

ICC Docket No. 13-0495

**Commonwealth Edison Company's Response to
Natural Resources Defense Council ("NRDC") Data Requests
NRDC 2.01 – 2.20**

Date Received: September 20, 2013

Date Served: October 3, 2013

REQUEST NO. NRDC 2.16:

On p. 65, starting at line 1405, Mr. Brandt explains that the company is requesting the approval of a "realization rate framework" analogous to the NTG framework in which past evaluation-based realization rates would be deemed until new values were developed and that new values would only applied prospectively.

- a. What is the Company's rationale for such a framework? While there is certainly a risk that realization rates will not be as forecast, isn't that a risk that the Company itself controls since realization rates are often a function of the care taken by Company staff and/or contractors in estimating savings?
- b. Please provide a history of realization rates by program from PY1 through PY5 (or the most recent year for which such rates are available).

RESPONSE:

- a. ComEd objects to this request to the extent it is based upon incorrect assumptions of law or fact or is based on facts that are not in evidence. Without waiving these foregoing objections or any of ComEd's General Objections, ComEd states as follows. In addition to the explanation provided on page 110 of ComEd's 2014-2016 Energy Efficiency and Demand Response Plan (ComEd Ex. 1.0), ComEd notes that its proposal merely seeks a continuation of the realization rate framework approved by the Commission in ICC Docket No. 10-0570, which has been applied during the last three (3) Plan years (Plan Year 4 through Plan Year 6).

Prior to approval of this realization rate framework, the independent evaluator would calculate the realization rate for each program element and apply that rate retrospectively to the program results. Under this approach, the risk associated with the realization rate was unmanageable because ComEd would not find out how the calculated realization rates would impact the program elements until the evaluation report was received 6-12 months after the Plan year had ended. As a result, there was no opportunity for ComEd to respond to the effect of the realization rate because the Plan year was already over.

To address these risks, ComEd proposed in ICC Docket No. 10-0570 a framework under which the realization rate would only apply prospectively. In other words, the newly calculated realization rates would not apply until the start of the next Plan year. This would provide ComEd with time to modify the program, or possibly the entire portfolio, if a dramatic shift in the realization rate occurs. For new program elements, the planning realization rate would be assumed until a realization rate is calculated, which would again

be applied prospectively at the start of the next Plan year (i.e., the next June 1st). The Commission approved this framework “with the following exception—Components of realization rates that are within the control of ComEd (E.g., data entry errors or custom engineering calculations) will not be deemed. Components of realization rates over which ComEd has no control shall be deemed as part of the deemed measure savings (e.g., in-service rates for CFLs).” *Commonwealth Edison Co.*, ICC Docket No. 10-0570, at 48-49 (Dec. 22, 2010). It is this framework, previously approved by the Commission, that ComEd requests again be approved in this docket for the same reasons.

- b. ComEd objects to this request because Plan Year 1 through Plan Year 5 are outside the scope of ComEd’s 2014-2016 Energy Efficiency and Demand Response Plan (“Plan 3”) at issue in this proceeding, and the information requested for these Plan Years is neither relevant nor likely to lead to the discovery of admissible evidence in this docket. Please see the attachment labeled as NRDC 2.16_Attach 1. The attachment file provides three (3) worksheets – the first worksheet, “RR Summary” contains PY1-PY4 realization rates, the second worksheet, “PY4 Deemed RR”, contains the PY4 filed realization rates, and the final worksheet, “PY5 Deemed RR”, contains the PY5 filed realization rates.

Realization Rate (Ratio of Research Findings Gross to Ex-Ante Gross Savings)

Program	PY1	PY2	PY3	PY4
ES Lighting	70%	74%	71%	68%
Fridge Recycling	75%	73%	75%	85%
Freezer Recycling	59%	73%	65%	75%
Multi-Family	90%	77%	128%	91%
Single Family		107%	83%	107%
CACES		33%	103%	104%
Home Energy Report			NA	NA
Clothes Washer Rebates				149%
Joint Elementary Education				100%
Complete System Replacement				60%
Standard	133%	121%	101%	104%
Custom	79%	85%	85%	80%
Mid-Stream Incentives (BILD)			110%	139%
Retro Commissioning	90%	91%	95%	91%
Small C&I Intro Kit	20%			
New Construction		85%	100%	88%
Industrial Systems/Compressed Air				75%
Small Business				86%
Data Centers				80%

ComEd Deemed Parameters - PY4

Program	Measure Description	Type	Value	Gross Savings Parameter Source
Res Lighting	Standard bulbs	RR	0.73	Category level; Table 3-14
	Specialty bulbs	RR	0.80	Category level; Table 3-14
	Fixtures	RR	0.89	Category level; Table 3-14
	All bulbs; fixtures	Delta Watts	varies by bulb	Calculate with Lumen Equivalence methodology; Table 3-14
	All bulbs- residential use	HOU	2.74	Average HOU PY3 Logger study
	Fixtures	HOU	2.57	PY3 lighting logger indoor HOU
Appliance Recycling	Refrigerators	RR	0.87	PY2 AR report; Table E-3
	Freezers	RR	0.89	PY2 AR report; Table E-3
	Window AC Units	RR	1.0	PY2 AR report; Table E-3 - no part use adjustment
Multi-Family	CFLs	RR	0.96	CFL RR; Table E-2
	CFLs	HOU	2.57	PY3 lighting logger indoor HOU
	Water measures (electric DHW)	RR	0.67	Other Measure RR; Table E-2
Single Family	CFLs	RR	0.97	CFL RR; Table E-0-3
	CFLs	HOU	2.57	PY3 lighting logger indoor HOU
	Water measures (electric DHW)	RR	0.84	Other Measure RR; Table E-0-3
CACES	Tune-up Measures	RR	NA	Savings based on formula
	Quality Installation Measures	RR	NA	Savings based on billing analysis
Prescriptive	Standard Measure Savings	RR	1.00	Individual measures updated to reflect PY2 evaluation -resulting RR's set to 1.0
Custom	All Measures	RR	NA	Custom realization rates not eligible for deeming at this time
Retro-Commissioning	Project Level	RR	NA	Retro-Commissioning RR not eligible for deeming at this time
C&I New Construction	Systems Track Projects	RR	0.85	Only Systems Track projects evaluated in PY2
	Comprehensive & Small Bus Track	RR	NA	
Compressed Air	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Midstream Incentives	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Small Business DI	Prescriptive based measures	RR	1.00	Some measures deemed per Prescriptive Program ⁽²⁾
	All Other Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Energy Efficiency RFI	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Home Energy Report	All Savings	RR	NA	New Program - realization rates not eligible for deeming at this time
Appliance Rebate	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Res. New Construction	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time

(1) Table References are to Program Year 2 ("PY2") Individual Program Evaluation Reports

