

**Energy Efficiency/ Demand Response  
Plan: Plan Year 2 (6/1/2009-5/31/2010)  
Evaluation Report: All Electric Single  
Family Home Energy Performance  
Tune-Up Program**

**Presented to**

**Commonwealth Edison Company**

**December 21, 2010**

Presented by

Randy Gunn  
Managing Director

Navigant Consulting  
30 S. Wacker Drive, Suite 3100  
Chicago, IL 60606

phone 312.583.5700  
fax 312.583.5701

[www.navigantconsulting.com](http://www.navigantconsulting.com)

The logo for Itron, with the word "Itron" in a bold, red, sans-serif font. A yellow triangle is positioned above the letter "n".The logo for Opinion Dynamics Corporation (ODC). It features the letters "ODC" in a large, blue, stylized font. Below it, the words "OPINION DYNAMICS CORPORATION" are written in a smaller, blue, sans-serif font.The logo for Michaels engineering. It features a stylized graphic of three blue and grey slanted bars to the left of the word "Michaels" in a bold, blue, sans-serif font. Below "Michaels", the word "engineering" is written in a smaller, blue, sans-serif font.



**Submitted to:**

ComEd  
Three Lincoln Centre  
Oakbrook Terrace, IL 60181

**Submitted by:**

Navigant Consulting, Inc.  
30 S. Wacker Drive, Suite 3100  
Chicago, IL 60606  
Phone 312.583.5700  
Fax 312.583.5701

**Contact:**

Randy Gunn, Managing Director  
312.938.4242  
randy.gunn@navigantconsulting.com

Jeff Erickson, Associate Director  
608.497.2322  
jeff.erickson@navigantconsulting.com

**Prepared by:**

Christina Torok, Principal Energy Consultant  
Itron, Inc.  
510.844.2884  
christina.torok@itron.com

Garrick Wahlstrand, Senior Analyst  
Opinion Dynamics Corporation  
510.444.5050, ext 108  
gwahlstrand@opiniondynamics.com

## Table of Contents

Section E.	Executive Summary .....	1
E.1	Evaluation Objectives .....	1
E.2	Evaluation Methods.....	1
E.3	Key Impact Findings.....	2
E.4	Key Process Findings.....	4
Section 1.	Introduction to the Program.....	6
1.1	Program Description.....	6
1.1.1	Objective .....	6
1.1.2	Implementation Strategy.....	7
1.1.3	Measures and Incentives.....	7
1.2	Evaluation Questions.....	8
Section 2.	Evaluation Methods.....	9
2.1	Analytical Methods.....	9
2.1.1	Impact Evaluation Methods.....	9
2.1.2	Process Evaluation Methods.....	10
2.2	Data Sources.....	11
2.3	Sampling Plan.....	12
Section 3.	Program Level Results.....	14
3.1	Impact Results.....	14
3.1.1	Default Savings Review.....	14
3.1.2	Tracking System Review .....	18
3.1.3	Ex-Ante Gross Impact, Summary of Accomplishments .....	20
3.1.4	Ex-Post Gross Impact, Summary of Adjustments .....	23
3.2	Adjustments for Measure Disposition .....	23
3.2.1	Gross Program Impact Results.....	35
3.2.2	Net Program Impact Results.....	35
3.3	Process Evaluation Results .....	42
3.3.1	Process Themes.....	42
3.4	Cost Effectiveness Review.....	54
Section 4.	Conclusions and Recommendations .....	56
4.1	Conclusions .....	56
4.1.1	Program Impacts .....	56
4.1.2	Program Processes .....	57
4.2	Recommendations.....	59
4.2.1	Impact Recommendations .....	59
4.2.2	Process Recommendations.....	60
Section 5.	Appendices.....	63
5.1	Data Collection Instruments.....	63

5.2	Default Savings Algorithm Review .....	99
5.2.1	Multi Family All Electric Efficiency Upgrade Program Default Savings Review .....	100
5.2.2	Single Family All Electric Home Energy Performance Tune Up Default Savings Review .....	111
5.3	Hot Water Heater Temperature Setback Impact Model .....	113

## Section E. Executive Summary

This document presents the PY2 (June 1 2009- May 31, 2010) Evaluation Report for the All Electric Single Family Home Energy Performance Tune-Up program. This 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 services are provided by an energy specialist for the nominal fee of \$25. The program completed its first full year of operation in May of 2010, with 760 homes participating. During PY2 the Program also ran an experimental pilot design with 92 customers participating. Relative to the current program design, the pilot had a larger co-payment (\$125) and provided additional services including blower door testing and air sealing measures.

### *E.1 Evaluation Objectives*

The goal of this report is to present a summary of the findings and results from the evaluation of the Program Year 2 (PY2) All Electric Single Family Home Energy Performance Tune-Up Program. The objectives of the evaluation are to: (1) quantify net energy and peak demand savings impacts from the program during Program Year 2 (PY2); and (2) to determine key process-related program strengths and weaknesses and provide recommendations to improve the program.

### *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, 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 E-0-1 below summarizes data collection activities, along with the details regarding the sampling and timing.

**Table E-0-1. Data Collection Activities**

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis	All Program Participants	Tracking Database	-	All	July–September 2010
In-depth Phone Interview	ComEd program manager	Contact from ComEd	Current and Former Program Managers, Program Implementer	2	August 2 and 11, 2010
CATI Phone Surveys	Program Participants	Tracking Database	Random Sample of Program Participants*	130	August 2010

\* A quota was imposed to ensure proportional representation of program pilot participants.

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

The impact results for the All Electric Home Energy Performance Tune-Up Program are shown in Table E-0-2 and Table E-0-3. Table E-0-2 shows the PY2 program goals, provided in MWh, as well as the ex-ante impact, the evaluation impact results and corresponding realization rates. The program had 760 participants and realized 638 MWh of net energy impact and 56.9 kW of net peak demand impact<sup>1</sup>. The evaluation findings indicate that the program exceeded net and gross energy impact goals.

---

<sup>1</sup> For this study peak hours are defined as non-holiday weekdays between 1:00 PM and 5:00 PM Central Prevailing Time (CPT) from June 1 to August 31. This is in accordance with the PJM manual 18, Energy Efficiency and Verification, of Mar 1 2010.

**Table E-0-2. Ex Post Gross Program Impact**

	PY2 Goal	Ex Ante* Impact	Evaluation Result	Realization Rate % of Ex-Ante	
				% Ex-Ante	% Goal
Participants (#customers)	-	760	760	100%	-
Gross Energy Impact (MWh)	671	605	721	119%	107%
Gross Demand Impact (kW)	-	60.3	64.1	106%	-
Net Energy Impact (MWh)	399	514	638	124%	160%
Net Demand Impact (kW)	-	51.2	56.9	111%	-

*\*From PY2 Ex-Ante & Plan summary.xls*

Table E-0-3 below shows the program's 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. Air Sealing measures associated with the pilot are excluded from the program impact evaluation. This exclusion is consistent with ComEd's decision not to take credit for pilot program savings at this time. Instead, ComEd will make a case during the next planning cycle to include impact from pilots to promote other research and development efforts.

**Table E-0-3. Ex Post Gross and Net Program Impact**

Measure	Measure Realization Rate	Ex-Post Gross kWh	Ex-Post Gross kW	NTG Ratio	Ex-Post Net kWh	Ex-Post Net kW
CFL	102%	249,486	22.5	72%	180,572	17.1
Kitchen Aerators	92%	59,491	6.1	97%	57,706	5.9
Bathroom Aerators	67%	46,996	6.4	97%	45,586	6.2
Showerheads	81%	175,329	8.8	93%	162,179	8.2
Pipe Insulation	100%	75,884	16.7	102%	77,402	17.0
<b>Total Direct Install</b>	-	607,186	61.7	87%	523,446	54.6
<i>Total Direct Install, Percent of Ex-Ante*</i>		90%	92%		92%	96%
<b>Other Program Measures and Recommendations</b>						
Water Heater Temperature Setback	-	14,100	1.6	100%	14,100	1.6
Energy Survey Recommendations	-	100,190	0.9	100%	100,190	0.9
<b>Total Program Impact</b>	-	721,476	64.1		637,735	56.9
<i>Total Impact as a Percent of Adjusted Ex-Ante*</i>	-	107%	96%		112%	100%

\* Ex-ante values prior to portfolio adjustments for the expected overall gross realization rate of 0.90.

## E.4 Key Process Findings

### Process Findings

Overall, this evaluation found that the program succeeded in delivering low-cost energy efficiency measures to high-use electric customers.

This evaluation found multiple indicators of program success including:

- Highly satisfied program participants
- A personable and engaged group of assessors interacting with customers



- Highly satisfying measures, especially CFLs

Several program design elements contributed to its success including:

- A marketing team that segmented and targeted ComEd customers eligible for this program
- A well-targeted marketing campaign that used appropriate channels and messaging to effectively identify and recruit program participants
- An adaptable incentive strategy that was altered as needed to reach the program's goals for participation and energy savings

However, there were some data points in this evaluation that indicate that the educational component, i.e., the energy survey report with recommendations, was overshadowed by the measure installation:

- A significant portion of respondents (29%) did not recall receiving a report with recommendations.
- Only a minority of respondents (39%) could recall a specific recommendation from the report.

## Section 1. Introduction to the Program

### 1.1 *Program Description*

The All-Electric Home Energy Performance Tune-Up 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. During PY2 the Program also ran an experimental pilot design with 92 customers participating. The pilot required a higher payment from participants in return for the additional services of blower door testing and air sealing measures.

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. However, during this same year a similar version of the program will start-up and continue past PY3 as a joint venture with Nicor Gas Company and Integrys Gas Companies.

#### 1.1.1 **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 will continue through the end of PY3 (May 31, 2011).

### 1.1.2 Implementation Strategy

#### *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 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 phone calls, telemarketing, and offers for restaurant vouchers and waived program fees.

#### *Roles of the Implementation Contractor*

ComEd has contracted Honeywell Utility Solutions to implement the Tune-Up 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.

### 1.1.3 Measures and Incentives

The Single Family Home Energy Performance program provides direct install services for the following measures for homes with an electric water heating appliance.

- 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-use, such as heating, air conditioning and lighting.

Program equipment and services are offered at the nominal and subsidized fee of \$25<sup>2</sup> per participating home.

## **1.2      *Evaluation Questions***

The evaluation sought to answer the following key researchable questions. Some of the researchable questions can be addressed in Program Year 3.

### Impact Questions:

1. What is the level of gross annual energy (kWh) and peak demand (kW) savings induced by direct install services?
2. How much energy and demand impact was achieved through recommended but non-incented measures?
3. What is the first year persistence of direct install measures?
4. What portion of participant water use is affected by program water savings measures?
5. What is the occupancy of homes retrofit through the program?
6. Create improved default savings estimates and NTG estimates for use in future year DSM plans.
7. What is the level of free ridership and participant spillover associated with the direct install measures?

### Process questions:

1. Are program implementation and tracking processes well established and efficient?
2. Are the program marketing plan and program promotional materials aligned with program benefits?
3. What are key barriers to participation for eligible ComEd customers? How can they be addressed by the program?
4. How satisfied are participating customers with the program?
5. How successful is the program in delivering its objective information to participants?

---

<sup>2</sup> The fee for Pilot program services was higher, \$125 to offset the added cost of the blower door test and air sealing measures.

## Section 2. Evaluation Methods

This section describes the analytic methods and data collection activities implemented as part of the PY2 process and impact evaluation of the Single Family All Electric Home Energy Performance Tune-Up Program, 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 **Impact Evaluation Methods**

##### *Gross Program Impact*

As part of the impact assessment for the All Electric Single Family Home Energy Performance Tune-Up Program, the Evaluation Team performed a mid-stream assessment of the program default measure impact calculations and algorithms. This review was completed in the middle of the program cycle—in February of 2010—and program staff used the results to inform the ex-ante impact claim for the program. The purpose of the default impact claim review was to assess the underlying algorithms, assumptions, and calculated default savings proposed by ComEd for the All-Electric Home Energy Performance Tune-Up Program in PY2. The review utilized a number of secondary data sources, including census data and publicly available research and evaluation reports. A summary of findings from this review is presented in Section 3.1, and the complete review is presented in Appendix 5.2.

The impact evaluation also includes several other 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:

- Measure installation rate
- First year measure persistence
- Home occupancy
- Partial retrofit adjustment (for water saving measures only)

The savings associated with energy survey recommendation uptake are estimated as part of the ex-post gross impact analysis; they are not part of net impact adjustments. This distinction is

consistent with a standard approach to information program impact evaluation, and is based on the observation that the implementation of recommended measures is immediately connected to program activities, unlike spillover which is closer in nature to a market effect. However, in some cases recommendations were made to install additional quantities of the direct install measures. Follow through on direct-install measure recommendations is considered part measure spillover, due to the inherent difficulty in distinguishing the two effects.

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. Engineering analysis was used to generate impact estimates for the survey recommendation uptake, using the details gathered through the energy survey and the self-reports. Engineering analysis methods includes building simulation modeling and Energy Star standard calculators for appliance upgrades.

All relevant details, algorithms, and results are presented in *Section 3.1 Impact Results*.

### ***Net Program Impact***

The primary objective of the net savings analysis for the Program is to determine the program's net effect on customers' electricity usage. This requires estimating what would have happened in the absence of the program. 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 phone surveys.

#### **2.1.2 Process Evaluation Methods**

The process evaluation consisted of 2 in-depth interviews: one with the ComEd Program Managers, and one with the program implementer, as well as telephone surveys with participants of the program

- **Program Staff Interview.** The interviews with key program implementation 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, participants were asked 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 responses are classified as dissatisfied, 4-6 are classified as neutral, 7 to 10 are classified as satisfied.

Throughout the process report, valid percents are shown. That is, respondents offering a “don’t know” or a refusal in response to a question are removed from the distribution.

The survey was fielded to both pilot program participants and full program participants. As discussed above, the pilot had 92 participating customers. Attention is paid to the distinction between pilot program and current program participants in the analysis of program satisfaction and barriers to participation. Moreover, participants under the current design are better positioned to provide process feedback to improve the program going forward. For this reason the focus of the analysis in this report is on program participants under the current design.

## 2.2 *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

Program staff members were interviewed over the phone in August 2010. Each interview lasted between 30 and 45 minutes and covered program design and implementation; marketing and promotion; and perceived barriers to participation.

A telephone survey of 130 PY2 program participants was conducted between August 23<sup>rd</sup> and August 26<sup>th</sup>, 2010. The interviews lasted an average of 16 minutes each. The telephone survey addressed both impact and process related research objectives including measure verification, measure persistence, measure satisfaction, net-to-gross investigations, marketing and

promotion, customer satisfaction, survey recommendations, and customer 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	July–September 2010
In-depth Phone Interview	ComEd program manager	Contact from ComEd	Current and Former Program Managers, Program Implementer	2	August 2 and 11, 2010
CATI Phone Surveys	Program Participants	Tracking Database	Random Sample of Program Participants*	130	August 2010

\* Note that a quota was imposed to ensure proportional representation of program pilot participants.

## 2.3 Sampling Plan

The program had 760 participants during PY2, of which 92 were in the pilot program. Each participant received a slightly different bundle of direct install measures, depending upon their preferences and the characteristics of the home. Installation rates for the five direct install measures ranged from 62% to 93%<sup>3</sup>. Each measure is expected to perform somewhat differently, with different measure satisfaction and varying rates of removal and failures. The pilot had 92 participants and the remaining 668 participated under the current design. The pilot and current program designs differ enough that it is reasonable to expect that participants may have differing levels of satisfaction with the program, as well as different free ridership and spillover traits. For these reasons, the sample design was constructed to meet a 90/10 accuracy and

---

<sup>3</sup> Sixty-two percent is the installation rate for kitchen aerator. Ninety-three percent is the installation rate for CFL.



precision objective at the measure level, and for participants under the current design, while remaining representative of the program as a whole.

Under the default assumption that the coefficient of variation for the objective metrics is 0.5, a sample of 70 participants is required to meet a 90/10 objective for accuracy and precision. The survey sample size was based on the objective of completing 70 surveys with participants in each measure category under the current program design, while retaining a representative approach to sampling. These objectives were met by setting the sample size such that the expected value of the number of survey completes with respondents in each measure category and under the current program design was at least 70. To calculate this expected value, 70 is divided by the product of the percent of participants under the current design (88%) and the lowest direct install measure penetration rate (62%). This calculation yields an objective sample size of 128, which was rounded to 130 to allow a small margin for invalid data.

The sample size of 130 was collected through a randomized sampling of program participants, with just one caveat. In order to ensure a proportional representation of Pilot participants, a quota was set at 12% of the survey sample size, or 16. Table 2-2 below shows the participant sample design and disposition.

**Table 2-2. Sample Design**

Participants	Population	Quota/Survey Completes	Proportion of Population
Full-program	668	114	17.1%
Pilot-program	92	16	17.4%
Total	760	130	17.1%

## Section 3. Program Level Results

### 3.1 *Impact Results*

This section is composed of five primary components.

- The first is a review of the key findings and recommendations resulting from this default savings review. A complete documentation of the review is presented in Appendix 5.2.
- The second is a review of the program tracking system.
- The third is a summary of ex-ante gross impact accomplishments.
- The fourth presents a summary of the adjustments applied to ex-ante gross impact and the resulting ex-post gross impact values.
- The fifth and final component is the presentation of the net-to-gross analysis and results.

The section closes with a summary of final PY2 net ex-post impact estimates for the program.

#### 3.1.1 **Default Savings Review**

This section summarizes key findings from the default savings review. As discussed previously, the review builds upon the default savings review completed for the ComEd Multi-Family program, which offers a very similar bundle of measures. The full text of the default savings review for both the Single Family and Multi-Family program is presented in Appendix 5.2. Table 3-1 below provides ComEd's original gross energy default savings and the default savings review recommended values. Note that the table reflects the bulbs offered at program launch. As the year progressed, 9 watt, 14 watt, and 19 watt CFLs were introduced. Going forward through PY3, only the 9, 14 and 19 watt bulbs will be offered, replacing the 40, 60 and 75 watt incandescent, respectively.

**Table 3-1. Proposed PY2 Default Gross Energy Savings Values**

Measure	Unit	ComEd Proposed PY2 Planning Estimate (Annual kWh/unit)	Evaluator Recommended (Annual kWh/unit)
13W CFL replacing 40W incandescent	Bulb	23.1	21.9
15W CFL replacing 60W incandescent	Bulb	38.4	36.5
20W CFL replacing 75W incandescent	Bulb	47.0	44.6
2.0 GPM low flow showerhead	Home	532	348
1.5 GPM kitchen faucet aerator	Home	210	137
1.5 GPM bath faucet aerator	Home	120	103
Hot water pipe wrap	Home	215	122

Separate discussions of the default savings value for each measure follow below.

### *Integral CFL Bulbs*

#### **Measure Definition**

This measure is defined as direct program installation of integral compact fluorescent lamps to replace incandescent lamps that the occupant states operate at least 2 hours per day. Through PY2 ComEd replaced incandescent bulbs with CFLs in accordance with the wattage replacement chart shown in Table 3-2. It is expected that as the program moves forward in PY3, the offerings will be limited to the 9, 14 and 19 watt CFLs, replacing incandescent wattages as shown below.

**Table 3-2. Baseline and CFL and Replacement Wattages**

Measure <sup>^</sup>	Base Incandescent (watts/lamp)	CFL (watts/lamp)	Delta Watts Reduction (watts/lamp)
9W CFL replacing 40W incandescent	40	9	31
13W CFL replacing 40W incandescent	40	13	27
14W CFL replacing 60W incandescent	60	14	46
15W CFL replacing 60W incandescent	60	15	45
19W CFL replacing 75W incandescent	75	19	56
20W CFL replacing 75W incandescent	75	20	55

<sup>^</sup>Although all of these CFL wattages were offered during PY2, only 9, 13 and 19 watt CFLs will be offered going forward in PY3.

The gross energy and demand algorithms used for evaluating the integral CFL measure savings are as follows:

$$\text{Gross kWh} = \frac{\text{Delta Watts} * \text{HOU/day} * 365 \text{ days/year} * \text{Installation Rate} * \text{Energy Interactive Effect}}{1000 \text{ Wh/kWh}}$$

$$\text{Gross Coincident kW} = \frac{\text{Delta Watts} * \text{Installation Rate} * \text{Coincidence Factor} * \text{Demand Interactive Effect}}{1000 \text{ W/kW}}$$

The installation rate accounts for CFLs installed through the program in the current program year and not since removed by the occupant. The ex-ante value of this parameter is assumed to be 0.95 for measure-level calculations<sup>4</sup>. The coincidence factor is estimated for ComEd's peak period<sup>5</sup> and it was recommended that no change be made to the assumed value of 0.081 that was used in the Multi-Family program during PY1. The demand interactive effect accounts for savings that the measures achieve through avoided air conditioning load because of reduced internal heat gains from the energy efficient lighting. The energy interactive effect accounts for increase in space heating and decrease in space cooling energy because of reduced internal gains from the energy efficient lighting. Insufficient data is available to estimate this parameter, and therefore the default value of 1 was recommended for interactive effects.

<sup>4</sup> In addition, to account for this and other similar issues, an overall portfolio adjustment of 0.90 is made to the aggregate ex-ante gross impact.

<sup>5</sup> Peak occurs during the four hours from 1 pm to 5 pm, Central Time, non-holiday weekdays, June 1 through August 31.

The CFL impact algorithms show that the change in wattage is directly proportional to the resulting impact. In cases where the wattage of removed equipment is unknown it must be estimated, such as is the case for the midstream CFL program. One approach commonly used to estimate the wattage change is to derive a “power factor” from available data. The power factor represents a multiplier that can be applied to the installed equipment to arrive at an estimate of the wattage of removed equipment. However, the relationship between wattages of installed and removed equipment may not be consistent across different wattage categories, and may not be a well behaved function in other respects as well. In the case of the Single Family program, the program implementer is in the home and has a direct influence over the change in wattage. Under the current program design, the program implementer is directed to replace lights in accordance with standards shown in Table 3-2 above<sup>6</sup>. It is advised that the program standards regarding wattage replacements be incorporated formally into the Operations Manual, the official protocol document used by the program implementer for training purposes.

