

**Energy Efficiency/ Demand Response  
Plan: Plan Year 3 (6/1/2010-5/31/2011)  
Evaluation Report: Single Family  
Programs**

**Presented to**

**Commonwealth Edison Company**

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## Section E. Executive Summary

This document presents the Program Year 3 (PY3; June 1, 2010- May 31, 2011) Evaluation Report of the All-Electric Single Family Home Energy Performance Tune-Up Program (“All-Electric Home”) as well as three single family pilot programs that were run in cooperation with Gas Utilities that share ComEd’s service territory. The pilots evaluated in this report include:

- Joint Single Family Retrofit Pilot Program, implemented cooperation with Nicor Gas (“Retrofit Pilot”)
- The Joint Single Family Direct Install Pilot Program is implemented in cooperation with Peoples Gas and the Chicagoland Natural Gas Savings program. (“Direct Install Pilot”)
- The Joint Single Family Air Sealing Pilot Program is implemented in cooperation with Peoples Gas and the Chicagoland Natural Gas Savings Program. (“Air Sealing Pilot”)

### All-Electric Home

The All Electric Home program offers educational and installation services including the provision of a comprehensive basket of electricity-saving measures targeted to owners of all-electric homes. The program offers low-cost direct install measures, including CFLs, low-flow showerheads, faucet aerators and pipe insulation. Additionally, the program offers an energy survey of the home and provides energy saving information and recommendations for energy-savings retrofits. The services are provided by an energy specialist for the nominal fee of \$25 (the remainder of the survey cost is subsidized by the program). The program completed its second full year of operation in May of 2011, with 438 homes participating. The program will not continue in PY4.

### Retrofit Pilot

The Joint Single Family Retrofit Pilot Program is implemented in cooperation with Nicor Gas. Throughout this report, we refer to the pilot as the “Retrofit Pilot” program. The Retrofit program targets single family homes in communities with older home stock within overlapping Nicor Gas and ComEd’s service territories. The program offers low-cost direct install measures, including CFLs, low-flow showerheads, and faucet aerators. Additionally, the program offers an energy audit of the home, provides energy saving information and recommendations for energy-savings retrofits, and funding for follow-up retrofits including air sealing and insulation. The program will continue in PY4.

### Direct Install Pilot

The Joint Single Family Direct Install Pilot Program was implemented in cooperation with Peoples Gas and the Chicagoland Natural Gas Savings Program, but will not continue in PY4. Throughout this report, we refer to this program as the “Direct Install Pilot” program. This

program targeted homes in areas with Area Median Incomes (AMIs) of 120% or less, and was open to both single family homes and multi-family dwellings with eight or fewer units. The program offered low-cost direct install measures, including CFLs, low-flow showerheads, and faucet aerators. It educated building owners and occupants about other energy efficiency opportunities available to them, including opportunities available through other residential programs.

### **Air Sealing Pilot**

The Joint Single Family Air Sealing Pilot Program is implemented in cooperation with Peoples Gas and the Chicagoland Natural Gas Savings Program, but will not continue in PY4. Throughout this report, we refer to this program as the “Air Sealing Pilot” program. This program, open to single family and two-unit residential homes, offered up-front site assessments to increase residential awareness of energy efficiency options and other residential program offerings. The program offered low-cost direct install measures, including CFLs, low-flow showerheads, and faucet aerators.

#### ***E.1 Evaluation Objectives***

The goal of this report is to present a summary of the findings and results from the evaluation of the four Program Year 3 (PY3) single family programs described above. The objectives of the evaluation are to: (1) quantify net energy and peak demand savings impacts from the program during PY3; and (2) to present key process-related program findings. Net energy and peak demand savings impacts are presented for all four programs, while process related findings are more limited owing to planned discontinuation of several of these programs. The Retrofit Pilot will continue in PY4, so we present the program’s achievements and opportunities for improvement. We also provide recommendations to improve the program. Since the Direct Install Pilot will not continue in PY4, we limit our reporting to the program’s achievements and opportunities for improvement. We do not provide a process evaluation for the Air Sealing Pilot because ComEd indicated it was a small program and that the utility would not be participating in a future, redesigned version of the program. A process evaluation was not conducted for the All-Electric Home program as this program will not be continuing in the future either.

#### ***E.2 Evaluation Methods***

This evaluation leverages program tracking data, telephone surveys completed with participants, interviews with program managers and implementers, secondary sources, and a variety of engineering and analytical techniques.

Methods applied in this evaluation include engineering research and literature reviews, analysis of tracking data, the fielding of a participant telephone survey, and in-depth interviews with program managers and implementers. Program tracking data and participant telephone

surveys are used to determine key impact parameters, including measure verification, measure removals, non-program qualifying installations, participant follow up on survey recommendations, and participant home occupancy. Telephone surveys with participants and professional interviews are used to investigate key process research questions, including customer satisfaction, program design, communications and marketing. Table ES-1 below summarizes data collection activities, along with the details regarding sampling and timing.

**Table ES-1. Data Collection Activities**

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis	All Program Participants	Tracking Database	-	All	May-August 2011
In-depth Telephone Interviews	Program Managers	Contact from ComEd	Current Program Managers, Program Implementer	3	May-June, 2011
CATI Telephone Surveys	All-Electric Home Participants	Tracking Database	Random Sample of Program Participants	91	July, 2011
	Retrofit Pilot Participants	Tracking Database	Random Sample of Program Participants*	122	
	Direct Install Pilot Participants	Tracking Database	Random Sample of Program Participants	68	
	Air Sealing Pilot Participants	Tracking Database	Random Sample of Program Participants	46	

\*A quota was imposed to ensure proportional representation of Retrofit program pilot direct install only and full pilot participants.

### ***E.3 Key Impact Findings and Recommendations***

For purposes of meeting statutory goal requirements, kWh savings from residential CFL installations have been deemed and are used instead of currently evaluated determinations. For PY3, the all-electric program net savings is 369 MWh and total savings from joint pilots with area gas companies was 2,130 MWh. Table ES-2 below presents the ex-ante impact including deemed values for CFL savings, the evaluation impact results and corresponding realization rate (RR) and net-to-gross (NTG) ratio by Single Family Program.

**Table ES-2. Gross and Net MWh Impact Summary – With Deemed Values**

Single Family Programs Deemed CFL Values	Measure Ex-Ante Gross MWh	RR	Ex-Post Gross MWh	NTG	Ex-Post Net MWh
All-Electric	469	85%	401	92%	369
Joint Programs	2740	98%	2680	79%	2130
Total Single Family	3209	96%	3081	81%	2499

The remaining sections of the report focuses on savings determined from the current evaluation of program parameters and measures. Table ES-3 provides breakdowns of Ex-Ante Gross MWh based on installed measures, Realization Rates, Ex-Post Gross MWh, Net-to Gross Ratios, and the Ex Post Net MWh Savings based on current year evaluated parameters. Across all four programs, the single family efforts have net savings of 2,171 MWh. More than half of which is associated with the Direct Install Pilot, which achieved 1,440 MWh.

**Table ES-3. Gross and Net MWh Impact Summary – Evaluated Parameters**

Single Family Programs	Measure Ex-Ante Gross MWh	RR	Ex-Post Gross MWh	NTG	Ex-Post Net MWh
<b>All-Electric</b>					
CFL	173.1	91%	156.8	89%	139.1
Low Flow Showerhead	133.3	66%	88.1	93%	81.9
Kitchen Aerator	39.3	86%	33.7	95%	31.9
Faucet Aerator	72.0	76%	54.9	95%	52.0
Hot Water Heater Turndown	7.0	100%	7.0	100%	7.0
Hot Water Pipe Insulation	44.0	100%	44.0	96%	42.3
Energy Survey					19.8
Sub-total All-Electric	468.7	83%	389.7	0.92	360.1
<b>Air Sealing Pilot</b>					
CFL	43.7	97%	42.3	0.76	32.3
<b>Direct Install Pilot</b>					
CFL	2,127.8	83%	1,767.9	0.81	1,439.8
<b>Retrofit Pilot</b>					
CFL	413.2	88%	362.1	68%	246.4
Water Measures	-	-	19.2	94%	18.0
Weatherization Measures	155.6	50%	77.1	98%	75.3
Sub-total Retrofit Pilot	568.8	81%	458.4	0.74	339.7

Table ES-4 below compares the impact results of the PY2 All-Electric Home Program to the PY3 All-Electric Home Program. As shown below, the total program year net kWh per home is fairly similar between the two program years, with PY3 being slightly lower (824 kWh for PY3 and 839 kWh for PY2).

**Table ES-4. PY3 vs. PY2 All-Electric Home Accomplishments**

All-Electric Home Program	Homes	Net kWh/ Home	Ex-Post Net MWh	RR*	NTG
<b>PY3 Accomplishments</b>					
CFL	422	329.7	139.1	91%	89%
Low Flow Showerhead	383	213.9	81.9	66%	93%
Kitchen Aerator	287	111.1	31.9	86%	95%
Faucet Aerator	410	93.0	38.1	76%	95%
Hot Water Pipe Insulation	361	117.2	42.3	100%	96%
Water Heater Turndown	37	188.0	7.0	-	100%
Energy Survey	437	45.2	19.8	-	100%
<i>Total PY3</i>	437	824.1	360.1	83%	0.92
<b>PY2 Accomplishments</b>					
CFL	709	254.7	180.6	102%	72%
Low Flow Showerhead	622	260.7	162.2	81%	93%
Kitchen Aerator	472	122.3	57.7	92%	97%
Faucet Aerator	681	66.9	45.6	67%	97%
Hot Water Pipe Insulation	622	124.4	77.4	100%	102%
Water Heater Turndown	75	188.0	14.1	-	100%
Energy Survey	760	131.8	100.2	-	100%
<i>Total PY2</i>	760	839.1	637.7	107%	88%

\* PY3 gross Realization Rate expressed as the ratio of ex-post gross to measure ex-ante.

More detailed impact results for the All-Electric Home Program, and the three single family pilots are shown in Table ES-5 through Table ES-8. Table ES-5 below shows the PY3 program goals, provided in MWh, as well as the ex-ante impact, the evaluation impact results and corresponding realization rates. Across all four programs, the single family efforts have net savings of 2,171 MWh. More than half of which is associated with the Direct Install Pilot, which achieved 1,440 MWh. Gross impact realization rates range from 81% for the Retrofit Program to 97% for the Air Sealing Pilot. The overall gross impact realization rate for all four programs together is 83%. Net-to-gross ratios range from 74% for Air Sealing Pilot and the Retrofit Pilot, to a high of 92% for the All-Electric Home Program.

**Table ES-5. Gross and Net MWh Impact Summary**

		Program Name				All Programs
		All-Electric Home	Air Sealing Pilot	Direct Install Pilot	Retrofit Pilot	
Gross Impact Realization Rate		83%	97%	83%	81%	83%
Net-to-Gross Ratio		0.92	0.76	0.81	0.74	0.82
Gross Energy Impact (MWh)	Goal	-	150	2,100	750	3,000
	Ex-Ante	469	44	2,128	569	3,210
	Ex-Post	390	42	1,768	458	2,658
	% of Ex-Ante	83%	97%	83%	81%	83%
	% of Goal	-	28%	84%	61%	89%
Net Energy Impact (MWh)	Goal	289	102	1,428	510	2,329
	Ex-Ante	361	31	1,486	444	2,321
	Ex-Post	360	32.3	1,440	340	2,172
	% of Ex-Ante	100%	103%	97%	76%	94%
	% of Goal	125%	31%	101%	67%	93%

Across all four programs, the single family efforts have achieved a net electricity demand savings total 295 kW, arising primarily from the Direct Install Pilot (146 kW) and the Retrofit Pilot (111 kW).

As shown in Table ES-6 below, gross impact realization rates range from 94% for the All Electric Homes Program to 345% for the Retrofit Pilot. The Retrofit Pilot only had ex-ante values for the CFL direct install measure and not the additional weatherization measures, which has resulted in a very high realization rate. For the insulation measures, the kW impact was calculated as explained in model 3 of the Attic Insulation model (see page 93). For the air sealing measure, the kW impact was calculated as the average ratio of kW impact per CFM reduction to kWh impact per CFM reduction as reported in the Texas TRM.

The overall gross impact realization rate for all four programs together is 131%. Net-to-gross ratios range from 74% for Air Sealing Pilot and the Retrofit Pilot, to a high of 93% for the All-Electric Home Program.

**Table ES-6. Gross and Net kW Demand Impact Summary**

		Program Name				All Programs
		All-Electric Home	Air Sealing Pilot	Direct Install Pilot	Retrofit Pilot	
Gross Impact Realization Rate		106%	117%	100%	356%	137%
Net-to-Gross Ratio		93%	74%	81%	90%	86%
Gross Demand Impact (kW)	Ex-Ante	35.3	3.8	183.7	35.7	262.7
	Ex-Post	37.3	4.3	179.0	123.2	343.8
	% of Ex-Ante	94%	113%	97%	345%	131%
Net Demand Impact (kW)	Ex-Ante	30.4	2.6	128.3	24.9	186.3
	Ex-Post	34.5	3.2	145.8	111.4	294.9
	% of Ex-Ante	114%	121%	114%	447%	158%

Table ES-7 below shows the All-Electric Home Program first year ex-post program impact by measure. Impacts are associated with the five direct install measures: CFLs, Low Flow Showerheads, Kitchen Aerator, Faucet Aerator and Hot Water Pipe Wrap, as well as Energy Surveys and Water Heater temperature turndown. The program achieved net savings of 360 MWh, most of which arise from CFL installations (39%) and showerheads (23%). Gross impact realization rates range from 67% for faucet aerators to 119% for pipe insulation. As is discussed in more detail in Section 3.1.3, the largest adjustment for the faucet aerator measure was the ‘partial retrofit’ adjustment, which controls for the reduced expected impact where a portion of a home’s faucets were not retrofit. (Please see Section 2.1.1 for a fuller discussion of the partial retrofit adjustment). The high gross realization rate for pipe insulation reflects a lower than expected attrition rate. Actual attrition was found to be 0% and the measured installation rate was 100%.

**Table ES-7. All-Electric Home Program Measure Level Energy Impact Results**

All-Electric Home	Homes	Gross Impact (MWh)			Net Impact (MWh)		
		RR	Ex-Ante	Ex-Post	NTG	Ex-Ante	Ex-Post
CFL	422	91%	173.1	156.8	89%	120.9	139.1
Low Flow Showerhead	383	66%	133.3	88.1	93%	107.5	81.9
Kitchen Aerator	287	86%	39.3	33.7	95%	31.7	31.9
Faucet Aerator	410	76%	72.0	40.3	95%	58.1	38.1
Hot Water Pipe Insulation	361	100%	44.0	44.0	96%	35.5	42.3
<b>Other Program Measures and Recommendations</b>							
Hot Water Heater Turndown	37	100%	7.0	7.0	100%	7.0	7.0
Energy Survey	437	-	0	19.8	100%	0	19.8
<b>Total Program Impact</b>	<b>438</b>	<b>83%</b>	<b>468.7</b>	<b>389.7</b>	<b>92%</b>	<b>360.7</b>	<b>360.1</b>

Altogether, nearly 7,500 homes participated in one of the three single family pilot programs resulting in an ex-post net energy impact of 1.8 GWh. Across all three pilots, the overall gross impact realization rate is 83% and the overall net-to-gross ratio is 80%. Individual pilot program gross energy impact realization rates range from 81% for the Retrofit Pilot to 97% for the Air Sealing Pilot. Net-to-gross ratios are 74% for both the Retrofit Pilot and the Air Sealing Pilot, and 81% for the Direct Install Pilot.

At the measure level, gross impact realization rates were generally high for CFLs, ranging from 83% for the Direct Install Pilot to 97% for the Air Sealing Pilot. The weatherization measures under the Retrofit Pilot had somewhat lower gross realization rates, ranging from 31% to 43% for the measures that were evaluated (100% for the measures that were not evaluated). A full discussion of the gross impact analysis methods and results is presented in Section 6.1.5 on page 84. Gross impact was not claimed for water saving measure due to the expectation of 100% gas water heat among participating homes. Some electric water heat equipment was identified in the study, so an ex-post impact is assigned.

Net-to-gross ratios are high for the weatherization and water saving measures, ranging from 93% to 99%. CFL net-to-gross ratios range from 68% for the Retrofit Pilot to 81% for the Direct Install Pilot. A full discussion of net-to-gross methodology is presented in Section 2.1.2 on page 29.

**Table ES-8. Pilot Program Measure Level Energy Impact Results**

Program	Homes	Gross Impact (MWh)			Net Impact (MWh)		
		RR	Meas Ex-Ante	Ex-Post	NTG	Ex-Ante	Ex-Post
<b>Air Sealing Pilot</b>							
CFL	135	97%	43.7	42.3	74%	30.5	31.5
<b>Direct Install Pilot</b>							
CFL	5,966	83%	2,127.8	1,767.9	81%	1,486.1	1,439.8
<b>Retrofit Pilot</b>							
CFL	1,300	88%	413.2	362.1	68%	288.6	246.4
Weatherization Measures							
Air Sealing	403	39%	55.0	21.6	99%	55.0	21.3
Attic Insulation	337	31%	50.4	15.7	98%	50.4	15.4
Floored Attic Insulation	133	43%	18.3	7.9	98%	18.3	7.7
Exterior Wall Insulation	28	100%	10.4	10.4	96%	10.4	10.0
Sloped Insulation	30	100%	3.2	3.2	96%	3.2	3.1
Knee Wall Insulation	77	100%	4.7	4.7	96%	4.7	4.5
Crawl Space Insulation	70	100%	1.9	1.9	96%	1.9	1.9
Duct Insulation	38	100%	5.2	5.2	99%	5.2	5.1
Rim Joist Insulation	252	100%	5.8	5.8	96%	5.8	5.6
Seal and Repair Ducts	8	100%	0.7	0.7	93%	0.7	0.6
Total Weatherization Measures	413	50%	155.6	77.1	98%	155.6	75.3
Other Program Impact Measures							
Kitchen Aerator	-	-	-	2.7	95%	-	2.5
Faucet Aerator	-	-	-	4.5	95%	-	5.7
Low-Flow Showerhead	-	-	-	10.5	93%	-	9.7
Total Other Program Impact	-	-	-	17.7	94%	-	18.0
Total Retrofit Pilot Impact	1,375	81%	568.8	457.0	74%	444.2	339.6
Total Pilot Programs	7,476	83%	2,740.3	2,267.1	80%	1,960.8	1,809.5

### Impact Recommendations

Impact recommendations are presented below for the Retrofit Pilot program only, as it is the only single family program addressed in this evaluation that is slated to continue into PY4.

## Tracking System

- If the current software specifications allow it, it is recommended that demand impact figures associated with Retrofit Pilot weatherization measures be generated for the tracking system.
- Ensure pre- and post-retrofit R-values are recorded for all insulation measures. The savings associated with installing insulation measures is highly dependent on the levels of pre-existing insulation.
- Other data that would be useful to evaluators include number of stories above grade, leakage type, and insulation type.
- The evaluation results presented in Sections 6.1.4 indicate that kWh and kW savings from weatherization and air sealing measures arise largely from reduced cooling loads. For this reason, they rely on specifications of air conditioning type and efficiency. *To support future impact evaluation, it is recommended that the tracking system store key information regarding the cooling system.* Ideally, this would include air conditioning type, capacity and efficiency. However, efficiency can be difficult to determine on-site, but the age and make / model information serves as an excellent reference.
- Lastly, the program provides the direct installation of water savings measures, but does not store the water heater fuel type in the tracking system. *It is recommended that the tracking system record the water heater fuel type of participating homes.*
- In developing cost savings estimates for the audit report presented to customers, an annual kWh savings of 51 was assumed for all CFLs installed. The average annual kWh savings for bulbs installed through the program is 44.5. *To avoid presenting overestimates of the annual energy cost savings, it is recommended that the assumed savings for CFLs be reduced from 51 kWh to 44.5 kWh for the purpose of customer audit report generation.*

## CFLs

- It is recommended that the PY4 program take care to make sure that CFLs installed through the program are replacing incandescent bulbs and not other CFLs.
- It is recommended that program contractors make sure the CFLs keep within prescribed wattage ranges of the incandescent bulb they are replacing.
- It is recommended that program contractors make sure the CFLs are installed in high use areas or that the estimated HOU be collected in the tracking system.

- It is recommended that ComEd monitor the levels of pre-existing CFLs in participating homes. Customers with high CFL saturation prior to participating are somewhat more likely to be free riders, and less likely to have high-use sockets qualifying for CFL retrofit. If ComEd observes a marked change in pre-existing saturation levels among participants, perhaps a change in program marketing, or even a new participant screening criteria, may help to preserve program impact.
- It is recommended that all of the above CFL guidelines and policies be documented in program operations manuals, and highlighted in related contractor training material.

## **Weatherization Measures**

- It is recommended that ComEd request the new model slated for use in PY4 to estimate weatherization measure impact, take into account the interactive effects of installing multiple measures, if it doesn't do so already.
- It is also recommended that one of the following options be used in future program year evaluations to assess the impact achieved by the weatherization measures: evaluate the ex-ante model calculations, conduct a billing analysis, or create more refined building simulation models on a subset of the population by either collecting more detailed home characteristic information at the time of participation or over the phone at a later date.
- To improve the overall cost effectiveness and impact performance of the attic insulation measure ComEd may consider capping pre-existing R-values for attic insulation at R-11.

## **Deemed Savings**

It is recommended that ComEd use a partially deemed approach for the Single Family program over the next cycle. Specifically, ComEd may consider using deemed gross savings values presented in Table ES-9 below. Also, please note that the deemed figures below represent gross savings. It is not recommended that net-to-gross ratios be deemed at this time, as they are tightly bound to delivery characteristics which may evolve as the program moves out of the pilot stages. In addition, the deemed savings values do not include an adjustment for invalid installations of CFLs (where CFLs replace CFLs). It is recommended that ComEd continue to monitor this parameter and consider measurement in future evaluations.

Deemed values are not recommended for the weatherization measures because the savings are subject to wide variation depending on the specific home characteristics. Moreover, the pre-retrofit condition has a significant impact on the magnitude of the measure savings as shown in Figure 6-1 on page 92.

**Table ES-9. Recommended Deemed Gross Savings Values**

Measure	kWh Savings	kW Savings	Assumptions
9 Watt CFL	28.5	0.0029	- per bulb - replaced a 40 watt incandescent bulb - hours of use=2.57
13 Watt CFL	24.8	0.0025	- 2.2% attrition rate - coincident factor=9.5%
14 Watt CFL	42.2	0.0043	- per bulb - replaced a 60 watt incandescent bulb - hours of use=2.57
15 Watt CFL	41.3	0.0042	- 2.2% attrition rate - coincident factor=9.5%
19 Watt CFL	51.4	0.0052	- per bulb - replaced a 75 watt incandescent bulb - hours of use=2.57
20 Watt CFL	50.5	0.0051	- 2.2% attrition rate - coincident factor=9.5%
Hot Water Heater Turndown	188.0	0.0215	- per home - assumptions are presented in Appendix Section 8.2 - electric water heater
Hot Water Pipe Insulation	122.0	0.0268	- per home - 12 linear feet of pipe insulation installed - electric water heater
Faucet Aerator	99.5	0.0068	- per home - 64% of bathroom faucets in home are fitted with 1 GPM aerators - 94% of aerators will not be removed in the first year - electric water heater
Kitchen Aerator	118.9	0.0104	- per home - 95% of kitchen faucets in home are fitted with 1.5 GPM aerators - 94% of aerators will not be removed in the first year - electric water heater
Low Flow Showerhead	462.1	0.0100	- per home - 86% of showerheads in home are retrofitted with 1.5 GPM showerheads - 89% of showerheads will not be removed in the first year - electric water heater

#### *E.4 Key Process Findings and Recommendations*

The process evaluation focused on the Retrofit (Nicor) and the Direct Install (Integrus) Pilot programs. The All-Electric Home Program will not continue after PY3.

##### **Retrofit Pilot**

This evaluation identified the following Retrofit Pilot program achievements:

- High conversion rate: 30% of those participants receiving audits also implemented at least one of the recommended retrofits.
- Generally high overall program satisfaction<sup>1</sup>: 79% of program participants indicated they were satisfied with the Retrofit Pilot program.
- Generally high satisfaction with the auditor/installer and scheduling of the appointment.
- High CFL satisfaction, with 42% of program participants stating they have a more positive attitude toward CFLs due to the program.

Retrofit Pilot program staff are well aware of several PY3 implementation issues given their experience with the Retrofit Pilot program. As a result, they plan to make several program implementation changes. Here are a few notable changes going into PY4:

- Increasing marketing efforts including cross program marketing, ComEd co-branding, etc.;
- Creating a “next steps” document providing participants information about how to proceed to the retrofit stage of the program;
- Using Energy Measure View software to free up auditor time and increase participant engagement with the audit;
- Increasing community outreach at environmentally focused events.

This evaluation also identified the following opportunities for improvement in the PY3 Retrofit Pilot implementation:

- The program did not reach its participation goals and hence its energy savings goals. Program staff cite two main reasons for this:
- Program outreach efforts were initially too conservative. By focusing on a few specific communities, program staff hoped to keep the program cost-effective and prevent it from becoming oversubscribed.
- The marketing was ill-timed: ComEd customers started receiving mailings referencing “heat loss” and “chills” during the summer months when customers were likely not feeling chilly.
- Most participants (66%) did not recall receiving CFL information from the program.

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<sup>1</sup> “Satisfaction” is defined as a 7 or higher on a scale from 0 (“very dissatisfied”) to 10 (“very satisfied”).

- Those participants receiving direct install measures only were significantly less satisfied with the program overall than were those implementing at least one recommended retrofit (average scores of 6.7 vs. 8.8 on a scale from 0 (“very dissatisfied”) to 10 (“very satisfied”). Explaining their dissatisfaction, Direct Install only participants listed issues with auditors seeming too sales-oriented and issues with contractors not following through on the installation of the recommended retrofits.

## **Direct Install Pilot**

This evaluation identified the following Direct Install Pilot program achievements:

- Highly satisfied program participants: 90% of program participants stated they were satisfied with the Direct Install Pilot program.
- Very high installer satisfaction: 97% reported satisfaction with the installers.
- Very high satisfaction with the scheduling: 98% reported satisfaction with the scheduling.
- High CFL satisfaction: The majority (89%) stated they were satisfied with the CFLs and most (75%) gave a 9 or 10 indicating that they were very satisfied.
- Increasing positive attitudes toward CFLs: the vast majority (86%) of participants reported that the program positively affected their attitudes towards CFLs.
- All participants who received mailings found them very or somewhat useful;

This evaluation also identified the following opportunities for improvement in the Direct Install Pilot implementation:

- Although satisfaction with CFLs and the program was high, many participants (56%) did not recall receiving information about CFLs through program materials.

## **Process Recommendations**

- Due to their experience with the Retrofit Pilot program, program staff is aware of several PY3 implementation issues and possible solutions. Here, we present key recommendations based on findings from interviews with program staff as well as a survey of participants. For a more detailed summary, see Section 8.2.2 on page 129.
- To meet participant demand in PY4, ComEd should consider providing more appointments during the evenings and on Saturdays, since customers may otherwise need to miss work on multiple days to participate in the program.

- To maximize the conversion rate (audit to retrofit) and increase participant satisfaction, ComEd should closely track and monitor key steps participants take in advancing through the program to retrofit installation. The program can address this key issue in the following specific ways:
- Consider providing participants a “next steps” sheet indicating how to proceed after the audit. Email communications, already planned for PY4, should be one way to deliver these “next steps.”
- Quickly convert audit results into work orders.
- Consider tracking unconverted participants by group (e.g., safety repairs pending; ready for retrofits, etc.) and target each with regular email reminders.
- Consider regularly reviewing participant satisfaction with the auditors. Direct Install-only participants were significantly less satisfied with the auditors than full participants were (8.3 vs. 9.2). Although ComEd will use different implementers in PY4, it is worth underscoring the importance of the auditors in their roles as the “face of the program” and of ComEd.
- As much as possible, attempt to take advantage of planned program changes to increase participant education in energy-saving tips, CFL information, and other ComEd programs. In PY3, ComEd leave-behind materials contained substantial amounts of information, but auditors were too busy to fully present these materials to participants. Additionally, program staff should use email communication (planned for PY4) to provide participants with further exposure to this information.

## *E.5 Cost Effectiveness Review*

ComEd uses DSM<sup>More</sup><sup>TM</sup> software for the calculation of the Illinois TRC test<sup>2</sup>. Table ES-10 summarizes the unique inputs used in the DSM<sup>More</sup> model to assess the TRC ratio for the Single Family All-Electric program in PY3. 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.

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<sup>2</sup> Demand Side Management Option Risk Evaluator (DSM<sup>More</sup>) software is developed by Integral Analytics.

**Table ES-10. Inputs to DSMore Model for Single Family All-Electric Program**

Item	Value Used
Measure Life	9
Utility Administration and Implementation Costs	\$469,708
Utility Incentive Costs	\$90,723
Net Participant Costs	\$155,393

Based on these inputs, the Illinois societal TRC for this program is 1.01 and the program passes the Illinois TRC test.

## Section 1. Introduction to the Program

### 1.1 Program Description

In this section, we describe the objectives, implementation strategies, and the measures and incentives of each of the programs.

#### 1.1.1 All-Electric Home Program

The All-Electric Home Program is a residential direct install and educational program offering low cost energy saving measures as well as a home energy survey to the single-family all-electric home market. The home energy survey provides recommendations for cost effective energy saving equipment upgrades, as well as maintenance and other every-day practices.

