AG Cross Ex. 1

# ComEd Customer Applications Program – Objectives, Research Design, and Implementation Details

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# ABSTRACT


Commonwealth Edison Company (ComEd) has launched an ambitious and comprehensive pilot program designed to resolve many uncertainties about how advanced metering infrastructure (AMI) technology can be used to stimulate changes in when and how households use electricity. The study was launched in response to the Illinois Commerce Commission order in Docket 07-0566, which authorized ComEd to install up to 200,000 AMI meters and use that customer base to characterize how behavioral modification inducements that use AMI influence consumer electricity usage.

There is a growing body of evidence that dynamic rates and enabling technology cause consumers to change the level or pattern of electricity consumption, or both. This evidence is sourced from pilots and experiments that have been constructed piecemeal and generally involved only a single application, or at most two or three applications and a relatively small number of customers. No single application has been shown to be most effective, and no portfolio of applications has emerged to address diverse population of households. The ComEd Customer Applications Program (CAP) was designed to address aspects of this shortcoming through the implementation of a comprehensive and scientific pilot to the test alternative price structures and enabling technologies.

The rate applications in the ComEd pilot are structurally different from the flat rate plan that most residential customers are on today. Some of these rates involve a restructuring of fixed rates as is the case with the time-of-use and inclining block rates. Other rates involve a dynamic aspect whereby the rate that applies to hourly consumption varies routinely to reflect the rise and fall of supply prices. Enabling technology was deployed to deliver information to consumers via several in-home display devices. A web-based information system also provides the household access to information about how it uses electricity. Additional information is mailed to participating consumers regarding their energy consumption at regular intervals.

The ComEd CAP is an 8,500-customer field trial of dynamic rates, enabling technology, customer education, and customer experience, using an opt-out customer enrollment methodology. The experiment combines the focus on individual applications, to quantify the impacts attributable to each, with combined applications that will provide insight into the role of scope economics in affecting how and when consumers use electricity. The purpose of this report is to present the research method for the CAP to provide understanding of how the CAP was designed, constructed, implemented, and executed including the hypotheses the project was designed to test. The report includes references to literature that informed those hypotheses.

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# 1 INTRODUCTION

The relationship that utilities enjoy with their customers historically can be described as a marriage of convenience (Honebein, 2010). In such a relationship, customers enter into a long-term relationship with a single utility that is maintained due to exclusive availability rather than choice (Fournier, 1998). While retail customer choice of generation supplier has altered this relationship somewhat, that opportunity is limited to only a few states. With the advent of the smart grid, smart meters, dynamic rates, and technologies that motivate or automate energy behavior (hereinafter called "customer applications"); the relationship utilities have with their customers is poised to move toward partnership: a long-term voluntary relationship that has high trust and commitment..

Partnership is a desirable goal for a number of reasons. There are operational benefits associated with partnership, in terms of increasing customer self-service, and associated cost savings related to account creation, management, and termination. There are energy efficiency, demand response, and load shifting benefits associated with partnership, that are amplified by increasing customer involvement in those areas and manifest by lower long-run supply costs. There are personal benefits associated with partnership, in terms of enhancing customer lifestyles associated with conservation, frugality, convenience, and technocentricity.[1]

Achieving these benefits requires that socio-technical systems are in balance. In a socio-technical system[2] there is an interaction of people and technology that, if designed correctly, leads to the emergence of greater performance (Trist and Murray, 1997). For smart grid customer applications, the social (people) side is represented by both customers and those who directly support customers, such as call center staff and field technicians. The technical side is represented by not only the physical technology, such as smart meters, communication networks, in-home displays, and programmable communicating thermostats, but also the know-how associated with dynamic rates and the methods for energy efficiency, demand response, and load shifting. Keeping the social side and the technical side in balance requires that both sides are systematically organized and jointly optimized. Doing so increases adoption and involvement, and avoids the paradoxical situation of new technology causing decreases in performance. It also ensures the optimal use of societal resources.

A method for organizing and optimizing the social and technical components of smart grid customer applications is customer experience design (Honebein & Cammarano, 2008). A customer experience is the interaction between a customer and a touchpoint representing the people and technology that engages the customer in a personal, memorable way (Pine &

[1] Technocentricity is a lifestyle associated with acquiring and using innovative, technology-oriented devices for both the utility of those devices as well as their emotional appeal.
[2] Socio is the social or people aspects of a system. Technical includes not only the computer and software systems, but also the state-of-the-art in terms of know-how (such as how to calculate dynamic rates) and tools.

Gilmore, 1999). For example, a customer's interaction with an in-home display (a touchpoint) to achieve an energy efficiency goal is a customer experience. A customer's interaction with a customer care specialist who can access information and explain the difference between an old rate and a new rate is also a customer experience. Other common touchpoints include the bill, educational materials, the website, a field service visit, and so on. Through customer experience design, touchpoints are designed and sequenced to address the rational and emotional aspects of the entire experience, leading to not only productivity, but to memorability (Honebein & Cammarano, 2009).

To drive customer adoption, involvement, and performance related to modifying the shape and magnitude of load, smart grid customer applications should embrace customer experience design principles. It is within this context that the ComEd Customer Applications Program (CAP) was conceived. CAP is an 8,500-customer randomized controlled field trial of dynamic rates, enabling technology, customer education, and customer experience, the first in the U.S. that used an opt-out methodology. Opt-out refers to enrolling all customers in a program upon its inception and removing them only if they specifically request. This represents a sharp departure from the utility practice of undertaking marketing and promotional activities to recruit customers to new service offerings.

## Purpose of This Report

The purpose of this report is to present the research method for the CAP. This method report describes how the CAP was designed, constructed, implemented, and executed. It is organized in three sections.

- Section 1 provides background information regarding the regulatory and stakeholder process that launched the CAP, the overall experimental design, and descriptions of the independent variables ComEd included in the experiment. It also discusses the hypotheses that the CAP tested, including the literature that informed those hypotheses.
- Section 2 presents an extensive research method, similar to what one would find in a peer-reviewed research journal. This method is very technical in nature, describing in precise detail what was done and how it was done. The casual reader may find this section tedious, but those who are designing subsequent studies should find the detail helpful for their projects. This section describes how the project was managed, how materials were developed, enabling technology that was used, how customer support and field services were provided, and how subjects were selected. It continues with a complete description of the four-phase procedure for how the CAP was executed, and the data collected.
- Section 3 offers some concluding remarks regarding the key points in the report and some lessons learned.

Readers will also find a complete set of references and an appendix that contains detailed experimental treatment matrices, examples of the communication and education materials, and examples of statements of work and requirements for the vendors who supported the CAP.

## Background[3]

The Illinois Commerce Commission, in its final order in Docket No. 07-0566, authorized ComEd to deploy a "pilot program" of up to 200,000 advanced electricity meters and associated advanced metering infrastructure (AMI). The Commission also directed ComEd to participate in a stakeholder workshop process intended to, "develop project goals, timelines, evaluation criteria, and Phase 0 technology selection criteria." (Order at 139). The Order neither specifically required, nor excluded, an examination of customer response enabled by the AMI deployment.

Early in the workshop process it became clear that parties to the stakeholder process did not believe that a complete assessment of the benefits and costs of an ultimate AMI deployment could be considered without examining potential changes in residential customer behavior that could result from pricing and technology options tied to the AMI system.[4] A key feature of an AMI deployment is that it provides much more granular energy use data which, when combined with pricing and technology options taking advantage of these data, may trigger changes in the level and shape of customer loads.

Two formal stakeholder workshops were held to explore residential customer-side issues. A number of separate brainstorming sessions were held with representatives of parties particularly interested in this issue in an effort to discuss various possible behind-the-meter elements of the initial AMI deployment. This collaboration produced the basic design for one of the most comprehensive customer behavioral assessments conducted for any utility in the country in terms of:

- The number of subjects in a randomized controlled field trial (RCFT)
- The number of rates simultaneously tested
- The number of enabling technologies simultaneously tested
- Assessing the effects of free versus purchased enabling technology
- Assessing the effects of bill protection
- Assessing the effects of customer education
- Assessing the effects of different enabling technology installation methods
- Assessing how the customer experience impacts customer adoption and performance related to customer applications

Based upon this stakeholder approach to design, an overall CAP objective emerged: "To test the impact of a wide spectrum of dynamic pricing options in conjunction with a wide range of

[3] Portions of this background section originally appeared in ComEd's June 1, 2009 AMI Attachment 4 regulatory filing, which was the first document describing the CAP methodology. Given the foundational nature of this content in establishing the direction for the CAP, it is repeated verbatim in this report.
[4] Feedback received during the AMI Workshop process demonstrated this interest. *See* ComEd AMI Workshop: 90-Day Report No. 1, Prepared for the Illinois Commerce Commission by R.W. Beck and Plexus Research, March 9, 2009.

enabling technologies on system peak demand, energy consumption and reliability."[5] Aligned with this objective were a set of research questions that the CAP sought to answer:

- What is the customer response to a variety of rate designs intended to modify the shape and magnitude of customer load?
- What is the impact of several on-premises devices on the shape and magnitude of customer load? These devices include those that provide real-time information on customer energy use and cost as well those designed to enable control of customer loads by the utility and customer.
- What is the level of customer receptivity to and patterns of use of these on-premises devices?
- What is the likely uptake of the rate applications and technologies that could be expected under a broader deployment?
- What combination(s) of pricing and technology options, as well as the methods of customer communication, create the most compelling customer-side offering(s) for an AMI deployment?
- What is the magnitude and value of changes in the shape and magnitude of customer loads as an input into the benefit-cost analysis of the AMI deployment?

## The ComEd Customer Applications Program (CAP) Design Overview

Using the objectives and research questions determined through the stakeholder process, the CAP design was developed with an overall framework organized around three focus areas:

- Energy efficiency and conservation – Customers permanently save energy through the installation of energy efficient equipment, or permanently alter their consumption behavior. Example: Replacing incandescent lights with compact fluorescent lamps (CFL), or setting thermostats higher throughout the summer.
- Demand response – Customers save energy during critical times by volunteering to temporarily reduce load when called upon. Example: Temporarily raise a thermostat to 78° or higher during peak hours of a summer day.
- Load shifting – Customers shift energy usage to different times of the day to take advantage of lower energy rates. Example: Doing laundry at 8:00 PM rather than 2:00 PM.

These three focus areas succinctly describe the desirable, measurable outcomes that could ultimately benefit society, regulators, utilities, and customers. However, achieving each of these outcomes must start with a change in customer performance. Customers must choose to install CFLs, raise their thermostat, and do laundry at different times. These kinds of behaviors are consistent with the service-dominant logic of marketing in which customers are co-creators of value (Vargo & Lusch, 2004, 2008). In other words, if customers do not perform, then the benefits associated with energy efficiency, demand response, and load shifting will not be realized.

[5] 2009 ComEd CAP Regulatory Filing, Attachment 4, p. 41.

The customer experience model selected that operationalizes the customer's role as a co-creator of value is the Coproduction Experience Model (CEM) (Honebein & Cammarano, 2005). As shown in Figure 1-1, a customer experience must orchestrate four primary variables to enhance customer performance: Vision, Access, Incentive, and Expertise. Vision describes the goals, expectations, and feedback integrated into an experience. Access reflects the environment of the experience and the tools, such as an in-home display, provided to customers. Incentive is the motivator that drives the customer to perform in a certain way, whether that incentive is a reward or punishment. Expertise is the knowledge and skill customers acquire through specific customer education programs such as an instruction manual.


**Figure 1-1**
**The Coproduction Experience Model (CEM)**

It is from this model, the stakeholder workshop process, and previous dynamic pricing and enabling technology experiments conducted by other utilities (Faruqui & Sergici, 2009; Faruqui, Sergici, and Sharif, 2009, EPRI 2008) that the independent variables for the CAP were derived (Table 1-1). The independent variables were then organized into an experimental matrix that illustrates the controls, the applications, and resulting comparisons (Figure 1-2).

**Table 1-1**
**Summary of CAP Independent Variables**

| Variable | CEM Linkage | Usage in AMI Assessment | Description |
|---|---|---|---|
| Meter Type | Access | Primary Variable | CAP included both existing load research interval meters and smart meters. |
| Rate Type | Incentive | Primary Variable | Electricity rates that provide incentives or disincentives for certain customer behaviors. |
| Enabling Technology Type | Vision, Access | Primary Variable | Website, in-home displays, and programmable communicating thermostats that provide customers information and feedback, or automatically control high-use appliances (i.e. central air conditioning). |
| Enabling Technology Acquisition | Access, Incentive | Secondary Variable | Policies providing customers enabling technology for free, or asking customers to purchase enabling technology. |

| | | | |
|---|---|---|---|
| Bill Protection | Access, Expertise | Secondary Variable | Policy that reduces customer risk associated with high bill consequences, allowing customers to experiment, explore, and learn from their own trial and error experienccs. |
| Customer Education | Expertise, Vision | Secondary Variable | Content, media, methods, and process for enhancing knowledge, skills and attitudes related to rates and enabling technology, as well as goals and tactics associated with energy efficiency, demand response, and load shifting. |
| Customer Experience | Access | Secondary Variable | Processes and procedures for installing smart meters, signing up customers for online access to data, notifying customers of demand response days, and so on. |

| | | Enabling Technology Type | | | | | |
|---|---|---|---|---|---|---|---|
| | | None | Removed | Enhanced Web (eWeb) | eWeb+ Basic IHD (BIHD) | eWeb+ Advanced IHD (AIHD) | eWeb+PCT /IHD (AIHD/PCT) |
| Flat Rate Type N = 1,650 | Flat Rate Existing Meter No Education | Control F1 N=450 | | | | | |
| | Flat Rate Existing Meter Education | | | Application F2 N=225 | | | |
| | Flat Rate AMI Meter Basic AMI Education | | | Control F3 N=225 | | | |
| | Flat Rate AMI Meter Education | | Application F4 N=0 | Application F5 N=225 | Application F6 N=300 | Application F7 N=225 | |
| Energy Efficiency Rate Type N = 750 | IBR Rate AMI Meter Education | | | Application E1 N=225 | Application E2 N=300 | Application E3 N=225 | |
| Demand Response Rate Type N = 3,525 | CPP/DA-RTP Rate AMI Meter Education | | | Application D1 N(a)=525 N(b)=225 | Application D2 N=525 | Application D3 N=525 | Application D4 N=525 |
| | PTR/DA-RTP Rate AMI Meter Education | | | Application D5 N=225 | Application D6 N=525 | Application D7 N=225 | Application D8 N=225 |
| Load Shifting Rate Type N = 2,625 | DA-RTP Rate AMI Meter Education | | | Application L1 N(a)=225 N(b)=225 | Application L2 N=525 | Application L3 N=225 | |
| | TOU Rate AMI Meter Education | | | Application L4 N=225 | Application L5 N(a)=525 N(b)=225 | Application L6 N(a)=225 N(b)=225 | |
| N = 8,550 | | N = 450 | N = 0 | N = 2,550 | N = 2,925 | N = 1,875 | N = 750 |

Primary Application | Not Used

**Figure 1-2**
**Experimental Design Matrix Incorporating the Three Primary Variables**

As shown in Figure 1-2, the experimental design reflects a randomized controlled field trial (RCFT) that varies rate type, enabling technology type, customer education (F2), bill protection (D1B, L1B), and enabling technology acquisition (L5B, L6B). Overall there are 25 application groups and two control groups. Note that cells D1, L1, L5, and L6 are bifurcated to test bill protection (D1b, L1b) and enabling technology purchase (L5b, L6b). These cells are included in the count.

One control group (F1) represents customers with a load research interval meter (not an AMI meter), a flat rate, and no information or education regarding energy efficiency, demand response, or load shifting beyond ambient communication.[6] These are the condition of service today for residential ComEd customers. The other control group (F3) represents customers with an AMI meter, who remain on the existing flat rate and receive only basic information regarding the meter installation, and who can view usage data online.

[6] Ambient communication is newspaper, radio, television, direct mail, web, and so on from ComEd or the marketplace.

The "N" shown in each cell represents the number of participants to be enrolled in each cell. This number is based upon guidelines suggested by Faruqui, Hledik & Sergici (2009) to provide sufficient statistical power while accommodating natural or opt-out attrition. To mitigate the risk of excessive attrition, the F1 control group, the BIHD cells, and the CPP cells were oversampled (identified in Figure 1-2 in bold).[7] The BIHD cells were selected because of the low barriers associated with adopting the BIHD. The CPP cells were selected because studies suggest that CPP results in greater usage reduction impacts (Faruqui & Sergici, 2009) and it was desired to have sufficient statistical power to replicate those studies. A more in-depth description of sample size and random assignment is presented in the Method section.

Green cells in Figure 1-2 indicate control (F1, F3) and application (all other) groups. Due to a change in the enabling technology type variable in which a basic website was removed, F4 remained in the matrix to comply with the tariff, but it was not assigned any subjects. Red cells indicate interactions that will not be tested for sake of efficiency, cost, and subject availability. They are excluded for one or more of the following reasons:

- The interaction is impractical (e.g., an existing meter does not enable web access).
- The interaction is inconsistent in terms of energy efficiency, demand response, and load shifting outcomes (e.g., flat rate and PCT).
- The interaction results have been examined in previous research (Faruqui, Sergici, & Sharif, 2009).
- The interaction could not be controlled sufficiently to mitigate a threat to validity.[8]

The following sub-sections describe the applications and associated hypotheses in the CAP. The applications include meter type, rate type, enabling technology type, enabling technology acquisition, customer education, and customer experience. In the interest of brevity, all hypotheses assume that secondary analysis will examine whether or not there are differences due to customer demographics and psychographics.