Hours-of-use is also directly proportional to CFL impact. The current Operations Manual advises on-site personnel to discuss each fixture with the customer to ensure that the hours of use are at least 2 per day. It is important that this policy continue and that it be implemented vigilantly. While average home saturation may affect the mean use hours for CFLs in the residential market as a whole, this program standard should ensure that mean operating hours for program bulbs remain above 2 hours per day.

#### ***Low Flow Showerheads and Faucet Aerators***

The low flow showerhead measure consists of the direct installation of a new showerhead to reduce the flow rate relative to the existing showerhead. The program implementation contractor visiting homes is instructed to visually inspect the base showerhead rated water flow and offer to replace it if it is rated at or greater than 2.5 GPM, which is the current Federal standard for maximum flow rate at 80 psi water pressure.

The faucet aerator measure consists of direct installation of a new faucet aerator to reduce the flow rate relative to the existing faucet. The measure savings analysis assumes replaced aerators account for all kitchen or bath faucet hot water use in the residence and that the implementation contractor does not replace existing low-flow faucet aerators.

The impact of both measures has a proportional relationship to occupancy. This is because the showerhead and aerator impact are derived from expected household water usage. The PY2 ex-ante occupancy assumption for single family dwellings is 2.75, based on 2006-2008 American Community Survey data from the US Census Bureau for Illinois.

---

<sup>6</sup> Going forward in PY3, only 9, 14 and 19 watt CFLs will be offered.

Although the program standards direct the implementation contractor to inspect the base showerhead to ensure the rated water flow is at least 2.5 GPM, similar directions are not included in the implementer's Operations Manual. Similarly, instruction and guidance regarding the characteristics of the base aerator are also missing from the Operations Manual. It is advisable to update the Operations Manual to include specific direction on the removed showerheads and aerators. Additional documentation of the flow rates of removed showerheads and aerators would enhance the robustness of the impact analysis.

Water usage assumptions reflect the full expected usage in the home, at the assumed occupancy level. Thus, for cases where not all the fixtures present in the home are retrofit, a downward adjustment in expected impact should also occur. Although usage per fixture is unlikely to actually be uniform, such an assumption is a good first approximation. Thus, it is advised that the Operations Manual provide specific guidance regarding a goal to retrofit all fixtures present in the home, and to note cases where some cannot be retrofit. Further, capturing the full number of fixtures present in the home, as well as the number of retrofit fixtures would improve ex-ante impact estimates by adjusting in advance for partial-retrofit cases.

### *Pipe Insulation*

The Single Family Home Energy Performance program includes the installation of up to 12 linear feet of pipe insulation on hot water pipes emanating from an electric water heating appliance. Details regarding the development of the algorithm used to generate the ComEd proposed default value of 215 kWh per year are not available for evaluator review. Appendix B of the ComEd's 2008-2010 Energy Efficiency and Demand Response Plan refers to DEER as the source of this value. The DEER 2005 report indicates that pipe wrap energy impact is 4 percent of household water heater energy consumption. The corresponding annual energy savings ranges from 111 to 133 kWh per year, depending upon the service territory. Research by the evaluation team indicates that there are currently no reliable estimates of unit energy consumption of electric resistance water heaters for single family detached dwellings in Illinois. It is recommended that the mean DEER value of 122 kWh per year per dwelling is adopted as the default savings value for the Single Family Home Energy Performance program.

### **3.1.2 Tracking System Review**

A final program tracking database was provided in support of this evaluation by ComEd in July of 2010. The tracking system contained 6,087 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.

Table 3-3 below shows the contents of the tracking system and the values that each component of the delivered tracking system holds.

**Table 3-3. 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. No missing values.
Phone	Area code and phone number. Missing or duplicate for 50 participants.
Premise ID	Unique ID for premise
Building ID	Unique ID for building
Room Type (CFL)	Bedroom, Bathroom, Living Room, Kitchen, Workshop, Bedroom, Office, Hallway, Dining Room, Exterior, Mud Room (unheated), Other
Wattage (CFL)	Values of 10, 11, 13, 14, 15, or 20
Installed Measure Name	Compact Fluorescent Bulb, Faucet Aerator, Kitchen Aerator, Hot Water Pipe Insulation $\frac{3}{4}$ , Hot Water Pipe Insulation $\frac{1}{2}$ , Low Flow Showerhead, Audit Fee, Audit Fee w/Blower
Installed Measure Quantity	Values ranging from 0-12
Energy savings	Values ranging from 23.1 to 532 kWh
Square feet of home	Values between 2 and 39,000 <sup>7</sup> . One participant with missing data.
Number of occupants	Values from 0 to 12. One participant with a zero entry.
Age of water heater	Values between 0 and 79.
Size of water heater	Most between 20 -80. A few outliers ranging from 1 and 100.
Water temperature before	Ranging from 93 to 177 degrees Fahrenheit. Six participants with blank or zero.
Water temperature after	Ranging from 92 to 144. Six participants with blank or zero.

### ***Overall Assessment***

The tracking system created by the program implementer and delivered by ComEd to the Evaluation Team was comprehensive and consistent. The tracking data was sufficient to

---

<sup>7</sup> Of the 760 participant records, 752 had square feet estimates between 500 and 10,000. Six records appear to be data entry errors, with 3 entries of less than 500 and three entries greater than 10,000.

provide a solid foundation on which to build the impact and process analyses. The most essential data, such as customer name, contact information and records of the installed measures were appropriately detailed and delivered in an organized and easily accessible fashion. The variables contained 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*

One area that could be improved in the tracking system is related to the recommendations provided to the participants. The energy survey report presents customers with a handful of recommendations for energy saving improvements. These recommendations are presented to the customer along with estimates of first year dollar savings and installation costs. If records of recommendations could be delivered with the tracking data, the analytical possibilities for evaluation would be substantially improved. First, telephone surveys could be used to follow up with customers regarding each specific recommendation provided to them. This would support the creation of a disposition for each recommendation, that would include information on which recommendations were rejected, which are under consideration, which have been implemented and which the customer has near-term or long-term plans to install. This information can be valuable in understanding what type of recommendations have higher follow through rates, and which are likely to be rejected, and why.

### **3.1.3 Ex-Ante Gross Impact, Summary of Accomplishments**

The Program operated under a first year impact goal of 671 MWh. Ex-ante impact assumptions and program tracking system data indicate participation in PY2 by 760 homes, and total program ex-ante gross energy impact of 605 MWh, with demand impact of 60 kW. The total Program PY2 ex-ante impact summary statistics are shown in Table 3-4.

**Table 3-4. Goals versus Total Ex Ante Program Impact, PY2**

	PY2 Goal	PY2 <i>Ex Ante</i> Values
Participants (#customers)	-	760
First Year Gross Energy Impact (MWh)	671	605
First Year Demand Impact (kW)	-	60.3



Table 3-5 below summarizes the program ex ante impact for each installed measure<sup>8</sup>. The program makes no impact claims for the energy survey, the blower door test and related building envelope measures or for the water heater turndown. The largest contributor to gross kWh impact is the installation of CFLs, which account for 245 of the 671 total MWh impact, or 36%. Low flow showerheads are a close second with 216 MWh or 32% of the total. Kitchen and faucet aerators combined account for 135 MWh or 20% of total ex-ante accomplishments. Pipe insulation has the smallest total measure impact at 11% of the total.

**Table 3-5. First Year Ex-Ante Impact by Measure, PY2 Accomplishments**

Measure	Homes	kWh Per Home	Total kWh	kW per Home	Total kW
Energy Survey	760	0	0	0	0
Blower Door (pilot)	92	0	0	0	0
CFL	709	345.9*	244,594	0.0327	23.19
Low Flow Showerhead	622	348.0	216,456	0.0176	10.92
Kitchen Aerator	472	137.0	64,664	0.014	6.63
Faucet Aerator	681	103.0	70,143	0.014	9.56
Hot Water Pipe Insulation	622	122.0	75,884	0.0268	16.65
Hot Water Heater Turndown	75	0.0	0	0	0
Total	760	883.9	671,741	0.0881	66.95

*\*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. Coincidence factor for CFLs is 0.081.*

Table 3-6 below summarizes tracking system 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 20 watt CFL. Fifty-two percent of program bulbs and 62 percent of CFL gross energy impact arise from 20 watt bulbs. The 15 watt bulbs are the second most common, accounting for 23 percent of bulbs and 22 percent of CFL energy impact.

<sup>8</sup> Measure ex-ante impacts do not incorporate the portfolio-level adjustment related to expected gross impact realization rates, and thus have a higher total value, 672 MWh versus 605 MWh.

**Table 3-6. First Year *Ex-Ante* Gross Impact Detail for CFL Installations, PY2 Accomplishments**

Wattage	Bulbs	Homes	kWh per Bulb per Year	Total kWh per Year	kW per Bulb	Total kW per Year
Unknown*	24	7	39.9	958	0.0038	0.1
11	175	20	24.8	4,340	0.0023	0.4
13	1,059	164	23.1	24,463	0.0022	2.3
14	271	35	39.3	10,650	0.0037	1.0
15	1,381	192	38.4	53,030	0.0036	5.0
20	3,216	483	47.0	151,152	0.0045	14.3
Total	6,126		39.9	244,594	0.0038	23.2

*\*Wattage data missing from installation record for 24 bulbs. An average wattage from the 6,102 bulbs with populated wattage data is used in lieu of missing data.*

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 3-7 below shows the percent of participating homes that installed each program measure type. CFL bulbs had the greatest penetration among participating homes at 93 percent. Faucet aerators were installed at 90 percent of participating homes, while kitchen aerators were installed in 62 percent. Pipe insulation and low flow showerheads were both installed in 82 percent of participating homes. Hot water heater turndown was performed in 75 homes, or 10 percent of participating homes.

**Table 3-7. Percent of Participating Homes Installing Each Program Measure Type, PY2**

Measure	Percent of Participating Homes Installing Measure
Audit Fee	100%
Blower Door Test (Pilot)	12%
Compact Fluorescent Bulb*	93%
Low Flow Showerhead	82%
Kitchen Aerator	62%
Faucet Aerator	90%
Hot Water Pipe Insulation	82%
Hot Water Heater Turndown	10%

### **3.1.4 Ex-Post Gross Impact, Summary of Adjustments**

This section summarizes the PY2 ex-post impact estimation approach and results for the Single Family All-Electric Home Energy Performance Tune-Up Program. More specifically, this section addresses the following adjustments to ex-ante impact values:

- Adjustments for removals and failures
- 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.

### **3.2 Adjustments for Measure Disposition**

The calculation of ex-post gross impact includes an adjustment to reflect the removal of program measures. For each installation recorded in the tracking system, phone 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. These data are collected with the following phone survey battery:

Disp\_1. Are all of the [MEASURE] you received from the program still installed in their original locations?

1. Yes
2. No
8. Don't know/Refused

[If Disp\_1 not equal to 1, ask ]

Disp\_2. Now, I would like to understand what happened to the [QTY] [MEASURE]. First, how many [MEASURE] are currently installed in their original location?

Disp\_3. How many are installed at some other location in your house?

Disp\_4. How many are in storage?

Disp\_5. How many were sold or given away?

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

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.

The ex-ante impact values for CFLs incorporate an assumed 5% measure attrition rate. This rate reflects the rate of expected attrition due to removals and failures. The findings from the survey analysis indicate the PY2 attrition rate was somewhat lower, at 3%. The correct adjustment to ex-ante savings is an increase equal to the ratio of 97% to 95%, or an upward adjustment of 2%.

Aerator and showerhead measures accrue impact on a per-home basis. The impact calculation is predicated on the assumption that all of the faucets and showerheads present in the home are retrofit through the program. The phone 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 phone 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 measure across homes, and the total fixtures present in those homes. Measure disposition findings and analysis results are shown in Table 3-8 below.

**Table 3-8. Measure Verification and Disposition**

Measure	CFL	Aerator	Showerheads	Pipe Wrap
Percent of Measures Verified Installed	100%	100%	100%	100%
Participant Respondents	115	114	107	86
Measure Disposition Sample Size	1,033 bulbs	325 aerators	163 showerheads	724 linear feet
Original Location	97%	97%	95%	100%
Moved	0%	1%	0%	0%
Thrown away	1%	0%	0%	0%
Stored	2%	2%	4%	0%
Gave away or sold	0%	0%	1%	0%
Ex-ante attrition rate	5%	0%	0%	0%
Adjustment to Gross Impact	102%	99%	96%	100%

The participant telephone survey collected information regarding the reasons participants removed measures. Survey results show that for CFLs, equipment failure was the primary reason for removal, while for water-saving measures, weak water pressure was the primary reason. Among CFL recipients, 8% of participants 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. Among aerator and showerhead recipients, 4% and 3% of the participants respectively stated that they removed one or more measures due to weak water pressure.

### *Partial Retrofit Adjustment*

As discussed above, 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>9</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 phone 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.

**Table 3-9. Partial Retrofit Adjustment**

Measure	Kitchen Aerator	Faucet Aerator	Showerheads
Ex-ante Percent of Fixtures Retrofit	100%	100%	100%
Average Percent of Fixtures Retrofit (Self-Report)	100%	74%	91%

### *Occupancy Adjustment*

As described in detail in the 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.

As shown in Table 3-10 below, program tracking system data yield a mean of between 2.40 and 2.46 persons per home, depending upon which measure recipient population is considered. The

---

<sup>9</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.

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 6 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. Due in part to a largely overlapping sample, this adjustment factor is the same for each measure, and is an increase of 6%.

Table 3-10 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 (A/B). 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 92% to 94%.

**Table 3-10. Occupancy Adjustment**

Measure		Kitchen Aerator	Faucet Aerator	Showerheads
A	Ex-ante assumed occupancy	2.75	2.75	2.75
B	Tracking system occupancy, all records	2.46	2.40	2.40
C	Tracking system occupancy, survey sample	2.16	2.16	2.22
D	Survey sample occupancy	2.28	2.28	2.36
E	Ex-ante to tracking adjustment factor (B/A)	89%	87%	87%
F	Survey-based adjustment (D/C)	106%	106%	106%
G	Final occupancy adjustment ((F*B)/A)	94%	92%	93%

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

Table 3-11 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. The adjustments are applied multiplicatively. Each represents a separate ‘realization rate,’ applicable to the entire measure gross impact. The reduction in measure impact ranges from an increase of 2% for CFLs to a reduction of 33% 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 10%, yielding a final first year ex-post gross impact for the direct install measures of 607,186 kWh and 61.7 kW.

**Table 3-11. Total Ex-Post Gross Impact Adjustments, Direct Install Measures**

Adjustment Factor	CFL	Kitchen Aerator	Faucet Aerator	Showerhead	Pipe Wrap	Overall
Removals/Storage	102%*	98%	98%	96%	100%	99%
Occupancy	-	94%	92%	93%	-	96%
Partial Fixture Retrofit	-	100%	74%	91%	-	94%
Total Ex-Post Gross Impact Adjustment	102%*	92%	67%	81%	100%	90%

\*The ex-ante attrition rate was greater than survey-verified attrition in PY2, indicating an upward adjustment to gross impact.

### *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 75 participating homes. These 75 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 5.3. 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 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 3-12.

The phone survey sample included 10 of the 75 participants receiving a temperature setback. The temperature setback was verified with each participant, and the possibility of any subsequent changes to the setting was also explored. All 10 participants verified the temperature setback and stated that no subsequent changes had been made to the setting.

**Table 3-12. 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	75 homes
Homes Reversing Temperature Setback	0
Per Unit Ex-Ante Gross Impact	0
Per Unit Ex-Post Gross Impact	188 kWh
Total Ex-Post Gross kWh	14,100 kWh
Total Ex-Post Gross kW	1.6 kW

### *Ex-Post Impact Results Summary for Energy Survey Recommendation Uptake*

The All Electric Single Family Home Energy Performance Tune-Up 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. Phone survey results were used to compile a list of respondents reporting measure recommendation implementation. Note that recommendation follow-through consisting of the installation of additional direct install measures is analyzed as measure spillover (see Section 3.1.6). This grouping was chosen due to the inherent difficulty in distinguishing the effect of experience with program measures from the effect of survey

---

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

recommendations. 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.

Table 3-13 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. Both participants were identified as receiving rebates for their refrigerator recycling from the ComEd AR program.

**Table 3-13. Ex-Post Gross Impact, Energy Survey Recommendation Uptake**

Adjustment Factor	Reported Adoptions	Recommended in Energy Survey
<b>Weatherization</b>		
Attic Insulation	5	5
Window Sealing	3	0
Insulation Basement or Crawlspace	2	2
Window Treatments	1	1
Air infiltration (other)	1	0
Total Weatherization	12	8
<b>Appliance Changes</b>		
Recycling refrigerator	2	2
ES Refrigerator	1	1
Ceiling Fan	1	0
New windows	1	0
New HVAC	1	0
<b>Total Appliance Changes</b>	6	3
<b>Practices</b>		
Thermostat Settings	2	0

Measure recommendations adopted by participants are considered eligible for program 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 phone survey data result in the identification of 8 measure adoptions eligible for program credit. These measures include 5 attic insulation installations, 2 basement insulation installations, and one Energy Star refrigerator.

#### **Impact Analysis of Survey Recommendation Uptake**

The Energy Star saving calculator was used to estimate the energy savings due to the new refrigerator. Demand savings for the refrigerator was calculated by assuming an even load over the year.

Attic and basement 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 the average of a small number of known characteristics of 7 houses sampled from program participants and assumptions of typical building construction in the Chicago area. The characteristics of the 7 houses that received an insulation recommendation through the program are shown in Table 3-14, with the calculated averages shown at the bottom of the table. The number of stories was not given directly in the energy survey reports, but was inferred from the total floor area and the attic or basement floor area recommended for insulation. Full modeled building characteristics are given in Table 3-15.

**Table 3-14. Home Characteristics, Insulation Adopters**

Measure	Age (years)	Floor Area (sq. ft.)	Number of Windows	Number of Doors	Stories*	Heating Type
House 1	32	2,574	18	4	2	HP
House 2	35	3,127	13	5	1.5	Elect. Furn.
House 3	30	2,678	8	4	2	HP
House 4	30	3,082	25	3	2-3	Elec. Furn
House 5	51	2,640	21	3	2	Elec. Boiler
House 6	20	2,076	6	3	2	Elec. Furn
House 7	34	1,100	11	2	2	Elec. Furn
Average	33	2,468	15	3	2	

*\*estimated from attic or basement area*

**Table 3-15. Selected Home Characteristics for Impact Modeling**

Characteristic	Selected Value
Square Feet	2,468 square feet floor area
Stories	2 story
Age	33 years old
Doors	3 doors (steel insulated), facing N, S, and E
Windows, Area	Window area 6% of floor area split evenly in each of the cardinal directions
Windows, Type	Double paned clear glass wood/vinyl windows (no low e)
Windows, Shading	Blinds, but shaded only 20%
Overhang	One foot overhang on top story
Basement Insulation	Unconditioned basement insulation R-30
Attic Insulation	Attic insulation R-45
Wall Insulation	Walls insulation R-11
Air Infiltration	0.40 ACH

Three types of heating systems were found in the sampled houses: two heat pumps, 4 electric furnaces, and one electric boiler. Two types of heating systems were modeled, a heat pump and electric resistance heat. Electric resistance was used because eQuest could not easily adequately model an electric furnace or electric boiler. This assumption will underestimate the house energy use and slightly underestimate savings as a result. However, the baseline yearly energy for the modeled electric resistance house is larger than the actual energy use of the sampled houses, likely due to underestimated solar gain or overestimated infiltration. Therefore, the underestimation of savings due to resistance heat being used is not a problem. The baseline energy use was calibrated to the average actual energy use of each heating system type. The modeled energy use of the heat pump house was 3.8% less than the actual energy use, and the modeled energy use of the electric resistance house was 6.5% more. It was not possible to calibrate lower than that since the only difference between the two house types was the heating system type. The savings found in each of the house types were combined using a weighted average to produce program level savings. In the case of attic insulation, the baseline case was modeled by reducing the attic insulation R-value to R-7. The basement insulation was held constant at R-30, as unconditioned basement ceilings are typically insulated in Chicago. Similarly, the baseline case for basement insulation used R-7 in the basement ceiling and held the attic insulation value constant at R-45. The results of the simulation are shown in Table 3-16.

The electric resistance houses use more energy because the heating systems are 100% efficient as opposed to on the order of 250% efficiency for heat pumps. Hence, the electric resistance houses show more savings. For all of the houses the savings were entirely during the heating season, with a small cooling penalty for adding insulation. This indicates that in the pre-retrofit case, summertime heat was actually escaping through the attic or basement plane, not unexpected for the Chicago climate where summer temperatures are relatively mild.

**Table 3-16. Simulation Modeling Results**

Measure	Heat Pump (kWh/year)	Electric Resistance (kWh/year)	Measure Impact (kWh/home)
Basement insulation baseline	29,470	37,550	
Attic insulation baseline	29,750	38,600	
Upgrade (attic and basement)	28,440	35,620	
Basement insulation savings	1,030	1,930	<b>1,673</b>
Attic insulation savings	1,310	2,980	<b>2,503</b>

Comparisons between the measure impact estimates that resulted from eQuest modeling and the first year savings estimates that were provided to participants yield some interesting findings. The first year savings estimates provided to participants in the energy survey report were expressed in dollars, not in kWh. At a conversion rate of 12 cents per kWh, which is the 2010 average residential electricity rate in Illinois, the first year savings estimates ranged from 4,957 to 14,390 kWh. These savings values correspond to a range of between 10% and 40% of participants' annual consumption. Through conversations with the program implementer we learned that the software used to generate the estimated savings was limited in its ability to accept varying levels of pre-existing insulation. The software was only able to produce savings estimates using a pre-existing insulation level of zero. Energy savings from insulation is very sensitive to the levels of pre-existing insulation, and the savings will be over-estimated quite a bit if this is not considered in savings estimation techniques. Further, all-electric customers currently receive a special electricity rate, which is quite a bit lower than the standard rate, at about 8 cents per kWh. These data suggest that the lower all-electric rate may not be the current assumption in the energy survey software that is used to generate the first year savings estimates.