Under the current program design the implementation contractor provides an energy assessment for a nominal fee of \$25 (the remainder of the survey cost is subsidized by the program). Energy survey software is used to conduct onsite energy savings analysis and provide an instant summary report with recommendations for the customer. During the survey and with the customer's approval, the visiting energy specialist will install up to ten CFLs in specific areas, faucet aerators, low-flow showerheads, and hot water pipe insulation where needed. In addition, if a central air conditioner is present, the assessment includes identification of the age and size of the unit and the last service date. The report will be presented to the customer with recommendations for upgrades and information about available rebates. The program in its current design will conclude at the end of PY3.

#### Objective

The objective of the program is to improve the efficiency of all-electric single family homes by offering a comprehensive package of low-cost retrofit measures, and providing information about other energy savings opportunities and incentives through ComEd's other residential energy efficiency programs.

#### Target Market

This program element is designed for existing all-electric single-family homes. All targeted customers taking delivery service from ComEd are eligible for this program regardless of their choice of supplier.

#### Program Duration

This program began operations in June of 2009 and continued through the end of PY3 (May 31, 2011).

## **Program Delivery Mechanisms and Marketing Strategy**

Program delivery consists of two main components: free low-cost measure installation (i.e., CFLs, low-flow showerheads, faucet aerators, and pipe wrap) and education of participants through discussion and a leave behind report. At the start of the two hour appointment, the implementation contractor performs a walk thru audit of the home, prepares a report and reviews it with the participants, installs relevant measures, and leaves behind the report which includes additional recommendations for the customer to implement.

The program's marketing strategy focuses on high use all-electric customers whose accounts are not in arrears. This target is a relatively small population. Repeated attempts are made to reach these customers including mailings, follow-up telephone calls, telemarketing, and offers for chances to win \$500 gift certificates from The Home Depot and waived program fees.

## **Roles of the Implementation Contractor**

ComEd has contracted Honeywell Utility Solutions to implement the All-Electric Home program and deliver it to all-electric customers. Honeywell works on marketing jointly with the utility, but is directly responsible for communicating with customers, scheduling appointments with participants, assessing participant homes, installing measures, and providing participants with energy surveys that include recommendations for further energy savings actions. The implementer also provides the utility with reporting which includes progress toward goals and participant- and measure-level databases.

## **Measures and Incentives**

The All-Electric Home program provides direct install services for the following measures for homes with an electric water heater.

- Integral Compact Fluorescent Light (CFL) Bulbs (up to 10)
- Low-Flow Showerhead, Fixed or Handheld
- Kitchen Faucet Aerators
- Bathroom Faucet Aerators
- Hot water pipe wrap (up to 12 linear feet)

In addition to these direct install services, the program offers an energy survey with recommendations for equipment upgrades and conservation practices that will reduce energy consumption. The recommendations are presented with details regarding expected costs and first year bill savings. The customer also receives a profile of their monthly energy use over a one year period, along with estimates of the distribution of energy consumption across major household end-uses, such as heating, air conditioning and lighting.

Program equipment and services are offered at the nominal and subsidized fee of \$25 per participating home.

## **1.1.2 Retrofit Pilot**

### **Objective**

The objective of the program is to improve the efficiency of targeted, single family homes in overlapping ComEd and Nicor Gas service territories by offering a comprehensive package of low-cost direct install and rebated air sealing and insulation measures, highlighted through an energy audit of the home.

### **Target Market**

This program is designed for existing single family homes in ComEd and Nicor Gas service territory. The program targets communities, focusing on those with older housing stock (i.e., homes constructed prior to 1970 with annual therm consumption greater than 1,250 therms).

### **Program Duration**

This program began operations in June 2010 and will continue beyond the end of PY3 (May 31, 2011).

### **Implementation Strategy**

#### **Program Delivery Mechanisms and Marketing Strategy**

Program delivery consists of two main components: 1) installation of free, low-cost measures (i.e., CFLs, low-flow showerheads, and faucet aerators); and 2) a home audit following Building Performance Institute (BPI) standards<sup>3</sup> resulting in a proposal of recommended air sealing and insulation retrofits. During the two-hour appointment, the implementation contractor performs a walk through audit of the home; installs relevant direct install measures; uses energy survey software to conduct on-site energy savings analysis and prepares a summary report; reviews the summary report with the participant; and provides the participant with a proposal that includes recommended weatherization retrofits. A self-addressed stamped envelope is included for customers to mail the signed proposals to the implementer. When the proposal arrives, the implementer prepares a work order and passes it along to weatherization subcontractors. Then, the weatherization subcontractor is responsible for calling the homeowner and scheduling retrofit work.

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<sup>3</sup> "The Building Performance Institute, Inc. (BPI) is a national standards development and credentialing organization for residential energy efficiency retrofit work." (Accessed from <http://www.bpi.org/> 9/21/11)

The program's marketing strategy focuses on high-use gas customers with older homes in ComEd's territory whose accounts are not in arrears. In PY3, this target mainly consisted of a relatively small population; in PY4, the program will begin expansion to cover the entire joint Nicor/ComEd service territory. In PY3, repeated attempts were made to reach these customers through a combination of three initial and follow-up mailings, as well as through community-based events. In PY3, ComEd did not pay for the marketing and outreach and thus had a limited role in it. Instead, Nicor Gas funded the marketing which had oversight by WECC and TSI. In PY4, however, ComEd will pay for and will have a much larger role in the program's marketing and outreach. In addition, the strategy has been expanded to include cross-program promotion and other marketing avenues (e.g., ComEd's website).

### **Roles of the Implementation Contractor**

In PY3, Nicor Gas hired Wisconsin Energy Conservation Corporation (WECC) to administer Nicor portion of the Retrofit program. ComEd and WECC jointly oversaw the implementation contractor and collectively managed the program. Thermo-Scan Inspections (TSI) implemented the program and supplied BPI-certified auditors to assess homes and oversee weatherization contractors. WECC was responsible for receiving calls from interested customers; and for scheduling audits. Both administrator and implementer provided ComEd and Nicor with reporting which included progress toward goals and participant and measure-level databases. In PY4, Conservation Services Group (CSG) will implement the program.

### **Measures and Incentives**

The Retrofit Pilot program provides direct install services for the following measures:

- CFLs (up to 10)
- Low-Flow Showerhead
- Kitchen Faucet Aerators
- Bathroom Faucet Aerators

In addition to these direct install services, the program offers an energy survey with recommendations for retrofits to reduce energy consumption. The recommendations include details regarding expected costs, the net cost after utility incentives, yearly and lifetime bill savings, and the number of years it will take before customer costs are repaid by savings. The customer also receives a packet of information regarding other energy savings tips. The program offers direct install measures and audits at the subsidized fee of \$50 per participating home. The program provides funding for 50% (up to \$1,250) of the total labor and material costs to install the recommended air sealing and insulation measures.

## 1.1.3 Direct Install Pilot

### Objective

The objectives of the program were 1) to improve the efficiency of targeted, single and multi-family homes in overlapping ComEd and Peoples Gas service territories by offering direct install measures including CFLs, low-flow showerheads, and faucet aerators; 2) to inform residents about other utility programs; and 3) to collect information on housing stock to provide information to ComEd on potential for other program participation.

### Target Market

This program targeted homes in areas with AMIs of 120% or less, and was open to both single family homes and multi-family dwellings with eight or fewer units.

### Program Duration

This program started in February 2011 and ended in May 2011. Peoples Gas will not continue this program in PY4, and ComEd cannot cost-effectively implement it alone.

### Implementation Strategy

#### Program Delivery Mechanisms and Marketing Strategy

Program delivery consisted of three main components: 1) free low-cost measure installation (i.e., CFLs, low-flow showerheads, and faucet aerators); 2) an education component including a fact sheet on measures installed during the visit; and 3) an energy survey of the home. The call center scheduled appointments with participants. During the 20-minute appointments, the installers gained written approval from the residents; installed the direct install measures where appropriate; educated building owners and occupants about other energy efficiency opportunities available to them, including opportunities available through other ComEd residential programs; and completed energy surveys of the homes (e.g., collected age and type of home information; checked for insulation; etc.).

The program used and tested three different marketing strategies. These included using mailers, using neighborhood sweeps in which the program sought support from local neighborhood leaders (e.g., block leaders, aldermanic offices, etc.), and working with community-based organizations (CBOs).

#### Roles of the Implementation Contractor

Peoples Gas hired Future Energy Enterprises to administer the Direct Install program. Future Energy and ComEd jointly oversaw the implementation contractor. Franklin Energy implemented the program by marketing the program; receiving calls from interested customers;

for scheduling direct install appointments; installing the measures; informing participants of other programs; and surveying the home. The implementer provided ComEd and Future Energy with reporting which includes progress toward goals and participant and measure-level databases.

## **Measures and Incentives**

The Direct Install Pilot program provided direct install services for the following measures at no cost to the participants:

- CFLs (up to 10)
- Low-Flow Showerhead (up to 2)
- Kitchen Faucet Aerators (up to 1)
- Bathroom Faucet Aerators (up to 2)

### **1.1.4 Air Sealing Pilot**

#### **Objective**

The objectives of the program were:

1. To improve the efficiency of single family and two-unit homes in ComEd and Peoples Gas service territory by offering direct install measures including CFLs, low-flow showerheads, and faucet aerators and rebated air sealing and insulation measures, highlighted through an energy assessment of the home;
2. To collect home survey information for future program design and implementation; and
3. To inform participants of other residential program offerings.

However, the program manager noted that, “Since ComEd only participated on the direct install portion of this program...from ComEd’s perspective it was a direct install program.” This means that the program focused on the implementation and savings resulting from the CFLs provided by ComEd.

#### **Target Market**

This program was designed for single family and two-unit homes in overlapping ComEd and Peoples Gas service territories. Generally, the program targeted communities geographically, focusing on those with older housing stock, such as those in the Beverly and Ward 18 neighborhoods. However, the program also targeted a historical bungalow association and low-to-moderate income customers.

## **Program Duration**

This program started in February 2011 and ended in May 2011. ComEd will not continue this program in PY4.

## **Implementation Strategy**

### **Program Delivery Mechanisms and Marketing Strategy**

Program delivery consisted of three main components: a home energy assessment which produced a list of recommended air sealing and insulation retrofits; free low-cost measure installation (i.e., CFLs, low-flow showerheads, and faucet aerators); and informing residents about other efficiency opportunities.

### **Roles of the Implementation Contractor**

There were three implementation contractors in this program, TSI, the Center for Neighborhood Technology (CNT), and Delta. Each provided the same services to participants yet each focused on a different customer target. TSI focused on the general market; CNT focused on members of the Historical Bungalow Association; and Delta focused on low-to-moderate income customers.

## **Measures and Incentives**

The Air Sealing Pilot program provided direct install services for the following measures:

- CFLs (up to 10)
- Low-Flow Showerhead
- Kitchen Faucet Aerators
- Bathroom Faucet Aerators
- In addition to these direct install services, the program offered an energy survey with recommendations for air sealing and attic insulation retrofits to reduce energy consumption. In addition, it offered equipment and services for \$125, which it refunded if air-sealing retrofits were completed.

## **1.2 *Evaluation Questions***

The evaluation sought to answer the following key researchable questions.

### **Impact Questions:**

For all four programs evaluated, the impact evaluation questions include:

1. What is the level of gross annual energy (kWh) and peak demand (kW) savings induced by direct install services and weatherization measures?
2. What is the level of free ridership and participant spillover associated with the direct install and weatherization measures for each program?
3. What portion of CFL installations are program-qualifying?

For the All-Electric Home Program, the impact evaluation questions also include:

- How much energy and demand impact was achieved through recommended but non-incented measures?
- What is the first year persistence of direct install measures?
- What portion of participant water use is affected by program water savings measures?
- What is the occupancy of homes retrofit through the program?

Process questions:

1. Are the pilot program marketing plans and promotional materials related to CFLs aligned with their benefits? Do they clearly communicate measure benefits?
2. How successful is the program in delivering CFLs to participants? Has there been resistance to the direct installation of CFLs among participating homes? If so, how can these be addressed by each program?
3. How satisfied are participating customers with the CFL direct install service? How satisfied are participants with the auditor and with the bulbs?
4. In regards to achieving kWh and kW savings, what is working well for the programs and what are some program challenges? How is the program attempting to overcome those challenges?

## Section 2. Evaluation Methods

This section describes the analytic methods and data collection activities implemented as part of the PY3 process and impact evaluation of all four of the Single Family Programs, including the data sources and sample designs used as the foundation for the data collection activities and analysis.

### 2.1 *Analytical Methods*

#### 2.1.1 **Gross Program Impact Evaluation Methods**

The impact evaluation includes several components. The first of which is a review of the program tracking system for completeness and accuracy. The second is a summary of program ex-ante gross impact accomplishments based on analysis of the tracking system. The third and final component of the gross impact study is a refinement and ‘true-up’ of the ex-ante impact values. This component of the impact study involves integrating program tracking system data and participant telephone survey data to refine gross impact estimates. More specifically, these data were used to refine the following elements relating to the gross impact of the direct install measures:

- Updates were made to impact calculations reflecting the most recent findings from CFL research conducted through the PY3 Residential Lighting Program Evaluation.
- Operating hours were confirmed at 2.57 hours per day per bulb, in accordance with the interior bulb results of the lighting logger study.
- Coincident Factor was updated from 8.1% to 9.5% , also in accordance with interior bulb logger study results
- Measure installation rate
- First year measure persistence
- Program-qualifying CFL installations
- Home occupancy (for water saving measures only)
- Partial retrofit adjustment (for water saving measures only)

The methods used to evaluate these elements are described below:

**Measure Installation Rate and First Year Measure Persistence**

For each installation recorded in the tracking system, telephone survey respondents were asked to confirm the total number of installed measures, and to note the number of installed measures that were subsequently removed. Respondents are asked to report the number of measures that remain installed in their original location; the number moved to another location within the home; the number put into storage; the number thrown away; and the number given away or sold.

**Program Qualifying CFL Installations**

The telephone survey also verified that the CFLs installed through the program replaced incandescent bulbs and were therefore “program qualifying”. This was assessed by asking the survey respondent “What type of light bulbs did the CFLs replace?” If the respondent answered CFL to this question, then the CFL installation was not considered to be program qualifying installation.

**Determining ‘CFLs for Credit’**

Participants were not asked to specify the overlap between the non-program qualifying installations and any CFLs that failed or were removed. If we remove from credit the number of non-program qualifying bulbs and also remove the number of failed bulbs, we will over-penalize the program for all cases where a non-program qualifying installation also failed. To guard against this, we used a measurement strategy that ensured the program would not be over-penalized. Specifically, in each case where the two penalties could affect the bulb, it was assumed that they did. For example, if a home had 2 bulbs that failed and one that was not program-qualifying, two bulbs were removed from credit. If a home had 2 bulbs that failed and 2 that were not program qualifying – 2 bulbs were removed from credit. If a home had 2 bulbs that failed and 3 that were not program qualifying, 3 were removed from credit. In algorithmic form, each homes ‘CFLs for credit’ percentage is calculated as:

$$\text{CFL\_For\_Credit} = 1 - \text{Max}(\text{nonQual}, \text{Rem\_Fail})$$

Where:

CFL\_For Credit = percent of installed bulbs credit to program accomplishments

Max=maximum of

nonQual= percent of non-program qualifying CFL bulbs

Rem\_Fail= percent of bulbs removed or failed

### **Home Occupancy (for water saving measures only)**

As described in detail in the PY2 Ex-Ante Gross Impact review, the expected annual energy impact of low flow showerheads and aerators is proportional to home occupancy. The ex-ante occupancy assumption is 2.75 persons per home. Occupancy data is collected during the home visit and is recorded in the program tracking system. The evaluation telephone survey also provided data on participant occupancy. The program ex-ante estimates were not adjusted for this data but the data was used by the EM&V team to adjust annual ex-post impact estimates. For a more detailed discussion of the occupancy adjustment, please see Section 3.1.3, page 43.

### **Partial Retrofit Adjustment (for water saving measures only)**

Aerator and showerhead measures accrue impact on a per-home basis. The ex-ante impact calculation is predicated on the assumption that all of the faucets and showerheads present in the home are retrofit through the program. The telephone survey queried participants for the total number of showerheads and faucets present in their home. The reduction in impact applied to each home that removed an aerator or showerhead is proportional to the percent of total showerheads or aerators that the removal represents.

For example, consider a home that has 2 showerheads, and for which 2 showerheads were replaced through the program. Further, consider that the homeowner reports having removed one showerhead. For this home, the impact credited to the program is reduced by  $\frac{1}{2}$ , in proportion to the percent of total showerheads removed from the home.

Kitchen and bathroom aerator installations are recorded separately and have different per-home ex-ante impact assignments corresponding to their different expected usage patterns. The participant telephone survey queries respondents for the total number of kitchen faucets and the total number of bathroom faucets. Separate adjustment factors are calculated for kitchen aerators and bathroom aerators based on the disposition of measures reported in the telephone survey. While the numbers in each disposition category are a percent of installed measures, the final adjustment is based on a calculation that incorporates the distribution of measures across homes, and the total fixtures present in those homes.

### **Additional Impact Measures Not Claimed in Ex-Ante Impact**

For the All-Electric Home Program, savings associated with energy survey recommendation uptake are estimated as part of the ex-post gross impact analysis. Telephone survey results were used to identify participants that had installed measures as a result of the program's energy saving recommendations. Copies of the energy survey reports provided to these customers were requested from ComEd as verification of the self-reported recommendations. The energy survey reports were also leveraged for important home characteristics and details. Impact credit was not applied for the implementation of conservation practices due to very limited ability to measure or verify these actions. However, measure installations are assigned impact values.

The Retrofit Pilot program was also allocated credit for measures not included in the ex-ante impact figures. This program involves the direct installation of low flow showerheads and faucet aerators, which will save electricity if the customer has an electric water heater. The program default assumption is that all customers have gas water heat, so no ex-ante electricity credit is claimed. The telephone survey revealed a small percentage of Retrofit Pilot participants had electric water heat. Water heat fuel type findings from the telephone survey, together with the All-Electric Home program per unit impact figures, were used to estimate the overall program electricity savings from these water saving measures. The free ridership and spillover rates among Retrofit Pilot participants for the water saving measures were not studied in this evaluation. The All-Electric Home program has some similar features, also offering direct installation of faucet aerators and low-flow showerheads. The net-to-gross findings for water savings measures for the All-Electric Home are applied to this segment of the Nicor Retrofit program.

### **2.1.2 Net Program Impact Evaluation Methods**

The primary objective of the net savings analysis is to determine each program's net effect on customers' electricity usage. This requires estimating what would have happened in the absence of program activities and incentives. After gross program impacts are adjusted, net program impacts are derived by estimating a Net-to-Gross (NTG) ratio. The NTG ratio quantifies the percentage of the gross program impacts that are attributable to the program. This includes an adjustment for free ridership (the portion of impact that would have occurred even without the program) and spillover (the portion of impact that occurred outside of the program, but would not have occurred in the absence of the program). A customer self-report method, was used to estimate the NTG ratio for this evaluation, using data gathered during participant telephone surveys.

#### **Free Ridership**

Free ridership cannot be measured directly due to absent empirical data regarding the counter-factual situation. Thus, free ridership is assessed as a probability score for each measure. The evaluation relies on self-reported data collected during participant telephone surveys to assign free ridership probability scores to each measure. More specifically, for each measure, the following questions are posed to each measure recipient:

- FR1. Had the participant heard about the program before or after they thought about installing the program measure?
- FR2. Did the participant have specific plans to install the measure before learning about the program?
- FR3. How likely was the participant to install the measure if they had not installed it through the program? (0-10 scale probability)

FR4. How critical was the program in the decision to install the measure? (0-10 scale)

FR5. Would the participant have installed the same measure within a year of when they did if the program didn't exist? (0-10 scale probability)

### Free Ridership Scoring

The free ridership data was assembled into a probability score in a step-by-step fashion, applying the following algorithm:

If the customer had not considered the measure prior to participating in the program then the probability of free ridership is estimated to be zero (based on FR1 above).

Similarly, if the customer did not have specific plans to install the program measure prior to participation, and the self-reported probability of installing the measure was less than or equal to 3 (on a 0-10 scale) then the probability of free ridership is estimated to be zero (based on FR2 and FR3).

If neither of the above criteria holds, then responses to questions FR3, FR4 and FR5 are used to calculate the probability of free ridership. The programs are primarily direct install programs, where the customer demonstrates very little initiative to install the measures, as the actual purchase and install activities were performed by program staff. For this reason, participant self-reported intentions to install these measures [FR3 and FR5] even without the program are discounted relative to the self-reported importance of the program to the installation [FR4], at a rate of 2 to 1. The corresponding formula for calculating free ridership is shown below:

$$3. [(FR3+FR5)/2 * (1/3) + (FR4)*(2/3)]$$

Note that in the above formula, if FR3 or FR5 are invalid (missing or "don't know") then the first component  $[(FR3+FR5)/2]$  relies on the non-missing factor. That is, if FR3 is invalid the formula is:  $[FR5*(1/3)+(FR4)*2/3]$ . If FR3 and FR5 are missing then the score is based on FR4 alone.

A bulb count weight is applied in calculating the overall result for CFL free ridership<sup>4</sup>, while other measure free ridership scores are aggregated using an equal weight, in accordance with the assignment of ex-ante impact.

The approach described above is consistent with the approach applied in the PY2 Evaluation. There was one new adjustment made to this approach for CFL free ridership measurement

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<sup>4</sup> Each participant free ridership score is assigned a weight in accordance with the number of bulbs installed in the home.

only. For CFL free ridership scoring, adjustments are made in a few special cases. In particular, free ridership scores are set to zero for customers who report a CFL spillover adoption, or have a low pre-retrofit CFL saturation rate.

- Customers that reported the program strongly influenced them to install additional CFLs following their participation (i.e. report spillover adoptions) are assumed not to be free riders. This is to reflect the most improbable event that these customers are highly influenced by the program to purchase more CFLs, yet would have purchased CFLs without the program in any case.
- Customers who reported that prior to participating in the program less than 10% of their sockets were already retrofit with CFLs are also assumed not to be free riders. In light of the direct install delivery approach, this adjustment reflects the empirical evidence of the customer's low propensity to install CFLs independently.

## Spillover

The objective of the spillover assessment is to estimate the impact arising from efficient measures installed as a result of the program that were not incented by the program. The evaluation relies on self-reported data collected during the telephone survey to identify these measures and assess the role of the program in the decision to install. For each measure installed through the program, the following questions are posed to each measure recipient:

- SP1. Have you installed any additional measures since receiving the ones through the program?
- SP2. How many additional measures did you install?
- SP3. How influential was the program in encouraging you to install these additional measures? (0-10 scale)

## Spillover Scoring

The survey data was assembled into an assessment of spillover impact through application of the following method:

If the customer installed additional units of the measure following their participation, and the program was highly influential in the decision to install those measures, the adoption is considered to be potentially program spillover.

1. [If SP1=1 and SP3 is greater than or equal to 8, then adoption is spillover]

## Considerations and Measure-Specific Adjustments to Spillover

### Compact Fluorescent Bulbs

The impact credit granted for CFL spillover adoptions must avoid double counting impact credit accrued already through the midstream residential lighting program, which was in operation throughout PY3. Last year, our first thought regarding the best way to be fair in assigning credit for CFL spillover adoptions was to reduce credit by the overall probability that any CFL bulb purchased in ComEd service territory would be a midstream program bulb. However, there are a couple of complicating factors to this approach. The first is that the market share of program bulbs is not a readily available number. Second, the residential lighting program PY3 evaluation results indicated a substantial amount of free ridership (41%), and there is no reason that one program's free ridership cannot be another program's net impact. Thus, it is not necessary that bulbs be un-incented for them to legitimately qualify for credit under the Single Family Program.

There is some available evidence regarding the CFL market share of residential lighting program bulbs. The PY2 residential lighting general population survey revealed that 87% of CFLs are purchased at stores participating in the ComEd lighting program. Among program stores, the shelf space dedicated to ComEd program CFL bulbs is 53% of the overall shelf space dedicated to CFLs (for standard bulbs), and 62% for specialty bulbs. If we assume shelf space relates directly to sales share, then 46% of standard CFLs and 54% of specialty bulbs are Residential Lighting program bulbs.

Due to the uncertainty in this area, we take a conservative approach and assume that only 50% of the impact arising from CFL spillover adoptions are creditable to the program. Again, even if these customers purchased a discounted bulb, the purchase decision was either influenced by both programs (making the 50% assumption reasonable) or influenced by only the Single Family Program (making the 50% assumption conservative).

### Pipe Insulation, Attic Insulation and Air Sealing

In the case of pipe insulation, the ex-ante impact is based on the installation of up to 12 linear feet. Customers that report the installation of additional pipe wrap qualifying as spillover are credited the per-home impact for the spillover adoption.

Similarly, participants in the Retrofit Pilot program that reported spillover adoptions of insulation and air sealing measures were credited an impact equivalent to the average ex-post impact over all the participants.

### **Net-to-Gross Ratio (NTG)**

The final net-to-gross ratios (NTG) for each measure are calculated as:

Where,

*Free ridership* is the energy savings that would have occurred even in the absence of program activities and sponsorship, expressed as a percent of gross impact.

And,

*Spillover* is the energy savings that occurred as a result of program activities and sponsorships, but was not included in the gross impact accounting, expressed as a percent of gross impact.

## 2.2 *Process Evaluation Methods*

The process evaluation consisted of three in-depth interviews: one with the ComEd Program Manager, one with the Retrofit Pilot program administrator, and one with the Direct Install Pilot program administrator. It also included telephone surveys with participants of the Retrofit Pilot and Direct Install Pilot programs

- **Program Staff Interviews.** The interviews with key program staff covered program design and implementation; marketing and promotion; and perceived barriers to participation.
- **Telephone Surveys.** The process evaluation component of the participant telephone survey obtained information on sources of program awareness, program satisfaction, measure satisfaction, barriers to participation, marketing effectiveness and other process-related issues.

In the telephone surveys, we asked participants numerous questions about satisfaction using a scale from 0 to 10, with 0 being the most dissatisfied, and 10 being the most satisfied. For the data analysis, the evaluation team grouped the responses into the following groups: 0 to 3 is dissatisfied, 4-6 is neutral, and 7 to 10 is satisfied.

Throughout the process report, we generally show only valid percents. That is, we typically remove respondents offering a “don’t know” or a refusal in response to a question.

## 2.3 *Data Sources*

Two primary data collection efforts were conducted in support of this evaluation: 1) in-depth interviews with program staff, and 2) a participant telephone survey. In addition to this primary data collection, other data sources are leveraged including:

- Program tracking data

- Program impact algorithms and assumptions
- Program energy survey reports
- Program collateral and marketing material
- Secondary sources

We interviewed program staff members over the telephone in May and June 2011. Each interview lasted approximately an hour and covered program design and implementation, marketing and promotion, and perceived barriers to participation.

We conducted a telephone survey of 327 PY3 program participants between July 14 and July 25, 2011. The interviews lasted an average of 11 minutes each. The telephone survey addressed both impact- and process-related research objectives including measure verification, measure persistence, CFL satisfaction, net-to-gross investigations, marketing and promotion, customer satisfaction, program impact on CFL attitudes, and participant suggestions for program improvement.

Table 2-1 below summarizes data collection activities, along with the details regarding the sampling and timing.

**Table 2-1. Data Collection Activities**

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis	All Program Participants	Tracking Database	-	All	May-August 2011
In-depth Telephone Interviews	Program Managers	Contact from ComEd	Current Program Managers, Program Implementer	3	May-June, 2011
CATI Telephone Surveys	All-Electric Home Participants	Tracking Database	Random Sample of Program Participants	91	July, 2011
	Retrofit Pilot Participants	Tracking Database	Random Sample of Program Participants*	122	
	Direct Install Pilot Participants	Tracking Database	Random Sample of Program Participants	68	
	Air Sealing Pilot Participants	Tracking Database	Random Sample of Program Participants	46	

\*A quota was imposed to ensure proportional representation of Retrofit Pilot program direct install only and full participants.

## 2.4 Sampling Plan

Under the default assumption that the coefficient of variation for the objective metrics is 0.5, the sample sizes were selected to meet a 90/10 objective for accuracy and precision for each program and key measures. For the All-Electric Home Program we divided the 90/10 sample size requirement (N=60) by the saturation rate of the least common key measure<sup>5</sup> (66%). This strategy yielded expected values for survey completes supporting 90/10 accuracy and precision for each measure. For the Retrofit Pilot program, a 90/10 sample was taken for participants that followed up with weatherization retrofits. A supplemental sample of direct-install only participants ensured the CFL result would be representative across both direct-install only customers and ‘full’ program participants. Table 2-2 below shows the participant population and sample design by program.

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<sup>5</sup> The saturation of water heater temperature turn-down was only 8 percent, and it was determined too costly to include this measure among those requiring a 90/10 result.

**Table 2-2. Sample Design**

Program	Population	Quota/Survey Completes	Proportion of Population
All-Electric Home	438	91	20.8%
Air Sealing Pilot	135	46	34.1%
Direct Install Pilot	5,966	68	1.1%
Retrofit Pilot (full program)	413	74	17.9%
Retrofit Pilot (direct install only)	962	48	5.0%
Total	7,914	327	4.1%

## Section 3. All-Electric Home Program Results

### 3.1 All-Electric Home Program Impact Results

This section is composed of four primary components.

- The first is a review of the program tracking system.
- The second is a summary of ex-ante gross impact accomplishments.
- The third presents a summary of the adjustments applied to ex-ante gross impact and the resulting ex-post gross impact values.
- The fourth and final component is the presentation of the net-to-gross analysis and results.