ComEd Deemed Parameters - PY5

Program	Measure Description	Type	Value	Gross Savings Parameter Source
Res Lighting	Standard bulbs	ISR		
	Specialty bulbs	ISR		
	Fixtures	RR	0.87	Category level; Lighting Table 3-23
	Fixtures	HOU/day	2.57	PY3 Logger study; & PY3 Table 3-17
Appliance Recycling	Refrigerators	RR	0.90	PY3 AR report; Table E-3
	Freezers	RR	0.75	PY3 AR report; Table E-3
	Window AC Units	RR	1.00	PY3 AR report; Table E-3 - no part use adjustment
Multi-Family	CFLs	ISR		
	Water measures (electric DHW)	RR	NA	RR not consistent w/ model changes
Single Family	CFLs	ISR		
	Hot water Heater Turndown	kWh/home	188	SF Rpt. Table ES-9
	Weatherization Measures	RR	NA	New Models in use -not evaluated
	Water measures (electric DHW)	RR	0.73	Wtd Avg. Measure RR; SF Table ES-3
CACES	Tune-up Measures	RR	NA	Program being sunset - no parameters to be deemed
	Quality Installation Measures	RR	NA	
Home Energy Report	All Savings	RR	NA	New Program - realization rates not eligible for deeming at this time
Clothes Washer/ Appliance	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Joint Elementary Energy	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Joint Complete System	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Residential New Construction	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Prescriptive	Standard Measure Savings	RR	NA	RR's set to 1.0 ⁽¹⁾
Custom	All Measures	RR	NA	Custom realization rates not eligible for deeming at this time
Retro-Commissioning	Project Level	RR	NA	Retro-Commissioning RR not eligible for deeming at this time
C&I New Construction	Systems Track Projects	RR	0.997	System Track NTG; Table E-3
	Comprehensive & Small Bus Track	RR	NA	ComEd will not deem PY3 value as not being representative
Industrial Systems	Compressed Air	RR	NA	New Program - realization rates not eligible for deeming at this time
	Process Heating	RR	NA	
	Refrigeration	RR	NA	
Midstream Incentives	CFLs	RR	NA	ComEd will not deem PY3 value as not being representative
	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Small Business DI	Prescriptive based measures	RR	NA	Some measures deemed per Prescriptive Program ⁽¹⁾
	All Other Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Energy Efficiency RFI	All Measures	RR	NA	Program being sunset - no parameters to be deemed
Data Centers	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Commercial Real Estate	All Measures	RR	NA	New Program - realization rates not eligible for deeming at this time
Third Party Administration	All Programs	RR	NA	New Program - realization rates not eligible for deeming at this time

(1) Table References are to Program Year 3 ("PY3") Individual Program Evaluation Reports

ICC Docket No. 13-0495

**Commonwealth Edison Company's Response to
Natural Resources Defense Council ("NRDC") Data Requests
NRDC 3.01**

Date Received: September 26, 2013

Date Served: October 11, 2013

REQUEST NO. NRDC 3.01:

The TRM states that only 69.5% of CFLs that are purchased through the Company's residential retail lighting program can be assumed to be providing savings in the year in which they are purchased. 15.4% are assumed to begin providing savings in the following year and 13.1% are assumed to begin providing savings two years after purchase.

- a. Please complete the following table, using actuals for PY5 (recognizing that they may have not been officially verified yet) and forecasts for PY6 through PY9. Note that the term "rebated" refers to any financial incentives, including upstream incentives, which the Company provided. Savings numbers should include net savings (i.e. including NTG adjustments). Note also that there are no columns for PY10 and PY11, though some savings from PY8 and PY9 activities would necessarily be claimed in those years.

	PY5	PY6	PY7	PY8	PY9
Total Number of CFLs Rebated					
MWh Savings from all CFLs that will ultimately be installed (i.e. using the TRM's 98.0% lifetime in-service rate – recognizing that not all these savings can be claimed immediately)					
MWh savings that can be claimed from units rebated in the year in which they were rebated (i.e. using the TRM's 69.5% first year in service rate)					
MWh savings that can be claimed from units rebated the previous year (i.e. using the TRM's 15.4% second year installation rate)					
MWh savings that can be claimed from units rebated two years ago (i.e. using the TRM's 13.1% third year installation rate)					
Total MWh savings that can be claimed (i.e. the sum of the three previous rows)					

- b. If the values in the last row for PY7 through PY9 are different than those included in the Company's plan for the residential lighting program please explain why.

RESPONSE:

- a. Please see the below table. The PY5 savings are based on Navigant’s (the independent evaluator) preliminary impact memo dated September 4, 2013, and assumes in service rates (“ISR”) by bulb type and carryover estimates included in memo. The PY6 estimates are ComEd portfolio values, excluding specialty bulbs sold through the Illinois Power Agency programs. Please also see ComEd response to subpart (b), below.

	PY5	PY6	PY7	PY8	PY9
Total Number of CFLs Rebated	10,897,894	7,733,000	8,050,000	7,350,000	4,570,000
MWh Savings from all CFLs that will ultimately be installed (i.e. using the TRM’s 98.0% lifetime in-service rate – recognizing that not all these savings can be claimed immediately)	383,470	215,800	123,333	107,654	65,391
MWh savings that can be claimed from units rebated in the year in which they were rebated (i.e. using the TRM’s 69.5% first year in service rate)	275,700	150,000	0	0	0
MWh savings that can be claimed from units rebated the previous year (i.e. using the TRM’s 15.4% second year installation rate)	56,900	58,600	0	0	0
MWh savings that can be claimed from units rebated two years ago (i.e. using the TRM’s 13.1% third year installation rate)	48,400	52,000	0	0	0
Total MWh savings that can be claimed (i.e. the sum of the three previous rows)	381,000	260,600	0	0	0

- b. In ComEd’s 2014-2016 Energy Efficiency and Demand Response Plan (“Plan 3”), the final Lifetime ISR was applied in the year of purchase. The actual amounts in Plan 3 assume that with the adjustments for past and future years, the effective ISR for each year would be equal to the final Lifetime ISR. Effectively, the only difference that would occur each year is due to the change in bulb count for each bulb type from year to year. Further, as different regulations take effect, ComEd does not know what the saving in future years will be. As such, this methodology eliminates the burdensome task of trying to determine carryover saving and more accurately reflects the proper yearly matching of costs and benefits related to each measure.

ICC Docket No. 13-0495

**Commonwealth Edison Company's Response to
Natural Resources Defense Council ("NRDC") Data Requests
NRDC 4.01 – 4.05**

Date Received: October 15, 2013

Date Served: October 31, 2013

REQUEST NO. NRDC 4.05:

In response to NRDC 3.01a, ComEd appears to be indicating that it rebated 10,897,894 CFLs in PY5 (Row 2, Column 2 in the table), that the total savings that will be realized from the 98% of those units that the TRM assumes will ultimately be installed is 383,470 MWh (Row 3, Column 2), that the 275,700 of those MWh were realized in PY5 (Row 4, Column 2) and that 58,600 of the MWh will be realized in PY6 (Row 5, Column 3). It references a Navigant "preliminary impact memo dated September 4, 2013 as the source for the PY5 numbers.

- a. Please provide a copy of the referenced Navigant memo.
- b. Please confirm that the interpretation of ComEd's answer provided above is accurate. If not, please explain what is inaccurate and why.
- c. Would ComEd agree that 383,470 MWh provided in Row 3, Column 2 suggest that ComEd will be able to claim 51,260 MWh in savings in PY7 from CFLs rebated in PY5 per the following calculation? If not, please explain what is inaccurate about the calculations and provide ComEd's best estimate of the actual MWh from PY5 rebated CFLs that it expects to be able to claim in PY7.

$$\begin{aligned} & (\text{Total annual MWh using 3-year ISR/3-year ISR}) * 3^{\text{rd}} \text{ Year ISR} = 3^{\text{rd}} \text{ Year MWh} \\ & (383,470/0.98) * 0.131 = 51,260 \end{aligned}$$

RESPONSE:

- a. Please see the attachment labeled as NRDC 4.05_Attach 1.
- b. Yes, the interpretation is correct. However, ComEd expects the numbers to be adjusted as evaluation results are finalized.
- c. ComEd does expect some CFL carryover from PY5 and PY6 to occur in PY7. However, the actual amount will be dependent on the CFL carryover methodology and calculation, which has been questioned by other parties. In ComEd's development of Plan 3, it simplified the estimates of CFL carryover by including savings from all sales (i.e., not installations) in a given year for PY7 through PY9 in the Residential Lighting Program. In this way, the CFL carryover did not need to be identified separately.