## Meter Type

Two types of meters were used in the CAP. One type of meter was an existing interval data meter currently used by ComEd for load analysis. The other type of meter was an AMI meter. The experiment does not directly control for the effects of meter type since it was decided that all customers receiving an AMI meter should also receive access to web usage data. The hypothesis related to this variable is as follows:

*H1: Meter type has no effect on electricity usage behaviors.*[9]

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[7] The acronyms used here to refer to independent variables are defined later in this section.

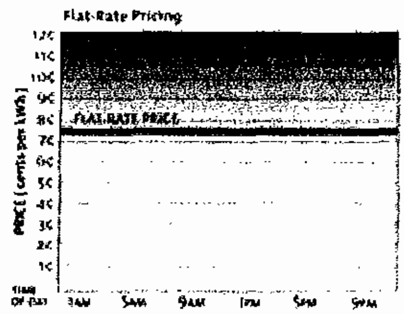
[8] We did not include a flat rate, AMI meter, no education, no enabling technology cell. This was done to accommodate the desire to release public information to the entire AMI footprint regarding the availability of online energy usage information.

[9] Per the previous footnote, we do not have a cell that isolates the meter variable. Our expectation is that there should be no significant difference between cells F1 and F3. However, cell F3 offers customers access to energy

## Rate Type

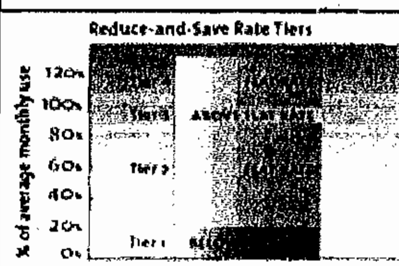
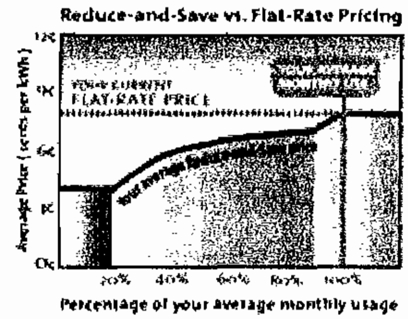
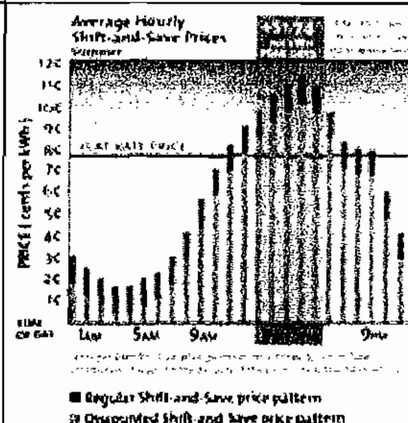
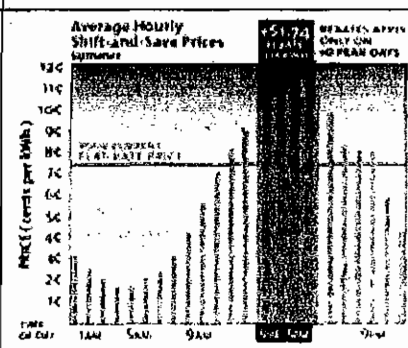
Six different types of rates were tested in the CAP. These rates, other than the flat rate (which ComEd already uses), reflect current widely-accepted structures for rate design and have been deployed across the U.S. (Faruqui, 2008; Faruqui & Sergici, 2009; Faruqui, Hledik, & Sergici, 2010; McCaffree, 2009). For example, critical peak pricing (CPP) is available on an opt-in basis for residential customers in Florida and California. Peak-time rebate (PTR) has been tested by the City of Anaheim and Baltimore Gas & Electric. Time-of-Use (TOU) pricing has been adopted in Arizona and is being pilot tested in Connecticut. Day-ahead real-time pricing (DA-RTP) is available to residential customers in Illinois. The increasing block rate (IBR) is used extensively in California. Table 1-2 describes each of the rate type variables used in the CAP.[10]

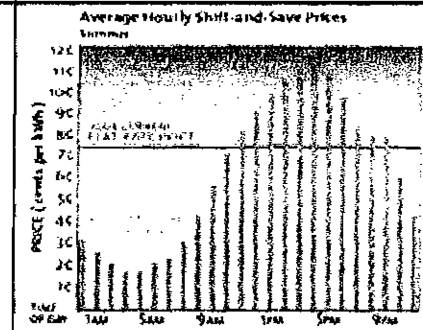
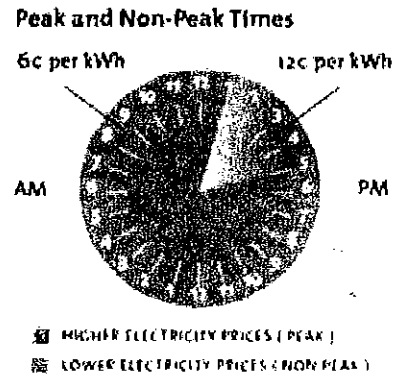
**Table 1-2**
**Rate Types Used In the CAP**

| Rate Type[11] | Focus Area | Description | Example |
|---|---|---|---|
| Flat Rate | None | One single rate. Flat rate cost per kWh ranges from 4.731¢ (non-summer, electric space heating) to 7.837¢ (summer, non space heating). |   |

information on the web. By removing F3 customers who created a web account from the analysis, we can test this hypothesis.

[10] Specific tariff details on these rate types may be found in experimental Rider AMP-CA.

| Rate Type[11] | Focus Area | Description | Example |
|---|---|---|---|
| IBR | Energy Efficiency | The increasing block rate (IBR) was designed so that customer costs would never exceed what the customer would have paid on the flat rate for the same level of electricity usage. There were four tiers, for which the nominal kWh levels were defined for each customer based on its five-year usage history.<br><br>Tier 1 – First 20% of usage, rate is 50% of the flat rate.<br><br>Tier 2 – Next 70% of usage, rate is the flat rate.<br><br>Tier 3 – Final 10% of usage, rate is 200% of the flat rate.<br><br>Tier 4 – Usage above 100%, rate is the flat rate. | <br> |
| CPP | Demand Response | The critical peak pricing (CPP) used was an hourly, day-ahead real-time price that includes a $1.74 capacity charge to encourage less electricity usage during peak hours. It is applied to the peak hours (1-5 p.m., no more than 10 summer days). Additionally, this rate offered a real-time price discount of 0.6¢ per kWh (Space Heat) and 1.3¢ per kWh (Non Space Heat). |  |
| PTR | Demand Response | The peak-time rebate (PTR) structure used was an hourly day-ahead real-time price that included a $1.74 rebate to encourage less electricity usage during peak hours. It is applied to the peak hours (1-5 p.m., no more than 10 summer days). To calculate the rebate, a customer's usage during the peak hours is compared to a reference level (which was derived from the customer's usage over the past five days). Customers earn a rebate for each kWh saved. |  |

| Rate Type[11] | Focus Area | Description | Example |
|---|---|---|---|
| DA-RTP | Load Shifting | The day-ahead real-time pricing (DA-RTP) structure used changes the price of electricity hourly over the course of a day. The day-ahead hourly prices come from PJM-administered markets |  |
| TOU | Load Shifting | The time-of-use (TOU) rate used has two price periods: a lower-commodity-price non-peak period, and a higher-commodity-price peak period. |   |

For flat rate, IBR, and TOU, electricity supply charge elements are distinguished by season (summer and non-summer), customer dwelling (single-family and multi-family), and customer class (space heat and non-space-heat)[11]. Other recovery elements are constant.

Of all the rates, the IBR that was designed has the lowest barriers for adoption due to reduced risk (as compared to the flat rate) and its ability to provide a lower average cost per kWh than the flat rate. Additionally, Faruqui (2008) has demonstrated that IBR has a strong effect on energy efficiency; however, since the IBR rate designed is much different than those used in California due to its "no risk" feature, it is not clear whether it will have the same level of impact as was reported for California.[12]

Faruqui, Hledik, and Sergici (2010) have shown that CPP rates have the greatest effect on reducing peak load when compared to PTR, DA-RTP, and TOU rates. It is expected that CPP would have a similar effect on load shape.

The following are the hypotheses associated with the rate type variable:

*H2a: The IBR rate is most easily adopted by customers.*

[11] Customer dwelling and class data are collected and maintained by ComEd.
[12] In typical IBR rate design, such as in California, the Tier 4 price would be higher than the Tier 3 price. However, to accommodate the concerns of consumer advocates regarding the potential punitive nature of a typical IBR rate, a no-risk IBR rate was designed.

*H2b: The IBR rate causes the greatest reduction in overall electricity usage during the year.*

*H2c: The CPP rate causes the greatest reduction in peak load during the summer.*

*H2d: The CPP rate causes flatter load shapes at all times during the year.*

*H2e: The CPP rate delivers the best combination of energy efficiency, demand response, and load shifting benefits.*

*H2f: Customers on the IBR rate will experience greater satisfaction than customers on the other rates.*

## Enabling Technology

Enabling technology is defined as services or devices that provide customers information about their electricity use or automate electricity use reduction based upon price or other signals. The intention of enabling technology is to motivate or automate actions associated with energy efficiency, demand response, and load shifting. Studies show that enabling technology has a positive effect on these outcomes (Darby, 2006; Faruqui, Hledik, and Sergici, 2010; Neenan, Robinson, and Boisvert, 2009).

The enabling technology selected reflects both *indirect* and *direct* feedback categories (Darby, 2006; Neenan, Robinson, and Boisvert, 2009). For indirect (daily) feedback, an enhanced website that provided day-after usage data in 30-minute increments was used (eWeb). For direct (real-time) feedback, a basic in-home display (BIHD) and an advanced in-home display (AIHD) were used. For direct (real-time plus) feedback, a combined advanced in-home display/programmable communicating thermostat (AIHD/PCT) was used. Descriptions of the specific products selected for each of these categories may be found in the Method section. These enabling technologies were selected to better understand the effects of these factors:

- Deployment cost. The cost to deploy the enabling technology (least expensive: eWeb; most expensive: AIHD/PCT).
- Installation. The effort required to install and activate the enabling technology (self-install: eWeb, BIHD; professional install: AIHD, AIHD/PCT).
- Information precision. The time period in which usage and price information is provided (real-time: BIHD, AIHD; day-after: eWeb).
- Features. The amount or sophistication of features related to managing electricity usage (basic: BIHD; advanced: eWeb, AIHD).
- Automation. The ability to automatically control a thermostat based upon price signals (none: eWeb, BIHD, AIHD; thermostat control: AIHD/PCT).
- Multi-function. Functionality that goes beyond just electricity usage, such as news, weather, music, and video (none: eWeb, BIHD; some: AIHD).

The research interests in enabling technology involve both the adoption of the technology and the technology's impact on energy usage behaviors. Antil (1988) defines adoption as when customers use a product repeatedly, or for non-durable goods, purchase a product repeatedly. This definition compliments Rogers' (1983) five-step adoption process: knowledge, persuasion, decision, implementation, and confirmation. Implementation and adoption are important measures for the CAP. Based on the usages described by Antil and Rogers, implementation is defined as 1) the activation of the device (for BIHD and AIHD), or 2) the creation of an account (in the case of eWeb). Adoption is defined as the continued use of the enabling technology over a given time period, measured through customer self-reports, "heartbeat" data from the in-home devices, and web visits.

The expectation is that enabling technology implementation will initially be low, but then continue to rise over time, as predicted by Rogers (1983). This effect is illustrated in Hydro One's 30,000-unit, self-installed in-home display (IHD) deployment, where 120,000 customers were offered an IHD in exchange for $10 shipping and handling (Rossini, 2009). Within the first four months, 12.85% of the target audience ordered the device, and after nine months, 25% of the target audience ordered. Of those orders, 89% implemented the device, resulting in a total implementation of 22.25%. However, after two years, only 29% of those customers reported still using the IHD.

Additional insights regarding adoption decay come from two studies. One in Oregon involved the same device priced at $29.99 (66% of customers still used the device after six months) (Scott, 2008). The other in Massachusetts involved the same device priced from free to $49.99 (67% still used the device after one year) (MacLellan, 2008).

The California Statewide Pricing Pilot (SPP) showed enabling technology implementation results similar to Hydro One. The SPP offered professionally-installed automated load control devices to CPP-rate customers for free (Charles River Associates, 2005). The opt-in rate for the pilot was 20%, and of that 20%, the implementation rate of enabling technology was 65%, yielding an overall implementation rate of 13%. Adoption data was not included in the report. While Hydro One and the SPP suggest an implementation rate of around 13%, reported implementation rates were much lower in the Connecticut Light & Power Plan-It Wise pilot, which provided customers real-time energy monitors or smart thermostats/switches. The opt-in rate for the pilot was 3.1%, and the opt-in rate for enabling technology was 87%, yielding an overall implementation rate 2.7%. Adoption data was not included in the report.

While the data from the studies above gives some insight regarding the implementation and adoption of enabling technology, there is little guidance as to what one might expect regarding implementation and adoption rates of solutions providing indirect and direct feedback. However, if one looks at the solutions selected for the CAP through the lenses of transaction cost (Coase, 1988) and complexity (Rogers, 1983), their implementation and adoption rates can be roughly predicted. Thus, the hypotheses associated with implementation and adoption are as follows:

*H3a: The BIHD will have a higher implementation rate than other enabling technology.*

*H3b: The BIHD will have a higher adoption rate than other enabling technology.*

As discussed at the beginning of this section, it is generally accepted that enabling technologies have a positive impact on a customer's energy usage behaviors. According to Neenan, Robinson, and Boisvert (2009), the conservation effect of daily/weekly feedback is 8%, real-time feedback is 7%, and real-time feedback plus is 12%. However, Neenan et al. do not report any results related to conservation effect when customers are offered multiple types of enabling technology, which is what the CAP offered customers. This research informed the following hypotheses:

***H3c:*** *A combination of direct and indirect feedback solutions will achieve greater energy efficiency, demand response, and load shifting benefits than indirect feedback solutions alone.*

***H3d:*** *The AIHD/PCT solution will achieve greater energy efficiency, demand response, and load shifting benefits than other enabling technology.*

***H3e:*** *The AIHD/PCT solution in combination with the CPP rate will achieve greater energy efficiency, demand response, and load shifting benefits than other enabling technology and pricing plan combinations.*

***H3f:*** *Customers who received and activated a BIHD will experience greater satisfaction than customers who have received and activated other enabling technology.*

## Enabling Technology Acquisition

A key question regarding enabling technology is whether or not customers will pay for the technology. Several studies have investigated this question, but never in the context of a controlled field experiment. To investigate this question further, the CAP tested two acquisition scenarios involving two enabling technologies, the BIHD and AIHD. For the BIHD, a majority of customers were provided the device for free, and a smaller group of customers were provided the device for purchase ($42). For the AIHD, the method was similar, except that the price was $84. Prices for both devices were significantly subsidized as compared to the actual retail cost of the devices. In this context, acquisition is defined as a customer accepting a device at specified prices, not the acquisition cost.

The Hydro One study described previously suggests that some customers will pay if the price is right. Hydro One provided customers an in-home display valued at $150 for just $10 (the price for shipping and handling) and implemented 30,000 devices over a nine month period. Additionally, it reports a conservation effect of 7.6% to 8.6% for customers with less than 15,000 kWh annually. Scott (2008, 2009) compared two methods of acquisition involving price. Group 1 was offered professional installation of an IHD at no cost following a home audit. Group 2 was offered to purchase a self-installed IHD online for $29.95 (a subsidized price). When surveyed a week after, the willingness to pay for both groups was low (65%/60% would pay $0-$40; 29%/37% would pay $41-$80). The conservation effect found in this study was not significantly different from zero.

NSTAR's study of IHD pricing involved four price points: free, $9.99, $29.99, and $49.99 (MacLellan, 2008). When customers were offered a free IHD during an energy audit, 94.3% acquired the IHD. When previous energy audit customers were offered a free IHD through a direct mail offer, 13.7% acquired. For the purchase scenarios, the response to a direct mail/media offer for the IHD was 5.7% ($9.99), 4.8% ($29.99), and 0.3% ($49.99). While the study does report an average annual bill savings of 2.9% ($63.51), the report does not break down savings by each price point.

In all of the studies above, the enabling technology was not offered in conjunction with a change to the customers' electricity pricing plan.

The last point to consider with enabling technology acquisition is the level of customer involvement as a function of the cost of a product. Involvement is a measure of one's interest or drive with a product (Mitchell, 1979). Given this definition, Antil (1984) suggests that a high cost product would result in greater involvement than a lower cost product. Thus, if a customer purchases a product, there is a higher level of commitment to use that product to create value. Hence, the following hypotheses:

***H4a**: The acquisition rate of free enabling technology will exceed purchased enabling technology.*

***H4b**: The implementation rate of purchased enabling technology will exceed free enabling technology.*

***H4c**: The adoption rate of purchased enabling technology will exceed free enabling technology.*

***H4d**: Purchased enabling technology will achieve greater energy efficiency, demand response, and load shifting benefits than free enabling technology.*

### Bill Protection

Bill protection, also known as a rate guarantee, assures customers that they will not pay more on a new rate than on an old rate (Faruqui, Sergici, & Wood, 2009). In the CAP, bill protection is defined as an offer to customers to credit them the difference between what they would have paid for consumption on an old pricing plan versus what they paid on a new pricing plan if the new pricing plan resulted in higher bills after one year. The CAP program provided bill protection to customers assigned to two cells (D1b and L1b).

There is debate about the efficacy of bill protection in making new electricity rates easier for customers to adopt, especially in pilot studies. Faruqui (2010) suggests that bill protection impacts study validity, while DOE (2010) and Faruqui, Sergici, and Wood (2009) suggest bill protection is a means of limiting attrition and increasing adoption, respectively. In non-pilot implementations of new rates, bill protection has been used to facilitate implementation and adoption of new rate programs (PG&E, 2009; NV Energy, 2009).