### **Summary of Survey Recommendation Uptake Impact**

The average impact per *un-rebated*<sup>11</sup> adoption is 2,142 kWh. It is important to note that the pilot participants make up 12 percent of the participant population<sup>12</sup>, but make up a much higher percentage (54%) of the impact resulting from measure recommendation uptake. It is apparent that measure follow through is much higher among the pilot participants, though the reason behind the difference is not equally clear. The willingness to pay a higher fee for program services<sup>13</sup> may translate into a greater propensity to seriously consider and follow through on recommendations. However, the association between the higher fee and greater rates of customer follow through is speculative. Table 3-17 below summarizes the credit applied to the program by itemizing the results of the survey sample, and the population level estimates.

**Table 3-17. Energy Survey Recommendation Uptake Impact**

Segment	Adjustment Factor	First Year kWh	First Year kW
<b>Sample Results</b>	<b>Total</b>	20,165	0.49
	<b>Rebated through other programs</b>	3,028	0.35
	<b>Total credited to SFHEP</b>	17,138	0.15
	<b>Credit per surveyed participant<sup>^</sup></b>	132	0.00
<b>Population Estimates</b>	<b>Total program population credit*</b>	100,190	0.85
	<b>Total credit as percent of ex-ante impact**</b>	15%	1%

<sup>^</sup>This is the average credit over the whole survey sample, i.e. the total impact for measure recommendation uptake divided by 130, the number of completed surveys.

<sup>\*</sup>This is the credit per surveyed participant multiplied by the total number of participants in the population.

<sup>\*\*</sup>Ex-ante impact prior to the portfolio adjustment of 0.90 for expected gross impact realization rate.

<sup>11</sup> Excluding the two cases of refrigerator recycling that were rebated through the ComEd Appliance Recycling program.

<sup>12</sup> Pilot participants also make up 12% of the sample, by design.

<sup>13</sup> As discussed in Section 1, pilot participants were required to provide a co-payment of \$125, while the current design requires a co-payment of \$25.

### 3.2.1 Gross Program Impact Results

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

Table 3-18 below summarizes the PY2 ex-post gross impact for the Single Family Home Energy Performance Program. The overall gross impact realization rate is 107% for energy and 96% for demand. The high realization rate for energy impact is driven largely by the absence of ex-ante impact estimates related to energy survey recommendations, which are estimated to have generated 100 MWh during PY2. The direct install measures make up 84% of the ex-post gross kWh impact, and 96% of the ex-post gross kW impact. Among the direct install measures, CFLs make the largest contribution to both energy and demand impact, with 35% and 37% 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 3-18. Ex-Post Gross Impact Summary**

Program Measure	Ex-Post kWh	Percent of Total Ex-Post kWh	Ex-Post kW	Percent of Total Ex-Post kW
CFL	249,486	35%	23.65	37%
Kitchen Aerators	59,491	8%	6.10	10%
Bathroom Aerators	46,996	7%	6.41	10%
Showerheads	175,329	24%	8.85	14%
Pipe Insulation	75,884	11%	16.65	26%
Total Direct Install	607,186	84%	61.65	96%
<i>Direct Install Gross Impact Realization Rate</i>	90%		92%	
Water Heater Temperature Setback	14,100	2%	1.61	3%
Energy Survey Recommendations	100,190	14%	0.85	1%
<b>Total</b>	721,476	100%	64.12	100%
<i>Gross Impact Realization Rate</i>	107%		96%	

### 3.2.2 Net Program Impact Results

This section summarizes the PY2 net-to-gross ratio estimation approach and results for the Single Family All-Electric Home Energy Performance Tune-Up 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. More specifically, for each direct install measure, the following free ridership battery is posed to each measure recipient:

FR1. At the time that you first heard about this program, had you...?

1. Already been thinking about installing [MEASURE]?
2. Already begun collecting information about [MEASURE]?
3. Had not thought about installing [MEASURE] before you first heard about the program
4. Other, specify
8. Don't know /Refused

[SKIP IF FR1 = 3]

FR2. Just to be sure I understand, did you have specific plans to install [MEASURE] before learning about the program?

1. Yes
2. No
8. Don't know/Refused

FR3. On a 0 to 10 scale, with 0 being not at all likely and 10 being very likely, how likely is it that you would have installed [MEASURE] if you had not received (it/them) through the program? [0-10, DK, REF]

I'm going to read two statements about the [MEASURE] you received. On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with each statement.

FR4. There may have been several reasons for the installation of the [MEASURE], but the program was a critical factor in my decision to have the [MEASURE] installed.

FR5. I would have installed [MEASURE] within a year of when I did even if I had not received (it/them) from the program.



### *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 SFHEP program then the probability of free ridership is estimated to be zero. That is:

1. [ If FR1=3 then free ridership score=0]

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, then the probability of free ridership is estimated to be zero.

2. [ If FR2=2 and FR3 is less than or equal to 3, then free ridership=0]

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 program is a direct install program, where the customer demonstrated 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.  $[(FR3+FR5)/2 * (1/3) + (10-FR4)*(2/3)]$

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:  $[FR5*(1/3)+(10-FR4)*2/3]$ . If FR3 and FR5 are missing then the score is based on FR4 alone [FR4].

A bulb count weight is applied in calculating the overall result for CFL free ridership<sup>14</sup>, while other measure free ridership scores are aggregated using an equal weight, in accordance with the assignment of ex-ante impact. Application of this algorithm results in the measure and program free ridership estimates shown in Table 3-19. The CFL free ridership is markedly higher than for the other measures, at more than one-third. The market for CFLs has gained some momentum due to market forces and trends, as well as the ComEd midstream lighting program. The midstream lighting program increases awareness and acceptance of CFLs, increasing the propensity of residential customers to select CFLs over incandescent bulbs.

---

<sup>14</sup> Each participant free ridership score is assigned a weight in accordance with the number of bulbs installed in the home.

**Table 3-19. Free Ridership Results by Measure**

Measure	Free Ridership
CFL	34%
Low Flow Showerheads	8%
Faucet Aerators	3%
Pipe Wrap	7%
Overall	26%

### *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 participant receiving a given direct install measure category, the following spillover battery is posed:

SP1. Have you installed any more [MEASURE] since you received the ones through the program?

1. Yes
2. No
8. Don't know/Refused

SP2. How many additional [MEASURE] have you installed?

SP3. How influential was the program in encouraging you to install the additional [MEASURE]? Please rate this on a 0-10 scale, where 0 means not at all influential and 10 means very influential.

### *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 direct install 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 for granted for CFL spillover adoptions must avoid double counting impact credit accrued already through the midstream residential lighting program, which was in operation throughout PY2. 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 PY2 evaluation results indicate a substantial amount of free ridership (46%), 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 SFHEP program.

There is some available evidence regarding the CFL market share of residential lighting program bulbs. The 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 SFHEP 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 SFHEP program (making the 50% assumption conservative).

### **Low Flow Showerheads and Faucet Aerators**

Crediting a spillover adoption toward program net impact is problematic if the spillover measure is a showerhead or an aerator. The problem arises from the approach to ex-ante impact. In particular, the ex-ante gross impact calculations for these measures assume the home is fully retrofit with these water saving measures. That is, the full complement of expected faucet and shower hot water use is affected by the retrofit. If some of the original faucets or showerheads remain unchanged by the program retrofit, an adjustment is applied to the ex-ante impact to yield ex-post gross impact. Spillover adoptions of showerheads and aerators are important to impact only to the extent that they offset an incomplete retrofit case. Spillover adoptions are incorporated into the impact calculation for showerheads and aerators as a component of the partial retrofit adjustment. The partial retrofit adjustment is calculated with and without the spillover credit and the difference is the spillover estimate.

In the case of pipe wrap, 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 ex-ante impact for the spillover adoption.

Spillover estimates, using this approach and expressed as a percent of measure ex-ante impact are shown in Table 3-20 below:

**Table 3-20. Spillover Results by Measure**

Measure	Percent of Participants Reporting Spillover Adoption	Mean Spillover Quantity per Adoption	Spillover Adjustment
CFL	26%	4.2 bulbs	6.4%*
Low Flow Showerheads	1%	1 showerhead	0.5%^
Faucet Aerators	0%	-	0%
Pipe Wrap	9%	22.4 LF	9%
Overall	-	-	3.5%

\*Calculated as  $(0.26 * 4.2 * 709 / 6,126) * 0.5$ , 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.

^Calculated as the difference in the partial retrofit adjustment with spillover credit versus without spillover credit.

Table 3-21 below integrates both net-to-gross analysis results and ex-post gross impact results to form final program impact estimates for PY2. The final net-to-gross ratios (NTG) for each measure are calculated as:

$$\text{NTG} = 100\% - \text{free ridership} + \text{spillover}$$

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.

The gross impact realization rates reflect the combined effect of measure removals, partial retrofits<sup>15</sup>, and home occupancy. 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 22% in kWh and 19% in kW. As discussed above, program activities also impacted energy 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, the program net impact for PY2 is 638 MWh and 57 kW, representing 112% and 100% of measure ex-ante impact claims, respectively.

**Table 3-21. Ex-Post Gross and Net Impact Summary**

Measure	Gross Impact RR	Ex-Post Gross kWh	Ex-Post Gross kW	NTG	Ex-Post Net kWh	Ex-Post Net kW
CFL	102%	249,486	23.65	72%	180,572.1	17.1
Kitchen Aerators	92%	59,491	6.10	97%	57,706.3	5.9
Bathroom Aerators	67%	46,996	6.41	97%	45,586.1	6.2
Showerheads	81%	175,329	8.85	93%	162,179.3	8.2
Pipe Insulation	100%	75,884	16.65	102%	77,401.7	17.0
<b>Total Direct Install</b>	90%	607,186	61.65	87%	523,445.5	54.4
<i>Total Direct Install as Percent of Ex-Ante*</i>		90%	92%		92%	96%
<b>Other Program Impact</b>						
Water Heater Temperature Setback	-	14,100	1.61	100%	14,100.0	1.6
Energy Survey Recommendations	-	100,190	0.85	100%	100,190	0.9
<b>Total</b>	-	721,476	64.12		637,735	56.9
<i>Total as Percent of Ex-Ante*</i>	-	107%	96%		112%	100%

\* These are measure level ex-ante values, prior to ex-ante portfolio adjustments reflecting an expected overall gross realization rate of 0.90.

<sup>15</sup> This is an adjustment reflecting the proportion of fixtures in the home retrofit, and applies to the low flow showerhead and faucet aerator measures. See the "Partial Retrofit Adjustment" section on page 3 for a more detailed discussion.

### 3.3 *Process Evaluation Results*

#### 3.3.1 **Process Themes**

The program is expected to operate under the current design through the end of PY3. However, during PY3 ComEd, Nicor Gas Company and Integrys Gas Companies are also expected to launch a joint venture. Since there is a relatively small market of all electric homes in ComEd service territory the addition of gas-heated homes will increase the potential for electric savings through the program. The new version of the program will also be a combined energy survey and direct install program for single family homes. As such, we focus this process evaluation on key findings and recommendations that may be incorporated into the joint version of the program during the PY3 transition year.

#### *Program Implementation and Tracking Processes*

Overall, program implementation was well-established and efficient in installing low-cost energy saving measures in all-electric homes. The program was successful in identifying, targeting and recruiting all-electric customers to participate. The program was effective in installing high efficiency CFLs and other measures in the highest energy-using, all-electric homes despite a small pool of eligible customers. Program managers believe that when the program is translated into serving gas customers, the program will be even more successful since there is a larger pool of gas customers.

In addition, the implementer was competent and adaptive to market conditions. We found that the implementer was competent, especially when interacting with utility customers. Program managers stated that the implementer was well-staffed with friendly, personable, and informative in-home personnel. Moving forward, this will be an important component of the joint version of the program, and the utility managers recognize its value: *"I think (the personable, customer-focused approach is) a huge take away for us; (we will) have a better appreciation of that for all the programs."* The implementer also adapted implementation practices as needed to improve program delivery. For example, the implementer switched from setting exact appointment times to providing windows of time in which the contractor would arrive and complete the program services. This allowed implementers to increase the number of homes visited from three to five per day. The implementer also started scheduling appointments geographically to save time spent driving in between participant homes.

The program experienced some obstacles when soliciting customers to participate. The main obstacles and corresponding solutions implemented by the program are presented below.

- Customers had difficulty scheduling home performance tune-up appointments during the work week. In response, the program offered Saturday appointments. Additionally, the implementation team narrowed the appointment-wait window from 3 to 2 hours.

- The program also faced customer uncertainty regarding the program and utility's true motivation. Some customers believed the program would try to sell them more products and services, especially given the low cost to participate and direct install measures. Some customers thought these services were "teasers" and the program would try to solicit them to buy further products and services.
- The program also faced difficulty while trying to recruit customers during "shoulder months" when customers were not motivated to reduce energy costs as they might be during the Summer or Winter. In response, the program introduced tactics during the Spring of 2010 to spur motivation, such as restaurant vouchers.

Data tracking for this program is one area in need of ongoing improvement. Overall, program managers believe the implementer did a good job of 1) providing them with weekly reports tracking progress toward goals at a high level; and 2) providing them with measure-specific information about number and type installed in each home. However, both ComEd and Honeywell noted that there had been a discrepancy in the number of records between the weekly reports and databases with measure-specific information. Managers explained that the discrepancy was due to 1) inconsistencies in the ways individual implementation staff members were recording data; and 2) getting a slow start on building a data export system to transfer data from the implementer to the utility. Both of these challenges now appear to have been overcome, but program staff should continue to closely monitor tracking processes especially when the program is expanded into the joint version.

## Marketing Channels

The program implementer varied the channels and incentives, from an informational approach through mailings, to telemarketing, to offering additional incentives such as waiving the \$25 fee and giving away \$50 restaurant vouchers. Below, we describe the program's marketing and outreach methods and their relative effectiveness.

The program contacted the target population<sup>16</sup> first through initial direct mail efforts targeting different towns in ComEd service territory every one to two weeks. After the program mailed letters, staff followed up with customers through telemarketing. Finally, in early April 2010, mail and telemarketing approaches were each combined with opportunities to receive services for free, or to receive restaurant vouchers.

The participant survey data show that the vast majority (83%) of program participants first heard about the program through the program's primary outreach efforts indicating that these

---

<sup>16</sup> Managers reported that the initial pool of all-electric customers was approximately 35,000. They then winnowed down the pool to non-low income, high energy users who were not in arrears, netting 10,000 potential participants.

efforts were effective in recruiting customers into the program. As shown in Table 3-22 below, Most participants (66%) first heard about the program by a brochure or flyer delivered through direct mail. The next largest group (17%) first heard about it from a ComEd representative.

**Table 3-22. How Participants First Heard of the Program<sup>17</sup>**

Outreach Method	Percent of Participants (n=109)
Brochure/Flyer through direct mail	66%
ComEd representative	17%
Customer called ComEd to ask about bill reduction	8%
Word of mouth	5%
Home association/administration	5%
TV or newspaper	1%
Total	100%

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: 47% of participants recommended flyers/ads/mailings, and 31% recommended bill inserts. Additionally, some mentioned phone calls. As shown in Table 3-23, these three outreach methods were the most frequently mentioned and the primary ones the program used. This suggests that the program chose effective outreach methods.

---

<sup>17</sup> The process analysis uses “valid” percents throughout this report, i.e., removing “don’t know” and refusal responses from the distributions.



**Table 3-23. Customer Recommended Outreach Methods**

Outreach Method	Percent of Participants* (n=114)
Flyers/Ads/Mailings	47%
Bill Inserts	31%
Phone calls	10%
Representatives	7%
Mass media (TV radio, newspaper)	5%
Gift cards/ free items	4%

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

Given that the joint version of the program will draw from a larger pool of customers, it may be less likely that the program needs to employ the adaptive marketing strategies they did in the current version. Instead, if bill inserts or mass mailings are options, the program may choose to continue with the successful mail-based efforts. While participants found the information in the mail materials very useful, the program should consider fine-tuning the message. The program should make sure that they emphasize that the measures are free and that a customized report is created.

### Marketing Messaging

We found that the outreach materials were useful to participants and well-aligned with program benefits. As shown in Table 3-24, the vast majority of participants (94%) 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.

**Table 3-24. Usefulness of Program Mailings**

Level of Usefulness	Percent of Participants (n=91 )
Very useful	66%
Somewhat Useful	28%
Not very useful	4%
Not at all useful	2%
Total	100%

The print materials emphasized the value of the program (i.e., \$300 value), energy efficiency, lower electric bills, and free measures. These points were highlighted in color or appeared early in the letter. Letters provided customers a program hotline number they could call to schedule an appointment. The direct mail pieces were single page letters using the ComEd insignia. Although mentioned, the customized report program component was relatively buried in marketing materials as it appeared at the end of the letter and was not in color. Given our survey findings in which participant recall for the report was low, it may be important for the program to place a greater emphasis on the report in future marketing materials.

The telemarketing calls emphasized providing customers with an understanding of their electricity usage; providing the customers with an energy specialist who would assess the home and install the program measures; and providing customers savings on their electricity bills. Notably, the scripts did not mention that the measures were free or that a customized report would be provided, although it is possible that this was discussed in the rest of the call. Further, the implementer team screened customers for receptivity to CFLs, emphasizing that a focus of the program was to provide up to ten free bulbs. Program managers believe that the high installation rate of CFL bulbs increases program cost effectiveness. However, it seems likely that this screening increases the average free ridership rate as it screens for people who were already favorably disposed toward CFLs. The program manager should compare the tradeoffs that this implies as the program's cost effectiveness is examined.

Program participants identified three main benefits to participating in the program: (1) Lower Energy Bills; (2) Increased awareness of home's energy use; and (3) Receiving energy saving measures. Over half (67%) said they received a lower energy bill after participating in the program. Participants (28%) also had increased awareness where energy had been previously wasted in their homes. Per one participant, *"(The program) helps you learn where you are wasting your energy."* Further, participants (21%) mentioned the actual energy saving measures as a key benefit gained from the program. Per one participant, *"We got things we never would have had like the aerators and all the bulbs. We probably would have never had that done (if it weren't for the program)".* The benefits identified by participants are presented in Table 3-25, and are in line with the program benefits communicated in the marketing materials.

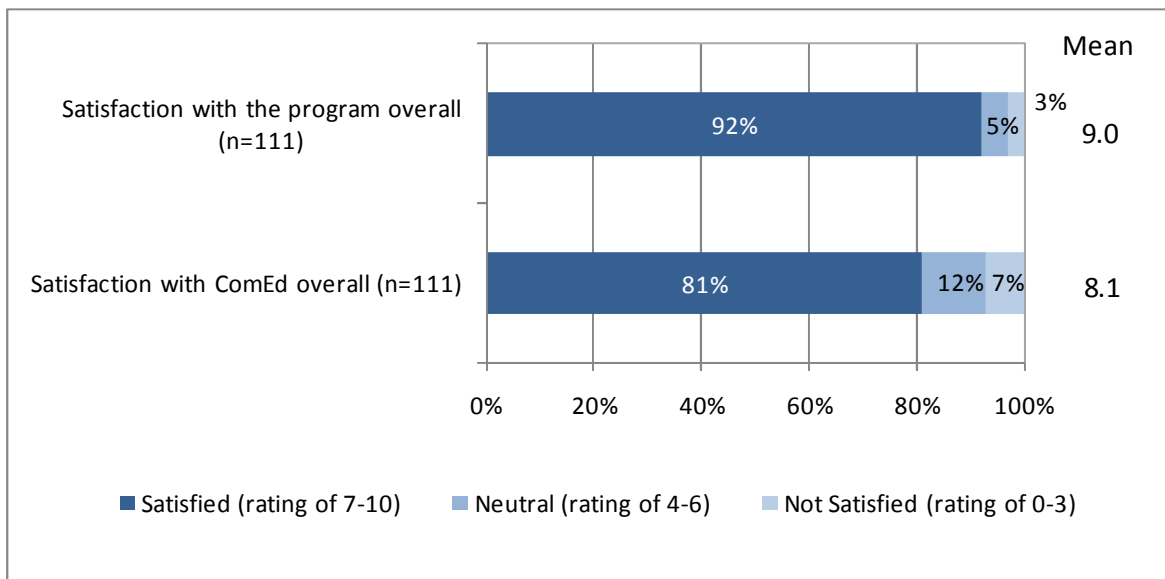
**Table 3-25. Participant-Identified Program Benefits (mult. response)**

Benefits	Percent of Participants (n=114)
Having a lower energy bill/use less energy	67%
Awareness/education/learning where energy had been wasted/Receiving recommendations	28%
Receiving the energy saving measures	21%

## Participant Satisfaction

Generally, program satisfaction was high across all elements of the program, further indicating that the program is well implemented. As shown in Figure 3-1, the vast majority (92%) of participants stated that they were satisfied with the program overall and most (73%) gave a 9 or 10 indicating that they were very satisfied with the program. In comparison, a smaller majority (81%) of participants stated they were satisfied with ComEd overall.<sup>18</sup>

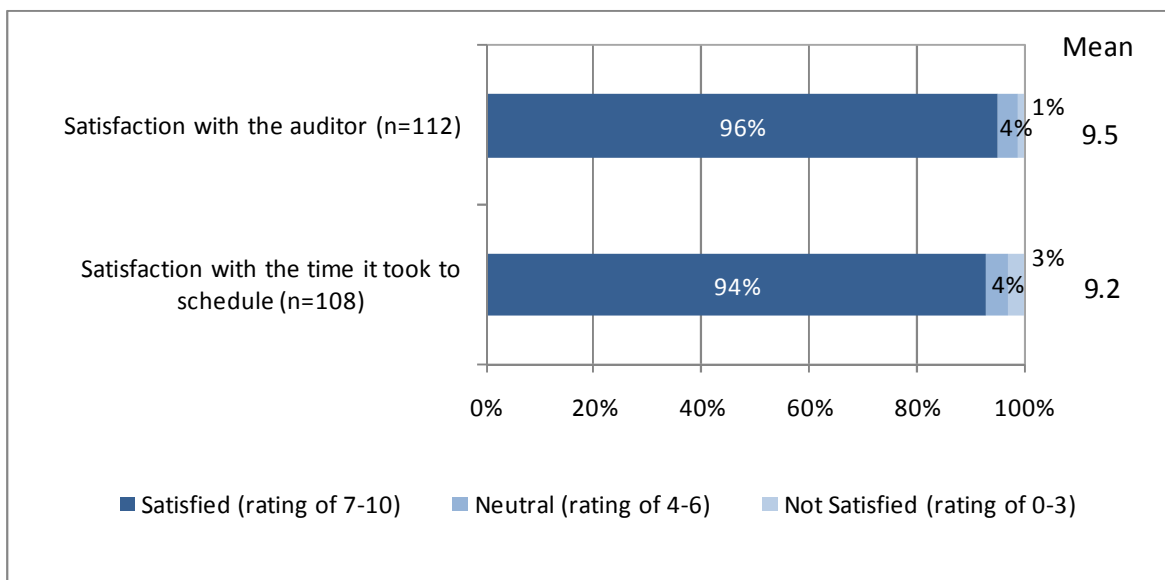
**Figure 3-1. Overall Program and Utility Satisfaction**



As shown in Figure 3-2, nearly all participants stated they were very satisfied with the energy specialist that visited their home and the time it took to schedule the visit. The vast majority (96%) stated that they were satisfied with the contractor and most (87%) gave a 9 or 10 indicating that they were very satisfied. The vast majority (94%) also stated that they were satisfied with the time it took to schedule the home visit and most (81%) gave a 9 or 10 indicating that they were very satisfied. The high participant satisfaction for program personnel matches program managers' characterizations of the on-site specialists being informative and personable.

