mutually-reinforcing.

For most recruits, joining the NDPT was their first major act of energy ownership. Some followed up immediately by taking action to save money. Others took too much reassurance from their early energy reports, which seemed to show a pattern of automatic saving. These participants delayed taking action because everything seemed to be going well in the program. In early summer, these procrastinators were "shocked" by extremely high electricity bills. The pattern of automatic saving due to lower off-peak rates had stopped. Their energy reports began to show that their accumulated savings were dwindling month by month. In some months, the energy reports were showing outright losses (as compared to the flat rate).

Choose When You Use had started by providing savings, but then it put these savings at risk[32]. These participants now they realized that savings from Choose When You Use weren't automatic after all. In fact, while their behavior could create savings, it could also take savings away. As these participants came to understand the program in more depth, they saw that serious changes in their electricity use would be required to save money through the summer. These households had to exercise more control over their electricity use, and invest themselves more in new behaviors. Energy ownership was a new type of saving, and NDPT participants developed energy ownership as they tried to save money.

Assessing Energy Ownership

At the close of the NDPT, we surveyed participants and the NDPT control group[33] about behaviors and beliefs that could indicate energy ownership. These behaviors and beliefs related to (1) seeking in-depth

[32] The NDPT provided a 'stake' to participants, reinforcing the view that they could succeed in the program. Then, in the summer, the program challenged participants to do more, or endure losses. For most participants, the reluctance to lose overcame the resistance to change.

[33] Enlistment, reenlistment, and transition are also behaviors indicative of energy ownership, as NDPT participants made decisions about whether or not to exercise energy ownership. It is relevant that recruiting for the NDPT was rapid for almost all of the required cells and strata, and reenlistment was strong even among participants who had lost money the first year and would face the second year without a bill guarantee. Transition at the close of the NDPT was at a high level considering it was both opt-in and a transition to time-varying rates that did not match the NDPT's rates.

knowledge of a situation, (2) seeking control of a situation, and (3) investing oneself in a situation.

Seeking In-Depth Knowledge

In the pursuit of ownership, in-depth knowledge comes first. To save money under NDPT rates, participants gathered in-depth knowledge of the rates and price structures. Participants needed to know how to manage their consumption intentions under the new rate structure in order to save money.

Saving money through time-varying electricity rates was a new experience for almost all of the NDPT participants. We examined three survey questions regarding the search for in-depth knowledge.

Table 39: NDPT 2015 Survey Question – Kilowatt-Hour Charge Knowledge[34]

NDPT 2015 Survey: Control vs. Participants 'True' Response to Question	
"I know about how much NV Energy charges my household for each kilowatt-hour of electricity we use."	
Group	**True (%)**
Control	25
Participants	46

The first question regarded basic knowledge of electricity prices. A larger proportion of NDPT participants than control group subjects reported knowledge of NV Energy prices. Even though flat rates were simpler and more familiar than time-varying rates, a lower percentage of control subjects knew about their flat-rate prices than participants who knew about their time-varying prices.

Table 40: NDPT 2015 Survey – Most Expensive Times[35]

NDPT 2015 Survey: Participants Level of Agreement with Time-Period Understanding							
Question	**Agreement (%)**						
	Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**	**No Opinion**	**Total**
"I understand when electricity is more expensive to use and when it's less expensive to use in the Choose When You Use program."	24	73	1	1	0	1	100

Participants were also asked about their knowledge of the Choose When You Use time periods. Almost every single participant surveyed reported knowledge of the Choose When You Use time periods (97%). Since these time periods were new to participants in the program, participants must have invested time

[34] All survey percentage totals are rounded to the nearest percent.
[35] All survey percentage totals are rounded to the nearest percent.

and attention to learn them.

The heuristics participants reported applying to electricity use were often based on time periods (e.g., "don't use any from 2 p.m. until 5 p.m.) rather than rate levels (e.g., "don't use any when the price is more than 12 cents per kilowatt-hour). One post-program focus group attendee summed up Choose When You Use as "*I watch for the best times*."