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Memorandum

Date: September 4th, 2013
To: David Nichols, ComEd, Illinois Commerce Commission and ComEd Residential Lighting Interested Parties
CC: Jeff Erickson, Randy Gunn, and Rob Neumann; Navigant Consulting
From: Amy Buege, Luke Scheidler, and Vanessa Arent; Navigant Evaluation Team
RE: Preliminary PY5 ComEd Residential Lighting Impacts

This memorandum (memo) presents preliminary impact estimates (ComEd Reported, Verified Savings¹, and Impact Evaluation Research Findings²) for the fifth program year (PY5) ComEd Residential Lighting Program evaluation. This is intended to provide ComEd with a preliminary review of the Residential Lighting Program impact estimation parameters prior to receiving the draft of the annual report. The impact parameter estimates presented in this memo include estimates for PY5:

- Bulb Sales
- Delta Watts
- Installation Rates
- Leakage Rate
- Residential/Non-residential Installation Location Split
- Hours of Use (HOU) and Peak CF
- Energy and Demand Interactive Effects
- PY5 Carryover Bulbs

¹ Verified Savings are calculated based on TRM deemed savings parameters (when available) and after evaluation adjustments to those parameters that are subject to retrospective adjustment for the purposes of measuring savings that will be compared to the utility's goals

² Impact Evaluation Research Findings are calculated based on evaluation estimated savings parameters regardless of whether the parameter is deemed for the Verified Savings analysis.

Preliminary PY5 Parameter Estimates

Table 1 below presents the preliminary PY5 Gross ComEd Reported, Verified Savings and Impact Evaluation Research impact parameter estimates (by bulb type where possible) alongside the similar estimates from PY4. A brief description of the derivation of the PY5 estimates is provided in the sections below.

Table 1. PY5 Gross Impact Parameter Estimates Compared to PY4

Gross Impact Parameters	Population	PY5 ComEd Reported	PY5 Verified Savings	PY5 Evaluation Research	PY4 Verified	PY4 Research
Program Bulb Sales	Standard CFLs	9,610,273	9,633,227	9,633,227	11,419,752	11,419,752
	Specialty CFLs	1,198,120	1,197,896	1,197,896	1,097,670	1,097,670
	LEDs	26,252	28,230	28,230	24,919	24,919
	Fixtures	34,713	33,035	33,035	101,090	101,090
	Coupons	5,506	5,506	5,506	5,599	5,599
	All PY5 Bulbs	10,874,864	10,897,894 ³	10,897,894	12,649,030	12,649,030
Delta Watts	Standard CFLs	-	46.7	46.7	48.7	48.6
	Specialty CFLs	-	31.0	36.5	39.6	50.0
	All PY5 Bulbs	-	45.0	45.5	48.0	48.8
Installation Rate	Standard CFLs	69.5%	69.5%	76%	73%	70%
	Specialty CFLs	79.5%	79.5%	92%	80%	75%
	LEDs	79.5%	95.0%	100%	80%	100%
	Fixtures	87.5%	87.5%	100%	89%	100%
	All PY5 Bulbs	71%	71%	78%	74%	70%
	Res/NonRes	97%/3% ⁴	98%/2%	98%/2%	95%/5%	95%/5%
Hours of Use & Peak CF	Res HOU	HOU from Tracking Data * 1.089 to adjust for NonRes	2.75	2.75	2.74	2.74
	Res CF		0.10	0.10	0.10	0.10
	NonRes HOU		13.16	13.16	12.23	12.23
	NonRes CF		0.69	0.69	0.66	0.66
	Overall HOU		2.92	2.92	3.17	3.17
	Overall CF		0.11	0.1	0.13	0.13
Leakage	All PY5 Bulbs	2.0%	2.0%	2.3%	0.0%	3.7%
Interactive Effects	Energy	1.06	1.03	1.03	1.03	1.03
	Demand	-	1.10	1.10	1.10	1.10
Carryover Bulbs	PY3 and PY4 Sales	-	3,104,788	3,391,174	2,673,129	2,673,129

Source: Evaluation Team Analysis

³ The Evaluation Research PY5 program bulb sales estimate is 23,030 bulbs higher than the ComEd reported due to a small number of bulbs sold in PY4 that were included as PY5 sales due to a delay in the receipt of the retailer invoices for these sales (and thus their exclusion from PY4 sales). This is described in further detail below.

⁴ From PY3 research.

Table 2 below presents similar estimates for the preliminary PY5 net impact parameters.

Table 2. PY5 Net Impact Parameter Estimates Compared to PY4

Net Program Impact Parameters	Population	PY5 ComEd Reported	PY5 Verified Savings	PY5 Evaluation Research	PY4 Verified Savings	PY4 Evaluation Research
NTGR	Standard CFLs	0.72	0.72	0.54	0.58	0.55
	Specialty CFLs	0.80	0.80	0.48	0.80	0.44
	All PY5 Bulbs	0.73	0.73	0.54	0.60	0.54

Source: Evaluation Team Analysis

Preliminary PY5 Impact Estimation

Based on the Gross and Net impact parameter estimates shown in the tables above,

Table 3 below presents estimated Net PY5 Program impacts for the Residential Lighting Program. The PY5 Verified Savings net energy savings estimate was 90% of the PY5 ComEd Reported net energy savings estimate.⁵ The PY5 Impact Evaluation Research Findings net energy savings estimate was 80% of the Verified Savings net energy savings estimate.

Table 3. PY5 Net Program Impacts

PY5 Population	Estimated Net Impacts	PY5 ComEd Reported	PY5 Verified Savings	PY5 Evaluation Research
PY5 Bulb Sales	Net MWh Savings	305,449	275,716	221,725
	Net MW Savings	-	251.1	201.9
	Net Peak MW Savings	-	29.0	23.4
Carryover Bulbs (from PY3 and PY4)	Net MWh Savings	-	105,371	116,206
	Net MW Savings	-	97.6	100.5
	Net Peak MW Savings	-	11.7	13.1

Source: Evaluation Team Analysis

PY5 Primary Data Sources

The primary data sources for the evaluation of the PY5 Residential ES Lighting Program included a tracking database, a goals tracker spreadsheet, in-store intercept surveys, shelf surveys, and the PY5

⁵ Using the ComEd reported estimate of 305,449 MWh.

Illinois Technical Reference Manual⁶ (PY5 IL TRM). Table 4 below provides a summary of the data sources including the targeted populations, the sample sizes, and the objectives of the efforts.

Table 4. PY5 Primary Data Sources and Objectives

Data Source	Targeted Population	Sample Size	Gross Impacts	Net Impacts	Process
Tracking Database	All Program Bulb Sales	All	X	X	
APT Goals Tracker Spreadsheet	All Program Bulb Sales	All	X	X	
In-Store Intercept Surveys	Retail Lighting Purchasers	792	X	X	X
In-Store Shelf Surveys	Program Stores	28 Stores	X	X	X
PY5 IL TRM	All Program Bulb Sales	All	X	X	

Tracking Database

The Residential Lighting Project Tracking Database included all upstream program CFL sales since the program inception. A number of data cleaning steps were taken to make sure PY5 bulb sales were complementary and non-overlapping with bulb sales attributed to PY1 through PY4. A small number of bulbs sold in PY4 were counted as PY5 sales due to a delay in the receipt of the retailer invoices for these sales and, thus, exclusion from the bulbs counted as PY4 sales.⁷ In addition, bulbs sold and included in PY4 or PY5 sales estimates that were later returned (as indicated by negative quantities in the program tracking data) were subtracted from the PY5 sales. The PY5 analysis dataset was finalized based on the most recent program tracking database received from ComEd (dated August 8, 2013). This dataset contained 270,709 records, representing 10,892,388 program bulbs and fixtures sold in PY4 (late invoices) and PY5. Additionally, the PY5 coupon dataset contained 2,563 records and 5,506 bulbs.

APT Goals Tracker Spreadsheet

⁶ State of Illinois Energy Efficiency Technical Reference Manual. Final, As of September 14th, 2012. Effective: June 1st, 2012.

⁷ The invoice dates in the program tracking database corresponding to PY5 sales are 6/27/12 to 6/21/13. These dates do not align with actual program year dates (6/1/12 to 5/31/13) due to a delay in data submittal from program partners.