According to Rogers (1983), *trialability* is an important characteristic of innovations. Removing risk, specifically financial risk in the case of bill protection, can increase one's willingness to try new innovations. It also may encourage one to experiment more with the innovation, fostering increased learning. However, the presence of bill protection may result in reduced customer performance related to energy efficiency, demand response, and load shifting due to the lack of a strong incentive. The hypotheses associated with bill protection are:

***H5a**: The adoption rate of a new pricing plan will be greater when bill protection is offered than when it is not offered.*

***H5b**: Customers without bill protection will achieve greater energy efficiency, demand response, and load shifting benefits than customers with bill protection.*

***H5c**: Customers with bill protection will experience greater satisfaction than customers without bill protection.*

## Customer Education

Customer education is a critical part of any new innovation. As defined by Honebein & Cammarano (2005), customer education is when a company invests in the improvement of customer expertise related to the goods and services offered by that company. Through customer education, a company builds a customer's content knowledge and process knowledge so that the customer can perform better with goods and services, leading to increased value (Mittal & Sawhney, 2001).

According to Honebein (1997), customer education is a process, not an event. Hence, it should be delivered throughout the lifecycle of a good or service, focusing on the learning objectives that are most relevant to the customer's place in that lifecycle. Customer education should also embrace a variety of instructional strategies, such as expository strategies (in which content and process knowledge is provided to customers through text, pictures, or video) and discovery strategies (in which content and process knowledge is derived from direct experience, and supported through coaching). Lastly, customer education should be developed systematically, using an instructional design model such as the analysis, design, development, implementation, and evaluation model (ADDIE). The customer education hypotheses are:

***H6a**: Customers receiving customer education will achieve greater energy efficiency, demand response, and load shifting benefits than customers who do not receive customer education.*

***H6b**: Customers who receive customer education along with an AMI-enabled flat rate and enabling technology will achieve greater energy efficiency, demand response, and load shifting benefits than customers who are not offered customer education and enabling technology.*

***H6c**: Customers who receive customer education along with an AMI-enabled non-flat rate and enabling technology will achieve greater energy efficiency, demand response, and load shifting benefits than customers who receive customer education, a flat rate, and enabling technology.*

***H6d**: Customers who receive customer education will experience greater satisfaction than customers without customer education.*

## Customer Experience

As stated at the beginning of this section, a customer experience is the interaction between a customer and a touchpoint representing the people and technology that engage the customer in a personal, memorable way (Pine & Gilmore, 1999). For the CAP, there were numerous touchpoints, from rate notification to the customer bill, and all those touchpoints needed to be orchestrated so that the customer experience was revealed to customers in a way that supported awareness, implementation, adoption, and ultimately energy efficiency, demand response, and load shifting benefits.

For smart grid customer application experiences, the five first principles outlined by Honebein, Cammarano, and Donnelly (2009) provide guidance for both design and research. These principles include 1) embracing customer-centered design; 2) blending rational and emotional experiences; 3) engaging customers in small, observable steps of adoption; 4) segmenting by observable customer actions; and 5) using action research to drive emergence and evolution of solutions. While the CAP embraces all of these principles, the principle which can be directly investigated is #3 – engaging customers in small, observable steps. This principle is derived from Freedman & Fraser's (1966) experiments related to the posting of public service signs in one's home. What they found was that customers who agreed to place small signs in their windows were more likely to place larger signs in the yards at a later date. In the CAP, there are a number of small steps that precede energy efficiency, demand response, and load shifting behaviors. These include completing a survey, requesting customer education, signing up for pricing notifications, and activating enabling technology. Hence, the hypothesis:

*H7a: Customers who engage in small, observable steps will achieve greater energy efficiency, demand response, and load shifting benefits than customers who do not engage in those steps.*

Another element of the CAP customer experience is customer enrollment. There are three strategies for enrolling customers in customer applications field trials: opt-in, opt-out, and mandatory (DOE, 2010). An opt-in strategy involves recruiting customers through marketing activities, typically involving a significant monetary incentive of up to $150 (BGE, 2009). Response rates to such marketing activity vary widely, from 3.1% (CL&P, 2010) to 20% (Charles River Associates, 2005). While opt-in customers are randomly assigned to treatments, the opt-in approach increases the threat of self-selection bias. An opt-out strategy, which seeks to simulate a default pricing plan, involves randomly assigning customers to a treatment and automatically enrolling them to receive the services associated with the pricing plan. After enrollment, customers can choose to opt-out to an alternative pricing plan. While this approach reduces the possibility of self-selection bias found in opt-in studies (which limits external validity), it increases the threat of customer complaints. A mandatory strategy is similar to the opt-out, except that customers can not opt-out. This increases the threat of customer complaints and potential human subject protection issues.[13]

[13] Human subject protection is the process of ensuring that the financial, physical, and psychological risks to research subjects do not outweigh the benefits offered by the research. Mandatory enrollment increases these risks due to the non-voluntary nature of the subjects' participation (Shadish, Cook, & Campbell, 2002).

The opt-in strategy has been the enrollment strategy of choice for dynamic pricing and enabling technology studies reviewed by Faruqui & Sergici (2009) and Faruqui, Sergici, and Sharif (2009). Based upon this assessment, it was determined that the CAP could provide a significant contribution to the field, in terms of addressing the self-selection bias criticisms of previous studies and replicating the results found in these studies, by using an opt-out strategy for customer enrollment. This yielded the following hypotheses:[14]

*H7b: An opt-out strategy will result in a higher enrollment percentage than an opt-in strategy.*

*H7c: An opt-out strategy will result in greater adoption of new pricing plans and enabling technology than an opt-in strategy.*

*H7d: An opt-out strategy will result in greater energy efficiency, demand response, and load-shifting benefits than an opt-in strategy.*

*H7e: Customer satisfaction with an opt-out strategy will not be significantly different than satisfaction with an opt-in strategy.*

Comparisons, such as shadow bills (DOE, 2010) and normative comparisons (Schultz, Nolan, Cialdin, Goldstein, & Griskevicius, 2007) have a significant role in the customer experience and the effects on customer performance related to energy efficiency, demand response, and load shifting behaviors. The CAP integrated both comparisons into its customer experience.

A "shadow bill" (or rate comparison) is a method of comparison that enables customers to compare the effects of an old pricing plan (for example, Flat Rate) and a new pricing plan (for example, CPP). Rate comparison in the context of the CAP is defined as the difference in electricity supply charges between the new rate and the old rate. While this comparison may have an effect on customers dropping out of the CAP if they are negatively impacted, focus groups suggest that such comparison is a key customer requirement, and may even create a compelling goal for customers. Normative comparisons, on the other hand, enable a customer to compare their energy usage behaviors to others. One method for doing this is "neighbor comparison", in which a customer's usage is compared to the average usage of approximately 100 neighbors. Through these comparisons, customers who use more energy than their neighbors may adopt behaviors that reduce usage so they are more like their neighbors. However, special care is required for customers who use less energy than their neighbors. Through the comparison, they may decide that they can use more energy, unless their performance is signaled as being desirable. Normative comparisons have been shown to have a positive conservation effect (OPOWER, 2010; Schultz et al. 2007) of 1.5 to 3.5%. This suggests the following hypotheses:

*H7f: Customers whose rate comparison shows a monthly loss will change their behavior in subsequent months to minimize that loss.*[15]

[14] The CAP unfortunately does not include another enrollment method treatment group against which it can test these hypotheses. However, the intention is to qualitatively compare what is learned in the CAP about enrollment method with other studies that use different enrollment methods, such as opt-in.

[15] "Loss" in the context of these hypotheses means that the customer is paying more on the new rate (i.e. CPP) than on the old rate (i.e. Flat Rate). "Gain" means the customer is paying less on the new rate.

*H7g: Customers whose rate comparison shows a cumulative loss will change their behavior in subsequent months to minimize that loss.*

*H7h: Customers whose rate comparison shows a monthly gain will have a drop-out rate that is less than customers who experience a monthly loss.*

*H7i: Customers whose rate comparison shows a cumulative gain will have a drop-out rate that is less than customers who experience a cumulative loss.*

*H7j: Customers who experience sequential monthly losses will have a drop-out rate that is higher than customers who do not experience sequential monthly losses.*

*H7k: Customers receiving normative comparisons will experience greater energy efficiency, demand response, and load-shifting benefits than customers not receiving normative comparisons.*

*H7l: Customers whose normative comparisons show them having higher electricity consumption than their neighbors will lower their electricity consumption.*

Notifications, whether they are for demand response events or when hourly prices exceed a certain amount, provide a customer experience that informs people of times when they should conserve or shift energy use. There are two types of notifications, push and pull. Push notifications are when customers are informed of events through a message "pushed" through media channels such as phone, e-mail, or text (SMS) messaging, as well as text and visual messaging through enabling technology. Pull notification is when customers seek out event or pricing information through a telephone call or by visiting a website. The hypotheses associated with notifications are:

*H7m: Customers who are notified of events will experience greater energy efficiency, demand response, and load-shifting benefits than customers who are not notified.*

*H7n: Customers who choose more than one notification media will experience greater energy efficiency, demand response, and load-shifting benefits than customers who do not.*

*H7o: Customers who view hourly pricing information online will experience greater energy efficiency, demand response, and load-shifting benefits than customers who do not.*

*H7p: Customers who sign up one or more family members for notification will experience greater energy efficiency, demand response, and load-shifting benefits than customers who do not.*

Customer support is a catalyst for encouraging adoption of new rates and enabling technologies, as well as energy use behavior change. Studies by NV Energy (Boice, 2009) and Connecticut Light & Power (CL&P, 2010) suggest that the status quo of utility customer support is a significant barrier to adoption. This is echoed by PG&E's response to the "smart meter revolt" in California: Creating more "Answer Centers" staffed with 165 additional CSRs (PG&E, 2010).

The customer experience for the CAP includes a specially-trained, third-party customer support center that provides support, troubleshooting, education, and human subject protections through telephone and e-mail media channels. It is expected that the customer support approach used will overcome the criticisms discussed above. The customer support hypotheses are:

***H7q**: Customers who contact the customer support center will experience greater energy efficiency, demand response, and load-shifting benefits than customers who do not.*

***H7r**: Customers on the CPP rate will contact the customer support center more frequently than customers on other rates.*

***H7s**: Customers on the CPP rate will have call durations that are longer than the durations for customers on other rates.*

***H7t**: Customers who are eligible to receive the BIHD will contact the customer support center more frequently than customers eligible to receive other enabling technology.*

***H7u**: Customers who are eligible to receive the BIHD will have call durations that are longer than durations for customers eligible to receive other enabling technology.*

***H7v**: Customer satisfaction with customer support center will meet or exceed satisfaction levels of benchmarked customer care centers.*

## Summary

Table 1-3 summarizes the hypotheses that will be tested in the CAP.

**Table 1-3**
**Summary of CAP Hypotheses**

| Variable | Hypotheses |
|---|---|
| Meter Type | ***H1**: Meter type has no effect on electricity usage behaviors.* |
| Rate Type | ***H2a**: The IBR rate is most easily adopted by customers.* |
| | ***H2b**: The IBR rate causes the greatest reduction in overall electricity usage during the year.* |
| | ***H2c**: The CPP rate causes the greatest reduction in peak load during the summer.* |
| | ***H2d**: The CPP rate causes flatter load shapes at all times during the year.* |
| | ***H2e**: The CPP rate delivers the best combination of energy efficiency, demand response, and load shifting benefits.* |
| | *H2f: Customers on the IBR rate will experience greater satisfaction than customers on the other rates.* |
| Enabling Technology | ***H3a**: The BIHD will have a higher implementation rate than other enabling technology.* |
| | ***H3b**: The BIHD will have a higher adoption rate than other enabling technology.* |
| | ***H3c**: A combination of direct and indirect feedback solutions will achieve greater energy efficiency, demand response, and load shifting benefits than indirect feedback solutions* |

| Variable | Hypotheses |
|---|---|
| | *alone.*<br>*H3d: The AIHD/PCT solution will achieve greater energy efficiency, demand response, and load shifting benefits than other enabling technology.*<br>*H3e: The AIHD/PCT solution in combination with the CPP rate will achieve greater energy efficiency, demand response, and load shifting benefits than other enabling technology and pricing plan combinations.*<br>*H3f: Customers who received and activated a BIHD will experience greater satisfaction than customers who have received and activated other enabling technology.* |
| Enabling Technology Acquisition | *H4a: The acquisition rate of free enabling technology will exceed purchased enabling technology.*<br>*H4b: The implementation rate of purchased enabling technology will exceed free enabling technology.*<br>*H4c: The adoption rate of purchased enabling technology will exceed free enabling technology.*<br>*H4d: Purchased enabling technology will achieve greater energy efficiency, demand response, and load shifting benefits than free enabling technology.* |
| Bill Protection | *H5a: The adoption rate of a dynamic pricing plan will be greater when bill protection is offered than when it is not offered.*<br>*H5b: Customers without bill protection will achieve greater energy efficiency, demand response, and load shifting benefits than customers with bill protection (?).*<br>*H5c: Customers with bill protection will experience greater satisfaction than customers without bill protection.* |
| Customer Education | *H6a: Customers receiving customer education will achieve greater energy efficiency, demand response, and load shifting benefits than customers who do not receive customer education.*<br>*H6b: Customers who receive customer education along with an AMI-enabled, flat rate and enabling technology will achieve greater energy efficiency, demand response, and load shifting benefits than customers who are not offered customer education and enabling technology.*<br>*H6c: Customers who receive customer education along with an AMI-enabled, non-flat rate and enabling technology will achieve greater energy efficiency, demand response, and load shifting benefits than customers who receive customer education, a flat rate, and enabling technology.*<br>*H6d: Customers who receive customer education will experience greater satisfaction than customers without customer education.* |
| Customer Experience – Observable Steps | *H7a: Customers who engage in small, observable steps will achieve greater energy efficiency, demand response, and load shifting benefits than customers who do not engage in those steps.* \ |
| Customer Experience – Opt-Out Enrollment | *H7b: An opt-out strategy will result in a higher enrollment percentage than an opt-in strategy.*<br>*H7c: An opt-out strategy will result in greater adoption of new pricing plans and enabling technology than an opt-in strategy.*<br>*H7d: An opt-out strategy will result in greater energy efficiency, demand response, and load-shifting benefits than an opt-in strategy.*<br>*H7e: Customer satisfaction with an opt-out strategy will not be significantly different than* |

| Variable | Hypotheses |
|---|---|
| | *satisfaction with an opt-in strategy.* |
| Customer Experience – Comparisons | ***H7f:*** *Customers whose rate comparison shows a monthly loss will change their behavior in subsequent months to minimize that loss.*<br><br>***H7g:*** *Customers whose rate comparison shows a cumulative loss will change their behavior in subsequent months to minimize that loss.*<br><br>***H7h:*** *Customers whose rate comparison shows a monthly gain will have a drop-out rate that is less than customers who experience a monthly loss.*<br><br>***H7i:*** *Customers whose rate comparison shows a cumulative gain will have a drop-out rate that is less than customers who experience a cumulative loss.*<br><br>***H7j:*** *Customers who experience sequential monthly losses will have a drop-out rate that is higher than customers who do not experience sequential monthly losses.*<br><br>***H7k:*** *Customers receiving normative comparisons will experience greater energy efficiency, demand response, and load-shifting benefits than customers not receiving normative comparisons.*<br><br>***H7l:*** *Customers whose normative comparisons show them having higher electricity consumption than their neighbors will lower their electricity consumption.* |
| Customer Experience – Notifications | ***H7m:*** *Customers who are notified of events will experience greater energy efficiency, demand response, and load-shifting benefits than customers who are not notified.*<br><br>***H7n:*** *Customers who choose more than one notification media will experience greater energy efficiency, demand response, and load-shifting benefits than customers who do not.*<br><br>***H7o:*** *Customers who view hourly pricing information online will experience greater energy efficiency, demand response, and load-shifting benefits than customers who do not.*<br><br>***H7p:*** *Customers who sign up one or more family members for notification will experience greater energy efficiency, demand response, and load-shifting benefits than customers who do not.* |
| Customer Experience – Customer Support | ***H7q:*** *Customers who contact the customer support center will experience greater energy efficiency, demand response, and load-shifting benefits than customers who do not.*<br><br>***H7r:*** *Customers on the CPP rate will contact the customer support center more frequently than customers on other rates.*<br><br>***H7s:*** *Customers on the CPP rate will have call durations that are longer than the durations for customers on other rates.*<br><br>***H7t:*** *Customers who are eligible to receive the BIHD will contact the customer support center more frequently than customers eligible to receive other enabling technology.*<br><br>***H7u:*** *Customers who are eligible to receive the BIHD will have call durations that are longer than durations for customers eligible to receive other enabling technology.*<br><br>***H7v:*** *Customer satisfaction with customer support center will meet or exceed satisfaction levels of benchmarked customer care centers.* |

With this background, pilot design overview, and hypothesis description, the following section will consider in more detail the steps taken to design and operationalize the research.

# 2 METHOD

This section outlines the methods undertaken to develop the customer experience associated with each of the applications, the enabling technology selection process, the customer support and field service resource requirements, the pilot sample population, the project phases from the customer's perspective, and the data to be measured as well as the data collection process.

## Project Execution and Management

ComEd contracted with Customer Performance Group and Accenture to execute and manage the CAP. Work was organized into five specific workstreams: Program Management, Enabling Technology, Customer Service, Measurement & Validation, and Customer Experience. Each workstream was assigned an individual to lead, with other individuals assigned for support. Key tasks were then assigned to each workstream, with a rough schedule that lead to a March, 2010 project launch. Figure 2-1 shows the original whiteboard plan depicting the workstream approach.

