Commonwealth Edison Company
Energy Efficiency/Demand Response Plan
Plan Year 1 (6/1/2008-5/31/2009)
Evaluation Report:
Central Air Conditioning Cycling

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Submitted To:
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E EXECUTIVE SUMMARY

Central Air Conditioning Cycling is ComEd's residential direct load control program, which allows ComEd to cycle off and on a participant's home central air conditioner condenser so it safely uses less electricity on the hottest days of the year. It is an on-going program that Commonwealth Edison began in 1996. At the end of 2007, there were approximately 50,000 participants in the program. Impact evaluation of this program is regularly performed by GoodCents Solutions, the installation contractor, based on a sample of approximately 250 customers that have whole house interval meters installed.

ComEd has a target of recruiting an additional 22,682 participants over three years for the Central Air Conditioning Cycling program as part of the Energy Efficiency and Demand Response Plan. Their plan calls for 8,092 new customers in Program Year 1 (PY1), 7,695 in Program Year 2 (PY2) and 6896 in Program Year 3 (PY3). Adding 8,092 new customers in PY1 is expected to create 11.7 MW of demand savings. Since this is a demand response program, there are no associated energy savings goals. The demand reduction achieved from these additional participants is expected to meet the statutory Demand Response goal, which is to reduce peak demand by 0.1% over the prior year for eligible customers.

Given that individual impacts are already estimated with a metered sample, the objective of this impact evaluation is to assess if the new participants in the program are significantly different in any way from the existing participants. The impact evaluation questions for this program are:

1. How do the new participants compare to the existing program participants?

2. Are their average demand reductions expected to be different in any way from what would be found in the metered sample?

If differences are found between the two participant groups, there may be a need to make adjustments to the impact per customer estimates from the sample to account for these differences among the new participants.

Verification and Due Diligence

Verification of participation in this program is overseen by the program implementer, GoodCents Solutions. They are responsible for reporting on load control switches that have been installed and removed as part of the program. All indications are that the GoodCents Solutions records of installations and removals are accurate and in good order.

Tracking System Review

We did not find any serious issues in the tracking system data for this program. In fact, we found the data to be consistent, clean and in good order. This is not surprising since the data is used for paying annual incentives, and there are financial consequences for poor program tracking.

Comparison of Existing and New Customers

This study uses billing and program tracking data analysis to evaluate the similarities between existing and new participants in the Central Air Conditioning Cycling program. All participants who joined the program on or after June 1, 2008 are considered new participants in this evaluation.

Upon examining the data for existing and new participants in the Central Air Conditioning Cycling program, there appears to be no significant difference between the two groups that would indicate a need to adjust the gross savings estimates for new participants. Characteristics that were examined for similarities were geographic location, energy use, presence of multiple central AC units in the home, and selection of cycling level.

Geographic Location

The two participant groups have very similar distributions across zip codes. While new participants show a slightly lower tendency to be in the 600 or 601 zip area, this difference is small. In fact, in both participant groups the zip areas of 600 and 601 are the dominant zip code groups. None of the zip code areas were left out of the new participant group.

Annual Energy Use

The distribution of annual energy use is very similar for the existing and new participant groups. The biggest difference between the two groups is that new participants are slightly more likely to have lower annual usage estimates. This reflects a limitation of the data that is available and is not a concern.

Multiple AC Units

In both groups, 92.4% have only a single air-conditioning unit. Among the 7.6% of customers that have multiple AC units in each participant group, almost all of them have just two units. Given the similarity in the distribution of multiple units, the impact estimates for new participants are not expected to be different from the impacts of the existing participants.

Cycling Levels

The most significant factor affecting the impact from direct load control is the cycling level chosen by the participant. Participants who choose 100% cycling (load shed) will contribute twice as much demand reduction as participants who choose 50% cycling. If new participants have different preferences than existing participants regarding this choice, the average impact for the new group could be very different. The data shows significant consistency in this choice between new and existing participants. Sixty percent of existing customers are on the 100% cycling option, and 61% of new customers selected the same option.

Verified Gross and Net Savings

ComEd's original target for the Central Air Conditioning Cycling program was 11.7 MW of summer peak savings from 8,092 new participants in PY1. This impact is based on the assumption that 40.9% of new participants will choose the 50% cycling option while 59.1% will choose the 100% load shed option. This is equivalent to 1.446 kW per participant. The final PY1 report of claimed savings shows 14.2 MW of savings from 9,810 customers at 1.446 kW per participant.

Table 1 compares ComEd's original program planning savings estimate for the program (11.7 MW) to the final program achievement evaluated savings estimate (14.4 MW). The biggest difference comes from the increase in the number of customers that joined the program. A smaller difference comes from the fact that the 100% cycling option was chosen by 61.1% of new customers, compared to the original estimate of 59.1%.

Table 1. Program Planning and Program Achievement Gross Savings Calculations

		Program Planning			Program Achievement		
Participant Group	**kW/Cust**	**Customers**	**Share**	**MW**	**Customers**	**Share**	**MW**
50% Cycling	0.909	3,310	40.9%	3.0	3,816	38.9%	3.5
100% Cycling	1.818	4,782	59.1%	8.7	5,994	61.1%	10.9
All Participants		8,092		11.7	9,810		14.4

Since there is no free ridership or spillover, the Net-to-Gross ratio for this program is one. The net savings equal the gross savings as shown in Table 2.

Table 2. Summary of Verified Gross and Net Savings

Central Air Conditioning Cycling Program PY1	**MWh Savings**		**MW Savings**		**Participation**	
	ComEd Reported	**Verified**	**ComEd Reported**	**Verified**	**ComEd Reported**	**Verified**
Gross Savings	-	-	14.2	14.4	9,810	9,810
Net-to-Gross Ratio	-	-	1	1	-	-
Net Savings	-	-	14.2	14.4	9,810	9,810

Process Evaluation

The three year evaluation plan for this program prescribes an impact evaluation each year and a process evaluation for Program Year 2 (PY2). The original plan was to conduct a participant survey after the summer of 2009 as part of the Year 2 process evaluation; part of the survey would explore issues around how customers recognized and responded to control events that were called.