Table 41: NDPT 2015 Survey Question – Understanding Programmable Thermostats

NDPT 2015 Survey: Control vs. Participants 'Yes' Response to Question	
"In our household, at least one person understands all about programming thermostats."	
Group	**Yes (%)**
Control	79
Participants	86

In addition to rates, the NDPT survey also asked about in-depth knowledge on other topics related to managing electricity use, such as thermostat programming. Participants reported knowledge of programming thermostats (86%) more often than control subjects did (79%).

The in-depth knowledge participants required for Choose When You Use was limited, but new to them. In general, survey results indicate that NDPT participants pursued in-depth knowledge and displayed more energy ownership than control group subjects.

Seeking Control

In the pursuit of ownership, seeking control is the second key behavior. Control includes both self-control and control of the situation itself. NDPT participants had to decide what to do, and take action. Their decisions and actions may have been conscious and deliberate, or instinctual and automatic, or a combination of the two.

To save money, some participants tried to time consumption. Timing consumption is a familiar habit of self-control (e.g., avoiding impulse purchases, scheduling activities, and delaying gratification). Timing electricity consumption can be particularly demanding because so many activities require electricity. In order to save money, the participants would have to consistently manage activities according to a rate schedule, losing flexibility. These efforts to take control required mental effort, and sometimes resulted in discomfort and inconvenience.

None of the NDPT participants could be certain about how the program would work out for them, because they had never experienced it before. They all began at the same place, seeking control over the situation. We examined a number of survey questions regarding the search for control.

Table 42: NDPT 2015 Survey – Program Control[36]

NDPT 2015 Survey							
Question	**Agreement (%)**						
	Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**	**No Opinion**	**Total**
"The Choose When You Use program provided control."	13	70	3	9	1	3	100
"My household controls how much electricity we use and when we use it."	12	82	1	3	0	1	100

NDPT participants generally strongly agreed or agreed that the program provided them with control (83%). A minority of participants (10%) noted that the program actually took away control from them. Focus group attendees with similar views said the NDPT took away control by reducing the flexibility of when they could use electricity at an economical price.

NDPT participants strongly agreed or agreed that they were in control of how much electricity their household used, and when they used it (94%). Participants were confident they had achieved control.

Table 43: NDPT 2015 Survey – Bill Size Responsibility[37]

NDPT 2015 Survey: Responsibility for Bill Size							
Question	**Agreement (%)**						
	Big Industrial/ Commercial Users	**My Household**	**NV Energy**	**The Public Utilities Commission**	**Other**	**No Response/Don't Know**	**Total**
"Who is primarily responsible for how big or small your household's electricity bills are?"	2	72	8	5	10	4	100
"Who has some responsibility for how big or small your household's electricity bills are?"	17	98	47	54	N/A	N/A	N/A

Responsibility for a situation is closely related to control over it. When participants were asked to pick the single most responsible party for the size of their electric bills, they overwhelmingly indicated that

[36] All survey percentage totals are rounded to the nearest percent.
[37] All survey percentage totals are rounded to the nearest percent.

their household was responsible. However, the survey also indicated that participants did not see themselves as having complete control over their household's electricity bills[38].

When participants were asked which parties bore some responsibility for the size of their electric bills, they again indicated overwhelmingly that their own households bore responsibility. However, approximately half of the participants who had completed the program assigned some responsibility for the size of their electricity bills to NV Energy and to the Public Utilities Commission.

Table 44: NDPT 2015 Survey– Change for Better Home Management

NDPT 2015 Survey: Control vs. Participants 'Yes' Response to Question	
"In our household, we change the way we use energy in order to better manage our home."	
Group	**Yes (%)**
Control	85
Participants	89
"In our household, we change the way we use energy in order to learn some new things or to have fun."	
Group	**True (%)**
Control	65
Participants	53
"In our household, we change the way we use energy in order to help the environment."	
Group	**True (%)**
Control	75
Participants	74

The survey also inquired into three motives beyond saving money that could lead participants to manage their electricity use: home management, learning new things and helping the environment.