The bulb information database tables typically used to obtain critical evaluation parameters such as lumens, manufacturer base wattage, and bulb wattage were not updated in PY5. Instead, these evaluation parameters were obtained from the APT Goals Tracker Spreadsheet. In general, the necessary evaluation parameters were available in Goals Tracker and the model numbers matched readily to the program tracking database. There were very few instances where lumen and/or manufacturer base wattage values were missing or incorrect. As in previous years, there were no fields for specialty bulb type, dimmable/non-dimmable, or reflector bulb type. These variables were extracted from the "Description" field for the purposes of this evaluation, but this is an imperfect process as the bulb description does not always specify the bulb type. These designations are important for establishing base wattages and would be helpful in future evaluations.

In-store Intercept Surveys

The PY5 evaluation plan called for completing 800 in-store intercept surveys with customers purchasing lighting products in program retailers during the PY5 program year. This 800-point target was set in order to capture a large enough sample of customers who were purchasing of both standard and specialty bulbs to allow for the estimation of program impact parameters by bulb type.⁸

Out of the 792 in-store intercept surveys completed, 323 were completed with customers purchasing program bulb and 500 were completed with customers purchasing non-program bulbs.⁹ In total, 4,678 bulbs were purchased by the surveyed customers. Table 5 below provides a distribution of the number of program and non-program bulbs sold by bulb type. Similar to previous program years, intercept respondents purchased significantly more standard CFLs than specialty CFLs, and very few purchased program LEDs. Incandescent bulbs continued to be the type of non-program bulb purchased most frequently by surveyed respondents (69% of non-program bulbs purchased were incandescents), followed by halogen, non-program CFL and lastly LED bulbs.

⁸ Due to the very small number of LED bulbs and LED and CFL fixtures sold through the program (61,265, <1% of overall program sales) the evaluation team was unable to estimate installation rates for these products. An installation rate of 100% was assumed for these products due to their high price and hence the unlikelihood that they would be purchased and not installed.

⁹ Thirty-one surveys were completed with customers purchasing of both program and non-program bulbs.

Table 5. Distribution of Bulbs Purchased by Bulb Type for Intercept Respondents

Program vs. Non Program	Bulb Type	Number of Bulbs Sold	% of Bulbs Sold
Program Bulbs	Standard CFLs	1,674	36%
	Specialty CFLs	317	7%
	LED	12	0%
Non-Program Bulbs	Incandescent	1,837	39%
	Halogen	526	11%
	Non-program CFL	201	4%
	LED	111	2%

Source: Evaluation Team Analysis

Shelf Surveys

In PY5, 28 shelf surveys were conducted, one at each store where in-store intercept surveys were completed. Similar to past years the PY5 shelf surveys were made up of two parts. The first was an assessment of the lighting products and promotional materials found in the store. The second part was an inventory of all medium screw based (MSB) CFL, LED, Halogen and Incandescent light bulbs (no fixtures were inventoried). This is a change from the PY4 evaluation for which only 75 and 100-Watt A-lamp replacement bulbs were inventoried in an effort to focus solely on the impact of EISA 2007 on these lamp categories. The PY5 inventory noted the product manufacturer, model number, type of bulb, wattage (both CFL and incandescent equivalent when available), lumen output, location in the store, quantity in the pack, approximate number of packages on the shelf, original price and discounted price (when available).

PY5 IL TRM

PY5 is the first year that ComEd has had a TRM in place to guide the estimation of Verified Savings. The PY5 IL TRM was a collaborative effort by members of the Illinois Energy Efficiency Stakeholder Advisory Group (SAG). As stated in the TRM, its purpose is "to provide a transparent and consistent basis for calculating energy (kilowatt-hours (kWh) or therms) and capacity (kilowatts (kW)) savings generated by the State of Illinois' energy efficiency programs.¹⁰" In some cases the Verified Savings impact parameters could be taken directly from the TRM; however in other cases it was necessary to estimate the Verified Savings impact parameters by applying findings from the PY5 Evaluation Research analysis to the TRM values (for example, estimating HOU using the residential vs. non-residential split of PY5 program bulbs).

PY5 Bulb Sales Estimates

¹⁰ Footnote from TRM: <http://www.ilga.gov/legislation/ilcs/ilcs5.asp?ActID=1277&ChapterID=23>

Verified Savings and Impact Evaluation Research Findings program bulb sales estimates were derived from the PY5 tracking databases provided by ComEd to the evaluation team. The total number of bulbs sold during the PY5 Residential Lighting Program is estimated to be 10,897,894,¹¹ which is a 14% decrease from the bulbs sold in the fourth program year (PY4) and a 3% decrease from the third program year (PY3) bulbs. Eighty-eight percent of these were standard bulbs, 11% were specialty bulbs, and the remaining 1% was comprised of LED lamps, LED fixtures, CFL fixtures, and coupon bulbs (mixture of bulb types). Table 6, below, shows that the large majority of standard and specialty bulbs were sold in multi-packs (98% and 89%, respectively), while, in comparison, LED lamps, LED fixtures, and CFL fixtures were sold exclusively as single packs.

Table 6. PY5 Sales of Single Pack vs. Multi-Packs

Single vs. Multi Pack Sales	Stand CFL	Spec CFL	Stand LED	Spec LED	CFL Fixture	LED Fixture	Coupon	Total	
Single	183,881	133,317	9,472	18,758	8,767	24,268	1,088	379,551	3%
Multi	9,449,346	1,064,579	-	-	-	-	4,418	10,518,343	97%
PY5 Total	9,633,227	1,197,896	9,472	18,758	8,767	24,268	5,506	10,897,894	100%

Source: Evaluation Team Analysis

Table 7 shows bulb sales by retailer type. Across all bulb types, 79% were sold at Do-It-Yourself (DIY) or Warehouse stores, driven primarily by large sales volumes of standard and specialty CFLs at these retailers. Standard LED lamps, CFL fixtures, and LED fixtures were sold almost entirely at DIY stores, and specialty LEDs were split approximately evenly between DIY and Warehouse stores. Coupon bulbs were only sold at small hardware stores in PY5.

¹¹ Total bulbs analyzed in PY5 include 10,869,358 bulbs sold in the PY5 invoice date range, plus 23,030 bulbs from PY4 that were not analyzed previously and 5,506 coupon bulbs..

Table 7. PY5 Bulb Sales by Type of Retailer

Retailer Type	Stand. CFL	Spec. CFL	Stand. LED	Spec. LED	CFL Fixture	LED Fixture	Coupon	Total
Big Box	1,238,082	163,057	4	51	-	-	-	1,401,194
DIY	4,729,492	762,885	9,468	9,709	8,767	24,268	-	5,544,589
Dollar Store	401,515	1,593	-	-	-	-	-	403,108
Electronics Store	4,770	277	-	-	-	-	-	5,047
Grocery	156,870	20,650	-	-	-	-	-	177,520
Small Hardware	317,296	27,194	-	-	-	-	5,506	349,996
Warehouse	2,785,202	222,240	-	8,998	-	-	-	3,016,440
PY5 Total Bulb Sales	9,633,227	1,197,896	9,472	18,758	8,767	24,268	5,506	10,897,894

Source: Evaluation Team Analysis

PY5 Delta Watts

Displaced watts or “Delta watts” is calculated as the difference between the program bulb wattage and baseline incandescent equivalent wattage. Program bulb wattages as specified by the manufacturer were easily obtained from the goals tracker.¹² Appropriate baseline wattages are more difficult to establish as this metric depends on various factors including bulb type / shape, directionality, and federal standards.¹³ In PY5, the Verified Savings delta watts estimates were based on the deemed base wattage estimates outlined in the PY5 IL TRM and Impact Evaluation Research Findings delta watts were estimated by applying a lumen mapping based on the program bulb type, bulb shape, and directionality (omni-directional, globes, directional, decorative). This evaluation approach is technology neutral, meaning that lumen ranges for specific bulb types are consistent across technologies. This method is similar to the Impact Evaluation Research Findings method applied in PY4 and is also the method currently under review for inclusion in Version 2.0 of the IL TRM (which will go into effect in PY6).