June, July and August of 2009 proved to be very cool for the Chicago area, and there was only one control event called for system-wide load reductions. Given that there had been very few high temperature days during the summer, it is likely that customers would not have been attuned to a single load control event at these temperatures.

Rather than getting atypical responses to some very important customer perception questions, it was decided to delay the participant survey to next summer. If temperatures are higher next summer, the surveys will provide more relevant data. Another advantage of waiting one summer is that the survey can be prepared in advance and implemented within days after the occurrence of control events. This will aid with customer recall and improve the accuracy of the survey results.

1 INTRODUCTION TO PROGRAM

Central Air Conditioning Cycling is a residential direct load control program that ComEd has been running since 1996. The following sections will describe the program in more detail and then introduce the evaluation questions that are the primary focus of this report.

1.1 Program Description

Central Air Conditioning Cycling is a residential direct load control program that allows ComEd to cycle off and on a participant's home central air conditioner condenser so it uses less electricity on the hottest days of the year. The air conditioner's fan remains powered to circulate air to help the participant's home stay comfortable.

Customers can select either a 50% cycling option or a 100% load shed option. They receive an annual incentive of $20 for cycling or $40 for load shed. Approximately 60% of participants are on the 100% load shed option.

Central Air Conditioning Cycling is an on-going program that Commonwealth Edison began in 1996. At the end of 2007, there were approximately 50,000 participants in the program. Impact evaluation of this program is regularly performed by GoodCents Solutions, the installation contractor, based on a sample of approximately 250 customers that have whole house interval meters installed. Estimated program impacts are reported annually to PJM ISO as demand response resources.

Control events were called fifteen times between 1996 and 2006. New guidelines from PJM now require that an annual system test be run at least once each year.

ComEd has a target of recruiting an additional 22,682 participants over three years for the Central Air Conditioning Cycling program as part of the Energy Efficiency and Demand Response Plan. Their plan calls for 8092 new customers in Program Year 1 (PY1), 7695 in Program Year 2 (PY2) and 6896 in Program Year 3 (PY3). Adding 8,092 new customers in PY1 is expected to create 11.7 MW of demand savings. Since this is a demand response program, there are no associated energy savings goals. The demand reduction achieved from these additional participants is expected to meet the statutory Demand Response goal, which is to reduce peak demand by 0.1% over the prior year for eligible customers.

1.2 Evaluation Questions

The three year evaluation plan for this program prescribes an impact evaluation each year and a process evaluation for Program Year 2 (PY2). This PY1 report addresses only impact evaluation.

GoodCents Solutions, the program implementer, has been performing impact evaluation for this program since its beginning. For the impact analysis, they use data from whole house interval meters on a sample of approximately 250 program participants.

Given that individual impacts are already estimated with a metered sample, the objective of this impact evaluation is to assess if the new participants in the program are significantly different in any meaningful way from the existing participants. The impact evaluation questions for this program are:

1. How do the new participants compare to the existing program participants?

2. Are their average demand reductions expected to be different in any way from what would be found in the metered sample?

If significant differences are found between the two participant groups, there may be a need to make adjustments to the impact per customer estimates from the sample to account for these differences among the new participants.

2 EVALUATION METHODS

Impact evaluation for this program is a bit different from what would normally be seen for other residential direct load control programs because this is an on-going program that already has established M&V procedures to estimate demand reduction impacts. The main task for this impact evaluation is to determine if new participants are likely to have similar impacts to the existing participants in the program, or if there are indications that impacts may be different.

The determination of similarity between new participants and existing participants will be based on a thorough examination of the customer characteristics using information that is available in the ComEd billing system and the program tracking database. Key areas for investigation will be geography (where are the new customers located?) and size (what is the average annual kWh usage?).

Another important factor to consider when comparing the two groups is the number of air-conditioners per home. If a customer has more than one central air-conditioner in their home, it is assumed they must have control switches on both to have their load controlled during events. Previous studies in other jurisdictions have shown that the number of central air-conditioners in the home can have a significant effect on the average impacts per air-conditioner. If there are multiple units, the cooling load is shared and each unit tends to be smaller and/or used less than a unit that is the only provider of cooling in a home. This is true even though multiple units often occur in larger homes.

The number of customers selecting 50% cycling vs. 100% load shed could also contribute to a difference in average impact per participant; however, this difference can be used directly to estimate adjusted impacts for the new program participants.

2.1 Analytical Methods

The primary focus of the annual impact evaluation is the comparison of characteristics between two groups of customers: existing participants and new participants. The goal is to determine if there are significant differences between the customer make-up of the two groups that could substantially affect their estimated average impacts during load control events.

Since the data that is used for this analysis is available for all participants, there is no need to establish statistical significance in the differences that are found. The analysis is done on a census of all participants rather than on a sample, so we can have 100% confidence in all of the differences that are found.

While the differences between the two groups in the characteristics that are examined will be known with certainty, it is still uncertain if those differences would make a real and substantial difference in the load impacts seen during direct load control events. Any observed difference in characteristics is an indicator of possible difference in load impacts, but judgment must be applied before carrying that difference forward as an adjustment to the realization rate for the program. Each case will be examined carefully for proper application to gross impact adjustment.

2.2 Data Sources

The main data source used for this evaluation is ComEd's residential CIMS database. Since the Central Air Conditioning Cycling program is tied to a tariff, most information on participants is in the billing system. The program implementer also keeps a program tracking database with some additional details related to installation, but most of the important information is transferred to the CIMS system as new participants join the program. Since the data for the program is kept in the CIMS database, we have complete information on all existing and new program participants.