#### 3.1.1 All-Electric Home Tracking System Review

A final program tracking database was provided in support of this evaluation by ComEd in June of 2011. The tracking system contained 3,388 rows, where each row is unique by the customer and measure installed. Records of CFL installations were further delineated by the wattage of the bulb, the number of bulbs installed, and the type of room in which they were installed. CFL savings in the tracking system were based on deemed kWh savings assuming an Hours of Use estimate of 2.34 hours/day. Evaluated savings were based on 2.57 hours/day from the ComEd Residential ENERGY STAR Lighting Program’s study completed during PY3. The All-Electric Single Family Program’s Gross MWh (based on installed measures) was 469 MWh. Table 3-1 shows the program level savings with deemed CFL values. Table 3-2 below shows the contents of the tracking system and the values that each component of the delivered tracking system holds.

**Table 3-1. All-Electric Home – Program Savings with Deemed Values**

Single Family Programs Deemed CFL Values	Measure Ex-Ante Gross MWh	RR	Ex-Post Gross MWh	NTG	Ex-Post Net Mwh
All-Electric	469	85%	401	92%	369

The remainder of the results section describes the PY3 evaluation-conducted findings and a comparison of various components within the program.

**Table 3-2. All-Electric Home - Tracking System Content Summary**

Variable Name	Values
Name	Customer Name, First and Last
Address	Street address, city, state, zip code
Date of Service	Month day and year of Participation. No missing values.
Phone	Area code and telephone number. Missing for 6 participants.
Premise ID	Unique ID for premise
Work order ID & Install ID	Unique ID for participant
Room Type (CFL)	Bedroom, Bathroom, Family Room/Sitting Room, Living Room, Kitchen, Work Area/Shop, Bedroom, Office/Study, Hallway, Dining Room, Exterior, Porch/Mud Room/Unheated, Other
Wattage (CFL)	Values of 9, 13, 14, 15, 19 or 20. Missing for 10 of the CFLs.
Installed Measure Name	Compact Fluorescent Bulb, Faucet Aerator, Kitchen Aerator, Hot Water Heater Turndown, Hot Water Pipe Insulation $\frac{3}{4}$ , Hot Water Pipe Insulation $\frac{1}{2}$ , Low Flow Showerhead, Audit Fee
Installed Measure Quantity	Values ranging from 0-12
Square feet of home	Values between 188 and 6,600. 178 participants had missing data.
Number of occupants	Values between 1 and 7. 178 participants had missing data.
Age of water heater	Values between 0 and 50. 178 participants had missing data.
Size of water heater	Values between 30 and 82. 178 participants had missing data.
Water temperature before	Ranging from 109 to 152 degrees Fahrenheit. 178 participants had missing data.
Water temperature after	Ranging from 109 to 130 degrees Fahrenheit. 178 participants had missing data.

### Overall Assessment

The tracking system created by the program implementer and delivered by ComEd to the Evaluation Team was well populated for records with a participation date prior to November 15, 2010 and less so for records with a participation date after November 15, 2010. The most essential data, such as customer name, contact information and records of the installed measures were appropriately detailed for all participants and delivered in an organized and easily accessible fashion. However, the 40 percent of records with a participation date after November 15, 2010 were missing some additional key information, such as; square feet of home, number of occupants, water heater temperature.

## Gaps and Areas for Improvement

As reported in PY2, tracking for this program would be improved by including electronic records of the recommendations made to participants. The All-Electric program is discontinued, but this note is included anyway in case it can assist in other future tracking system design.

### 3.1.2 All-Electric Home Ex-Ante Gross Impact, Summary of Accomplishments

In PY3, the All-Electric Home Program reported a first year net impact goal of 816 MWh. Ex-ante impact assumptions and program tracking system data indicate participation in PY3 by 438 homes resulting in a total program ex-ante net energy impact of 361 MWh (44% of goal). Table 3-3 below summarizes the program ex-ante impact for each installed measure. The program makes no impact claims for savings from the energy survey. The largest contributor to gross kWh impact is the installation of CFLs, which account for 168 of the 417 total MWh impact, or 40%. Low flow showerheads come in second with 112 MWh or 27% of the total. Kitchen and faucet aerators combined account for 94 MWh or 22% of total ex-ante accomplishments. Pipe insulation and hot water heater turndown have the smallest percent of total measure impact at 9% and 2%, respectively.

**Table 3-3. All-Electric Home - First Year Ex-Ante Impact by Measure, PY3 Accomplishments**

Measure	Homes	kWh Per Home*	Total MWh	kW per Home	Total kW
Energy Survey	437	0	0	0	0
Compact Fluorescent Bulb**	422	397.9	167.9	0.034	14.50
Low Flow Showerhead	383	292.3	112.0	0.013	4.83
Kitchen Aerator	287	115.1	33.0	0.010	2.89
Faucet Aerator	410	147.6	60.5	0.010	4.13
Pipe Insulation	361	102.5	37.0	0.023	8.13
Water Heater Turndown	37	188.0	7.0	0.022	0.80
Total	438	952.9	417.4	0.081	35.27

\* The figures in this table are ComEd adjusted Ex-ante figures, which applies an assumed realization rate to Measure Ex-ante figures. The applied assumed realization rates are 97% for CFL and 84% for water saving measures.

\*\*Ex-ante gross impacts for CFLs are based on the number of CFL bulbs installed and the delta wattage of each bulb. Impact per home is calculated by dividing the total ex-ante kWh impact from CFLs by the number of homes with CFL installations. Impacts for the remaining measures are applied on a per-home basis. CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post.

Table 3-3 below summarizes the wattage level data regarding the program installations of CFL bulbs and the associated ex-ante gross impact. The table shows the total number of bulbs installed for each wattage category, as well as the number of unique homes in which these bulbs

were installed. The per-bulb impact and total impact by wattage category are also shown. The most commonly installed program bulb is the 19 watt CFL. Thirty-four percent of program bulbs and 39 percent of CFL gross energy impact arise from 19 watt bulbs. The 14 watt bulbs are the second most common, accounting for 32 percent of bulbs and 30 percent of CFL energy impact.

**Table 3-4. All-Electric Home - Ex-Ante Gross Impact Detail for CFL Installations, PY3**

Wattage	Bulbs	Homes	kWh per Bulb per Year**	Total MWh per Year	kW per Bulb	Total kW per Year
Unknown*	10	3	44.0	0.4	0.004	0.04
9	92	26	28.2	2.6	0.002	0.22
13	369	63	24.6	9.1	0.002	0.78
14	1,207	189	41.9	50.5	0.004	4.36
15	335	57	40.9	13.7	0.004	1.18
19	1,301	211	51.0	66.3	0.004	5.72
20	505	90	50.0	25.3	0.004	2.18
Total	3,819	422	44.0	167.9	0.004	14.50

\*Wattage data missing from installation record for 10 bulbs. An average wattage from the 3,809 bulbs with populated wattage data is used in lieu of missing data.

\*\*Ex-ante gross kWh and kW values include an assumed realization rate of 97%, or equivalently, 3% attrition.

Each home received an energy survey and a bundle of direct install measures. The content of this bundle depends on the unique features of the home. Equipment installation is at the discretion of the homeowner, and program guidelines limit some installations. For example, guidelines state that CFL bulbs should replace incandescent bulbs. Table 3-5 below shows the percent of participating homes that installed each program measure type. CFL bulbs had the greatest penetration among participating homes at 96 percent. Faucet aerators were installed at 94 percent of participating homes, while kitchen aerators were installed in 66 percent of homes. Pipe insulation and low flow showerheads were both installed in more than 80 percent of participating homes. Hot water heater turndown was estimated to be performed in 8 percent of participating homes<sup>6</sup>.

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<sup>6</sup> Hot water heater turndown was flagged as installed in only three homes in the tracking data. However, the information contained in the water heater temperature before and after suggests that there were homes that had their water heaters turned down, but were not flagged as such.

**Table 3-5. All-Electric Home - Percent of Participating Homes Installing Each Program Measure Type, PY3**

Measure	Percent of Participating Homes Installing Measure
Audit Fee	100%
Compact Fluorescent Bulb	96%
Low Flow Showerhead	87%
Kitchen Aerator	66%
Faucet Aerator	94%
Pipe Insulation	82%
Water Heater Turndown	8%

**3.1.3 All-Electric Home Ex-Post Gross Impact, Summary of Adjustments**

This section summarizes the PY3 ex-post impact estimation approach and results for the All-Electric Home Program. More specifically, this section addresses the following adjustments to ex-ante impact values:

- Adjustments for removals, failures and non-program qualifying CFLs
- Adjustments for partial retrofits (water saving measures)
- Adjustments for home occupancy

In addition, impact estimates are derived for measures not currently included in ex-ante impact claims, including the water heater temperature setback and the energy efficiency survey recommendations.

**Application of Measure Disposition to Impact Calculations**

The calculation of ex-post gross impact includes an adjustment to reflect the removal of program measures. Measures that are thrown away, given away, sold, or put into storage before end of the program year are excluded from the program’s first year energy impact. For measures that accrue impact on a per-unit basis, this is reflected in a proportional reduction in impact in light of removal rates assumed in the ex-ante impact estimates. For measures that accrue impact on a per-home basis the adjustment is a bit more involved. Details of this adjustment are included in the Gross Program Impact Evaluation Methods section (Section 2.1.1 on page 26).

The ex-ante impact values for CFLs incorporate an assumed 3 percent measure attrition rate. This rate reflects the rate of expected attrition due to removals and failures. The findings from the survey analysis indicate the PY3 attrition rate was somewhat higher, at 4 percent. Other adjustments to the gross impact include an upward adjustment of 1% for a slightly higher amount of reported bulbs installed than reported in the tracking database and an 8 percent downward adjustment for non-program qualifying CFLs installs. The non-program qualifying CFL installs are defined as a CFL replacing another CFL. The combined result of all of these adjustments to the ex-ante savings is a decrease equal to the ratio of 91 percent to 97 percent, or a downward adjustment of 7 percent. Measure disposition findings and analysis results are shown in Table 3-6 below.

**Table 3-6. All-Electric Home - Measure Verification and Disposition**

Measure	CFL	Aerator	Low Flow Showerhead	Pipe Insulation
Percent of Measures Verified Installed	101%	99%	99%	100%
Participant Respondents	82	83	79	58
Measure Disposition Sample Size	762 bulbs	244 aerators	124 showerheads	594 linear feet
Measure Still in Use	96%	94%	89%	100%
Original Location	96%	94%	87%	100%
Moved	0%	0%	2%	0%
Not in Original Location	4%	6%	11%	0%
Thrown away	1%	2%	2%	0%
Stored	3%	4%	8%	0%
Gave away or sold	0%	0%	1%	0%
Non-program Qualifying CFL Install	8%	N/A	N/A	N/A
Ex-ante attrition rate	3%	16%	16%	16%
Adjustment to Gross Impact <sup>7</sup>	93%	111%	105%	119%

The participant telephone survey collected information regarding the reasons participants removed measures. Survey results show that for CFLs, equipment failure was the primary

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<sup>7</sup> Adjust to the ex-ante gross impact, which already incorporates an expected 97% realization rate, or equivalently 3% attrition.

reason for removal, while for water-saving measures, weak water pressure was the primary reason. Among CFL recipients, 6% of participants stated that they removed one or more bulbs due to equipment failure, which may indicate a quality issue with the type of CFLs offered through the program. Among aerator and showerhead recipients, 7% and 11% of the participants respectively stated that they removed one or more measures due to weak water pressure.

**Partial Retrofit Adjustment**

As discussed in the Partial Retrofit Adjustment (for water saving measures only) section on page 28, showerhead and aerator impact assumptions are a function of expected household water use, which in turn is dependent on occupancy. The ex-ante impact assumption is that 100% of the home’s shower and faucet use is affected by the retrofit. However, if only a subset of the fixtures present in the home are retrofit, then only an analogous subset of associated water use is affected by the retrofit. For example, consider a home with 4 showers where 2 are retrofit through the program. Under the simplifying assumption that each shower present in the home has equal probability of being used, it follows that half of the home’s annual shower usage will be affected by the retrofit.<sup>8</sup>

The program tracking system recorded the number of fixtures retrofit with each measure. These fixture counts were confirmed with respondents. The total number of kitchen faucets, bathroom faucets and showerheads were also collected from participants during the telephone survey. For each survey respondent, the ratio of installed measures to the total number of fixtures is calculated. The mean of this ratio represents the final partial retrofit adjustment, which is presented in Table 3-7 below.

**Table 3-7. All-Electric Home - Partial Retrofit Adjustment**

Measure	Kitchen Aerator	Faucet Aerator	Low Flow Showerhead
3.2 Ex-ante Percent of Fixtures Retrofit	100%	100%	100%
Average Percent of Fixtures Retrofit (Self-Report)	95%	64%	86%

**Occupancy Adjustment**

As described in detail in the PY2 Ex-Ante Gross Impact review, the expected annual energy impact of low flow showerheads and aerators is proportional to home occupancy. The ex-ante

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<sup>8</sup> Of course some showers and faucets would be used more than others but the program tracking data does not differentiate at that level of detail. The evaluation survey could have been designed to support faucet-specific volume calculations but at the cost of a significantly longer survey.

occupancy assumption is 2.75 persons per home. Occupancy data is collected during the home visit and is recorded in the program tracking system. The evaluation telephone survey also collected data on participant occupancy. The program ex-ante estimates were not adjusted for this data but the data was used by the EM&V team in determining ex-post impact estimates.

As shown in Table 3-8 below, program tracking system data yield a mean of between 2.44 and 2.49 persons per home, depending upon which measure recipient population is considered. The evaluation survey found more participants per home than the tracking system but less than the ex-ante assumption, producing a mean survey result that is between 1 percent lower and 9 percent higher than the tracking system estimates.

Using the survey data we calculated an adjustment factor to apply to the tracking data to increase average occupancy for the whole participant population in proportion to the differences observed over the telephone survey sample.

Table 3-8 below summarizes the occupancy data from the tracking system and the ex-ante algorithms. Also shown are the adjustment factors that are applied to compensate for differences in the self-reported survey data and tracking system data. The 'Ex-ante to tracking adjustment factor' is the ratio of the tracking system occupancy to the ex-ante occupancy assumption (B/A). The 'Survey-based adjustment' is the ratio of the survey confirmed occupancy to the tracking system occupancy (D/C). The latter is calculated only for those measure recipients that were part of telephone survey sample. The survey sample happens to have slightly lower occupancy than the broader participant population. Essentially, the sample is used to true up the tracking data occupancy result, not to replace it. The tracking data is a more comprehensive source, and should be leveraged accordingly. These adjustments together yield the final occupancy adjustments shown at the bottom of the Table, which range from 88 percent to 97 percent.

**Table 3-8. All-Electric Home - Occupancy Adjustment**

Measure		Kitchen Aerator	Faucet Aerator	Low Flow Showerhead
A	Ex-ante assumed occupancy	2.75	2.75	2.75
B	Tracking system occupancy, all records	2.45	2.49	2.44
C	Tracking system occupancy, survey sample	2.06	2.09	2.20
D	Survey sample occupancy	2.26	2.16	2.18
E	Ex-ante to tracking adjustment factor (B/A)	89%	91%	89%
F	Survey-based adjustment (D/C)	109%	103%	99%
G	Final occupancy adjustment ((F*B)/A)	97%	94%	88%

**Ex-Post Impact Results Summary for Direct Install Measure**

Table 3-9 below summarizes all of the ex-post impact adjustments applied to each measure. These include adjustments for measure removal, occupancy, and partial fixture retrofit for the water-saving measures. It also includes an update to the CFL coincident factor adjustment reflecting the latest ComEd lighting logger study. The adjustments are applied multiplicatively. Each represents a separate ‘realization rate,’ applicable to the entire measure gross impact. The change in measure impact ranges from an increase of 19 percent for pipe wrap to a reduction of 33 percent for faucet aerators. The faucet aerator impact reduction is a result primarily of partial retrofits of bathroom faucet fixtures. Overall, the adjustments reduce gross impact by 12 percent for energy and increase gross impacts by two percent for demand, yielding a final first year ex-post gross impact for the direct install measures of 363.0 MWh and 35.1 kW.

**Table 3-9. All-Electric Home - Total Ex-Post Gross Impact Adjustments<sup>^</sup>, Direct Install Measures**

Adjustment Factor	CFL	Kitchen Aerator	Faucet Aerator	Low Flow Showerhead	Pipe Insulation	Overall
Removals/Storage/Invalid	93%	111%*	111%*	105%*	119%*	103%
Occupancy	-	97%	94%	88%	-	91%
Partial Fixture Retrofit	-	95%	64%	86%	-	79%
Coincident Factor Adjustment**	117%	-	-	-	-	117%
Total Ex-Post Gross Impact Adjustment	93%/110%**	102%*	67%	79%	119%*	88%/102%**

<sup>^</sup>Adjustments are versus adjusted ex-ante gross impact which incorporates expected realization rate of 97% for CFL and 84% for water heating measures.

\*The ex-ante attrition rate was greater than survey-verified attrition in PY3, indicating an upward adjustment to gross impact.

\*\* The two numbers represent kWh adjustment and kW adjustment, respectively. Demand figures were adjusted to reflect a higher ex-post coincident factor: ex-ante is 8.1% while ex-post is 9.5%.

### Ex-Post Impact Results Summary for Water Heater Temperature Setback

The program implementer that visited the home to install program measures also occasionally reduced the temperature setting on the water heater. This was done with the consent of the participants and only when the setting was above the recommended 120° Fahrenheit. The program representative performing the temperature setback recorded the temperature setting both before and after the setback, and these data were stored in the program tracking system. The program tracking system data indicate that water heater setback was performed in approximately 37 participating homes<sup>9</sup>. These 37 participants had an average pre-existing temperature setting of 136° Fahrenheit, and in all cases the temperature setting was reduced to 120° Fahrenheit. An engineering model of residential water heater energy consumption was used to generate estimates of energy savings from water heater temperature setback. Details of this model are presented in Appendix 9.2 on page 135. The model was calibrated to program home occupancy and expected faucet and shower usage and flow characteristics of participating homes. The model was used to generate water heater energy consumption with the outlet temperature set 136° Fahrenheit and again with outlet temperature set at 120° Fahrenheit. This exercise yields a savings estimate of 188 kWh per year. Demand is estimated by

<sup>9</sup> Hot water heater turndown was flagged as installed in only three homes in the tracking data. However, the information contained in the water heater temperature before and after suggests that there were homes that had their water heaters turned down, but were not flagged as such.

division of kWh by the total number of hours in a year (8,760) consistent with a relatively flat assumed load shape. A summary of these findings is presented below in Table 3-10.

The telephone survey sample included none of the 37 participants receiving a temperature setback. Therefore, the temperature setback was not verified with any participants

**Table 3-10. All-Electric Home - Ex-Post Gross Impact, Water Heater Temperature Setback**

Adjustment Factor	WH Setback
Mean Pre-Existing Temperature Setting (average)	136 °F
Post Temperature Setting	120 °F
Homes with WH Temperature Setback	37 homes
Homes Reversing Temperature Setback	n/a
3.3 Per Unit Ex-Ante Gross Impact	0.188 MWh
Per Unit Ex-Post Gross Impact	0.188 MWh
3.4 Total Ex-Post Gross kWh	6.968 MWh
3.5 Total Ex-Post Gross kW	0.8 kW

**Ex-Post Impact Results Summary for Energy Survey Recommendations Uptake**

The All-Electric Home Program includes the provision of an energy survey report. This report contains customized information about energy consumption in the home<sup>10</sup>, as well as a list of recommended energy conservation measures and practices tailored to the characteristics of the home. The measure recommendations include a description of the measure, and estimates of annual dollar savings, costs and simple payback. During the participant telephone survey, respondents were prompted to discuss their energy saving recommendations and to report whether any of the recommendations had been implemented.

Telephone survey results were used to compile a list of respondents reporting measure recommendation implementation. Copies of the energy survey reports were obtained from ComEd for each customer identified as having installed a measure outside of the direct-install measures. The reports were used to verify that the measure had been recommended, and to identify characteristics of the home that would help inform an impact analysis of the installed measures.

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<sup>10</sup> A summary of historical monthly energy consumption, as well as an estimated breakdown of energy consumption by end use category.

Table 3-11 below summarizes the measure recommendations that survey respondents reported implementing. The table also shows how many of the reported adoptions were found in the energy survey report.

There are two participants that report recycling a second refrigerator. Both of these customers also had a corresponding recommendation in their energy survey report. Since ComEd has an Appliance Recycling (AR) program, customer tracking information was used to search for corresponding records in the ComEd Appliance Recycling tracking system. Neither participant was identified as receiving rebates for their refrigerator recycling from the ComEd AR program.

**Table 3-11. All-Electric Home - Ex-Post Gross Impact, Energy Survey Recommendation Uptake**

Adjustment Factor	Adoptions Taken		Planned Adoptions	
	Reported Adoptions	Recommended in Energy Survey	Reported Adoptions	Recommended in Energy Survey
<b>Home Specific Recommendation</b>				
Attic insulation	1	1	3	2
Other insulation			3	1
Replaced old refrigerator with a new one	2	2*		
Water heater turndown	1	1		
<i>Total Home Specific Recommendations</i>	4	4	6	3
<b>Additional Energy Conservation Practices</b>				
Weather stripping/caulking windows	7		1	
Cut down on water use	1	1		
Window treatments	2	2		
Clean/replace HVAC filters	1	1		
Weather stripping doors	2			
Turn off lights when not in use	1			
Reduce plug load	1			
Install more pipe wrap			2	2
Replace windows			1	
Replace exterior lighting			1	
<i>Total Additional Energy Conservation Practices</i>	15	4	5	2

\* One of these participants was recommended to unplug their second fridge.

Measure recommendations adopted by participants are considered eligible for program savings credit if the following conditions hold:

- The implemented recommendation is identified in the energy survey report
- The implemented recommendation is not rebated through other ComEd programs

Analysis of these conditions in the telephone survey data result in the identification of four measure adoptions eligible for program credit. These measures include one attic insulation installation, two refrigerator replacements, and one water heater turndown.

**Impact Analysis of Survey Recommendation Uptake**

Attic insulation savings were calculated using eQuest, an industry standard modeling software that uses DOE-2 as the simulation engine. The model was run using a typical Chicago house, developed from a small number of known characteristics of the home that installed insulation and assumptions of typical building construction in the Chicago area. Impact for water heater temperature turndown was assigned consistent with the direct install measure impact – using an average participating home value. Refrigerator replacement impact figures are based on a recent impact study conducted by the Evaluation Team for an east coast utility.

**Summary of Survey Recommendation Uptake Impact**

The average impact per adoption is 1,027 kWh. Table 3-12 below summarizes the credit applied to the program by itemizing the results of the survey sample, and the population level estimates.

**Table 3-12. All-Electric Home - Energy Survey Recommendation Uptake Impact**

Segment	Adjustment Factor	First Year MWh	First Year kW
Sample Results	Total	4.1	0.30
	Rebated through other programs	0	0
	Total credited to SFHEP	4.1	0.30
	Credit per surveyed participant <sup>^</sup>	0.0451	0.00
Population Estimates	Total program population credit <sup>*</sup>	19.8	1.43
	Total credit as percent of ex-ante impact <sup>**</sup>	4%	0%

<sup>^</sup> This is the average credit over the whole survey sample, i.e. the total impact for measure recommendation.  
<sup>\*</sup> This is the credit per surveyed participant multiplied by the total number of participants in the population.

### 3.5.1 All-Electric Home Program Gross Impact Results

#### Overall Ex-Post Gross Impact Summary

Table 3-13 below summarizes the PY3 ex-post gross impact for the All-Electric Home Program. The overall gross impact realization rate is 93 percent for energy and 106 percent for demand. The direct install measures make up 93 percent of the ex-post gross kWh impact, and 94 percent of the ex-post gross kW impact. Among the direct install measures, CFLs make the largest contribution to both energy and demand impact, with 40 percent and 43 percent of program totals, respectively. Low flow showerheads weigh in at number two in kWh impact, but are outperformed by pipe insulation for kW impact.

**Table 3-13. All-Electric Home - Ex-Post Gross Impact Summary**

Program Measure	Ex-Post MWh	Percent of Total Ex-Post MWh	Ex-Post kW	Percent of Total Ex-Post kW
Compact Fluorescent Bulbs	156.8	40%	15.9*	43%
Kitchen Aerators	33.7	9%	3.0	8%
Faucet Aerators	40.3	10%	2.8	7%
Low Flow Showerheads	88.1	23%	3.8	10%
Pipe Insulation	44.0	11%	9.7	26%
Total Direct Install	363.0	93%	35.1	94%
<b>Direct Install Gross Impact Realization Rate</b>	88%		102%	
Water Heater Temperature Setback	7.0	2%	0.8	2%
Energy Survey Recommendations	19.8	5%	1.4	4%
<b>Total</b>	389.7	100%	37.3	100%
<b>Gross Impact Realization Rate</b>	93%		106%	

\* CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post.

### 3.5.2 All-Electric Home Program Net Impact Results

This section summarizes the PY3 net-to-gross ratio estimation approach and results for the All-Electric Home Program.

### Free Ridership

The objective of the free ridership assessment is to estimate the impact of program incented measures that would have been installed even in the absence of the program. This cannot be measured directly due to the inability to observe behavior in the absence of the program. Thus, free ridership is assessed as a probability score for each measure. The evaluation relies on self-reported data collected during participant telephone surveys to assign free ridership probability scores to each measure. Details on the free ridership telephone survey battery and scoring methods are presented within Section 2.1.2 Net Program Impact Evaluation Methods (page 29). Application of this algorithm results in the measure and program free ridership estimates shown in Table 3-14. The CFL free ridership is markedly higher than for the other measures, at 20 percent, though much lower than the midstream lighting program CFL free ridership, measured at 41% in PY3. The proactive delivery of a direct install program generally lowers expected free ridership levels relative to an approach relying on customer self-installation.

**Table 3-14. All-Electric Home - Free Ridership Results by Measure**

Measure	Free Ridership
Compact Fluorescent Bulbs	20%
Low Flow Showerheads	5%
Aerators	7%
Pipe Insulation	7%
Overall	11.6%

### Spillover

The objective of the spillover assessment is to estimate the impact arising from efficient measures installed as a result of the program that were not incented by the program. The evaluation relies on self-reported data collected during the telephone survey to identify these measures and assess the role of the program in the decision to install. Details on the spillover telephone survey battery and the spillover calculation are presented within Section 2.1.2 Net Program Impact Evaluation Methods on page 31. Spillover estimates, using this approach and expressed as a percent of measure ex-ante impact are shown in Table 3-15 below.

**Table 3-15. All-Electric Home - Spillover Results by Measure**

Measure	Percent of Participants Reporting Spillover Adoption	Mean Spillover Quantity per Adoption	Spillover Adjustment
Compact Fluorescent Bulbs	22%	7.4 bulbs	9.0%*
Low Flow Showerheads	0%	-	0%
Aerators	0%	-	0%
Pipe Insulation	3%	15.0 LF	3%
Overall	-	-	3.8%

*\*Calculated as  $(0.22 * 7.4 * 709 / 6,126) * 0.5$ , where 709 is the number of participants receiving CFLs, 6,126 is total number of program bulbs, and 0.5 is the reduction to avoid double counting with the midstream lighting program.*

Table 3-16 below integrates both net-to-gross (NTG) analysis results and ex-post gross impact results to form final PY3 program savings estimates based on deemed kWh impacts from CFL measures. Please see the Net-to-Gross Ratio (NTG) section for details on the NTG formula (page 32).

**Table 3-16. ComEd PY3 Single Family Home Energy Savings  
Deemed Savings Values (CFLs only)**

Single Family Programs	Ex-Ante Measure MWh	RR	Ex-Post Gross MWh	NTG	Ex-Post Net MWh
<b>All-Electric</b>					
CFL	173.1	100%	173.1	0.89	154.1
Showerheads	133.3	66%	88.0	0.93	81.8
Kitchen Aerators	39.3	86%	33.8	0.95	32.1
Faucet Aerators	72.0	76%	54.7	0.95	52.0
Hot Water Pipe Insulation	44.0	100%	44.0	0.96	42.2
Hot Water Heater Turndown	7.0	100%	7.0	1.00	7.0
Energy Survey	0.0	0%	0.0	1.00	0.0
Sub-Total	468.7	85%	400.6	0.92	368.5
<b>Air-Sealing Pilot</b>					
CFL	43.7	100%	43.7	0.74	32.3
<b>Direct install Pilot</b>					
CFL	2,127.8	100%	2,127.8	0.81	1,723.5
<b>Retrofit Pilot</b>					
CFL	413.2	100%	413.2	0.68	281.0
Water measures	0		17.7	0.94	16.6
Weatherization measures	155.6	50%	77.8	0.98	76.2
Sub-Total Pilot	568.8	89%	508.7	0.73	373.9
<b>Total Pilots</b>					
Total Pilots	2,740.3	98%	2,680.2	0.79	2,129.7

Table 3-17 below integrates both net-to-gross (NTG) analysis results and ex-post gross impact results to form final program impact estimates using the evaluated parameters for PY3. Please see the Net-to-Gross Ratio (NTG) section for details on the NTG formula (page 32). The gross impact realization rates reflect the combined effect of measure removals, partial retrofits,<sup>11</sup> home occupancy and non-program qualifying installs. The combined effect of the gross impact realization rates and the net-to-gross ratios on the direct install measure impact is a reduction of 19% in kWh and 6% in kW. As discussed above, program activities also impacted energy

<sup>11</sup> This is an adjustment reflecting the proportion of fixtures in the home retrofit, and applies to the low flow showerhead and aerator measures. See the "Partial Retrofit Adjustment" section on page 27 for a more detailed discussion.

consumption through water heater temperature setbacks and the provision of energy conservation measure recommendations. Measure recommendations had a good response rates and consisted of major energy saving retrofits, such as attic insulation and refrigeration. All told, PY3 program net impacts, using evaluated parameters, is 360 MWh and 34.5 kW, representing 100% and 114% of measure ex-ante impact claims, respectively. The net impact from the PY3 All-Electric Home program was adjusted to 369 MWh to include deemed kWh impacts from CFL measures.