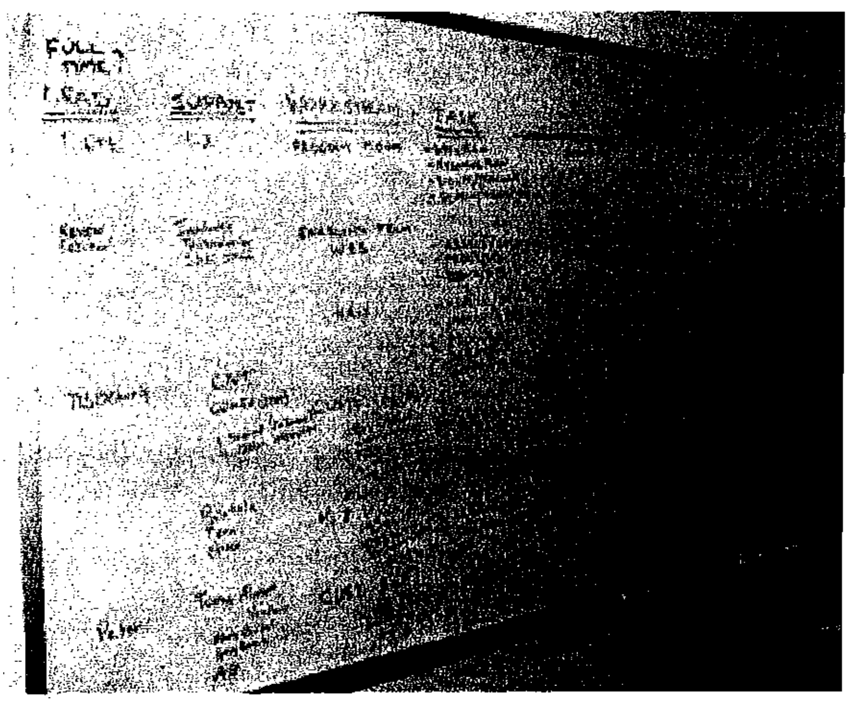


**Figure 2-1**
**Whiteboard depicting the CAP workstreams**

The workstreams were then integrated within an organizational structure (Figure 2-2). The heart of the organizational structure is the Program Management Office (PMO), which had primary accountability for the CAP.

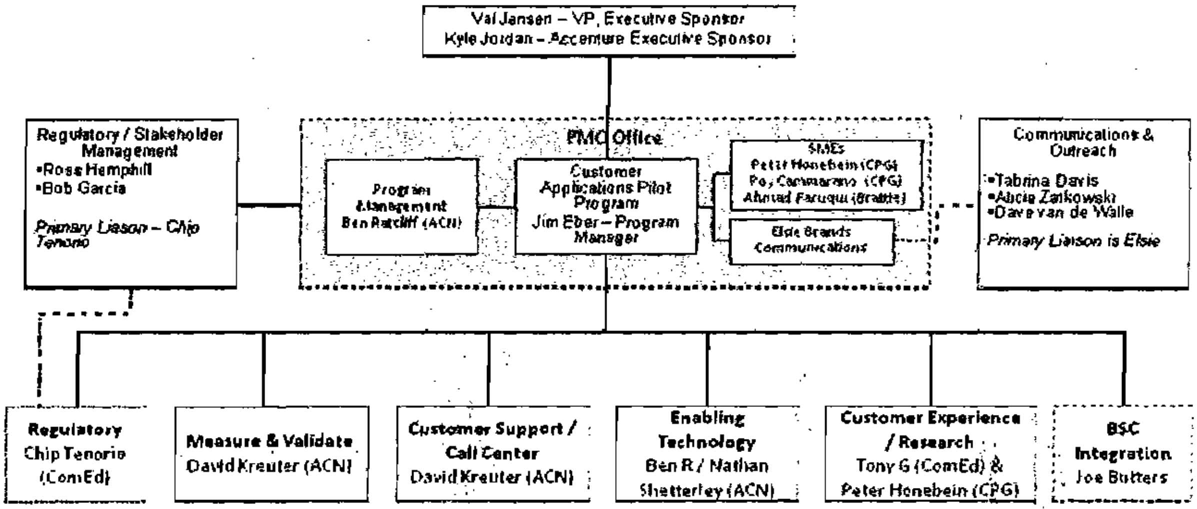



**Figure 2-2:**
**The CAP Organizational Chart**

Management of the project was consistent with methods associated with the Project Management Book of Knowledge (PMBOK). The leader of each workstream developed a task-oriented work plan and schedule, which fed into the overall project schedule which was managed by the PMO (Figure 2-3).

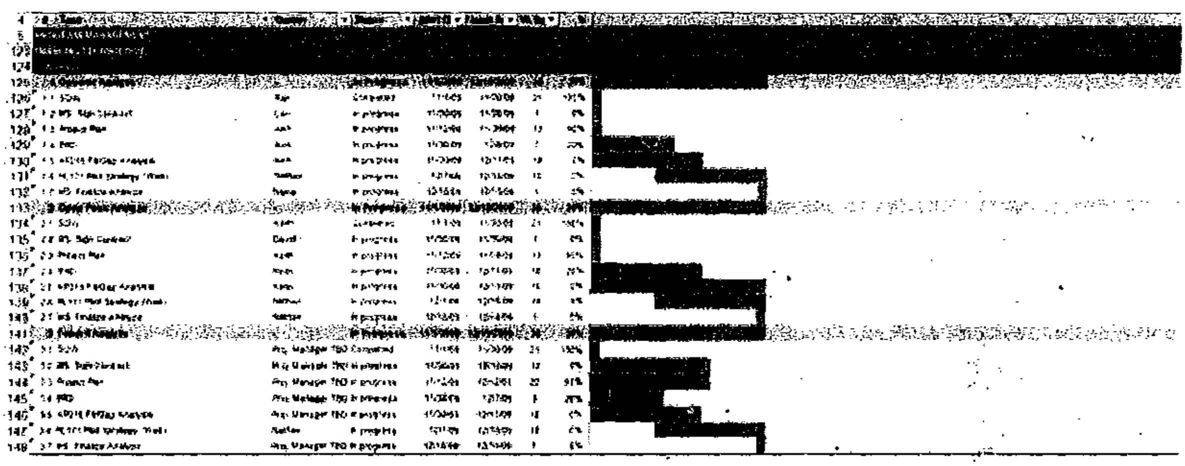


**Figure 2-3:**
**Master project schedule for the CAP.**

Project team meetings were conducted at least weekly, with the frequency increasing to daily during program launch. At three intervals during the project, "all hands" walkthroughs were conducted to assess and evaluate the deliverables associated with each workstream (Figure 2-4).

During these walkthroughs, workflow leaders or their support staff demonstrated deliverables, explained how IT systems would process data, and identified issues or barriers associated with the project.

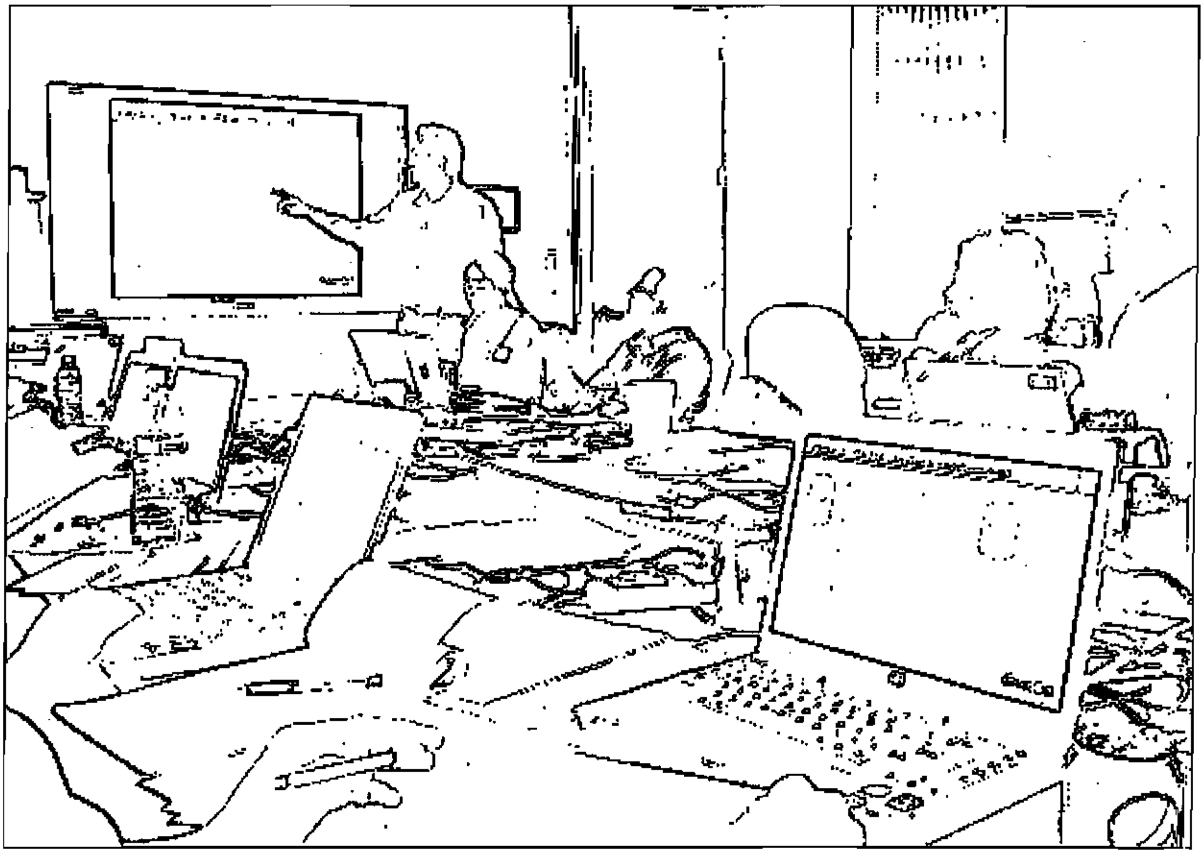


**Figure 2-4:**
**A walkthrough explaining how daily files move between ComEd and its customer support vendor (CNT).**

As the CAP moved closer to the launch date, an implementation schedule was developed to provide a day-by-day view of the project. This enabled the PMO to coordinate the specific tasks associated with each workstream during the implementation phase of the project (Figure 2-5).

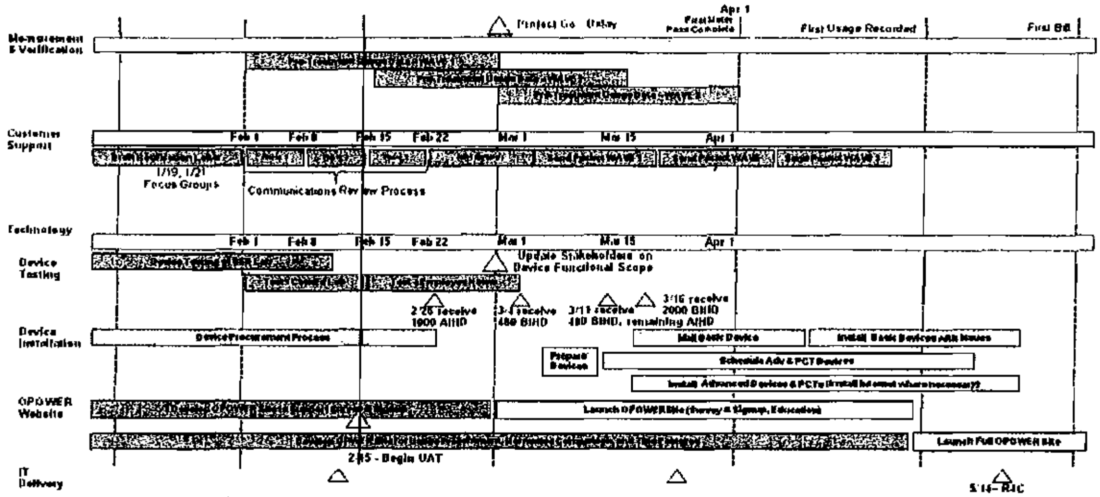



**Figure 2-5:**
**The CAP implementation schedule**

After the launch of the CAP, key CAP metrics were provided daily to the CAP team and other internal stakeholders in the form of "dashboard reports." There were two versions of this report. One version was a daily e-mail summary of key metrics such as opt-outs, inbound customer contacts, enabling technology implementation, and survey completion. The other version was a weekly PowerPoint slide deck that contained an elaborate set of metrics at the experimental cell level as well as results associated with specific program measures (Figure 2-6).

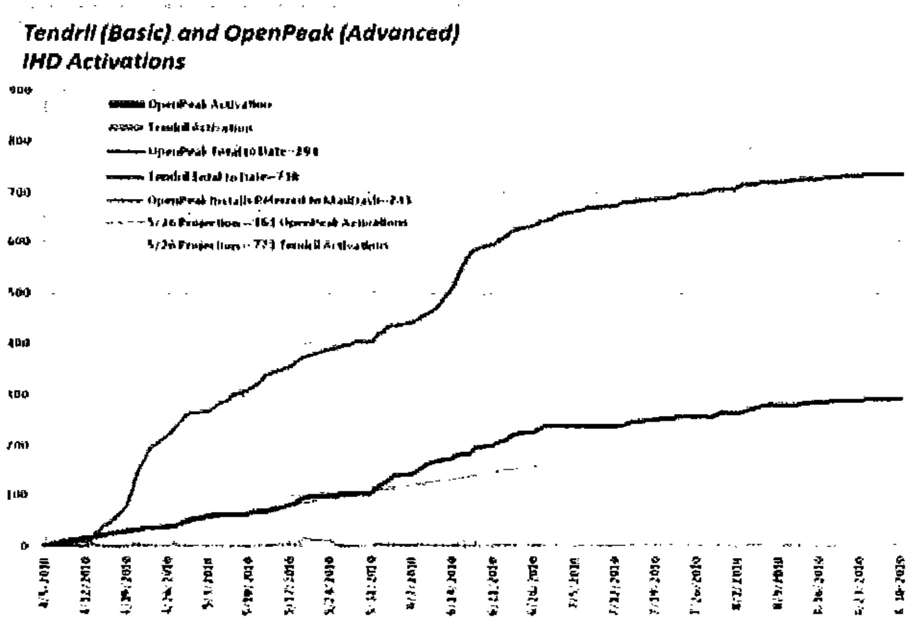



**Figure 2-6:**
**Slide from the weekly dashboard report illustrating IHD implementation trends.**

Ongoing management of the CAP by the PMO focused on identifying, prioritizing, delegating, and resolving issues as they arose. Details of what was managed can be found in the Procedures sub-section later in this document.

## Rate Design

ComEd contracted with The Brattle Group to design the five new pricing plans associated with the CAP. These included inclining block rate (IBR), critical peak price (CPP), peak time rebate (PTR), day-ahead, real-time pricing (DA-RTP), and time-of-use pricing (TOU). Rate design involved developing and validating the rate formulas to ensure sufficient revenue generation and revenue neutrality. The resulting rate designs are described in detail in Rider AMP (Attachment 1), Rider AMP (Attachment 2), and Rider AMPCA (Attachment 3).[16]

The impact of CPP, PTR, DA-RTP, and TOU on customer's electricity supply charge was assessed using interval data from ComEd's load research meters.

- First, hourly usage data from the year 2008 for 1,760 customers was obtained. This data represented four classes of residential customers. It included single- and multi-family homes, and customers with and without electric space heating. Analysis indicated the sample was representative of ComEd's entire population of residential customers.

- Second, a Critical Peak Pricing (CPP) rate was developed.[17] To do this, the usage profiles and information related to ComEd's existing residential rate were analyzed. Customers on the CPP rate pay a price that varies by hour and is lower than the flat rate for most hours of the year. During the late afternoon hours on a limited number of summer days during which demand for electricity is at its highest, customers pay a higher price.

- Third, after developing the CPP rate, each customer's bill on both the existing flat rate and on the new CPP rate was computed. Comparing these bills indicates whether a customer should expect a bill increase or decrease on the CPP rate. However, this analysis does not capture the bill savings if customers changed their usage behavior. To estimate this, a moderate reduction in usage during the higher priced hours (ten percent) was applied.[18] Then the bills were recalculated.

The results of this impact analysis showed that most customers who took no action could expect annual savings or impacts in the following ranges:

- CPP = -15% to +15%

[16] These documents may be found at http://www.icc.illinois.gov/docket/files.aspx?no=09-0263&docId=137071&m=0.
[17] We developed this rate to be "revenue neutral." This means that, in the absence of any change in usage behavior, the average customer's electricity bill would not change when moving from the existing rate to the new rate.
[18] The ten percent figure is a conservative estimate based on analysis of customer response to dynamic rates in several states including Maryland, Connecticut, and California. Customers who reduced usage by more than this conservative average could see proportionately greater bill savings.

- PTR = -5% to +5%
- DA-RTP = -6% to +6%
- TOU = -3% to +3%

Some adjustments were made to the rates following ComEd's electricity procurement event in May, 2010. These adjustments included an increase to the CPP and PTR amounts (from $1.20 to $1.74), and the addition of a 0.6¢ to 1.3¢ discount (depending upon rate class) to the day-ahead hourly prices for the CPP rate.