Home management was an important motivation for energy ownership regardless of the NDPT. Survey responses indicate that at the close of the NDPT, participants were about as likely as control subjects to be managing their electricity use with home management in mind.

Participants were less likely than control subjects to be managing energy use for curiosity or simple enjoyment. This finding is consistent with focus group and interview testimony that once participants had established a set of new habits, they did not continue to try new things incrementally. Some said they had learned what they needed to learn.

[38] Many of the 'other' answers in the survey were from participants who refused to assign responsibility to a single party, despite the form of the question.

Some participants cited stewardship as a motive for managing electricity use, but the survey indicated that at the close of the NDPT, participants were about as likely as control subjects to be managing their electricity use with the environment in mind.

NDPT participants strongly agreed that the program provided control, and left them in control of how and when they used electricity. Even though a majority of participants said they shared responsibility for the size of their electric bills with other parties, 94% of participants strongly agreed or agreed that their household was primarily responsible. Home management or helping the environment motivated participants no more than control group subjects, and participants were less motivated than control group subjects by learning or having fun.

Investing Oneself

In the pursuit of ownership, investing oneself is the third key behavior. In-depth knowledge may lead to control, but that control may merely be a means to endure or cope with the situation. In the NDPT, the step of investing oneself, completing the pursuit of ownership, comes when the participant makes the situation their own. The owner realizes that they are competent and effective in the situation, achieving their goals through their actions. We examined several survey questions regarding the search for self-investment.

Table 45: NDPT 2015 Survey Question – Time Spent on Energy Use at Home[39]

NDPT 2015 Survey: Control vs. Participants 'Amount of Time' Response to Question								
"What is the best estimate of how much time you and the other members of your family typically spend thinking about or talking about energy use at home?"								
Group	**Response (%)**							
	Daily	**At Least Weekly**	**At Least Twice a Month**	**Every Month**	**A Couple of Times per Year**	**We Don't At All**	**Don't Know or Other**	**Total**
Control	12	13	13	15	6	36	5	100
Participants	7	17	18	16	13	23	6	100

At the close of the NDPT, participants' estimates of the frequency household members thought about or discussed energy use were in a similar range as control subjects' estimates. The self-investment of Choose When You Use participants did not express itself in more time spent consciously thinking about or talking about energy use at home. Only about one-quarter of the participants were thinking or talking about electricity use at home at least weekly. Control subjects reported spending nearly the same amount of time on energy management in the absence of the program. These findings are consistent with many participants' testimony that they decided to make a few changes, and then briefly check their energy reports to see if those changes saved money.

[39] All survey percentage totals are rounded to the nearest percent.

Table 46: NDPT 2015 Survey Question – NV Energy MyAccount

NDPT 2015 Survey: Control vs. Participants 'Yes' Response to Question	
"Someone in my household looks at our NV Energy MyAccount information on the NV Energy website at least once per month."	
Group	**Yes (%)**
Control	38
Participants	49

NDPT participants were more likely to say that someone in their household looked at their NV Energy MyAccount information on the NV Energy website at least once per month, as compared to control customers. Higher engagement with the NV Energy website may indicate more attention to NV Energy communications.

According to some Choose When You Use participants, the program's real impact came not in the amount of time, but rather in the kind of time that was required (i.e., occasionally stressful, inconvenient and uncomfortable time). Some participants would add that the program was nevertheless money-saving, challenging, and habit-forming. Overcoming negative experiences and achieving positive experiences both lead to further self-investment.

Table 47: NDPT 2015 Survey – Negative Experiences

NDPT 2015 Survey: Participants Level of Agreement							
Group	**Agreement (%)**						
	Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**	**No Opinion**	**Total**
"The Choose When You Use program was inconvenient."	4	15	5	57	18	1	100
"The Choose When You Use program was uncomfortable."	3	15	3	65	13	1	100
"The Choose When You Use program required a lot of mental effort."	4	15	4	62	14	1	100

As the end of the NDPT, a minority of participants (19%) strongly agreed or agreed that the program was inconvenient. More than three-quarters of participants (77%) strongly disagreed or disagreed. Participants reported a variety of behaviors associated with inconvenience (e.g., driving across town to reset a thermostat, remembering to do the laundry late at night, reminding family members of rate periods).

