Commonwealth Edison Company Direct Load Control Pilot for the Peak Time Savings Program

January 31st, 2014

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I. Executive Summary

On February 21, 2013, the Illinois Commerce Commission ("Commission") approved ComEd's Rider PTR – Peak Time Rebate ("Rider PTR"), an opt-in, market-based demand response program for customers with smart meters that will be marketed as the "Peak Time Savings" or "PTS" program.[1] The Commission also directed ComEd to design a pilot program where some PTS program participants will be provided with direct load control ("DLC") technology[2], so that a comparison can be made between PTS participants with DLC and PTS participants without DLC. This comparison is intended to allow the Commission to make a reasoned decision regarding whether to adopt DLC technology as part of the PTS program. Following consultation with the Smart Grid Advisory Council, ComEd has developed a proposed DLC pilot program for the Commission's consideration.

The objectives of the proposed DLC pilot program are to:

- Determine the incremental impact of DLC technology on electricity curtailment for PTS customers in order to determine whether offering DLC technology to PTS customers is cost effective.
- Understand the incremental impact of offering DLC technology on PTS enrollment in order to determine whether offering DLC technology to PTS customers is cost effective.
- Identify the incremental effect of DLC technology on customer satisfaction for customers enrolled in the PTS program

The proposed DLC pilot incorporates an event-based randomized control trial ("RCT") design. A RCT refers to a type of scientific experiment designed to ensure that the groups receiving the experimental treatment and the control groups not receiving the experimental treatment are identical in every way except for the fact that one group is exposed to the treatment under study and the other is not. Here, as explained in more detail below, the treatment ComEd proposes to test during the DLC pilot through its event based RCT design is providing customers with DLC equipment at no or reduced cost and controlling the load of such customers during an event. The "treatment customers" or "treatment groups" will be customers provided DLC equipment at no or reduced costs who have their load controlled during an event. The "control groups" or "control customers" will be customers that received DLC equipment at no or reduced costs but for whom a curtailment event is not initiated.

An event-based RCT design allows ComEd to vary the treatment and control customers for different curtailment events and avoids the need to deny or defer DLC equipment to DLC pilot participants in order to create control groups. ComEd considers this approach to be highly preferable due to the

[1] Residential customers participating in the PTS program will receive bill credits for the kilowatt-hours ("kWh") of estimated electricity reduction achieved by such customers during curtailment periods, which are specific periods of time identified by ComEd during which participating customers will be requested to temporarily reduce their electric load. A PTS customer that responds to such a call by reducing their electricity usage during a curtailment period will receive credits, but no penalty will be imposed for customers who do not respond.

[2] DLC technology is equipment that is capable of automatically controlling air conditioning equipment upon receiving a direct signal from a curtailment provider (in this case, ComEd).

customer dissatisfaction that would likely result from recruiting customers into the DLC pilot and denying or deferring receipt of DLC equipment for some of those customers. The proposed DLC pilot design includes both major residential customer types (single-family and multi-family) as well as both types of air conditioning equipment (central air conditioning ("Central AC") and window or plug-in air conditioning ("Plug-in AC")). This pilot design will provide data on a broad range of DLC equipment (i.e. DLC device for Central AC, programmable communicating thermostat ("PCT") for Central AC, and DLC device for Plug-in AC).

The proposed DLC pilot design includes five (5) groups. Table 1 - DLC Pilot Design Summary describes ComEd's proposed DLC pilot program design with respect to customer types, groups, enrollment / enabling technology offers, and enrolled target. ComEd proposes that each group include 500 customers in order to ensure that statistically significant conclusions can be obtained for all relevant treatment groups.

Table 1 - DLC Pilot Design Summary

Customer Type	Group	Enrollment Offer / Enabling Technology Offer	Enrolled Target
Single Family with Central AC	Group 1	Peak Time Savings + None	500
	Group 2	Peak Time Savings + DLC Device for Central AC	500
	Group 3	Peak Time Savings + PCT (customer purchased with bill credit for portion of cost)	500
Multi Family with Plug-in AC	Group 4	Peak Time Savings + None	500
	Group 5	Peak Time Savings + DLC Device for Plug-in AC	500

A comparison of enrollment rates for the PTS program across the five groups will identify the extent to which the offer of free or partially customer funded enabling technology increases enrollment in the PTS program. A comparison of the acceptance rate in Group 1 against Groups 2 and 3, or the acceptance rate in Group 4 against Group 5 provides the relevant data to answer the question: "does the offer of technology increase PTS enrollment?" This is further discussed below.

An assessment of the impact of the technology on load reductions during PTS events will be made by dividing participants in each group into subgroups and alternating the subgroup that is notified or

curtailed for each event. Impacts will be estimated using household level interval data from the installed base of smart meters for participants in Groups 1 through 4 and from end-use data for Group 5. A comparison of load reductions for the treatment customers and the control group customers for each event will provide a direct measure of the effect of the DLC technology over and above the load reductions that would be obtained from PTS without DLC technology.

The proposed DLC pilot is structured with 6 key work stream / task areas:

1. Customer Experience / Customer Education Design
2. DLC Enabling Technology Selection & Implementation
3. Pilot Program Marketing / Recruiting
4. DLC Enabling Technology Installation
5. Pilot Program Execution / PTS Curtailment Events
6. Measurement and Validation ("M&V") Evaluation Report

ComEd proposes to start recruiting customers to participate in the DLC pilot program following approval by the Commission, and conclude that process by the end of March, 2015. Participation in the pilot would span the summer of 2015 for curtailment events. Evaluation of the DLC pilot program, including load impacts, impacts on customer enrollment, and impacts on overall customer satisfaction will be documented in a report that will be filed and provided to Staff and the service list in ICC Docket No. 12-0484 by December 31, 2015. To execute the pilot, ComEd proposes the following project schedule, as shown in Figure 1 - High Level Project Schedule:

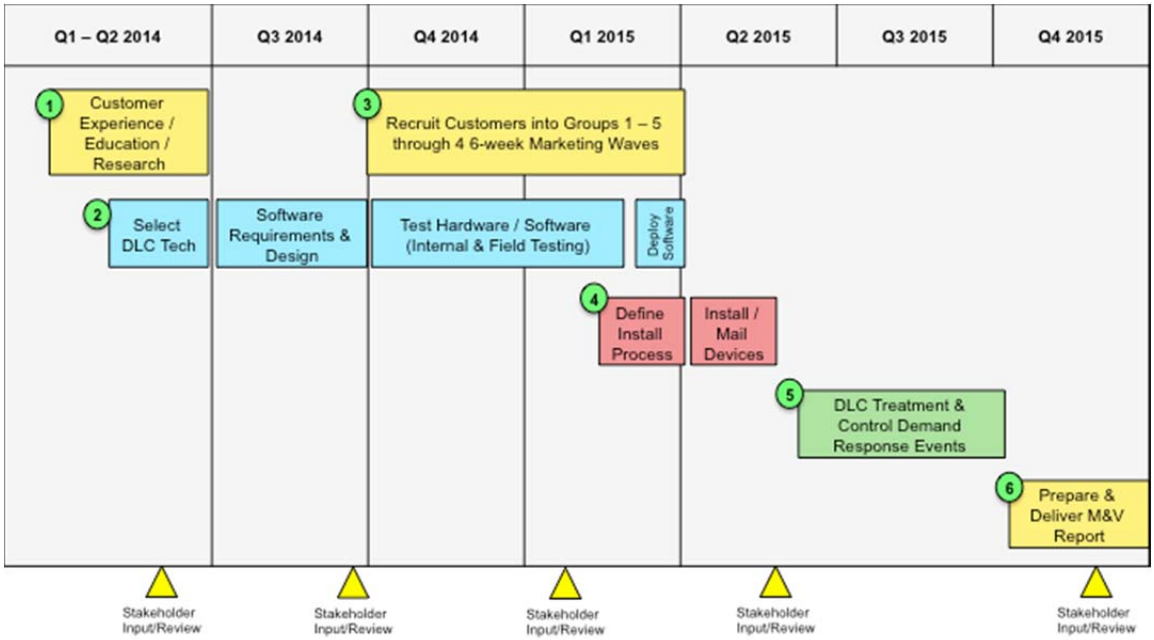


Figure 1 - High Level Project Schedule

ComEd estimates that the cost to design, build, test, and operate the DLC pilot program will be approximately $2,567,500.

II. Background

A. Overview of the Peak Time Savings Program

ComEd's PTS program is an opt-in program for customers with smart meters who take service under Rider PTR. Under the PTS program, participating residential customers will receive bill credits for the kWh of estimated electricity reduction achieved by such customers during specific periods of time identified as curtailment periods. ComEd will request that customers participating in the PTS program temporarily reduce their electric load during a curtailment period. A PTS customer that responds to such a call by reducing electricity usage during a curtailment period will receive credits, but no penalty will be imposed for customers who do not respond. Electricity usage reductions will be measured by comparing actual usage during a curtailment period to estimated usage determined using a customer baseline load ("CBL") methodology. The credits provided to PTS customers will be fully funded through ComEd's bidding of PTS resources into the capacity and energy markets of PJM International, L.L.C. ("PJM"), with the vast majority of compensation coming from PJM's capacity market.

The PTS program provides that no curtailment period may occur prior to June 1, 2015. The PTS program provides for a peak time rebate of $1.00/kWh for both 2015 and 2016. The total PTS credit for each event, provided to a participating customer, is the product of the $1.00 per kWh credit and the estimated amount of kWh reduction achieved by the participant during the event.

B. ICC Ruling on the Need for ComEd to Conduct a Pilot that Assesses the Value of Providing DLC Technology with PTS

On February 21, 2013, the Commission entered an Interim Order in Docket No. 12-0484 ("Interim Order"). In its Interim Order, the Commission determined there were too many unanswered questions to decide whether DLC should be provided to all PTR participants, but directed ComEd to design a pilot DLC program, with input from the SGAC, in order to develop data to answer those questions. These questions included: (1) how much energy is curtailed with or without DLC technology; (2) how much demand response ComEd is able to bid into PJM with or without DLC technology; (3) how much revenue would be received from PJM with or without DLC technology; (4) what would the level of customer satisfaction be with or without DLC technology; and (5) what would the cost of PTS be with or without DLC technology.