## Materials Development

Materials for the CAP consisted of printed materials, electronic materials, and automated telephone call scripts. These materials were prepared using methods and standards consistent with customer-centered design (Honebein, Cammarano, and Donnelly, 2009), customer education design (Honebein, 1997), and ComEd's internal style guides (ComEd, 2009; Exelon, 2009). To assist with the initial customer experience design and materials prototypes, ComEd contracted with Prophet. Customer-centered design activities, followed by three rounds of initial focus groups (July 2009 (English, N=24), August 2009 (English, N=48), and December 2009 (English and Spanish, N=48)), provided initial customer guidance regarding the customer experience and the nature, content, and quantity of the materials. Based upon these activities and focus groups, the following communication themes and standards were established:

- Thematic platform: Your Energy. Your Way.
  - Simplicity, Value, Guidance, Confidence, Control
- Writing style
  - 8$^{th}$ grade reading level.
  - Active voice.
  - Chunking content into blocks of no more than seven items. Three is desirable.
  - Simple to complex sequencing.
- Instructional design
  - Engage verbal, visual, and kinesthetic learning styles.
  - Integrate presentation, practice, and feedback.
- Measures of quality that reflect:
  - Effectiveness – The materials enable the audience to pass a test or perform a task to a specific standard of performance.
  - Efficiency – The materials use the fewest pages and words to enable the reader to pass a test or perform a task to a specific standard of performance.
  - Appeal – The audience likes the materials, finds the materials easy to read.

- English and Spanish language.

Since this study assesses the impact of customer education materials on customer performance, it is important to discuss the development and validation of those materials, specifically around their effectiveness. Reigeluth (1983, p. 20) defines the effectiveness of instruction as something, "...which is usually measured by the level of student achievement of various kinds." The operational definition for "student achievement" consists of a learning objective and a corresponding criterion-referenced test item that assesses whether the customer has mastered the learning objective (Honebein, 1997).

For example, a key learning objective associated with the CAP rate notification materials is, "State the name of the new pricing plan that starts on May 1, 2010." The corresponding criterion-referenced test item for this learning objective is:

1. What electricity rate will be in effect at your residence in May, 2010?
    a. Flat-rate price
    b. Tier-rate price
    c. Shift-and-Save price
    d. Reduce-and-Save price
    e. Do not know

Consistent with this definition of "achievement," a set of learning objectives and corresponding criterion-referenced test items for the CAP were created by analyzing CAP content, the content of other AMI programs, and the content of third-party energy efficiency and demand response education providers. The resulting objectives and test items were validated by internal ComEd energy efficiency and demand response experts, as well as enabling technology experts where applicable.

The educational materials developed, specifically the Rate Notification Letter (RNL) and the Customer Education Package (CEP), aligned with the validated learning objectives and test items, and were validated through a formative evaluation process (Dick & Cary, 1990). Two methods for formative evaluation were used, single-subject testing and focus groups (Brenneman, 1989; de Jong & Schellens, 1998).

Two rounds of single-subject testing for materials associated with cell D2 were conducted. The first round involved a convenience sample of adult non-ComEd customers (N=4) and ComEd customers (N=5) using RNL and CEP materials. Subjects were given a pre-test, the materials, and then a post-test. Both the RNL and CEP showed statistically-significant pre/post test improvements, with post-test mastery achieved for the two primary learning objectives, the electricity rate in effect on May 1, 2010 (89%) and the general nature of that rate (100%). Testing effect was minimized by using different pre/post test questions. However, there may be some testing effect due to the lack of time separating the pre-test and the treatment. The second round involved a convenience sample of adult ComEd customers (N=9). For this group, the testing effect was further minimized by administering the pre-test, then waiting two days before administering the materials and post-test. Results were similar to the first round of single-subject tests.

For the final tests of the cell D2 materials, four focus groups were conducted (N=48). These focus groups evaluated the RNL, the CEP, the customer bill, and the printed OPOWER monthly energy report. After the first two focus groups (round 1), modifications were made to the materials based upon the results. Quantitative assessment of the materials focused on scaled ratings of 10 "tenets" or qualities of the materials. In round 1, only one tenet exceeded the desired threshold of 75%. In the second two focus groups (round 2), five tenets exceeded the desired threshold. Due to time and resource constraints, no further testing was conducted. The final RNL and CEP materials may be found in Appendix **Error! Reference source not found.** and **Error! Reference source not found.**, respectively.

Based upon the template established by the testing of the D2 materials, 27 unique sets of materials (one set for each cell) were created for the RNL and the CEP (See Appendix **Error! Reference source not found.** for a table depicting the content each control and treatment group received). Control group cells F1 and F3 received scaled-down versions of the RNL that were configured so as not to cause any confounding variables (for example, the RNL for cell F1 consisted of a survey and a disclosure sheet). English and Spanish versions of the materials were prepared, with the materials designed so that English was on the front, and Spanish was on the back. Table 2-1 summarizes the elements and components of the primary educational materials.

**Table 2-1**
**Primary Education Materials**

| Rate Notification Letter Elements | Customer Education Package Elements | OPOWER Monthly Energy Report Components for Reduce-and-Save and Shift-and-Save Pricing Plans[19] |
|---|---|---|
| - Letter (one page)<br>- FAQ sheet (one page)<br>- Program Disclosure (one page)<br>- Survey A (three pages)<br>- Customer Education Request Postcard<br>- Pricing Plan Magnet<br>- AIHD free, AIHD purchase, and BIHD purchase promotion (one page; only included in appropriate cells). | - Cover (one page)<br>- Pricing Plan (one page)<br>- Managing Usage and Costs (one page)<br>- Tools to Help You Save (one page)<br>- Tracking Your Results (one page)<br>- How the Smart Meter System Works (one page) | - Johnson Box section (slot 1, front page)[20]<br>- Rate Comparison (slot 2, front page)<br>- Last Month Neighbor Comparison (slot 3, front page)<br>- Last 12 Months Neighbor Comparison section (slot 5, back page)<br>- Energy Tips (slot 6, back page) |

[19] Customer-friendly names were given to the different rates in the customer education materials. IBR was referred to as the Reduce-and-Save pricing plan, while CPP, PTR, RTP, and TOU were referred to as the Shift-and-Save pricing plan.
[20] A Johnson Box is a box found at the top of direct mail letters containing the key message of the letter.

A matrix depicting the specific OPOWER monthly reports each cell received may be found in Appendix **Error! Reference source not found. Error! Reference source not found.**. Customers assigned to the Flat Rate pricing plan received the standard OPOWER monthly report (See Appendix **Error! Reference source not found. Error! Reference source not found.**). Customers assigned to other pricing plans were to have received an OPOWER monthly energy report that was customized to include a Rate Comparison section and a quarterly educational focus section (See Appendix **Error! Reference source not found. Error! Reference source not found.**). However, due to technical issues associated with the accuracy of the comparison, this version of the OPOWER report was never implemented; it was replaced with a rate comparison letter that was delivered to customers in September, 2010. Since the OPOWER energy tips library only included energy efficiency tips, new energy tips related to demand response and load shifting were created. Furthermore, an editorial calendar was established (see Table 2-2) that specified the educational content to appear on the report.

| Month | Slot 2 | Slot 3 | Slot 5 | Slot 6 |
|---|---|---|---|---|
| May 2010 | About the Rate Plan Comparison | Last Month Neighbor Comparison | Last 12 Month Neighbor Comparison | Segmented Tips (3)<br>• 1 DR No-Cost<br>• 1 DR Investment<br>• 1 EE |
| June 2010 | Last Month Neighbor Comparison[21] | Last 12 Month Neighbor Comparison | Neighbor Efficiency Rank | Segmented Tips (3)<br>• 1 DR No-Cost<br>• 1 DR No-Cost<br>• 1 Rate Plan Comparison Referral |
| July 2010 | " | Last 12 Month Neighbor Comparison | Neighbor Efficiency Rank | Segmented Tips (3)<br>• 1 DR No-Cost<br>• 1 DR Investment<br>• 1 Rate Plan Comparison Referral |
| August 2010 | " | Last Month Neighbor Comparison | Last 12 Month Neighbor Comparison | Understanding Defeat the Peak |
| September 2010 | " | " | " | Understanding Non-Summer Usage Patterns |

[21] The rate plan comparison was designed to start in June. However, due to technical issues associated with the accuracy of the comparison, it was delayed until September and moved to a customer letter (rather than included on the monthly report). Slot 6 was modified to include an energy tip that gave customers a telephone number they could call to get their rate comparison.

| Month | Slot 2 | Slot 3 | Slot 5 | Slot 6 |
|---|---|---|---|---|
| October 2010 | " | " | " | Segmented Tips (3)<br>• 1 EE No-Cost<br>• 1 EE Investment<br>• 1 LS No-Cost |
| November 2010 | " | " | " | Segmented Tips (3)<br>• 1 EE No-Cost<br>• 1 EE Investment<br>• 1 LS Investment |
| December 2010 | " | " | " | Understanding Enhance the Efficiency |
| January 2011 | " | " | " | Segmented Tips (3)<br>• 1 EE No-Cost<br>• 1 EE Investment<br>• 1 EE Investment |
| February 2011 | " | " | " | Segmented Tips (3)<br>• 1 EE No-Cost<br>• 1 EE Investment<br>• 1 EE No-Cost |
| March 2011 | " | " | " | Understanding Shift the Use |
| April 2011 | " | " | " | Segmented Tips (3)<br>• 1 LS No-Cost<br>• 1 LS Investment<br>• 1 EE Investment |

**Table 2-2**
**OPOWER Monthly Report Editorial Calendar**

In addition to the RNL, CEP, and OPOWER monthly energy report, several supplemental educational, notification, and promotional materials were developed for the CAP. These materials included:

- Education Materials
    - Tendril Insight Quick-Start Guide (four pages) (see Appendix **Error! Reference source not found.**)
    - OpenPeak Quick-Start Guide (four pages)
    - Tendril Insight Instructional Videos (seven videos, 10.5 minutes total)
    - OpenPeak Instructional Videos (nine videos, 13.5 minutes total)

- CPP/PTR Pricing Plan Update Letter (one page)

- Notification Materials
    - Smart Meter Installation Materials
    - New Pricing Plan Reminder Scripts for Phone
    - Peak Day Notification Scripts for Phone, E-mail, Text, and IHD messaging (See Appendix **Error! Reference source not found.**)
    - Pricing Notification Scripts for Phone, E-mail, Text, and IHD messaging (See Appendix **Error! Reference source not found.**)
    - Bill Messages
- Promotion Materials
    - Tendril Insight and OpenPeak Direct Response Letters (one page) (See Appendices **Error! Reference source not fouud.** and **Error! Reference source not found.**)
    - Tendril Insight and OpenPeak Automated Call Scripts
    - ComEd.com/SmartTools Direct Mail

For the supplemental education materials, the quick-start guides (four pages) were developed using methods similar to those described above and were tested using single-subject testing with a convenience sample of ComEd customers (N=2). The instructional videos were developed using methods similar to those described above, but were not tested due to time and resource constraints. The CPP/PTR Pricing Plan Update letter was created to inform customers about a 54¢/kWh increase to the CPP peak day price and the PTR peak day rebate due to capacity charge increases that occurred after initial RNL mailing. Its content and structure are consistent with the RNL.

Smart meter installation notification materials were used to inform customers about smart meter installation. Design and development of these materials were guided by lessons learned from San Diego Gas & Electric's (SDG&E) installation pilot. Customer satisfaction with the door hanger and field card materials, assessed through a telephone survey (N=402), was an 8.5 on a 10-point scale (where 10=Extremely Satisfied) (Blackstone Group, 2010). The complete set of installation materials were:

- Notification letter. Consists of a one-page signed letter and a one-page fact sheet.
- Automated call script
- Door hanger. Used by installers to confirm installation.
- Field card. Used by installers to hand out to customers who have questions.
- Truck signage

Other notification materials consisted primarily of short messages that were distributed automatically to customers, on an ad hoc basis, scheduled basis, or during certain events. The content and structure of these scripts were derived from the education materials. The scripts were not tested with customers due to time and resource constraints.

Additional promotional materials were created to increase adoption of the BIHD and AIHD devices, as well as the website. For the devices, the direct response letters and automated phone scripts were created in consultation with an expert direct response copywriter. However, due to time and resource constraints, these materials were not tested prior to distribution. For the website, ComEd communications created direct mail materials that were distributed to the entire AMI footprint.

End-of-study materials include Survey B, which will assess customer involvement and satisfaction, and the CAP Debriefing Report, which will report the personal and overall results to CAP customers.

## Enabling Technology

Selection of the enabling technology was conducted through an RFP process. Twenty-two vendors submitted proposals. Proposals were reviewed and scored by ComEd. An example of the scope of work is included in Appendix **Error! Reference source not found.**.

A General Electric I-210+n smart meter was installed on the premises of all CAP customers. Remote connect/disconnect features were enabled. Outage notification was disabled. Communication between the meter and ComEd was provided by Silver Springs Networks. Pricing and messaging information between the CAP and in-home devices was provided by a custom-designed Energy Information System (EIS) that was developed by Calico Energy (formerly Invaluable Technologies).

For the eWeb website (ComEd.com/SmartTools), a customized version of OPOWER's 3.0 Platform was used.

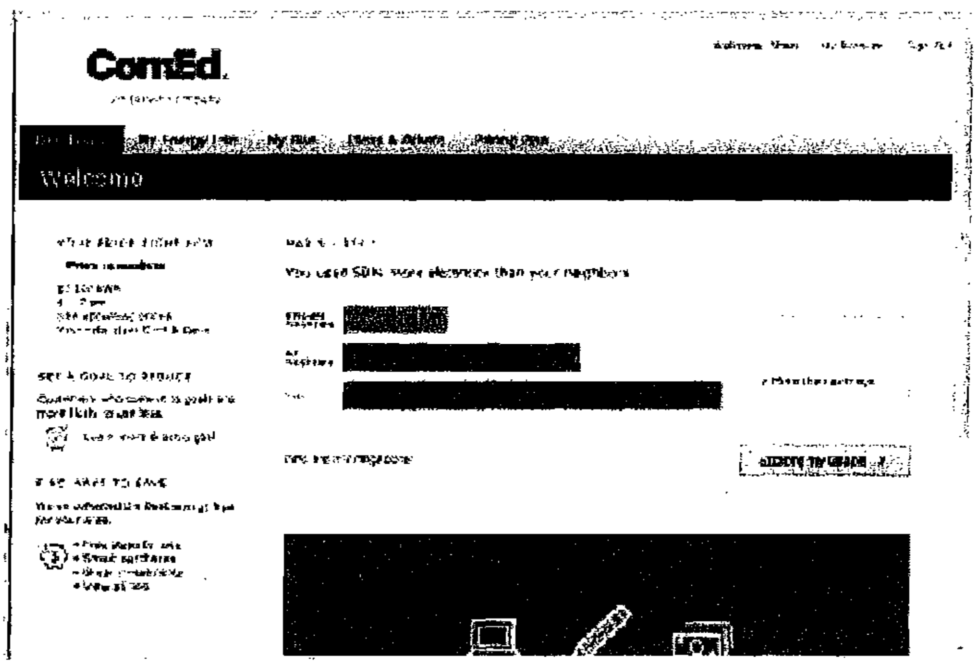



**Figure 2-7**
**ComEd.com/SmartTools Website - Dashboard View**

This website provided CAP customers the following features:

- Account creation
- Online Survey
- Neighbor Comparison
- Day-ahead and day-of hourly pricing information
- Day-after usage information by hour, day, and month
- Support for all CAP pricing plans (Flat, IBR, CPP, PTR, RTP, and TOU)
- Goal setting and goal progress feedback (online and on OPOWER report)
- Energy Tips
- CAP-specific pricing plan educational materials

For the basic in-home display (BIHD), the Tendril Insight (P20413-000; Firmware v1.8.5b4471 (March 2010)) was used. The factory-supplied box included the device, a "Call to Activate" sticker directly applied to the device, and a one page (double sided) device setup sheet. The shipping box contained the factory-supplied box, plus a printed, 28-page user manual and the ComEd quick-start guide.

For the advanced in-home display (AIHD), the OpenPeak Energy Manager (v.25567 (software); v.8492 (firmware)) was used. There were two configurations of this device.

- Professionally Installed. The factory-supplied box included the device and a 12-page, printed OpenPeak quick-start guide. The ComEd quick-start guide was provided separately to the customer by the field technician.
- Self-Installed. The factory-supplied box included the device, a "Call to Activate" sticker directly applied to the device, and a 12-page, printed OpenPeak quick-start guide. The shipping box contained the factory-supplied box, plus a printed, one page (double sided) device setup sheet and the ComEd quick-start guide.

Customers receiving the OpenPeak device who did not have Internet service were provided with a Clear Spot 4G Wimax router. Customers who had Internet service, but not a wireless router, were provided with a Belkin Wireless G router (Model F5D7234-4).

For the programmable, communicating thermostat, the Radio Thermostat CT30 was used. Along with this device customers received a printed, 16-page CT30 Operations Guide and the one page (double sided) OpenPeak Thermostat App Guide.

Tendril Echo repeaters were professionally installed at customer residences when proximity issues prevented the Tendril or OpenPeak devices from connecting to the meter.

## Customer Support

CNT Energy was contracted to provide Level 1 and Level 2 customer support for the CAP (levels are explained below). An example of the scope of work is included in Appendix **Error! Reference source not found.**.

The "ComEd SmartTools" call center was the first point of contact for any CAP customer who had questions about their pricing plan, enabling technology, and smart meter. The call center was staffed by two managers, one supervisor, and five operations assistants (OAs). Hours of operation were 7 a.m. to 6 p.m., Monday through Friday. Services were provided in both English and Spanish. In addition to handling inbound calls and e-mail, the call center also made proactive outbound calls and provided an automated recording of the current and day-ahead hourly prices.

Customer support was structured in four levels. Level 1 was the OAs (first point of contact) and Level 2 was the OA's managers. Level 3 customer support, which handled issues that the SmartTools call center could not resolve, involved a five-member SWAT team representing project management, customer experience, and enabling technology. Issues were escalated from Level 2 to Level 3 through an e-mail message to the SWAT team. A member of the SWAT team then logged the issue to an online tracking system and assigned responsibility to a SWAT team member. The SWAT team member then owned the issue until resolution, which included potential Level 4 escalations. Level 4 support included internal and external (vendor) experts.