A minority of participants (18%) strongly agreed or agreed that the program was uncomfortable. Participants reported a variety of behaviors associated with discomfort (e.g., too much heat and humidity inside at the end of a summer day, too much cold during precooling, concern about adequate heating or cooling for pets). Seventy-eight percent of participants strongly disagreed or disagreed that the program was uncomfortable.

In addition, a minority of participants (19%) strongly agreed or agreed that the program required a lot of mental effort. Seventy-six percent of participants strongly disagreed or disagreed. Participants reported a variety of behaviors associated with mental effort (e.g., keeping rate schedules in mind, paying attention to the clock when performing household chores, tracking down small-scale uses of electricity).

For participants who reenlisted in and completed Choose When You Use, some reported experiencing inconvenience, discomfort, or a lot of mental effort. These experiences were negative, but their presence indicated that these participants had invested themselves in the program. These experiences were also mild enough for participants to be invested in the program, but not negative enough to lead them to leave the program.

NDPT research also asked participants about three kinds of positive experiences Choose When You Use may have brought them: saving money, providing an interesting challenge, and helping participants to be good citizens.

Most of the Choose When You Use participants saved money during the program. However, due to time-varying rate design and weather, the NDPT was a very different program for participants in the North and the South.

Table 48: NDPT Results – Participant Savings

NDPT Results: Participants Savings				
Group	**Savings ($)**			
	Program Year 1	**(%)**	**Program Year 2**	**(%)**
Total North Participants	1,734	100	1,220	100
North – Saved Money	980	57	832	68
North – Lost Money	754	43	388	32
Total South Participants	3,082	100	2,398	100
South – Saved Money	2,743	89	2,220	93
South – Lost Money	399	11	178	7
Total All Participants	4,816	100	3,618	100
All – Saved Money	3,723	77	3,052	84
All – Lost Money	1,153	23	566	16

In the North, participants were only slightly more likely to save money (57%) than lose money (43%) in Program Year 1, and nearly a third of participants (32%) lost money in Program Year 2. In the South, as

noted earlier, some participants benefited from a bill mistake and saved more money in Program Year 1 than they would have otherwise, which helped lead the strong majority of participants to save money in Program Year 1 (77%). In Program Year 2, without the mistake but with more experience, five out of six participants (84%) in the South saved money.

Saving money was the primary energy ownership behavior of Choose When You Use. It was a new behavior, and a direct result of shifting electricity use successfully under time-varying rates. Participants understood saving money was their best indicator of success in the program[40].

Table 49: NDPT 2015 Survey – Positive Experiences[41]

NDPT 2015 Survey: Positive Experience							
Group	**Agreement (%)**						
	Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**	**No Opinion**	**Total**
"The Choose When You Use program provided an interesting challenge."	11	65	7	15	1	1	100
"The Choose When You Use program helped us be good citizens."	8	66	11	8	2	5	100

At the end of the NDPT, more than three-quarters of participants (76%) strongly agreed or agreed that the program was an interesting challenge. Participants reported a variety of behaviors associated with an interesting challenge (e.g., investigating the electricity usage of different appliances, realizing that a ceiling fan would help by operating in reverse during winter, experimenting with different approaches to precooling). In both the North and South, many participants had invested themselves in the challenge of responding to time-varying rates and found it interesting to do so. A minority (16%) strongly disagreed or disagreed.

Seventy-four percent of participants strongly agreed or agreed that the program helped them be good citizens. Participants reported a variety of behaviors associated with being good citizens (e.g., speaking with family members about electricity use management, thinking about avoiding power plant construction through their actions, developing self-control in electricity use). A small minority (10%) strongly disagreed or disagreed. Participants had feedback only on their money savings, and were offered no representations about their contribution to society, so they had to draw a conclusion about stewardship benefits on their own.