The Commission directed ComEd to file testimony by February 1, 2014, describing the design it would propose for a DLC pilot and any other information ComEd deems relevant to proceeding with the pilot. The Commission also directed that implementation of a DLC Pilot should coincide with PTS in the summer of 2015 and a report of the results of the first year should be filed by the end of 2015.

C. Objectives of the DLC Pilot

Beginning in June 2013 and continuing through calendar year 2013, ComEd met with SGAC and other stakeholders to develop a DLC pilot program in order to determine the benefits of offering DLC technology as part of the PTS program. The identified objectives of the DLC pilot include the following:

- Determine the incremental impact of DLC technology on electricity curtailments for PTS customers in order to determine whether offering DLC technology to PTS customers is cost effective.
- Understand the incremental impact of offering DLC technology on PTS enrollment in order to determine whether offering DLC technology to PTS customers is cost effective.
- Identify the incremental effect of DLC technology on customer satisfaction for customers enrolled in PTS program

The purpose of this DLC Pilot Plan is to describe how the proposed DLC pilot program design addresses these objectives, outline the processes proposed for implementing the pilot, and propose a plan for the evaluation. The evaluation is intended to yield statistically valid estimates of customer response during PTS curtailment events with and without the enabling technology. In addition, it will provide insight into the receptiveness of customers to the PTS program with DLC technology included in the offer.

Section III - DLC Pilot Program Design and Evaluation Process describes in detail the proposed pilot design for DLC of residential Central AC and Plug-In AC units. It describes the DLC technology under consideration, pilot program design options, and the proposed pilot design recommended for Central AC customers and for Plug-in AC customers. Finally, it describes the measurement and evaluation requirements; specifically, the M&V components of the DLC pilot program. The evaluation requirements include details about the key measures and methods associated with the pilot program. Section IV - Customer Experience Process describes the specific customer interactions that will take place under the pilot program. Section V - DLC Pilot P presents the project plan. The project plan includes the specific tasks, resource requirements, responsibilities, schedule, budget, and deliverables. An appendix provides detailed information and elaboration about the process used to identify enabling technology and develop a high-level pilot program cost element.

III. DLC Pilot Program Design and Evaluation Process

The primary focus of the PTS DLC pilot program is to assess the impact of the offer of enabling technology on customer enrollment in the PTS program and to assess the impact of providing enabling technology as part of PTS on the magnitude of electricity curtailment. A carefully designed pilot simplifies impact evaluation and helps ensure that any observed change in the variable of interest (e.g., peak period energy use) is the result of the factors being tested (referred to as the treatment, which in this case is the offer of PTS with technology). This section summarizes the proposed design of ComEd's PTS pilot. Section III.A provides a brief overview of the enabling technology that ComEd is considering for use in its DLC pilot. Section III.B provides a brief summary of design options that ComEd considered while designing the DLC pilot. Section III.C summarizes the proposed design for the load control pilot for

Central AC for Residential Single Family customers. Section III.D discusses the design of the pilot for Plug-in AC for Residential Multi Family customers.

A. DLC Enabling Technology Considerations

The DLC pilot program will investigate the effect of three combinations of enabling technology, type of customer class (single family or multi family) and type of air conditioning unit (Central AC or Plug-in AC) on PTS program enrollment and performance during PTS curtailment events as described in Table 2 - DLC Technology Overview.

Table 2 - DLC Technology Overview

Enabling Technology	Description	Example[3]
Single Family Central Air-Conditioner Device	A Single Family Central Air-Conditioner Device is a device that is connected directly to the Central AC unit. The device is able to connect directly to ComEd's paging network. Once the device is connected to the paging network, during PTS curtailment events, the device will receive a signal from the utility and the air-conditioner unit will be controlled. Customers are able to over-ride the direct control process.	
Single Family Programmable Communicating Thermostat	A programmable, communicating thermostat ("PCT") automates the heating, ventilation, and air conditioning ("HVAC ") equipment. Customers can program the PCT to heat and cool to specific temperatures at specific times of the day. The PCT connects to the Internet through a WIFI connection and can receive signals from the utility or customer to raise or lower temperature during curtailment events.	

[3] Enabling technology examples shown in this table are for illustration purposes only. No endorsement implied.

Enabling Technology	Description	Example[3]
Multi Family Plug-in AC Control Device	A Multi Family Plug-in AC Control Device is a simple device that is placed between the wall outlet and the Plug-in AC unit. The device connects to the Internet via WIFI, 3G, or a gateway. Once the device is connected to the Internet, during PTS curtailment events, the Plug-in AC unit will receive a signal from the utility and will be controlled. Customers are able to over-ride the direct control process.	

B. Pilot Design Options

A minimum objective for any experiment or pilot is internal validity. Internally valid load impact estimates in the context of a DLC pilot means that there is no other explanation for any observed difference in usage for PTS participants who are and are not provided with enabling technology other than the equipment itself. Put another way, internally valid estimates are devoid of selection bias or the potential influence from exogenous factors such as weather, the economy, the implementation of energy efficiency measures, or other factors. Internal validity should be a minimum objective for any pilot. In practice, this minimum objective is often violated through poor pilot design or through a failure to anticipate possible factors that can undercut internal validity, such as a failure to consider the fact that you can't force enabling technology on pilot participants or that not all households who accept the technology will necessarily have it successfully installed.

The best way to ensure that any estimated load impacts are internally valid is to compare the usage of treatment customers before and after exposure to the treatment with the usage of an identical group of customers who do not have enabling technology. This identical group of customers is referred to as a control group. The key word in the last sentence is "identical." If the control and treatment groups differ in any way other than the fact that one is exposed to the treatment and the other is not, any observed difference in their usage could be due to the preexisting difference and not due to the treatment being studied. For example, if those who enroll in the PTS program have higher or lower peak period usage than the population at large, any difference in usage between the participant population and the general population after participants enroll in the program and accept the load control devices might not be due to the treatment but rather to the preexisting difference in loads.

Randomized control trials ("RCT") are designed to ensure that treatment and control customers are identical in every way except for the fact that one group is exposed to the treatment and the other is not. For many treatments of interest in the electricity industry, such as time of use rates and energy efficiency measures, once a customer enrolls, the treatment is in effect all the time. For these programs, an RCT design requires recruiting customers and then denying or delaying the treatment to

half of those who agree to enroll. This "recruit and deny/delay" approach often raises concerns among utility decision makers (and often among regulators and interveners as well) because of fears that it will create dissatisfaction among those who are denied the rate after trying to enroll.[4]

Figure 2 - RCT Design and Evaluation (Recruit and delay/deny) shows an illustrative example of how an RCT is set up and used to estimate load impacts. The impacts are estimated using what is called a difference-in-differences ("DiD") calculation. A DiD calculation subtracts the pretreatment difference, i.e., the difference between treatment and control group loads before the treatment is in effect for the treated group, from the post-treatment difference, i.e., the difference between the two groups after the treatment is in effect.[5] Even though random assignment significantly reduces the risk that any observed difference is due to anything other than the treatment itself, using a DiD calculation eliminates any pretreatment difference that might occur through random chance. When sample sizes are small, there is a higher likelihood that pretreatment differences exist. With large samples, as long as the random assignment is implemented properly, any pretreatment difference should be negligible. However, this approach is sub-optimal due to the customer dissatisfaction that would likely result from recruiting customers into the DLC pilot and denying or deferring receipt of DLC equipment for some of those customers.

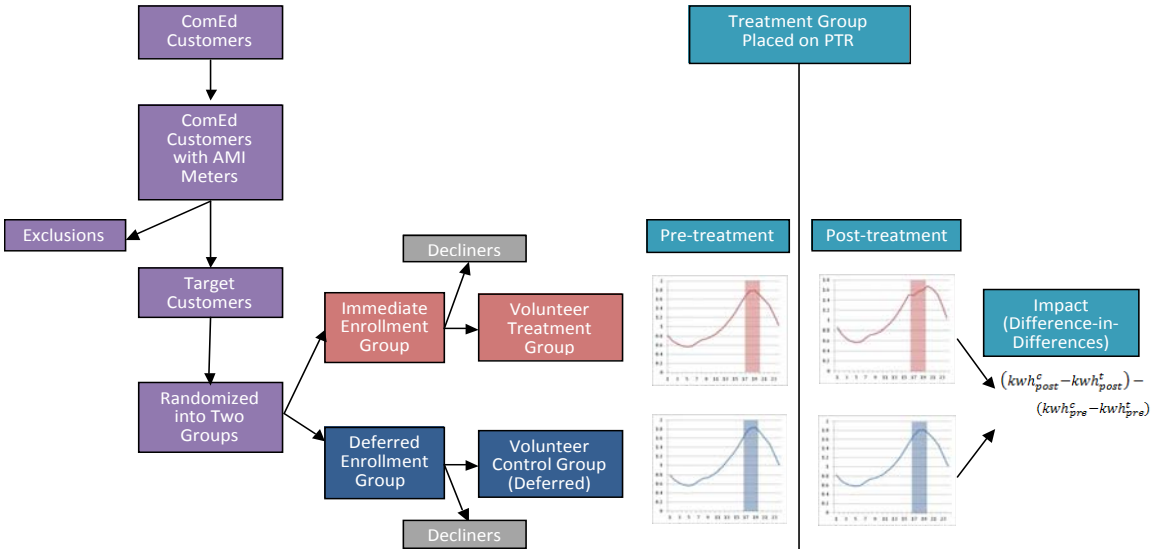


Figure 2 - RCT Design and Evaluation (Recruit and delay/deny)

[4] There have been several recent, successful applications of this approach in the context of pricing pilots in the electricity industry. The Sacramento Municipal Utility District ("SMUD") just finished the second year of a pricing pilot that employed a recruit and delay (for two years) RCT design. Marblehead Municipal Light District recently completed a pricing pilot that employed the offer of a programmable communicating thermostat that delayed the installation of the thermostat for some customers for a year.