**Table 3-17. All-Electric Home - Ex-Post Gross and Net Impact Summary –Evaluated Parameters**

Measure	Gross^ Impact RR	Ex-Post Gross MWh	Ex-Post Gross kW	NTG	Ex-Post Net MWh	Ex-Post Net kW
Compact Fluorescent Bulbs	93%/110%*	156.8	15.9	89%	139.1	14.1
Kitchen Aerators	102%	33.7	3.0	95%	31.9	2.8
Faucet Aerators	67%	40.3	2.8	95%	38.1	2.6
Low Flow Showerheads	79%	88.1	3.8	93%	81.9	3.5
Pipe Insulation	119%	44.0	9.7	96%	42.3	9.3
<b>Total Direct Install</b>	<b>88%/102%*</b>	<b>363.0</b>	<b>35.1</b>	<b>92%</b>	<b>333.4</b>	<b>32.3</b>
<i>Total Direct Install as Percent of Ex-Ante</i>	-	88%	102%	-	81%	94%
<b>Other Program Impacts</b>						
Water Heater Temperature Setback	100%	7.0	0.8	100%	7.0	0.8
Energy Survey Recommendations	-	19.8	1.4	100%	19.8	1.4
<b>Total Program</b>	<b>93%/106%*</b>	<b>389.7</b>	<b>37.3</b>	<b>92%</b>	<b>360.1</b>	<b>34.5</b>
<i>Total as Percent of Ex-Ante</i>	-	93%	106%	-	100%	114%

<sup>^</sup>Gross impact realization rates reflect the ratio of ex-post gross impact to adjusted measure ex-ante impact, where the latter reflects expected realization rates of 97% for CFL and 84% for water saving measures.

\* CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post. The coincident factor adjustment to the gross impact realization rate applies only to kW, not kWh.

**Section 4. Air Sealing Pilot Program Results**

**4.1 Air Sealing Pilot Impact Results**

This section is composed of four primary components.

- The first is a review of the program tracking system.
- The second is a summary of ex-ante gross impact accomplishments.
- The third presents a summary of the adjustments applied to ex-ante gross impact and the resulting ex-post gross impact values.
- The fourth and final component is the presentation of the net-to-gross analysis and results.

**4.1.1 Air Sealing Pilot Tracking System Review**

Two program tracking databases were provided in support of this evaluation by ComEd in July of 2011. One tracking database was from CNT and contained 124 PY3 participants, of which 78 installed at least 1 CFL. The other database was from TSI and contained 92 PY3 participants, of which 57 installed at least 1 CFL. Table 4-1 below shows the contents of the two tracking systems and the values that each component holds. Although there were other measures installed through this program, CFLs were the only electricity saving measure installed and therefore evaluated.

**Table 4-1. Air Sealing Pilot - Tracking System Content Summary**

Variable Name	Values
Name	Customer Name, First and Last
Address	Street address, city, state, zip code
Date of Service	Month, day and year of Participation. No missing values.
Phone	Area code and telephone number. Missing for 1 participant.
Peoples Gas and ComEd Account Number	Unique ID for account
Age of House	Not in CNT file. Values between 1890 and 1968. Three participants had missing data.
Number of Stories	Not in CNT file. Values between 1 and 4. Two participants had missing data.
Conditioned Square Feet	Not in CNT file. Values between 663 and 11,803. Two participants had missing data.
Installed Measure Name	9 Watt CFL, 14 Watt CFL, 19 Watt CFL
Installed Measure Quantity	Values ranging from 0-20

### Overall Assessment

The tracking system created by the program implementer and delivered by ComEd to the Evaluation Team contained participant data sufficient to complete an impact evaluation. The most essential data, such as customer name, contact information and records of the wattages of CFLs installed were appropriately detailed and delivered in an organized and easily accessible fashion.

### Gaps and Areas for Improvement

Although it is not necessary for the analysis conducted in this report, information on the rooms where the CFLs were installed would have been good information with which to verify the CFL installations with the participants.

#### 4.1.2 Air Sealing Pilot Ex-Ante Gross Impact, Summary of Accomplishments

In PY3, the Air Sealing Pilot Program reported a first year gross impact goal of 150 MWh. Ex-ante impact assumptions and program tracking system data indicate participation by 135 homes, and total program ex-ante gross energy impact of 42 MWh, with demand impact of 3.7 kW. The total pilot program ex-ante impact summary statistics are shown in Table 4-2.

**Table 4-2. Air Sealing Pilot - Goals versus Total Ex-Ante Program Impact**

	Homes	kWh Per Home	Total MWh	kW per Home	Total kW
Goals	-	-	150	-	-
Ex-Ante	135	314.2*	42.4^	0.0271	3.66
Percent of Goal	-	-	28%	-	-

*\*Ex-ante gross impacts are based on the number of CFL bulbs installed and the delta wattage of each bulb. Impact per home is calculated by dividing the total ex-ante kWh impact from CFLs by the number of homes with CFL installations. CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post.*

*^Ex-ante figures incorporate an assumed attrition of 3% relative to measure ex-ante*

Table 4-3 below summarizes the wattage level data regarding the program installations of CFL bulbs and the associated ex-ante gross impact. The table shows the total number of bulbs installed for each wattage category, as well as the number of unique homes in which these bulbs were installed. The per-bulb impact and total impact by wattage category are also shown. The most commonly installed program bulb is the 14 watt CFL. Eighty-four percent of program bulbs and 83 percent of CFL gross energy impact arise from 14 watt bulbs. The 19 watt bulbs are the second most common, accounting for 12 percent of bulbs and 14 percent of CFL energy impact.

**Table 4-3. Air Sealing Pilot - Ex-Ante\* Gross Impact Detail for CFL Installations, PY3**

Wattage	Bulbs	Homes	kWh per Bulb per Year	Total MWh per Year	kW per Bulb	Total kW per Year
9	38	20	28.2	1.1	0.0024	0.09
14	844	127	41.9	35.3	0.0036	3.05
19	118	38	51.0	6.0	0.0044	0.52
Total	1,000	135	42.4	42.4	0.0037	3.66

*\*Ex-ante figures reflect an assumed attrition of 3% relative to measure ex-ante*

#### 4.1.3 Air Sealing Pilot Ex-Post Gross Impact, Summary of Adjustments

This section summarizes the PY3 ex-post impact estimation approach and results for the Air Sealing Pilot Program. More specifically, this section addresses adjustments made for removals, failures and non-program qualifying CFLs.

### **Application of Measure Disposition to Impact Calculations**

The calculation of ex-post gross impact includes an adjustment to reflect the removal of program measures. CFLs that are thrown away, given away, sold, or put into storage before end of the program year are excluded from the program's first year energy impact. Details of this adjustment are included within the Gross Program Impact Evaluation Methods section (Section 2.1.1 on page 26). This is reflected in a proportional reduction in impact in light of removal rates assumed in the ex-ante impact estimates.

The ex-ante impact values for CFLs incorporate an assumed three percent measure attrition rate. This rate reflects the rate of expected attrition due to removals and failures. The findings from the survey analysis indicate the PY3 attrition rate was somewhat lower, at one percent. Other adjustments to the gross impact include a downward adjustment of 1% for a slightly lower amount of reported bulbs installed than reported in the tracking database and a two percent downward adjustment for non-program qualifying CFLs installs. The non-program qualifying CFL installs are defined as a CFL replacing another CFL. The combined result of all of these adjustments to the ex-ante savings is a decrease equal to the ratio of 96.7 percent to 97 percent, or a downward adjustment of 0.3 percent, as shown in Table 4-4 below.

**Table 4-4. Air Sealing Pilot - Measure Verification and Disposition**

Measure	CFL
Percent of Measures Verified Installed	99.3%
Participant Respondents	46
Measure Disposition Sample Size	298 bulbs
CFLs Still in Use	99%
Original Location	99%
Moved	0%
Not in Original Location	1%
Thrown away	0%
Stored	1%
Gave away or sold	0%
Non-program Qualifying CFL Install	2%
Ex-ante attrition rate	3%
Gross Impact Realization Rate <sup>^</sup>	99.7%

<sup>^</sup>Gross impact realization rate reflects the ratio of ex-post gross impact to ex-ante gross impact, where ex-ante impact is the measure ex-ante adjusted for expected attrition of 3%

#### 4.1.4 Air Sealing Pilot Program Gross Impact Results

##### Overall Ex-Post Gross Impact Summary

Table 4-5 below summarizes the PY3 ex-post gross impact for the Air Sealing Pilot Program. While the operating hours incorporated in PY3 ex-ante estimates are consistent with the PY3 lighting logger study, the coincident factor is not. An adjustment was made to demand savings consistent with the findings of the PY3 CFL lighting logger study that the interior CFL bulb coincident factor is 9.5%, up from the 8.1% ex-ante assumption. The overall gross impact realization rate is 100 percent for energy and 117 percent for demand.

**Table 4-5. Air Sealing Pilot - Ex-Post Gross Impact Summary**

Program Measure	Ex-Post MWh	Ex-Post kW
Compact Fluorescent Bulb Gross Impact	42.3	4.3
<i>Gross Impact Realization Rate</i>	100%	117%

#### 4.1.5 Air Sealing Pilot Program Net Impact Results

This section summarizes the PY3 net-to-gross ratio estimation approach and results for the Air Sealing Pilot Program.

##### Free Ridership

The objective of the free ridership assessment is to estimate the impact of program incented measures that would have been installed even in the absence of the program. This cannot be measured directly due to the hypothetical nature of the counter-factual situation. Thus, free ridership is assessed as a probability score for each measure. The evaluation relies on self-reported data collected during participant telephone surveys to assign free ridership probability scores to each measure. Details on the free ridership telephone survey battery and scoring methods are presented within the Net Program Impact Evaluation Methods section (on page 29). Application of this algorithm results in a free ridership estimates of 30 percent. Again this is lower than the ComEd midstream lighting program CFL free ridership level (41%). The proactive approach of direct install delivery tends to lower expected free ridership. At the same time, there is upward pressure on free ridership resulting from trends in the lighting market and the market transformation effects of the ComEd Midstream Lighting Program.

##### Spillover

The objective of the spillover assessment is to estimate the impact arising from efficient measures installed as a result of the program that were not incented by the program. The evaluation relies on self-reported data collected during the telephone survey to identify these measures and assess the role of the program in the decision to install. Details on the spillover telephone survey battery and the spillover calculation are presented within the Net Program Impact Evaluation Methods section (on page 31). Spillover estimates, using this approach and expressed as a percent of CFL ex-ante impact are shown in Table 4-6 below:

**Table 4-6. Air Sealing Pilot - Spillover Results**

Measure	Percent of Participants Reporting Spillover Adoption	Mean Spillover Quantity per Adoption	Spillover Adjustment
Compact Fluorescent Bulb	15%	4.8 bulbs	4.84%*

\*Calculated as  $(0.15 * 4.8 * 135 / 1,000) * 0.5$ , where 135 is the number of participants receiving CFLs, 1,000 is total number of program bulbs, and 0.5 is the reduction to avoid double counting with the midstream lighting program.

Table 4-7 below integrates both net-to-gross (NTG) analysis results and ex-post gross impact results to form final program impact estimates for PY3. See the Net-to-Gross Ratio (NTG) section for details on the NTG formula (on page 32).

The gross impact realization rates reflect the combined effect of measure removals and non-program qualifying installs. The combined effect of the gross impact realization rates and the net-to-gross ratios on the impact is a reduction of 26% in kWh and 13% in kW. The program net impact for PY3 is 31.5 MWh and 3.2 kW, representing 74% of CFL ex-ante kWh impact claims and 87% of CFL ex-ante kW impact claims.

**Table 4-7. Air Sealing Pilot - Ex-Post Gross and Net Impact Summary**

Measure	Gross Impact RR	Ex-Post Gross MWh	Ex-Post Gross kW*	NTG	Ex-Post Net MWh	Ex-Post Net kW*
Compact Fluorescent Bulb	100%/117%*	42.3	4.3	74%	31.5	3.2
<b>Total as Percent of Ex-Ante</b>	-	100%	117%	-	74%	87%

\* CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post. The coincident factor adjustment to the gross impact realization rate applies only to kW, not kWh.

**Section 5. Direct Install Pilot Program Results**

**5.1 Direct Install Pilot**

This section is composed of five primary components.

- The first is a review of the program tracking system.
- The second is a summary of ex-ante gross impact accomplishments.
- The third presents a summary of the adjustments applied to ex-ante gross impact and the resulting ex-post gross impact values.
- The fourth is the presentation of the net-to-gross analysis and results.
- The fifth and final component is a discussion of the process findings.

**5.1.1 Direct Install Pilot Tracking System Review**

A final program tracking database was provided in support of this evaluation by ComEd in July of 2011. The tracking system contained 26,300 rows with dates in PY3, of which 11,225 were CFL measures. Each row is unique by the customer and CFL wattage installed. Although there were other measures installed through this program, CFLs were the only electricity saving measure installed, and therefore evaluated. Table 5-1 below shows the contents of the tracking system and the values that each component of the delivered tracking system holds.

**Table 5-1. Direct Install Pilot - Tracking System Content Summary**

Variable Name	Values
Name	Customer Name, First and Last
Address	Street address, city, state
Date of Service	Month day and year of Participation. No missing values.
Phone	Area code and telephone number. Missing for 95 participants.
Account Number	Unique ID for account
Install ID	Unique ID for participant measure
Installed Measure Name	9 Watt CFL, 14 Watt CFL, 19 Watt CFL
Installed Measure Quantity	Values ranging from 0-15
Program Year	2010

## Overall Assessment

The tracking system created by the program implementer and delivered by ComEd to the Evaluation Team contained participant data sufficient to complete an impact evaluation. The most essential data, such as customer name, contact information and records of the wattages of CFLs installed were appropriately detailed and delivered in an organized and easily accessible fashion.

## Gaps and Areas for Improvement

Although it is not necessary for this analysis, information on the rooms where the CFLs were installed would have been good information with which to verify the CFL installations with the participants.

### 5.1.2 Direct Install Pilot Ex-Ante Gross Impact, Summary of Accomplishments

In PY3, the Direct Install Pilot Program reported a first year gross impact goal of 2,100 MWh. Ex-ante impact assumptions and program tracking system data indicate participation in by 5,966 homes, and total program ex-ante gross energy impact of 2,064 MWh, with demand impact of 178.2 kW. The total pilot program ex-ante impact summary statistics are shown in Table 5-2.

**Table 5-2. Direct Install Pilot - Goals versus Total Ex-Ante Program Impact**

	Homes	kWh Per Home	Total MWh	kW per Home	Total kW
Goals	-	-	2,100	-	-
Ex-Ante	5,966	346.0*	2,064	0.0299	178.2
Percent of Goal	-	-	98%	-	-

*\*Ex-ante gross impacts are measure ex-ante figures adjusted for expected attrition of 3% for CFLs and are based on the number of CFL bulbs installed and the delta wattage of each bulb. Impact per home is calculated by dividing the total ex-ante kWh impact from CFLs by the number of homes with CFL installations. CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post.*

Table 5-3 below summarizes the wattage level data regarding the program installations of CFL bulbs and the associated ex-ante gross impact. The table shows the total number of bulbs installed for each wattage category, as well as the number of unique homes in which these bulbs were installed. The per-bulb impact and total impact by wattage category are also shown. The most commonly installed program bulb is the 14 watt CFL. Fifty-eight percent of program bulbs and 59 percent of CFL gross energy impact arise from 14 watt bulbs. The 19 watt bulbs are the second most common, accounting for 22 percent of bulbs and 27 percent of CFL energy impact.

**Table 5-3. Direct Install Pilot - Ex-Ante<sup>^</sup> Gross Impact Detail for CFL Installations, PY3**

Wattage	Bulbs	Homes	kWh per Bulb per Year	Total MWh per Year	kW per Bulb	Total kW per Year
9	10,354	2,462	28.2	292.1	0.0024	25.22
14	29,157	5,342	41.9	1,220.4	0.0036	105.38
19	10,824	3,408	51.0	551.5	0.0044	47.62
Total	50,335	5,966	41.0	2,064.0	0.0035	178.22

<sup>^</sup>Ex-ante gross figures are measure ex-ante values adjusted for expected attrition of 3%.

### 5.1.3 Direct Install Pilot Ex-Post Gross Impact, Summary of Adjustments

This section summarizes the PY3 ex-post impact estimation approach and results for the Direct Install Pilot Program. More specifically, this section addresses the true up of impact estimates consistent the latest PY3 logger study, as well as adjustments made for removals, failures and non-program qualifying CFLs.

#### Application of Measure Disposition to Impact Calculations

The calculation of ex-post gross impact includes an adjustment to reflect the removal of program measures. CFLs that are thrown away, given away, sold, or put into storage before end of the program year are excluded from the program’s first year energy impact. Details of this adjustment are included within the Gross Program Impact Evaluation Methods section (Section 2.1.1 on page 26). This is reflected in a proportional reduction in impacts in light of removal rates assumed in the ex-ante impact estimates. The ex-ante impact values for CFLs incorporate an assumed three percent measure attrition rate. This rate reflects the rate of expected attrition due to removals and failures. The findings from the survey analysis indicate the PY3 attrition rate was somewhat lower, at two percent.

Gross impact adjustments also consider the survey-based finding that 15 percent of program bulbs replaced existing CFLs. This figure stood out to the Evaluation Team as needing another layer of research and verification. The survey center went back and listened to samples of conducted interviews to verify that the questions were properly posed and understood by the participant. They verified that indeed customers understood the question and were responding appropriately. The tapes also revealed that customers were supportive of the in-kind replacement, because their existing CFL was older and didn’t perform as well as newer bulbs.

Note that methods were developed to ensure there was no double counting of penalties for CFL removal/failure and non-program qualifying installations were applied. If it was possible that these two occurrences could have occurred for the same bulb, it was assumed they did occur for the same bulb. For a fuller discussion and the specific algorithm applied, see Section 2.1.1, page 27. The combined result of all of these adjustments to the ex-ante savings is a realization rate equal to the ratio of 83 percent to 97 percent, or a downward adjustment of 14 percent, as shown in Table 5-4 below.

**Table 5-4. Direct Install Pilot - Measure Verification and Disposition**

Measure	CFL
Percent of Measures Verified Installed	100%
Participant Respondents	68
Measure Disposition Sample Size	603 bulbs
CFLs Still in Use	98%
Original Location	98%
Moved	0%
Not in Original Location	2%
Thrown away	2%
Stored	0%
Gave away or sold	0%
Non-program Qualifying CFL Install	15%
Ex-ante attrition rate	3%
Gross Impact Realization Rate <sup>^</sup>	86%

<sup>^</sup>Gross impact realization rate reflects the ratio of ex-post gross impact to ex-ante gross impact, where ex-ante impact is the measure ex-ante adjusted for expected attrition of 3%

#### 5.1.4 Direct Install Pilot Program Gross Impact Results

##### Overall Ex-Post Gross Impact Summary

Table 5-5 below summarizes the PY3 ex-post gross impact for the Direct Install Pilot Program. The overall gross impact realization rate is 86 percent for energy and 100 percent for demand. An adjustment of 117 percent was applied to the ex-ante CFL kW savings to adjust for the updated coincident factor identified in the PY3 midstream lighting evaluation. Ex-ante kW

estimates reflect an interior bulb CFL coincident factor of 8.1%, and ex-post figures reflect the new updated value of 9.5%.

**Table 5-5. Direct Install Pilot- Ex-Post Gross Impact Summary**

Program Measure	Ex-Post MWh	Ex-Post kW
Compact Fluorescent Bulb Gross Impact	1,767.9	179.0
<b>Gross Impact Realization Rate<sup>^</sup></b>	86%	100%

<sup>^</sup>Gross impact realization rate reflects the ratio of ex-post gross impact to ex-ante gross impact, where ex-ante impact is the measure ex-ante adjusted for expected attrition of 3%

**5.1.5 Direct Install Pilot Program Net Impact Results**

This section summarizes the PY3 net-to-gross ratio estimation approach and results for the Direct Install Pilot Program.

**Free Ridership**

The objective of the free ridership assessment is to estimate the impact of program incented measures that would have been installed even in the absence of the program. This cannot be measured directly due to the hypothetical nature of the counter-factual situation. Thus, free ridership is assessed as a probability score for each measure. The evaluation relies on self-reported data collected during participant telephone surveys to assign free ridership probability scores to each measure. Details on the free ridership telephone survey battery and scoring methods are presented within the Net Program Impact Evaluation Methods section (on page 29). Application of this algorithm results in a free ridership estimates of 20 percent, a figure much lower than the ComEd midstream Residential Lighting Program free ridership, measured at 41% in PY3. The proactive delivery involved of a direct install program generally lowers expected free ridership levels.

**Spillover**

The objective of the spillover assessment is to estimate the impact arising from efficient measures installed as a result of the program that were not incented by the program. The evaluation relies on self-reported data collected during the telephone survey to identify these measures and assess the role of the program in the decision to install. Details on the spillover telephone survey battery and the spillover calculation are presented within the Net Program Impact Evaluation Methods section (on page 31). Spillover estimates, using this approach and expressed as a percent of CFL ex-ante impact are shown in Table 5-6 below:

**Table 5-6. Direct Install Pilot - Spillover Results**

Measure	Percent of Participants Reporting Spillover Adoption	Mean Spillover Quantity per Adoption	Spillover Adjustment
Compact Fluorescent Bulb	9%	2.3 bulbs	1.18%*

\*Calculated as  $(0.09 * 2.3 * 5,966 / 50,335) * 0.5$ , where 5,966 is the number of participants receiving CFLs, 50,335 is total number of program bulbs, and 0.5 is the reduction to avoid double counting with the midstream lighting program.

Table 5-7 below integrates both net-to-gross (NTG) analysis results and ex-post gross impact results to form final program impact estimates for PY3. See the Net-to-Gross Ratio (NTG) section for details on the NTG formula (on page 32).

The gross impact realization rates reflect the combined effect of measure removals and non-program qualifying installs. The combined effect of the gross impact realization rates and the net-to-gross ratios on the impact is a reduction of 30% in kWh and 18% in kW. The program net impact for PY3 is 1,440 MWh and 145.8 kW, both representing 70% of CFL ex-ante kWh impact claims and 82% of CFL ex-ante kW impact claims.

**Table 5-7. Direct Install Pilot - Ex-Post Gross and Net Impact Summary**

Measure	Gross Impact RR <sup>^</sup>	Ex-Post Gross MWh	Ex-Post Gross kW*	NTG	Ex-Post Net MWh	Ex-Post Net kW*
Compact Fluorescent Bulb	86%/100%*	1,767.9	179.0	81%	1,439.8	145.8
<b>Total as Percent of Ex-Ante</b>	-	86%	100%	-	70%	82%

<sup>^</sup> Gross impact realization rates is the ration of ex-post gross impact to ex-ante impact, where ex-ante impact is the measure ex-ante adjusted for an expected 3% attrition rate.

\* CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post. The coincident factor adjustment to the gross impact realization rate applies only to kW, not kWh.

## 5.2 Direct Install Pilot Process Evaluation Results

ComEd joined the Direct Install Pilot program for a few months in the first half of 2011. The program presented an opportunity for ComEd to reach gas customers in its service territory; increase awareness of ComEd programs generally; and gain information on existing homes in that territory for future program design and implementation. Since Peoples Gas discontinued the program, ComEd will not participate in the program in PY4.

As the program will not continue next year, our process evaluation is relatively limited to documentation activities. For example, while we surveyed program participants, we did not ask for their suggestions for program improvement. In this section, we integrate findings from the program manager and the program administrator interviews with those from the participant telephone survey.

## **Marketing Channels**

As outlined in Section 1.1.3 above, the program used and tested three different marketing strategies (mailings, neighborhood sweeps, and Community Based Organizations). Neighborhood sweeps worked with local community organizations to help garner support from local neighborhood leaders. The CBO (Community Based Organizations) outreach, which included Energy Action Network sites, focused on developing, marketing, and launching outreach campaigns including web-blasts, a postcard mailing, and presentations at a community-based organization meeting. These efforts may have resulted in the spread of program information by word-of-mouth. While we do not have enough information or data to determine which of the three methods was most effective, the participant survey data show that the majority (57%, Table 5-8) of program participants first heard about the program through word-of-mouth, followed by brochures, flyers, or direct mail (21%) and CBOs or events (6%). This is consistent with the program manager's view of the participation trend:

*"It was much better to reach out to customers either electronically through email or through community events. But if the email went through what we were calling trusted sources, through community organizations that residents were already linked into, it was a huge success. We did that specifically with the Direct Install program that Franklin Energy implemented between us and Peoples Gas... (The Program) initially sent out some direct mail pieces and we felt like it was falling completely on deaf ears. And then we went through some of the community organizations that were, for example, faith based, (using) their news letters or their e-blasts and all of a sudden the program took off like wildfire."-Program Manager*

In this light, neighborhood sweeps and CBOs seem to be both credible and effective ways to reach this population.

**Table 5-8. How Direct Install Participants First Heard of the Program (Unaided)**

Outreach Method	Percent of Participants (n=68)
Word of mouth	57%
Brochure/Flyer through direct mail	21%
Community organization/event	6%
Other mass advertisement	3%
ComEd representative	3%
Newspaper	3%
Other	3%
Customer called ComEd to ask about bill reduction	2%
Internet	2%
Telephone call (not ComEd specific)	2%
Total	100% <sup>1</sup>

<sup>1</sup> Due to rounding percentages, do not add to 100%

We followed up with Direct Install Pilot program participants who did not identify first learning about the program through the mail to see if they nonetheless recalled hearing about the program this way when asked directly. Most respondents (86%) stated that they did not, while a few recalled mailer information (14%). This means that 30% of all participants encountered information about the program through mail outreach efforts.

### **Marketing Messaging**

We found that the mailings were useful to participants. As shown in Table 5-9, the majority of participants (75%) who recalled receiving direct mail materials found them very useful and all of the participants found them at least somewhat useful, in providing information about the program, indicating that the program honed in on important information to include in these mailings.

**Table 5-9. Usefulness of Program Mailings for Direct Install Pilot Participants**

Level of Usefulness	Percent of Participants (n=20)
Very useful	75%
Somewhat Useful	25%
Not very useful	0%
Not at all useful	0%
Total	100%

The mail materials emphasized lower energy bills, and free direct-install measures (low-flow showerheads, faucet aerators, and CFLs). Letters provided customers with a hotline and website they could use for more information and scheduling details. The program sent one initial mailing; in addition, community leaders or community organizations also delivered program postcards and other outreach materials. Both Chicagoland and ComEd co-branded all materials.

Program participants identified three main benefits to participating in the program: 1) lower energy bills or saving money (67%); 2) receiving program equipment (14%); and 3) saving energy or increased efficiency (8%). One participant, who cited the program equipment, stated, *“It gave me a chance to try out the new bulbs to see if I wanted to purchase them.”* Table 5-10 presents the benefits identified by participants. The messaging of the marketing materials reflected the top three benefits.

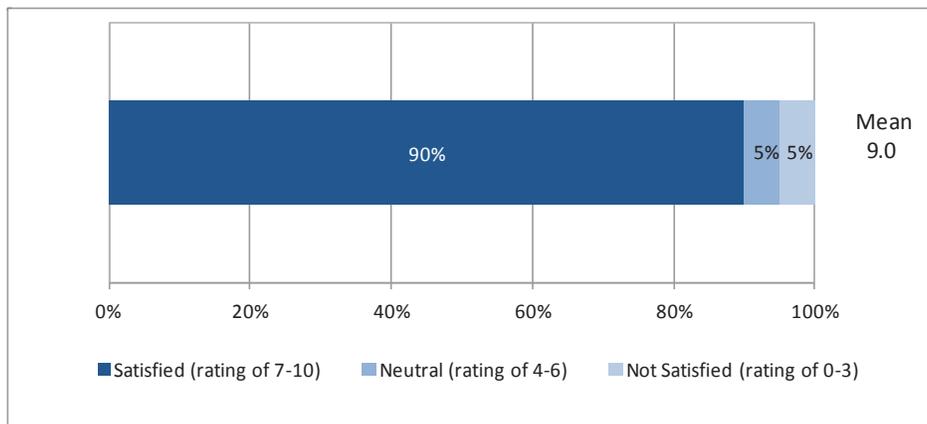
**Table 5-10. Participant-Identified Direct Install Pilot Program Benefits (mult. response)**

Benefits	Percent of Participants (n=64)
Having a lower energy bill/saving money	67%
Receiving the program equipment	14%
Saving energy/increased efficiency	8%
No Benefits	6%
Increased understanding of one’s home/energy usage	5%
Helps the environment/other “green” rationale	5%
Other	3%
Receiving the energy survey recommendations	2%
Improvements made to equipment in home	2%

**Participant Satisfaction**

Generally, program satisfaction was high across all elements of the program, indicating that the program was well implemented. As shown in Figure 5-1, a vast majority (90%) of participants stated that they were satisfied with the program overall and most (78%) gave a 9 or 10 indicating that they were very satisfied with the program.