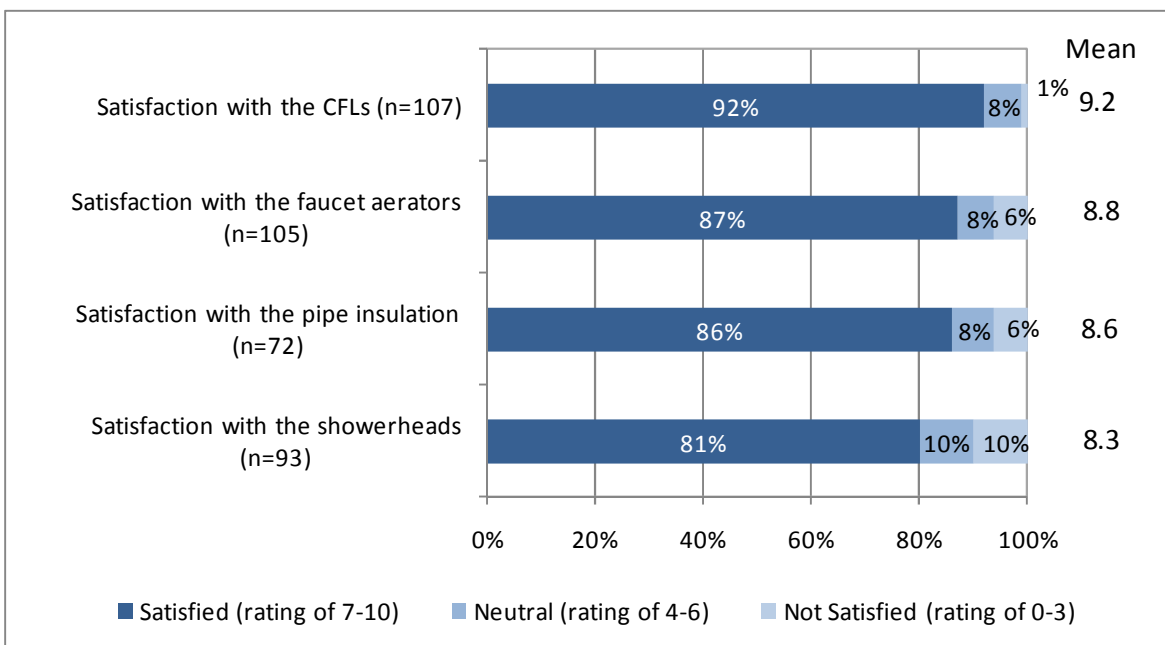
<sup>18</sup> Most participants who stated they were dissatisfied with the utility overall cited high rates or high bills as the reason for their dissatisfaction.

**Figure 3-2. Satisfaction with In-Home Staff and Scheduling**



As shown in Figure 3-3, participant satisfaction was also high for the installed measures, especially CFLs. The vast majority (92%) stated that they were satisfied with the CFLs and most (80%) gave a 9 or 10 indicating that they were very satisfied. This indicates that the program made good decisions to increase the maximum number of CFLs installed to ten, and should continue this measure's central role in the joint version of the program.

**Figure 3-3. Satisfaction with Direct Install Measures**



When we asked participants to give reasons for any program dissatisfaction, they mainly provided measure-specific reasons focused on showerheads not providing enough water. For example one participant stated: *"We like a good healthy flow (from the showerhead) and this is very mild, (there's) not enough water pressure."* A few participants also stated that the faucet aerators did not provide enough flow: *"I'm used to having more force from the showerhead and faucet and I prefer that sort of power."* These are common reactions to water saving measures in the general population and are likely not indicative of a program-specific issue.

Since participant satisfaction for all program components and measures was generally high, it is not surprising that when prompted, only one-quarter of participants offered suggestions to improve the program. In fact a relatively high proportion (13%) highlighted that the program is good as-is. This is further indication of a well-designed and implemented program.

Among the participants who did make a suggestion (25%), the most frequent suggestion was that the program should provide follow-up or provide feedback on the actual savings achieved as a result of program participation. Making energy saving recommendations more specific was also mentioned by a relatively high proportion of participants. This finding reflects other findings related to the energy survey report and is covered in the next section.

**Table 3-26. Suggestions for Program Improvement (mult. response)**

Benefits	Percent of Participants (n=29)
Provide follow-up/ give feedback on savings	21%
Make recommendations more specific	17%
Assessment should cost less/be free	14%
Make more customers aware of the program	14%
Improve the quality of the measures	14%
Give more information (e.g., on alternative energy)	10%
Provide more free items/subsidize bigger measures	7%
Simplify recommendations	7%
Other	3%

### Energy Survey Report Recall and Satisfaction

The energy survey report is an important program component as it offers participants the education needed to take further energy reducing actions in their home beyond the direct install measures. Yet as shown in Table 3-27, a significant portion of participants (29%) did not

remember receiving a report with a set of energy saving recommendations. While 71% of participants remember receiving the recommendations, only about half of this group (39%) remembered a specific recommendation made during the home visit. This indicates that some participants may not know where to start in taking energy efficient action based on anything they may have learned about through the program. Low participant recall is unexpected considering that the implementation manager highlighted the energy specialists' focus on the report:

*“Going over (the report) with (the participants) is the most important part: going through and explaining how the recommendations that we’re making are actually going to help; how easy they are to do on your own; ... It’s a communication factor and it’s an education factor that gets people to not only appreciate and understand what they’re doing with all this stuff but also you get ... more savings in the future.” – Program Implementation Staff*

Given this emphasis of the program while in participant homes, it is possible there are other reasons for this disconnect including general memory issues among participants.

**Table 3-27. Recall of Program Recommendations**

	Totals (n=114)
Remembered receiving recommendations	71%
Do not remember receiving recommendations	29%

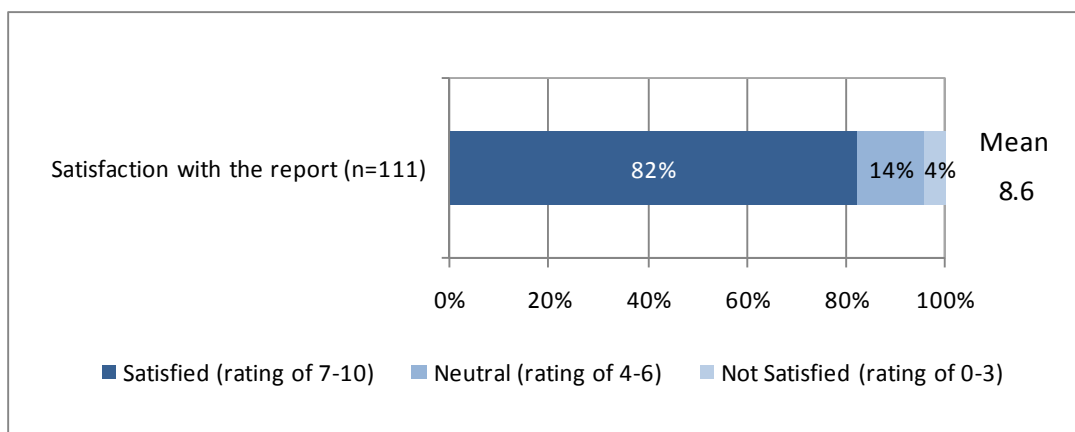
Many participants (44%) who could remember receiving recommendations nevertheless could not recall specific ones. However, as shown in Table 3-28, participants who could recall a specific one primarily cited insulating various spaces in their homes; installing more CFLs or other energy efficient lighting; and replacing old appliances, especially refrigerators.

**Table 3-28. Specific Recommendations Recalled (mult. response)**

Recommendations	Percent of Participants (n=81)
(Don't Know)	(44%)
Wall, ceiling, crawl space or attic insulation	15%
CFLs/lighting	10%
New refrigerator	6%
Recycle/get rid of extra refrigerator/old appliances	6%
Adjust heating/cooling temperatures	4%
Replace windows	4%
Window insulation or sealing	4%
New AC	3%
Pipe insulation	3%
New furnace	3%
New water heater	3%
Other	4%

Although generally high, participant satisfaction with the energy survey report was low compared to satisfaction with other program components and suggests there may be some room for improvement. As shown in Figure 3-4, only 82% of participants stated they were satisfied with the report.

**Figure 3-4. Report Satisfaction**



## Actions Taken and Planned

Table 3-29 below summarizes the proportions of participants who implemented and plan to implement program recommendations. Approximately one in five participants (18%) had implemented program recommendations at the time the participant survey fielded, primarily by installing CFLs or other efficient lighting. Additionally, almost one-quarter of participants plan to implement some of the recommendations. Many of the recommendations provided to participants are high-cost such as replacing windows or refrigerators. In interviews, program managers suggested that some participants have economic limitations to installing recommended measures, and comfort limitations to adopting energy efficient behaviors. When asked what actions participants plan to take, most plan to adopt lower cost measures such as insulation, CFLs and air sealing.

**Table 3-29. Program Recommendations Implemented or Planned**

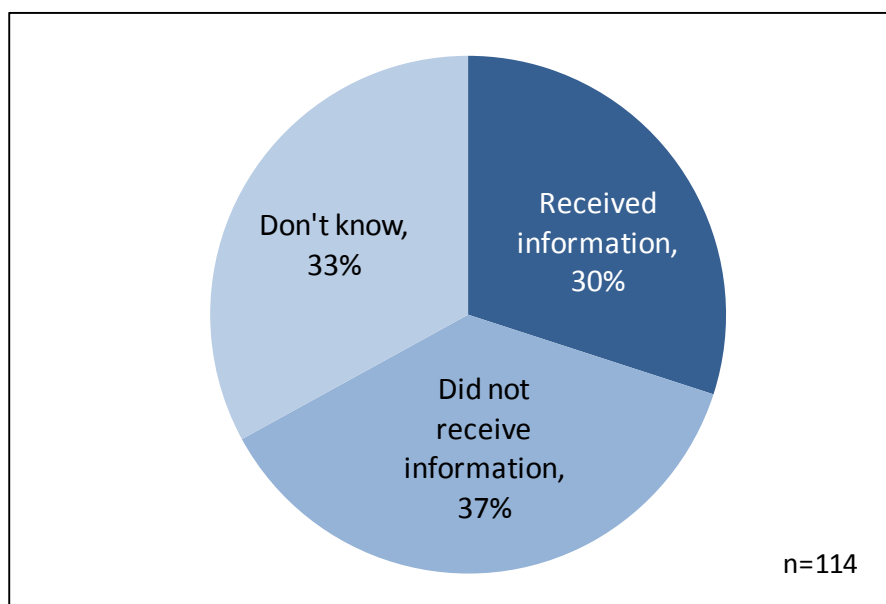
	Implemented Recommendations (n=114)	Plan to Implement Recommendations (n=114)
Yes	18%	23%
No	82%	77%

## Channeling to other programs

Although the visiting energy specialists are supposed to leave behind information about other ComEd programs, only a small portion of the participants stated they received it, and an even smaller portion participated in these other programs. As shown in Figure 3-5, only 30% of participants stated they received any information and another 33% stated that they did not recall. These proportions suggest that the installation process and energy survey report may have overshadowed information on other programs.



**Figure 3-5. Recall Receiving Other Program Information**



Among those who stated they received information on other programs, 62% recalled at least one program, while 38% did not. Table 3-30 lists the ComEd programs participants recalled. Participants most often recalled the AC tune up and appliance recycling programs.

**Table 3-30. Other ComEd Programs Recalled (mult. Response)**

Benefits	Percent of Participants (n=34)
AC Tune Up	24%
Appliance recycling	21%
SmartMeter program to turn off AC at peak times	6%
Bulb discounts	6%
Other services (i.e., tree trimming)	6%
Energy Saving Programs (general)	6%
Discounts on windows	3%
Reduce rates for all electric/off peak use	3%
(Could not recall, don't know)	38%

Among those participants who recalled receiving information on other programs, 15% participated in other programs. These participants most often participated in the AC Tune Up

program. Thus, there is some evidence that the program successfully channeled some participants into other programs. Although the program does not track channeling into other programs, we found some evidence for channeling by searching other program databases. Following their participation in the program, 2% of the participants participated in the ComEd appliance recycling program and 1% went on to participate in the residential AC program.

### 3.4 *Cost Effectiveness Review*

This section addresses the cost effectiveness of the All Electric Single Family Home Energy Performance Tune-U program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. The TRC test is defined in the Illinois Power Agency Act SB1592 as follows:

*“ ‘Total resource cost test’ or ‘TRC test’ means a standard that is met if, for an investment in energy efficiency or demand-response measures, the benefit-cost ratio is greater than one. The benefit-cost ratio is the ratio of the net present value of the total benefits of the program to the net present value of the total costs as calculated over the lifetime of the measures. A total resource cost test compares the sum of avoided electric utility costs, representing the benefits that accrue to the system and the participant in the delivery of those efficiency measures, to the sum of all incremental costs of end-use measures that are implemented due to the program (including both utility and participant contributions), plus costs to administer, deliver, and evaluate each demand-side program, to quantify the net savings obtained by substituting the demand-side program for supply resources. In calculating avoided costs of power and energy that an electric utility would otherwise have had to acquire, reasonable estimates shall be included of financial costs likely to be imposed by future regulations and legislation on emissions of greenhouse gases.”<sup>19</sup>*

ComEd uses DSMore™ software for the calculation of the TRC test.<sup>20</sup> The DSMore model accepts information on program parameters, such as number of participants, gross savings, free ridership and program costs, and calculates a TRC which fits the requirements of the Illinois legislation. Environmental benefits have been quantified for CO<sub>2</sub> reductions, using a value of \$0.013875 per kWh.

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

---

<sup>19</sup> Illinois Power Agency Act SB1592, pages 7-8.

<sup>20</sup> Demand Side Management Option Risk Evaluator (DSMore) software is developed by Integral Analytics.

record. This method captures the impact on electric prices that comes from extreme weather conditions. Extreme weather creates extreme peaks which create extreme prices. These extreme prices generally occur as price spikes and they create a skewed price distribution. High prices are going to be much higher than the average price while low prices are going to be only moderately lower than the average. DSMore is able to quantify the weighted benefits of avoiding energy use across years which have this skewed price distribution.

Table 3-31 summarizes the unique inputs used in the DSMore model to assess the TRC ratio for the All Electric Single Family Home Energy Performance Tune-U program in PY2. 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 3-31. Inputs to DSMore Model for All Electric Single Family Home Energy Performance Tune-U Program**

Item	Value Used
Measure Life	9 years
Participants	760
Annual Gross Energy Savings	721MWh
Gross Coincident Peak Savings	0.1 MW
Net-to-Gross Ratio	72% to 102%
Utility Administration and Implementation Costs	\$66,431
Utility Incentive Costs	\$198,628
Participant Contribution to Incremental Measure Costs	\$25

Based on these inputs, the TRC for this program is 0.95 and the program does not pass the TRC test. The standard TRC calculation produced by DSMore is 0.69. This was the first full year of operation of the All Electric Single Family Home Energy Performance Tune-Up program. Administrative costs are highest in the startup year of a program. It is expected that administrative costs will moderate and participation will increase in future years. The combined effect should be increased savings at a lower cost per unit, creating a TRC that is greater than one.

## Section 4. Conclusions and Recommendations

### 4.1 *Conclusions*

This section highlights the findings and recommendations from the evaluation of the All Electric Home Energy Performance Tune-Up Program 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 2 (PY2); 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.

#### 4.1.1 **Program Impacts**

The program achieved 721 MWh gross and 638 MWh net energy savings during PY2. It achieved 64.1 kW gross and 56.9 kW net demand impact. Energy survey recommendation uptake was responsible for 16% of the net energy impact, or 100 MWh. The adopted recommendations consisted primarily of insulation measures, both attic and basement. The estimated impact from the insulation measures on peak demand was zero, so the contribution to net demand impact arising from survey recommendation uptake is only 1.5 percent.

Gross impact realization rates varied from 67% for faucet aerators to 102% for CFL, and the total was 90%. Lower gross impact realization rates are attributable primarily to partial retrofit adjustments and removals, while the higher realization rate associated with CFL is due to a lower than expected attrition rate (3% measured versus 5% 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 34%, while other measure free ridership ranged from 3% to 8%. The high CFL free ridership is reflective of an evolving market for CFLs, due in part to the ComEd residential midstream lighting program, as well as other market forces. At the same time, CFLs had very high rate of participant spillover, with more than 25% 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 6.4% of the ex-ante CFL impact.

Table 4-1 presents key impact evaluation results by measure, including ex-ante and ex-post gross and net savings.

**Table 4-1. Ex-Post Gross and Net Program Impact**

Measure	Gross Impact Realization Rate	Ex-Post Gross kWh	Ex-Post Gross kW	NTG Ratio	Ex-Post Net kWh	Ex-Post Net kW
CFL	102%	249,486	23.7	72%	180,572	17.1
Kitchen Aerators	92%	59,491	6.1	97%	57,706	5.9
Bathroom Aerators	67%	46,996	6.4	97%	45,586	6.2
Showerheads	81%	175,329	8.9	93%	162,179	8.2
Pipe Insulation	100%	75,884	16.7	102%	77,402	17.0
<b>Total Direct Install</b>		607,186	61.7		523,446	54.4
<i>Total Direct Install, Percent of Ex-Ante*</i>		90%	92%		92%	96%
<b>Other Program Measures and Recommendations</b>						
Water Heater Temperature Setback	-	14,100	1.6	100%	14,100	1.6
Energy Survey Recommendations	-	100,190	0.9	100%	100,190	0.9
<b>Total Program Impact</b>	-	721,476	64.1		637,736	56.9
<i>Total Impact as a Percent of Ex-Ante*</i>	-	107%	96%		112%	100%

\* Ex-ante value, prior to the portfolio adjustment reflecting an expected overall gross realization rate of 0.90.

#### 4.1.2 Program Processes

Overall, this evaluation found that the program succeeded in delivering low-cost energy efficiency measures to high-use electric customers. This evaluation found multiple indicators of program success including:

- Highly satisfied program participants: 92% 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'). Additionally, when asked to provide suggestions for improvement, a

relatively high proportion (13%) of all participants highlighted that the program is good as-is.

- A personable and engaged group of assessors interacting with customers: 96% of program participants rated their satisfaction with their visiting energy specialist a 7 or higher on a scale from 0 ('very dissatisfied') to 10 ('very satisfied').
- Highly satisfying measures: participant satisfaction ranged from 81% to 92% across the four measures, with CFLs receiving the highest ratings.
- The program reached its participation and energy savings goals: The program recruited 760 participants into the program during PY2 meeting the energy savings goals.

Several program design elements contributed to its success including:

- A marketing team that segmented and targeted ComEd customers eligible for this program.
- A well-targeted marketing campaign that used appropriate channels and messaging to effectively identify and recruit program participants.
- An adaptable incentive strategy that was altered as needed to reach the program's goals for participation and energy savings.

This program is both a resource acquisition program and an education program. The education component of this program needs to be stressed in the program design and delivery to achieve the additional savings the evaluation quantified. There were several data points in this evaluation that indicate that the direct install measures had more of an impact on the participants than the educational components did.

- A significant portion of respondents (29%) did not recall receiving a report with recommendations.
- Only a minority of respondents (39%) could recall a specific recommendation from the report.
- One in five (18%) implemented at least one recommendation provided by the program at the time of the participant survey and 23% plan to implement at least one recommendation. While this is a great accomplishment for this program, educational programs should consider program design changes that strive for an even greater conversion rate.

## 4.2 *Recommendations*

### 4.2.1 **Impact Recommendations**

It is recommended that the operations manual be expanded to reflect guidelines regarding the existing versus replacement bulb wattages for CFLs. This will support greater certainty around the removed wattage assumptions, and avoid any need to rely on estimated power factors which typically reflect self-installed CFLs, not direct installs.

It is recommended that specific requirements related to the removed and replaced faucet aerators and showerheads be added to the program Operations Manual. Currently there is little documentation of the efficiency characteristics of the removed equipment. Consideration can be given to having the Operations Manual requirements specify a physical inspection of the removed showerhead for an imprinted GPM, along with an instruction to replace the showerhead only when it is greater than or equal to 2.5. Similarly, for aerators a bag test might be required where there is already some form of aeration on the faucet.

It is recommended that the total number of showerheads, kitchen faucets, and bathroom faucets present in the home be noted for tracking in addition to the number installed. The percent of total fixtures that are retrofit has a substantial bearing on impact that can be expected. These data could help to inform ex-ante gross impact estimates.

It is recommended that the participant tracking system be updated to include data reflecting the specific energy survey recommendations provided to each participant. Ideally, the tracking system data would include the recommended measure description, and estimated costs and energy savings expressed in kWh.

If the current software specifications allow it, it is recommended that demand impact figures associated with recommended measures be generated for the tracking system. Information regarding expected demand impact would be useful to the impact evaluation.