Verified Savings

The IL TRM specifies unique baseline watts calculation methodologies for standard CFLs, specialty CFLs, CFL fixtures, and LED downlights. For standard CFLs and CFL fixtures, delta watts were calculated based on the lumen ranges specified in Table 8. For the PY5 evaluation, bulbs with lumen

¹² The Goals Tracker spreadsheet contained manufacturer incandescent equivalent wattages for all retailers but one.

¹³ The Energy Independence and Security Act 2007 (EISA) and the Energy Policy and Conservation Act of 2012 (EPACT).

output in the uppermost range (1490 – 2600 lumens) were subject to the new EISA standards and have reduced baseline wattage of 72 watts. All other standard CFLs and CFL fixtures were evaluated according to the “Pre-EISA” incandescent equivalent. Baseline wattages for standard LEDs (A-lamps) were also established using Table 8, as the PY5 IL TRM did not have specific guidance for this lamp type.

Table 8. IL TRM Baseline Wattage Specifications for Standard CFLs and CFL Fixtures

Minimum Lumens	Maximum Lumens	Incandescent Equivalent Pre-EISA 2007 (WattsBase)	Incandescent Equivalent Post-EISA 2007 (WattsBase)	Effective date for EISA 2007 implementation
1490	2600	100	72	June 2012
1050	1489	75	53	June 2013
750	1049	60	43	June 2014
310	749	40	29	June 2014

Source: Illinois Statewide Technical Reference Manual – effective June 1st, 2012

Baseline wattages for specialty CFLs were established based on the lumen ranges specified in Table 9.

Table 9. IL TRM Baseline Wattage Specifications for Specialty CFLs

Incandescent Bulbs (watts)	Minimum Light Output (lumens)	Common ENERGY STAR Qualified Bulbs (Watts)
25	250	4 to 9
40	450	9 to 13
60	800	13 to 15
75	1,110	18 to 25
100	1,600	23 to 30
125	2,000	22 to 40
150	2,600	40 to 45

Source: Illinois Statewide Technical Reference Manual – effective June 1st, 2012

Finally, baseline wattages for LED fixtures¹⁴ and LED downlights were established based on Table 10 below.

Table 10. IL TRM Baseline Wattage Specifications for LED Fixtures and Downlights

Bulb Type	Efficacy (lumen/Watt)	Lumens	LED Watts (Watts/EE)	Incand./Halogen Watts	CFL Watts
PAR20 screw-in lamps	10-15	460-810	13	46	18
PAR30 screw-in lamps	(incandescent/halogen) 35-45 (CFL reflector)	600-1005	15	67	20
PAR38 screw-in lamps	40-60 (LED)	630-1170	18	78	23
MR16/PAR16 pin-based lamps	15-25 (Incandescent) 50 (LED)	300-500	8	20	
		525-875	14	35	
		750-1250	20	50	
Recessed downlight luminaries	35 (fixture efficacy with a CFL lamp) 42-86 (LED fixture)	540 500-650 1000	11 12 13	50 65 100	15 18 25
Track lights (R20)	10-15	320-675	8	45	10
Track lights (BR30 and BR40)	(incandescent/halogen) 35-45 (CFL reflector) 40-60 (LED)	440-975	11	65	18

Source: Illinois Statewide Technical Reference Manual – effective June 1st, 2012

Evaluation Research Findings

The PY5 IL TRM basewatt methodology is an improvement over the previous deemed “one-size-fits-all” lumen mapping for all bulb types used in PY4 as it uses different methods for establishing basewatts for different bulb types. Despite this, the evaluation team believes there is still room for improvement. The evaluation team recommends establishing baseline wattage by using lumen mapping that is specific to bulb type, shape, and directionality (omni-directional, globes, directional, decorative). Additionally, the evaluation team recommends a technology neutral approach, meaning that lumen ranges for specific bulb types should be consistent across technologies (the current TRM, for instance, uses different lumen ranges for CFL reflector bulbs than for LED reflector bulbs).

¹⁴ Technically the PY5 IL TRM did not contain a section specifically pertaining to LED fixtures and thus the LED Downlights section was applied as most LED fixtures contained LED downlight bulbs.

The proposed method was first used to calculate the Impact Evaluation Research Findings in PY4. It is also the method now under review for PY6 IL TRM. The evaluation team believes this method is a more robust means of establishing incandescent equivalent wattage across all bulb types. This is especially true for specialty CFLs and LEDs. Since lumen output is a measure of the total light produced in all directions from a source, bulbs such as reflectors (and LEDs in general) that focus light in a single direction require a different lumen mapping than a standard CFL. It is important to note that while lumens are becoming a more universal metric for light output across bulb types, industry experts suggest that lumens alone are not adequate to fully characterize the performance of directional lamps.¹⁵ The bulb type lumen mapping recommended for PY5 is adapted from the new Energy Star draft specification for lamps and the EPACT luminous efficacy requirements for incandescent reflector lamps.¹⁶ The lumen ranges and incandescent equivalencies for bulbs subject to EISA¹⁷ are identical to the current specifications for standard CFLs and CFL fixtures presented in Table 8. Table 11 below shows the lumen to incandescent equivalencies for directional and non-directional bulbs for EISA exempt bulb types.

¹⁵ The Lighting Research Center notes that "Most lamp manufacturers do not publish lumen output ratings for MR16 lamps or other reflectorized lamps in their catalogs. Instead, they publish beam angle and [Center Beam Candle Power], which provide more accurate information about the performance characteristics of the lamp." Similarly, Sylvania reports that "Requests are often received for the lumen output values for aluminum reflector or AR-type lamps. Usually, this is a meaningless specification; candlepower is the appropriate value for a reflector lamp since they are used for accent and display lighting."

<http://www.lrc.rpi.edu/programs/nlpip/lightingAnswers/mr16/performance.asp>

<http://assets.sylvania.com/assets/documents/faq0007-0297.cb5b8f25-05ee-463d-8d0c-c60912a4adf7.pdf>

¹⁶<http://www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0131-0005>

http://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/lamps/V1.0_Draft_2_Specification.pdf74749-8e30

¹⁷ Twist, dimmable twist, globe (less than 5" in diameter and > 749 lumen), candle (shapes B, BA, CA > 749 lumens), candelabra base lamps (>1049 lumens), intermediate base lamps (>749 lumens).

Table 11. Evaluation Baseline Wattage Specifications EISA Exempt Bulbs

Bulb Type	Lower Lumen Range	Upper Lumen Range	WattsBase
Standard Spirals >= 2601 lumens	2601	2999	150
	3000	5279	200
	5280	6209	300
3-Way	250	449	25
	450	799	40
	800	1099	60
	1100	1599	75
	1600	1999	100
	2000	2549	125
	2550	2999	150
Globe (medium and intermediate bases less than 750 lumens)	90	179	10
	180	249	15
	250	349	25
	350	749	40
Decorative (Shapes B, BA, C, CA, DC, F, G, medium and intermediate bases less than 750 lumens)	70	89	10
	90	149	15
	150	299	25
	300	749	40
Globe (candelabra bases less than 1050 lumens)	90	179	10
	180	249	15
	250	349	25
	350	499	40
	500	1049	60
Decorative (Shapes B, BA, C, CA, DC, E, G, candelabra bases less than 1050 lumens)	70	89	10
	90	149	15
	150	299	25
	300	499	40
	500	1049	60
Reflector with medium screw bases w/ diameter <=2.25"	400	449	40
	450	499	45
	500	649	50
	650	1199	65

Source: Evaluation Team Analysis

Table 11(continued). Evaluation Baseline Wattage Specifications EISA Exempt Bulbs

Bulb Type	Lower Lumen Range	Upper Lumen Range	WattsBase
R, PAR, ER, BR, BPAR or similar bulb shapes with medium screw bases w/ diameter >2.5" (*see exceptions below)	2601	2999	150
	640	739	40
	740	849	45
	850	1179	50
	1180	1419	65
	1420	1789	75
	1790	2049	90
	2050	2579	100
	2580	3429	120
	3430	4270	150
R, PAR, ER, BR, BPAR or similar bulb shapes with medium screw bases w/ diameter > 2.26" and ≤ 2.5" (*see exceptions below)	540	629	40
	630	719	45
	720	999	50
	1000	1199	65
	1200	1519	75
	1520	1729	90
	1730	2189	100
	2190	2899	120
*ER30, BR30, BR40, or ER40	400	449	40
	450	499	45
	500	649-1179**	50
*BR30, BR40, or ER40	650	1419	65
*R20	400	449	40
	450	719	45
*All reflector lamps below lumen ranges specified above	200	299	20
	300	399-639**	30

Source: Evaluation Team Analysis

Using the baseline wattages methods established above, delta watts was calculated for each program bulb by subtracting the program bulb wattage from the TRM or evaluation baseline wattage. Average delta watts values by bulb type are presented in Table 12, below.