[5] In practice, the DiD calculation is typically done using a fixed-effects panel regression. The estimated impacts using a panel regression and a simple DiD calculation should be identical but the standard errors of the estimated impacts will be smaller using the regression approach.

When a treatment of interest is not in effect on all event days, as is the case for PTS participants with or without load control technology, it is possible to use an RCT design without denying enrollment to anyone. This is done by randomly assigning enrolled PTS customers to two groups and alternating event days across the groups. We refer to this as an event-based RCT design. Figure 3 - Event-based RCT Design & Evaluation contains an illustrative overview of the design and evaluation for using an event-based RCT. ComEd could apply the event-based RCT design to the 500 customers enrolled in any of the treatment groups. Each group could be randomly assigned to two subgroups of 250 each; designated A and B. On one event day, Sub-group A would be called and Sub-group B would act as the control. On the next day, Sub-group B would be called and Sub-group A would act as the control, and so on. Impact estimates using this approach are devoid of selection effects and, unlike with the standard RCT design, are not reliant on the availability of pretreatment data because switching the A and B groups across events will self-correct any random differences in the assignment of customers to the two groups (as long as the number of events is sufficiently large). In other words, there is no need to do a DiD calculation in this context. A pilot based on an event-based RCT design will produce internally valid load impact estimates for PTS with and without load control.

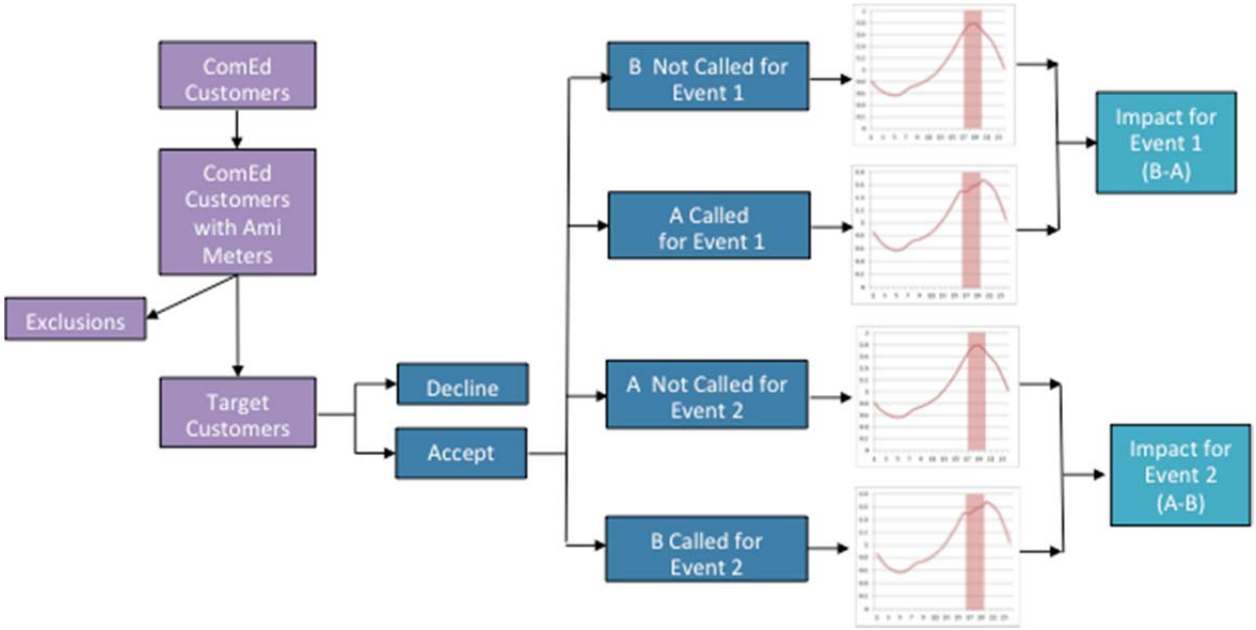


Figure 3 - Event-based RCT Design & Evaluation

Another possible approach to experimental design is a randomized encouragement design (RED). Figure 4 - Design & Evaluation for an RED shows the design and analysis approach for an RED. Under this design, PTS participants are randomly assigned to two groups before recruitment is conducted; then, one group is solicited for participation in the pilot program while the other is not (indeed, the latter group does not even know that an experiment is being conducted). Among the group that is solicited for participation in the pilot program, some customers will accept the treatment offer and others will not. For analysis purposes, both those who do and those who do not accept the offer are treated as if they are in the treatment group and their usage is compared with that of the control group. This is

referred to as the "intention to treat" impact. This estimate is diluted by the fact that some in the treatment group will not actually accept the treatment offer, but the impact for those who do accept the offer can still be obtained in a second stage calculation by dividing the intention-to-treat impact by the percent of those encouraged to participate who actually did take up the offer.

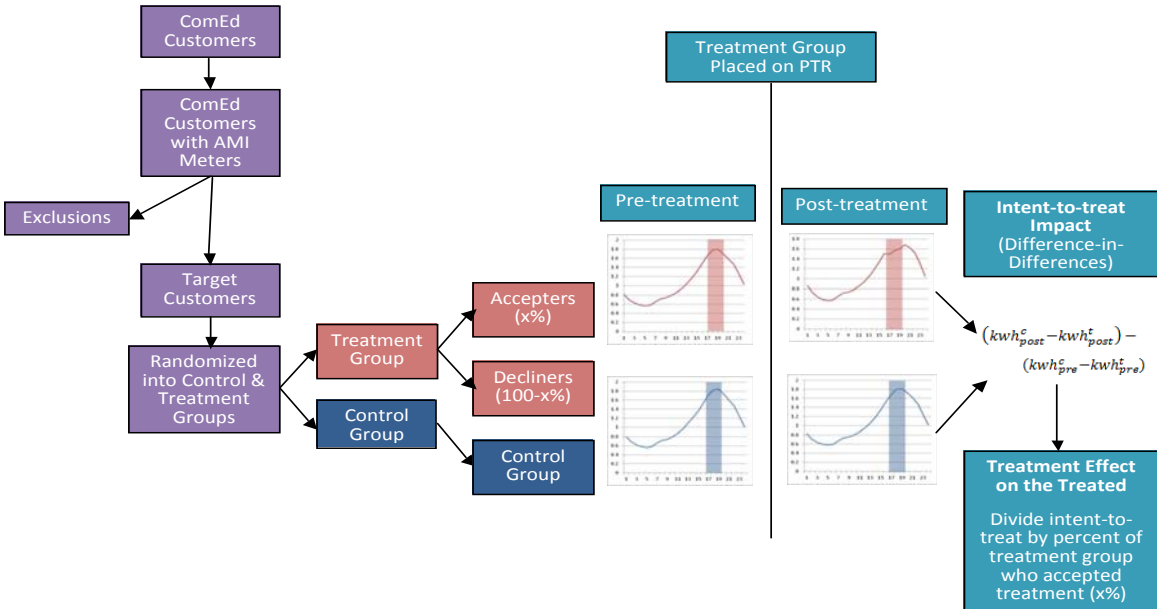


Figure 4 - Design & Evaluation for an RED

The problem with an RED design is that the dilution factor, which is a function of the customer acceptance rate, may produce impacts that are too small to measure given the planned sample size. For example, if 5% of PTS participants who are offered PTS with load control technology take it, and the expected average energy impact is 20%, the sample sizes for the treatment and control groups must be large enough to estimate a 1% impact (i.e., 20% of 5%) in the initial step of the estimation process. The sample size needed to estimate a 1% impact is much larger than the sample size needed to estimate a 20% impact. If there is a high degree of confidence that the acceptance rate and impacts will be above a certain level, it is straightforward to consider whether the incremental cost of an RED compared with an RCT is worth it to avoid the potential customer dissatisfaction of implementing a recruit and deny/delay design. However, there is a risk that the estimate of minimum acceptance rate and the size of the impact may be too optimistic. If, for example, it turned out that 5% of customers took the offer and the average effect size was 5%, the samples based on the more optimistic values would not be large enough to detect the 0.25% (i.e., 5% of 5%) savings in the first evaluation step.

The three pilot designs summarized above are experimental designs that have high internal validity and can rigorously establish causality between the treatment and observed impacts. There are alternative options, collectively referred to as quasi-experimental approaches, which are commonly used for evaluation purposes. One such alternative option involves the selection of a control group after

recruitment using propensity score matching or some other statistical matching algorithm that identifies customers with similar observable characteristics to the self-selected treatment group. With suitable pretreatment data, ex post matching may produce defensible estimates of energy impacts in these cases. However, if pretreatment data is not available, matching is still possible for event-based programs using non-event day data but this scenario must assume that there are no spillover effects from the treatment on non-event days or the method will produce biased results. Matching does not have the same internal validity as RCT or RED experimental design, because it is possible that unobservable differences between treatment and ex post control participants is the cause of observed differences during the treatment period.

Another quasi-experimental approach, referred to as "within-subjects" analysis, uses the treatment group as its own control by comparing customer usage under both treatment and non-treatment conditions. This approach is commonly used for event-based programs like PTS with load control technology because the treatment is in effect on some days and not others, and energy use on the non-event days can be used as a reference load to represent what usage would have been on the event day if load control had not been initiated or customers had not otherwise responded to the PTS incentive. The accuracy of impacts using this within-subjects method is a function of the availability of good proxy days (i.e., days when events are not called that have weather and other conditions similar to event days), the accuracy of the modeling used to reflect day-to-day variation in loads caused by weather and other factors and whether or not the treatment of interest has spillover effects on non-event days. It is difficult to accurately measure the impact of weather and other factors and typically nearly impossible to test whether there are spillover effects on non-event days that might bias the event-day impact estimates. Although commonly used for event-based programs, impacts based on within-subjects analysis are always less defensible than those obtained through RCT or RED designs and may be inferior to those obtained from matching methods.[6]

In summary, ComEd recommends an event-based RCT design for the proposed DLC pilot program. ComEd believes an event-based RCT design approach offers the most cost effective program. Further, this approach maintains the highest degree of internal validity with the lowest potential impact on customer satisfaction.