The participant survey results indicate that insulation is relatively frequently recommended in energy survey reports. Further, insulation recommendations are relatively frequently implemented by participants. The energy impact associated with this measure is highly sensitive to the levels of pre-existing insulation. Currently, recommendations for adding attic insulation are provided to homes with existing insulation of less than 6 inches. At the same time, due to limitations in the energy survey software the calculations of energy savings are based on zero existing insulation. An upgrade of the software to accommodate varying levels of existing insulation would be a notable improvement in the accuracy of the energy savings estimates presented to the customer. If nothing else, a notation of the pre-existing insulation levels for program tracking would be quite useful to future impact evaluation efforts.

It is recommended that the energy survey report include the date of the last AC maintenance, and if appropriate, provide a recommendation for AC tune-up, along with information on available ComEd program subsidies.

Data indicate that the dollar savings estimates presented to the customer may be using a higher assumed cost per kWh than the 7.8 cents that is currently charged under the all-electric rate. It is recommended that the calculation of expected dollar savings associated with measures be reviewed for consistency with the all-electric rate.

Energy survey recommendation uptake is estimated to have generated 100 MWh of impact in PY2, making up 16% of total program net energy impact. It would therefore seem acceptable to add an ex-ante claim for the energy survey to the existing claims for the direct install measures. It is important to note that much of the recommendation uptake occurred within the pilot program participant population. Participants under the current design adopted recommended measures that achieved 45 MWh of energy savings, or 70 kWh per participant during PY2. If an ex-ante claim is made for energy survey recommendation uptake, it should not exceed 70 kWh per participant. Also, the annual impact arising from survey recommendations is much more uncertain than those associated with direct install measures. It is uncertain how many participants will have opportunities and available capital to install efficiency measures in their homes based on survey recommendations, let alone how many will follow through on recommendations during the first year. Any ex-ante impact claim associated with energy survey recommendation uptake will carry with it greater levels of uncertainty than other measure claims.

The water heater temperature setback is estimated to have generated 14 MWh of impact during PY2, or 2% of net impact. Participant phone surveys indicated that those receiving temperature setbacks accepted the new setting and did not re-set the temperature subsequently. Thus, there is evidence of measure persistence, and solid record keeping including pre- and post- setback temperatures. Unlike recommendation uptake, temperature setback records support a high degree of certainty in estimating the rate that temperature setback is implemented. For these reasons, it would be reasonable and prudent to add a program ex-ante claim for water heater temperature setback of 188 kWh per occurrence.

#### **4.2.2 Process Recommendations**

While this program in its current form will expire at the end of PY3, many design elements may be folded into an upcoming joint gas and electric program originating during the same year. As such, we recommend that program staff consider the recommendations below based on lessons learned from the evaluation of the All-Electric program.



### *Tracking Processes*

Although challenges with tracking and database transfer appear to have been overcome, we make the following recommendations:

- Closely monitor program record keeping. Ensure that program staff enter participant and measure-specific information uniformly, by reviewing records monthly.
- Test database transfer procedure. A process by which data is transferred to ComEd, Nicor Gas, and Integrys Gas Companies should be established early and tested to ensure clear communication and documentation. Program data should be transferred quarterly to ensure that transfer procedures are working smoothly.

### *Marketing and Outreach Materials*

The program was generally well designed and implemented, but some of the program benefits to participants did not appear to be consistently highlighted. The program should consider developing the outreach materials in the following ways:

- Highlight Saturday appointments. The program has been designed with the convenience of Saturday appointments and should highlight it to encourage participation of those who work during the week.
- Highlight 'free' measures in telemarketing scripts. If the program chooses to use telemarketing in the future, the script should state that the measures are 'free' to encourage greater customer interest.

### *Energy Survey Report*

The energy survey report is an important part of the program and could lead participants to take future action. However, many respondents do not remember receiving the energy survey report and fewer could recall a specific recommendation. To increase participant recall of the report and to minimize lost opportunities, we make the following recommendations:

- Prime customer expectation for the energy survey report by highlighting it in marketing and outreach materials. Neither the mailings nor the telemarketing script highlighted a customized report. Although the report was emphasized in-home by the visiting energy specialist, it may have been overshadowed by the immediacy of measure installation. Given low participant recall for the report, it may be necessary to start building expectation for it prior to the assessment, by highlighting it in marketing and outreach materials.
- Make the report more 'user-friendly', by ranking recommendations (e.g., the 'top three') based on the participant's home and energy use patterns. A few participants stated the

report was not specific enough or that it needed to be simplified. We recommend that the report include a short list, through which the participant can get the most ‘bang-for-the-buck’ through changes in behavior and expenditures on additional measures.

### *Feedback and Leverage Opportunities*

Among the participants who did make a suggestion for program improvement, the most frequent suggestion was that the program should provide feedback on actual savings as a result of program participation. Notably this suggestion reflects existing program messaging emphasizing energy savings. Thus, it shows that there is potential for long term relationships with participants based on a shared focus of energy savings, through which further energy savings may occur. To leverage customer interest in energy savings, we make the following recommendations:

- Provide follow-up feedback on actual savings. Although providing feedback may require further program design work, it may create increased participant satisfaction and provide the program opportunities for case studies or testimonials to use in future promotion and outreach.
- Leverage participant interest in actual savings to encourage future energy savings actions. We recommend that if the program does provide participants with follow-up savings information, it also uses the opportunity to remind them of the energy survey report and recommendations. Further, the program could use this time to document whether participants have taken any further actions to reduce energy consumption and potentially attribute these additional savings to the program’s efforts. The program could also remind participants of other attractive ComEd programs to help them acquire additional energy saving measures.

## Section 5. Appendices

### 5.1 Data Collection Instruments

#### Single Family All Electric Home Performance Tune-Up Program

##### Participant Survey Instrument

PY2 Evaluation (June 1, 2009 – May 31, 2010)

FINAL: August 27, 2010

#### SAMPLE VARIABLES USED IN THE SURVEY INSTRUMENT

ODCID

Customer\_NAME

*Contact name in tracking database*

PHONE

CQTY – CFL QUANTITY

AQTY – AERATOR QUANTITY

SQTY – SHOWERHEAD QUANTITY

PQTY – PIPE INSULATION INCHES

CROOM1- CROOM6

*None*

*Bedroom*

*Dining room*

*Exterior= Exterior of the home*

*Family room/Sitting room = family room*

*Hallway*

*Kitchen*

*Living room*

*Office/Study = office*

*Porch/Mudroom/Unheated = porch*

*Bathroom Toilet = bathroom*

*Unlisted/Other = (do not ask about)*

*Work area/Shop = work area*

PART\_DATE

*date of participation (ex. July 1, 2010)*

WFLAG

*flag if Water Heater Was Set Back (0,1)*

CFLAG

*flag if CFL was installed (0,1)*

PFLAG

*flag if Pipe Insulation was installed (0,1)*

AFLAG

*flag if Kitchen or Faucet Aerator was installed (0,1)*

KITCHEN AERATOR FLAG (KAFLAG)

*Flag if Kitchen Aerator was installed (0,1)*

SFLAG

*flag if Low Flow Showerhead was installed (0,1)*

## INTRODUCTION

Hello, this is [INTERVIEWER'S NAME] from Opinion Dynamics calling on behalf of ComEd. This is not a sales call. We are contacting customers who have participated in ComEd's *Home Performance Tune-Up Program*. May I please speak with [CUSTOMER\_NAME]? [If needed: This program provided educational information and free installation of energy efficient upgrades such as CFL light bulbs. I'd like to assure you that your responses will be kept confidential and your individual responses will not be revealed to anyone.]

Are you the person who was most familiar with the upgrades? (If not may I please speak with the person who was most familiar with the upgrades?)

CONTINUE WITH RIGHT PERSON: We are conducting a study to evaluate ComEd's *Home Performance Tune-Up Program* and would like to include your opinions. This study is required by the Illinois Commerce Commission and will be used to verify the effectiveness of the program and to make improvements.

(IF NEEDED: It will take about 15 minutes.)

## S. SCREENERS



To start, we have several questions regarding the upgrades that were installed in your home. The answers to these questions are very important so that ComEd can determine how much energy is being saved.

S1. Our records show that during the visit to your home, a ComEd representative gave you the following upgrades. Please confirm that this is correct. Did you receive.... [1=YES, 2=NO, 8=DON'T KNOW, 9=REFUSED]

- a. [If CFL=1] Compact Fluorescent Light Bulbs
- b. [If AERATOR=1] Faucet Aerators
- c. [IF SHOWERHEAD =1] A low flow showerhead
- d. [IF PIPE=1] Pipe Wrap Insulation

[CONTINUE IF ANY S1a-d = 1, ELSE THANK AND TERMINATE]

Now I would like to ask you about the upgrades you received through the program.

**[ROTATE ORDER OF SECTIONS C, FA, SH AND PW]**

### **C. CFL MEASURE VERIFICATION**

**[ASK SECTION IF S1a =1]**

CFLMV1. [Wording if CFL\_QTY=1] Our records show that [CFL\_QTY] CFL was installed during the *Home Performance Tune-Up* visit to your home. Is this correct?

[Wording if CFL\_QTY>1] Our records show that [CFL\_QTY] CFL(s) were installed during the *Home Performance Tune-Up* visit to your home. Is this correct?

- 1. Yes, quantity is correct
- 2. No, quantity is incorrect
- 8. (Don't know) [SKIP TO NEXT SECTION]
- 9. (Refused) [SKIP TO NEXT SECTION]

**[ASK IF CFLMV1=2]**

CFLMV2. How many CFLs were installed during the *Home Performance Tune-Up*? [Prompt for best guess.] NUMERIC OPEN END up to 999, DK, REF] [USE AS CFL\_QTY FOR REMAINDER OF SURVEY UNLESS DK OR REF, **IF DK OR REF THEN SKIP TO NEXT SECTION**]

CFLMV3. Our records indicate that CFLs were installed in the [CFL\_ROOM\_1], [CFL\_ROOM\_2], [CFL\_ROOM\_3], [CFL\_ROOM\_4], [CFL\_ROOM\_5], and [CFL\_ROOM\_6]?  
**[DO NOT INSERT VARIABLE IF CFL\_ROOM\_1-CFL\_ROOM\_6 = UNLISTED/OTHER]**

Is this correct?

1. (Yes)
2. (No, specify)
8. (Don't know)
9. (Refused)

CFLMV4. What type of light bulbs did the CFLs replace? (Select all that apply)

1. Halogen
2. Incandescent
3. CFL
00. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF CFLMV4=3]

CFLMV5. How many CFLs were removed and replaced with other CFLs that you received from the program? [NUMERIC OPEN END up to CFL\_QTY (OR 12), DK, REF]

CFLMV6. [Wording if CFL\_QTY=1] Is the CFL you received from the program still installed in the original location?

[Wording if CFL\_QTY>1] Are all of CFLs you received from the program still installed in their original locations?

1. (Yes) [SKIP TO [CFLMV19](#)]
2. (No)
8. (Don't know) [SKIP TO [CFLMV19](#)]
9. (Refused) [SKIP TO [CFLMV19](#)]

[ASK IF CFLMV6 =2 AND CFL\_QTY=1]

CFLMV7. Which of the following best describes what happened to the CFL that was removed? (READ LIST AND RECORD ONE RESPONSE)

1. It is installed at some other location in your home
2. It was thrown away
3. It is in storage
4. It was sold or given away
00. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF CFLMV7=1]

CFLMV7a. Which room in the house was the CFL bulb moved to? (SELECT ONE)

1. (Bedroom)

2. (Dining room)
3. (Exterior)
4. (Family room/Sitting room)
5. (Hallway)
6. (Kitchen)
7. (Living room)
8. (Office/study)
9. (Porch/Mudroom/Unheated)
10. (Bathroom)
11. (Garage)
12. (Basement)
00. (Other, specify)
98. (Don't know)
99. (Refused)

[ASK IF CFLMV6 =2 AND CFL\_QTY>1]

CFLMV8. Now, I would like to understand what happened to the [insert CFL\_QTY] CFLs. First, how many CFLs are currently installed in their original location? [NUMERIC OPEN END up to CFL\_QTY, DK, REF]

[CHECK IF CFLMV8=VERIFIED QUANTITY, THEN SKIP TO CFLMV19]

[ASK IF CFLMV6 =2 AND CFL\_QTY>1]

CFLMV9. How many are installed at some other location in your house? [NUMERIC OPEN END up to CFL\_QTY, DK, REF]

[ASK IF CFLMV9>0 (BUT NOT DK/REF)]

CFLMV10. Which rooms in the house were the program bulbs moved to? (SELECT ALL THAT APPLY)

1. (Bedroom)
2. (Dining room)
3. (Exterior)
4. (Family room/Sitting room)
5. (Hallway)
6. (Kitchen)
7. (Living room)
8. (Office/study)
9. (Porch/Mudroom/Unheated)
10. (Bathroom)
11. (Garage)
12. (Basement)

- 00. (Other, specify)
- 98. (Don't know)
- 99. (Refused)

[IF CFLMV9+8 = VERIFIED QUANTITY, THEN SKIP TO CFLMV16]

[ASK IF CFLMV6 =2 AND CFL\_QTY>1]

CFLMV11. How many program bulbs have been thrown away? [NUMERIC OPEN END up to CFL\_QTY, DK, REF]

[IF CFLMV11+9+8 = VERIFIED QUANTITY, THEN SKIP TO CFLMV16]

[ASK IF CFLMV6 =2 AND CFL\_QTY>1]

CFLMV12. How many are in storage? [NUMERIC OPEN END up to CFL\_QTY, DK, REF]

[IF CFLMV12+11+9+8 = VERIFIED QUANTITY, THEN SKIP TO CFLMV16]

[ASK IF CFLMV6 =2 AND CFL\_QTY>1]

CFLMV13. How many were sold or given away? [NUMERIC OPEN END up to CFL\_QTY, DK, REF]

[IF CFLMV8 OR CFLMV9 OR CFLMV11 OR CFLMV12 OR CFLMV13 = 98 or 99 THEN SKIP TO CFLMV15]

[CFL\_QTY check

IF CFLMV8+ CFLMV9+ CFLMV11+ CFLMV12+ CFLMV13= CFL\_QTY  
then proceed to CFLMV15.

ELSE IF CFLMV8+ CFLMV9+ CFLMV11+ CFLMV12+ CFLMV13> CFL\_QTY  
then read "I must have made a mistake, those quantities add up to more than were installed through the program. Let me read through the last few questions again" and skip back to CFLMV8

ELSE IF CFLMV8+ CFLMV9+ CFLMV11+ CFLMV12+ CFLMV13< CFL\_QTY  
then proceed to CFLMV14]

CFLMV14. What was done with the remaining [CFL\_QTY -( CFLMV8+ CFLMV9+ CFLMV11+ CFLMV12+ CFLMV13) CFLs? [OPEN END, DK, REF]

[ASK IF CFLMV13>0 (BUT NOT DK/REF) OR CFLMV7=4]



CFLMV15. [Wording if CFL\_QTY=1 OR CFLMV13=1] Is the CFL you sold or gave away located in ComEd's service territory?

[Wording if CFLMV13>1] Are all of the CFLs sold or given away located in ComEd's service territory?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF CFLMV6=2]

CFLMV16. Why [were the CFLs/was the CFL] moved from [their/its] original location?  
(MULTIPLE RESPONSE UP TO 7 RESPONSES)

1. (Equipment failed)
2. (Didn't work properly)
3. (Wrong size – too small or too large)
4. (Low water flow)
5. (Didn't like the color)
6. (Didn't like the appearance/unattractive)
00. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF CFLMV6=2]

CFLMV17. What did you replace the CFL(s) with? (MULTIPLE RESPONSE)

1. (With a new CFL)
2. (With an incandescent bulb)
4. (Did not replace)
00. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF CFLMV7=3 OR CFLMV12>0 (BUT NOT DK/REF)]

CFLMV18. When do you think you will install the CFL(s) you put in storage? Would you say ... (READ ANSWER LIST)

1. Within the next 3 months
2. 3 to 6 months from now
3. 6 to 12 months from now
4. More than a year from now
5. Never
8. (Don't know)
9. (Refused)

CFLMV19. Have you installed any more CFLs since you received the ones through the program?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF CFLMV19=1, ELSE SKIP TO CFLMV22]

CFLMV20. How many additional CFLs have you installed? [NUMERIC OPEN END up to 999, DK, REF]

CFLMV21. How influential was the program in encouraging you to install the additional CFL(s)? Please rate this on a 0-10 scale, where 0 means not at all influential and 10 means very influential. [0-10, DK, REF]

CFLMV22. Since receiving CFLs from the program, have you recommended CFLs to anyone else?

1. Yes
2. No
8. (Don't know)
9. (Refused)

CFLMV23. At the time that you first heard about this program, had you...? (READ LIST UNTIL RESPONDENT SAYS NO)

1. Already been thinking about installing CFLs?
2. Already begun collecting information about CFLs?
3. (Had not thought about installing CFLs before you first heard about the program)
4. (Other, specify)
8. (Don't know)
9. (Refused)

[SKIP IF CFLMV23=3]

CFLMV24. Just to be sure I understand, did you have specific plans to install CFLs before learning about the program?

1. Yes
2. No
8. (Don't know)
9. (Refused)

CFLMV25. On a 0 to 10 scale, with 0 being not at all likely and 10 being very likely, how likely is it that you would have installed CFLs if you had not received (it/them) through the program? [0-10, DK, REF]

[IF (CFLMV24=2 OR CFLMV23=3) AND (CFLMV25<=3) THEN SKIP TO NEXT SECTION]

I'm going to read two statements about the CFLs you received. On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with each statement.

CFLMV26. There may have been several reasons for the installation of the CFLs, but the program was a critical factor in my decision to have the CFLs installed. [0-10, DK, REF]

CFLMV27. I would have installed CFLs within a year of when I did even if I had not received (it/them) from the program. [0-10, DK, REF]

### **Consistency Check & Resolution**

[CFLCC1 will be asked only for those respondents who have a clear inconsistency between responses (i.e., all but one of the questions are at one end of the spectrum for free ridership while one question is at the other spectrum.) The question responses that will be used to trigger CFLCC1 are:

- CFLMV25 (how likely is it that you would have installed the same item)
- CFLMV26 (program was a critical factor in my decision to install item)
- CFLMV27 (would have installed item within a year, without the program)

{IF CFLMV25 = 0,1,2 AND CFLMV26 = 0,1, 2 AND CFLMV27 = 8, 9,10, ASK CFLCC1.  
INCONSISTENCY1='you would likely not have installed the CFLs without the program but that differs from when you said the program was not a critical factor and you would install the CFLs within a year'}

{IF CFLMV25 = 8, 9,10 AND CFLMV26 = 8, 9,10 AND CFLMV27 = 0,1, 2, ASK CFLCC1.  
INCONSISTENCY1= 'you would likely have installed the CFLs without the program but that differs from your response that the program was a critical factor and you would not have installed the CFLs within the year'}

{IF CFLMV26 = 0,1, 2 AND CFLMV25 = 0,1, 2 AND CFLMV27 = 0,1, 2, ASK CFLCC1.  
INCONSISTENCY1='the program was not a critical factor in your decision to install the CFLs but that differs from your response that you would not have installed the CFLs within the year'}

{IF CFLMV26 = 8, 9,10 AND CFLMV25 = 8, 9,10 AND CFLMV27 = 8, 9,10, ASK CFLCC1.  
INCONSISTENCY1='the program was a critical factor in your decision to install the CFLs but that differs from your response that you would have installed CFLs within the year without the program'}

{IF CFLMV27 = 8, 9,10 AND CFLMV25 = 0,1, 2 AND CFLMV26 = 0,1,2, ASK CFLCC1.  
INCONSISTENCY1= 'you would not have installed the CFLs within the year but that differs

from your response that the program was not a critical factor and you were likely to install the CFLs without the program’}

{IF CFLMV27 = 0,1, 2 AND CFLMV25 = 8, 9,10 AND CFLMV26 = 8,9,10, ASK CFLCC1.  
INCONSISTENCY1=‘you would have installed the CFLs within the year but that differs from your response that you were not likely to install the CFLs and the program was a critical factor’}}

CFLCC1. Let me make sure I understand you. Earlier, you said [insert inconsistency1]. Please tell me in your own words what influence, if any, the program had on your decision install the CFLs at the time you did? [OPEN END, DK, REF]

## FA. FAUCET AERATOR MEASURE VERIFICATION

### [ASK SECTION IF S1b=1]

AERMV1. [Wording if AER\_QTY=1] Our records show that [AER\_QTY] faucet aerator was installed during the *Home Performance Tune-Up* visit to your home. Is this correct?

[Wording if AER\_QTY>1] Our records show that [AER\_QTY] faucet aerators were installed during the *Home Performance Tune-Up* visit to your home. Is this correct?

1. Yes, quantity is correct
2. No, quantity is incorrect
8. (Don’t know) [SKIP TO NEXT SECTION]
9. (Refused) [SKIP TO NEXT SECTION]

### [ASK IF AERMV1=2]

AERMV2. How many faucet aerators were installed? [Prompt for best guess.] [NUMERIC OPEN END up to 999, DK, REF] **[IF DK OR REF, SKIP TO NEXT SECTION]**[USE AS AER\_QTY FOR REMAINDER OF SURVEY]

AERMV3. [Wording if AER\_QTY=1] Is the faucet aerator still installed in the original location?  
[Wording if AER\_QTY>1] Are all of faucet aerators still installed in their original locations?

1. (Yes) [SKIP TO [AERMV8](#)]
2. (No)
8. (Don’t know) [SKIP TO [AERMV8](#)]
9. (Refused) [SKIP TO [AERMV8](#)]

### [ASK IF AERMV3 =2 AND AER\_QTY=1]

AERMV3a. Which of the following best describes what happened with the faucet aerator?  
(READ LIST AND RECORD ONE RESPONSE)

1. It is installed at some other location in your home
2. It was thrown away
3. It is in storage
4. It was sold or given away
0. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF AERMV3 =2 AND AER\_QTY>1]

Now, I would like to understand what happened to the [insert AER\_QTY] aerators. How many... [SHOW ON SAME SCREEN]

AERMV3b. Are currently installed in their original location?

[CHECK IF AERMV3b =VERIFIED QUANTITY, THEN SKIP TO AERMV8]

AERMV3c. Are installed at some other location in your house?