Table 12. Average Delta Watts Value Across All Bulbs

	Stand. CFLs	Spec. CFLs	CFL Fixtures	Stand. LED	Spec. LED	LED Fixtures	Coupon	All PY5
Bulbs Sold	9,633,227	1,197,896	8,767	9,472	18,758	24,268	5,506	10,897,894
Avg Bulb Wattage	17.0	18.2	25.6	11.6	14.1	11.0	20.2	17.5
Avg Delta Watts (Verified Savings)	46.7	31.0	58.3	48.0	52.4 ¹⁸	52.7	45.3	45.0
Avg Delta Watts (Eval. Research)	46.7	36.5	58.3	48.0	31.2	36.7	45.8	45.5

Source: Evaluation Team Analysis

Across all bulb types, the variation in delta watts resulting from the two methods (Verified Savings and Impact Evaluation Research Findings) is only 0.5%. However, this figure masks larger differences between the approaches for some lamp types. The largest portion of bulb sales (standard CFLs) has no variation between the two methods (the lumen mapping is identical between the two methods). This is also the case for CFL fixtures and standard LEDs. The other bulb types show higher variation across the delta watts calculations. The differences are most apparent for both specialty LED lamps and LED fixtures, where delta watts from the Impact Evaluation Research Findings approach are 40% and 30% lower, respectively, than the values from the PY5 Verified Savings approach.

Both the specialty LED and LED fixtures categories are comprised primarily of various types of reflector lamps (R20, R30, BR30, PAR30, etc.). The current TRM lumen ranges specified in Table 10 for LED reflectors are based on common light output values for different technologies (incandescent, CFL, LED) and average bulb wattages by bulb type (PAR20, PAR30, etc.) to establish wattage equivalencies (Verified Savings). Alternatively, the evaluation teams recommended Impact Evaluation Research Findings method starts with the lumen output requirements for incandescent reflector lamps as specified in EPACT (and supplemented by Energy Star). Because the Impact Evaluation Research Findings method is based on the Federal standard for reflector lamps and the fact that any bulb replacing an incandescent bulb should have comparable light output, the evaluation team believes this method is a more robust means of establishing baseline wattages for these specialty lamps.

CFL Installation Rates

¹⁸ The TRM based delta watts estimate for specialty LEDs is based on the evaluation team's interpretation of the TRM guidelines presented in Table 10 above, however not all PY5 program bulbs fit into the lumen bins specified by the TRM. Sam Dent of VEIC suggested (in an email dated 9/2/2013) using the midpoint of the LED luminous efficacy ranges presented to establish base wattages for these bulbs. Updating the base wattages to conform to this suggestion had little impact on the delta watts estimates, reducing the delta watts estimate for specialty LEDs by only 1% and reducing overall PY5 delta watts by only 0.002%.

Verified Savings

As laid out in the PY5 IL TRM, the Verified Savings first-year installation rate estimate is assumed to be 69.5% for Standard CFLs, 79.5% for Specialty CFLs, 87.5% for CFL fixtures (based on the Interior Hardwired CFL Fixture section of the TRM which covers all PY5 CFL fixtures) and 95% for LEDs (based on the Downlight LED section of the TRM as 2/3rds of LED program bulbs are downlights and all LEDs are significantly more expensive than CFLs and thus are likely to have very high installation rates). LED fixtures were not called out separately in the PY5 IL TRM and so the CFL fixture installation rates were applied to LED fixtures as well.

Impact Evaluation Research Findings

The overall Impact Evaluation Research Findings estimated installation rate (IR) across bulb and retailer types based on the PY5 in-store intercepts was estimated to be 78%. This estimate is 11% higher than the PY4 Evaluation Research estimate of 70%. Both standard and specialty CFL installation rates were found to be higher in PY5 than in PY4 (standard increased from 70% to 76% and specialty increased from 75% to 92%).

As seen in past evaluation years, the installation rate for specialty CFLs was found to be higher (92%) than the installation rate of standard CFLs (76%).¹⁹ An installation rate of 100% was assumed for LED bulbs and fixtures (both LED and CFL fixtures). Standard CFLs represent 88% of program bulb sales in PY5, so despite the high specialty CFL and LED installation rates, the overall PY5 installation rate (across all bulb types) was just 2% higher than the standard CFLs IR, at 78%.

Table 13 below shows installation rates broken out for standard and specialty CFLs²⁰ across a variety of factors: the retailer type (e.g., Big Box, DIY, Warehouse), whether or not the intercept survey took place during a demo event, total number of CFLs purchased, and whether or not the model the customer was purchasing was one of two "top-selling" program models.²¹

¹⁹ These results are retailer sales-weighted results, meaning the intercept survey results were weighted back by retailer type to the overall retailer type distribution of the population of program bulbs sold.

²⁰ This table does not include CFL fixtures or any LED products (bulbs or fixtures).

²¹ These two "top-selling" models made up approximately 29% of total PY4 bulb sales.

Table 13. Installation Rate Estimates by CFL Type and Respondent Characteristic

Population		In-store Intercept Installation Rate		
		Standard	Specialty	All CFLs
Overall Non-Weighted		75%	92%	77%
Retailer Type	Big Box	76%	91%	78%
	DIY	80%	92%	82%
	Warehouse	69%	91%	70%
	Retailer Sales W'd	76%	92%	78%
Demo Event	Yes	72%	95%	-
	No	76%	90%	-
Total CFLs Purchased	1	100%	100%	-
	2-4	87%	91%	-
	5-10	72%	90%	-
	11+	69%	93%	-
Top sellers	Top 2 Models	71%	--	-
	Exclude Top 2 Models	79%	92%	-

Source: Evaluation Team Analysis

As the table above shows, installation rates seemed to vary by retailer type. On average, customers purchasing standard or specialty CFLs from DIY stores reported installation rates 16% higher than customers who purchased program CFLs from Warehouse stores (82% versus 70%, respectively). The overall installation rate for program CFLs sold at Big Box stores fell between the DIY and Warehouse, (78%). Across all three retailer types the installation rates for specialty CFLs remained largely unchanged, and the fluctuation in overall CFL installation rates was driven primary by the differences between the installation rates of standard CFLs (although these differences were not significant at the 90% level).

In PY5, a portion of the in-store intercept data collection coincided with in-store demonstration events being conducted by the program implementation team. The evaluation team looked into whether purchasing program bulbs during a demonstration event had a significant impact on the anticipated installation rate of program bulbs, to see if the information customers were receiving from program reps during demo events were encouraging them to install a greater percentage of the bulbs they were purchasing. The results for standard and specialty CFLs were mixed, with standard bulbs purchasers reporting lower installation rates if the bulbs were purchased during a demo event and specialty bulb purchasers reporting higher installation rates if the bulbs were purchased during a demo event. Neither of these differences was statistically significant at the 90% level.