2.3 Sampling Plan

Sampling is not an issue for the impact evaluation. Data from the billing system was collected and analyzed for the entire population of existing and new participants since there is no extra cost for data collection. There are approximately 50,000 existing customers and 10,000 new customers in the analysis. Using all participants in the analysis eliminates the potential problem of sampling bias in the results.

3 PROGRAM LEVEL RESULTS

The following sections will report on the program level evaluation results. First, impact evaluation results will be shown, followed by information on the process evaluation.

3.1 Impact

The impact results reported here will cover several important facets of the impact evaluation of the Central Air Conditioning Cycling program. First, there will be a discussion of verification and due diligence issues which speak to the reliability of the data collected for this program. Second, a tracking system review will report on the usability and completeness of the program tracking data collection system for this program. Third, impact parameter estimates and overall impact results will be reported at both the Gross and Net levels.

3.1.1 Verification and Due Diligence

Verification of participation in this program is overseen by the program implementer, GoodCents Solutions. They are responsible for reporting on load control switches that have been installed and removed as part of the program. All indications are that these records of installations and removals are accurate and in good order.

Customers also contribute to verification of participation for this program since they expect to receive a bill incentive after the switches are installed. If they have a switch installed on their home but they do not get entered into the billing system as a participant in the program, it is likely that they will report this situation to ComEd so it can be remedied and they can receive their incentive.

The opposite is less true. If they no longer participate in the program or have their switch removed, they may not report receiving an incentive in error. Given the annual cost of incentives for maintaining customers in the program, ComEd, and consequently GoodCents Solutions, have a strong financial incentive for keeping their records accurate.

All direct load control programs like this that have one-way communication systems (i.e., control signals get broadcast out to switches, but switches do not send any acknowledgement signals back) have difficulty identifying failed switches and switches that do not respond to particular events. The cost of a two-way communication system is very high and generally not justified by the benefits it would bring to the direct load control program. For that reason, the most cost-effective course of action for verification of working switches in a one-way communication system is a rotational plan for checking switches at some regular interval. ComEd has a five year maintenance program which means every switch is checked at least once every five years.

It is estimated that roughly 10% of switches are found to have problems during the maintenance checks. Combining the five-year maintenance schedule with 10% failed switches after five years, the overall failure rate at any given time is probably close to 5%. This is a low number, but even so, GoodCents Solutions does make an adjustment to their impact estimates to account for homes in the metered sample that do not show response to events. This non-response may be due to a non-working switch, or to the fact that air-conditioning is not in use in the home on the control event days. Either way, impact estimates are being properly adjusted for the unavoidable existence of non-working switches in the participant

population. Consequently, we can say that based on the five year maintenance schedule and the non-response correction GoodCents Solutions makes to the estimate of savings from the sample data, it is likely that the existence of non-working switches is properly accounted for in the estimation of program impacts.

3.1.2 Tracking System Review

We did not find any serious issues in the tracking system data for this program. In fact, we found the data to be consistent, clean and in good order. This is not surprising since the data is used for paying annual incentives and there are financial consequences for poor program tracking.

The summary data for this program was consistent with the individual tracking system data. ComEd keeps a spreadsheet-based Central Air Conditioning Cycling Scorecard. This Scorecard is updated monthly with the number of AC Cycling participants added to the program. The Scorecard for June 1, 2009 indicates that 9,810 new participants were added to the program during PY1 (June 2008 through May 2009). This represents an on-going count of new participants.

Summit Blue verified this count by looking at dates that individual new participants joined the program. There was good correspondence on a monthly basis between the Scorecard customer counts and Summit Blue's customer counts. That is, during a month when there was a large jump in the number of customers added, both the Scorecard and the Summit Blue estimates increased in tandem.

While there was close correspondence in the monthly customer additions, there was not an exact match. Over the twelve months of PY1, the Scorecard counted 9,810 new participants while the Summit Blue method estimated 9,676 new participants. The Summit Blue estimate is about 1.5% lower than the Scorecard estimate. This difference can be explained and is not a cause for concern.

The Summit Blue estimate was based on a snapshot of the participants in the tracking system after the end of PY1. Due to normal customer churn that comes from people moving out of their homes, it is likely that some participants who joined during the year were no longer participating after the end of PY1. A difference of 1.5% is reasonable for this type of comparison where real-time data accumulations are being compared to an after-the-fact snapshot of the customer count. The real-time data accumulation is the best count of new participants since the after-the-fact count will change depending on when the snapshot is taken. The evaluation team does not believe the Scorecard count of 9,810 new participants should be adjusted in any way. The analysis verifies that it is an accurate number even though it cannot be matched exactly. The team believes the Scorecard estimate is more accurate than Summit Blue's, due to the real-time nature of the data that was used and Summit Blue's inability to have similar data.

3.1.3 Gross Program Impact Parameter Estimates

Upon examining the data for existing and new participants in the Central Air Conditioning Cycling program, there appears to be no significant difference between the two groups that would indicate a need to adjust the per customer impact estimates for new participants. This section will show the comparative statistics for geographic location, annual energy use, number of multiple AC units and cycling level.