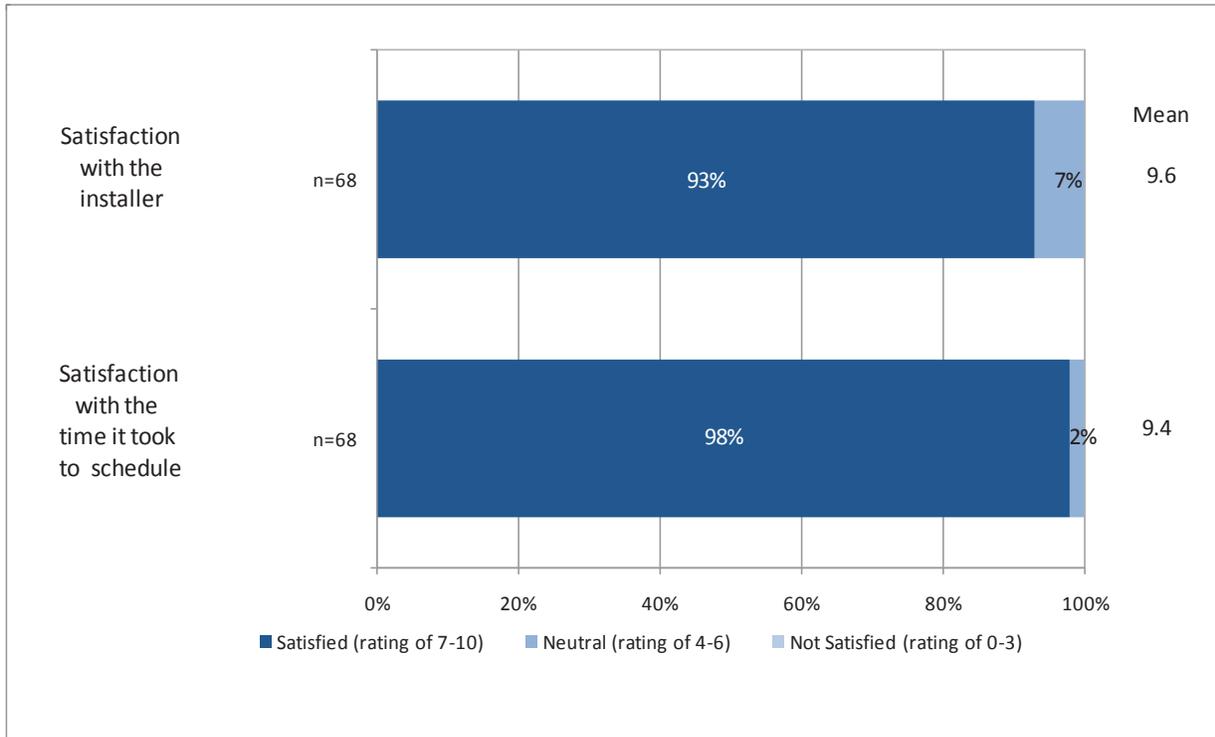
**Figure 5-1. Overall Direct Install Program Satisfaction**



The few participants who were dissatisfied with the program and who provided a reason for their dissatisfaction reported not liking CFLs, not liking the low-flow showerheads, or not seeing any energy savings. Each of these groups consisted of less than 1% of the Direct Install Pilot participants.

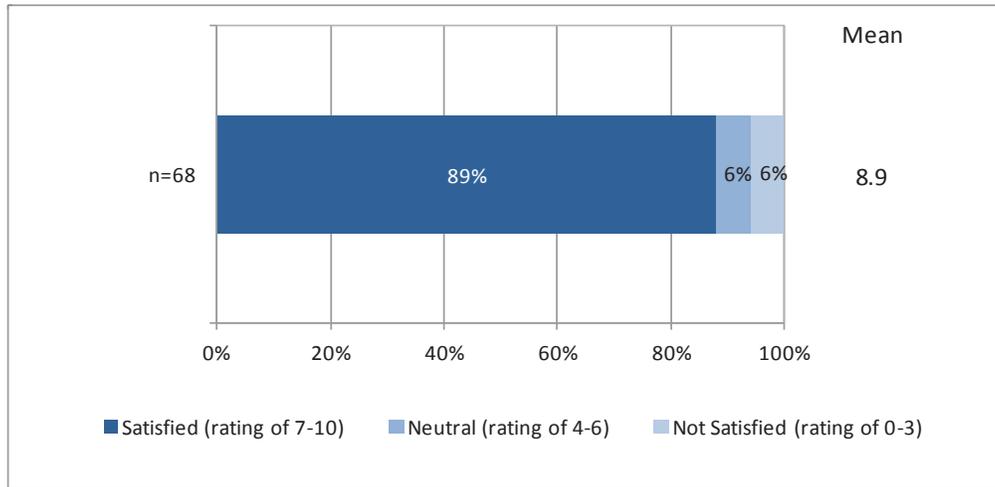
As shown in Figure 5-2 below, the vast majority of participants stated they were very satisfied with the installer that visited their home as well as the time it took to schedule the visit. Satisfaction with the installers (Figure 5-2) was very high with 93% reporting high satisfaction. Nearly all participants (98%) stated that they were satisfied with the time it took to schedule the home visit.

**Figure 5-2. Satisfaction with Direct Install Pilot Installer and Scheduling**



As shown in Figure 5-3 below, participant satisfaction with the CFLs was also high. The majority (89%) stated that they were satisfied with the CFLs and most (75%) gave a 9 or 10 indicating that they were very satisfied.

**Figure 5-3. Satisfaction with CFLs among Direct Install Pilot Participants**

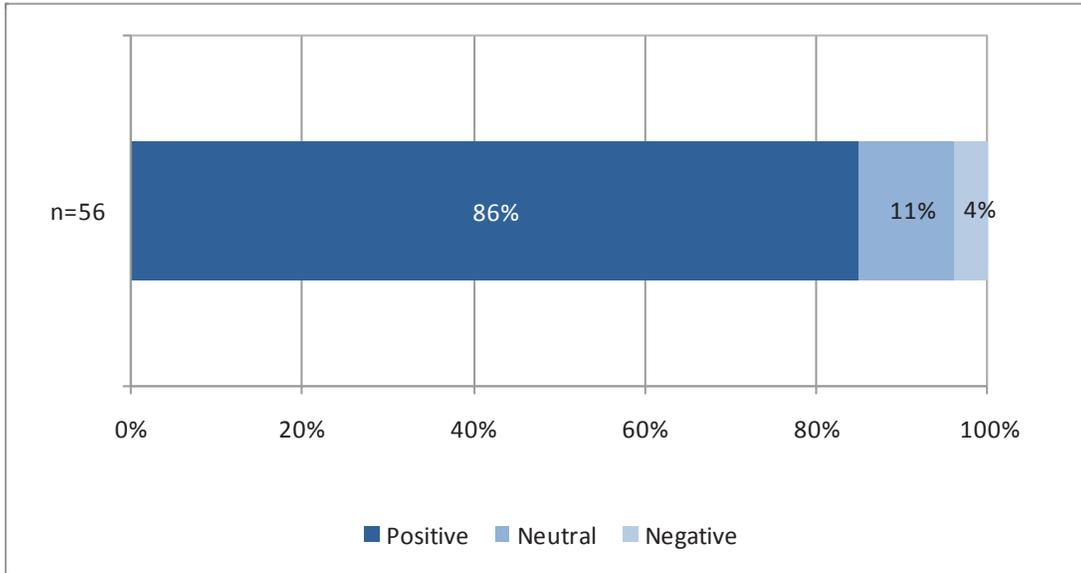


### Attitudes Towards and Acceptance of CFLs

There was no resistance among participants to the installation of CFLs. Every participant in the Direct Install program had at least one CFL installed, with the median being 10 (the maximum offered) per site.

As shown in Figure 5-4 below, the vast majority (86%) of respondent attitudes towards CFLs were positively impacted by this program. Only two participants (4%) stated a decrease in attitude, with one stating that the bulbs were too dim and the other stating that the bulbs had “burnt out.” A few others (11%) claimed they were not affected by the program (“neutral”).

Figure 5-4. Impact on CFL Attitudes

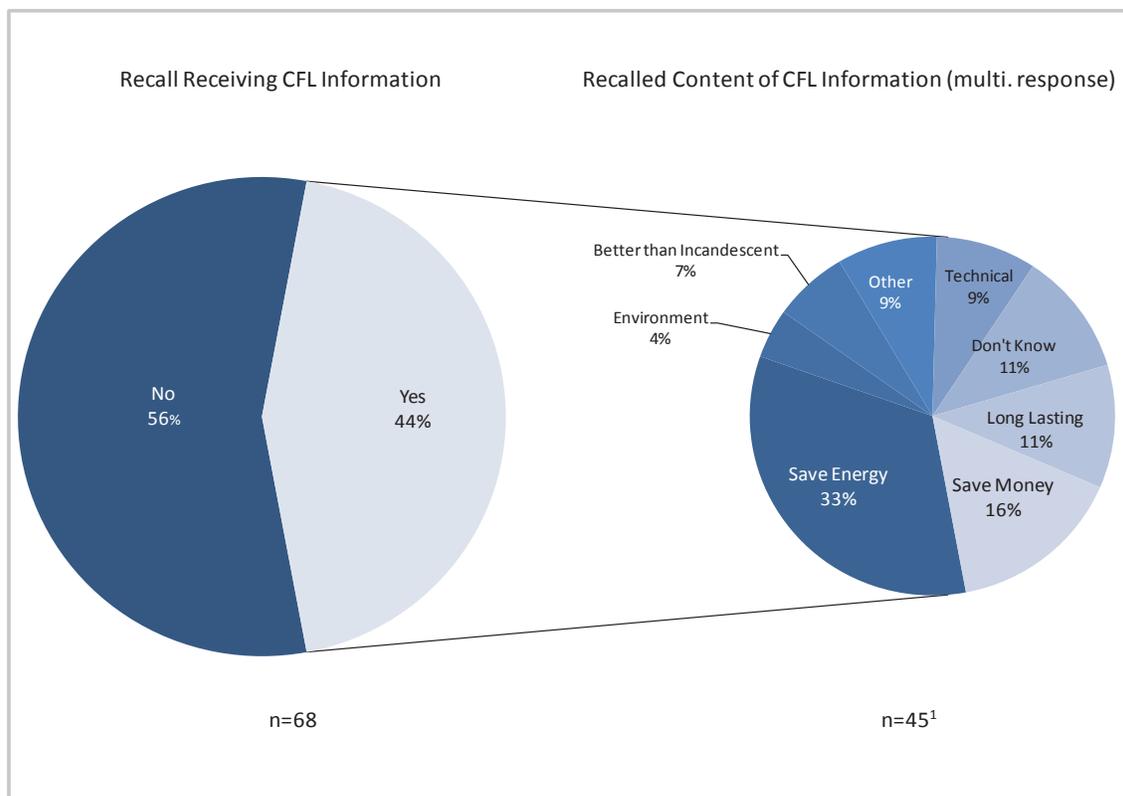


Some respondents (44%) recalled receiving information about CFLs through program materials, though just over half (56%) did not. Assuming that all participants did receive the program leave-behind material, one reason that participants may not have been able to recall the information is the speed at which the program was delivered. As the program manager explained,

*The appointment was roughly ... a 15 minute appointment... (The installers) focused on the DIs; they went through the leave-behind material; and then they quickly went over with the customer a summary report of the measures that were installed and the projected benefit of those measures.*

As shown in Figure 5-5 below, participants were most likely to remember that CFLs were efficient and save energy (33%); that CFL bulbs would help them save money on their energy bill (16%); and that CFLs are long lasting (11%). A sizeable portion could not recall the content of the information they had received (11%). Some also remembered technical information (9%), and how CFLs compare to incandescent bulbs (7%).

**Figure 5-5. Participants Recalled Receiving CFL Information (mult. response)**



<sup>1</sup> This n value is the number of total responses, not the number of participants.

## Section 6. Retrofit Pilot Program Results

### 6.1 *Retrofit Pilot Impact Results*

This section is composed of five primary components.

- The first is a review of the program tracking system.
- The second is a summary of ex-ante gross impact accomplishments.
- The third presents a summary of the adjustments applied to ex-ante gross impact and the resulting ex-post gross impact values.
- The fourth is the presentation of the net-to-gross analysis and results.
- The fifth and final component is a discussion of the process findings.

#### 6.1.1 **Retrofit Pilot Tracking System Review**

Two program tracking database were provided in support of this evaluation. The first tracking system contained the 413 customers that participated in the full Retrofit Pilot program. When a customer participates in the “full” Retrofit Pilot program it means that they had not only direct install measures installed in their home, but also went on to install at least one of the recommended weatherization measures. The second tracking system contained an additional 962 customers that participated in the direct install only portion of the program. These customers did not go on to install any of the recommended weatherization measures during this program year. Of the 962 participants contained in this database, 787 had CFLs installed. The direct install participants that did not have CFLs installed were not included in this evaluation because the other direct install measures achieve only gas savings.

Table 6-1 below shows the contents of the tracking system and the values that each component of the delivered tracking system holds.

**Table 6-1. Retrofit Pilot - Tracking System Content Summary**

Variable Name	Values
Name	Customer Name, First and Last
Address	Street address, city, zip code
Date of Service	Month day and year of Participation. One missing value.
Phone	Area code and telephone number. Missing for 441 participants.
Annual Therm Consumption	Not included in the Direct Install Only Tracking database. Values between 410 and 13,881. Missing for 3 participants.
Conditioned Square feet	Not included in the Direct Install Only Tracking database. Gas for all participants.
Heating System	Not included in the Direct Install Only Tracking database. Gas for all participants.
Wattage (CFL)	Values of 9, 14, or 19.
Flags for the Installed Measures	Compact Fluorescent Bulb, Air Sealing, Attic Insulation, Floored Attic Insulation, Exterior Wall Insulation, Sloped Insulation, Knee Wall Insulation, Crawl Space Insulation, Duct Insulation, Rim Joist Insulation, Seal and Repair Ducts
Installed Measure Quantity	For CFLs, values ranging from 0-42. One participant had 42 CFLs installed, the next highest amount of CFLs installed was 17. For the Insulation measures, values ranging from 0 to 3,307.
Attic Insulation Pre-R-Value	Not included in the Direct Install Only Tracking database. Values ranging from 0-62
Pre and Post Blower Door Results	Not included in the Direct Install Only Tracking database. Values ranging from 1,125 to 18,181. Seven participants had missing data.
Actual and Target CFM Reduced	Not included in the Direct Install Only Tracking database. Values ranging from 78 to 7,707. Seven participants were missing the target CFM reduced and 10 were missing the actual CFM reduced.
Actual Percent of CFM Reduced	Not included in the Direct Install Only Tracking database. Values ranging from 2% to 68%. Nine participants had missing data.
Cost, Energy and Therm Savings	Not included in the Direct Install Only Tracking database. Included for each Indirect measure.

## Overall Assessment

The tracking system created by the program implementer and delivered by ComEd to the Evaluation Team contained the most essential data, such as customer name, contact information and records of the installed measures. These variables were appropriately detailed and delivered in an organized and easily accessible fashion. The variables that were included in the tracking system were well populated, and contained just a small number of outliers that appeared to be data entry errors or something similar.

## Gaps and Areas for Improvement

The most critical missing elements in the tracking are the pre- and post-retrofit R-values for the insulation measures. These were, for the most part, unrecorded in the tracking database. For most insulation measures tracking data was limited to the square feet installed, and the cost and savings estimates. The savings associated with installing insulation measures is highly dependent on the levels of pre-existing insulation. This data appears to have been available, as it is an element in the audit tool. Please see Section 7.1.2 below for a full discussion of data collected in the audit that would benefit future evaluation teams. The savings associated with installing insulation measures is highly dependent on the levels of pre-existing insulation. *It is recommended that the levels of pre-existing insulation be noted in the tracking system for all insulation types.*

The air sealing and attic insulation measures were the exceptions to this. For these measures the tracking system held more detailed data. For the air sealing measure, the tracking data contained pre- and post-retrofit blower door results. For attic insulation, tracking data contained pre-retrofit and post-retrofit R-values.

The evaluation results presented below (in Sections 6.1.4) indicate that kWh and kW savings from weatherization and air sealing measures arise largely from reduced cooling loads. For this reason, they rely heavily on assumptions about air conditioning type and efficiency. *To support future impact evaluation, it is recommended that the tracking system store key information regarding the cooling system.* Ideally, this would include air conditioning type, capacity and efficiency. However, efficiency can be difficult to determine on-site, but the age and make / model information serves as an excellent reference.

Lastly, the program provides the direct installation of water savings measures, but does not store the water heater fuel type in the tracking system. The assumption embedded in PY3 ex-ante impact estimates was that all participants had gas-fueled water heaters. However, the telephone survey revealed that some participants had electric water heaters. *It is recommended that the tracking system record the water heater fuel type of participating homes.*

### 6.1.2 Retrofit Pilot Review of a Sample of Home Audits

A sample of five audits were reviewed as part of this evaluation. The major findings are as follows:

- There were a few items that were contained in the audit but were not recorded in the tracking database that would have been helpful in this analysis. Specifically, cooling SEER, seasonal efficiency AFUE or HSPF, number of stories above grade, leakage type, insulation type, pre- and post-R-values for the insulation measures and the auditors' notes.
- There were also a few items that were not recorded in the audit that would have been helpful to the evaluation. Specifically, more detailed air conditioner information and water heater fuel type (all were assumed to be gas).
- The claimed savings for the air sealing measure was based on the 25% reduction goal and was not updated to reflect the actual CFM percent reduced. The average actual percent of CFM reduced was 24%, with the lowest percent reduced being 2% and the highest percent reduced being 68%.

In developing cost savings estimates for customers associated with measures, an annual kWh savings of 51 was used for all CFLs installed. This is a simpler approach than using the CFL-specific delta watts figures, which for this program range from 29.1 to 52.5 kWh savings. The average annual kWh savings for CFLs installed through this program is 44.5, which means the average person was told they would save \$0.81 more per year than the savings reported in this evaluation. The average customer might not notice the \$0.81 difference, but one person was given an estimate that was \$35 higher than the ex-ante calculated savings and 25% of the participants were given a savings estimate that was between \$10 and \$35 higher than implied by the CFL ex-ante kWh figures. This issue was corrected in the tracking database, but the high estimated savings was reported to customers in their audit. Overestimating the annual energy cost savings of measures may lead to low customer satisfaction. *It is recommended that the assumed savings for CFLs used to inform customers about expected energy cost savings be reduced from 51 kWh to 44.5 kWh.*

### 6.1.3 Retrofit Pilot Ex-Ante Gross Impact, Summary of Accomplishments

In PY3, the Retrofit Pilot Program reported a first year gross impact goal of 750 MWh. Ex-ante impact assumptions and program tracking system data indicate participation in PY3 by 1,375 homes resulting in a total program ex-ante gross energy impact of 556 MWh (74 percent of goal).

**Table 6-2. Retrofit Pilot – Total Ex-Ante Program Impact, PY3**

	PY3 Goal	PY3 Ex-Ante Values ^
Participants (#customers)	-	1,375
First Year Gross Energy Impact (MWh)	750	556
First Year Gross Demand Impact (kW)	-	34.6

^ PY3 ex-ante impact is the measure ex-ante adjusted for an expected 3% attrition rate for CFLs.

Table 6-3 below summarizes the program ex-ante impacts for each installed measure. The largest contributor to gross kWh impact is the installation of CFLs, which account for 401 MWh of the 556 total MWh impact, or 72 percent. Air sealing comes in second with 55 MWh or 10 percent of the total. Attic and floored attic insulation combined account for 69 MWh or 12 percent of total ex-ante accomplishments. All of the rest of the measures combined account for 32 MWh or six percent of total ex-ante accomplishments.

**Table 6-3. Retrofit Pilot - First Year Ex-Ante Impact by Measure, PY3**

Measure	Homes	kWh Per Home	Total MWh	kW per Home	Total kW
CFL	1,125	356.3	400.8	0.0308	34.61
Air Sealing	403	136.4	55.0	-	-
Attic Insulation	337	149.4	50.4	-	-
Floored Attic Insulation	133	137.8	18.3	-	-
Exterior Wall Insulation	28	371.1	10.4	-	-
Sloped Insulation	30	106.2	3.2	-	-
Knee Wall Insulation	77	60.8	4.7	-	-
Crawl Space Insulation	70	27.7	1.9	-	-
Duct Insulation	38	136.8	5.2	-	-
Rim Joist Insulation	252	23.1	5.8	-	-
Seal and Repair Ducts	8	86.9	0.7	-	-
Total	1,375	404.6	556.4	0.0252	34.61

\*Ex-ante gross impacts for CFLs include an adjustment to measure ex-ante of 3% for assumed attrition. CFL figures are based on the number of CFL bulbs installed and the delta wattage of each bulb. Impact per home is calculated by dividing the total ex-ante kWh impact from CFLs by the number of homes with CFL installations. Impacts for the remaining measures are applied on a per-home basis. CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post.

Table 6-4 below summarizes the wattage level data regarding the program installations of CFL bulbs and the associated ex-ante gross impacts. The table shows the total number of bulbs installed for each wattage category, as well as the number of unique homes in which these bulbs were installed. The per-bulb impact and total impact by wattage category are also shown. The most commonly installed program bulb is the 14 watt CFL. Forty-nine percent of program bulbs and 48 percent of CFL gross energy impact arise from 14 watt bulbs. The 19 watt bulbs are the second most common, accounting for 36 percent of bulbs and 43 percent of CFL energy impact.

**Table 6-4. Retrofit Pilot - Ex-Ante Gross Impact Detail for CFL Installations, PY3**

Wattage	Bulbs	Homes	kWh* per Bulb per Year	Total MWh per Year	kW* per Bulb	Total kW per Year
9	1,347	444	28.2	38.0	0.0024	3.28
14	4,583	994	41.9	191.8	0.0036	16.56
19	3,356	944	51.0	171.0	0.0044	14.77
Total	9,286	1,125	43.2	400.8	0.0037	34.61

*^Ex-ante figures include an adjustment of 3% versus measure ex-ante, reflecting assumed attrition rates.*

Each home received an energy survey and a bundle of direct install measures. The content of this bundle depends on the unique features of the home. Equipment installation is at the discretion of the homeowner, and program guidelines limit some installations. For example, guidelines state CFL bulbs should replace incandescent bulbs. Table 6-5 below shows the percent of participating homes that installed each program measure type. CFL bulbs had the greatest penetration among participating homes at 82 percent. Air sealing was performed at 29 percent of participating homes, while attic insulation was installed in 25 percent of homes.

**Table 6-5. Retrofit Pilot - Percent of Participating Homes Installing Each Program Measure Type, PY3**

Measure	Percent of Participating Homes Installing Measure
Compact Fluorescent Bulb	82%
Air Sealing	29%
Attic Insulation	25%
Floored Attic Insulation	10%
Exterior Wall Insulation	2%
Sloped Insulation	2%
Knee Wall Insulation	6%
Crawl Space Insulation	5%
Duct Insulation	3%
Rim Joist Insulation	18%
Seal and Repair Ducts	1%

**6.1.4 Retrofit Pilot Ex-Post Gross Impact, Summary of Adjustments**

This section summarizes the PY3 ex-post impact estimation approach and results for the Retrofit Pilot Program. More specifically, this section addresses the true-up of savings estimates to reflect the most recent lighting logger study results, as well as adjustments made for removals, failures and non-program qualifying CFLs. Impact estimates are derived for measures not currently included in ex-ante impact claims, including aerators and low flow showerheads.

**Application of Measure Disposition to Impact Calculations**

The calculation of ex-post gross impacts includes an adjustment to reflect the removal of program measures. Measures that are thrown away, given away, sold, or put into storage before end of the program year are excluded from the program’s first year energy impact. For CFLs this is reflected in a proportional reduction in impact in light of removal rates assumed in the ex-ante impact estimates. Details of this adjustment are included in the Gross Program Impact Evaluation Methods section (Section 2.1.1 on page 26).

The ex-ante impact values for CFLs incorporate an assumed three percent measure attrition rate. This rate reflects the rate of expected attrition due to removals and failures. The findings from the survey analysis indicate the PY3 attrition rate was somewhat higher, at four percent.

Other adjustments to the gross impact include a downward adjustment of four percent for a slightly lower amount of reported bulbs installed than reported in the tracking database and a three percent downward adjustment for non-program qualifying CFLs installs. The non-program qualifying CFL installs are defined as a CFL replacing another CFL. The combined result of all of these adjustments to the ex-ante savings is a realization rate equal to the ratio of 88 percent to 97 percent, or a downward adjustment of 10 percent. Measure disposition findings and analysis results are shown in Table 6-6 below.

**Table 6-6. Retrofit Pilot - Measure Verification and Disposition**

Measure	CFL
Percent of Measures Verified Installed	96%
Participant Respondents	107*
Measure Disposition Sample Size	855 bulbs
Measure Still in Use	96%
Original Location	95%
Moved	0%
Not in Original Location	4.2%
Thrown away	0.5%
Stored	3.7%
Gave away or sold	0%
Non-program Qualifying CFL Install	3%
Ex-ante attrition rate	3%
Gross Impact Realization Rate <sup>^</sup>	90%

\*This is higher than the number of surveyed participants because 2 respondents said that they did not have any CFLs installed and therefore did not complete a survey.

<sup>^</sup>Gross impact realization rate is the ratio of ex-post impact to ex-ante impact, where ex-ante impact values reflect assumed attrition of 3% versus ex-ante measure savings.

The participant telephone survey collected information regarding the reasons participants removed measures. Survey results show that for CFLs, brightness, color, poor quality lights, and equipment failure were the reasons for these removals. Among CFL recipients, 5% of participants (but less than 1% of the bulbs) stated that they removed one or more bulb due to equipment failure, which may indicate a quality issue with the type of CFLs offered through the program.

The ‘full’ program participants were also asked to verify the weatherization measures that were installed through the program. The results were somewhat surprising, and lower than expected. After some deliberation, the Evaluation team determined that the accuracy of the verification rates is difficult to rely on given the inherent difficulty of identifying weatherization measures. Weatherization measures are often not viewed day-to-day and almost never interacted with. Thus, the self-reported verification rates are not used in calculating a realization rate for the weatherization measures. However, they are worth mentioning. The most reasonable verification rate was given for attic insulation, which was verified by 95 percent of participants. Air sealing, duct insulation, and other insulation measures were verified by 77, 63, and 79 percent of participants, respectively. This means that between 21 and 37 percent of these participants do not remember having the measure installed. These results are worth mentioning because if they were installed through the program the customer not only agreed to have them installed, but also agreed to pay half of what it costs to install these measures. *It is recommended that paperwork and verbal communications with customers increase the emphasis on the full list of installed measures.* This could help avoid customer misperceptions and confusion about services received and paid for, which may improve customer satisfaction levels.

#### **6.1.5 Retrofit Pilot Program Weatherization Models**

There were 10 distinct air sealing and weatherization measures installed as part of the follow up retrofit element of the program. These are also referred to as “indirect” installed measures to distinguish them from the direct install measures. As described in the Tracking System Assessment above (Section 6.1.1) the information regarding most of the weatherization measures was incomplete, and would not support a robust impact assessment. Further, most of the savings is concentrated in the Air Sealing, Attic Insulation and Floored Attic Insulation measures. These three measures together with CFLs make up 94% of the total program ex-ante kWh savings. Given the available data and the distribution of ex-ante savings, only these four measures are evaluated.

In order for ComEd to best capture savings from weatherization measures going forward it is recommended that;

- Levels of pre-existing insulation be noted in the tracking system for all insulation types. Other data housed in the audit tool that would be useful to evaluators include number of stories above grade, leakage type, and insulation type.
- The tracking system store key information regarding the cooling system. Ideally, this would include air conditioning type, capacity and efficiency. However, efficiency can be difficult to determine on-site, but the age and make / model information serves as an excellent reference.

- One of the following options be used in future program year evaluations to assess the impact achieved by the weatherization measures: evaluate the ex-ante model calculations, conduct a billing analysis, or create more refined building simulation models on a subset of the population by either collecting more detailed home characteristic information at the time of participation or over the phone at a later date.
- ComEd should consider decreasing the maximum pre-existing R-Value allowable for attic insulation participation to R-11. As shown in Figure 6-1 on page 92, the impact of the attic insulation measure declines exponentially with the increase in pre-retrofit R-Value.

### Air Sealing

In PY3, 403 participants had air sealing measures installed through the program. The claimed savings for the air sealing measure in PY3 was 55.0 MWh (10% of the total claimed kWh savings). However, it should be noted that the claimed savings reported for this measure was not correlated to the actual (or targeted) percent of CFMs reduced. Instead, the claimed savings was correlated to the homes pre-retrofit leakage condition. The tracking database indicates three groups of values when annual kWh savings for the air sealing measure is divided by the total home square footage. It is assumed that the 3 values correlate to how leaky the home was prior to participation as shown in the table below. The average actual percent of CFM reduced was 24%, with the lowest percent reduced being 2% and the highest percent reduced being 68%.

**Table 6-7. Retrofit Pilot - Home Leakage**

Leakage Type	Leakage Description	Approximate Annual kWh per Total Home Square Foot	Percent of Participant Population
1	Not very leaky	~0.027	1%
2	Moderately leaky	~0.038	26%
3	Very leaky	~0.047	72%

The audit samples also show that this calculation is based on the therm savings for this measure multiplied by 0.885 to get the air handler fan kWh savings. No air conditioner cooling load savings is applied to the ex-ante measure kWh savings.

To evaluate the validity of the claimed savings values, three models were run. The first model was run using *SitePro* software. *SitePro* is an Itron-developed building prototype, load shape and measure analysis tool. *SitePro* utilizes DOE-2 building simulation models to estimate HVAC loads and energy use, and utilizes well tested algorithms for estimating non-HVAC energy use. The second model was run using a model developed by LBNL and DOE called

Home Energy Saver (found at <http://hes.lbl.gov/consumer/>). The third model was calculated using the formula for air sealing from Texas' Technical Resource Manual (TRM).