As shown in the table above, an analysis of the correlation between installation rates and the total number of CFLs purchased found there was a clear and significant trend across standard CFL purchasers whereby the fewer the number of standard CFLs a respondent purchased, the higher their reported installation rate. A similar trend was not found for specialty CFLs; however that may have been caused by the small samples sizes of respondents purchasing large quantities of specialty CFLs.

In PY5 there were two standard CFL program bulb models that received larger than average program discounts. The sales of these two models in PY5 accounted for approximately 29% of total program bulb sales. The two top-selling models were standard CFLs sold in multi-packs; one was an 8-pack of standard CFLs manufactured by GE and sold through a warehouse store, and the other was a 4-pack of standard CFLs manufactured by TCP and sold through a DIY store. The evaluation team looked at installation rates specifically for these top-selling models, as well as for all other bulbs excluding these top-selling models, and found that installation rates for the top-selling models were approximately 10% lower than for the other models in the program.²²

Program Bulb Leakage Rate

Verified Savings

The PY5 IL TRM does not specifically call out a leakage rate for program bulbs; however, a lifetime installation rate of 98% is assumed for all bulb types (CFLs, LEDs and Fixtures), thus, the evaluation team equates this to a 2% non-installation rate would could be caused by a number of factors including leakage, breakage or loss.

Impact Evaluation Research Findings

In PY5, the overall leakage rate across bulb types and retailer types was estimated to be 2.3%²³, which is a decrease from the PY4 value which was just less than 4%. The PY5 program bulbs leakage was primarily driven by three program bulb purchasers who said that they were planning to install the bulbs they purchased in their homes that were located outside of ComEd service territory. The contact zip codes that the three leakage bulb purchasers provided were located in Wisconsin, Iowa, and Illinois.

In total, 12 survey respondents that were purchasing program bulbs said that they were planning to install the program bulbs outside of ComEd service territory, but nine of these 12 respondents then went on to provide a contact zip code located within ComEd territory. As a result the bulbs being purchased by these nine respondents were not deemed "leaked" bulbs. Bulbs purchased by

²² This difference was not statistically significant at the 90% level.

²³ The 90/10 confidence interval on the leakage estimate based on the intercept surveys is a lower bound of 2% and an upper bound of 5.5%.

customers who reside within ComEd service territory and have a supplier other than ComEd, but are still billed by ComEd, are not considered leakage bulbs.

Residential/Non-residential Installation Location Split

Verified Savings

The PY5 IL TRM does not dictate a residential versus non-residential split that is to be applied in the calculation of Verified Savings. Instead, it states "If the implementation strategy does not allow for the installation location to be known (e.g. an upstream retail program), evaluation data could be used to determine an appropriate residential versus commercial split." Therefore the evaluation team has applied the 98/2 split based on the PY5 Evaluation Research analysis (described in detail below) to estimate the PY5 Verified Savings.

Impact Evaluation Research Findings

The percentage of program bulbs being installed in residential versus non-residential locations in PY5 was estimated to be 98/2²⁴ based on data collected during the in-store intercept surveys. This is a higher proportion of residential installations than the past three program years' evaluation-based estimates (95/5 in PY4, 97/3 in PY3, and 90/10 in PY2). During the PY4 and PY5 data collection, a follow up question was asked of those respondents who indicated they planned on installing the program bulbs they were purchasing in their business which was either an apartment building or a hotel/motel. The follow up question asked these respondents whether these program bulbs would likely be installed within a common area of the building or within an individual unit/room. Those respondents reporting that the program bulbs would be installed within an individual unit/room were classified as residential installations and assigned residential HOU and CF estimates.

Residential/Non-residential HOU and Peak CF

The following HOU and Peak CF estimates are used for both the Verified Savings and Impact Evaluation Research Findings impact estimates.

Residential HOU and Peak CF

The residential HOU and Peak CF estimates used to calculate both the Verified Savings and Impact Evaluation Research Findings impact estimates for the PY5 Residential Lighting evaluation were taken from the PY5 IL TRM.²⁵ These TRM estimates were based on the lighting logger study

²⁴ This analysis excluded program bulbs that were reportedly installed in locations outside of ComEd service territory.

²⁵ The residential HOU assumptions are based upon the Standard CFL TRM estimates for standard CFLs and coupons sales, the Specialty CFL TRM estimates for specialty CFLs (although the estimate for Globe bulbs in the Specialty portion of the TRM was in error and so Sam Dent has opened a TRM tracker request for next version of

conducted as part of the PY3 ComEd Residential Lighting evaluation and are the best estimates available for ComEd at this time. There are currently loggers installed in ComEd customer's homes that will be analyzed as part of the PY6 evaluation.

Non-residential HOU and Peak CF

Similarly, the non-residential HOU and Peak CF estimates used to calculate both the Verified Savings and Impact Evaluation Research Findings impact estimates for the PY5 Residential Lighting evaluation were taken from the commercial lighting portion²⁶ of the PY5 IL TRM. The commercial lighting portion of the TRM provides distinct HOU and CF estimates for a large number of non-residential business types.

As mentioned above, in PY5 all customers who reported that they planned to install the program bulbs they were purchasing in their business were asked to describe the business type activity of that location. Of the respondents who purchased bulbs for their business, 35% reported that the bulbs would be installed in an apartment building, followed an equal number of respondents who reported that the bulbs would be installed in office buildings or retail/service locations (21% each), and the remaining 19% of respondents said that the bulbs would be installed in restaurants, hotel/motels, or public assembly locations (e.g. church, theater, conference center). Overall non-residential averages were estimated by weighting these business type specific HOU and CF estimates by the proportions of bulbs falling into each business type based on the self-reported data collected during the intercept surveys. These overall weighted non-residential estimates are shown in Table 14 below. The PY5 IL TRM did not include deemed HOU or Peak CF estimates for bulbs installed within public assembly buildings, and thus the "Miscellaneous" category estimates were used for these program bulbs.²⁷

the TRM and we've applied the correct HOU estimate), the Interior Hardwired CFL fixture TRM estimates for CFL and LED fixtures, and the LED Downlights TRM estimates for all LEDs (downlights are 2/3rds of program LEDs).

²⁶ Due to the small percentage of program bulbs that are installed in non-residential locations (<3%) and the small proportion of PY5 bulbs that are LEDs or Fixtures (~0.5%), the non-residential HOU and Peak CF assumptions for all PY5 bulbs are all taken from the screw-based HOU and Peak CF estimates found in the table in section 4.5 of the TRM.

²⁷ The "Miscellaneous" category HOU estimate is roughly 12 hours/day.

Table 14. Non-residential HOU and Peak CF Estimates

ComEd Business Type	%	Bulbs	Annual HOU	Daily HOU	Peak CF
Apartment	31%	8	5,950	16.30	0.75
Office	25%	22	4,439	12.16	0.66
Restaurant	6%	1	3,673	10.06	0.80
Retail/Service	25%	24	4,719	12.93	0.83
Hotel/Motel	6%	7	5,311	14.55	0.21
Public Assembly	6%	6	4,576	12.54	0.66
Bulb Weighted Average	100%	68	4,804	13.16	0.69

Source: Evaluation Team Analysis

Interactive Effects

The Interactive Effects estimates laid out below are used for both the Verified Savings and Impact Evaluation Research Findings impact estimates. To estimate interactive effects between the reduction in waste heat from more efficient lighting and the resulting changes in HVAC system demand, Waste Heat Factors for summer peak demand savings (WHFd) and energy savings (WHFe) were developed using the PY5 IL TRM and data from the 2009 U.S. DOE EIA Residential Energy Consumption Survey (RECS 2009, for residential only). The analysis methods and data sources²⁸ used to estimate these Waste Heat factors in PY5 were nearly identical to those used in PY4, resulting in very similar results across the two program years. The exception to this was for the PY5 non-residential Waste Heat Factor estimates which were based upon those found in the PY5 IL TRM rather than the KEMA PY4 Operations Manual, and weighted based upon the distribution of self-reported²⁹ non-residential PY5 business types where program bulbs were installed. Additionally, the overall PY5 average Waste Heat Factors were weighted based upon the PY5 estimated Residential/Non-Residential split.