[40] Saving money in Choose When You Use was not the same thing as shifting electricity use, because shifting electricity use occurred well before, and independent of, any confirmation of saving money. Shifting electricity use could also fail to result in monetary savings, as when some participants misunderstood the rate periods.
[41] All survey percentage totals are rounded to the nearest percent.

The prevalence of participants' positive experiences in Choose When You Use was high. Participants generally saved money in Choose When You Use, providing validation about the program's initial claims. They found ways to believe that the program was an interesting challenge and that it helped them be better citizens. Many participants found ways to cope with any discomfort, inconvenience, or mental stress that may have challenged them from time to time, so that by the time the NDPT was over, they didn't see the program in only those terms. Participants' self-investment consisted of coming to see the program through the attitude of energy ownership.

Satisfaction with Energy Ownership

We next examine how satisfied participants were with the energy ownership they achieved through Choose When You Use. We considered these three perspectives on satisfaction:

1. Money Saved
2. Key Features
3. Transition

Money Saved

Participants enlisted in the NDPT in order to save money: "*I joined, and became interested, because I wanted to save money. Nothing else mattered to me. I wanted to save money*," one said. Research indicated a complex picture that not only included actual savings, but prospective savings, the status of savings, and other factors.

As noted earlier, typical savings between the North and South differed substantially. Participants in the North who shifted usage by a great deal typically saved only a modest amount of money, while others saved almost no money at all. Participants in the South saved much larger sums[42].

In addition, losses were higher in the North than the South. At the end of Program Year 1, 754 of 1,734 participants (43%) in the North received a refund under their bill guarantee for losses incurred. The average refund in the North was $82.40. In the South, 339 of 3,082 participants (11%) received a refund under their bill guarantee for losses incurred. The average refund in the South was $62.79[43]. Some participants commented that the first-year bill guarantee had provided reassurance for them as they signed up for Choose When You Use. "*You can't lose,*" several said.

After Program Year 1, 379 participants (22%) in the North and 356 participants (12%) in the South opted-out of the NDPT, and not all of these participants lost money. The explanation for these decisions,

[42] Participants were unaware of the differences in rate structures between the North and the South and saw only their own household's monthly energy reports.

[43] A billing error ln Program Year 1 led some South participants to experience smaller losses (and thus smaller refunds, or no refunds at all) than they should have received. Analysis suggests that post-Program Year 1 opt-out rates in the South would have been resembled those in the North absent the error. However it is also important to note that not every participant who lost money in Program Year 1 opted out of the NDPT, and not every participant who saved money elected to remain.

as explained by many participants, involved prospective savings[44].

There were some participants who saved money, but chose to leave the NDPT after Program Year 1. Direct customer testimony also offered an explanation of why participants who had saved money left Choose When You Use. Some money-savers said they had been too uncomfortable, inconvenienced, or burdened by the mental effort the program required.

Another major element of the savings picture for participants was the status of "saver". Actual and prospective savings were important to NDPT participants, yet many participants said they were unaware of specifically how much they were actually saving, or what their true prospects were. Few participants spent much time with their energy reports, and fewer were attending to the numbers. Instead, most participants paid attention to their status: they were saving, or they were not.

One North focus group attendee said: "*I didn't save a ton of money,*" but "*I think it's important…to save. And you know, you save a little bit.*" A South attendee had a similar thought: *"every month I do see a little bit of savings, and I'm like, 'perfect, that's great.'*" Another North attendee said:

> *"I just looked at the sheets they sent us…I'm doing my best. I really didn't save a whole lot, but I didn't break it down…this month you saved whatever, I can't remember what the amounts were, but I remember every month it said I saved."*

Another North attendee confirmed: *"we always had a savings every month."* A North attendee who "*didn't have the time to really analyze it*" said "*I just like the idea of coming home and seeing a smiley face on the bill, 'I saved', I just move on, you know.*" A South attendee complimented NV Energy, saying: "*if you follow basic rules, you'll save money, just like any other program. And they're out for your benefit.*" Another South attendee agreed: *"I used to think I was really good at energy savings…and it turns out I was, but now I'm better.*"

As one North attendee put it:

> "*if you get the 'smiley face' you knew you're doing good. If you didn't, then you knew that you needed to go back and do something better. You can just quickly determine what you're doing.*"

The 'smiley face' was an indicator that a participant had saved something that month, but did not indicate how much a participant had saved. Most participants were satisfied with saving 'something' because the 'smiley face' told them they should be. Perhaps they had not saved enough to be enthusiastic, but they were doing something right, and they had the potential to do even better in the future.