C. Proposed DLC Pilot Sample Size

The sample sizes needed for the pilot are a function of a number of factors, including:

- The expected impact;
- The desired level of precision in the estimates;
- Normal variation in peak period energy use;
- The number of event days called; and

[6] For a comparison of impacts based on RCT/RED, propensity matching and within-subjects analysis, see Section III.9 of Jimenez, Potter and George. *Smart Pricing Options Interim Evaluation.* Prepared for the U.S. Department of Energy Lawrence Berkeley National Laboratory.

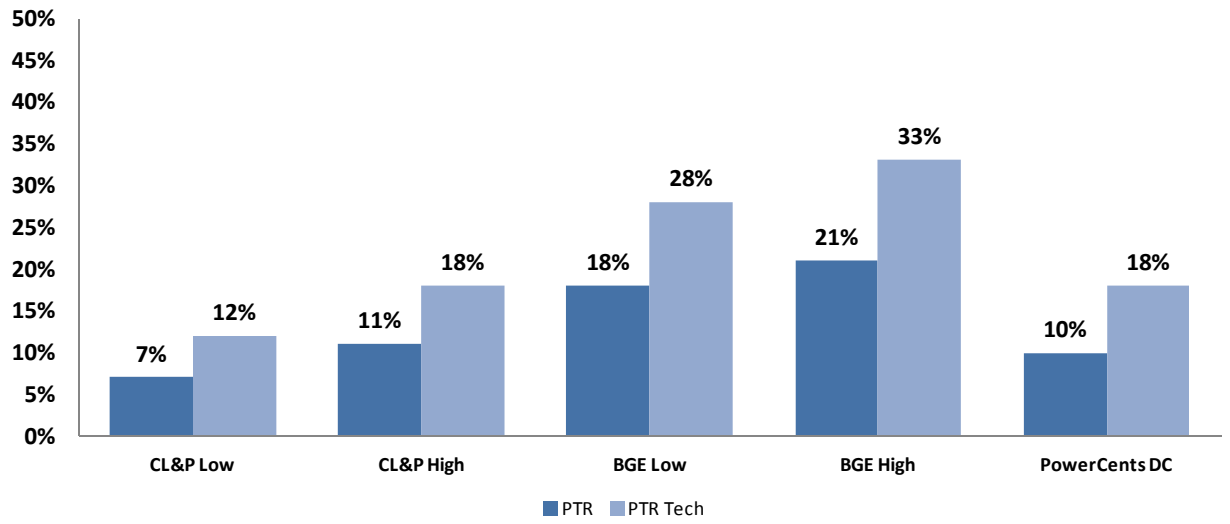
- The research design and analytical methodology used to estimate the impacts.

A sample of 2,000 residential customers from ComEd's service territory was used to determine the required sample sizes for a given level of precision and expected impact sizes given the day-to-day fluctuation in peak period electricity use. Table 3 - Confidence Bands for Given Sample Sizes summarizes this analysis. As seen in the table, enrolling 500 customers into the treatment group and splitting them into two groups of 250 each produces a 95% confidence band of ±2.35% if the expected effect size is 10% and the number of event days is 6 (3 for each group). Put another way, if the estimated incremental impact of the technology is 10%, there would be only a 5% chance that the actual impact is less than 7.65% or greater than 12.35% (10%±2.35%). If 10 events were called (5 for each group), the 95% confidence band would be ±1.81%, i.e., if the estimated incremental impact of the technology is 10%, there would be only a 5% chance that the actual impact is less than 8.19% or greater than 11.81% (10%±1.81%).

Table 3 - Confidence Bands for Given Sample Sizes

Sample Size	# of Events	Expected Incremental Impact	90% Confidence Band	95% Confidence Band
250A/250B	6	10%	±1.97%	±2.35%
		20%	±2.67%	±3.18%
	10	10%	±1.52%	±1.81%
		20%	±1.96%	±2.33%
500A/500B	6	10%	±1.54%	±1.83%
		20%	±1.98%	±2.36%
	10	10%	±1.13%	±1.34%
		20%	±1.52%	±1.81%

Figure 5 - Impact Estimates from Peak Time Rebate (or Peak Time Savings) Pilots summarizes the results from several prior peak time rebate pricing pilots from Connecticut Light and Power ("CL&P"), Baltimore Gas and Electric ("BGE"), and the PEPCO service area in Washington, DC ("PowerCentsDC"). As seen in prior pilots, peak time rebates without technology have produced average impacts roughly in the 10% to 20% range and impacts with enabling technology have been roughly 20% to 30%. Given this data, setting the target enrollment to equal 500 customers, split into A and B groups of 250 each, is reasonable.



Rebate/kWh	$0.78	$1.74	$1.16	$1.75	$0.66

Figure 5 - Impact Estimates from Peak Time Rebate (or Peak Time Savings) Pilots

D. Proposed Pilot Design for Residential Central AC

ComEd plans to assess the impact of load control on two distinct customer segments: single family households with Central AC, discussed in this section, and multi-family households with Plug-in AC units, discussed in Section III.D. Single family households represent roughly 65% of ComEd's residential customer population, and roughly 87% of single family households have Central AC.[7]

Figure 6 - Proposed Pilot Design for Single Family Central AC shows the proposed pilot design for the single family, Central AC segment. Within the single family, Central AC segment, two technologies and offers will be tested. One is a load control device that will cycle the Central AC unit so that it runs less often during an event period than it would in the absence of cycling. The other is a PCT that can adjust the temperature setting to reduce load during the event period. More details about the specific enabling technology that will be used in the pilot are contained above in Section III. A.

The proposed single family Central AC pilot involves an event-based RCT design as described in Section III .B. It is designed to assess the impact of the offer of a DLC device or a discounted PCT on program enrollment and electricity curtailment. ComEd will offer to install a DLC device or provide a bill credit for customers that purchase and install a PCT. The DLC and PCT offers will be made in conjunction with the marketing of the PTS program.

[7] The single family and multi family percentages are determined from the numbers of single family and multi family accounts in 2012 shown on page 1 of Schedule A-3(a) that ComEd filed in April 2013 in its 2013 formula rate update in Docket No. 13-0318. The Central AC and Plug-in AC percentages are from page 4 of Opinion Dynamics Corporation. *ComEd Residential Saturation/End Use, Market Penetration and Behavioral Study.* April 2013. This report can be found in Appendix E of ComEd Ex. 1.0, as filed in ComEd's 2013 energy efficiency and demand response plan proceeding, Docket No. 13-0495

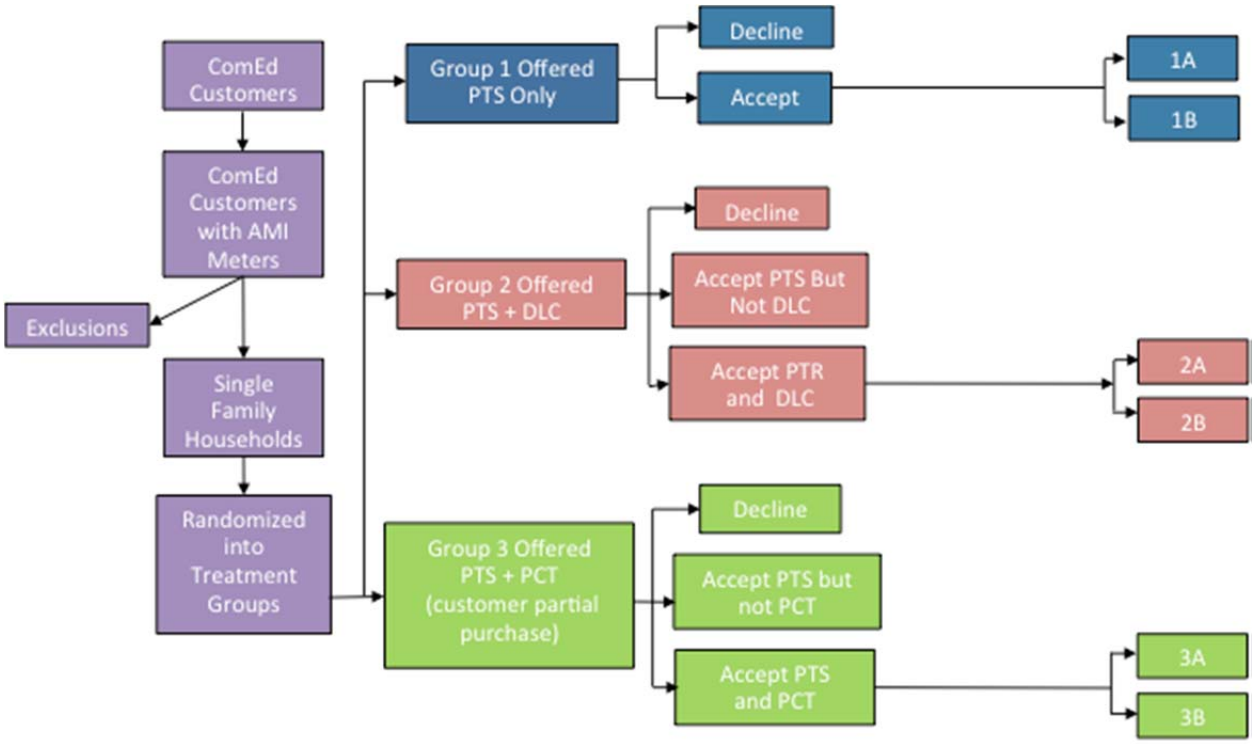


Figure 6 - Proposed Pilot Design for Single Family Central AC

The pilot design anticipates an enrollment of 500 customers in each of the three groups under the single family, Central AC category. In order to reach this goal of 500 customers, ComEd will randomly select three groups of single family customers, consisting of about 10,000 each from the roughly 500,000 customers that will have smart meters at the outset of the pilot recruitment period which is planned to begin in fall 2014. This recruitment will be discussed further in Section IV – Customer Experience Process. These three groups will be offered, respectively, PTS with no enabling technology, PTS with free DLC or PTS with the offer of a bill credit if they purchase and install a PCT on their own. ComEd has not yet finalized the marketing channels that will be used for these three groups of customers, but they most likely will be direct mail and perhaps email. From a pilot design perspective, it is essential that mass media promotion be avoided, since who does and does not receive an offer must be tightly controlled.