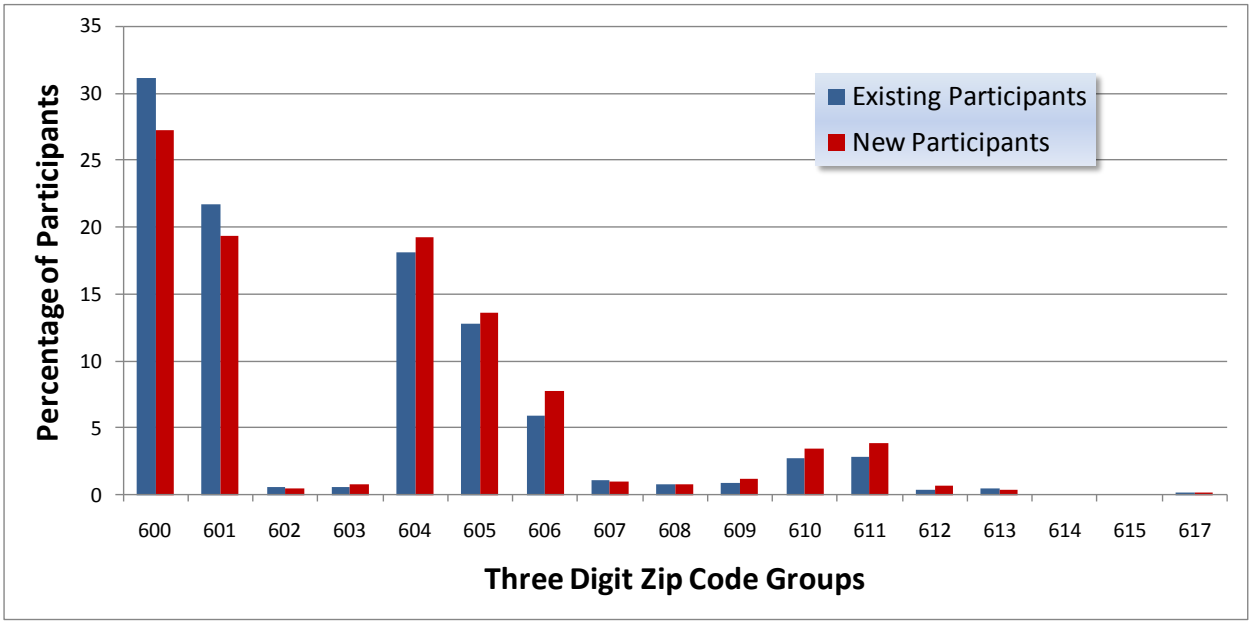
Geographic Location

Geographic location was examined to see if the two groups had different geographic distributions. If the two groups had a different geographic makeup then it would be more likely that the two groups have a different socio-economic mix. A different socio-economic mix would be an indicator that savings might

be different for the respective groups. For example, higher income areas are more likely to have larger homes requiring more air conditioning.

Figure 1 compares existing participants to new participants by their three digit zip code group. The two participant groups have very similar distributions across zip codes. While new participants show a slightly lower tendency to be in the 600 or 601 zip area, this difference is small. In fact, in both participant groups, the zip areas of 600 and 601 are the dominant zip code groups. None of the zip code groups were left out of the new participant group.

Figure 1. Compare Geographic Location by Participant Group

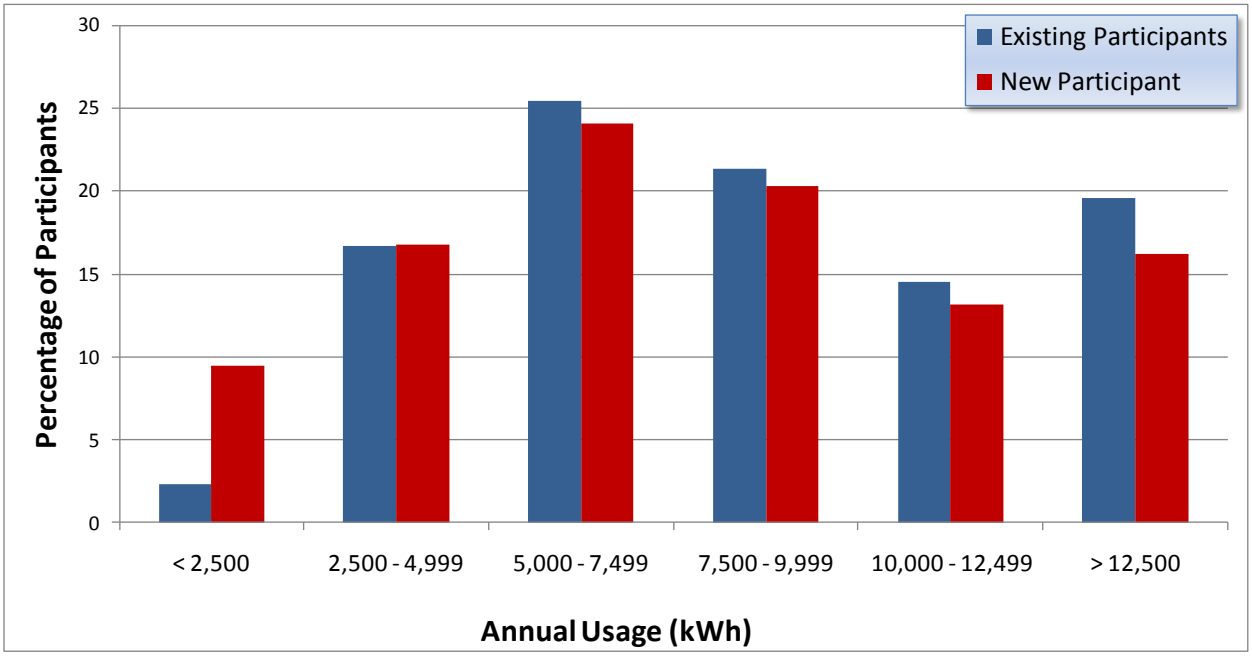


Annual Energy Use

The distribution of annual energy use for existing and new participants was also compared. A significant difference between the groups would imply that there may be different air conditioning usage characteristics which would affect impact estimates.

Figure 2 shows that the distribution of energy use is very similar for the existing and new participant groups.

Figure 2. Compare Energy Usage by Participant Group



The biggest difference between the two groups is that new participants are slightly more likely to have lower annual usage estimates. However, as described below, this likely reflects a characteristic of all new participants and is not a concern.

New participants are more likely to be new customers, and as new customers they may not have a full year of energy usage data available yet. Corrections were made to take this into account. Annual usage was estimated for each individual customer as their average kWh/day over the available data times 365 days (a standard year). In this way, all of the annual usage estimates were normalized to the same number of billing days.