[IF AERMV3b+c = VERIFIED QUANTITY, THEN SKIP TO AERMV5]

AERMV3d. Have been thrown away?

[IF AERMV3b+c+d= VERIFIED QUANTITY, THEN SKIP TO AERMV5]

AERMV3e. Are in storage?

[IF AERMV3b+c+d+e = VERIFIED QUANTITY, THEN SKIP TO AERMV5]

AERMV3f. Were sold or given away?

[NUMERIC OPEN END up to AER\_QTY, DK, REF]

[IF AERMV3b or AERMV3c or AERMV3d or AERMV3e or AERMV3f=98 OR 99 THEN SKIP TO AERMV4]

[MEAS\_QTY check

If AERMV3b+AERMV3c+AERMV3d+AERMV3e+AERMV3f = AER\_QTY

then proceed to AERMV4.

Else if AERMV3b+AERMV3c+AERMV3d+AERMV3e+AERMV3f > AER\_QTY

then read “I must have made a mistake, those quantities add up to more than were installed through the program. Let me read through the last few questions again” and skip back to AERMV3b

Else if  $AERMV3b + AERMV3c + AERMV3d + AERMV3e + AERMV3f < AER\_QTY$   
then proceed to AERMV3g]

AERMV3g. What was done with the remaining  $[AER\_QTY - (AERMV3b + AERMV3c + AERMV3d + AERMV3e + AERMV3f)]$  aerators? [OPEN END, DK, REF]

[ASK IF  $AERMV3f > 0$  (BUT NOT DK/REF) OR  $AERMV3a = 4$ ]

AERMV4. [Wording if  $AER\_QTY = 1$  OR  $AERMV3f = 1$ ] Is the aerator you sold or gave away located in ComEd’s service territory?

[Wording if  $AERMV3f > 1$ ] Are all of the aerators you sold or gave away located in ComEd’s service territory?

1. Yes
2. No
8. (Don’t know)
9. (Refused)

[ASK IF  $AERMV3 = 2$ ]

AERMV5. Why [was/were] the aerator(s) moved from [their/its] original locations? (MULTIPLE RESPONSE UP TO 7 RESPONSES) [WORDING CHANGE BASED ON  $AER\_QTY$ ]

1. (Equipment failed)
2. (Didn’t work properly)
3. (Wrong size – too small or too large)
4. (Low water flow)
5. (Didn’t like the color)
6. (Didn’t like the appearance/unattractive)
0. (Other, specify)
8. (Don’t know)
9. (Refused)

[ASK IF  $AERMV3 = 2$ ]

AERMV6. What did you replace the aerator(s) with? (MULTIPLE RESPONSE)

1. With a new high efficiency aerator
2. With a less efficient aerator
3. Re-installed old equipment
4. Did not replace
0. (Other, specify)
8. (Don’t know)
9. (Refused)

[ASK IF AERMV3a=3 or AERMV3e>0 (BUT NOT DK/REF)]

AERMV7. When do you think you will install the aerator(s) that are in storage? Would you say ... (READ ANSWER LIST)

1. Within the next 3 months
2. 3 to 6 months from now
3. 6 to 12 months from now
4. More than a year from now
5. Never
8. (Don't know)
9. (Refused)

AERMV8. Have you installed any more faucet aerators since you received the ones through the program?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF AERMV8=1, ELSE SKIP TO AERMV11]

AERMV9. How many additional aerators have you installed? [NUMERIC OPEN END up to 999, DK, REF]

AERMV10. How influential was the program in encouraging you to install the additional aerator(s)? Please rate this on a 0-10 scale, where 0 means not at all influential and 10 means very influential. [0-10, DK, REF]

AERMV11. Since receiving aerators through the program, have you recommended aerators to anyone else?

1. Yes
2. No
8. (Don't know)
9. (Refused)

AERMV12. At the time that you first heard about this program, had you...? (READ LIST UNTIL RESPONDENT SAYS NO)

1. Already been thinking about installing aerators?
2. Already begun collecting information about aerators?
3. (Had not thought about installing aerators before you first heard about the program)
4. (Other, specify)
8. (Don't know)

9. (Refused)

[SKIP IF AERMV12=3]

AERMV13. Just to be sure I understand, did you have specific plans to install aerators before learning about the program?

1. Yes
2. No
8. (Don't know)
9. (Refused)

AERMV14. On a 0 to 10 scale, with 0 being not at all likely and 10 being very likely, how likely is it that you would have installed the same aerator(s) if you had not received (it/them) through the program? [0-10, DK, REF]

[IF (AERMV13=2 or AERMV12=3) AND (AERMV14<=3) THEN SKIP TO NEXT SECTION]

I'm going to read two statements about the aerators you received. On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with each statement.

AERMV15. There may have been several reasons for the installation of the aerators, but the program was a critical factor in my decision to have the aerators installed. [0-10, DK, REF]

AERMV16. I would have installed aerators within a year of when I did even if I had not received (it/them) from the program. [0-10, DK, REF]

### Consistency Check & Resolution

[AERCC1 will be asked only for those respondents who have a clear inconsistency between responses (i.e., all but one of the questions are at one end of the spectrum for free ridership while one question is at the other spectrum.) The question responses that will be used to trigger AERCC1 are:

- AERMV14 (how likely is it that you would have installed the same item)
- AERMV15 (program was a critical factor in my decision to install item)
- AERMV16 (would have installed item within a year, without the program)

{IF AERMV14 = 0,1,2 AND AERMV15 = 0,1, 2 AND AERMV16 = 8, 9,10, ASK AERCC1.

INCONSISTENCY1='you would likely not have installed the aerators without the program but that differs from when you said the program was not a critical factor and you would install the aerators within a year'}

{IF AERMV14 = 8, 9,10 AND AERMV15 = 8, 9,10 AND AERMV16 = 0,1, 2, ASK AERCC1.

INCONSISTENCY1= 'you would likely have installed the aerators without the program but that



differs from your response that the program was a critical factor and you would not have installed the aerators within the year’}

{IF AERMV15 = 0,1, 2 AND AERMV14 = 0,1, 2 AND AERMV16= 0,1, 2, ASK AERCC1.  
INCONSISTENCY1=‘the program was not a critical factor in your decision to install the aerators but that differs from your response that you would not have installed the aerators within the year’}

{IF AERMV15 = 8, 9,10 AND AERMV14 = 8, 9,10 AND AERMV16 = 8, 9,10, ASK AERCC1.  
INCONSISTENCY1=‘the program was a critical factor in your decision to install the aerators but that differs from your response that you would have installed aerators within the year without the program’}

{IF AERMV16 = 8, 9,10 AND AERMV14 = 0,1, 2 AND AERMV15 = 0,1, 2, ASK AERCC1.  
INCONSISTENCY1= ‘you would not have installed the aerators within the year but that differs from your response that the program was not a critical factor and you were likely to install the aerators without the program’}

{IF AERMV16 = 0,1, 2 AND AERMV14 = 8, 9,10 AND AERMV15 =8, 9,10, ASK AERCC1.  
INCONSISTENCY1=‘you would have installed the aerators within the year but that differs from your response that you were not likely to install the aerators and the program was a critical factor’]AERCC1. Let me make sure I understand you. Earlier, you said [insert inconsistency1]. Please tell me in your own words what influence, if any, the program had on your decision install the aerator(s) at the time you did? [OPEN END, DK, REF]

## SH. SHOWERHEAD MEASURE VERIFICATION

### [ASK SECTION IF S1c=1]

SHOWMV1. [Wording if SHOW\_QTY=1] Our records show that [SHOW\_QTY] showerhead was installed during the *Home Performance Tune-Up* visit to your home. Is this correct?  
[Wording if SHOW\_QTY>1] Our records show that [SHOW\_QTY] showerheads were installed during the *Home Performance Tune-Up* visit to your home. Is this correct?

1. Yes, quantity is correct
2. No, quantity is incorrect
8. (Don’t know) [SKIP TO NEXT SECTION]
9. (Refused) [SKIP TO NEXT SECTION]

### [ASK IF SHOWMV1=2]

SHOWMV2. How many showerheads were installed? [Probe for best estimate] [NUMERIC OPEN END up to 999, DK, REF] [IF DK OR REF, THEN SKIP TO NEXT SECTION] [USE AS SHOW\_QTY FOR REMAINDER OF SURVEY]

SHOWMV3. [Wording if SHOW\_QTY=1] Is the showerhead still installed in the original location?

[Wording if SHOW\_QTY>1] Are all of these showerheads still installed in their original locations?

1. (Yes) [SKIP TO SMV10]
2. (No)
8. (Don't know) [SKIP TO SMV10]
9. (Refused) [SKIP TO SMV10]

[ASK IF SHOWMV3=2 AND SHOW\_QTY=1]

SHOWMV3a. Which of the following best describes what happened with the showerhead?

(READ LIST AND RECORD ONE RESPONSE)

1. It is installed at some other location in your home
2. It was thrown away
3. It is in storage
4. It was sold or given away
0. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF SHOWMV3=2 AND SHOW\_QTY>1]

Now, I would like to understand what happened to the [insert SHOW\_QTY] showerheads.

How many... [SHOW ALL ON SAME SCREEN]

SHOWMV4a. Are currently installed in their original location?

[CHECK IF SHOWMV4A =VERIFIED QUANTITY, THEN SKIP TO SHOWMV10]

SHOWMV4b. Are installed at some other location in your house?

[IF SHOWMVa+b = VERIFIED QUANTITY, THEN SKIP TO SHOWMV7]

SHOWMV4c. Have been thrown away?

[IF SHOWMVa+b+c = VERIFIED QUANTITY, THEN SKIP TO SHOWMV7]

SHOWMV4d. Are in storage?

[IF SHOWMVa+b+c+d = VERIFIED QUANTITY, THEN SKIP TO SHOWMV7]

SHOWMV4e. Were sold or given away?

[NUMERIC OPEN END up to SHOW\_QTY, DK, REF]

[IF SHOWMV4a OR SHOWMV4b OR SHOWMV4c OR SHOWMV4d OR SHOWMV4e=98 OR 99 SKIP TO SHOWMV6]

[SHOW\_QTY check

IF SHOWMV4a+ SHOWMV4b+ SHOWMV4c+ SHOWMV4d+ SHOWMV4e= SHOW\_QTY  
then proceed to SHOWMV6.

ELSE IF SHOWMV4a+ SHOWMV4b+ SHOWMV4c+ SHOWMV4d+ SHOWMV4e >  
SHOW\_QTY

then read "I must have made a mistake, those quantities add up to more than were installed  
through the program. Let me read through the last few questions again" and skip back to  
SHOWMV4a

ELSE IF SHOWMV4a+ SHOWMV4b+ SHOWMV4c+ SHOWMV4d+ SHOWMV4e <  
SHOW\_QTY

then proceed to SHOWMV5]

SHOWMV5. What were done with the remaining [SHOW\_QTY -( SHOWMV4a+ SHOWMV4b+  
SHOWMV4c+ SHOWMV4d+ SHOWMV4e)] showerheads? [OPEN END, DK, REF]

[ASK IF SHOWMV4e>0 (BUT NOT DK/REF) OR SHOWMV3a=4]

SHOWMV6. [Wording if SHOW\_QTY=1 OR SHOWMV4e=1] Is the showerhead you sold or  
gave away located in ComEd's service territory?

[Wording if SHOWMV4e>1] Are all of the showerheads you sold or gave away located in  
ComEd's service territory?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF SHOWMV3 = 2]

SHOWMV7. Why were the showerhead(s) moved from [its/their] original location? (MULTIPLE  
RESPONSE UP TO 7 RESPONSES)

1. (Equipment failed)
2. (Didn't work properly)
3. (Wrong size – too small or too large)
4. (Low water flow)
5. (Didn't like the color)
6. (Didn't like the appearance/unattractive)
0. (Other, specify)
8. (Don't know)

9. (Refused)

[ASK IF SHOWMV3=2]

SHOWMV8. What did you replace the showerhead(s) you removed with? (MULTIPLE RESPONSE)

1. With a new high efficient shower head
2. With a less efficient showerhead
3. Re-installed old equipment
4. Did not replace
0. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF SHOWMV3a=3 OR SHOWMV4d>0 (BUT NOT DK/REF)]

SHOWMV9. When do you think you will install the showerhead(s) you put in storage? Would you say ...(READ ANSWER LIST)

1. Within the next 3 months
2. 3 to 6 months from now
3. 6 to 12 months from now
4. More than a year from now
5. Never
8. (Don't know)
9. (Refused)

SHOWMV10. Have you installed any more low-flow showerheads since you received the ones through the program?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF SHOWMV10=1, ELSE SKIP TO SHOWMV13]

SHOWMV11. How many additional showerheads have you installed? [NUMERIC OPEN END up to 999, DK, REF]

SHOWMV12. How influential was the program in encouraging you to install the additional showerheads? Please rate this on a 0-10 scale, where 0 means not at all influential and 10 means very influential. [0-10, DK, REF]

SHOWMV13. Since receiving showerheads through the program, have you recommended low flow showerheads to anyone else?

1. Yes
2. No
8. (Don't know)
9. (Refused)

SHOWMV14. At the time that you first heard about this program, had you...? (READ LIST UNTIL RESPONDENT SAYS NO)

1. Already been thinking about installing low flow showerheads?
2. Already begun collecting information about low flow showerheads?
3. (Had not thought about installing low flow showerheads before you first heard about the program)
4. (Other, specify)
8. (Don't know)
9. (Refused)

[SKIP IF SHOWMV14=3]

SHOWMV15. Just to be sure I understand, did you have specific plans to install low flow showerheads before learning about the program?

1. Yes
2. No
8. (Don't know)
9. (Refused)

SHOWMV16. On a 0 to 10 scale, with 0 being not at all likely and 10 being very likely, how likely is it that you would have installed the same showerheads if you had not received (it/them) through the program? [0-10, DK, REF]

[IF (SHOWMV15=2 or SHOWMV14=3) AND (SHOWMV 16=<3) THEN SKIP TO NEXT SECTION]

I'm going to read two statements about the showerheads you received. On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with each statement.

SHOWMV17. There may have been several reasons for the installation of the low flow showerheads, but the program was a critical factor in my decision to have the showerheads installed. [0-10, DK, REF]

SHOWMV18. I would have installed low flow showerheads within a year of when I did even if I had not received (it/them) from the program. [0-10, DK, REF]

## Consistency Check & Resolution

[SHOWCC1 will be asked only for those respondents who have a clear inconsistency between responses (i.e., all but one of the questions are at one end of the spectrum for free ridership while one question is at the other spectrum.) The question responses that will be used to trigger SHOWCC1 are:

- SHOWMV16 (how likely is it that you would have installed the same item)
- SHOWMV17 (program was a critical factor in my decision to install item)
- SHOWMV18 (would have installed item within a year, without the program)

{IF SHOWMV16 = 0,1,2 AND SHOWMV17 = 0,1, 2 AND SHOWMV18 = 8, 9,10, ASK SHOWCC1. INCONSISTENCY1='you would likely not have installed the showerheads without the program but that differs from when you said the program was not a critical factor and you would install the showerheads within a year'}

{IF SHOWMV16 = 8, 9,10 AND SHOWMV17 = 8, 9,10 AND SHOWMV18 = 0,1, 2, ASK SHOWCC1. INCONSISTENCY1= 'you would likely have installed the showerheads without the program but that differs from your response that the program was a critical factor and you would not have installed the showerheads within the year'}

{IF SHOWMV17 = 0,1, 2 AND SHOWMV16 = 0,1, 2 AND SHOWMV18 = 0,1, 2, ASK SHOWCC1. INCONSISTENCY1='the program was not a critical factor in your decision to install the showerheads but that differs from your response that you would not have installed the showerheads within the year'}

{IF SHOWMV17 = 8, 9,10 AND SHOWMV16 = 8, 9,10 AND SHOWMV18 = 8, 9,10, ASK SHOWCC1. INCONSISTENCY1='the program was a critical factor in your decision to install the showerheads but that differs from your response that you would have installed showerheads within the year without the program'}

{IF SHOWMV18 = 8, 9,10 AND SHOWMV16 = 0,1, 2 AND SHOWMV17 = 0,1, 2, ASK SHOWCC1. INCONSISTENCY1= 'you would not have installed the showerheads within the year but that differs from your response that the program was not a critical factor and you were likely to install the showerheads without the program'}

{IF SHOWMV18 = 0,1, 2 AND SHOWMV16 = 8, 9,10 AND SHOWMV17 = 8, 9,10 ASK SHOWCC1. INCONSISTENCY1='you would have installed the showerheads within the year but that differs from your response that you were not likely to install the showerheads and the program was a critical factor'}}

SHOWCC1. Let me make sure I understand you. Earlier, you said [insert inconsistency1]. Please tell me in your own words what influence, if any, the program had on your decision install the showerhead(s) at the time you did? [OPEN END, DK, REF]

## **PW. PIPE WRAP MEASURE VERIFICATION**

**[ASK SECTION IF S1d=1]**

PIMV1. [Wording if PI\_QTY=1] Our records show that [PI\_QTY] lineal foot of pipe wrap insulation was installed during the *Home Performance Tune-Up* visit to your home. Is this correct?

[Wording if PI\_QTY>1] Our records show that [PI\_QTY] linear feet of pipe wrap insulation were installed during the *Home Performance Tune-Up* visit to your home. Is this correct?

1. Yes quantity is correct
2. No, quantity is incorrect
8. (Don't know) SKIP TO NEXT SECTION
9. (Refused) SKIP TO NEXT SECTION

**[ASK IF PIMV1=2]**

PIMV2. How many linear feet of pipe wrap were installed during the *Home Performance Tune-Up*? [Probe for best estimate] [NUMERIC OPEN END up to 999, DK, REF] [IF DK OR REF, SKIP TO NEXT SECTION]

PIMV3. Was the pipe insulation installed on bare pipes, or did it replace some existing insulation?

1. (Installed on bare pipes)
2. (Replaced existing insulation)
3. (Installed on top of existing insulation)
00. (Other, specify)
8. (Don't know)
9. (Refused)

PIMV3a. Is the pipe wrap still installed in the original location?

1. (Yes) [SKIP TO QPIMV7]
2. (No)
8. (Don't know) [SKIP TO QPIMV7]
9. (Refused) [SKIP TO QPIMV7]

**[ASK IF PIMV3a =2]**

PIMV3b. Which of the following best describes what happened with the pipe wrap? (READ LIST AND RECORD ONE RESPONSE)

1. It is installed at some other location in your home
2. It was thrown away
3. It is in storage
4. It was sold or given away
0. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF PIMV3b=4]

PIMV3c. Is the pipe wrap located in ComEd's service territory?

1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

[ASK IF PIMV3a=2]

PIMV4. Why was the pipe wrap moved from its original location? (MULTIPLE RESPONSE UP TO 7 RESPONSES)

1. (Equipment failed)
2. (Didn't work properly)
3. (Wrong size – too small or too large)
4. (Low water flow)
5. (Didn't like the color)
6. (Didn't like the appearance/unattractive)
0. (Other, specify)
8. (Don't know)
9. (Refused)

[ASK IF PIMV3a=2]

PIMV5. What did you replace the pipe wrap with? (MULTIPLE RESPONSE)

1. (Other pipe insulation)



- 2. (Did not replace)
- 0. (Other, specify)
- 8. (Don't know)
- 9. (Refused)

[ASK IF PIMV3b=3]

PIMV6. When do you think you will install the pipe wrap that you stored? Would you say  
...(READ ANSWER LIST)

- 1. Within the next 3 months
- 2. 3 to 6 months from now
- 3. 6 to 12 months from now
- 4. More than a year from now
- 5. Never
- 8. (Don't know)
- 9. (Refused)

PIMV7. Have you installed any more pipe wrap since you received it through the program?

- 1. Yes
- 2. No
- 8. (Don't know)
- 9. (Refused)

[ASK IF PIMV7=1, ELSE SKIP TO PIMV10]

PIMV8. How many additional linear feet of pipe wrap have you installed? [NUMERIC OPEN  
END up to 999, DK, REF]

PIMV9. How influential was the program in encouraging you to install the additional pipe wrap? Please rate this on a 0-10 scale, where 0 means not at all influential and 10 means very influential. [0-10, DK, REF]

PIMV10. Since receiving pipe wrap through the program, have you recommended pipe wrap insulation to anyone else?

1. Yes
2. No
8. (Don't know)
9. (Refused)

PIMV11. At the time that you first heard about this program, had you...? (READ LIST UNTIL RESPONDENT SAYS NO)

1. Already been thinking about installing pipe wrap insulation?
2. Already begun collecting information about pipe wrap insulation?
3. (Had not thought about installing pipe wrap insulation before you first heard about the program)
4. (Other, specify)
8. (Don't know)
9. (Refused)

[SKIP IF PIMV11=3]

PIMV12. Just to be sure I understand, did you have specific plans to install pipe wrap insulation before learning about the program?

1. Yes
2. No
8. (Don't know)
9. (Refused)

PIMV13. On a 0 to 10 scale, with 0 being not at all likely and 10 being very likely, how likely is it that you would have installed the same pipe wrap insulation if you had not received it through the program? [0-10, DK, REF]

[IF (PIMV12=2 or PIMV11=3) AND (PIMV 13<=3) THEN SKIP TO NEXT SECTION]

I'm going to read two statements about the pipe wrap you received. On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with each statement.

PIMV14. There may have been several reasons for the installation of the pipe wrap, but the program was a critical factor in my decision to have the pipe wrap insulation installed. [0-10, DK, REF]

PIMV15. I would have installed pipe wrap insulation within a year of when I did even if I had not received it from the program. [0-10, DK, REF]

### Consistency Check & Resolution

[PICC1 will be asked only for those respondents who have a clear inconsistency between responses (i.e., all but one of the questions are at one end of the spectrum for free ridership while one question is at the other spectrum.) The question responses that will be used to trigger PICC1 are:

- PIMV13 (how likely is it that you would have installed the same item)
- PIMV14 (program was a critical factor in my decision to install item)
- PIMV15 (would have installed item within a year, without the program)

{IF PIMV13 = 0,1,2 AND PIMV14 = 0,1, 2 AND PIMV15 = 8, 9,10, ASK PICC1.