A comparison of enrollment rates in the PTS program across the three groups will indicate the extent to which the offer of free or customer-purchased enabling technology increases enrollment in the PTS program. The relevant comparison for answering the question, "Does the offer of technology increase PTS enrollment?" is between the acceptance rate for customers recruited for Group 1 with the acceptance rate for customers recruited for Group 2 and Group 3, including those who accept PTS and DLC, those who accept PTS but decline DLC and those who accept both but for whom the equipment could not successfully be installed. Comparing Group 1 acceptance rates with the acceptance rate for

those that have the DLC equipment successfully installed could understate the influence of the offer of technology on customer enrollment.

An assessment of the impact of the DLC technology on load reductions during PTS events will be made using the alternating A/B control strategy discussed in Section III.B. and depicted in Figure 3 - Event-based RCT Design & Evaluation. Impacts will be estimated using household level interval data. A comparison of loads for the Sub-group A and Sub-group B customers for each group provides a direct measure of the total effect of the participation in a curtailment event. A comparison of participation between the various groups will allow us to judge the impact of technology on participants' performance during curtailment events.

If the target enrollment is 500 customers in each of Groups 1, 2 and 3, the number of customers that will receive offers is a function of the expected acceptance rate. The acceptance rate is unknown and, indeed, is one of the key factors of interest. If the expected acceptance rate is 5%, it would be necessary to solicit participation from roughly 10,000 customers for each group, or 30,000 customers total for Groups 1, 2 and 3. ComEd will initially market to a small test group, for example 1,000 of the 10,000 customers, to assess likely acceptance rates so as to avoid over or under recruiting. This is particularly important for technology pilots since miscalculations can be costly (e.g., if the acceptance rate is 10% and ComEd markets to 10,000 customers, the pilot budget would need to cover 1,000 devices for each of Groups 2 and 3 rather than the target of 500 devices for each group).

In summary, the proposed pilot design for Central AC in single family households includes the following features:

- An assessment of the offer of DLC and a bill credit for a PCT on customer enrollment in PTS for single family households with Central AC;
- An assessment of the incremental impact of DLC and PCTs on electricity curtailment for PTS customers that accept these enabling technologies using an event-based RCT design and whole premise interval data;
- Target installations of 500 DLC devices (at no cost to customers) and 500 PCTs purchased and installed by customers in response to the offer of rebates covering part of the cost of the PCT (Group 3) ;
- Groups 1, 2 and 3 will be chosen at random from the target population with smart meters; marketing will begin following Commission-approval of the PTS program. Events will be called during summer 2015 with the impact evaluation report filed by December 31, 2015.

E. Proposed Pilot Design for Multi Family Plug-in AC

Single family households represent roughly 65% of ComEd's residential customer population. The remaining 35% of the residential population lives in multifamily dwellings. More than half of all multi-family dwellings have Plug-in AC units. The average number of Plug-in AC units per multifamily dwelling is 1.8. Roughly 38% of these units have cooling capacities of 6,000 BTUs or less and have loads when they are running of roughly 0.5 kW. Approximately one third of Plug-in AC customers say they have the

unit "turned on a few times each summer" while about 23% say the unit is "turned on just about all summer." 45% of customers say the unit is "turned on quite a bit."[8]

Plug-in AC units can be controlled by installing a device between the wall outlet and the unit plug that can cycle the Plug-in AC in a way similar to Central AC load control devices. The Plug-in AC device described in this pilot program allows two-way communication through the internet, and also records run time and energy use of the Plug-in AC unit. As such, the impact evaluation can be based on air conditioning electricity usage (or end-use) data. This allows for impacts to be estimated with smaller sample sizes than would be needed if the impacts were being based on whole house data since the "signal to noise" ratio with end use data is much greater than with whole building data for loads this small. This end use data should also allow ComEd to obtain very useful information on air conditioning duty cycles across the entire summer in addition to obtaining highly accurate load impact information. Plug-in AC energy use is likely to be more diverse than Central AC use as some units are located in bedrooms and may only run at night while others are designed to cool the entire apartment and may operate similarly to Central AC (although perhaps with more manual control, which would add to the diversity in loads). This technology is further discussed in Section III.A.

The conceptual design for the multi-family Plug-in AC pilot is the same as for the Central AC pilot – an event-based RCT. Figure 7 - Proposed Pilot Design for Multi Family Plug-in AC shows the proposed pilot design for the multi-family Plug-in AC segment. The target sample size will also be the same – approximately 500 total devices installed, with half being cycled for an event and the other half being used as a control group, and vice versa for the next event. Customers will be recruited in a similar manner as for the Central AC load control group (Group 2 in Section III.C) and the influence of the incentive on PTS enrollment will be assessed. As stated above, ComEd plans to create two groups of multi-family households – one group will be offered PTS without an offer of enabling technology, and one group will be offered PTS with a free Plug-in AC control device. In order to have 500 customers per group that will participate in the pilot, two groups of multi-family households, about 10,000 each, will be chosen at random from the roughly 500,000 customers that will have smart meters at the outset of the pilot recruitment period which is planned to begin in fall 2014. This mirrors the plan described above in Section III.C - Proposed Pilot Design for Residential Central AC. This recruitment will be discussed further in Section IV – Customer Experience Process. Both of these groups will be marketed to through the same PTS marketing channels described for Central AC customers in Section III.C - Proposed Pilot Design for Residential Central AC. The same comparisons described for Central AC customers Group 1 and Group 2 in Section III.C - Proposed Pilot Design for Residential Central AC will be applied for customers in Group 4 and Group 5.

[8] Opinion Dynamics. *Op. cit.*

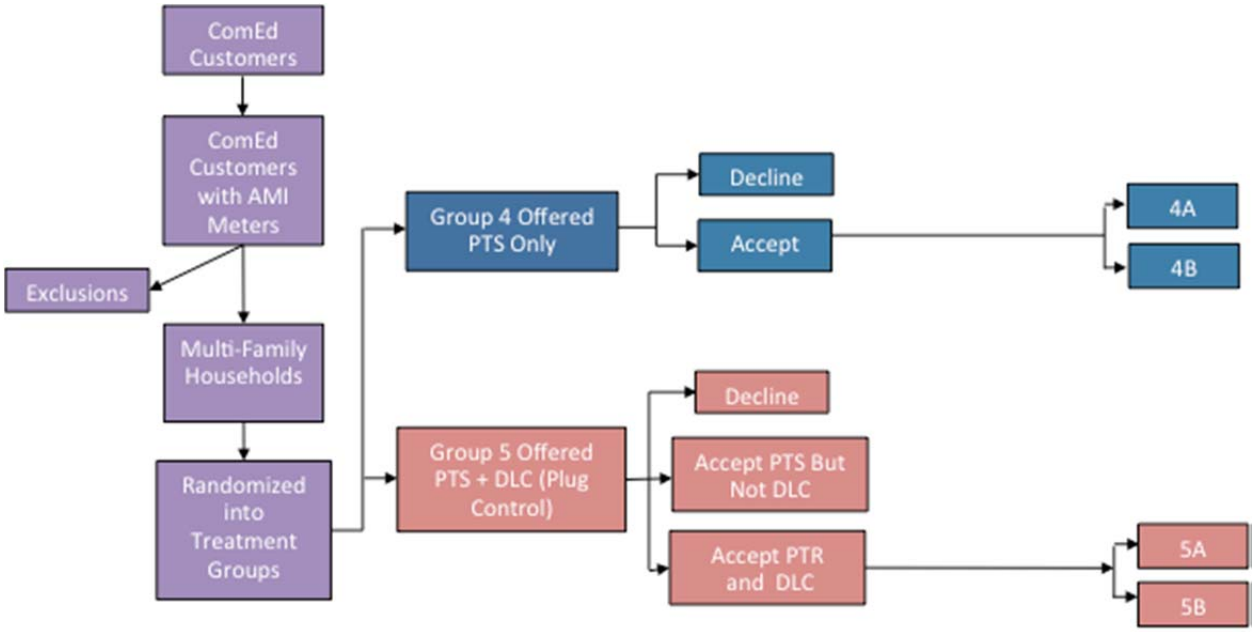


Figure 7 - Proposed Pilot Design for Multi Family Plug-in AC

The sample size determination will follow the same approach and assumptions used for selecting the sample size for Groups 1, 2, and 3. If the target enrollment is 500 for each of Groups 4 and 5, the number of customers that will receive offers is a function of the expected acceptance rate. Assuming an acceptance rate of 5%, it would be necessary to solicit participation from roughly 10,000 customers for each group, or 20,000 customers total for Group 4 and Group 5.

The Plug-in AC portion of the pilot has two challenges that the load control pilot for Central AC does not face: (1) the fact that many AC units are hard wired to the electrical system and, therefore, cannot be controlled using Plug-in AC devices; and (2) evidence from other pilots (although not PTR pilots) suggesting that some customers may not plug the devices in once they are received. The first issue will need to be addressed during recruitment and enrollment through screening questions to identify units that can be controlled through the plug device. The second issue can be monitored through the two way communication capabilities of the unit (e.g., ComEd will know whether or not the device is plugged in) and addressed through follow up with customers who have not plugged the device in.

F. Summary DLC Pilot Proposed Design

Table 4 - Summary DLC Pilot Proposed Design summarizes the proposed DLC pilot program that will be offered across two customer segments: 1) Single Family with Central AC; 2) Multi Family with Plug-in AC.