However, if a customer only has several months of data available and that data does not cover the high use months, their average kWh/day will be lower than a customer that has data for an entire year. Since PY1 is a June through May year, new customers that come onto the system during the year are likely to have missed the summer season and would have lower average kWh/day values. This would account for the slight shift to lower usage values for the new participant group.

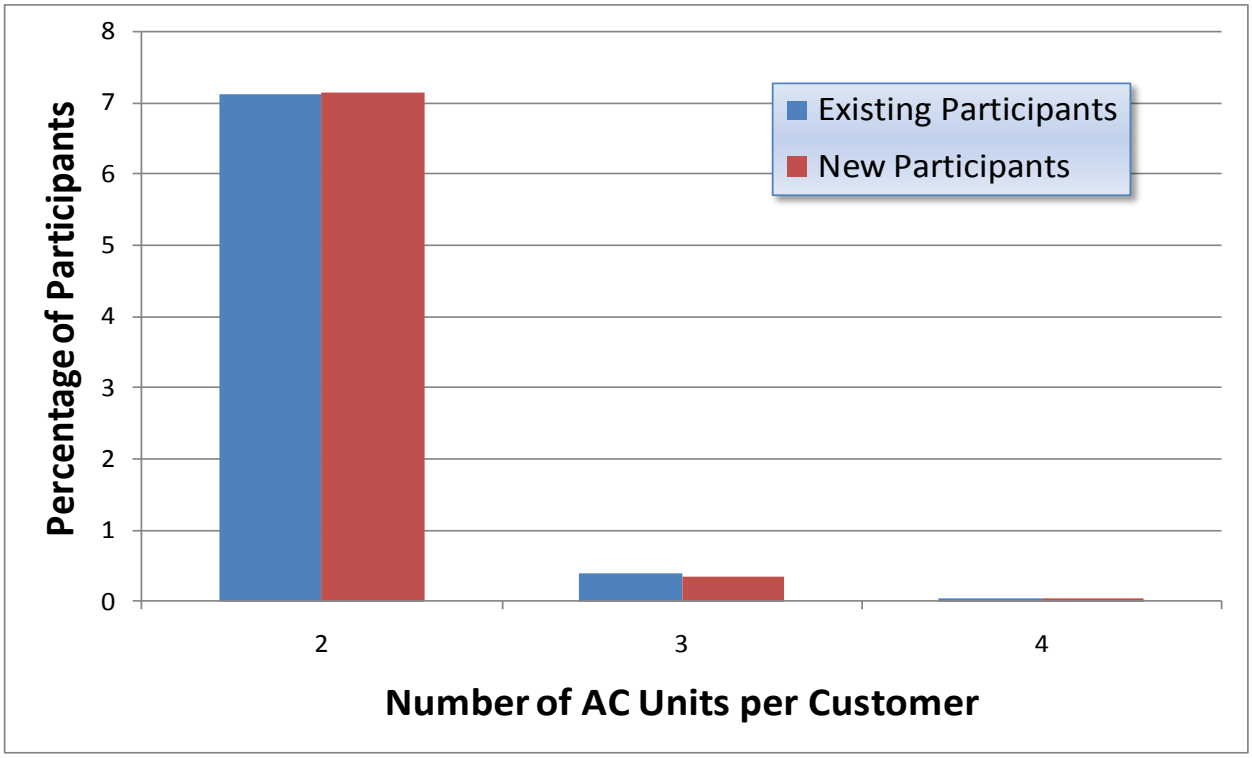
It is recommended that this assessment be verified next year when a full year of usage data is available for customers that were new participants in PY1.

Multiple AC Units

The number of switches per participant was examined to identify any potential differences between the participant groups. Multiple switches indicate that the customer has multiple AC units. Multiple AC units can affect the average usage of the individual AC units. Identifying if the occurrence of multiple AC units is significantly different for one participant group will identify whether changes need to be made to account for these differences.

In both groups, 92.4% have only a single air-conditioning unit. Figure 3 shows that among the 7.6% of customers that have multiple AC units in each participant group, almost all of them have just two units.

Figure 3. Compare Multiple AC Units by Participant Group



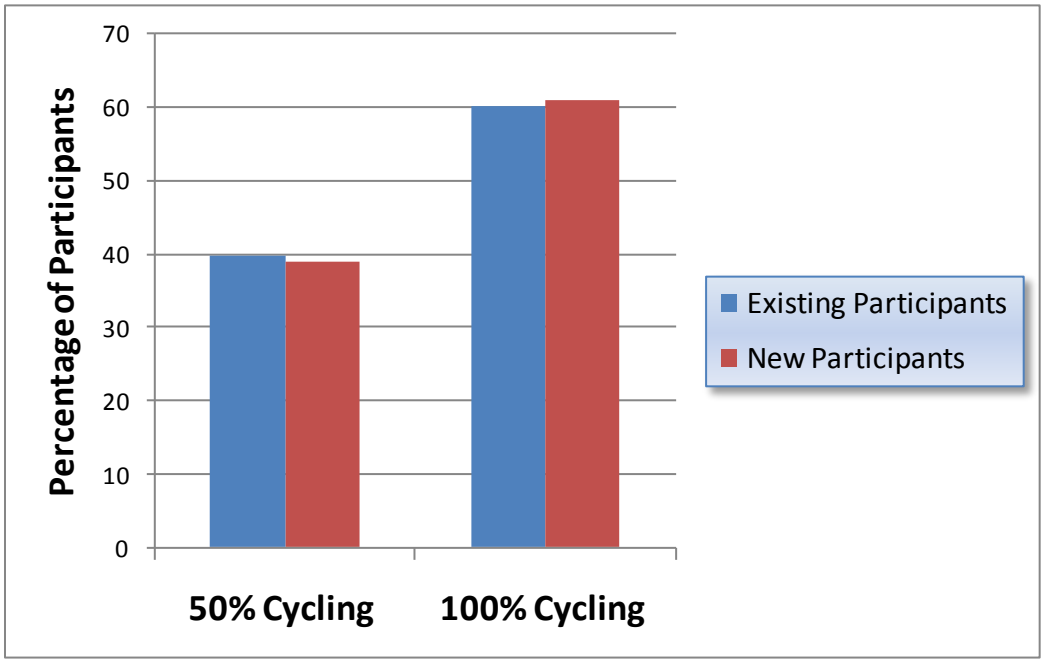
Given the similarity in the distribution of multiple units, the impact estimates for new participants are not expected to be different from the impacts of the existing participants.