The status of "saver" can help explain why many participants remained in Choose When You Use even after their efforts at energy ownership had yielded only a small financial result. A participant opting-out

[44] Because leaving the program required opting-out, it might be thought that just as money-losing participants hadn't been able to save, they hadn't been able to figure out how to opt out either. However, the Choose When You Use opt-out materials were specific and the opt-out process was simple. Customer testimony across opt-in and opt-out participants did not indicate difficulty with the process.

would lose the title of 'saver.'

Our findings indicate that many participants were satisfied with the energy ownership they achieved in terms of saving money. While actual savings were important, so were the prospects of saving in the future, and the status of being a saver.

Key Features

We also considered participants' satisfaction with some key features of the Choose When You Use program. We consider participant satisfaction with the:

1. Education materials
2. Programmable thermostat
3. Energy report

With regards to energy ownership, the education materials were directly focused on providing in-depth knowledge of how participants could manage electricity use at home. Control was offered through the design of the online game (PLW) by repeating questions, and developing participants' confidence. Self-investment was enabled through time spent engaging with questions about electricity use at home, and through the standard game mechanics (e.g., scoring, competing, winning, earning status and prizes).

Table 50: NDPT 2015 Survey Question – Education Materials Satisfaction[45]

NDPT 2015 Survey: Participant Satisfaction Level							
Question	**Satisfaction Level (%)**						
	Very Satisfied	**Satisfied**	**Neither Satisfied Nor Dissatisfied**	**Dissatisfied**	**Very Dissatisfied**	**Don't Know or Refused**	**Total**
"How satisfied were you with the energy education materials, such as the game, deck of cards, and puzzles?"	26	42	13	5	2	12	100

At the close of the program, participant satisfaction levels with the education treatment were high. In focus groups and interviews, participants who played the game were generally positive about the education treatment, and indicated that they found it challenging, fun, and valuable.

Despite these strong ratings, PLW game players did report issues. Some participants found the game uninteresting, while others were irritated by technical glitches that made gameplay unavailable. Technical glitches were particularly annoying because prizes were available for real-time play. Some participants were annoyed by the repetitive nature of the questions, and the intrusive nature of the

[45] All survey percentage totals are rounded to the nearest percent.

gameplay. Some participants said the response time for answers was too short, while others grew disinterested over time because many of the curriculum items did not apply to them.

Table 51: NDPT 2015 Survey Question – Programmable Thermostat Satisfaction[46]

NDPT 2015 Survey: Participant Satisfaction Level							
Question	**Satisfaction Level (%)**						
	Very Satisfied	**Satisfied**	**Neither Satisfied Nor Dissatisfied**	**Dissatisfied**	**Very Dissatisfied**	**Don't Know or Refused**	**Total**
"How satisfied was your household with the new programmable thermostat and website?"	55	35	2	4	1	2	100

The NDPT technology treatment was an established commercial offering in a category familiar to homeowners. Participant satisfaction levels with the technology treatment were very high. In focus groups and interviews, participants were generally positive about the technology treatment, especially the remote access feature. However, some participants found the optimization feature confusing. Many commented that the optimization feature hadn't been clearly explained, and they didn't understand that the programming would automatically nudge thermostat settings in an effort to save more money. Once informed of this activity, participants were divided about whether or not optimization was a good idea for them.

Another key feature of the NDPT was monthly energy reports. Few participants had received energy reports before, although all of them had received bills. The energy reports provided program information and feedback on the results of shifts in electricity use, in terms of amount of money saved, and status as a saver.