All of the models were first run assuming that the type of air conditioner present in the home was a central air conditioning unit. However, the participant survey found that not all of the program participants had central air conditioning. The survey found that 89 percent of PY3 air sealing participants had central air conditioning, 10 percent had room air conditioners, and 1 percent had no air conditioning. Adjustments were made to each of the models to account for different types of air conditioning found in the participant sample.

**Model 1: *SitePro*.** The table below specifies the inputs to the *SitePro* model. Most of these inputs are taken from the Residential Central Industrial CAC/Gas Heating prototype model built into *SitePro*. The inputs that were adjusted from the prototype are indicated by an asterisk (\*), the input that was modeled for air sealing is indicated by a double asterisk (\*\*), and the input that was modeled for attic insulation measures is indicated by a triple asterisk (\*\*\*)

**Table 6-8. Retrofit Pilot - SitePro Model Inputs**

Input	Value
Climate Zone	Residential Central Industrial
Weather Data*	Chicago, IL TMY
HVAC System	CAC/Gas Heating
Home Square Feet	2,391
# of Floors	2.1559
# of People in House by Age Group (0-5, 6-18, 19-24, 25-35, 36-55, 55+, Total)	0.2295, 0.5425, 0.1554, 0.4045, 0.8652, 0.5882, 2.7854
% of Foundation -- Slab/Crawl/Basement	15.92%/10.89%/76.93%
% of Roof -- Flat/Attic/No Roof	5%/95%/0%
Ceiling R-value***	17.98293 (Modeled for Attic Insulation Measures)
Wall R-value	8.616
Floor R-value	1.847222
Basement R-value	10
Heating Efficiency	79.0155 AFUE
Cooling Efficiency*	11 SEER
% of Window Area	0.1534
Air Changes per Hour (ACH)**	Modeled (prototype value=0.54)
Aspect	1.3
Wall Type	1
Window U-Value	0.474
Window SC	0.58
# with Electric Heat/Gas Heat/Other Heat*	0/1/0
# of Water Heaters -- Electric/Gas/Other*	0/1/0
# of Refrigerator1 -- Side-by-side FF/Top Mount FF/Top Mount Manual	0.2696/0.6237/0.1067
# of Refrigerator2 -- Frost Free/Manual Defrost	0.1521/0.09
# of Freezer -- Upright FF/Upright Manual/Chest	0.062/0.1401/0.2484
# of Clothes Dryers -- Electric/Gas/Other	0.4685/0.4747/0
# of Cooking -- Electric/Gas/Other	0.4723/0.5277/0
# Other Appliances -- Clothes Washer/Dishwasher/Microwave/Color TV/Pool/Spa	0.9433/0.7288/0.8942/2.4192/0.0382/0.0508

The impact is modeled in *SitePro* by first running a simulation using the prototype characteristics and then rerunning the simulation with a retrofit air changes per hour (ACH) and holding all other parameters fixed. These simulations produce estimates of the total annual whole building energy usage for both the prototype home and air sealing retrofit home conditions. The difference between these two simulations is the impact of the program measure.

The *SitePro* model resulted in a negative total kWh impact. A 25% reduction in air changes per hour (ACH) produced a -0.009 kWh annual savings per home square foot. More specifically, this model shows no fan savings for the heating component of the HVAC system and added AC usage due to the decreased ability of the home to release its hot air. The total program annual kWh savings for this measure as calculated by *SitePro* is -12.4 MWh (or -23% of the claimed kWh savings).

**Model 2: Home Energy Saver (HES).** The second model run used the Home Energy Saver (HES) program. The table below specifies the inputs to the HES model. Most of these inputs are taken from the prototype model built into HES. The adjusted inputs are indicated by an asterisk (\*).

**Table 6-9. Retrofit Pilot - Home Energy Saver Model Inputs**

Input	Value
Zip Code	60302
Year House was Built	1964
People Living in the House by Age (0-5, 6-13, 14-64, 65+)	0, 1, 2, 0
Stories Above Ground Level	1
Heated or Cooled Floor Area	1800
Type of Foundation	Conditioned Basement
Foundation or Floor Insulation	No/Don't Know
Ceiling Insulation Level	R-11 (4-6 inches)
Roof Insulation Level	R-0
Attic or Ceiling Type	Unconditioned Attic
Wall Insulation	No/Don't know
Weather-Stripping or Caulking to Prevent Air Leakage	No
Windows	Double Pane, Clear, Wood or Vinyl - 216 sqft
Clothes Washer	Yes
# of Refrigerators	1
Water Heater	Unknown Age, 40 gallons, Natural Gas
Heating Equipment	Unknown Age, Central Gas Furnace
Cooling Equipment	Unknown Age, Central Air Conditioner
Duct Location*	Unknown
Ducts Insulated*	No/Don't know
Boiler Pipe Insulation	No/Don't Know

The impact is modeled in HES by running a simulation using the prototype characteristics and then selecting the air sealing measure upgrade in the recommendation section of the HES program. The HES program then provides an estimate of the savings expected from installing the air sealing measure in the modeled home.

This model calculated a 0.016 kWh annual kWh savings per home square foot for a 25% reduction in the blower door CFM. The total annual program savings for this measure as calculated by HES is 21.6 MWh (or 39% of the claimed savings).

**Model 3: Based on Texas TRM.** The final model was based on the deemed values from the Texas TRM, adjusted for weather differences. This model calculated a 0.013 kWh annual savings per home square foot for the air sealing measure and a kW demand savings of 0.00001 per home square foot. This results in a total annual program savings of 17.8 MWh (or 32% of the claimed savings).

**Results.** The results of the three models are shown in Table 6-10 below. The *SitePro* model is the most detailed model that was run as is shown by the number and value of the inputs in Table 6-8. By comparison the HES model had fewer inputs and more unknown values as shown in Table 6-9. The TRM from Texas was modified to better reflect ComEd’s climate, but was originally designed for a very different climate and adjustments are not able to fully compensate for this mis-matching. If all three models were reasonably consistent, we would recommend SitePro, since it is the most detailed and relevant model. However, the SitePro model results showed a small negative savings for the air sealing measure, contradicting the assertion by Energy Star, the Midwest Energy Efficiency Alliance and the U.S. Department of Energy that air sealing saves energy over both heating and cooling seasons<sup>12</sup>. It is perhaps somewhat interesting that Illinois state sponsored energy efficiency information promotes air sealing in the heating season, while tips for the cooling season do not include air sealing, only insulation<sup>13</sup>. If the two building simulation modeling tools had been consistent, the evaluation team would recommend the more detailed and customized modeling done with SitePro tool be selected as the best estimate. However, in this case, the results diverge and there is not a sufficient preponderance of evidence to conclude that air sealing results in negative energy savings. Thus, the HES model results were selected as the preferred estimate, as they are consistent with positive energy savings and better customized to Illinois than the adjusted Texas TRM.

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<sup>12</sup> <http://www.mwalliance.org/resources/efficiency-tips>.  
[http://www.energystar.gov/ia/new\\_homes/features/AirSealing\\_062906.pdf](http://www.energystar.gov/ia/new_homes/features/AirSealing_062906.pdf)  
<http://www.ornl.gov/sci/roofs+walls/insulation/fact%20sheets/Air%20sealing%20technology%20fact.pdf>

<sup>13</sup> <http://www2.illinois.gov/keepwarm/documents/airsealing.pdf>,  
<http://www2.illinois.gov/KeepCool/Documents/sumguide.pdf>

**Table 6-10. Retrofit Pilot - Final Air Sealing Model Results Comparison**

Model Used	Annual kWh per Home	Model Results in Annual MWh	Percent of Claimed Savings	Model Recommended
SitePro	-30.8	-12.4	-23%	No
<b>Home Energy Saver (HES)</b>	<b>53.6</b>	<b>21.6</b>	<b>39%</b>	<b>Yes</b>
Texas TRM	44.2	17.8	32%	No
Claimed Savings	136.5	55	100%	

### Attic Insulation

In PY3, 337 participants installed a total of 346,291 square feet of attic insulation through the program. The claimed savings for the attic insulation measure in PY3 was 50.4 MWh (9% of the total claimed kWh savings). Notes that accompanied the tracking database stated that, “The attic insulation goal was to bring it up to an R-38. If the pre R-value was over 30, no attic insulation should have been added; however, if air sealing was required, the existing attic insulation would require touch-up (i.e., additional insulation)”. Nineteen of the 377 participants had pre-retrofit R-values greater than R-30 in the tracking database. These participants received no evaluation annual kWh savings. For all other participants the post-insulation R-value used was assumed to be R-38, since the tracking database did not contain post-insulation R-values.

To evaluate the validity of the claimed savings values three models were run. The first model was run using *SitePro* software. *SitePro* is an Itron-developed building prototype, load shape and measure analysis tool. *SitePro* utilizes DOE-2 building simulation model to estimate HVAC loads and energy use, and utilizes well tested algorithms for estimating non-HVAC energy use. The second model was run using a model developed by LBNL and DOE called Home Energy Saver (found at <http://hes.lbl.gov/consumer/>). The third model was calculated using the formula for attic/roof/ceiling insulation (retrofit) from Ohio’s Technical Resource Manual (TRM).

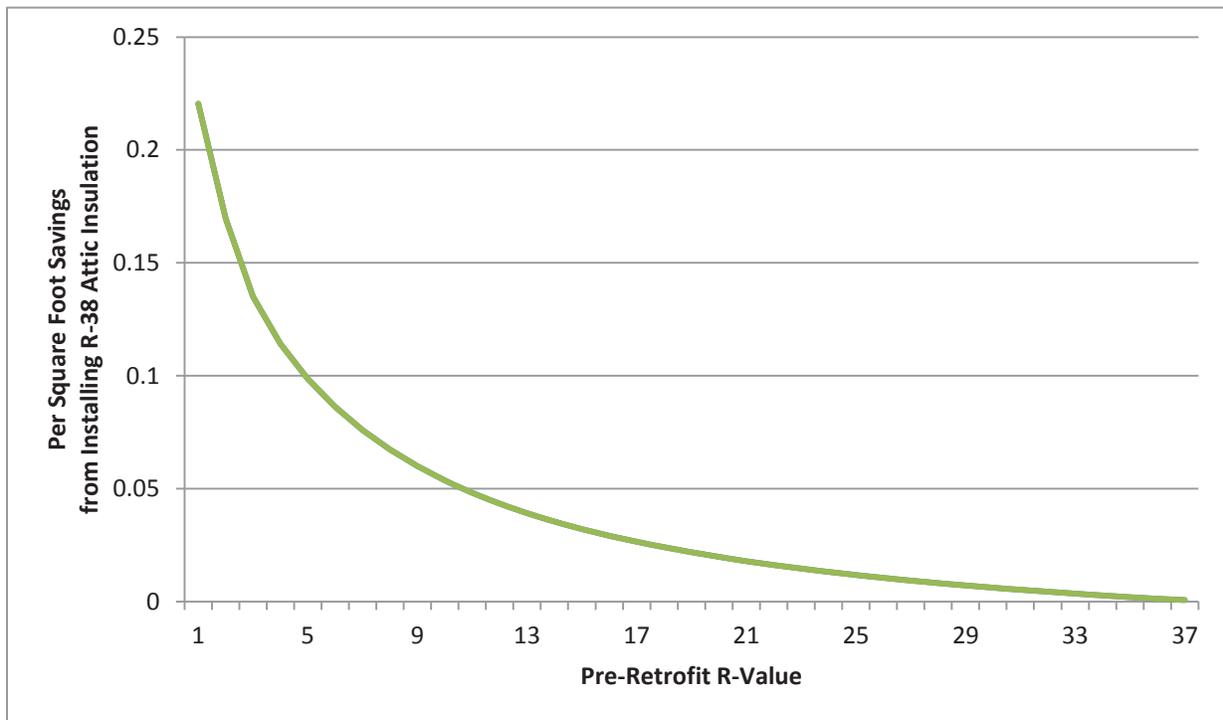
All of the models were first run assuming that the type of air conditioner present in the home was a central air conditioning unit. However, the participant survey found that not all of the program participants had a central air conditioning. The survey found that 91 percent of PY3 attic insulation participants had central air conditioning, 7 percent had room air conditioners, and 2 percent had no air conditioning. Adjustments were made to each of the models to account for different types of air conditioning found in the sample.

**Model 1: *SitePro*.** The *SitePro* model was used to calculate a per attic square foot kWh savings based on the pre-retrofit R-value recorded in the tracking data and a post-retrofit R-value of R-38. The impact is modeled in *SitePro* by first running a simulation using the prototype

characteristics and then rerunning the simulation adjusting the Attic Insulation R-Value to R-38 and holding all other parameters fixed. These simulations produce estimates of the total annual whole building energy usage for both the prototype home with a range of pre-retrofit R-values and attic insulation post-retrofit R-38 home conditions. The difference between these two simulations is the impact of the program measure.

As shown in Figure 6-1 below, the per attic square foot kWh savings ranged from 0 to 0.22 depending on how much insulation was present before participation in the program. Note that this model assumes the home has central air conditioning. After adjusting the results for type of air conditioning, the total annual program savings for this measure as calculated by *SitePro* is 15.7 MWh (or 31% of the claimed savings). Table 6-8 on page 87 in the air sealing section specifies the inputs to the *SitePro* model.

**Figure 6-1. Retrofit Pilot - *SitePro* Model kWh Savings per Square Foot of Attic Insulation Installed by Pre-Retrofit R-Value**



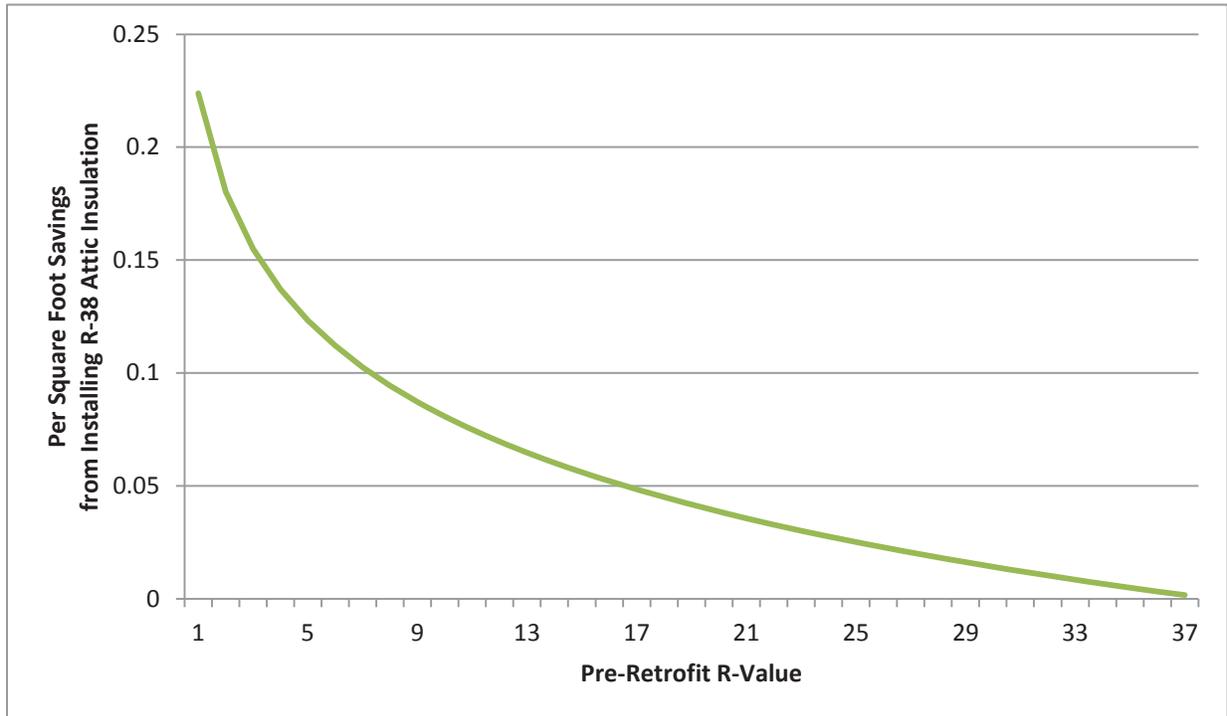
**Model 2: Home Energy Saver (HES).** The model created by using Home Energy Saver (HES) is fairly similar to the results of the *SitePro* model. Just like the *SitePro* model, this model was also used to calculate a per attic square foot kWh savings based on the pre-retrofit R-value recorded in the tracking data and a post-retrofit R-value of R-38.

The impact is modeled using HES by running a simulation using the prototype characteristics and then selecting the attic insulation measure R-38 upgrade in the recommendation section of

the HES program. The program then provides an estimate of the savings expected from installing the attic insulation measure in the modeled home.

As shown in Figure 6-2 below, the per attic square foot kWh savings ranged from 0.0 to 0.22 depending on how much insulation was present before participation in the program. Note that this model assumes the home has Central AC. After adjusting the results for type of AC, the total annual program savings for this measure as calculated by HES is 22.0 MWh (or 44% of the claimed savings). Table 6-9 on page 89 in the air sealing section specifies the inputs to the HES model.

**Figure 6-2. Retrofit Pilot - Home Energy Saver Model kWh Savings per Square Foot of Attic Insulation Installed by Pre-Retrofit R-Value**



**Model 3: Based on Ohio TRM.** The last model uses the following formula from Ohio’s attic/roof/ceiling TRM:

$$kWh\ Savings = ((1/R_{exist} - 1/R_{new}) * CDH * DUA * Area) / 1000 / \eta_{Cool}$$

$$kW\ Savings = \Delta kWh / FLH_{cool} * 0.5$$

Where:

Rexist = existing effective whole-assembly thermal resistance value (from tracking data)

Rnew = new total effective whole-assembly thermal resistance value (from tracking data)

CDH = Cooling Degree Hours (7,368 CDH at Chicago Midway base temp 75°F  
<http://www.degreedays.net/>)

DUA = Discretionary Use Adjustment to account for the fact that people do not always operate their air conditioning system when the outside temperature is greater than 75°F (the TRM uses 0.75)

Area = Square footage of insulation area (from tracking data)

$\eta_{\text{Cool}}$  = Efficiency of air conditioning equipment (11 SEER)

FLHcool = Full load cooling hours<sup>14</sup>

Using this formula and adjusting for type of AC, the total program annual kWh savings for this measure is 14.3 MWh (or 28% of the annual claimed kWh savings).

**Results.** The results of the three models are shown in Table 6-11 below. The *SitePro* model is the most detailed model that was run as is shown by the number and value of the inputs in Table 6-8. By comparison the HES model had fewer inputs and more unknown values as shown in Table 6-9. And although the TRM from Ohio was modified to adjust for ComEd's climate, it was not specifically created for ComEd's climate and is less reliable than the other models. Of the three models run, the *SitePro* model was selected because this model is the most detailed and closest to the average result of the three models. The three models run indicate that the claimed savings is between 28% and 44% of claimed savings.

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<sup>14</sup> Based on Full Load Hour assumptions taken from the ENERGY STAR calculator ([http://www.energystar.gov/ia/business/bulk\\_purchasing/bpsavings\\_calc/Calc\\_CAC.xls](http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls)) and reduced by 33% due to assumption that the average air conditioning is oversized by 50% (Neme, Proctor, Nadal, 1999; "National Energy Savings Potential From Addressing Residential HVAC Installation Problems"). Note this approach results in full load hour estimates within 10% of measured estimates from the Energy Center of Wisconsin, May 2008 study; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research."

**Table 6-11. Retrofit Pilot - Final Attic Insulation Model Results Comparison**

Model Used	Annual kWh per Home	Model Results in Annual MWh	Percent of Claimed Savings	Model Recommended
<b>SitePro</b>	<b>46.6</b>	<b>15.7</b>	<b>31%</b>	<b>Yes</b>
Home Energy Saver (HES)	65.3	22	44%	No
Ohio’s attic/roof/ceiling TRM	42.4	14.3	28%	No
Claimed Savings	149.6	50.4	100%	

**Floored Attic Insulation**

In PY3, 133 participants installed a total of 46,896 square feet of floored attic insulation through the program. Floored attic was separated from the attic insulation measure in the tracking database. The floored attic measure was installed when the attic had a floor. The claimed savings for the attic insulation measure in PY3 was 18.3 MWh (3.3% of the total claimed kWh savings). The program notes that accompanied the tracking database state that, “The attic insulation goal was to bring it up to an R-38”. The tracking database did not contain any information on pre- or post-insulation R-values. A few simulations were run using *SitePro* to demonstrate the range of annual kWh savings that could possibly be achieved by this measure.

The impact is modeled in *SitePro* by first running a simulation using the prototype characteristics and then rerunning the simulation adjusting the Attic Insulation R-Value to R-38 and holding all other parameters fixed. These simulations produce estimates of the total annual whole building energy usage for both the prototype home and attic insulation retrofit home conditions. The difference between these two simulations is the impact of the program measure.

The first simulation assumed everyone had a pre-insulation R-value of 1.5 and a post-insulation R-value of 38. This simulation resulted in 7,900 annual kWh savings (or 43% of the claimed annual kWh savings for this measure).

The pre-retrofit R-Value was not available for floored attic insulation measure recipients. In lieu of this information, the second simulation used the pre-insulation R-value from the attic insulation measure (as opposed to the floored attic insulation measure). A post-insulation R-value of 38 was assumed, consistent with program standards. This simulation resulted in 4,471 annual kWh savings (or 24% of the claimed annual kWh savings for this measure).

All of the models were first run assuming that the type of air conditioner present in the home was a central air conditioning unit. However, the participant survey found that not all of the program participants had a central air conditioning. The survey found that 88 percent of PY3

floored attic insulation participants have central air conditioning and 12 percent have room air conditioners. Adjustments were made to each of the models to account for different types of air conditioning found in the sample.

**Results.** The results of the two models are shown in Table 6-12 below. The *SitePro* model was selected for the attic insulation measure as shown in Table 6-11. However, the pre-retrofit R-value for floored attic insulation was not included in the tracking database so this value had to be estimated. Of the two models run, the model assuming that the pre-retrofit insulation R-value was 1.5 was selected because there was insufficient evidence the pre-retrofit insulation level was higher. With no evidence regarding the levels of pre-existing insulation, the evaluation team recommends what is essentially the 'known' required adjustment. Please note that it is not unlikely that the true distribution of pre-existing insulation reflects higher pre-existing R-Values and lower impact. Simulation 2 reflects one possibility of how the results may be sensitive to differences in pre-existing R-value distributions.

**Table 6-12. Retrofit Pilot - Final Floored Attic Insulation Model Results Comparison**

Model Used	Annual kWh per Home	Model Results in Annual MWh	Percent of Claimed Savings	Model Recommended
<i>SitePro</i> Simulation 1 – Pre-Insulation R-value=1.5	59.4	7.9	43%	Yes
<i>SitePro</i> Simulation 2 – Pre-Insulation R-value=Variable	33.8	4.5	24%	No
Claimed Savings	137.6	18.3	100%	

**Interactive Effects**

The attic and air sealing measures were modeled to assess the interactive effects of installing both measures. The models indicated little to no interactive effect, and therefore no adjustment was made for this. It is unclear if interactive effects were accounted for as part of the claimed savings values for each of the measures. If interactive effects were not included, it is recommended that the duct measures be evaluated for their interaction with the insulation measures.

**6.1.6 Retrofit Pilot Program Gross Impact Results**

**Overall Ex-Post Gross Impact Summary**

Table 6-13 below summarizes the PY3 ex-post gross impact for the Retrofit Pilot Program. The overall gross impact realization rate is 79 percent for energy. The 90 percent realization rate for

CFL energy impact is driven largely by the verified quantity and removed measures. The CFL measure makes up 82 percent of the ex-post gross kWh impact, and 30 percent of the ex-post gross kW impact. Among the weatherization measures, air sealing and attic insulation make the largest contribution to both energy and demand impacts, with 5 and 4 percent of program total kWh and 20 and 14 percent of program total kW, respectively.

For the insulation measures, the kW impact was calculated as explained in model 3 of the Attic Insulation model (see page 93). For the air sealing measure, the kW impact was calculated as the average ratio of kW impact per CFM reduction to kWh impact per CFM reduction as reported in the Texas TRM.

**Table 6-13. Retrofit Pilot - Ex-Post Gross Impact Summary**

Program Measure	Ex-Post MWh	Percent of Total Ex-Post kWh	Ex-Post kW*	Percent of Total Ex-Post kW
CFL	362.1	82%	36.7	30%
<b>Total Direct Install</b>	90%		106%	
<i>Direct Install Gross Impact Realization Rate</i>				
Air Sealing	21.6	5%	24.5	20%
Attic Insulation	15.7	4%	17.3	14%
Floored Attic Insulation	7.9	2%	8.7	7%
Exterior Wall Insulation	10.4	2%	11.4	9%
Sloped Insulation	3.2	1%	3.5	3%
Knee Wall Insulation	4.7	1%	5.1	4%
Crawl Space Insulation	1.9	0%	2.1	2%
Duct Insulation	5.2	1%	5.7	5%
Rim Joist Insulation	5.8	1%	6.4	5%
Seal and Repair Ducts	0.7	0%	0.8	1%
<b>Total Program</b>	439.2	100%	122.2	100%
<i>Gross Impact Realization Rate</i>	79%		-	

\*CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post.

### 6.1.7 Retrofit Pilot Program Net Impact Results

This section summarizes the PY3 net-to-gross ratio estimation approach and results for the Retrofit Pilot Program.

#### Free Ridership

The objective of the free ridership assessment is to estimate the impact of program incented measures that would have been installed even in the absence of the program. This cannot be measured directly due to the hypothetical nature of the counter-factual situation. Thus, free ridership is assessed as a probability score for each measure. The evaluation relies on self-reported data collected during participant telephone surveys to assign free ridership probability scores to each measure. Details on the free ridership telephone survey battery and scoring methods are presented within the Net Program Impact Evaluation Methods section (on page 29). Application of this algorithm results in the measure and program free ridership estimates is shown in Table 6-14. The CFL free ridership is higher than for the other measures, at 34%, but lower than the ComEd midstream lighting program CFL free ridership (41%). The proactive delivery of a direct install program helps temper free ridership. At the same time there are market trends and forces increasing free ridership for CFLs, including the Midstream Lighting Program, which increases awareness and acceptance of CFLs, increasing the propensity of residential customers to select CFLs over incandescent bulbs.

**Table 6-14. Retrofit Pilot - Free Ridership Results by Measure**

Measure	Free Ridership
Compact Fluorescent Bulbs	34%
Air Sealing	8%
Attic Insulation	9%
Floored Attic Insulation	9%
Exterior Wall Insulation	11%
Sloped Insulation	11%
Knee Wall Insulation	11%
Crawl Space Insulation	11%
Duct Insulation	8%
Rim Joist Insulation	11%
Seal and Repair Ducts	-
Overall	27%

## Spillover

The objective of the spillover assessment is to estimate the impact arising from efficient measures installed as a result of the program that were not incented by the program. The evaluation relies on self-reported data collected during the telephone survey to identify these measures and assess the role of the program in the decision to install. Details on the spillover telephone survey battery and the spillover calculation are presented within the Net Program Impact Evaluation Methods section (on page 31). Spillover estimates, using this approach and expressed as a percent of measure ex-ante impact are shown in Table 6-15 below.

**Table 6-15. Retrofit Pilot - Spillover Results by Measure**

Measure	Percent of Participants Reporting Spillover Adoption	Mean Spillover Quantity per Adoption	Spillover Adjustment
Compact Fluorescent Bulbs	9%	4.8 bulbs	2.5%*
Weatherization Measures	7%	various	7%
Overall	-	-	3.75%

*\*Calculated as  $(0.09 * 4.8 * 1,125 / 9,286) * 0.5$ , where 1,125 is the number of participants receiving CFLs, 9,286 is total number of program bulbs, and 0.5 is the reduction to avoid double counting with the midstream lighting program.*

Table 6-16 below integrates both net-to-gross (NTG) analysis results and ex-post gross impact results to form final program impact estimates for PY3. See the Net-to-Gross Ratio (NTG) section for details on the NTG formula (on page 32).

The gross impact realization rates reflect the combined effect of measure removals and non-program qualifying installs. The combined effect of the gross impact realization rates and the net-to-gross ratios on CFL impact is a reduction of 39 percent in kWh and 28 percent in kW. As discussed above, program activities also impacted energy consumption through water heater measures. All told, the program net impact for PY3 is 338 MWh and 111.4 kW.

**Table 6-16. Retrofit Pilot - Ex-Post Gross and Net Impact Summary**

Measure	Gross Impact RR <sup>^</sup>	Ex-Post Gross MWh	Ex-Post Gross kW	NTG Ratio	Ex-Post Net MWh	Ex-Post Net kW
CFL	90%/106%*	362.1	36.7	68%	246.4	25.0
<i>Total Direct Install as Percent of Total Ex-Ante</i>	-	65%	106%	-	44%	72%
<b>Weatherization Measures</b>						
Air Sealing	39%	21.6	24.5	99%	21.3	24.5
Attic Insulation	31%	15.7	17.3	98%	15.4	17.3
Floored Attic Insulation	43%	7.9	8.7	98%	7.7	8.7
Exterior Wall Insulation	100%	10.4	11.4	96%	10.0	11.4
Sloped Insulation	100%	3.2	3.5	96%	3.1	3.5
Knee Wall Insulation	100%	4.7	5.1	96%	4.5	5.1
Crawl Space Insulation	100%	1.9	2.1	96%	1.9	2.1
Duct Insulation	100%	5.2	5.7	99%	5.1	5.7
Rim Joist Insulation	100%	5.8	6.4	96%	5.6	6.4
Seal and Repair Ducts	100%	0.7	0.8	93%	0.6	0.8
<b>Total Weatherization Measures</b>	50%	77.1	85.5	98%	75.3	85.5
<i>Total Weatherization as Percent of Total Ex-Ante</i>	-	14%	-	-	14%	-
<b>Other Program Impact</b>						
Kitchen Aerator	-	2.7	0.2	-	2.5	0.2
Faucet Aerator	-	4.5	0.3	-	4.3	0.3
Low-Flow Showerhead	-	10.5	0.5	-	9.8	0.4
<b>Total Other</b>	-	17.7	1.0	-	16.6	0.9
<i>Total Other as Percent of Total Ex-Ante</i>	-	3%	-	-	3%	-
<b>Total Program Impact</b>						
<b>Total</b>	82%	457.0	123.2	74%	338.3	111.4
<i>Total as Percent of Ex-Ante</i>	-	82%	-	-	61%	-

\* CFL coincidence factor is 0.081 for ex-ante and 0.095 for ex-post. The coincident factor adjustment to the gross impact realization rate applies only to kW, not kWh. Realization rates reflect the ratio of ex-post to ex-ante impact, where ex-ante reflects assumed attrition rate of 3% for CFLs.