The call center used several software tools to provide customer support. The primary application was Salesforce, which provided information about customers and allowed OAs to document the results of customer interactions. ComEd's iView application allowed OAs to view customer bills. The OPOWER CSR Tools application allowed OAs to view a customer's monthly energy report and online hourly usage data.

OAs were trained using structured on-the-job (S-OJT) training methods (Jacobs, 1992). In addition, all OAs received a binder containing all customer communication materials, as well as S-OJT forms and service scripts. Reviews of call recordings with actual customers provided OAs direct feedback on their performance as well as additional coaching.

## Field Services

Mad Dash was contracted to provide field service for installation and maintenance of BIHD, AIHD, and PCT enabling technology. The services provided by this vendor included scheduling of appointments, installation of AIHD systems (OpenPeak, Radio Thermostat, Belkin Wireless Router, and Clear Spot 4G Internet Service), on-site troubleshooting, maintenance, and replacement of AIHD and BIHD systems, and installation of Tendril Echo repeaters as necessary. Hours for scheduling and installation services matched that of the customer support center.

Field service personnel were trained to not only install the enabling technologies, but also to provide basic education regarding the function of those technologies. However, field service personnel were trained to refer customer questions regarding the new pricing plans, smart meters, and other elements of the CAP to the SmartTools call center.

## Sample

The sample for the CAP was drawn from two distinct sample populations in the Chicago area (Figure 2-8). One population, the "AMI Footprint", involved approximately 100,000 customers from the I-290 corridor region of Chicago (Bellwood, Berwyn, Broadview, Forest Park, Hillside, Maywood, Melrose Park, Oak Park, and River Forest – Figure 2-9) and 29,000 customers from the Humbolt Park neighborhood in the City of Chicago (Figure 2-10).

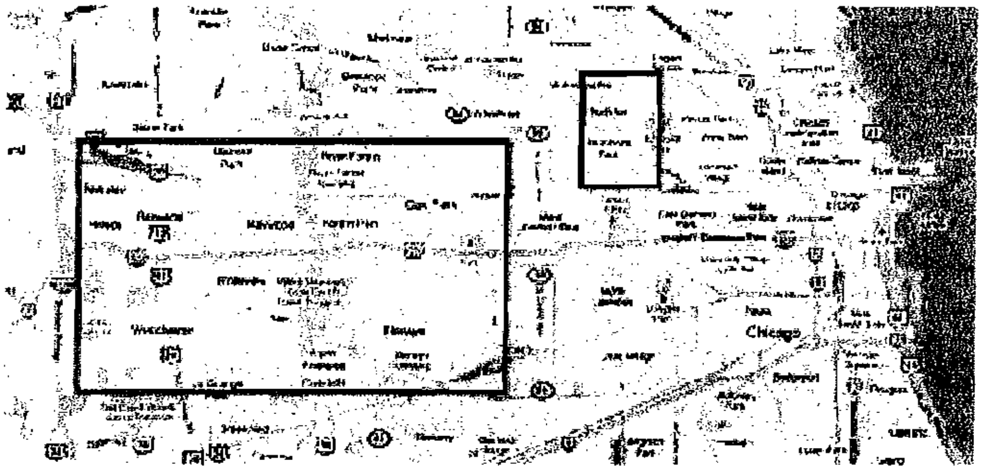


**Figure 2-8**
**Regions for the Two AMI Footprints**

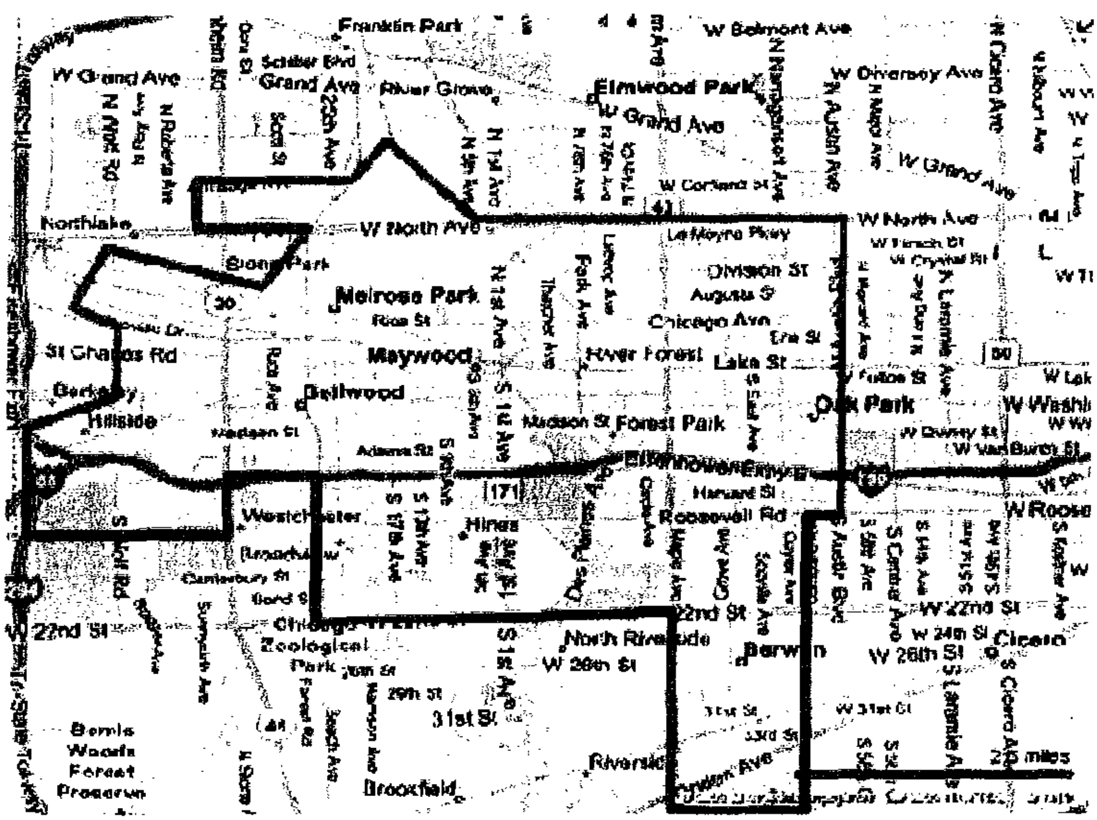



**Figure 2-9**
**Map of the I-290 Corridor AMI Footprint**

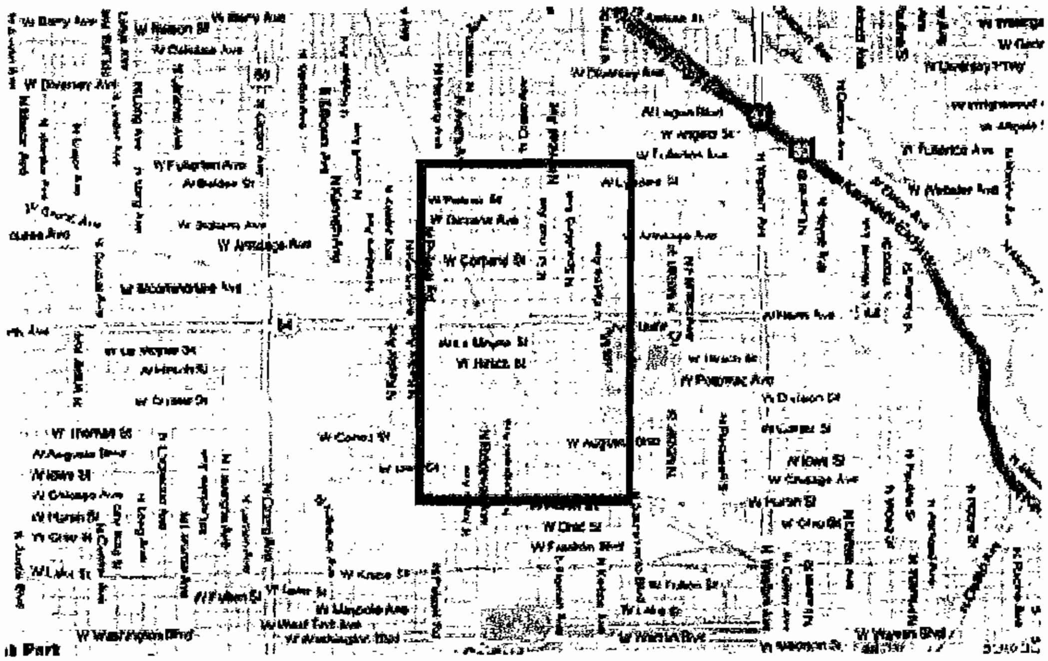


**Figure 2-10**
**Map of Humboldt Park AMI Footprint in the City of Chicago**

These geographic regions were selected for their representativeness of the ComEd service territory, using criteria such as usage level, single-family/multi-family ratio, and demographics. The second population, the "Non-AMI Footprint", involved approximately 2,250 customers outside the AMI footprint who are part of ComEd's load research sample. The load research sample was also representative of ComEd's overall service territory. Prior to random selection, 28,316 AMI footprint customers and 282 non-AMI footprint customers were excluded due to conditions associated with the AMP-CA tariff[22], such as non-active accounts, participation on a retail electric supplier (RES) rate, and whether the customer was a ComEd employee. Table 2-3 summarizes the population and the global exclusions.

**Table 2-3**
**Summary of Sample Population and Global Exclusions**

| Task | AMI Footprint | Non-AMI Footprint |
|---|---|---|
| Gather master list of customers | 129,165 | 2,249 |
| Exclude customers based on the following characteristics (see Pilot Exclusion Rules -- v.4) | | |
| Customer does not have an active account. | 26,578 | 197 |
| Customers participating in another pilot. Number Excluded: | 860 | 28 |
| Customers enrolled in RRTP. Number Excluded: | 155 | 4 |

[22] This is the ICC-approved tariff that authorizes ComEd to conduct the CAP. AMP-CA stands for "Advanced Metering Projects-Customer Applications."

| | | |
|---|---|---|
| Customers on a RES rate. Number Excluded: | 7 | 0 |
| Customers on a Net Metering rate. Number Excluded: | 1 | 5 |
| Customer is in the Non-AMI Footprint (an RLS Premise): | 34 | N/A |
| Customer Has Multiple Meters: | 231 | 47 |
| ComEd Employee. Number Excluded: | 86 | 1 |
| Remove customers whose mail was returned during meter installation: | 346 | 0 |
| Pre-pilot Participant | 18 | 0 |
| Calculate master list of candidate customers less exclusions: | 100,849 | 1,967 |
| **Total Customers Eligible for the Pilot** | **102,816** | |

Statistical Package for the Social Sciences (SPSS) was used to randomly assign subjects to control and treatment cells. The non-AMI footprint customers were randomly assigned to cells F1 and F2 (M=984; SD=65.2). The AMI footprint customers were randomly assigned to the other 25 cells (M=4,043; SD=72.03). After random assignment to cells, customers were then randomly sequenced within each cell. Random sequencing was done to allow for subsequent enrollment waves if a need as would be the case if there were excessive opt-outs.

Three additional cell-specific exclusions were then performed. First, for cells E1, E2, and E3, the AMP-CA tariff required customers to have at least a five year billing history: 303 customers not meeting this criterion were excluded. Second, for BIHD, AIHD, and AIHD/PCT cells, technical assessments determined that there was a high probability that devices would not work on second floor or above in multi-family residences. An automated analysis of customer addresses identified 1,733 customers who appeared to live in second floor or above multi-family residences, and these customers were excluded. Third, there were technical issues between ComEd and OPOWER that would prevent certain customers from being able to access the ComEd.com/SmartTools website. 158 customers who were not in the OPOWER data feed were excluded.

Prior to final customer enrollment, another 206 customers were removed from the CAP due to their accounts being "finaled." "Finaled" means that the customer terminated electric service (typically due to moving) between the time the Rate Notification Letter was mailed and the enrollment date. The resulting sample size for each CAP cell is shown in Table 2-4.

**Table 2-4**
**Final Populations of Each Cell**

| Cell | Rate | Initial Population | Accounts "Finaled" Before Enrollment | Final Population |
|---|---|---|---|---|
| F1 | FLR | 450 | 3 | 447 |
| F2 | FLR | 225 | 2 | 223 |
| F3 | FLR | 225 | 8 | 217 |
| F5 | FLR | 225 | 5 | 220 |
| F6 | FLR | 300 | 12 | 288 |

| Cell | Rate | Initial Population | Accounts "Finaled" Before Enrollment | Final Population |
|---|---|---|---|---|
| F7 | FLR | 225 | 3 | 222 |
| E1 | IBR | 216 | 7 | 209 |
| E2 | IBR | 293 | 5 | 288 |
| E3 | IBR | 215 | 3 | 212 |
| D1 | CPP | 525 | 13 | 512 |
| D1B | CPP | 225 | 3 | 222 |
| D2 | CPP | 525 | 14 | 511 |
| D3 | CPP | 524 | 18 | 506 |
| D4 | CPP | 525 | 15 | 510 |
| D5 | PTR | 225 | 5 | 220 |
| D6 | PTR | 525 | 13 | 512 |
| D7 | PTR | 225 | 5 | 220 |
| D8 | PTR | 225 | 3 | 222 |
| L1 | DAR | 224 | 6 | 218 |
| L1B | DAR | 225 | 8 | 217 |
| L2 | DAR | 525 | 14 | 511 |
| L3 | DAR | 225 | 13 | 212 |
| L4 | DAR | 225 | 6 | 219 |
| L5 | TOU | 525 | 13 | 512 |
| L5B | TOU | 225 | 4 | 221 |
| L6 | TOU | 225 | 7 | 218 |
| L6B | TOU | 225 | 6 | 219 |
| Non-participant | N/A | N/A | N/A | N/A |
| **Total Participants** | | **8522** | **214** | **8308** |

## Procedure

A unique feature of the CAP is that it is an opt-out study, designed to simulate a default pricing plan. Unlike other studies, in which participants must be recruited to participate, the CAP participants were automatically placed on a pricing plan, but had the option to drop out anytime during the pilot term. The procedure reflects this opt-out design.[23]

[23] The experimental methods and procedures for this study were reviewed by a third-party Institutional Review Board (IRB). The purpose of this review was to ensure the methods employed in this study offered sufficient

As shown in Figure 2-11, the procedure for the CAP was designed as an integrated customer experience that systematically connected the three primary parts of the experience: before, during and after. The "before" experience reflected steps 1-4 in the diagram, which focused on notifying customers of the new pricing plan and providing customers the technologies they were assigned. The "during" experience involved steps 5 and 6 in the diagram, which focused on the day-to-day routine of using electricity and paying the bill, as well as receiving pricing and peak day notifications to stimulate behavior change. The "after" experience involved transitioning customers off the CAP and debriefing them regarding their personal results and the entire results of the program.

The CAP customer experience design provided the blueprint for the study procedure. This blueprint was implemented in the following manner:

- Before (Steps 1-4) – March 24 through June 15, 2010
    - Phase 1 – Primary Communications for Awareness, Notification, and Enabling Technology Adoption
    - Phase 2 – Supplemental Communications for Awareness and Enabling Technology Adoption
- During (Steps 5 and 6) – June 1, 2010 through April 30, 2011
    - Phase 3 – Bills, Monthly Reports, and Pricing Notifications
- After (Step 7) – April 1, 2011 through July 31, 2011
    - Phase 4 – Transition Back to Flat Rate and Study Debriefing

Each of these steps is described in the following sub-sections.

protections to customers. Using the Department of Health and Human Services regulations found at 45 CFR 46.101(b), the IRB determined that the CAP study was exempt from IRB oversight.

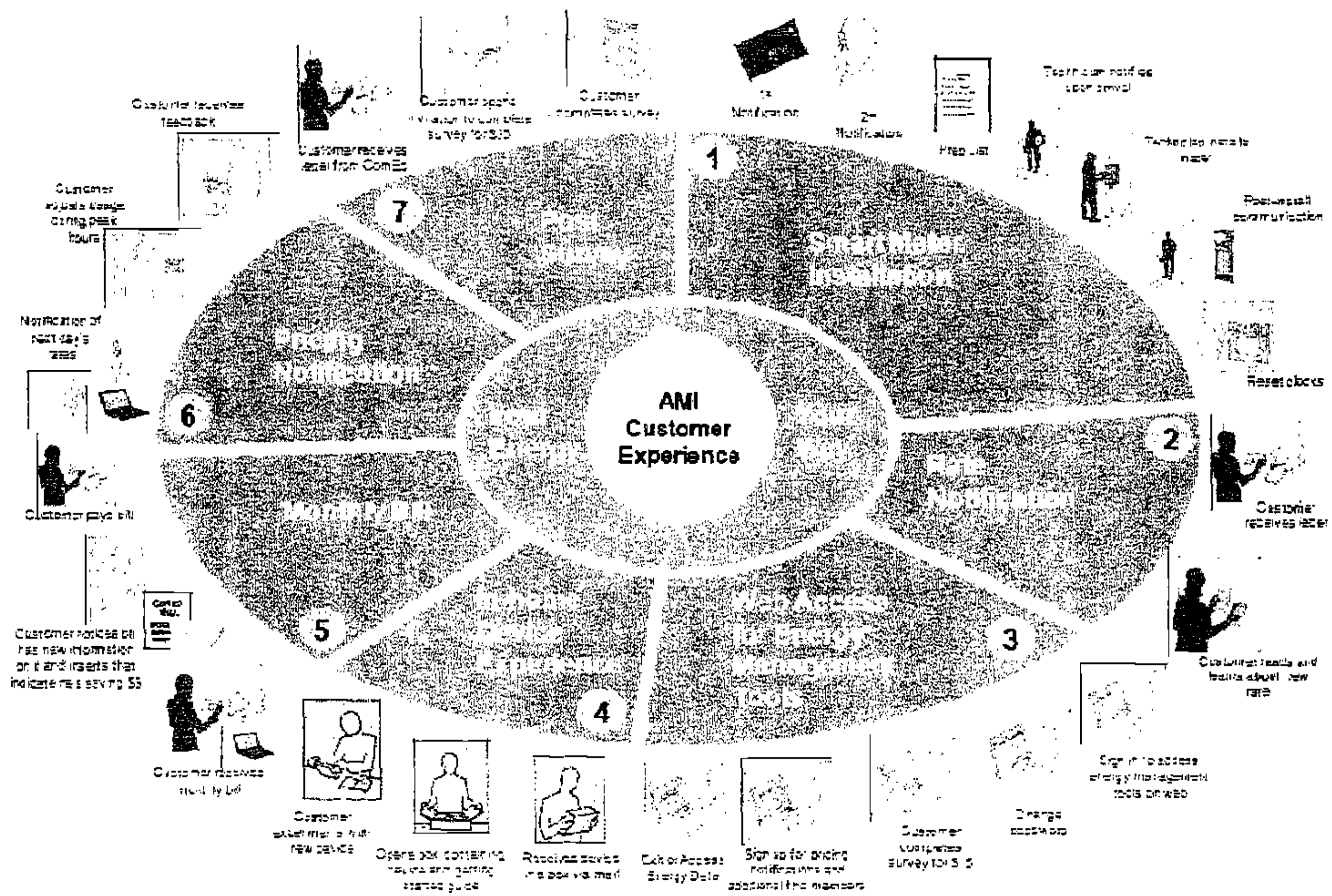



Figure 2-11
CAP Customer Experience Design

### *Phase 1: Primary Communications for Awareness, Notification, and Enabling Technology Adoption*

On October 22, 2009, customers in the AMI footprint began receiving Smart Meter Installation Notification Letters. An automated phone call reminding customers of installation was made approximately one week prior to meter installation. Meter installation commenced on November 9, 2009. This sequence of notification and installation continued in waves until March, 2010.