There were many participants who indicated that the energy reports worked well for them. "*I learned what I needed to learn from the mailings*," one participant said, referring to the energy reports. "*If I didn't have them before, I wouldn't have made changes*," another added. A focus group attendee commented: "*One thing I liked was every month they gave you a different energy-saving tip. I read them. I read them out loud to my family, and I tried to make everyone follow them*."

Research indicated that Choose When You Use participants were generally satisfied with the energy ownership they achieved through three of the program's key features. Participants appreciated the education materials, the thermostat and the energy reports, which enabled participants to achieve in-depth knowledge, control, and self-investment.

[46] All survey percentage totals are rounded to the nearest percent.

Transition

The third indicator of participants' satisfaction with energy ownership that we examined was their transition choices. Transition was a direct indicator of satisfaction with energy ownership, because transition to time-varying rates following the NDPT was an opt-in choice.

At the close of the program, participants surveyed expressed strong interest in time-varying rates.

Table 52: NDPT 2015 Survey Question – Time-Varying Electricity Rate

NDPT 2015 Survey: Control vs. Participants 'Yes' Response to Question	
"In our household, we'd like to be placed on a new energy rate that charges us less for energy during 'off-peak' times."	
Group	**True (%)**
Control	30
Participants	64

NDPT participants, having had exposure to a time-varying rate, were much more likely than control group subjects to express interest in a time-varying rate. Most participants had the experience of saving something, and achieving a level of energy ownership, as a result of a time-varying rate.

We may interpret intent to continue with a time-varying rate as one indication of satisfaction with the NDPT at the close of the program. At the close of Program Year 2, transition back to a flat rate was automatic, unless participants opted in to a time-varying rate. Participants in the North were offered a single time-varying rate as an option, and participants in the South were offered a choice of two. The following table shows the results of participants' choices.

Table 53: NDPT Participant Transition to New Rates by Type

NDPT Participant Transition to New Rates by Type			
Region	**Rate Type**	**Participants (#)**	**Participants (%)**
North	Flat	784	64
	Time-of-Use	435	36
	Other	1	--
	Total	1,220	100
South	Flat	1,277	53
	Time-of-Use A	902	38
	Time-of-Use B	215	9
	Other	4	--
	Total	2,398	100

At the close of the program, 78% of surveyed participants expressed a preference for a time-varying rate, and 43% actually opted-in to a time-varying rate when given the option. Participant testimony in

interviews and focus groups indicated that some participants did not understand the transition options presented to them. Some participants did not understand the deadlines for response, while others were certain they had responded when they had not. Because transition to a time-varying rate required actively opting-in, confused and procrastinating customers were moved to the flat rate.[47]

Transition to a time-varying rate can be taken as an indicator of energy ownership, and satisfaction with energy ownership, on the part of those participants.

One North attendee discussed the choice to remain on a time-varying rate:

> *"I had gotten used to the schedule, because I was religious about following it. I mean, I never once did any laundry or ran the dishwasher at the peak time, not a single time. And so I was used to it by that time, and I figured, there's no reason not to continue."*

Other North focus group attendees noted how easy it was to remain on a time-varying rate. One said he made "*a quick decision*" because he "*didn't use that much electricity anyway.*" Another attendee explained: *"after two years you're pretty much trained on when to use your power, so why not continue?"* A third agreed: *"it's pretty ingrained."* Retraining was a switching cost. Once invested, energy owners would require reasons to change.

In the South, 88% had remained in the program for the second year, and 46% of these converted to a time-varying rate afterwards.[48] These were higher numbers than in the North, and based on generally higher bills, higher potential for saving, and a more obvious focus on air conditioning behavior. Despite these differences, converts in the South expressed similar thinking to those in the North: habits were in place, savings were something, and savings might improve in the future.

Direct research with participants who backed away from time-varying rates (either by opting out, or converting back to the flat rate) indicated that these participants were generally satisfied with the program they had left. Interviewees recalled that they had volunteered for the program (it was their choice), and they had been promised an opportunity, which they had received. They recalled that they were provided a Bill Guarantee for the first year. They were then given an opportunity to leave, and they hadn't been forced to continue at the end of the program. These participants said they had given it the program "*a good try,*" and they were disappointed that the program hadn't delivered the savings they had hoped for. But almost without exception, these participants didn't blame the program or the utility for their circumstances. They simply said Choose When You Use hadn't worked out for them.