Cycling Levels

The most significant factor affecting the impact from direct load control is the cycling level chosen by the participant. Participants who choose 100% cycling (load shed) will contribute twice as much demand reduction as participants who choose 50% cycling. If new participants have different preferences than existing participants regarding this choice, the average impact for the new group could be very different.

Figure 4 shows significant consistency in this choice between new and existing participants. Sixty percent of existing customers are on the 100% cycling option, and 61% of new customers selected the same option.

Figure 4. Compare Cycling Levels by Participant Group



3.1.4 Gross Program Impact Results

Previous analysis done by GoodCents Solutions using the metered interval data produced an estimate of 0.909 kW savings per participant at the 50% cycling level.[1]

This impact estimate is based on regression analysis of metered whole house load data from the summers of 2005 and 2006. These summers contained several control events and many high temperature days which allowed for the estimation of impacts across a wide range of summer temperatures. The regression models estimated impacts based on the hour of the day, the maximum daily temperature, and the connected A/C load. All of the control events were at the 50% cycling level, so the results of the evaluation are impacts for 50% cycling.

The data also supplied an estimate of the correction factor that should be used to account for non-working switches and non-use of air-conditioning. By manual observation, they found that 29 out of 145 participant meters did not show any response to control signals. This created a correction factor of 29 / 145, or 20%. This means that it is expected that 80% of participants will respond to each control event. The estimated impacts from the regression models, which reflect only responsive customers, are multiplied by the 80% de-rating factor to reflect the average impact per program participant.

On pages 23 through 32 of their report, GoodCents Solutions uses the results of their regression models adjusted by the de-rating factor and a losses factor to create estimates of potential load reduction for each daytime hour on summer weekdays at different maximum daily temperatures. These estimated impacts follow the specific reporting guidelines required by PJM. One part of these requirements is to report expected impacts for a PJM system peak day.

[1] "ComEd's Nature First A/C Load Control Measurement and Verification, 2006 Revision and Revised PJM Control Matrices", GoodCents Solutions, March 2007

GoodCents Solutions analyzed temperature data to find the expected maximum daily temperature in ComEd's service territory on PJM's RTO Peak Days. Temperature data collected from the O'Hare weather station for 1998 through 2006 showed that ComEd's average temperature during PJM's summer system peaks was 90.38° F.[2] This is cooler than what is normally expected for maximum daily temperatures on ComEd's system peak days, and it reflects the fact that the PJM peak is normally set by high temperatures in the north eastern region of the U.S. Chicago peak weather runs a bit cooler during these times of peak eastern summer temperatures.

The key impact estimate can be found on page 24 of the 2006 Revised Report. At Hour Ending 16:00 on a day when the maximum daily temperature reaches 90.38 degrees, the expected impact per participant from 50% cycling is reported to be -0.9926 kW. This value is the expected load reduction at the generator busbar. To estimate load reduction at the customer level, the reported impact needs to be divided by the line loss factor of 1.092. This calculation, -0.9926 kW / 1.092, reveals the underlying load impact per participant of -0.909 at the customer level. Impacts need to be reported at the customer level for this program to be consistent with impacts reported for other programs in the portfolio.

This information was the basis of the program planning estimate of impacts per customer used in the development of the ComEd demand response plan. Assuming that 100% cycling customers would contribute twice as much load reduction as a 50% cycling customer, the contribution to load reduction was estimated to be 0.909 x 2 = 1.818 kW for each participant that chose the 100% cycling option. As shown in Table 3, it was assumed in the program planning estimation of impacts that there would be 8,092 new participants and 40.9% of them would choose the 50% cycling option, and 59.1% would choose the 100% cycling option.

Table 3. Program Planning and Program Achievement Gross Savings Calculations

		Program Planning			Program Achievement		
Participant Group	**kW/Cust**	**Customers**	**Share**	**MW**	**Customers**	**Share**	**MW**
50% Cycling	0.909	3,310	40.9%	3.0	3,816	38.9%	3.5
100% Cycling	1.818	4,782	59.1%	8.7	5,994	61.1%	10.9
All Participants		8,092		11.7	9,810		14.4

The program achievement number of new participants was 9,810, which exceeded the customer sign-up goal by 21%. The program achievement shares turned out to be very close to the original estimate. The 100% cycling option was chosen by 61.1% of new customers, compared to the estimate of 59.1%. This small difference in shares contributed to a small increase in the average impact per customer. The program achievement weighted average impact per customer turned out to be 1.464 kW instead of 1.446, as shown in the equations below. This contributed to an overall achievement of 14.4 MW of load reduction from new participants.

(0.909 x 40.9%) + (1.818 x 59.1%) = 1.446 kW per participant

(0.909 x 38.9%) + (1.818 x 61.1%) = 1.464 kW per participant

[2]GoodCents Solutions, "ComEd's Executive Summary of the Nature First Air Conditioning Load Study," Updated May 15, 2007.

ComEd's original target for the Central Air Conditioning Cycling program was 11.7 MW of summer peak savings from 8,092 new participants during PY1. The final PY1 report of claimed savings shows 14.2 MW of savings from 9,810 customers. Both numbers are based on an average impact of 1.446 kW per customer. The original target was exceeded mainly due to additional participation, but also due to slightly higher enrollment in the 100% load shed option than what was expected.