On March 24, 2010, the SmartTools call center went live and the ComEd.com/SmartTools website went live with a limited feature set (account creation, Survey A, advice and ideas, and pricing plan education). Between March 24 and March 27, 2010, 8,308 customers assigned to the CAP were mailed the rate notification letter (RNL).[24] A $15 bill credit for completing Survey A was offered as an incentive to open the letter and return the survey.

Response to the RNL consisted of returned surveys, returned postcards, returned mail, and phone calls. When surveys and postcards were received by the SmartTools call center, the call center performed data entry into the CAP database. If customers requested additional education either on the survey or postcard, the SmartTools call center processed those requests and sent customers the Customer Education Packet. Returned mail names and addresses were entered into a spreadsheet and the spreadsheet was sent to ComEd to update or verify the status of the customer. If the customer still had a valid account, or if there was a new address, then a duplicate RNL was sent to the customer. Inbound phone calls received from customers during normal business hours were handled by SmartTools operations assistants, and a detailed record of the call was recorded in the Salesforce database.

On April 5, 2010, the field service vendor started installing AIHDs. On April 6, 2010, the vendor started shipping BIHD to customers and continued shipping in waves according to the following schedule.

- 4-6-10: 2 pallets mailed out of Carol Stream post office. Total QTY: 683
- 4-14-10: 2 pallets mailed out of South Suburban post office. Total QTY: 500
- 4-16-10: 2 pallets mailed out of Chicago post office. Total QTY: 415
- 4-20-10: 2 pallets mailed out of Carol Stream post office. Total QTY: 447
- 5-6-10: 2 pallets - 1 pallet mailed out of Chicago post office, 1 pallet mailed out of Carol Stream post office. Total QTY: 511

Due to the limited number (<1%) of AIHD installations being scheduled by customers, the SmartTools call center initiated an outbound telephone survey starting on April 7, 2010. Calls

[24] Contrary to customer requirements collected in August 2009 and integrated communications plans developed by ComEd Communications, Operations, and CAP in October and November 2009, no broad-based awareness communication was provided to customers in the AMI footprint between the smart meter installation notification and rate notification. There are two reasons for this. First, due to time and resource constraints, ComEd was not able to execute an overall AMI awareness campaign prior to CAP rate notification. Second, concerns about the spill-over effects of the "smart meter revolt" situations in California and Texas at the time caused ComEd to take a more conservative and limited approach to broad communications.

were made to a randomly selected group of AIHD customers (N=473; Total Contacted = 101). The purpose of this survey was to assess the reasons why customers were not calling to schedule installation of the AIHD, and then to offer AIHD installation. A second outbound telephone survey to customers who had not scheduled AIHD installation but who had returned Survey A was also conducted (N=95).

On April 27, 2010, customers were officially enrolled in the CAP. Any customers who were "finaled" (meaning that they terminated service with ComEd) were removed from the enrollment. Additionally, between April 27 and May 27, 2010, any CAP customers who "finaled" are counted as "Finaled Before Enrollment" (code FB), meaning they left their premise prior to billing on a CAP rate. The net results of this are that any CAP customer who discontinued service prior to May 27, 2010 was not enrolled in the CAP.

On April 30, 2010, CAP customers on billing cycle 1 went live on their new pricing plan. Customers on other billing cycles went live on the new pricing plan on the day their billing cycle started.

### *Phase 2: Supplemental Communications for Awareness and Enabling Technology Adoption*

Based upon the results of the April 7, 2010 AIHD telephone survey, in which 36% of customers contacted did not recall receiving the RNL, the CAP team determined that supplemental customer communication was necessary to achieve two objectives: 1) remind customers about the change to their pricing plan; 2) encourage customers to schedule or activate the enabling technologies associated with their pricing plan. Table 2-5 summarizes the communications touchpoints that focused on generating awareness, increasing understanding, and driving adoption of smart meters, pricing plans, and enabling technologies. In this table, the touchpoint type reflects either planned communications (P) or supplemental communications (S). The Web, BIHD, and AIHD columns list the number of CAP customers associated with that enabling technology who were sent the message associated with the touchpoint. Totals at the bottom of the table derive and summarize the number of customer touches related to CAP awareness and enabling technology adoption.

**Table 2-5**
**Primary and Supplemental Communication Touchpoints for CAP Customers**

| Touchpoint | Date(s) | Type | Web | BIHD | AIHD | Description |
|---|---|---|---|---|---|---|
| Installation Letter | 10/22/09 – 3/31/10 | P | 8,100 | 2,925 | 2,625 | Smart meter installation notification letter. |
| Installation Reminder Call | 10/22/09 – 3/31/10 | P | 8,100 | 2,925 | 2,625 | Smart meter installation automated reminder call. |
| Installation | 11/9/09 – 3/31/10 | P | 8,100 | 2,925 | 2,625 | Smart meter installation, with door knock and door hanger/contact card. |

| Touchpoint | Date(s) | Type | Web | BIHD | AIHD | Description |
|---|---|---|---|---|---|---|
| RNL Mailing | 3/24/10 | P | 8,100 | 2,925 | 2,625 | Customers notified of BIHD and AIHD. Extra promotional page included in the RNL for AIHD Free, AIHD Purchase, and BIHD Purchase customers. |
| CEP Mailing | April 2010 | P | 1,889 | 702 | 630 | Estimated requests for customer education package based upon a response rate of 24%. |
| BIHD Device Mailing | 4/6/10 | P | 0 | 2,700 | 0 | BIHDs mailed to all BIHD Free customers. |
| AIHD Research | 4/7/10 – 5/3/10 | S | 0 | 0 | 568 | Calls made to AIHD customers to inquire about why they have not called to schedule their AIHD. Included a random sample of customers, plus 95 customers who had returned Survey A. |
| Rate Reminder Automated Call | 5/5/10 | S | 6,450 | 2,625 | 2,400 | Calls made to BIHD and AIHD Reduce-and-Save and Shift-and-Save pricing plan customers to remind them of the pricing plan change in May. |
| AIHD Automated Calls | 5/11/10 | S | 0 | 0 | 448 | This involves automated calls preceding the mailing of the OpenPeak devices and the OpenPeak direct mail letters to customers. |
| AIHD Device Mailings | 4/28/10<br>5/12/10 | S | 0 | 0 | 569 | This involves mailing OpenPeak devices to 1) AIHD customers who returned the survey; and 2) randomly selected AIHD customers from cells D3 and D4. |
| AIHD and BIHD Purchase Direct Mail Calls | 5/17/10 | S | 0 | 225 | 1,370 | Outbound automated telephone calls to AIHD Free, AIHD Purchase, and BIHD Purchase customer who are not part of the 5/12/10 device mailing. This is part of the "experiment within an experiment" plan. |
| AIHD and BIHD Purchase Direct Mail | 5/19/10 | S | 0 | 225 | 1,370 | Mailing of direct mail pieces to AIHD Free, AIHD Purchase, and BIHD Purchase customers. This is part of the "experiment within an experiment" plan. |
| OPOWER Introductory Energy Management Report | 5/21/10 – 5/31/10 | P | 7,875 | 0 | 0 | Mailed an introductory energy management report to CAP customers to remind them about the new pricing plan and introduce them to neighbor comparisons and energy tips. |
| AIHD Callbacks | 6/2/10 | S | 0 | 0 | 569 | Outbound call to AIHD customers who were mailed a device on 4/28/10 or 5/12/10, inquiring about activation or return. |
| BIHD Activation Reminder Calls | 6/2/10 | S | 0 | 2,300 | 0 | This automated call informs BIHD Free customers that an activation reminder letter is coming. |

| Touchpoint | Date(s) | Type | Web | BIHD | AIHD | Description |
|---|---|---|---|---|---|---|
| BIHD Activation Reminder Letter | 6/7/10 | S | 0 | 2,300 | 0 | This mailing reminds BIHD Free customers to activate the device, or mail it back to us using a pre-paid shipping label. |
| CPP/PTR Rate Update Letter | 6/14/10 | S | 3,300 | 1,050 | 1,500 | This mailing informs CPP and PTR customers that the peak day rate or rebate has increased by 54¢/kWh. |
| IHD Sched./ Activate | 3/24/10 - 5/28/10 | P | 220 | 404 | 185 | Total number of customers who have called the SmartTools call center to schedule or activate a device. |
| Web Reminder Letter | 6/10/10 | S | 8,100 | 2,925 | 2,625 | Mailing to all AMI footprint customers announcing that ComEd.com/SmartTools is up and running. |
| Notification Update Letter | 8/10/10 | S | 1,089 | NA | NA | This mailing reminds CAP customers who do not appear to be receiving phone notifications of peak-day alerts to update their notification information via postcard or website. |
| Billing Issues Letter | 8/15/10 | S | 1,837 | NA | NA | This mailing informs a subset of CAP customers about why they have not received a bill. |
| Rate Comparison Letter | 9/17/10 | S | 5,056 | NA | NA | This mailing provides CAP customers on Reduce-and-Save and Shift-and-Save pricing plans a three-month rate comparison. This rate comparison was originally to appear on the monthly Opower report, but was discontinued due to data quality issues. |
| Total | | | 68,216 | 27,156 | 22,734 | The total number of customer/ communication touchpoints. |
| Population | | | 8,100 | 2,925 | 2,625 | The estimated population of Web, BIHD, and AIHD cells. Does not take into account opt-out or finaled customers. |
| Total Touches | | | 8.42 | 9.28 | 8.66 | The total number of touches (Total/Population) |
| Total CAP Touches | | | 5.42 | 6.28 | 5.66 | The total number of touches involving awareness of CAP and its related enabling technologies. Formula is (Total Touches – 3), where 3 equals the smart meter installation communications that did not contain any CAP content. |
| BIHD/AIHD Touches | | | NA | 4.28 | 3.66 | The total number of times BIHD and AIHD customers were touched and communicated to about the devices. Formula is (Total CAP Touches – 2), where 2 equals the Rate Reminder and Web Reminder letters that did not contain any BIHD or AIHD content. |

### *Phase 3: Billing, Monthly Reports, and Pricing Notifications*

CAP customers in billing cycle 1 began receiving bills associated with the new pricing plans on June 1, 2010, with customers on other billing cycles receiving their first bills on the corresponding bill cycle dates in June. OPOWER monthly energy reports were sent to customers approximately two weeks after customers received the bill. This sequence of bill and monthly energy report was to be repeated every month for the 12 month CAP program.

Between June 2010 and September 2010, up to10 peak day events were to be simulated. However, due to conflicts with the timing of ComEd's rate case announcement, the start date for peak day events was delayed until July 2010. As illustrated in Figure 2-12, the conditions triggering a peak day event were associated with weather conditions, with the desirable condition being a temperature of 85° or higher. Once a target day was identified, team members were notified of the possibility of an event. A day before the event, appropriate departments in ComEd indicated that they were ready for the event, and based upon another check of weather and PJM data, the decision to call the event was made. Customers were then notified of peak day events by automated phone call, e-mail, and/or text message a day ahead of the event (according each customer's notification preferences, which they specified on Survey A or on the ComEd.com/SmartTools website), and IHD messaging during the day of the event. Table 2-6 shows the peak day events that were called during summer 2010.

**Table 2-6**
**Summer 2010 Peak Day Events**

| Event # | Date |
|---|---|
| 1 | July 14 |
| 2 | July 23 |
| 3 | July 27 |
| 4 | August 19 |
| 5 | August 20 |
| 6 | August 31 |
| 7 | TBD |
| 8 | TBD |
| 9 | TBD |
| 10 | TBD |

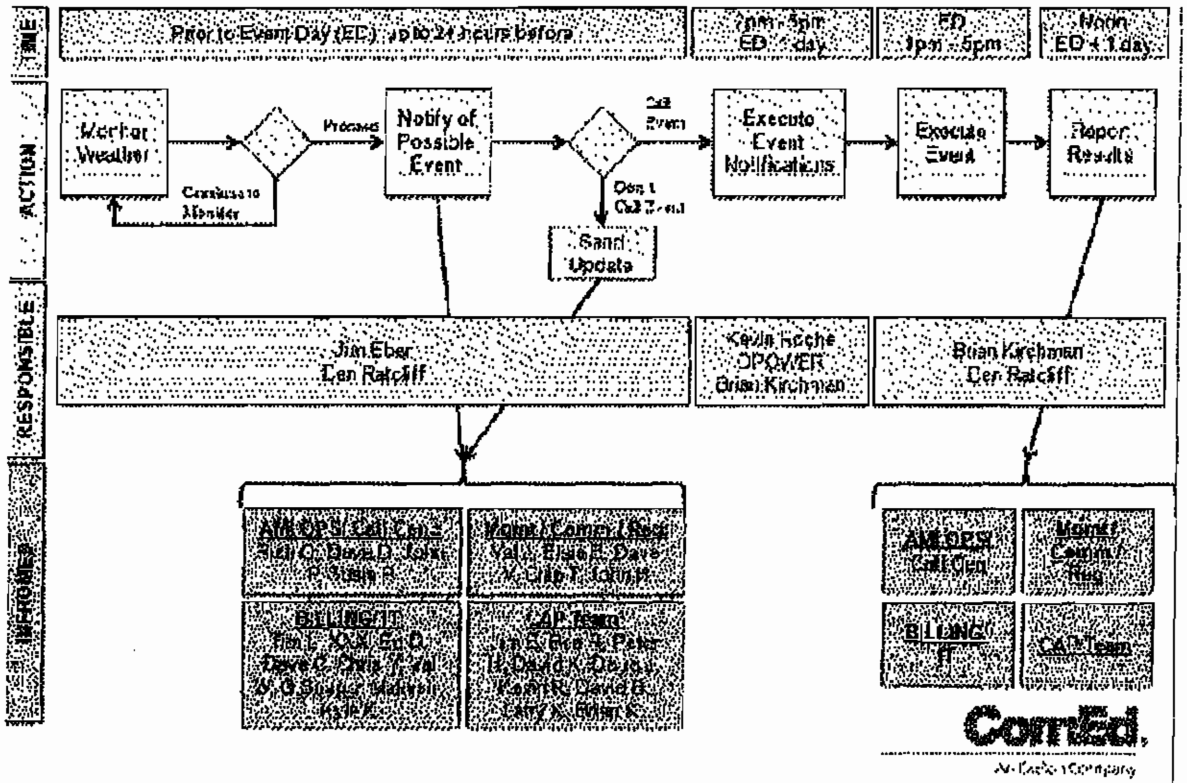



**Figure 2-12**
**Peak Day Event Workflow**

In addition to the peak day event notifications, customers whose pricing plans involved a day-ahead hourly rate received day-ahead high price notifications when the hourly price of electricity was to exceed 13¢ per kWh. Customers were notified of high price events by automated phone call, e-mail, and/or text message a day ahead of the event (according each customer's notification preferences), and IHD price messaging during the day of the event. Additionally, customers could access day-ahead and day-of pricing by phone and at the ComEd.com/SmartTools website.

Figure A-7 in Appendix **Error! Reference source not found.** illustrates how peak day and high price notifications were disseminated across the different control and application groups.

### *Phase 4: Transition Back to Flat Rate Pricing and Study Debriefing*

On April 4, 2011, CAP customers will be notified through an automated phone call and through a mailed letter notifying them that the CAP will end on April 30, 2011 and that they will be switched back to Flat-Rate pricing starting in May, 2011. Additionally, this letter will provide customers the ability to request a bill credit for the difference if the annual costs associated with the new rate exceeded the annual costs if they had remained on their old rate. Included with this letter will be Survey B to collect customer opinions about the CAP (Note that customers who did not complete Survey A will receive an extended version of Survey B that includes the Survey A items). The deadline for completing Survey B will be June 15, 2011. Customers who complete Survey B will receive a $35 honorarium, and customers who complete the extended Survey B will receive a $50 honorarium.