Energy ownership may have been a bounded, light and occasional attitude for many Choose When You Use participants, but in the pursuit of savings, 43% of them were satisfied enough to take up a new

[47] The initial NDPT recruiting materials were written in a direct marketing format, focused on the opportunity to save, and persuasively inviting enrollment. The NDPT reenlistment materials focused on the money-saving or money-losing results from Program Year 1, and were opt-out. The NDPT transition materials compared rate options in some detail, and were opt-in for time-varying rates.

[48] Furthermore, of the 308 NDPT technology-treatment participants in the North, 84 (27%) signed up with the mPowered program after the NDPT. In the South, 237 of 755 technology treatment participants (31%) moved to mPowered.

time-varying rate at the end of the program.

Conclusion

The attitude of energy ownership and satisfaction with energy ownership were displayed in certain behaviors and statements of NDPT participants. Our research indicates that many NDPT participants sought in-depth knowledge, sought control, and invested themselves in the program.

At the beginning of the program, participants sought knowledge by trying out new behaviors, and evaluated the program based on its prospects (the opportunity to save money). The in-depth knowledge participants required for Choose When You Use consisted of paying attention to how they were using electricity under time-varying electric rates, adopting heuristics for their behavior, and glancing at their monthly energy reports to see whether or not their heuristics were working.

As the program continued, participants worked to establish new habits that left them in control. NDPT participants strongly agreed that the program provided control, and left them responsible for how and when they used electricity. Changing habits in the face of constraints required effort, but participants found ways to endure any inconvenience, discomfort, and the mental effort they may have experienced. The control participants achieved was not complete, but the achievement was theirs. They established new habits of using electricity.

As they worked to achieve control, participants invested themselves in these new habits, and invested themselves in a new attitude. Savings were modest for many, but the status of 'saver' was confirmed. Participants found the program to be an interesting challenge, and energy ownership developed in the pursuit of saving money.

Our research also indicates that participants displayed satisfaction with their energy ownership. To understand participants' satisfaction with the energy ownership they achieved through the NDPT, we discussed savings, key program features, and transition decisions. While actual savings were important, so were the prospects of saving in the future, and the status of being a saver. Participants were generally satisfied with the program's key features, and employed them in their pursuit of savings.

Many participants were pleased to move forward with time-varying rates after Choose When You Use. At the end of the NDPT, 43% of participants opted to continue with a time-varying rate, which can be taken as an indicator of satisfaction with energy ownership.

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Definition of Terms

This table provides an alphabetical list of terms used within the company and throughout the report.

Table 54: Definition of Terms

Acronym	Description
AMI	Advanced Metering Infrastructure
ASD	Advanced Service Delivery
BDG	Boice Dunham Group
CBSP	Consumer Behavior Study Plan
CPP	Critical Peak Pricing
D-1	Single Family Residential Customer Class (NV Energy North)
DM-1	Multi-Family Residential Customer Class (NV Energy North)
DOE	Department of Energy
DPT	Dynamic Pricing Trial
DR	Demand Response
DRMS	Demand Response Management System
DSM	Demand Side Management
GLR	Guaranteed Lowest Rate
HVAC	Heating, Ventilation, and Air Conditioning
IHD	In Home Display
kW	Kilowatt
kWh	Kilowatt-hours
LBNL	Lawrence Berkeley National Laboratory
LMS	Load Management Systems
MDM or MDMS	Meter Data Management System
NDPT	Nevada Dynamic Pricing Trial
NPC	Nevada Power Company
NVE	NV Energy
PCT	Programmable Controllable Thermostat
PUCN	Public Utilities Commission of Nevada
RM	Multi-Family Residential Customer Class (NV Energy South)
RNI	Regional Network Interface (head end)
RS	Single Family Residential Customer Class (NV Energy South)
SGIG	Smart Grid Investment Grant
SPPC	Sierra Pacific Power Company
TOU	Time-of-Use