We have verified the math used to calculate the year-end numbers for new participants and impact per customer and believe these values are an accurate estimate of gross savings from the Central Air Conditioning Cycling program in PY1 if they are adjusted to reflect the actual mix of 50% cycling and 100% load shed customers. A remaining question, however, is whether or not the PJM-based estimates of 0.909 kW for 50% cycling and 1.818 kW for 100% load shed are an appropriate estimate of load reduction at the time of ComEd system peak.

First, we will consider the use of 0.909 kW per participant for 50% cycling. This estimated impact is very consistent with what is found for other residential air conditioning direct load control programs across the country. Impact estimates for this type of program are generally near 1 kW per participant.[3] Differences will occur based on the hours of the day that an event is called and the outdoor temperatures during the event.

Looking at the hours of the day, it should be noted that the estimate of -0.909 kW is specifically for hour ending 16:00. If a control event is called for ComEd, it is likely it will last for a period of at least three hours since that is the daily limit for 100% load shed. Looking at the GoodCents Solutions report for the three-hour period of hour ending 15:00 to hour ending 17:00 (2:00 to 5:00 p.m.), the average load reduction over those three hours is 90% of the maximum hour (-0.819 instead of -0.909). This would indicate that the load impact estimate should be 10% lower over the three hour control period.

However, outdoor temperatures have a greater relative effect on impacts than hours of the day. The impact estimate of -0.909 is based on a maximum daily temperature of 90.38° F to be consistent with PJM system peak days. On a ComEd system peak day it is likely that the temperatures will be much higher. If maximum daily temperature is 95° F instead of 90.38° F, the GoodCents Solutions study indicates that impacts will be -1.056 kW per customer instead of -0.909, which is an increase of 16%. If the temperature reaches 99° F, the predicted impact is -1.195 (an increase of 31%).

Looking at both hours of the day and maximum daily temperatures, it can be seen that these two effects offset each other with the temperature effect being greater. Rather than trying to adjust the estimated impact for each of these effects, ComEd has chosen to maintain consistency with the PJM estimates and stick with -0.909 kW per customer for estimating program goals and achievements. This is a conservative estimate since it is likely that temperatures on a ComEd system peak day will increase impacts beyond this level for 50% cycling. Given the importance of being able to achieve estimated demand reductions for demand response programs, we concur that the impact estimate should be kept conservative and we do not recommend any changes to it.

Next, we will consider the use of 1.818 kW per participant for 100% load shed. ComEd assumes that the load impact from 100% load shed will be twice as great as the estimated load impact for 50% cycling. We find this to be a reasonable assumption. A residential air-conditioner running for a full sixty minutes during a single hour on a very hot summer weekday afternoon can use anywhere from 2 to 6 kW,

[3]Mary Klos, Summit Blue Consulting, "A Regional Look at Residential DLC Impacts," Association of Energy Services Providers (AESP) teleconference presentation, February 2008.

depending on the size and efficiency level of the unit and the cooling requirements of the home. As outdoor temperatures increase, average usage over a group of air-conditioners gets closer and closer to sixty minutes out of the hour. Given the 20% de-rating factor found in the GoodCents Solutions study, 1.818 kW fits reasonably into the low end of this range.

While many studies have been done on the impacts of 50% cycling, 100% load shed estimates are rare. While ComEd's current estimate of 1.818 kW per customer for 100% load shed appears reasonable based on known information, a verification of that number based on metered data from a 100% load control event would be valuable. Given that most program participants are choosing the 100% load shed option, we recommend conducting a test at this level on a very hot weekday during the next summer with high temperatures.

3.1.5 Net Program Impact Parameter Estimates

There is no free ridership or spillover expected in a direct load control program. Customers cannot install a control switch on their own and have no reason to do so without a program and an incentive from the utility.

3.1.6 Net Program Impact Results

Since there is no free ridership or spillover, the Net-to-Gross ratio for this program is one. The net savings equal the gross savings as shown in Table 4.

Table 4. Summary of Verified Gross and Net Savings

Central Air Conditioning Cycling Program PY1	MWh Savings		MW Savings		Participation	
	ComEd Reported	Verified	ComEd Reported	Verified	ComEd Reported	Verified
Gross Savings	-	-	14.2	14.4	9,810	9,810
Net-to-Gross Ratio	-	-	1	1	-	-
Net Savings	-	-	14.2	14.4	9,810	9,810

3.2 Process

The evaluation plan for this program called for a process evaluation in Year 2. The original plan was to conduct a participant survey after the summer of 2009 as part of the Year 2 process evaluation. Part of the survey would explore issues around how customers recognized and responded to control events that were called.

June, July and August of 2009 proved to be very cool for the Chicago area and there was only one control event called for system-wide load reductions. This event met the new PJM requirement that at least one control event be called each summer to test the system. The event was called on August 14. All 50% cycling customers were cycled from 12:00 to 16:00 Central Time. All 100% load shed customers were interrupted from 13:00 to 14:00 Central Time. A small group of 100% load shed customers in a load research group (about 100 customers) were interrupted from 13:00 to 16:00 Central Time to collect

additional load research data. However, the temperature was 87 degrees from 14:00 to 16:00 that day, which is relatively cool for a summer peak temperature. Given that there had been very few high temperature days during the summer, it is likely that customers would not have been attuned to a single load control event at these temperatures.

Rather than getting atypical responses to some very important customer perception questions, it was decided to delay the participant survey to next summer. If temperatures are higher next summer the surveys will provide more relevant data. Another advantage of waiting one summer is that the survey can be prepared in advance and implemented within days after the occurrence of control events. This will aid with customer recall and improve the accuracy of the survey results.

3.2.1 Program Theory

A program theory model was not developed for this program since it has been up and running for several years.