## 6.2 *Retrofit Pilot Program Process Results*

### **Process Themes**

The Retrofit Pilot program presented an opportunity for ComEd to reach gas customers in its service territory; increase awareness of ComEd programs generally; and gain information on existing homes in that territory for future program design and implementation.

Overall, the Retrofit Pilot program had mixed success in PY3. Although the program did not meet its participation goals, the conversion (audit to retrofit) rate was high and program staff learned key lessons. In PY4, ComEd will likely benefit from major program changes, many of which program staff are already planning to implement. In this section, we discuss the PY3 implementation of the Retrofit program focusing on 1) ways that the program might benefit in PY4 from changes in the current implementation design, and 2) determining how well the program design and activities supported the installation of program CFLs in participant homes. We base our findings on interviews with the ComEd program manager, WECC program staff for Nicor, and telephone survey data of 120 participants.

### **Program Implementation and Tracking Processes**

In PY3, the program initially targeted older, high gas-using houses in three communities: Des Plaines, Elmhurst, and Oak Park. Program staff believed these homes offered the best potential for meeting goals while being geographically close enough together to keep auditor travel cost-effective. Further, by focusing on a few specific areas, program staff hoped to keep the program from becoming oversubscribed. However, the program later expanded its geographical focus to try to meet goals. Throughout PY3, there were several design and implementation issues. We discuss them and the program's plans for improvement here.

### **Scheduling**

For participants, there appeared to be two main issues with PY3 implementation: scheduling and knowing where they were in the program process. Program staff explained that for some participants, taking a day off from the work week was difficult. Additionally, as many as four days could be required to fully participate in the program: one for the initial audit; another for any necessary safety repairs (i.e., combustion, exposed wiring, etc.); another for the retrofits; and a final one for an inspection. As program staff explained, although one auditor was available for Saturday appointments, this might sometimes result in the participant being "waitlisted."

*"There are some customers that specify a Saturday, and we only have typically one auditor on each Saturday, and they like to stay in a certain area. You can't have an auditor running from one side of Illinois to the other side of Illinois. So those people will end up getting wait listed..." - Program Staff*

Findings from participant interviews presented below (see Table 6-23) also provide some evidence that scheduling was an issue that contributed to lower participant satisfaction. Although program staff acknowledged that scheduling was an issue, they did not provide solutions for it at the time of the interviews.

## Next Steps

Following the audit, some participants were unsure about where they stood in the program process and how to continue to the next steps. Program staff stated that, even though auditors explained next steps to participants during the home audit, the two to two and half hour audit process sometimes produced so much new information that it could confuse participants about how to proceed. This could be exacerbated by having to take care of safety repairs before the retrofits could begin. Participants' suggestions for improvement through our survey effort also reflected their frustration with lack of program follow-through (see Table 6-23). Program staff are aware that a sheet listing "next steps" could help alleviate this issue:

*"(The next steps were) explained to them (by the auditor), but three months down the road after they fix something they're not going to remember that. So I think (it) would be helpful to have (a) 'next steps' sheet." - Program Staff*

## Education

ComEd took advantage of the site audits to deliver ComEd-branded leave-behind materials to participants. The materials included:

- Buckslip (a small direct mail insert approximately the size of a dollar bill) for the appliance recycling program
- Brochure explaining the benefits of CFLs, ways to receive more, and how to recycle them
- Tri-fold Smart Ideas for Your Home (SIFYH) brochure
- Energy usage guide
- DOE booklet
- Refrigerator clip magnet with ComEd's logo and website
- Postcard reminding the customers of ComEd's involvement in the program

However, the program staff was concerned that the program did not provide participants with enough education. The current program design does not leave the auditor much time to discuss energy efficiency with participants.

*"(There is not a lot of time for) chatting to go over (energy efficiency topics) and why (the participant) would do something, and the benefits. (The audit) was more business-like. ... Some of the auditors were better than others at the actual education piece: talking to them about turning down their water heater, and some other more behavioral things, not just focusing on just what this program provides" - Program Staff*

Further, as shown in Table 6-23, a sizeable portion of participants were interested in expansion of the program to include additional measures. It is possible that other ComEd programs could meet these participants' needs but they were not made aware of them. As described in the following paragraph, the program has found a way moving forward into PY4 to free up auditor time and possibly increase participant education.

## Implementer Tool

CSG, the new PY4 implementer, is developing a web portal called Energy Measure View, which links participants with the program. Participants will complete an initial online audit of their home before the auditor arrives. This gives the program several advantages. First, it gives the auditor an overview of the energy efficiency of the site and a "head start" on the audit since the information is automatically pulled into the auditor's software modeling tool. Second, it primes participants on the topics that are pertinent to a home energy analysis, likely assisting the dialogue between auditor and homeowner and supporting a conceptual framework that may help the participant retain efficiency information.

## Streamlining Work Orders

Following home audits and any recommended retrofits, implementation staff prepared work orders for participants interested in retrofits. However, early in PY3, the administrator's modeling tool was not tailored to the Retrofit program well enough to provide a seamless transition from audit results to work order. The program staff explained that as a result, there was "more manual work (placed) on the auditors and primarily on TSI's manager." Additionally, since the audit tool was not connected to an automated data system and since local personnel resources at TSI were limited, a reporting backlog developed that the program administrator had to assist with to complete reporting and documenting activities. The program staff does not expect that either of the issues described above will persist in PY4 since 1) the program will use CSG's modeling tool; 2) the new implementer appears to have sufficient local staff; and 3) having gone through one year of piloting, the program will have *"a more formal and structured reporting process and data transfer process."*

## Emailing Participants

A final change the program manager is considering for PY4 is electronic communications, i.e., email, with participants since the program "does require a fair amount of customer interaction and potentially multiple appointments." Email could be used for appointment confirmation, for directing the participant to the Energy Measure View tool, and for viewing the proposal and next steps. The program manager noted that the email would not be the exclusive communication method used; instead it would bolster telephone and paper communications:

*When the customer receives the message in a couple of different ways, it's more likely that the information will be better understood. - Program Manager*

Even though the program did not meet its goals for the number of homes it assessed in PY3, it achieved its targeted conversion rate of 30%. This suggests that the program's communication with participants around the retrofit recommendations and the ways for implementing them is effective.

## **Marketing Channels**

PY3 marketing and outreach efforts were paid for and led by Nicor, while ComEd played only a limited role. As the program manager explained,

*"We didn't (have) more involvement in the PY3 ... marketing (because) we were still trying to feel out ... how much of an uptick ComEd could really get on the electrical saving side. This is definitely a gas driven program and we were approaching it a little bit conservatively just to make sure we had a cost effective program...And since Nicor was going to be doing this program anyhow, we thought initially a good way to approach it would be for them to continue with their marketing efforts. Since we were not helping to pay for the marketing piece of it in PY3, we obviously didn't then joint brand (materials)." - Program Manager*

Throughout PY3, there were several issues with the program's marketing and outreach, which consisted mainly of mailers and a few community events. We discuss them and the program's plans for improvement here.

## **Over-Enrollment Concern**

Program staff explained that another possible reason the program did not reach its goals was that they wanted to err on the side of not over enrolling the program. Program staff focused on outreach to households that had high potential for energy savings through program activities, while avoiding over enrolling the program and not being able to meet high customer demand. The program manager explained that staff wanted to keep the program cost-effective and keep participant satisfaction high:

*"We were concerned with a negative impact if there was a great interest and then not having customers being able to participate because of over enrollment. So we definitely spent PY3 trying to figure out that balance of getting all the homes to participate that we could afford to participate... without getting that over enrollment. And now (with hindsight) we realize we definitely fell on more the conservative side (in PY3). (Now, in PY4, we) feel like we can safely promote it more openly and see how far we can go in that direction."- Program Manager*

Concerned about over enrollment, program staff kept marketing efforts relatively limited. For example, the program was not listed on ComEd websites.

## Mailer Timing

Mailings consisted of an introductory post card, and second or third follow-up letters primarily to the three communities previously listed. The mailings focused on providing potential participants with a \$50 “top to bottom energy analysis,” “free upgrades,” i.e., direct install measures, and funding for recommended retrofits identified by the audit. Although the mailers supported the program’s marketing efforts, the timing of the mailers did not. Program manager explained that the timing of the mailers was poor because targeted ComEd customers started receiving these mailings referencing “heat loss” and “chills” during the summer months when customers were likely not feeling chilly.

*“(When) we rolled out too quickly in the summer, we really didn’t hit the customers when it really piques their interest.... So I think what we realized was ...a lot of the early messaging in summer fell on deaf ears.” - Program Manager*

Customer interest in the program picked up later in the fall and winter, but by that time, the program had spent a significant portion of its marketing budget on mailers. Further, the program sent follow-up mailers to areas that had already had a high response rate and were possibly over-saturated. Once the program staff understood the saturation issue, it sent out mailers in February and March to a new set of customers in other zip codes and received a good response. Program staff believe the marketing approach was one reason the program did not meet its goals.

*“I think part of (not meeting our goals) had to do with the mailing strategy; we probably should have waited and sent more mailers in the fall. We also then retargeted areas that had a high response rate...(but) I think we had already saturated those areas. So we didn’t necessarily get a huge response from resending in the fall... At the very, very end, (we) sent out to about twenty new zip codes and got another huge response....but audits were finishing. Audits had to be done by the end of April so that we still had a month to get the work done. So you only left yourself a month to pick up a number of audits...So I think we should have done that sooner.” - Program Staff*

Going forward, program staff plan to carefully consider the seasonality of the message when determining when mailers are sent out.

## Community Events

The program also did outreach at community events with mixed success. Environmentally-focused events were good venues for the program. These included the Evanston Green Living Festival and the Chicago Wilderness Congress where program staff believe attendees were predisposed to considering energy-saving measures. The number of sign-ups and the conversion rates were relatively high. Outreach at local fire department open houses was less successful. The table below summarizes these community outreach efforts.

**Table 6-17. Community Outreach Events**

Date	Event	Total Sign-Ups	Completed Audits*	Completed Audits as Percent of Sign-Ups	Completed Retrofit*	Percent Converted from Audit to Retrofit
10/2/10	Evanston Green Living Festival	46	29	63.0%	9	31.0%
10/23/10	Willowbrook FD Open House	5	3	60.0%	1	33.3%
10/30/10	Bloomingtondale FD Open House	8	1	12.5%	0	0%
11/4/10	Chicago Wilderness Congress	26	9	34.6%	0	0%
Total:		85	42	49.4%	10	23.8%

\*As of 3/5/2011

The program manager explained that the environmentally focused events appeared to be more effective than mailers in some communities.

*“(These outreach events) were effective in those communities where we found direct mail not effective at all. It was much better to reach out to (these) customers... through community events.” - Program Manager*

Since the environmentally focused events have been so successful for the program, the program staff included 12 of them in the PY4 design and scope of work with CSG.

Consistent with the program’s PY3 marketing activities, the participant survey data show that the vast majority (85%, Table 6-18) of Retrofit participants first heard about the program through direct mail indicating that this effort was effective in recruiting customers into the program.

**Table 6-18. How Retrofit Pilot Participants First Heard of the Program (Unaided)**

Outreach Method	Percent of Participants (n=118)
Brochure/Flyer through direct mail	85%
Community organization/event	3%
Customer called ComEd to ask about bill reduction	3%
Word of mouth	3%
Internet	3%
Other mass advertisement	2%
ComEd representative	<1%
Newspaper	<1%
Telephone call (not ComEd specific)	<1%
Total	100%

We followed up with those Retrofit Pilot program participants who did not identify first learning about the program through the mail to see if they nonetheless also recalled hearing about the program this way. About half stated that they had, which increases the total percentage of participants reached through the mail to 92%.

When asked how ComEd should try to reach out to their customers to encourage participation, most participants highlighted a method that includes a mail-based component (Table 6-19): 41% of participants recommended flyers/ads/mailings, and 17% recommended bill inserts. Of the various methods presented, the flyers/ads/mailings method was by far the most frequently listed as the preferred method of communication. This suggests that the program chose an effective outreach method for households who reside in older homes.

**Table 6-19. Retrofit Pilot Participant Recommended Outreach Methods**

Outreach Method	Percent of Participants* (n=122)
Flyers/Ads/Mailings	41%
Bill Inserts	17%
Mass media (TV radio, newspaper)	7%
Advertising (general, unspecified)	7%
Email/Internet	7%
Testimonials re: energy savings	6%
Use current outreach methods	6%
Other (i.e. word of mouth, target new construction, etc)	5%
Telephone calls	3%
Representatives	<1%

\*Multiple responses were gathered for this question, if offered.

Going forward, the program plans to expand marketing and outreach. First, all printed materials will include ComEd branding as well as Nicor branding. Second, the program will increase cross-promotional marketing. Beyond providing Retrofit participants with refrigerator recycling program information, the program will promote other ComEd programs as well. The program manager highlighted the opportunity that ComEd has due to the Retrofit program interacting directly with participants:

*“Not all of our residential programs have direct interaction with the customer.... So I think when on the residential side we have a program (such as this) that does have that direct customer interaction, it’s a great opportunity to promote our other programs that don’t have that interaction.” - Program Manager*

Finally, ComEd will promote the Retrofit Pilot program through other programs, on its website, and through educational awareness tours.

**Marketing Messaging**

We found that the outreach materials were useful to participants and well aligned with program benefits. As shown in Table 6-20, the vast majority of participants (98%) who recalled receiving direct mail materials found them “very” or “somewhat” useful in providing

information about the program, indicating that the program generally honed in on important information to include in these mailings.<sup>15</sup>

**Table 6-20. Usefulness of Program Mailings for Retrofit Pilot Participants**

Level of Usefulness	Full Participants (n=57)	Direct Install Only (n=45)	Percent of All Participants (n=102)
Very useful	82%*	53%	70%
Somewhat Useful	16%	42%	28%
Not very useful	2%	2%	2%
Not at all useful	0%	2%	1%
Total	100%	100%**	100%**

\* There is a significant difference between the Full and DI only participants with regard to who considered the mailer “Very” or “Somewhat” useful.

\*\*Due to rounding, some group values do not total 100%

The mail materials emphasized energy savings, lower energy bills, the energy audit, free direct-install measures, and rebates for recommended measures (i.e., 50% up to \$1,250 for labor and materials). The first paragraph mentioned energy savings, lower energy bills, and the energy audit, while the other key points appeared in a bulleted list. Postcards and letters provided customers with a hotline and website they could use for more information and scheduling details.

Program participants identified three main benefits to participating in the program: 1) lower energy bills; 2) saving energy/increased efficiency; and 3) having a more comfortable home. Over half (61%) said that they received a lower energy bill after participating in the program. Some participants (16%) were also concerned about increasing energy efficiency and saving energy independent of cost savings. For example, one participant listed “*making my house more energy efficient*” as the primary benefit. Some participants (16%) also mentioned having a more comfortable house as a key benefit gained from the program. According to one participant, “*Comfort in the home is the main benefit.*” Table 6-21 presents the benefits identified by participants. Two of the top three (lower energy bills and energy efficiency) are in line with the program benefits communicated in the marketing materials.

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<sup>15</sup> Please note: we call attention to any statistically significant differences between those Retrofit participants receiving only direct install measures (“DI only”) and those Retrofit participants that incorporated at least one recommended retrofit measure (“Full Participants”). Any differences that are not presented as statistically significant have not been found to be so.

**Table 6-21. Participant-Identified Retrofit Benefits (mult. response)**

Benefits	Percent of Participants (n=122)
Having a lower energy bill/saving money	61%
Saving energy/increased efficiency	16%
Having a more comfortable home	16%
Increased understanding of one’s home/energy usage	8%
Receiving the program equipment	6%
Receiving the energy survey recommendations	6%
Improvements made to equipment in home	6%
Helps the environment/other “green” rationale	5%

**Full vs. Direct Install Only Participation**

Through our survey effort, we focused on direct install only (DI only) participants to understand why they did not follow through on recommended air sealing and insulation retrofits. As shown in Table 6-22 below, the primary reason DI only participants gave was that the measures were either too expensive or not worth the cost of installation (34%). For example, one participant said, *“The payback takes too long compared to the initial cash investment.”* Another said, *“I agreed it was a good idea, but I didn’t want to spend that much money.”*

The second most commonly cited reason (11%) was that the participant intended to install the measures, but that there was no follow-through. For example, one participant said that they did not install any recommended measures *“because the company never contacted me. I had to call... they promised to send something else and they never did.”* Another said, *“I sent a copy of the proposal [to the contractor] but I never got anything back but a call.”* It is possible that these DI only participants would have become full participants if the contractor they were working with had been more responsive. If so, this would represent a 6% increase in full participation. Recognizing this opportunity, the program staff has planned several changes in PY4 (i.e., a “next steps” sheet; smoother conversion of audit results to a contractor work order; email communications with participants).

**Table 6-22. Reasons for Avoiding Audit Recommendations**

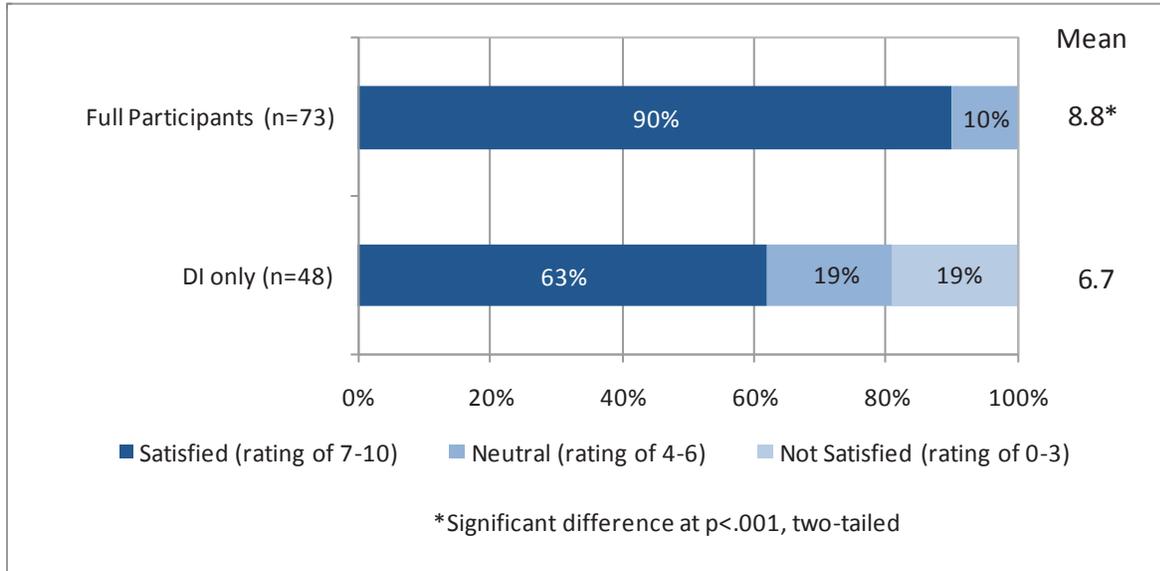
Reason for Avoiding Audit Recommendation	Percent (n=44)
Recommendations were too expensive/not worth cost	34%
Intended to but there was no follow through	11%
Didn't think it was necessary	9%
Elected to work with another contractor/program	9%
Did install recommendations	9%
Elected to do install measures myself	7%
Poorly presented proposal	7%
Already had measures installed	2%
Wanted a second opinion	2%
Other	9%
Total	100%*

\*Due to rounding, percentages do not add to 100%

### **Participant Satisfaction**

Generally, program satisfaction was high across all elements of the program, indicating that the program is generally well implemented. A large majority (79%) of participants stated that they were satisfied with the program overall, and half (52%) gave a 9 or 10 indicating that they were very satisfied with the program. Though program satisfaction was high overall, it differed significantly between Full and DI only participants. As shown in Figure 6-3, the vast majority of Full participants (90%) claimed to be satisfied with the Retrofit program, with the remaining 10% being neutral. A much smaller majority of the DI only participants (63%) were satisfied, and nearly one fifth (19%) were dissatisfied.

**Figure 6-3. Overall Retrofit Pilot Program Satisfaction**



The reasons for dissatisfaction with the Retrofit Pilot program among dissatisfied Direct Install only participants generally fell into two main categories. First, one third (33%) of these participants had issues with the auditors. Here are two examples:

*“More of a sale than an energy audit.” -DI only Participant*

*“I didn't know if it was a good price or not because it was a private company, and there was nothing saying it was directly ComEd or anything. And it wasn't even a local company, I don't think, it was someone from Ohio or Indiana.” -DI only Participant*

Second, about a quarter of the dissatisfied DI only participants (27%) had issues with scheduling contractors following the audit:

*“There's no follow through. I got some new light bulbs and nothing else. No phone call, nothing.”-DI only Participant*

*“They never showed up.” -DI only Participant*

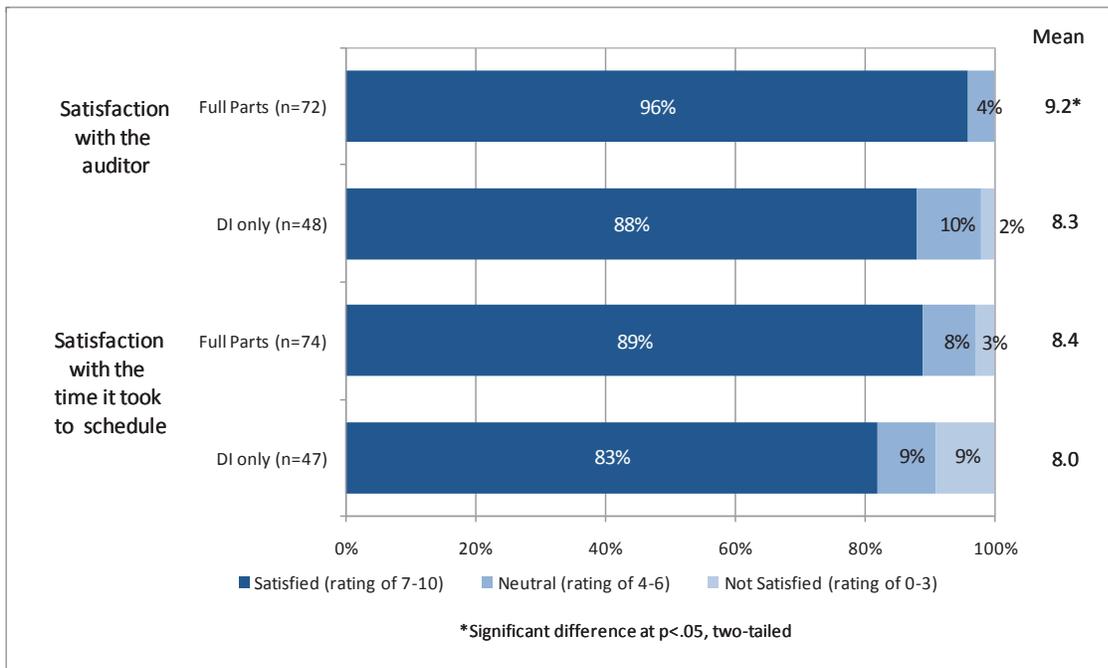
*“It was the lack of completion of the work and the scheduling of the work really.” -DI only Participant*

As shown in Figure 6-4 below, the vast majority of participants stated they were very satisfied with the energy specialist who visited their home and the time it took to schedule the visit. However, consistent with the reasons for dissatisfaction among dissatisfied DI only participants described above, the DI only participants reported a significantly lower average satisfaction rating than did the full participants (8.3 vs. 9.2). This difference becomes more apparent when

we examine the satisfaction scores for participants who gave a 9 or 10 indicating that they were very satisfied (79% of Full Participants, 56% of DI only).

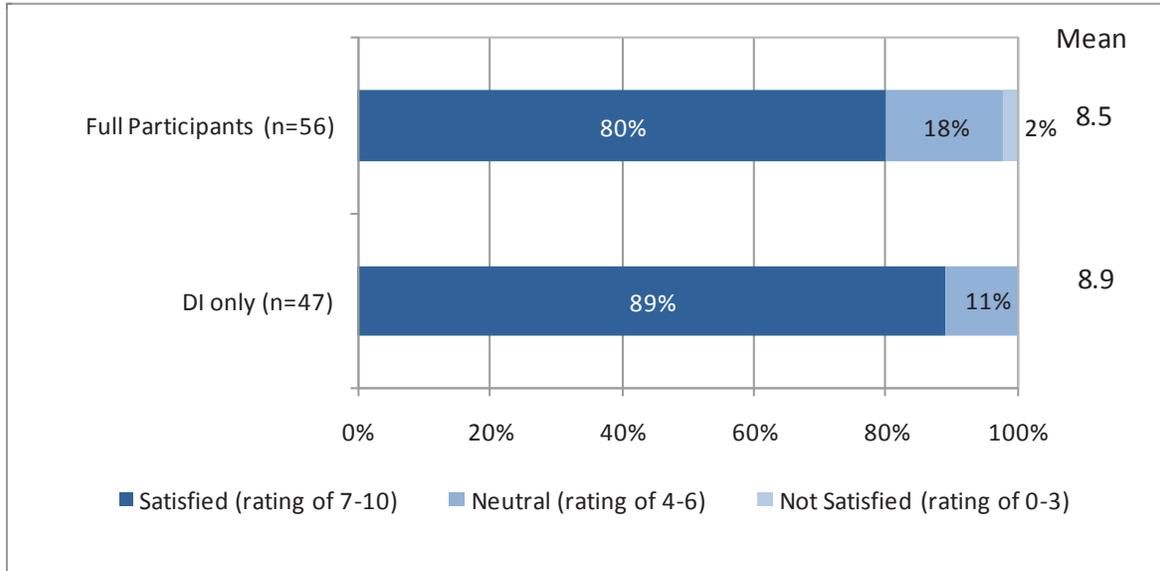
The vast majority of both groups (89% of Full participants, 83% of DI only) stated that they were satisfied with the time it took to schedule the home visit, and many (53% of Full Participants, 47% of DI only) gave a 9 or 10 indicating that they were very satisfied.

**Figure 6-4. Satisfaction with Auditor and Scheduling**



As shown in Figure 6-5 below, participant satisfaction with the CFLs was also high. The majority (80% of Full Participants, 89% of DI only) stated that they were satisfied with the CFLs, and most (68% of Full, 68% of DI only) gave a 9 or 10 indicating that they were very satisfied. This indicates that CFLs should continue to play a central role in the PY4 version of the program.

**Figure 6-5. Satisfaction with CFLs**



When we asked participants if they had any suggestions to improve the program, a moderate proportion (14%) highlighted that the program is good as-is. Though this is an indication of a well-designed and implemented program, about half of the participants did offer suggestions for improvement (Table 6-23).

The top three suggestions for program improvement were to 1) expand the program to include different measures; 2) improve follow-through; and 3) make the program recommendations more affordable. The most frequent suggestion (23%), from both Full participants (19%) and DI only participants (29%), was that the program should be expanded. For example, one participant stated: *“They could cover a wider breadth of upgrades including outdoor lighting and outlet covers.”* Others suggested upgrades including solar, duct repair, and programmable thermostats. Some also suggested expanding the program to a wider range of communities and housing types. Overall, this suggests that participants value program delivery and services. It may also represent lost opportunities for ComEd in that these participants may not have been properly referred to other relevant programs.

The second most frequently mentioned item (18%), both for Full participants (16%) and DI only (21%), was for better follow-through after the audits had been completed. For example, one participant stated: *“It would be great to get a follow up report with energy trending ... I am interested in knowing if my investment was worth it.”* Some participants found that though the energy audit resulted in suggestions for additional measures, there was no follow-up with Nicor or affiliated contractors. For example, one participant said, *“I sent a copy of the proposal but I never got anything back but a call. I told them I would like to continue but I think it was the contractor that didn’t follow*

through” and that the program could be improved by their being responsive. *“I didn’t hear from them.”*

The third suggestion for improvement across both groups (16% for Full, 18% for DI only participants), was that program recommendations should be made more affordable. For example, one participant said, “There was a lot I had to pay for out-of-pocket. It would have been nice to have more help.” Participants focused both on eliminating the \$50 charge for the audit, as well as increasing possible rebates for suggested improvements.