In July, the study will be terminated by sending CAP customers a study debriefing letter. The purpose of this letter will be to share with customers the results that they experienced as well as the results of the experiment.

## Measures, Data Collection, and Data Storage

The measures that were collected involved quantitative and qualitative data representing economic and social outcomes. As previously mentioned, economic outcomes measure changes in electricity consumption for energy efficiency, demand response, and load shifting. The primary measures that were used for electricity consumption are electricity usage (in kWh) and cost (in dollars). Data for electricity usage came from interval meter readings with a sensitivity of 30-minute intervals. At least one month of baseline data were collected prior to CAP customers starting their new pricing plans. Twelve months of interval data were collected for CAP customers between the time the customer's smart meter was certified and April 30, 2011. Rate data came from the AMP-CA Energy Supply Charges supplements.

Social outcomes measure demographics, psychographics, awareness, adoption, involvement, and satisfaction. Demographic and psychographic data about CAP customers were collected by Survey A, which was administered to customers through their choice of paper, online, or telephone between March 24, 2010 and June 15, 2011. Awareness data, in terms of smart meter installation, pricing plan, and enabling technology, were collected through ad hoc telephone surveys.

Adoption data were collected through a variety of channels, including Survey A, postcards, inbound and outbound telephone, ad hoc telephone surveys, ComEd.com/SmartTools, e-mail, and return mail. Both quantitative and qualitative adoption data were collected. The qualitative data consisted of written summaries of customer interactions and call recordings. The adoption data that were collected reflects the observable actions of customers, starting with small actions (completing the survey, requesting additional customer education, providing an e-mail address for notifications, and so on) that ultimately lead to larger actions (allowing installation of an AIHD, reducing usage on a peak day, and so on). Adoption data also included drop outs, which are customers who elect not to participate in the CAP. Customers who want to drop out must call ComEd to drop out. During this call, it was attempted to retain customers by reminding them of the opportunity, the enabling technology that was offered to them, and the survey honoraria. As a last resort, customers were offered a rate guarantee, which credits customers at the end of the study if the new rate resulted in higher bills than the old rate.

Involvement data will be collected through Survey B, inbound and outbound call center calls, ad hoc telephone surveys, e-mail, ComEd.com/SmartTools, and the Energy Information System (EIS). Involvement measures the customer's interest and drive associated with the CAP (Mitchell, 1979). The number of SmartTools logins and the number of SmartTools web page visits are examples of involvement data. So are the number of BIHDs and AIHDs that remained activated on the network. Qualitative involvement data consisted of written summaries of customer interactions and call recordings.

Customer satisfaction data will be collected through Survey B, as well as ad hoc telephone surveys, inbound and outbound call center calls, and e-mail. Qualitative satisfaction data consisted of written summaries of customer interactions and call recordings.

All data entry activities, such as entering Survey A data, were performed by CNT Energy.

### *Measurement and Validation Database (MVDB)*

ComEd contracted with Accenture to manage the data associated with the CAP. Qualitative and quantitative data (with the exception of call recordings) were stored in the Measurement and Validation Database (MVDB). MVDB was built using SQL Server 2008. This platform was chosen to 1) simplify support, since there was already expertise with this platform in ComEd marketing and 2) increase the speed with which the database and reporting could be modified to meet evolving requirements. MVDB was supported by the ComEd marketing department for the duration of the CAP. For data privacy and confidentiality that reflects the Council of American Survey Research Organizations (CASRO) code of standards and ethics, customer data was keyed with a unique and anonymous Subject Number. A password-protected table that contained actual customer names and account numbers was maintained for troubleshooting purposes, with access limited to non-ComEd personnel, specifically the external database administrator.

MVDB stored four categories of data:

- Account information (customer name, address, contact information)
- Customer billing and usage information (both historical and that which occurs during the pilot)
- Customer interaction data (records of inbound and outbound customer contacts, educational materials they have received, surveys, etc.)
- Device information (AMI meters, in-home devices, thermostats, ZigBee modems, etc.)

This data was stored in approximately 40 tables in the SQL Server 2008 database (Figure 2-13). The primary key to the non-parameter tables is the BillAccountNumber, which corresponds to the ID_BA in CIMS, which the MVDB receives from CIMS during the enrollment process. The tables fall into several groupings:

- Customer Tables, which store the customer information, demographics, credit amounts, usage baselines, and so on.
- Enrollment Tables, which store the pilot treatment cell in which the customer is included and their status in that cell.
- Device Tables, which store the relationship between the customer and the various in-home devices used at their premise.

- Customer Interaction Tables, which store information about in- and out-bound communication with the customer, as well as lists of materials that the customer receives during the pilot and their survey responses (and questions).
- Static parameter tables for rates, treatment cells, media types, device types, and so on.
- "Less static" parameter tables used to calculate various indices that marketing and the customer care center use to assess customer status in the pilot.

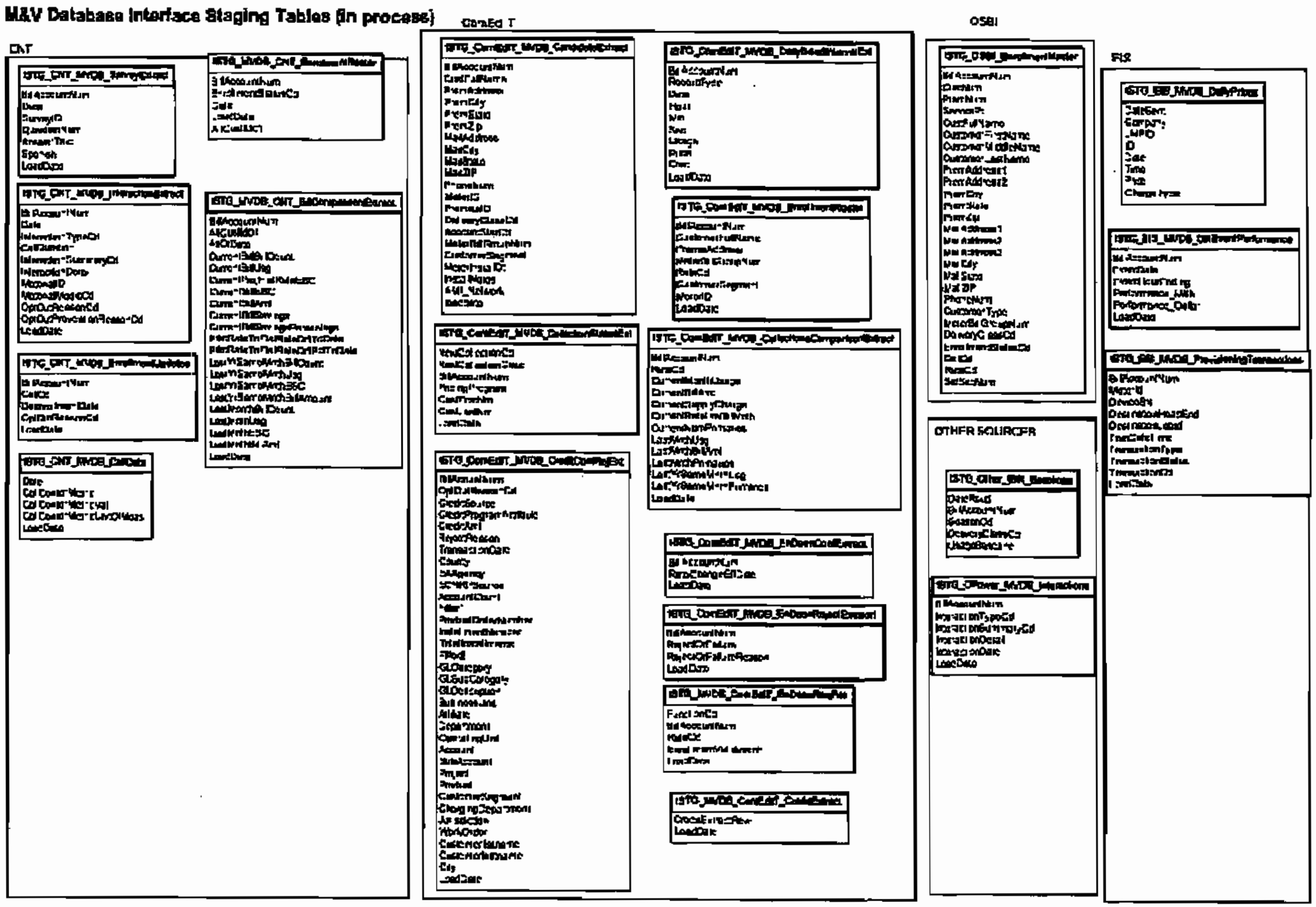



**Figure 2-13**
**MVDB Tables**

The MVDB collected information from several sources, as illustrated in Figure 2-13. All file exchanges were accomplished via SFTP in comma-delimited formats. The sources and destinations of data were:

- ComEd IT (various systems, including CIMS, MDM, or CDW)
- EIS
- CNT (the pilot's customer care vendor)
- OPower (the pilot's enhanced web vendor)
- OSBI (the ComEd Operations Strategy and Business Intelligence department)
- Marketing itself (to derive indices that are used to guide CNT)

Here is an example of how the data flows depicted in Figure 2-14 work. When a customer uses electricity, the interval usage data is stored in CIMS/MDM/CDW. This is then transformed into Billed Hourly Usage and uploaded into the MV database daily. When a customer calls CNT, the CNT operations assistant (OA) can open the customer's record in Salesforce and see their data. Also, after the CNT OA finishes the call with the customer, a record of that call (the customer interaction data) is entered into Salesforce. On a daily basis, the customer interaction data is then sent to the MV database.

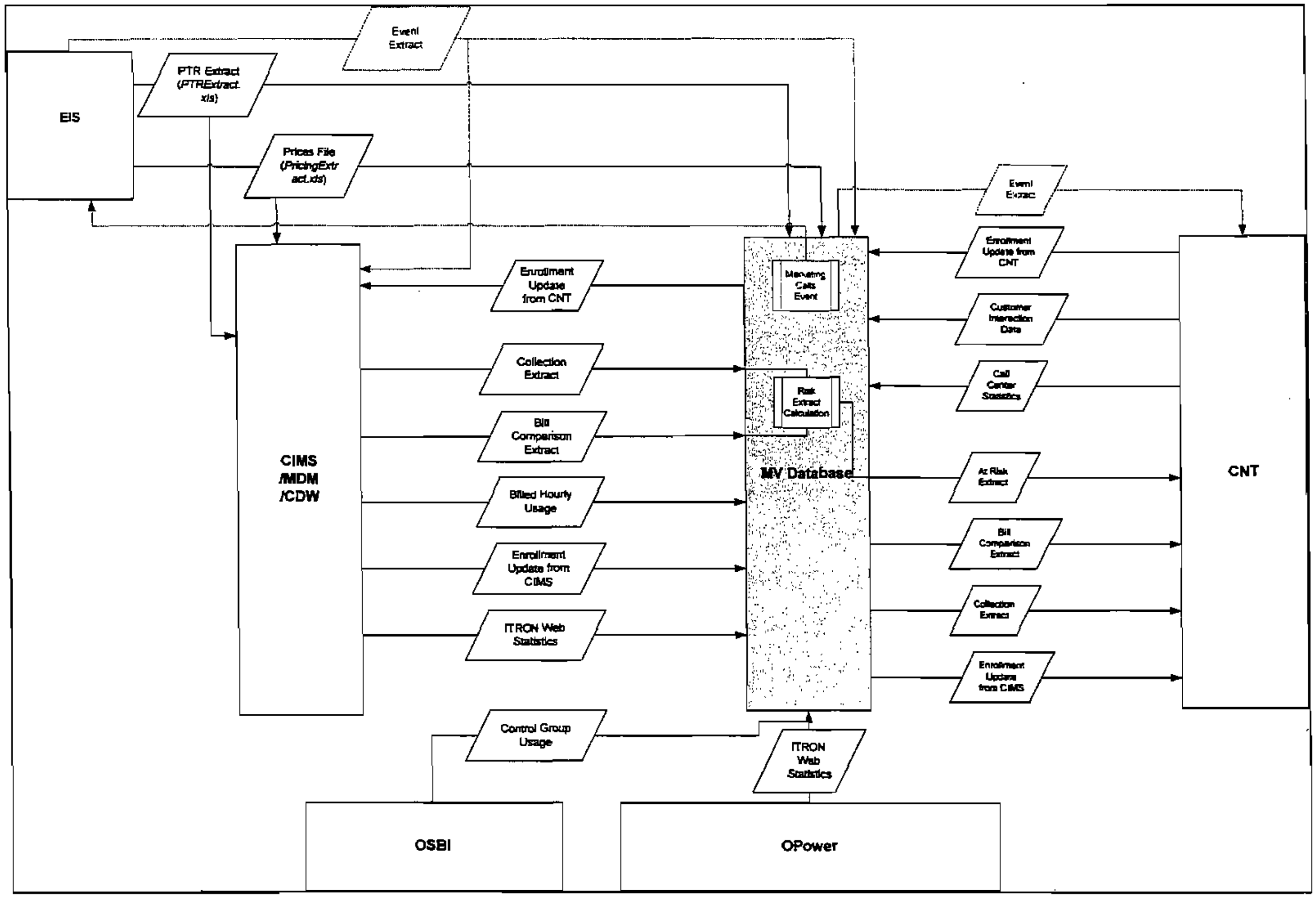



**Figure 2-14**
**Data Flows into MVDB**

# 3 CONCLUDING REMARKS

This report is the first in a series of reports that discuss the design and results associated with the ComEd customer applications program (CAP). This report presented a detailed overview describing how the CAP was conceived, designed, constructed, and executed. As the first opt-out pilot in the U.S., the CAP breaks new ground in terms of the potential to better understand customer adoption of new rates and enabling technologies, and the effect of these rates and technologies on energy efficiency, demand response, and load shifting behaviors. The key points to take away from this report include the following:

- CAP was conceived through a collaborative process between ComEd and its stakeholders. Through the stakeholder workshop process, ComEd collected a comprehensive set of requirements representing the needs of stakeholders and customers. These requirements established the foundation for the independent variables that were selected for the CAP.

- CAP was designed using a customer-centered design approach. Through this approach, customer requirements collected from primary and secondary research were blended with evidence-based models and principles from the consumer behavior, behavioral economics, behavioral health, human performance, and instructional design fields. The result is a coordinated and orchestrated set of touchpoints focused on delivering a customer experience.

- The CAP was constructed in a relatively short time frame (June, 2009 through March, 2010) using several technologies that were either untested or didn't exist. Billing systems needed to be enhanced to support five new rates. An energy information system needed to be constructed to deliver pricing information and alerts to in-home displays. In-home display firmware needed to be enhanced to support six types of rates. A call center needed to be implemented. Twenty-seven unique RNLs and CEPs needed to be developed and tested. And a database that could track all the data, results, and customer interactions generated during the CAP needed to be built.

- The CAP was executed on-time. The call center and ComEd.com/SmartTools website went live on March 24, 2010, and 27 unique versions of the RNLs were sent to the correct 8,522 customers. By June 30, 2010, 33% of customers had completed Survey A, 25% of customers had requested the CEP, 24% of customers sent a BIHD had activated it, and only 1% of customers had dropped out. Yet there have been some challenges that may have an impact on results we ultimately report from the CAP (all data below is reported as of June 30, 2010).

- Only 21 (2.8% of eligible customers) AIHD/PCTs have been installed. This is an insufficient number from which to generate statistically significant results regarding the technology's impact on energy efficiency, demand response, and load shifting.

- Only 218 (0.9% of eligible customers) AIHDs have been activated. This is an insufficient number from which to generate statistically significant results regarding the technology's impact on energy efficiency, demand response, and load shifting. However, by combining cells D3 and D4, we may have a sufficient number of subjects (N=108) from which to generate statistically significant results.

- Only 297 (3.8% of eligible customers) ComEd.com/SmartTools website accounts have been created. This is an insufficient number from which to generate statistically significant results regarding the technology's impact on energy efficiency, demand response, and load shifting.

- Pricing and cost information has not been displaying correctly on the BIHD and AIHD. This has caused several customer complaints, with a few customers returning the enabling technology to ComEd. ComEd is working to solve these issues before the first peak day event in July.

- A data quality issue delayed the rate comparison module from being included on the OPOWER monthly report. It was discovered in early June that the rate comparison data on the OPOWER monthly report was not matching the data on customer bills. Thus, we removed the rate comparison module from the OPOWER report and included an energy tip directing customers to call the SmartTools call center for the comparison.

- Over the course of the program, the project team validated and learned best practices for rolling out customer application programs within an AMI program. Some highlights include:
  - Have clear sponsorship. A successful program includes ownership at the top and tight coordination across all impacted chains of the organization from Customer Care, Marketing, AMI Operations, and Corporate Communications.
  - Select enabling technology vendors early in the process. Having time for an extra iteration of testing will help the overall customer experience and adoption.
  - Operationalize the AMI Operations organization, set meters, and achieve success in read rates and billing before initiating customer programs. Critical path items include meter deployment, device certification with AMI vendor, meter communication, and meter certification.
  - Ensure quality of the data. Interval data will move through different processes and be distributed to different endpoints (in-home displays, web reports, bills, and so on). Appropriate controls and quality gates are necessary.
  - Include adequate time in customer-facing communication materials deployment schedule for multi-stage review process.

- o Maintain a tight change control process and vendor relationship to ensure requirements are fully met and tested. The technology in the customer applications space is still relatively immature.
- o Slowly deploy technology in the field, first at friendly sites, and slowly expand to additional customers. Deployment of technology across a communications network and into inconsistent environments such as customer's homes adds increased challenges to issue resolution.

The next report scheduled for the CAP is the analysis plan. The analysis plan will describe the analysis methods that will be used to test the hypotheses specified in this report.

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