INCONSISTENCY1='you would likely not have installed the Pipe insulation without the program but that differs from when you said the program was not a critical factor and you would install the Pipe insulation within a year'}

{IF PIV13 = 8, 9,10 AND PIMV14 = 8, 9,10 AND PIMV15 = 0,1, 2, ASK PICC1.

INCONSISTENCY1= 'you would likely have installed the Pipe insulation without the program but that differs from your response that the program was a critical factor and you would not have installed the Pipe insulation within the year'}

{IF PIMV14 = 0,1, 2 AND PIMV13 = 0,1, 2 AND PIMV15 = 0,1, 2, ASK PICC1.

INCONSISTENCY1='the program was not a critical factor in your decision to install the Pipe insulation but that differs from your response that you would not have installed the Pipe insulation within the year'}

{IF PIMV14 = 8, 9,10 AND PIMV13 = 8, 9,10 AND PIMV15 = 8, 9,10, ASK PICC1.

INCONSISTENCY1='the program was a critical factor in your decision to install the Pipe insulation but that differs from your response that you would have installed Pipe insulation within the year without the program'}

{IF PIMV15 = 8, 9,10 AND PIMV13 = 0,1, 2 AND PIMV14 = 0,1, 2, ASK PICC1.

INCONSISTENCY1= 'you would not have installed the Pipe insulation within the year but that differs from your response that the program was not a critical factor and you were likely to install the Pipe insulation without the program'}

{IF PIMV15 = 0,1, 2 AND PIMV13 = 8, 9,10 AND PIMV14 = 8, 9,10, ASK PICC1.  
INCONSISTENCY1='you would have installed the Pipe insulation within the year but that differs from your response that you were not likely to install the Pipe insulation and the program was a critical factor'}}

PICC1. Let me make sure I understand you. Earlier, you said [insert inconsistency1]. Please tell me in your own words what influence, if any, the program had on your decision install the pipe insulation at the time you did? [OPEN END, DK, REF]

### **TC. TEMPERATURE CHANGE VERIFICATION AND IMPACT**

[Ask if WH\_Turndown=1, Else SKIP TO AV1]

EE1. Our records indicate that the ComEd service representative turned down the temperature on your water heater; is this correct?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[Ask if WH\_Turndown=1 AND EE1=1, ELSE SKIP TO AV1]

EE2. Have you or other members of your household changed the temperature setting since the ComEd representative turned the setting down?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF WH\_Turndown =1 AND EE2=1, ELSE SKIP TO AV1]

EE3. How did you change the setting?

1. Turned it back up
2. Turned it down further

00. (Other, specify)

8. (Don't know)

9. (Refused)

#### **AV. ENERGY SURVEY VERIFICATION AND IMPACT**

We're almost done with the survey; we only have about 5 minutes left for a few questions.

#### **[ASK ALL]**

AV1. Do you remember receiving a home survey with energy saving recommendations as part of this program (if needed: *ComEd's Home Performance Tune-Up Program*)?

1. Yes

2. No

8. (Don't know)

9. (Refused)

[ASK IF AV1=1, ELSE SKIP TO OA1]

AV2. What recommendations do you remember receiving from the ComEd representative that visited your home? [OPEN END, DK, REF]

[SKIP TO OA1 IF AV2=DK OR REF]

AV3. Have you implemented any of the recommendations?

1. Yes

2. No

8. (Don't know)

9. (Refused)

[ASK IF AV3=1]

AV4. Which recommendations have you implemented? [OPEN END, DK, REF]

AV5. Do you have plans to implement any of the recommendations in the future?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF AV5=1]

AV6. Which one(s)? [OPEN END, DK, REF]

#### **O. OTHER PROGRAM AWARENESS**

OA1. At the time of the audit, did the auditor give you any information on any other ComEd programs?

1. Yes
2. No
8. (Don't know)
9. (Refused)

OA3. What other ComEd programs are you aware of? [DO NOT READ. MULTIPLE RESPONSES, UP TO 3. DK REF]

01. (Appliance Recycling)
02. (AC Tune Up)
00. (Other specify )
- 96
98. (Don't know)
99. (Refused)

OA4. Have you participated in any other ComEd programs?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK if OA4=1]

OA5. Which ComEd program(s) have you participated in? [DO NOT READ. MULTIPLE RESPONSES, UP TO 3. DK REF]

1. (Appliance Recycling)
2. (AC Tune Up)
0. (Other specify )
8. (Don't know)
9. (Refused)

## **P. PROCESS**

P1. How did you *first* hear about ComEd's *Home Performance Tune-Up* Program?

1. (Brochure/Flyer through Direct Mail)
2. (Internet)
3. (Customer called ComEd to ask about reducing energy bill)
4. (ComEd representative – other)
5. (Word-of-Mouth)
00. (Other, specify)
8. (Don't know)
9. (Refused)

[SKIP IF P1=1]

P1a Do you recall receiving information about the program through the mail?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF P1a=1 OR P1=1, ELSE SKIP TO P2b]

P2. Thinking about the materials you received through the mail, how useful were the materials in providing information about the program? Would you say they were...

1. Very useful
2. Somewhat useful

- 3. Not very useful
- 4. Not at all useful
- 8. (Don't know)
- 9. (Refused)

[ASK IF P2=3,4]

P2a. What would have made the materials more useful to you? [MULTIPLE RESPONSE, UP TO 3]

- 1. (More detailed information)
- 2. (Where to get additional information)
- 00. (Other, specify)
- 8. (Don't know)
- 9. (Refused)

[ASK ALL]

P2b. How would you suggest ComEd try to reach out to their customers to get them to participate in this program? [DO NOT READ. ALLOW MULTIPLE RESPONSES]

- 1. (With representatives)
- 2. (With phone calls)
- 3. (Flyers/ads/mailings)
- 4. (Bill inserts)
- 5. (Homeowners association)
- 00. (Other, specify)
- 8. (Don't know)
- 9. (Refused)

P3. On a scale of 0 to 10, where 0 is very dissatisfied and 10 is very satisfied, how would you rate your satisfaction with... [SCALE 0-10; 96=not applicable, 98=Don't know, 99=Refused]

- a. The home performance REPORT you received that showed your home's energy usage and recommended ways to save energy.
- b. [ASK IF S1a=1] The CFL bulbs installed through the program
- c. [ASK IF S1b=1] The faucet aerators installed through the program
- d. [ASK IF S1c=1] The low flow showerheads installed through the program



- e. [ASK IF S1d=1] The pipe insulation installed through the program
- f. The time it took to schedule the Home Performance assessment
- g. The ComEd SERVICE REPRESENTATIVE that assessed your home's energy performance.
- h. The *Home Performance Tune-Up* program overall
- i. ComEd overall

[ASK IF ANY P3a-h <=4]

P5. You mentioned you were not satisfied with some aspect of the program. Why did you give this rating? [OPEN END, DK, REF]

P6. What do you see as the main benefits to participating in the *program*? [DO NOT READ; MULTIPLE RESPONSE, UP TO 3]

- 1. (Having a lower energy bill)
- 2. (Receiving the program equipment)
- 3. (Receiving the energy survey recommendations)
- 00. (Other, specify)
- 8. (Don't know)
- 9. (Refused)

P7. How could the program be improved from your perspective? [OPEN END, DK, REF]

### HC. HOME CHARACTERISTICS

And I just have a few more questions for demographic purposes. These questions will also help us determine how much energy is being saved in your home.

HC1. Do you own or rent your home?

- 1. Own
- 2. Rent/lease
- 00. (Other, specify)
- 8. (Don't know)
- 9. (Refused)

HC2. How many full or half bathrooms do you have in your home? (PROBE: A full bathroom is one that has a sink with running water, and a toilet, and either a bathtub or shower. A half bathroom has either a toilet or a bathtub or a shower) [NUMERIC OPEN END up to 99, DK, REF]

[ASK IF S1c=1]

HC3. In total, how many showers are present in your home? [NUMERIC OPEN END up to 99, DK, REF]

[ASK IF KITCHEN AERATOR=1]

HC4. How many faucets are there in your *kitchen*? [NUMERIC OPEN END up to 99, DK, REF]

[ASK IF S1b=1]

HC5. Now thinking about your home's bathrooms, how many faucets are there, all together, in all of your home's *bathrooms*? [NUMERIC OPEN END up to 99, DK, REF]

[ASK IF S1a=1]

HC6. Before participating in the program, approximately what percent of the screw-in light bulb sockets in your home were already equipped with CFL bulbs? [NUMERIC OPEN END up to 99, DK, REF]

## **O. OCCUPANCY**

OC1. Including yourself, how many people currently live in your home in the following age ranges; ...less than 18 years old [NUMERIC OPEN END up to 99, DK, REF]

OC2. ...18-24 years old [NUMERIC OPEN END up to 99, DK, REF]

OC3. ...25-34 years old [NUMERIC OPEN END up to 99, DK, REF]

OC4. ...35-44 years old [NUMERIC OPEN END up to 99, DK, REF]

OC5. ...45-54 years old [NUMERIC OPEN END up to 99, DK, REF]

OC6. ...55-64 years old [NUMERIC OPEN END up to 99, DK, REF]

OC7. ...65 or older [NUMERIC OPEN END up to 99, DK, REF]

OC8. Has the number of people living in your house changed since [PART\_DATE]?

1. Yes, the number has increased
2. Yes, the number has decreased
3. No change
8. (Don't know)
9. (Refused)

[ASK IF OC8=1 or 2, ELSE SKIP TO CLOSING]

OC9. How many more or less people are currently living in your home versus [PART\_DATE]?  
[NUMERIC OPEN END up to 99, DK, REF]

OC10. In what month and year did the number of people in your household change? [ALLOW  
MULTIPLE RESPONSES, UP TO 3]

00. [RECORD MONTH/YEAR]
8. (Don't know)
9. (Refused)

## CLOSING

Those are all the questions I have. On behalf of ComEd, thank you very much for your time.



## ComEd In-Depth Interview Guide for Program Manager, Implementation Staff: All-Electric Home Performance Tune Up

Respondent name:

---

---

Respondent phone number:

---

---

Respondent title:

---

---

Company name:

---

---

Date and time of interview:

---

---

Interviewer:

---

---

### Introduction

“Thank you for taking the time to talk with me today. The Opinion Dynamics evaluation team is currently conducting a study for ComEd. There are two aims of this interview: first, we’d like to find out how the All-Electric Home Performance Tune Up program has gone during PY2. We’d like to get your insight by asking you some questions that should not take any longer than 45 minutes to an hour.”

**Note to Interviewer:** Numbered questions should be asked for the interview, while questions preceded by dashes should be used as follow-ups or clarification as necessary.

### Role in Program

1. First, could you tell me about your role in the program?
  - What are you responsible for?
  - What have you been doing on a daily basis?
  - Who do you normally interact with?

## **Program Design and Implementation**

2. How has program implementation gone in PY2?
  - Were there any major challenges to implementation that carried over from PY1?
  - When did you consider implementation to be going smoothly and what were the indicators?
  - Did any problems with implementation surface over the course of the program?
  - Are you aware of any ways that implementation may have caused successes or problems along the way?
3. What would you say were the key takeaways or lessons learned from program implementation, if any, which could be applied to similar, future programs?
4. How has the tracking process gone?
  - Have there been any major challenges to tracking during PY2?
  - When did you consider tracking to be going smoothly and what were the indicators?
  - Did any problems with tracking surface over the course of the program?
  - Did they have a system that tracked actions taken by participants after the Tune Up? Conversion rate related?
5. What would you say are the key takeaways or lessons learned from tracking, if any, which could be applied to similar, future programs?

## **Program Marketing and Promotion**

6. Can you talk a little about how you marketed the program in PY2 both in terms of the messaging and the marketing channels you used?

7. What would you say are the key takeaways or lessons learned from marketing and promotion, if any, which could be applied to similar, future programs?

### **Barriers to Participation**

8. What have been the key barriers to participation for eligible ComEd customers?
9. How have the barriers been addressed by the program?
  - How successful have program attempts to decrease barriers been?
10. What would you say are the key takeaways or lessons learned around barriers to participation, if any, which could be applied to similar, future programs?

### **Customer Satisfaction**

11. [Interviewer: acknowledge that we are assessing this on our own from upcoming participant surveys but want their perspective] From your perspective, how satisfied are the participants with the program?
12. How do you know how satisfied they are? Do you have a built in process for assessing and addressing customer satisfaction?

### **Information Delivery to Participants**

13. [Interviewer: acknowledge that we are assessing this on our own from upcoming participant surveys but want their perspective] From your perspective, how well do customers retain recommendation information and knowledge of available incentive programs?
  - How is the information given to customers?
  - Is there any indication that customers have had difficulty understanding the information?
  - To what extent does this program attempt to cross-promote other ComEd programs through information given during the Tune Up?

14. From your perspective, what are the main barriers to and motivation, if any, for the adoption of recommended measures?
15. Is there a system for tracking customers after they have the Tune Up to see whether they participate in other programs or take other action?
16. Have you experienced any issues/challenges with the direct install component of the program?
17. What would you say are the key takeaways or lessons learned around delivering information to participants, if any, that might be applied to other programs like this in the future?

## Closing

18. Is there anything else that you think we should know based on our conversation today?

## 5.2 *Default Savings Algorithm Review*

This section presents the results of the default savings algorithm review. The review of measures savings was conducted initially by the Evaluation Team members assigned to the ComEd Multi Family All Electric Efficiency Upgrade Program. This material was expanded upon and tailored for application to the Single Family All Electric Home Energy Performance Tune Up program. The Single Family Program has all of the direct install measures that are offered through the Multi-Family Program, but also offers hot water pipe wrap, which the Multi-Family Program does not.

As discussed previously, these reviews were conducted to improve the accuracy of ex-ante program impact claims, and minimize the potential for major ex-post adjustments to program savings.

This Appendix has two components. The first is the default savings review conducted for the Multi Family Program. This is followed by a summary of how the Multi-Family default savings were adapted to the Single Family Program, and a discussion of the savings associated with hot water pipe wrap.

## 5.2.1 Multi Family All Electric Efficiency Upgrade Program Default Savings Review

### *Integral CFL Bulbs*

#### **Measure Definition**

This measure is defined as direct program installation of integral compact fluorescent lamps to replace incandescent lamps that the occupant states operate at least 2 hours per day. ComEd proposes the replacements shown in Table 5-1.

**Table 5-1. Baseline and CFL Replacement Lamp Wattages**

Measure	Base Incandescent (watts/lamp)	CFL (watts/lamp)	Delta Watts Reduction (watts/lamp)
13W CFL replacing 40W incandescent	40	13	27
15W CFL replacing 60W incandescent	60	15	45
20W CFL replacing 75W incandescent	75	20	55

#### **Algorithms**

The gross energy and demand algorithms used for evaluating the integral CFL measure savings are as follows:

$$\text{Gross kWh} = \frac{\text{Delta Watts} * \text{HOU/day} * 365 \text{ days/year} * \text{Installation Rate} * \text{Energy Interactive Effect}}{1000 \text{ Wh/kWh}}$$

$$\text{Gross Coincident kW} = \frac{\text{Delta Watts} * \text{Installation Rate} * \text{Coincidence Factor} * \text{Demand Interactive Effect}}{1000 \text{ W/kW}}$$

The installation rate accounts for CFLs installed through the program in the current program year and not since removed by the occupant. The coincidence factor is estimated for ComEd's peak period that occurs during the four hours from 1 pm to 5 pm, Central Time, non-holiday weekdays, June 1 through August 31. The demand interactive effect accounts for savings that the measures achieve through avoided air conditioning load because of reduced internal heat gains from the energy efficient lighting. The energy interactive effect accounts for increase in space heating and decrease in space cooling energy because of reduced internal gains from the energy efficient lighting.



### **Assumptions**

ComEd's parameter assumptions for calculating tracking system savings using the algorithms above are provided in Table 5-2. Table 5-2 also provides a summary of our evaluation team review and recommendations for ComEd's assumptions.

**Table 5-2. Default Savings Assumptions for CFL Gross Impacts**

Gross Impact Parameter	ComEd Assumed Values	Evaluation Review Comments
Incandescent Wattage	Table 2	Acceptable
CFL Wattage	Table 2	Acceptable
Delta Watts Saved	Table 2	Acceptable
Daily Hours of Use (HOU)	2.34 hours	Acceptable
Operating Days per Year	365	Acceptable
Installation Rate	Propose to use 1.0 and let evaluation realization rate account for lamp removal	Recommend ComEd use 0.95 for program tracking savings, based on the 5% removal rate found in the PY1 ComEd Residential Lighting evaluation.
Coincidence Factor	Not Identified	Recommend ComEd use 0.081 for PY2, the same value used in PY1.
Demand and Energy Interactive Effects	Not Addressed	Recommend ComEd use 1.0 for both factors in PY2.

*Source: Excel spreadsheet file name "PY2 planning estimates - savings". Provided by ComEd 12/17/2009.*

### **Results**

Table 5-3 summarizes ComEd's proposed annual kWh default savings and the evaluation team's recommended values, based on Table 5-2 assumptions. The difference between the ComEd values and those we recommend is the inclusion of the 95% installation rate in the evaluator proposed savings.

**Table 5-3. Default Savings Assumptions for CFL Gross Impacts**

Measure	Unit	ComEd proposed (annual kWh/unit)	Evaluation Team Recommended (annual kWh/unit)	Evaluation Team Recommended (peak kW reduced/unit)
20W CFL replacing 75W incandescent	Per lamp	47.0	44.6	0.0042
15W CFL replacing 60W incandescent	Per lamp	38.4	36.5	0.0035
13W CFL replacing 40W incandescent	Per lamp	23.1	21.9	0.0021

***Low-Flow Fixed Showerhead or Handheld Showerhead***

**Measure Definition**

This measure consists of direct installation of a new showerhead to reduce the flow rate relative to the existing showerhead. The program implementation contractor instructs its energy specialists to visually inspect the base showerhead rated water flow and offer to replace it if it is rated at or greater than 2.5 GPM, which is the current Federal standard for maximum flow rate at 80 psi water pressure.

ComEd's specification sheets for the Multi-Family Retrofit Program for PY1 state that the fixed low flow showerhead "Meets ANSI/ASME Specification A112.18.1M 2.0 GPM MAX" while the handheld showerhead "Exceeds ANSI/ASME Specification A112.18.1M 2.5 GPM MAX." The product distributor's web site indicates that the fixed showerhead is rated at 2.0 gallons per minute, while the handheld showerhead is shown with a flow rate of 2.0 gallons per minute (which clarifies exceeding 2.5 GPM).

It is assumed that installed showerheads are not later removed by the occupant during the program year.

### **Algorithms and Assumptions**

ComEd's 2008 – 2010 efficiency program plan<sup>21</sup> identifies DEER as the source of the Multi-Family Retrofit Program PY1 and proposed PY2 default savings of 355 kWh saved per multifamily residence for installing low flow showerheads, but DEER 2005 shows a savings value of 69.6 kWh/yr for each showerhead installed (multifamily for Pacific Gas & Electric).

The ComEd default value can be reproduced with the following calculation methodology and assumptions that are similar to those used by technical reference manuals from other states:

$$\begin{aligned} \text{Gallons saved per year} &= (\text{flow rate reduction})[2.5 \text{ base GPM} - 2.0 \text{ low flow GPM} \\ &= 0.5 \text{ GPM}] * (\text{occupants per residence}) * [2 \text{ per residence}] * (\text{daily showers per resident}) [1 \\ &\text{daily shower per resident}] * (\text{minutes/shower}) [8 \text{ minutes/shower}] * (365 \text{ days/year}) \\ &= 2,920 \text{ gallons/year per multifamily residence} \end{aligned}$$

$$\begin{aligned} \text{Gross kWh/yr saved} &= (\text{gallons saved})[2920 \text{ gal}] * (\text{shower temp} - \text{water heater cold inlet temp}) \\ &[100-55 \text{ deg F}] * 8.3 \text{ Btu/gallon} * 1 \text{ kWh/3412 Btu} / (\text{water heater efficiency}) [0.9] \\ &= 355 \text{ kWh/year per multifamily residence} \end{aligned}$$

The PY1 default gross demand savings were assumed equivalent to the DEER 2005 peak demand reduction per unit (based on demand savings between 12-6pm May through October), which is as follows.

$$\text{Coincident Peak kW Savings} = 0.0153 \text{ peak kW per multifamily residence}$$

The evaluation team has reviewed default savings, algorithms, and assumptions from national sources and from several nearby jurisdictions, including Ontario, Minnesota, Michigan, and Wisconsin. The most thorough analyses of showerhead savings are provided in a report from Lawrence Berkeley National Lab<sup>22</sup> ("LBNL report") and a report from Summit Blue conducted for Enbridge Gas Distribution and Union Gas in Ontario<sup>23</sup>. These reports identify a more complex algorithm for calculating water reduction:

---

<sup>21</sup> Commonwealth Edison, Commonwealth Edison Company's 2008-2010 Energy Efficiency and Demand Response Plan, November 15, 2007, Docket No. 07-0540

<sup>22</sup> Biermayer, Peter J., Potential Water and Energy Savings from Showerheads, March 17, 2006, Lawrence Berkeley National Laboratory.

<sup>23</sup> Cook, Gay and Barkett, Brent, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 23, 2008. Summit Blue Canada Inc.

*Shower Water Use (gallons/year) =*

household members \* showers per capita per day \* shower length \* proportion of showering activity affected by replacement \* as-used water flow rate

Where

- As-used water flow rate is equal to the maximum rated flow rate times a “throttling factor” to account for water pressure at the residence that is less than the 80 psi rating pressure, for limiting the flow by throttling back (closing) the control valve during the shower, and partial clogging in household pipes.

*Shower water energy saved =*

shower water use reduction\* (Temperature of shower - Temperature of incoming cold-water) \*conversion to energy / water heater recovery efficiency

The key difference between ComEd’s algorithm and assumptions and the more complex algorithm is basing the flow rate reduction on the “as-used” conditions. The LBNL and Enbridge/Union Gas reports included a throttling factor to account for field measured flow rates that were lower than showerhead 80 psi rated flows.

The LBNL and Enbridge/Union Gas studies found a range of values for each of the algorithm parameters among the field research studies identified as supporting documentation. The Enbridge/Union Gas study cites a 90% confidence range of approximately  $\pm 40\%$  around each recommended default savings value. Several key parameters that are behavioral in nature have a significant impact on savings. These include shower temperature, length of showering time, and number of showers per day.