There was a significant difference between the Full participant and the DI only participant groups with respect to their satisfaction with the representative that visited their home (see Figure 6-5 above). The suggestions for improvement reflect this as well. Those in the DI only group were twice (18% vs. 9%) as likely to cite a need for better contractors, workers, and assessors. For example, one DI only participant said that they were dissatisfied with the contractor because *“They didn’t give us a complete analysis, they completely missed one whole room. They also told us that we had to hurry up and make a decision as they were losing their contract with Nicor.”*

**Table 6-23. Suggestions for Retrofit Pilot Program Improvement (mult. response)**

Suggestions for Improvement	Full Part (n=48)	DI only (n=44)	Total (n=92)
Expanded program (i.e. measures, geographic area, housing types, etc.)	19%	29%	23%
Better follow through	16%	21%	18%
Make program/recommendations more affordable	16%	18%	17%
Employ better contractors/workers/assessors	9%	18%	13%
More advertising and promotion	14%	3%	9%
Improved communication	7%	12%	9%
Make program faster/improve scheduling	7%	0%	4%
Make program simpler/easier (general)	0%	9%	4%
Improve quality of measures	2%	3%	3%
Other	3%	9%	5%

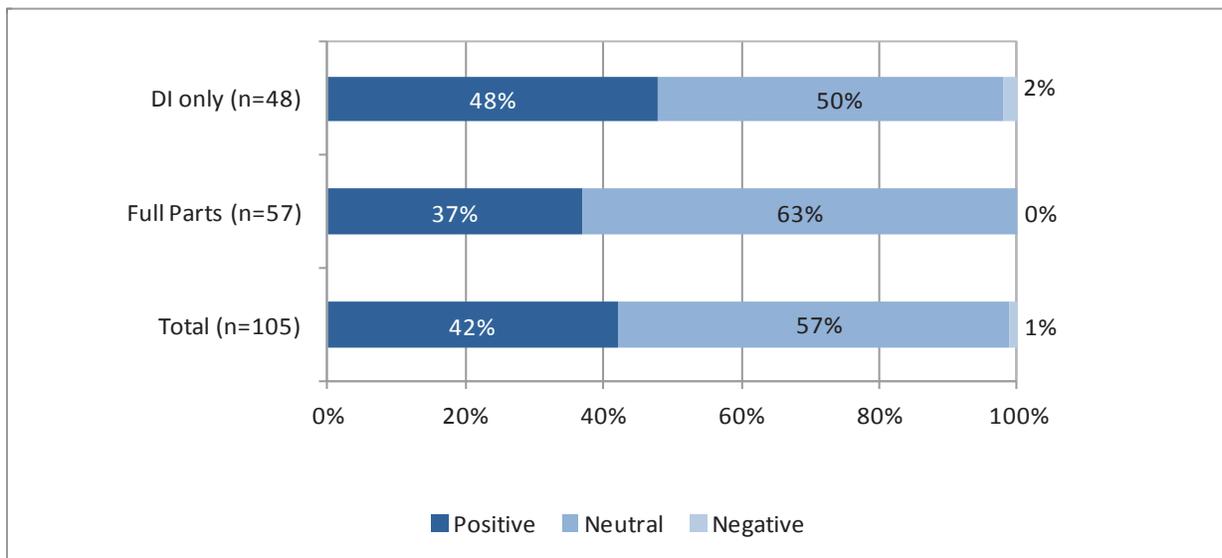
**Attitudes Towards and Acceptance of CFLs**

There was little participant resistance to the installation of CFLs. Only 12% of survey participants did not have CFLs installed during the initial audit. Of these, 80% indicated that

the reason they did not have CFLs installed was they already had as many CFLs installed as was feasible. This means that only 2% of all participants turned down the opportunity to have CFLs installed. This is consistent with program staff perceptions that there were no significant barriers to installing CFLs in participant homes.

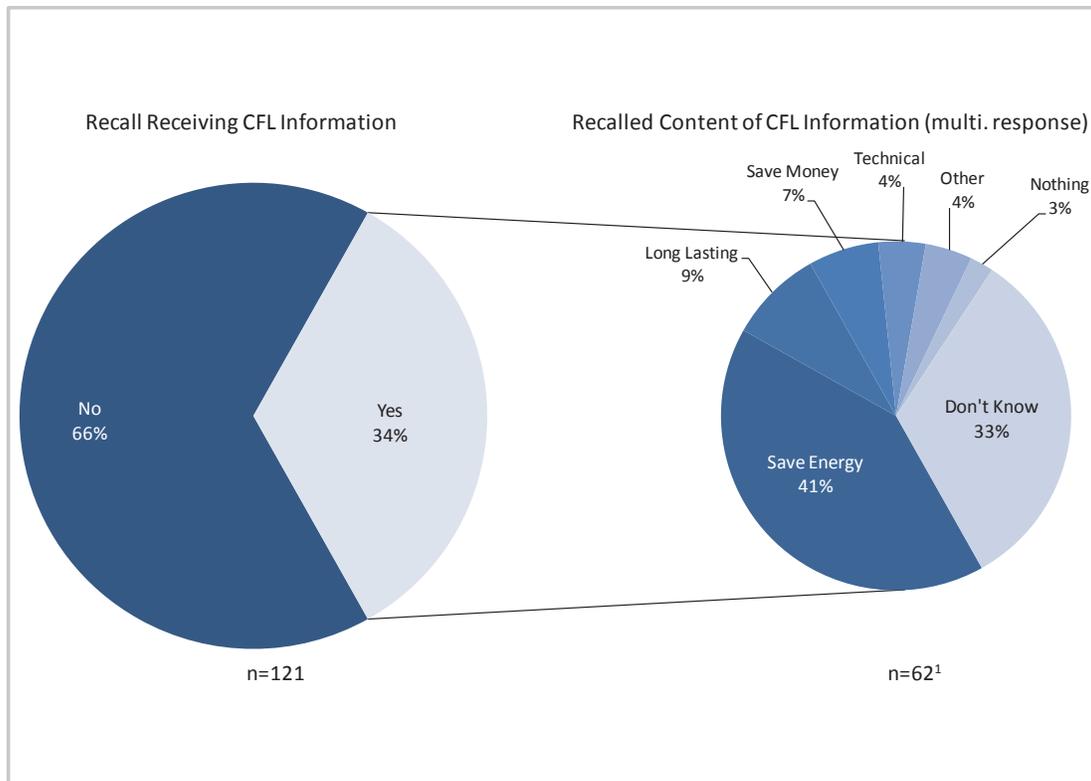
The Retrofit Pilot program had a positive influence on a large portion of participants in terms of attitudes towards CFLs. As shown in Figure 6-6, 42% reported a positive change, only 1% reported a negative change, and the rest reported no change.

**Figure 6-6. Impact on CFL Attitudes among Retrofit Pilot Participants**



A sizeable portion (34%) of respondents stated that they did remember learning more about CFLs, though most (66%) did not. As can be seen below in Figure 6-7, the information about CFLs that was most likely to be remembered by participants as having been received was that the bulbs were energy efficient (41%), though a sizeable portion (33%) could not recall the content of the information they had received. Some also remembered that CFLs are longer – lasting (9%); recalled that they allow savings on utility bills (7%); and remembered technical information about CFLs (4%).

**Figure 6-7. Retrofit Pilot Participants Recalled Receiving CFL Information**



<sup>1</sup> This n value is the number of total responses, not the number of participants.

These findings are consistent with program staff perceptions of the limited time that auditors could devote to talking about CFLs while focusing on the audit and the direct installations. On average, auditors only had time to inform the participants that the CFLs were free. Going forward, the program might instruct the auditors to refer participants to the leave-behind packet, which includes considerable information on the CFLs. Additionally; the program’s plan to include email communication could deliver CFL information to participants.

## Section 7. Cost Effectiveness Review

This section addresses the cost effectiveness of the Single Family program. Cost effectiveness is assessed through the use of the Illinois Total Resource Cost (TRC) test. The Illinois 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.<sup>16</sup>*

ComEd uses DSMore™ software for the calculation of the Illinois TRC test.<sup>17</sup> The DSMore model accepts information on program parameters such as number of participants, gross savings, free ridership, program costs and CO<sub>2</sub> reductions. It then calculates a TRC that 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 PJM Northern Illinois 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 that extreme weather has on electricity prices. Extreme weather generally results in electricity price spikes and creates 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.

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<sup>16</sup> Illinois Power Agency Act SB1592, pages 7-8.

<sup>17</sup> Demand Side Management Option Risk Evaluator (DSMore) software is developed by Integral Analytics.

## Results

Table 7-1 summarizes the unique inputs used in the DSMore model to assess the TRC ratio for the Single Family program in PY3. 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 7-1. Inputs to DSMore Model for Single Family All-Electric Program**

Item	Value Used
Measure Life	9
Utility Administration and Implementation Costs	\$469,708
Utility Incentive Costs	\$90,723
Net Participant Costs	\$155,393
Measure Life	9

Based on these inputs, the Illinois societal TRC for this program is 1.01 and the program passes the Illinois TRC test.

## Section 8. Conclusions and Recommendations

### 8.1 Conclusions

This section highlights the findings and recommendations from the evaluation of the four Single Family Programs on behalf of ComEd. The objectives of the evaluation were to: (1) quantify net energy and peak demand savings impacts from the program during Program Year 3 (PY3); and (2) to determine key process-related program strengths and weaknesses and provide recommendations to improve the program.

Below are the key conclusions and recommendations.

#### 8.1.1 Program Impacts

Official savings are determined using deemed parameters when applicable. The savings used to determine whether the ComEd portfolio met its statutory goals was 2,499 net MWh for the Single Family programs. This includes 369 MWh in the All-Electric Program and 2,130 MWh across the three jointly implemented pilot programs with gas companies.

On an evaluated parameter basis, across all four programs, the single family efforts have achieved a net savings of 2,171 MWh, most of which is associated with the Direct Install Pilot, which achieved 1,440 MWh. Gross impact realization rates range from 82% for the Retrofit Pilot to 100% for the Air Sealing Pilot. The overall gross impact realization rate for all four programs together is 86%. Net-to-gross ratios range from 74% for Air Sealing Pilot and the Retrofit Pilot, to a high of 92% for the All-Electric Home Program.

Table 8-1 presents key impact evaluation results (using evaluated parameters) by measure, including ex-ante and ex-post gross and net savings.

**Table 8-1. Net and Gross MWh Impact Summary by Program – Evaluated Parameters**

		Program Name				All Programs
		All-Electric Home	Air Sealing Pilot	Direct Install Pilot	Retrofit Pilot	
Gross Impact Realization Rate		93%	100%	86%	82%	86%
Net-to-Gross Ratio		92%	74%	81%	74%	82%
Gross Energy Impact (MWh)	Goal	-	150	2,100	750	3,000
	Ex-Ante	417	42	2,064	556	3,080
	Ex-Post	390	42	1,768	458	2,658
	% of Ex-Ante	93%	100%	86%	82%	86%
	% of Goal	-	28%	84%	61%	89%
Net Energy Impact (MWh)	Goal	289	102	1,428	510	2,329
	Ex-Ante	361	31	1,486	444	2,321
	Ex-Post	360	31	1,440	340	2,171
	% of Ex-Ante	100%	103%	97%	76%	94%
	% of Goal	125%	31%	101%	67%	93%

Across all four programs, the single family efforts have achieved a net electricity demand savings total 295 kW, arising primarily from the Direct Install Pilot (146 kW) and the Retrofit Pilot (111 kW). As shown in Table 8-2 below, gross impact realization rates range from 100% for the Direct Install Pilot to 356% for the Retrofit Pilot. The Retrofit Pilot only had ex-ante values for the CFL direct install measure and not the additional weatherization measures, which has resulted in a very high realization rate. The overall gross impact realization rate for all four programs together is 137%. Net-to-gross ratios range from 74% for Air Sealing Pilot and the Retrofit Pilot, to a high of 93% for the All-Electric Home Program.

**Table 8-2. Net and Gross kW Demand Impact Summary by Program**

		Program Name				All Programs
		All-Electric Home	Air Sealing Pilot	Direct Install Pilot	Retrofit Pilot	
Gross Impact Realization Rate		106%	117%	100%	356%	137%
Net-to-Gross Ratio		93%	74%	81%	74%	82%
Gross Demand Impact (kW)	Ex-Ante	35.3	3.7	178.2	34.6	251.8
	Ex-Post	37.3	4.3	179.0	123.2	343.8
	% of Ex-Ante	106%	117%	100%	356%	137%
Net Demand Impact (kW)	Ex-Ante	30.4	2.6	128.3	24.9	186.3
	Ex-Post	34.5	3.2	145.8	111.4	294.9
	% of Ex-Ante	114%	121%	114%	447%	158%

### All Electric Home

The All-Electric Home program achieved 390 MWh gross and 360 MWh net energy savings during PY3. The program achieved 125% of its net goal of 289 MWh and 100% of its net ex-ante claimed savings of 361 MWh.

At this measure level, gross impact realization rates varied from 67% for faucet aerators to 119% for pipe insulation, and the total program was 93%. Lower gross impact realization rates are attributable primarily to partial retrofit and occupancy adjustments, while the higher realization rate associated with pipe insulation is due to a lower than expected attrition rate (0% measured versus 16% expected).

The net-to-gross analysis found very low free ridership rates for all of the direct install measures, with the exception of CFLs. The estimated free ridership rate for CFLs was 20%, while other measure free ridership ranged from 5% to 7%. While CFL free ridership is higher than the other measures, it is well below the CFL free ridership of the midstream lighting program, measured at 41%. The direct install delivery strategy helps temper free ridership, but at the same time an evolving market for CFL's and the market transformation effects of the midstream lighting program put upward pressure on CFL free ridership. CFLs also had a high rate of participant spillover, with more than 22% of participants surveyed reporting a spillover CFL adoption. Due to the presence of the ComEd midstream lighting program and the need to avoid double counting impact, spillover credit for these CFL was substantially reduced, yielding a final CFL spillover credit of 9% of the ex-ante CFL impact. The spillover and free ridership calculations contributed to an overall net-to-gross ratio of 92%.

### **Air Sealing Pilot**

The Air Sealing Pilot program installed 1,000 CFL bulbs in 135 homes, which achieved 31MWh net energy savings during PY3. The program achieved 31% of its net goal of 102 MWh and 103% of its ex-ante claimed savings of 31 MWh.

The net-to-gross analysis found a free ridership rate of 30% for CFLs, quite a bit lower than the midstream lighting program free ridership rate of 41% in PY3. The Direct Install Program had a high rate of CFL participant spillover, with 15% of participants surveyed reporting a spillover CFL adoption. Due to the presence of the ComEd Midstream Lighting Program and the need to avoid double counting impact, spillover credit for these CFL was reduced, yielding a final CFL spillover credit of 4.84% of the ex-ante CFL impact. These two factors contributed to an overall net-to-gross ratio of 74%.

### **Direct Install Pilot**

The Direct Install Pilot program installed 50,335 CFL bulbs in 5,966 homes, which achieved 1,440 MWh net energy savings during PY3. It achieved 124 kW net demand impact. The program achieved 101% of its net goal of 1,428 MWh and 97% of its ex-ante claimed savings of 1,486 MWh.

The net-to-gross analysis found a free ridership rate of 20% for CFLs. Nine percent of participants surveyed reported a spillover CFL adoption. Due to the presence of the ComEd midstream lighting program and the need to avoid double counting impact, spillover credit for these CFL was reduced accordingly, yielding a final CFL spillover credit of 1.18% of the ex-ante CFL impact. These two factors contributed to an overall net-to-gross ratio of 81%.

### **Retrofit Pilot**

The Retrofit Pilot program achieved 340 MWh net energy savings during PY3. It achieved 123 kW gross and 111 kW net demand impact. The program achieved 67 percent of its net goal of 510 MWh and 76 percent of its ex-ante claimed savings of 444 MWh.

Measure specific gross impact realization rates (for the measures that were evaluated) varied from 31% for attic insulation to 90% for CFLs, and the total program gross impact realization rate is 82%. Attic insulation and air sealing impacts are much lower than ex-ante claimed impacts. We did not have the models used to calculate the ex-ante numbers so we cannot comment on why the claimed savings was so high.

The net-to-gross analysis found relatively low free ridership rates for all of the measures, with the exception of CFLs. The estimated free ridership rate for CFLs was 34%, while other measure free ridership ranged from 8% to 11%. The higher CFL free ridership is reflective of a continually maturing market for CFLs, due in part to the ComEd residential midstream lighting

program. At the same time, CFLs had a relatively low rate of participant spillover, with 9% of participants surveyed reporting a spillover CFL adoption. After accounting for the effects of the ComEd midstream lighting program, the final CFL spillover credit equal to 2.5% of the ex-ante CFL impact was assigned. The spillover and free ridership calculations contributed to an overall net-to-gross ratio of 74%.

### 8.1.2 Program Processes

#### Retrofit Pilot Program

Overall, this evaluation found that the program succeeded in delivering low-cost energy efficiency measures, especially CFLs, to ComEd customers served by Nicor Gas. This evaluation found multiple indicators of program success including:

- **High conversion rate:** 30% of those participants receiving audits also implemented at least one of the recommended retrofits.
- **Generally satisfied program participants:** 79% of program participants rated their overall satisfaction with the program a 7 or higher on a scale from 0 (“very dissatisfied”) to 10 (“very satisfied”).
- **High satisfaction with the auditor:** Although both high, the Full and DI only participants’ average scores (9.2 vs. 8.3) significantly differed. This was primarily due to scheduling issues with contractors; and a few participants expressed dissatisfaction with the auditors’ sales approach.
- **High satisfaction with the scheduling:** The vast majority of both groups (89% of Full participants, 83% of DI only) stated they were satisfied with the time it took to schedule the home visit and many (53% of Full Participants, 47% of DI only) gave a 9 or 10 indicating that they were very satisfied.
- **High CFL satisfaction:** The majority (80% of Full Participants, 89% of DI only) stated that they were satisfied with the CFLs, and most (68% of Full, 68% of DI only) gave a 9 or 10 indicating that they were very satisfied. The means were high at 8.5 (Full) and 8.9 (DI only).
- **Increase in CFL-Positive Attitudes:** 42% reported a positive increase due to program participation, only 1% reported a negative change, and the rest reported no change.

Although this program was successful in many ways, it did not reach its participation goals and hence its energy savings goals. Program staff cite two main reasons for this:

- Program outreach efforts were initially too conservative. By focusing on a few specific communities, program staff hoped to keep the program cost-effective and prevent the program from becoming oversubscribed.
- The marketing was ill-timed: ComEd customers started receiving mailings referencing “heat loss” and “chills” during the summer months when customers were likely not feeling chilly.

Program staff were well aware of the many improvements they can make to the program moving into PY4. Here we list the outreach and implementation improvements that program staff highlighted:

- Streamline the process for creating work orders from audits using CSG’s modeling tool.
- Create a “next steps” document providing participants information about how to proceed to the retrofit stage of the program.
- Include the Energy Measure View software that will free up some auditor time to discuss more energy saving tips with participants and increase participant engagement with the audit.
- Increase email communications with participants to lessen administrative burdens.
- Increase ComEd branding throughout program and make use of ComEd websites and cross-program promotion.
- Improve timing of marketing considering the seasonality of the messaging.
- Continue community outreach at environmentally focused events.

## Direct Install Program

Overall, this evaluation found that the program succeeded in delivering CFLs to ComEd customers served by Peoples Gas. This evaluation found multiple indicators of program success including:

- **Highly satisfied program participants:** 90% of program participants rated their overall satisfaction with the program a 7 or higher on a scale from 0 (“very dissatisfied”) to 10 (“very satisfied”) and most (78%) gave a 9 or 10 indicating that they were very satisfied with the program.
- **Very high satisfaction with the installer:** 97% reported satisfaction with the installers.
- **Very high satisfaction with the scheduling:** 98% reported satisfaction with the scheduling.

- **High CFL satisfaction:** The majority (89%) stated that they were satisfied with the CFLs and most (75%) gave a 9 or 10 indicating that they were very satisfied.
- **Increase in CFL-Positive Attitudes:** the vast majority (86%) of participants reported that the program positively affected their attitudes towards CFLs. Putting aside those who were not affected by the program (“neutral”, 11%), the difference among those positively (86%) and negatively influenced (4%) by the program yields a net increase of 82% in positive attitude toward CFLs for the program.

Marketing and outreach efforts appeared effective and appropriate for the program:

- **“Word-of-mouth” marketing:** The majority (57%) of participants first heard about the program through word-of-mouth marketing which likely reflects the program’s use of neighborhood sweeps, and CBOs for outreach.
- **The mailing provided useful information:** All participants stated that the program mailings were “very” or “somewhat” useful in providing information about the program, indicating that the program generally honed in on important information to include in these mailings.

Although satisfaction with CFLs and the program was high, many participants (56%) did not recall receiving information about CFLs through program materials.

## 8.2 Recommendations

### 8.2.1 Impact Recommendations

Impact recommendations are presented below for the Retrofit Pilot program only, as it is the only single family program addressed in this evaluation that is slated to continue into PY4.

#### Tracking System

Beginning in PY4 new modeling software will be used by the Retrofit Program to generate ex-ante savings estimates for the air sealing and insulation measures. If the current software specifications allow it, it is recommended that demand impact figures associated with Retrofit Pilot weatherization measures be generated for the tracking system. Information regarding expected demand impact would be useful to the impact evaluation.

The most critical missing elements in the tracking are the pre- and post-retrofit R-values for the insulation measures. These were, for the most part, unrecorded in the tracking database. For most insulation measures tracking data was limited to the square feet installed, and the cost and savings estimates. The savings associated with installing insulation measures is highly dependent on the levels of pre-existing insulation. This data appears to have been available, as it is an element in the audit tool. The savings associated with installing insulation measures is

highly dependent on the levels of pre-existing insulation. *It is recommended that the levels of pre-existing insulation be noted in the tracking system for all insulation types.* Other data housed in the audit tool that would be useful to evaluators include number of stories above grade, leakage type, and insulation type.

The evaluation results presented in Sections 6.1.4 indicate that kWh and kW savings from weatherization and air sealing measures arise largely from reduced cooling loads. For this reason, they rely heavily on specification of air conditioning type and efficiency. *To support future impact evaluation, it is recommended that the tracking system store key information regarding the cooling system.* Ideally, this would include air conditioning type, capacity and efficiency. However, efficiency can be difficult to determine on-site, but the age and make / model information serves as an excellent reference.

Lastly, the program provides the direct installation of water savings measures, but does not store the water heater fuel type in the tracking system. The assumption embedded in PY3 ex-ante impact estimates was that all participants had gas-fueled water heaters. However, the telephone survey revealed that some participants had electric water heaters. *It is recommended that the tracking system record the water heater fuel type of participating homes.*

In developing cost savings estimates for the audit report presented to customers, an annual kWh savings of 51 was assumed for all CFLs installed. This is a simpler approach than using the CFL-specific delta watts figures, which for this program range from 29.1 to 52.5 kWh savings. . The average annual kWh savings for bulbs installed through the program is 44.5. The result of the discrepancy is that 25% of participants were given cost saving estimates between \$10 and \$35 higher than indicated by the CFL bulbs they installed. *To avoid presenting overestimates of the annual energy cost savings of measures it is recommended that the assumed savings for CFLs used to inform customers about expected energy cost savings be reduced from 51 kWh to 44.5 kWh.*

## **CFLs**

It is recommended that the PY4 program take care to make sure that CFLs installed through the program are replacing incandescent bulbs and not other CFLs.

It is recommended that program contractors make sure the CFLs keep within prescribed wattage ranges of the incandescent bulb they are replacing.

It is recommended that program contractors make sure the CFLs are installed in high use areas or that the estimated HOU be collected in the tracking system.

It is recommended that ComEd monitor the levels of pre-existing CFLs in participating homes. Customers with high CFL saturation prior to participating are somewhat more likely to be free riders, and less likely to have high-use sockets qualifying for CFL retrofit. If ComEd observes a marked change in pre-existing saturation levels among participants, perhaps a change in

program marketing, or even a new participant screening criteria, may help to preserve program impact.

It is recommended that all of the above CFL guidelines and policies be documented in program operations manuals, and highlighted in related contractor training material.

## **Weatherization Measures**

A new impact model will be used for the weatherization measures in the PY4 Retrofit Pilot program. Information on this new model is not available to the Evaluation team so we cannot comment on it. *However, it is recommended that the new model take into account the interactive effects of installing multiple measures, if it doesn't do so already.*

*It is also recommended that one of the following options be used in future program year evaluations to assess the impact achieved by the weatherization measures: evaluate the ex-ante model calculations, conduct a billing analysis, or create more refined building simulation models on a subset of the population by either collecting more detailed home characteristic information at the time of participation or over the phone at a later date.* Furthermore, it is very important to the models that all of the information available on the homes be provided to the evaluation team. Most importantly, the evaluation team needs information about the pre-existing measures to assess the impact from the pre- to post-condition. Also, any additional information on the home helps to create a more accurate model. With less information, more assumptions have to be made.

The impact of insulation is very sensitive to the pre-existing insulation levels. As shown in Figure 6-1 on page 92, installation of attic insulation into an attic with pre-existing insulation level of R-5 achieves impact of roughly half what the same retrofit would yield in an attic with R-1. Pre-retrofit insulation of R-10 reduces the impact to about 1/3 of the same retrofit over R-1. Currently, the program standards set the maximum pre-existing R-value to be R-30. However, the impact gained by adding insulation to an attic with R-30 is extremely small; it is on the order of 20 kWh annually for a 2,000 square foot retrofit. *To improve the overall cost effectiveness and impact performance of the attic insulation measure it is recommended that pre-existing R-values for attic insulation be set to a maximum value of R-11.*

## **Deemed Savings**

It is recommended that ComEd use the deemed savings values presented in Table 8-3 below, in future evaluations. Deemed values were not provided for the weatherization measures because the savings associated with these measures can vary widely depending on the specific home characteristics. Moreover, the pre-retrofit condition has a significant impact on the magnitude of the measure savings as shown in Figure 6-1 on page 92.

**Table 8-3. Recommended Deemed Savings Values**

Measure	kWh Savings	kW Savings	Assumptions
9 Watt CFL	28.5	0.0029	- per bulb - replaced a 40 watt incandescent bulb - hours of use=2.57
13 Watt CFL	24.8	0.0025	- 97.8% attrition rate - coincident factor=9.5%
14 Watt CFL	42.2	0.0043	- per bulb - replaced a 60 watt incandescent bulb - hours of use=2.57
15 Watt CFL	41.3	0.0042	- 97.8% attrition rate - coincident factor=9.5%
19 Watt CFL	51.4	0.0052	- per bulb - replaced a 75 watt incandescent bulb - hours of use=2.57
20 Watt CFL	50.5	0.0051	- 97.8% attrition rate - coincident factor=9.5%
Hot Water Heater Turndown	188.0	0.0215	- per home - assumptions are presented in Appendix Section 8.2 - electric water heater
Hot Water Pipe Insulation	122.0	0.0268	- per home - 12 linear feet of pipe insulation installed - electric water heater
Faucet Aerator	99.5	0.0068	- per home - 64% of bathroom faucets in home are fitted with 1 GPM aerators - 94% of aerators will not be removed in the first year  - electric water heater
Kitchen Aerator	118.9	0.0104	- per home - 95% of kitchen faucets in home are fitted with 1.5 GPM aerators - 94% of aerators will not be removed in the first year  - electric water heater
Low Flow Showerhead	462.1	0.0100	- per home - 86% of showerheads in home are retrofitted with 1.5 GPM showerheads - 89% of showerheads will not be removed in the first year  - electric water heater

### 8.2.2 Process Recommendations

Process recommendations are presented below for the Retrofit Pilot program only, as it is the only Single Family program that is slated to continue into PY4.

#### Scheduling

There are multiple times that participants may need to miss work to participate in the program. In PY3, only one auditor was available to perform audits on Saturdays.

- To meet participant demand in PY4, ComEd may want to work with the contractors and encourage them to increase (or reschedule) their staff as necessary to cover evenings and weekends for customers.

## **Converting from Audit to Retrofit**

Program staff are also already aware that participants were sometimes delayed in their attempts to get to the next steps due to the slow conversion of the audit results into a work order, an issue that will likely be resolved when the CSG modeling tool and software is used. However, we wish to underscore the importance of following up with participants quickly once audits have been completed:

- Monitor the conversion of audit results into work orders.

Program staff are already aware that participants may not remember what steps they need to take to have recommended retrofits installed and are planning on a "next steps" approach to inform participants, possibly delivered through email. Considering participant suggestions regarding both program and contractor follow-through, we wish to underscore the importance of managing participant expectations and status here:

- Ensure that participants know the necessary steps to go from audit to retrofit installation. Track unconverted participants by type (safety repairs pending; ready for retrofits, etc.) and target each with regular email reminders. Additionally, the program should consider some follow up and determine why some participants are not advancing to conversion, including making sure that program-affiliated contractors are following through on appointments made with participants.
- Ensure that program-affiliated contractors are following through on appointments made with participants.

## **Education**

ComEd leave-behind materials contain a lot of information. However, auditors are too busy to fully present the educational materials or introduce other ComEd programs, which may have been helpful to the sizeable portion (23%) of participants interested in program expansion (e.g. adding more measures). Auditors should prioritize participant education, including introductions to other ComEd programs, which will be helpful to those interested in measures not offered by the Retrofit program. While participant satisfaction with CFLs was high, only 34% recalled receiving CFL information from the program. Going forward in PY4, the new Energy Measure View will help streamline the audit process so the auditor will have more time available for education. Further, having thought through their home's energy use, participants will be more likely to absorb more information during the audit. Additionally, the program plans to make more use of email communication.

- The program should inform participants about energy-saving tips, CFL information, and other ComEd programs that may be appropriate for the participant, through email and/or the auditor.

## **Auditor**

While program participants were generally satisfied with the program overall, DI only participants gave significantly lower ratings than full participants did (6.7 vs. 8.8). Explaining their dissatisfaction, DI only participants listed issues with the auditors among others. Consistent with this finding, DI only participants were significantly less satisfied with the auditors than full participants were (8.3 vs. 9.2). Although ComEd will use different implementers in PY4, it is worth underscoring the importance of the auditors in their roles as the “faces” and representatives of the program and ComEd.

- The program should regularly review participant satisfaction with the auditors.