Table 4 - Summary DLC Pilot Proposed Design

Customer Type	Group	Enrollment Offer / Enabling Technology Offer	Enrolled Target
Single Family with Central AC	Group 1	Peak Time Savings + None	500
	Group 2	Peak Time Savings + DLC Device for Central AC	500
	Group 3	Peak Time Savings + PCT (customer purchased with bill credit for portion of cost)	500
Multi Family with Plug-in AC	Group 4	Peak Time Savings + None	500
	Group 5	Peak Time Savings + DLC Device for Plug-in AC	500

G. Pilot Program Evaluation - Measurement and Validation

In the fall of 2015, following the first round of curtailment events under the PTS program that take place during the prior summer, ComEd will evaluate the effect that DLC technology had on three key objectives: 1) PTS program enrollment; 2) incremental effect on electricity curtailment performance during events; and 3) impact on customer satisfaction with the PTS program.

1. Evaluation Incremental Effect on PTS program enrollment

During the DLC pilot program enrollment period, scheduled to begin following Commission-approval of the PTS program, ComEd will market the specific treatment offer to each of the five pilot design treatment groups as described in Table 4 - Summary DLC Pilot Proposed Design. ComEd will measure the difference between the treatment and control groups in order to measure the effect the offer of DLC technology has on enrollment. For single family customers, Group 1 will serve as the control group and Group 2 and Group 3 will serve as two independent treatment groups.[9] For example, ComEd will measure the rate at which customers accept the respective enrollment offer in each group. If Group 2's acceptance rate is greater than that of Group 1's acceptance rate and is statistically significant, we can

[9]When comparing enrollment rates for Groups 1, 2 and 3, it will be necessary to adjust for differences in the screening criteria that apply to each group. For example, customers in Group 4 will be allowed to enroll whether or not they have AC whereas all customers in Group 5 must have plug-in AC and internet connectivity. These selection criteria will impact enrollment rates. ComEd will need to gather sufficient information as part of the enrollment process to factor these criteria into the comparison of enrollment rates for each group.

infer that the Group 2 offer has a measureable incremental impact on enrollment in the PTS program. The same evaluation and conclusion can be made for Group 3.

As shown in Figure 4, the offers made to Group 2 and Group 3 participants allow for the option to decline the technology but still accept enrollment in PTS. These customers will be tracked accordingly and the results will be included in the written evaluation report.

For multi-family customers, ComEd will perform the same evaluation analysis as performed for single family customers. In this situation, Group 4 will serve as the control group and Group 5 will serve as the treatment group. If Group 4's acceptance rate is greater than that of Group 5 and is statistically significant, we can infer that the Group 5 offer has a measureable incremental impact to enrollment in the PTS programs. As described for single family customers, Figure 5 shows that offers made to multi-family customers in Group 5 also allow for the option to decline the technology but still accept enrollment in PTS. This data will be captured and reported in a similar fashion.

2. Evaluation of Incremental Effect on Electricity Curtailment

Analysis of the DLC program pilot results requires ComEd to capture and retain several specific data elements. Comprehensive data collection will be a key input to the M&V phase of the assessment. The primary data element necessary to complete the evaluation objective is hourly interval usage data. Usage data will be collected for all participants in each of the DLC pilot program groups. The time interval of the usage data will be hourly, expressed as an average over that hour (i.e., kWh per hour).

To measure impacts for each treatment group (1 through 5), ComEd will compare loads for treatment and control groups and will calculate measured differences between each subgroup. As described in Section III, the treatment and control subgroups will be contained within each of the test cells (groups 1 through 5). Each cell will be broken into two randomly selected sub-groups of 250 participants each, designated "A" and "B". For each event, ComEd will rotate which sub-group is the treatment group and which is the control group.

For example, sub groups A and B under Group 2 will be compared against each other to determine if the use of DLC technology (i.e. the treatment sub-group) had a statistically significant impact in the load reduction compared with customers whose technology was not directly controlled during the curtailment event (i.e. the control sub-group). The same comparison approach will be repeated for Group 3 and Group 5.

3. Impact on Customer Satisfaction

In the fall of 2015, ComEd will use a 3rd party service to execute a customer satisfaction survey. The objective of the survey is to understand if DLC technology had a statistically significant impact on customer satisfaction. The survey will be given to a representative sample of each of the DLC pilot program design groups, Groups 1 – 5. Where applicable, the survey will ask customers a series of questions related to various aspects of the program, including the enrollment process, the installation process, ease and use of the technology, curtailment event process, and overall benefit received from

participating in the program. ComEd will also look into offering a post-curtailment event survey. The post-curtailment event survey will be used to compare differences in reported comfort after a direct load control event for the various test groups.

4. Evaluation Process and Evaluation Report

By December 31, 2015, ComEd will file in the instant proceeding a detailed DLC pilot evaluation report. The report will describe both the qualitative and quantitative results observed during the DLC pilot program. The report will summarize the incremental impact the offer of DLC technology has on: 1) enrollment in the PTS program; 2) the incremental impact of electricity curtailment performance during curtailment events; and 3) the impact to customer satisfaction.

IV. Customer Experience Process

A. Customer Selection, Marketing, & Enrollment

ComEd's PTS program is scheduled to launch in October 2014, beginning with the enrollment process. ComEd will market the PTS program to all customers who have already received an AMI Meters, as well as to customers as they have AMI Meters installed. Given that the DLC pilot is for customers who enroll in the PTS program, it makes sense for ComEd to begin the DLC pilot enrollment process at the same time as the PTS program enrollment process. To preserve the integrity of the pilot program, customers who will be offered the DLC technology must be randomly selected.[10] Prior to enrollment launch (approximately during September 2014), ComEd will randomly select a group of 30,000 single family customers and 20,000 multi-family customers from a group of customers who have Smart Meters installed. ComEd will verify that this group is representative of ComEd's service territory

ComEd will recruit customers in four waves; each wave will be spread out over 6 week periods. The first wave will begin approximately on October 1, 2014, the second approximately on November 14, 2014, the third approximately on January 1, 2015, and the final wave approximately on February 15, 2015. Each wave will be offered to approximately 2,500 customers. Customers selected will receive direct offers to participate in the DLC pilot program via the mail or other available channels such as email, and each offer will be for participation in one of the five DLC pilot program offers.

<u>Single Family DLC Pilot Marketing Offer</u> – From the group of 30,000 randomly-assigned customers, ComEd will offer customers one of three DLC pilot program offer letters:

1) Group 1 - 10,000 Single Family Customers offered PTS
2) Group 2 – 10,000 Single Family Customers offered PTS and free DLC Central AC control device
3) Group 3 - 10,000 Single Family Customers offered PTS and option to purchase a PCT with a bill credit for part of the costs

[10] Depending upon the makeup of the population of customers in the smart meter footprint at the time and the general population, ComEd may use a stratified random sample rather than a simple random sample so as to facilitate extrapolation of the pilot findings to the general population.

Multi-Family DLC Pilot Marketing Offer – From the group of 20,000 randomly-assigned customers, ComEd will offer customers one of 2 DLC pilot program offer letters:

1) Group 4 - 10,000 Multi Family Customers offered PTS
2) Group 5 – 10,000 Multi Family Customers offered PTS and free Plug-in AC control device

Based on the first wave acceptance rate, ComEd will adjust the remaining wave sizes. If the acceptance rate is significantly higher than 5%, ComEd may make fewer offers in the future. If the acceptance rate is lower than expected, ComEd may elect to increase the size of the next wave. The acceptance rate will be evaluated for each offer group independent of the acceptance rate for the other groups. Further, ComEd may utilize additional enrollment tactics as long as the tactics do not jeopardize the validity of the pilot program. These tactics may include an automated phone call or a follow-up letter to prompt the customer to action. However, once a customer has been offered a DLC pilot program group, that customer will not receive an offer to participate in a different group.

Once a customer elects to participate in the DLC pilot program, they will need to contact ComEd either though a phone or web channel to complete the enrollment. Instructions for completing the enrollment process will accompany the offer materials. ComEd will track which customers have been offered participation (by treatment group) and which customers accept participation. During the enrollment completion process, ComEd will gather the remaining elements necessary to complete enrollment. Those items include asking the customer to participate in a short socio-demographic survey. Further, customers may be asked for updated contact information, which may be used during curtailment events. For customers accepting and purchasing the PCT, ComEd will explain how the payment process will be completed. The payment process is further described in section IV.B.2. Finally, for those customers needing DLC equipment installed, ComEd will complete the installation reservation process with the customer.

B. DLC Technology Fulfillment / Installation

As discussed above, the DLC Pilot Program design includes 3 treatment groups where customers will receive enabling technology as part of the pilot program: Group 2, Group 3, and Group 5. Customers in one of these 3 treatment groups will either acquire technology through a 3rd party provider, have technology delivered or mailed, or have an on-site professional perform the installation. The type of fulfillment or installation varies by treatment group.

1. Customers Requiring Central AC Device Installation (Group 2)

Customers who accept ComEd's offer to participate in the DLC pilot in Group 2 will have their Central AC device installed at their premises by a professional installer. ComEd will provide customers with information on the installation process and work with these customers to determine a mutually agreeable installation date.

2. Customers Acquiring PCT Devices (Group 3)

Customers who accept ComEd's offer to participate in the DLC pilot in Group 3 will be instructed on the process to purchase their PCT device. The customer will need to purchase their device and perform the required installation. In order to participate in Group 3 of the pilot program, customers will need to have a WIFI network within their home. ComEd will assist customers who request that ComEd complete the installation; however, this service will not be the default method offered. Once ComEd verifies that customers have installed their PCT device and connected the device to their WIFI network, ComEd will issue a bill credit in the amount of $100 for purchasing and installing the device. The total purchase price for the PCT will vary based on which device is selected for the pilot program. Customers are required to keep their device connected to the WIFI network throughout the course of the pilot program.

3. Customers Requiring Plug-in AC Device Delivery (Group 5)

Customers who accept ComEd's offer to participate in the DLC pilot in Group 5 will be instructed on the process by which they will receive their Plug-in AC device. The default process to acquire this technology is in-home delivery. ComEd will contact each Group 5 customer prior to mailing the device, in order to further understand more about their Plug-in AC unit setup. Specifically, it will be necessary for ComEd to understand the location of the unit within the home, the type of unit, and if the customer has an existing WIFI connection. Once the screening process has taken place, ComEd will mail the Plug-in AC control device to the customer. The mailed device will include instructions to set up the device and connect to WIFI. If, during the screening process, the customer informs ComEd they do not have WIFI in their home, ComEd will provide a device that is able to connect to existing 3G Mobile networks. The cost of providing this device will be part of the cost of the DLC pilot program. Depending on the setup and type of Plug-in AC unit, ComEd may need to schedule the installation by a professional installer. Further, ComEd will assist customers who request that ComEd complete the installation process.