We compared the ComEd default assumption of 355 kWh per year per residence with results from other jurisdictions. As shown in Table 5-4, annual kWh savings for the showerhead flow rate reduction measure varied widely, even when the assumptions were adjusted to reflect ComEd’s program.

**Table 5-4. Comparison of Default Savings for Showerhead Flow Reduction**

Jurisdiction	Annual Savings Default Value	Adjustment Made by Evaluation Team to Reflect ComEd Program
California	69.6 kWh/yr per showerhead	From DEER 2005 for Pacific Gas & Electric, for a 2.5 GPM rated base case and a 2.0 GPM rated replacement.
Ontario	252 kWh/yr per apartment	The detailed algorithms and assumptions of the Enbridge/Union gas study were applied to ComEd multifamily electric by adjusting for 2.35 occupants (vs. 3.1) and using the Enbridge TAPS as-used flow rates (a field measured 2.26 GPM base case and 1.78 GPM as-used flow for a 2 GPM rated replacement). The 90% confidence range around 252 kWh/yr is 151 kWh/yr to 353 kWh/yr ( $\pm 40\%$ ).
Michigan <sup>24</sup>	345 kWh/yr per apartment	Deemed values database shows 518 kWh/yr for a 2.5 GPM to 1.75 GPM measure, which we adjusted to a 2.0 GPM replacement fixture (0.5/0.75).
Minnesota <sup>25</sup>	376 kWh/yr per apartment	Basis is Minneapolis for a 30 gallon tank (3 bedrooms or less)
Wisconsin <sup>26</sup>	460 kWh/yr per apartment	Adjusted to reflect ComEd's 2.0 GPM replacement versus Wisconsin's 1.75 GPM replacement, US Census data for Illinois shows 2.35 occupants per rental household versus 2.06 in Wisconsin, and ComEd's estimated 55F water mains temperature versus 50F for Wisconsin.
ComEd	355 kWh/yr per apartment	

The default savings from California, Wisconsin, Minnesota, and Michigan either have unsupported assumptions or missing factors and we do not recommend them for ComEd. We

<sup>24</sup> Michigan Public Service Commission, U-15800 Michigan EO Plan Deemed Savings Measures, [http://www.michigan.gov/mpsc/0,1607,7-159-52495\\_53472---,00.html](http://www.michigan.gov/mpsc/0,1607,7-159-52495_53472---,00.html), database 010809, accessed January 2010.

<sup>25</sup> Minnesota Department of Commerce, Deemed Savings Database, ResidentialElectricDHW\_v02.xls, <http://www.commerce.state.mn.us/DeemedSavings/ApprovedElectric/>, accessed January 2010.

<sup>26</sup> Patrick Engineering and PA Government Services, Inc., ACES: Default Deemed Savings Review, June 24, 2008, Public Service Commission of Wisconsin, Madison, Wisconsin.

recommend a default annual savings value that reflects the algorithms and assumptions in the LBNL report, adjusted for ComEd's multifamily program. The recommended gross impact parameters are provided in Table 5-5.

**Table 5-5. Evaluation Recommended Assumptions for Low Flow Showerhead Gross Impacts**

Gross Impact Parameter	Assumed Values	Reference and Evaluator Comments
Household members per rental unit	2.35	2006-2008 American Community Survey data from the US Census Bureau for Illinois
Showers per capita per day	0.70	LBNL report, referencing the 1999 Residential End Uses of Water study from the American Water Works Association Research Foundation
Shower length	8.2 minutes	LBNL report, referencing metered data from the 1999 Residential End Uses of Water study
Proportion of showering activity affected by replacement	100%	We assumed the program will install showerheads on all shower fixtures used by the occupants.
Rated maximum flow rate of base case showerhead	2.5 GPM at 80 psi	This Federal standard has been in place since 1994.
Rated maximum flow rate of replacement showerhead	2.0 GPM at 80 psi	Program specifications
Throttling factor to adjust maximum 80 psi rated flows to as-used flow rates	0.90	From the LBNL report, which cites 0.90 as the average for a range of 2.0 GPM (throttled, lower psi) to 2.5 GPM (pressure compensating models) for 80 psi rated 2.5 GPM showerheads. Using 0.90, the as-used flow rate reduction is $0.90 * (2.5 - 2.0) = 0.45$ GPM.
Average cold water temperature	55 F	Based on an NREL algorithm <sup>27</sup> : 49 F average ambient temperature for Chicago, plus 6 F
Average mixed temperature of shower	105 F	LBNL report and Enbridge/Union Gas study references
Water heater efficiency	0.91	ComEd 2008-2010 energy efficiency plan, Appendix B <sup>28</sup>

<sup>27</sup> Jay Burch and Craig Christensen, TOWARDS DEVELOPMENT OF AN ALGORITHM FOR MAINS WATER TEMPERATURE, National Renewable Energy Laboratory, Golden CO.

## **Results**

Table 5-6 provides the default savings impacts from applying the assumptions in Table 5-5 to the recommended LBNL showerhead algorithms above. The recommended default peak kW reduction value is unchanged from PY1. The units for all showerhead savings are per multifamily residence.

**Table 5-6. Evaluation Recommended Default Savings for Direct Installation of 2.0 GPM Showerheads**

Measure	Unit	Gross Default Savings (annual kWh/unit)	Gross Default Savings (peak kW/unit)
Direct install a 2.0 GPM @80psi rated low flow showerhead on all apartment unit fixtures rated at or over 2.5 GPM	Per multifamily residence	297	0.015

### ***Swivel Kitchen Faucet Aerator & Bathroom Faucet Aerator***

#### **Measure Definition**

This measure consists of direct installation of a new faucet aerator to reduce the flow rate relative to the existing faucet. This measure savings analysis assumes replaced aerators account for all kitchen or bath faucet hot water use in the multifamily residence and that the energy specialist does not replace existing low-flow faucet aerators.

Product specifications sheets provided by ComEd for the PY1 evaluation are designated as “Rev: 11/01/01” which implies a 2001 revision date. The specifications for aerator models AMFA012 and AMFA013 are given as 2.3 GPM and 1.5 GPM. The spec sheet for the dual spray swivel aerator model AMFA035 says that the aerator must be 2.2 GPM at 60 psi.

Since the current Federal standard for maximum flow rate is 2.2 GPM at 60 psi water pressure, the product distributor’s web site was accessed to verify current models. Model FA012CPB1 is a 1.5 GPM kitchen or bath aerator, and the FA013CPB1 is a 2.0 GPM aerator. The dual spray swivel aerator is available in a 1.5 GPM model and a 2.0 GPM model.

---

<sup>28</sup> Commonwealth Edison, Commonwealth Edison Company’s 2008-2010 Energy Efficiency and Demand Response Plan, November 15, 2007, Docket No. 07-0540

Program documents do not address field assessment of the base water flow rate, a key factor in the savings calculation. It is assumed that installed aerators are not later removed by the occupant during the program year.

### **Algorithms and Assumptions**

For PY2, ComEd has proposed that default values for gross energy and demand savings be derived from algorithms used by the Wisconsin Focus on Energy program, with assumptions adjusted to ComEd service territory. The Wisconsin Focus on Energy algorithms and assumptions are provided in the deemed savings report for their multifamily program, ACES: Default Deemed Savings Review. Our review of the Wisconsin default values identified unsupported assumptions that we conclude could over-estimate savings, after comparing with other references.

A similar set of algorithms with well documented assumptions drawn mostly from field research studies is provided by the Summit Blue report for Enbridge Gas Distribution and Union Gas. The Enbridge/Union Gas algorithms are provided below:

$$\text{Water savings per year (gallons/year)} = \text{Household water use} * \text{flow reduction}$$

Where

- Household water use = Household members \* total daily household faucet use per capita \* 365 days \* % of use affected by replacement
- Flow reduction = % flow rate reduction \* % of straight-down-the-drain use
- Straight-down-the-drain use = Percent of water that flows straight down the drain since water volume that fills a sink for batch use is not affected by the flow rate.

*Faucet water energy savings =*

$$\text{Aerator water use reduction} * (\text{Avg. faucet mix temperature} - \text{Temperature of incoming cold-water}) * \text{conversion to energy} / \text{water heater recovery efficiency}$$

The units for all faucet aerator savings estimations are per multifamily residence.

The evaluation recommended gross impact parameter assumptions for calculating tracking system savings using the algorithms listed above are provided in Table 5-7.



**Table 5-7. Evaluation Recommended Assumptions for Faucet Aerator Gross Impacts**

Gross Impact Parameter	Assumed Values	Reference and Evaluator Comments
Household members per rental unit	2.35	2006-2008 American Community Survey data from the US Census Bureau for Illinois
Total daily household faucet use	14 gallons per capita per day at 365 days per year	References provided in Summit Blue Enbridge/Union Gas study
Percent of household faucet use affected – kitchen	65% of total faucet use	Provided in Summit Blue Enbridge/Union Gas study, assuming all kitchen faucet use is treated by the direct install program
Percent of household faucet use affected – bath	35% of total faucet use	Provided in Summit Blue Enbridge/Union Gas study, assuming all bath faucet use is treated by the direct install program
Percent flow rate reduction, 2.2 GPM to 1.5 GPM full-on average flow (@ 60psi)	32%	Summit Blue Enbridge/Union Gas study, $(2.2 - 1.5)/2.2$ . Flow ratings at 60 psi are assumed representative of typical residential water pressures.
Percent of water that flows straight down the drain	50% kitchen	
70% bath	Summit Blue Enbridge/Union Gas study	
Average faucet mixing temperature	90 F	References provided in Summit Blue Enbridge/Union Gas study
Average cold water temperature	55 F	Based on an NREL algorithm <sup>29</sup> : 49 F average ambient temperature for Chicago, plus 6 F
Water heater efficiency	0.91	ComEd 2008-2010 energy efficiency plan, Appendix B <sup>30</sup>

<sup>29</sup> Jay Burch and Craig Christensen, TOWARDS DEVELOPMENT OF AN ALGORITHM FOR MAINS WATER TEMPERATURE, National Renewable Energy Laboratory, Golden CO.

<sup>30</sup> Commonwealth Edison, Commonwealth Edison Company's 2008-2010 Energy Efficiency and Demand Response Plan, November 15, 2007, Docket No. 07-0540

## Results

Table 5-8 provides the default savings impacts from applying the assumptions in Table 5-7 to the faucet aerator algorithms above. The recommended default peak kW reduction values are unchanged from PY1. The units for all faucet aerator savings are per multifamily residence.

**Table 5-8. Evaluation Recommended Default Savings for Direct Installed Faucet Aerators**

Measure	Unit	Gross Default Savings (annual kWh/unit)	Gross Default Savings (peak kW/unit)
Direct install 1.5 GPM rated aerators on all kitchen faucets	Per multifamily residence	117	0.012
Direct install 1.5 GPM rated aerators on all bath faucets	Per multifamily residence	88	0.012

Table 5-9 provides ComEd's proposed gross energy default savings and our recommended values.

**Table 5-9. Proposed PY2 Multi Family Default Gross Energy Savings Values**

Measure	Unit	ComEd Proposed (annual kWh/unit)	Evaluator Proposed (annual kWh/unit)
13W CFL replacing 40W incandescent	Bulb	23.1	21.9
15W CFL replacing 60W incandescent	Bulb	38.4	36.5
20W CFL replacing 75W incandescent	Bulb	47.0	44.6
2.0 GPM low flow showerhead	Apartment	355	297
1.5 GPM kitchen faucet aerator	Apartment	145	117
1.5 GPM bath faucet aerator	Apartment	83	88

## 5.2.2 Single Family All Electric Home Energy Performance Tune Up Default Savings Review

This section serves as an addendum to the PY2 Default Savings Review for the Multi Family All Electric Efficiency Upgrade Program. The purpose of the Multi-Family Default Savings Review was to assess the underlying algorithms, assumptions, and calculated default savings proposed by ComEd for PY2 . Specifically, the Multi-Family Default Savings Review addresses measures offered through the Multi-Family Program, and provides recommended alternative values where another approach was judged to be more accurate. The purpose of this Single Family addendum is to address the default savings values proposed for measures offered through the Single Family All Electric Home Energy Performance Tune Up Program. All of the measures offered through the Multi-Family Program are also offered through the Single Family Program, and consistency across these two programs' default savings values is highly recommended.

A coordinated effort was made between the evaluation teams for the Multi Family and Single Family Home Energy Performance Programs in reviewing the default savings values applied for both programs. There is one measure offered through the Single Family program that is not addressed in the Multi-Family Default Savings Review, hot water pipe wrap. Pipe wrap impact assumption recommendations are provided in this document.

The Single Family Home Energy Performance program provides direct install services for the following measures for homes with an electric water heating appliance.

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

Table 5-10 provides ComEd's proposed gross energy default savings and our recommended values. Both Multi-Family and Single Family values are shown.

**Table 5-10. Proposed PY2 Default Gross Energy Savings Values**

Measure	Unit	ComEd Proposed PY2 Planning Estimate* (Annual kWh/unit)		Evaluator Recommended  (Annual kWh/unit)	
		Multi- Family	Single- Family	Multi- Family	Single- Family
13W CFL replacing 40W incandescent	Bulb	23.1	23.1	21.9	21.9
15W CFL replacing 60W incandescent	Bulb	38.4	38.4	36.5	36.5
20W CFL replacing 75W incandescent	Bulb	47.0	47.0	44.6	44.6
2.0 GPM low flow showerhead	Home	355	532	297	348
1.5 GPM kitchen faucet aerator	Home	145	210	117	137
1.5 GPM bath faucet aerator	Home	83	120	88	103
Hot water pipe wrap	Home	-	215	-	122

The remainder of this document will address the default savings value for each measure installed through the Single Family Home Energy Performance Program.

### *CFL*

Impact calculations for CFL bulbs are not affected by dwelling type. While it is possible there is a measurable difference in typical hours of use between multi-family and single-family dwellings, available data do not support such distinctions. Thus, default savings values should be consistent across the multi-family and single family applications of CFL bulbs.

### *Low Flow Showerheads and Faucet Aerators*

The Multi-Family Default Savings Review sets forth algorithms and parameter values for retrofits of low flow showerheads and faucet aerators. The selected algorithms and parameter values are equally applicable to both single family and multi-family dwellings, with the important exception of the occupancy parameter value. Occupancy is expected to differ by

dwelling type. Moreover, the impact of both measures has a proportional relationship to occupancy.

The occupancy parameter value recommended in the Multi-Family Default Savings Review for multi-family dwellings in Illinois is 2.35 persons. This value originates with the 2006-2008 American Community Survey data from the US Census Bureau for Illinois, which reports a mean occupancy for single family dwelling in Illinois to be 2.75 persons per dwelling. Based on these statistics, the recommended occupancy adjustment factor in moving from multi-family default impact to single family default values is the ratio of 2.75 to 2.35, which is 1.17.

The recommended default savings values shown in Table 5-10 for low flow showerheads and faucet aerators are consistent with recommendations made in the January 29 Memorandum, simply adjusted for an assumed occupancy of 2.75 instead of 2.35 persons per dwelling.

An optional approach to using a uniform occupancy adjustment, is to use record and tracking to occupancy of participating homes, and apply a per occupant savings value rather than a per home savings value. Regardless of the method invoked for default savings, occupancy among participating households is a parameter that should be researched in the PY2 evaluation process.

### ***Pipe Insulation***

The Single Family Home Energy Performance program includes the installation of up to 12 linear feet of pipe insulation on hot water pipes emanating from an electric water heating appliance. Details regarding the development of the algorithm used to generate the ComEd proposed default value of 215 kWh per year are not available for evaluator review. Appendix B of the ComEd's 2008-2010 Energy Efficiency and Demand Response Plan Appendix B refers to DEER as the source of this value. The DEER 2005 report indicates that pipe wrap energy impact is 4 percent of household water heater energy consumption. The corresponding annual energy savings ranges from 111 to 133 kWh per year, depending upon the service territory. Research by the evaluation team indicates that there are currently no reliable estimates of unit energy consumption of electric resistance water heaters for single family detached dwellings in Illinois. It is recommended that the mean DEER value of 122 kWh per year per dwelling is adopted as the default savings value for the Single Family Home Energy Performance program.

### **5.3 *Hot Water Heater Temperature Setback Impact Model***

The model used to estimate the impact from water heater temperature setback is described in this section. The model is designed to estimate the volume of household hot water usage. The energy consumed by the water heater is a function of the volume of water and the differential between the inlet and the supply water temperatures. Water heater energy consumption is modeled under a water heater supply temperature set point of 136°, representing the pre-

retrofit case, and 120° Fahrenheit, representing the post-retrofit case. The difference in water heater energy consumption under these two scenarios is the estimates impact from the temperature set-back.

The model requires information on low flow shower plumbing fixtures, shower and bath activity, appliance holdings and activity for clothes washers and dishwashers, water heater energy factor (EF), as well as inlet and supply water temperatures and occupancy. Behavioral data assumptions include showers per week, baths per week, clothes washes per week, dishwasher loads per week and the presence of low flow showerheads.

The values selected for model assumptions are primarily based on studies conducted in other service territories<sup>31</sup>. However, several key input assumptions are adjusted to be consistent with the Single Family Home Energy Performance participant population and related impact assumptions. Assumptions tailored to SFHEP program data include home occupancy, shower flow (GPM), minutes per shower, and showers per day (per person).

Although the energy required to meet hot water demand in the home varies significantly with the inlet water temperature, the *change* in energy due to a water heater temperature setback is unaffected by the inlet water temperature, as it does not change in the pre-and post-retrofit conditions. Annual impact for water heater temperature setback is shown below:

$$\text{Annual_Impact} = \sum_{month=1}^{12} \left( \left( \frac{\text{kWh}}{\text{month}} \right) (\text{supply}_{\text{temp}_a}) - \left( \frac{\text{kWh}}{\text{month}} \right) (\text{supply}_{\text{temp}_b}) \right)$$

Where,

$$\frac{\text{kWh}}{\text{month}} = \frac{\text{btu}}{\text{month}} / \left( \frac{\text{btu}}{\text{kWh} * EF} \right)$$

and,

$$EF^{32} = 0.9$$

$$\text{Btu/kWh} = 3,414$$

$$\frac{\text{btu}}{\text{month}} = \frac{\text{btu}}{\text{day}} * \frac{\text{day}}{\text{month}}$$

---

<sup>31</sup> Details regarding these studies and service territories may not be shared due to disclosure and other legal agreements.

<sup>32</sup> EF=Energy Factor

The water temperature differential between inlet and outlet supply water, in conjunction with the mass of water supplied, defines the hot water load over a given time interval; shown below for one day. Hot water load is given by:

$$\frac{\text{btu}}{\text{day}} = \frac{\text{gallons}}{\text{day}} * C_p * (\text{supply}_{\text{temp}} - \text{inlet}_{\text{temp}})$$

Where,

$$\frac{\text{Gallons}}{\text{Day}} = (\text{shower} + \text{bath} + \text{dishwasher} + \text{clothes\_washer} + \text{faucet\_flow} + \text{faucet\_fill})$$

$C_p$  = specific heat of water (8.33 Btu/Gallon·°F)

And,

$$\text{Shower} = \frac{\text{shower}_{\text{minutes}}}{\text{day}} * \text{GPM} * [(\text{shower}_{\text{temp}} - \text{inlet}_{\text{temp}}) / (\text{supply}_{\text{temp}} - \text{inlet}_{\text{temp}})]$$

Where,

$$\frac{\text{Shower}_{\text{minutes}}}{\text{day}} = (\text{Persons}) * \left( \frac{\text{showers}}{\text{day/person}} \right) * \left( \frac{\text{minutes}}{\text{shower}} \right)$$

Persons = 2.4

Showers/day/person=1

Minutes/shower=8

GPM= gallons per minute =2.07<sup>33</sup>

Shower<sub>temp</sub>=105° F

Supply<sub>temp</sub>=water heater set point = 136° F in pre-case or 120° F in post-case

Inlet<sub>temp</sub>=incoming water temperature=65° F<sup>34</sup>

$$\text{Bath} = \left( \frac{\text{baths}}{\text{day}} \right) * \left( \frac{\text{gallons}}{\text{bath}} \right) * \left[ \frac{\text{bath}_{\text{temp}} - \text{inlet}_{\text{temp}}}{\text{supply}_{\text{temp}} - \text{inlet}_{\text{temp}}} \right]$$

Where,

Baths/day = 0.17

Gallons/bath=50

$$\text{Dishwasher} = \left( \frac{\text{loads}}{\text{day}} \right) * \left( \frac{\text{gallons}}{\text{load}} \right)$$

Where,

---

<sup>33</sup> This is the low flow showerhead adjusted for the presence of un-retrofit fixtures in the sample.

<sup>34</sup> The impact from water heater temperature setback is neutral with respect to this parameter

$$\text{Loads/day} = 0.56$$

$$\text{Gallons/load} = 9$$

$$\textbf{Clothes Washer} = \left(\frac{\text{loads}}{\text{day}}\right) * [(\text{Pr}(\text{CW}))] * \left(\frac{\text{gallons}}{\text{load}}\right)$$

Where,

$$\text{Pr}(\text{CW}) = \text{probability of having a clothes washer} = .91$$

$$\text{Loads/day} = 0.79$$

$$\text{Gallons/load} = 9.4$$

$$\textbf{Faucet Flow} = \left(\frac{\text{gallons}}{\text{day}}\right) * \left[\frac{\text{faucet}_{\text{temp}} - \text{inlet}_{\text{temp}}}{\text{supply}_{\text{temp}} - \text{inlet}_{\text{temp}}}\right]$$

Where,

$$\text{Gallons/day} = 8.6$$

$$\text{Faucet}_{\text{temp}} = 94^{\circ} \text{ F}$$

$$\textbf{Faucet Fill} = \left(\frac{\text{gallons}}{\text{day}}\right) * \left[\frac{\text{fill}_{\text{temp}} - \text{inlet}_{\text{temp}}}{\text{supply}_{\text{temp}} - \text{inlet}_{\text{temp}}}\right]$$

Where,

$$\text{Gallons/day} = 10.2$$

$$\text{Fill}_{\text{temp}} = 105^{\circ} \text{ F}$$