3.3 Cost Effectiveness

This section addresses the cost effectiveness of the Central Air Conditioning Cycling program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. The TRC test is defined in the Illinois Power Agency Act SB1592 as follows:

> *" 'Total resource cost test' or 'TRC test' means a standard that is met if, for an investment in energy efficiency or demand-response measures, the benefit-cost ratio is greater than one. The benefit-cost ratio is the ratio of the net present value of the total benefits of the program to the net present value of the total costs as calculated over the lifetime of the measures. A total resource cost test compares the sum of avoided electric utility costs, representing the benefits that accrue to the system and the participant in the delivery of those efficiency measures, to the sum of all incremental costs of end-use measures that are implemented due to the program (including both utility and participant contributions), plus costs to administer, deliver, and evaluate each demand-side program, to quantify the net savings obtained by substituting the demand-side program for supply resources. In calculating avoided costs of power and energy that an electric utility would otherwise have had to acquire, reasonable estimates shall be included of financial costs likely to be imposed by future regulations and legislation on emissions of greenhouse gases."*[4]

ComEd uses DSMore™ software for the calculation of the TRC test.[5] The DSMore model accepts information on program parameters, such as number of participants, gross savings, free ridership and program costs, and calculates a TRC which fits the requirements of the Illinois legislation.

One important feature of the DSMore model is that it performs a probabilistic estimation of future avoided energy costs. It looks at the historical relationship between weather, electric use and prices in the MISO region and forecasts a range of potential future electric energy prices. The range of future prices is correlated to the range of weather conditions that could occur, and the range of weather is based on weather patterns seen over the historical record. This method captures the impact on electric prices that comes from extreme weather conditions. Extreme weather creates extreme peaks which create extreme

[4] Illinois Power Agency Act SB1592, pages 7-8.

[5] Demand Side Management Option Risk Evaluator (DSMore) software is developed by Integral Analytics.

prices. These extreme prices generally occur as price spikes and they create a skewed price distribution. High prices are going to be much higher than the average price while low prices are going to be only moderately lower than the average. DSMore is able to quantify the weighted benefits of avoiding energy use across years which have this skewed price distribution.

Table 5 summarizes the unique inputs used in the DSMore model to assess the TRC ratio for the Central Air Conditioning Cycling program in PY1. Most of the unique inputs come directly from the evaluation results presented previously in this report. Measure life estimates and program costs come directly from ComEd. All other inputs to the model, such as avoided costs, come from ComEd and are the same for this program and all programs in the ComEd portfolio.

Table 5. Inputs to DSMore Model for Central Air Conditioning Cycling Program

Item	Value Used
Measure Life	15 years
Participants	9,810
Annual Gross Energy Savings	0 MWh
Gross Coincident Peak Savings	14.42 MW
Net-to-Gross Ratio	100%
Utility Annual Administration Costs (internal labor)	$87,793
Utility Depreciation Cost for Switches (first year)	$7,971
Utility Depreciation Cost for Switches (annual costs over a 40 year lifetime)	$15,941
Utility Other Costs (first year marketing costs)	$476,027
Utility Annual Incentive Costs	$62,952[6]
Participant Contribution to Incremental Measure Costs	$0

Based on these inputs, the TRC for this program is 3.33 and the program passes the TRC test.

At this time, additional benefits related to reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

[6] This incentive cost reflects the 2008 payments to customers. Since payments are made monthly from June thru September, there were only partial payments made to most customers in the first year. Subsequent years would have the total incentive payments for this group of customers around $316,000, but there would also be significant but unknown offsets from PJM revenues. A value of $63,000 for net incentive payments in future years is likely an overstated, and hence conservative, estimate. Additional refinement of this estimate is not necessary since the incentive level does not affect the TRC calculation.

4 CONCLUSIONS AND RECOMMENDATIONS

This report is the Program Year 1 assessment of the Central Air Conditioning Cycling program. Program evaluation work will continue for Program Years 2 and 3, providing the opportunity to refine and update the assessment each year and watch for any trends that occur that would change the impact estimates.

The following conclusions highlight the major findings and recommendations presented in this Program Year 1 report.

Number of Participants in the Air-Conditioning Load Control Program

The original goal was to add 8,092 new participants to the Central Air Conditioning Cycling program in PY1. The actual number of new participants was 9,810. This was verified with an assessment of program start dates for all new program participants.

Geographic Location of Participants

The geographic locations of existing participants and new participants were not significantly different from each other. Different locations could indicate different participant characteristics that would need to be considered in the estimation of impacts for the program. This finding indicates that there is no need to adjust the estimated impact per existing customer to represent a new customer based on geographic differences. This should be watched in future years to see if the small differences grow larger.

Participant Energy Use Patterns

Average annual energy use statistics for existing participants and new participants were not significantly different. The analysis for this comparison looked at average use over the year as a whole since that is the data that was available. Since air-conditioning use occurs during the summer months, a comparison of summer usage may produce a better comparison than the annual totals used. There was some indication of lower average annual use among new participants, but it is believed that this is a reflection of the fact that they were more likely to be new customers without a full year of kWh usage data. This assumption should be verified next year after a full year of data is available for each of the new participants in PY1.

Participants with Multiple Central AC units

The number of participants with multiple central AC units was very similar between the two participant groups. This should be monitored each year.

Recommendations Concerning Modification of Reported Savings

The evaluation team has verified the reported year-end numbers for new participants and impact per customer and recommends modifications to the reported savings of 14.2 MW for this program based on the actual shares of 50% cycling and 100% load shed that were selected by the new participants. The verified savings for this program is 14.4 MW for both gross and net savings. Summit Blue does not see any need for ComEd to change their program planning estimate of savings per customer for future year targets since their estimates were very close.

Recommendations Concerning Future Metered Data Tests

While many studies have been done on the impacts of 50% cycling, 100% load shed estimates are rare. While ComEd's current estimate of 1.818 kW per customer for 100% load shed appears reasonable based on known information, a verification of that number based on metered data from a 100% load control event would be valuable. Given that most program participants are choosing the 100% load shed option, the evaluation team recommends conducting a test at this level on a very hot weekday during the next summer with high temperatures.