C. Curtailment Events

Prior to the start of the summer curtailment events, ComEd will randomly split each treatment group into the two separate sub-groups described above – Sub-Group A and Sub-Group B. As described in Section III – DLC Pilot Design and Evaluation Process, ComEd will rotate Sub-Group A and B in curtailment events. For a curtailment event, one sub-group will be the treatment group and the other sub-group will be the control group, so that each customer receives an equal opportunity at the benefits associated with curtailment events as well as ensuring that the experience of each treatment sub-group is consistent for the evaluation. After each event, ComEd will rotate the treatment and control group. At the end of the summer, each sub-group will be a treatment group and a control group for an equal number of events.

D. Hypothetical DLC Pilot Program Customer Experience

ComEd believes that a successful pilot program requires a well-designed and executed Customer Experience process. As a result, ComEd will begin the design of the DLC pilot program with the development of the Customer Experience and Education design. More information on this task can be found in Section IV, Subsection A. Table 5 - Hypothetical DLC Pilot Program Customer Design highlights the proposed pilot program customer experience as of the pilot planning stage.

Table 5 - Hypothetical DLC Pilot Program Customer Design

	Hypothetical Customer Experience
Step 1 Determine Random Selection Group	ComEd will randomly select a group of 30,000 single family customers and 20,000 multi family customers from a group of customers who have Smart Meters installed.
Step 2 Assign Customers to Treatment Groups and Make Program Offer	Customers selected will receive pilot program direct offer via the mail with one of 5 DLC pilot program offers. 1) Group 1 - 10,000 Single Family Customers offered PTS 2) Group 2 – 10,000 Single Family Customers offered PTS and free DLC AC control device 3) Group 3 - 10,000 Single Family Customers offered PTS and option to purchase a PCT with a bill credit for part of the costs 4) Group 4 - 10,000 Multi Family Customers offered PTS 5) Group 5 – 10,000 Multi Family Customers offered PTS and free DLC Plug-in AC control device
Step 3 Enroll Customer in Program	Customers who are interested in signing up for their respective offer will contact ComEd through a specialized phone or web channel to complete the signup process. Additional enrollment steps include: • Screening for selection factors such as Central AC or Plug-in AC units, access to the Internet, etc. • Socio-demographic survey (optional but encouraged) • Technology Installation (if necessary) • Program Materials / Education
Step 4 Install DLC Equipment	Customers who are offered DLC technology that requires an on-site installation specialist will be contacted by ComEd to schedule their installation. ComEd will work with each customer to complete the installation prior to the Summer of 2015.
Step 5 Customer Education Outreach Prior to Summer	Prior to the summer of 2015 (approximately April or May of 2015), ComEd will reach out to all DLC pilot program customers to educate them on the program components and benefits of participation. Each treatment group will receive tailored education relevant to their technology / group.

Step 6 Call Curtailment Events	ComEd will call a series of curtailment events throughout the summer. Customers assigned to sub-group A within each of the treatment groups will have their respective DLC technology controlled during the event. Customers assigned to sub-group B within each of the treatment groups will have their respective DLC technology controlled during the next event, and so on.
Step 7 Collect Data and Perform Evaluation	Throughout the summer, ComEd will collect and evaluate usage data to compare load reductions between treatment and control sub-groups for each of the DLC pilot program groups. The data will be summarized in an evaluation report.
Step 8 Customer Satisfaction Survey	At the conclusion of the summer curtailment event months, ComEd will conduct a customer satisfaction survey with DLC program customers to understand satisfaction differences between the DLC pilot program groups.

V. DLC Pilot Program – Project Plan

A. Program Management

For purposes of this planning document, ComEd has put together a high-level project schedule and associated task list. Figure 8 - High-Level Project Schedule depicts a 2-year project schedule timeline. Table 6 - High Level Project Plan accompanies Figure 8 - High-Level Project Schedule with more detailed description of the tasks. The project schedule is structured with 6 key workstream / task areas:

1. Customer Experience / Customer Education Design
2. DLC Enabling Technology Selection & Implementation
3. Pilot Program Marketing / Recruiting
4. DLC Enabling Technology Installation
5. Pilot Program Execution / Curtailment Events
6. M&V Evaluation Report

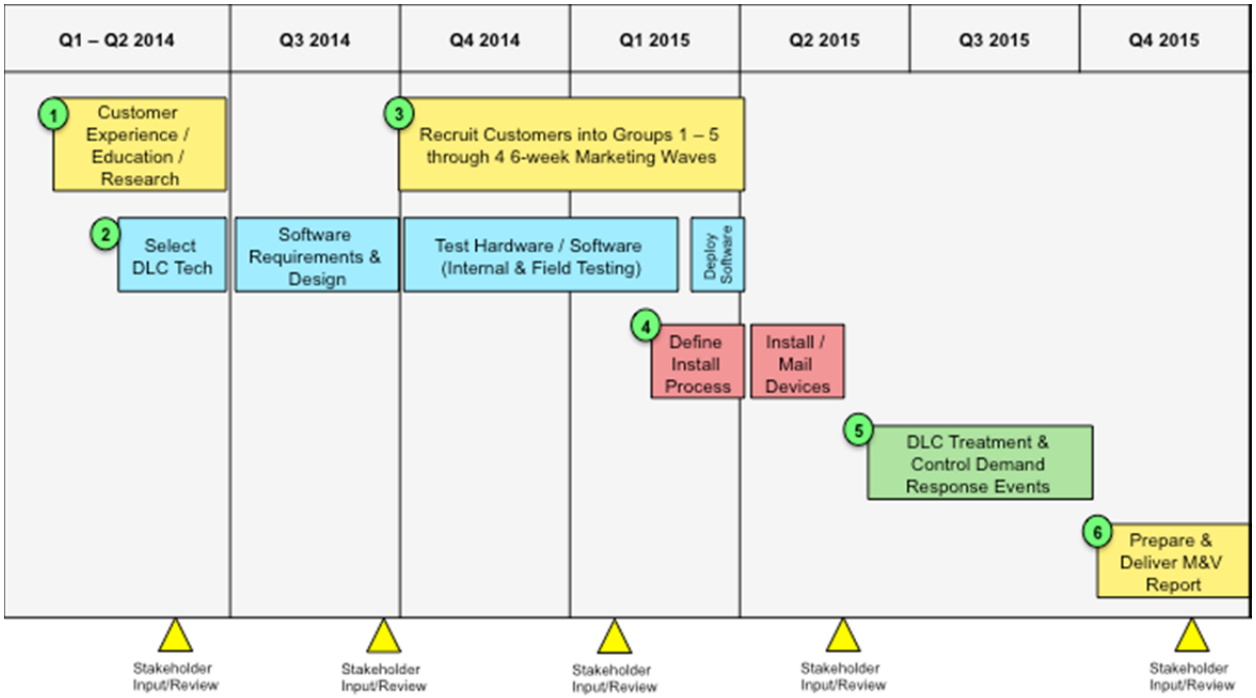


Figure 8 - High-Level Project Schedule

Table 6 - High Level Project Plan

Project Objective	Description/Scope
1. Design the DLC Pilot Program customer experience and customer education 1	The customer experience involves all of the events, processes, and customer touchpoints associated with a customer's interaction with the DLC pilot. Customer education involves the process, content, and media used to enhance the customer's knowledge of electricity curtailment and enabling direct load control technologies. Customer experience and customer education must be ready for implementation by Q4, 2014 and should embrace customer-centered design practices.

Project Objective	Description/Scope
2. Select enabling technologies offering the greatest value and Design, Test, and Deploy technology 2	The DLC pilot program includes three different types of enabling technology: • Central AC control device • Programmable communicating thermostat (PCT) • Plug-in AC control device ComEd has already developed and distributed a comprehensive RFP (Included in Appendix). In order to use these devices during curtailment events in the summer of 2015, the following milestones must be met: • Vendors selected by Q2, 2014 • Software Requirements & Design Complete, Q3, 2014 • Test Hardware and Software in ComEd test locations (i.e. employee homes), Q1 2015 • Deploy Software, Q1 2015
3. Recruit customers into Groups 1 – 5 over the course of 4 marketing waves. 3	Make program offers to Groups 1 – 5 beginning in October 2014 and concluding in March of 2015. Program recruitment needs to be complete by March to allow enough time for device installation prior to the curtailment event window, which begins in June 2015. Throughout this process, ComEd will also offer customers education about the program and the enabling technology.
4. Install/Deliver DLC technology 4	For applicable treatment groups, ComEd will install the enabling technology from March through May of 2015. Installation versus delivery will depend on which treatment group a customer is subscribed.
5. Test the impact of direct load control devices in conjunction with PTS program. 5	Treatment and control experimental aspects of the pilot program will commence in June 2015 and conclude in September 2015. Each customer grouping Group 1 – 5 will be split into sub-groups A & B (i.e. Group 1A). A curtailment event will either be called for sub-group A or sub-group B. If sub-group A is the treatment group, sub-group B will act as the control group during that curtailment event. The subsequent curtailment event will have sub-group B as the treatment group and sub-group A as the control group. ComEd anticipates calling at least 6 events during the DLC pilot program, where sub-group A would be the treatment group for 3 events and sub-group B would be the treatment group for the remaining 3 events.
6. Deliver the DLC pilot program Assessment Evaluation Report. 6	The report will be filed in the instant docket no later than December 31, 2015, and will discuss the incremental impact the DLC technology had on customer performance during and adoption of PTS program.

B. Budget

ComEd has developed a high-level estimated project costs to implement the DLC pilot program. The costs are primarily based on information gathered through the RFP process. The remaining cost estimates are based on ComEd's experience administering similar customer application pilot programs.

Table 7 - Estimated Costs (Dependent on DLC Technology Selected)

Customer Type	Group	Enrollment Offer / Enabling Technology Offer	Estimated Cost
Single Family with Central AC	Group 1	Peak Time Savings Only	$881,500
	Group 2	Peak Time Savings + DLC Device for Central AC	
	Group 3	Peak Time Savings + PCT (customer purchased with bill credit for portion of cost)	$200,000
Multi Family with Plug-in AC	Group 4	Peak Time Savings + None	$300,000[11]
	Group 5	Peak Time Savings + DLC Device for Plug-in AC	

Table 8 - Estimated Program Costs

Program Costs for Single Family with Central AC	Estimated Cost
Program Management	$503,000
Device Installation	$143,000
Marketing & Customer Service	$400,000
Measurement & Validation	$100,000
Customer Satisfaction Survey	$40,000

Table 9 - Total DLC Program Cost

Total Pilot Program Cost	Estimated Cost
Single Family with Central AC and Multi Family with Plug-in AC	$2,567,500

[11] The Plug-in AC control device cost estimate is for a complete turn-key solution including hardware, software, installation, marketing and customer service

APPENDIX: DLC Technology Competitive Selection

The Commission directs ComEd to structure a competitive bid process, or Request for Proposals (RFP) process, to select the enabling technology implemented as part of the DLC pilot program. At this stage of the DLC pilot planning, the RFP process allows ComEd to best understand the state of the DLC technology industry as well as be able to more accurately predict the costs associated with a DLC pilot program.

A. Design & Distribute RFP for DLC Pilot Technology and Implementation

ComEd designed and distributed a comprehensive DLC RFP on October 4th, 2013. In order to respond to the RFP, each bidder was required to provide a separate bid for at least one of the following items:

- DLC technology hardware (Central AC switch, Plug-In AC switch, or programmable communicating
- DLC technology software
- DLC Technology installation
- Marketing
- Customer Support
- Measurement and Verification (M&V) services

In addition, each respondent was allowed to submit a bid for the cost of turnkey services, which would include all of the above services and additionally:

- Project management
- System integration

Submitting a turnkey bid was not required in order to respond to this RFP.

1. Direct Load Control Technology Hardware

ComEd asked each responding vendor to provide detail information, for each of the following questions:

- What model AC switches do you propose using for this pilot?
- What model thermostat do you propose using for this pilot?
- Please identify any known brand/model of ACs that the switch is NOT compatible with
- Please identify any known brand/model of ACs that the thermostat is NOT compatible with
- How is the event communicated on the device? (Thermostat only)
- What percent of ACs in ComEd's territory are the AC switches compatible with?
- How does this device function for customers in multi family rate classes? (For split systems, through the wall systems, or Window units)
- What network does the device use to cycle the AC? (SSN AMI Network, Zigbee, WIFI, Paging Network)
- Can the device firmware/software be updated remotely?

- How does the device cycle the AC unit?
- Do you have any existing customers with devices in the ComEd service territory?

ComEd asked each responding vendor to provide pricing for devices in quantity blocks of 100, 500, 1,000, and 10,000 units. At the time the RFP was distributed, ComEd had not yet performed sample sizing analysis, as described in Section III, and therefore asked bidders for a range of quantities.

2. Direct Load Control Technology Software

ComEd asked each Hardware or Software responding vendor to provide detail information, for each of the following questions:

- Please explain what software is required to communicate with and control all devices
- What systems are required to run the software?
  Please demonstrate with diagrams/screenshots/demos where applicable:
  - How are devices provisioned?
  - How are devices inventoried?
  - How are devices connected?
  - How are the devices monitored?
  - How are events called?
  - How are events recorded?
  - How long of an event history is stored?
  - How are maintenance issues identified?
- Please provide a logical architecture diagram and a physical architecture diagram.
- List each major system component that is contained within the proposed solution & describe their software architecture
- Explain your implementation methodology for a typical installation. Do you use a formal methodology and/or adjust to the specific situation?
- What systems integration is needed with ComEd systems including Billing and Customer service?
- Within your application, are you dependent upon specific middleware technologies? If yes, please describe and state whether the transactions are synchronous or asynchronous or both.
- Describe the application's auditing, logging, and run-time control features
  What were the Architecture changes between the current release and the prior release of the product?
  - Do all the product modules have the same architecture?
  - If architecture changes are different at module level, please describe changes at a module level.
  - What systems integration is required and what is optional?
  - What API protocols does your system support, including Open ADR?
- Hardware IT requirements for software
  - What hardware is required to operate the software systems? This does not include the actual devices themselves, just any servers or other IT required for operating software

  - Please explain if software will be hosted on third-party servers
- Security/Authentication
  - Provide a detailed technical description of your product's security services.
  - Does the system support role-based and/or group-level access rights? If so, describe each level available and the permissions controlled.
  - Explain how the system receives information authentication from other authentication processes (e.g., LDAP).
  - Does the system provide an audit trail linking users to all transactions? If so, describe.
  - Explain how the system allows authorized users to access data and content via the Internet. Explain configuration requirements.
  - Describe how the system enables restricted access to selected portions/modules/services and data
- Performance / Scalability
  - Define the number of transactions that the system has been designed to process. Are there limitations on the number of transactions that the system can process?
  - Is the system scalable to support more users without major upgrade? Please explain. Are there pre-defined limits (e.g. Concurrent number of user, number of sites, transaction volume)?
  - Describe the hardware and software requirements needed to make the application provide 'HIGH AVAILABILITY' (24x7 operations).
- Data
  - Describe data modeling approach that was utilized to develop the application. For example, are you using industry standards such as CIM (Common Information Model) to develop data model, application, and data integration needs?
  - Does the proposed solution possess an API that enables the import and export of data?
  - Describe the standard data archiving and retrieval mechanism?
  - Identify the expected growth in the database after one year of normal processing.
  - Describe the increased storage requirements if the number of transactions increases by 10%.
  - Does the proposed solution support canned and ad-hoc reporting?

3. Installation

ComEd asked each responding vendor to provide detail information, for each of the following questions, if they elected to bid on Installation services:

- Please explain the device installation process and list all requirements for this process
- Please provide wiring diagrams for devices
- How labor intensive is installation?
- Describe the system used to track device installation process, including customer scheduling, installation status, and reporting process.
- Describe capabilities to store hardware procured prior to customer installation.

- Can the customer install devices themselves? If yes, how would you propose ComEd deliver the device to the Customer?
- If you are bidding on hardware, please provide the per unit installation costs:
- If you are not bidding on hardware, please provide the per unit installation costs for typical:
    - Central AC DLC switches
    - PCTs
- Please note any volume pricing variations

4. Marketing

ComEd asked each responding vendor to provide detail information, for each of the following questions, if they elected to bid on marketing services:

- Please describe what marketing materials you would prepare for each customer
- How would marketing materials differ based on different technologies and/or control strategies offered to customers?
- What techniques would you implement, if any, to understand the effectiveness of the marketing materials. How would you propose ComEd adjust marketing materials to improve customer acquisition?
- Please provide pricing for at least one of the following:
    - Assuming 5,000 solicitations are required, how much would it cost to provide marketing materials on a per customer basis?
    - Assuming 500 customers are required to enroll, how much would all marketing materials costs to enroll this number of customers?

5. Customer Support

ComEd asked each responding vendor to provide detail information, for each of the following questions, if they elected to bid on Customer Support services:

- Please explain the call center support process you propose for this pilot
- Please explain the internet and/or social media support process you propose for this pilot
- How long will it take to have call center fully operational?
- How long will it take to have call center fully operational?
    - How long will it take to develop call scripts?
    - How long will it take to staff and train representative?
- How many call center representatives do you estimate it will take per 10,000 enrolled customers?
- Please list the channels customer service representatives can use to communicate with customers
- Within how many seconds do you propose to answer 90% of incoming phone calls?
- What average handle times can you to commit to over a given month?
- Will you record customer conversations, and if so, will those recording be available to ComEd?

- Will ComEd have the ability to listen in to phone calls live?
- What metrics will the vendor be able to track?
- What metrics will the vendor be able to track?
- Will a customer be able to speak with a representative at any time?
- Please provide pricing for proposed customer support for Level 1 questions (questions that can be resolved without significant expertise)
- Please provide pricing for proposed customer support for Level 2 questions (questions not answered in the level 1 process
- Please provide service level agreements for every 10,000 customers to which you would be able to commit

6. Measurement and Verification (M&V)

ComEd asked each responding vendor to provide detail information, for each of the following questions, if they elected to bid on Evaluation Measurement & Verification services:

- Please describe the M&V process you would employ
  - What statistically analyses would you conduct to determine impacts of DLC technology?
- Please describe the IT systems necessary for M&V
  - Describe the database that stores which customers are in which treatment cells
    - How does this database integrate with other ComEd IT systems?
    - How does this database integrate with other DLC pilot specific IT systems?
- How large of a sample is required to draw statistically valid conclusions on:
  - Opt-in enrollment rates
  - Participation rates and load response for enrolled customers (and the incremental load ComEd is able to bid into PJM power markets, and the associated revenue, as a result of the DLC technology)
  - Customer satisfaction for enrolled customers
- Detail the pricing for M&V services

B. Vendor RFP Evaluation Process

ComEd release the RFP to vendors on October 4th, 2013 and required vendors to respond with a completed response by October 22nd, 2013. ComEd held a public webinar to answer any questions about the RFP on October 10th, 2013.

ComEd evaluated each response for completeness and ability to meet the minimum requirements for each section a vendor provided a response. All of the vendors who responded were invited to present their proposal to ComEd in person. The vendor demonstration took place on November 19th, 20th, and 25th of 2013. The demonstrations allowed for the vendors to demonstrate their understanding of ComEd's DLC pilot, demonstrate how their technology would meet the objectives of the pilot, their solution integration strategy, and any other relevant information. The demonstrations also allowed ComEd to answer any outstanding questions.

At the time of this plan, ComEd used this process to understand the technology available for DLC as well as to estimate the cost of the DLC pilot program.