Residential Interactive Effects

The RECS 2009 data indicates that 69% of homes in Illinois are single family homes, and 31% are multi-family. The evaluation team then used the ComEd PY3 lighting onsite inventory data to estimate the proportion of program bulbs that are installed in interior (93%) and exterior (7%) locations. Applying the dwelling type distribution and interior/exterior distribution yielded a weighted average WHFd of 1.09.

²⁸ At this time the RECS2009 data set and PY3 ComEd lighting inventory continue to be the most recently available data for this analysis.

²⁹ Based on the PY5 in-store intercept surveys.

Cooling energy savings factors for single family and multi-family homes were taken from the PY5 IL TRM. To populate the electric heating penalty algorithm for ComEd service territory, it was necessary to develop estimates for the proportion of single family and multi-family homes with electric heating, and then within those proportions, the relative distribution of resistance heating and heat pump heating (by vintage) to develop a weighted average heating COP. The evaluation team developed these estimates using PY5 ComEd estimates of the proportion of single family and multi-family homes with electric heating, and using the RECS 2009 dataset for the East North Central Census Division (IL, IN, MI, OH, WI) for the distributions of resistance heating and heat pump heating by vintage (there was insufficient data representation in the Illinois RECS dataset to develop parameter values at the necessary level of specificity by heating technology and vintage). As shown in Table 15 below, 1.5% of single family homes in ComEd territory have electric heat, while 13.2% of multi-family homes have electric heat. For both single family and multi-family homes, the large majority of electric heating systems are electric resistance technologies and the small percentage of homes with electric heat pumps tend to have systems built more recently than 2006. The weighted average COP from these technology distributions is 1.27 for single family homes and 1.02 for multi-family homes.

Table 15. Assumptions Used to Electric Heating Penalties

Bulb Location	Dwelling Type	Electric Heat	Electric Resistance Heat	Heat Pump >2006	Heat Pump <2006	Heater COP, Wgtd Avg
Single family	69%	1.5%	1%	0.3%	0.1%	1.27
Multi-family	31%	13.2%	13%	0.2%	0%	1.02

Source: Evaluation Team Analysis

These values, when applied to the electric heating penalty algorithm in the TRM, yielded electric heating penalty factor values of 0.99 for single family homes (i.e., small electric heating penalty indicated by small difference from a value of 1.0) and a moderately larger heating penalty factor of 0.94 for multi-family homes. As shown in Table 16, when the electric cooling savings factors and electric heating penalty factors are combined for each dwelling type, the net result is a slight energy savings factor for single family homes at 1.05, a small penalty for multi-family homes at 0.98, and a weighted overall average of 1.03. That is, the electric heating penalty is less than the cooling energy savings benefit.

Table 16. Assumptions Used to Derive WHFe

Bulb Location	Cooling Benefit Factor	Electric Heating Penalty	Overall WHFe
Single family	1.06	0.99	1.05
Multi-family	1.04	0.94	0.98
All Dwelling Types	1.05	0.98	1.03

Source: Evaluation Team Analysis

The overall average of 1.03 is driven by a few key factors. Although a smaller percentage of homes have electric heating than have central AC systems, the percentage of light savings that must be heated (49%) is higher than the percentage of lighting savings that result in reduced cooling loads (27%), according to the REMRate modeling underlying the PY5 IL TRM values. These values are based on modeling results of several different configurations and IL locations of homes. Also, the average COP for heating systems (1.02-1.27) is considerably lower than that for cooling systems (2.8), which effectively means that heating systems have to expend more energy to replace a “lost” kWh of lighting waste heat than cooling systems would have to expend to remove that same kWh, so changes in lighting waste heat are effectively more.

To estimate interactive effects between the reduction in waste heat from more efficient lighting and the resulting changes in HVAC system demand, Waste Heat Factors for summer peak demand savings (WHFd) and energy savings (WHFe) were developed again using the PY5 IL TRM and RECS 2009 data. To develop the overall WHFd estimate, the evaluation team first developed an interior WHFd estimate by dwelling type and then added an adjustment factor for the proportion of program bulbs installed in exterior locations, for which energy and demand interactive effects do not apply. The RECS 2009 data for Illinois indicate that 69% of homes in Illinois are single family homes, and 31% are multi-family. The evaluation team applied these proportions to the single family and multi-family WHFd factors from the TRM to yield a total interior WHFd of 1.10, as shown in Table 17. The evaluation team then used the ComEd PY3 lighting onsite inventory data to estimate the proportion of program bulbs that are installed in interior (93%) and exterior (7%) locations. Applying a neutral WHFd factor of 1.0 to these exterior bulbs yielded overall WHFd factors for single family and multi-family of 1.10 and 1.07, respectively. Weighted across dwelling types, these yielded an overall WHFd factor for all program bulbs of 1.09.

Table 17. Assumptions Used to Derive WHFd

Bulb Location	Dwelling Type	Interior Cooling Demand Factor, IL TRM	% Exterior Bulbs, Cooling Factor 1.0	Overall WHFd
Single family	69%	1.11	7%	1.10
Multi-family	31%	1.07	7%	1.07
All Dwelling Types	100%	1.10	7%	1.09

Source: Evaluation Team Analysis

Non-Residential Interactive Effects

Program bulbs reported to be installed in commercial location were assigned Energy and Demand Interactive Effects (IE) based on the PY5 IL TRM and the self-reported business type of the location where the program bulbs were installed. Table 18 below shows the distribution of commercial building types reported by respondents and the estimated Energy and Demand IE of these commercial locations based on the PY5 IL TRM. This table also presents the overall bulb weighted average Energy and Demand IE of the PY5 In-store Intercept survey respondents.

Table 18. Respondent Reported Business Type and Associated Energy and Demand IEs

ComEd Business Type ³⁰	n	Bulbs	Energy IE	Demand IE
Apartments – Common Areas ³¹	5	8	1.04	1.07
Office Building	4	22	1.25	1.30
Restaurant	1	1	1.34	1.65
Retail/Service	4	24	1.24	1.44
Hotel/Motel	1	7	1.15	1.51
Public Assembly	1	6	1.24	1.46
Bulb Weighted Average	16	68	1.21	1.36

Source: PY5 In-store Intercept Surveys and PY5 IL TRM

Weighting the overall Energy and Demand Interactive Effects residential and commercial installations by the proportion of program bulbs going into each of these building types yields an overall program wide Energy IE of 1.03 and Peak CF of 1.10, as shown in Table 19.

Table 19. Weighted Overall Energy and Demand Interactive Effects

Sector	% of installs	Energy IE	Demand IE
Residential	97%	1.03	1.09
Non-Residential	3%	1.21	1.36
Overall	100%	1.03	1.10

Source: Evaluation Team Analysis

Carryover Bulb Savings Estimation

The PY5 Residential CFL energy and demand savings estimates include savings resulting from bulbs purchased during PY3 and PY4, but that were not installed (i.e., used by the consumer) in the program year during which they were purchased. Similarly, saving from program bulbs purchased in PY5, but not installed in PY5, can be counted in future program years. This section presents

³⁰ The HOU and Peak CF estimates for Apartments, Public Assembly and Missing business types were set equal to the Miscellaneous HOU and Peak CF estimates from the Operations Manual.

³¹ Respondents who reported their program bulbs were installed within private spaces (in-unit) at an apartment complex were treated as residential installations.

savings from the current carryover bulbs based on the Verified Savings and Impact Evaluation Research Findings methods.

PY5 Current Carryover Savings Estimation

Table 20 below shows that between 3.1 million (Verified Savings) and 3.4 million (Impact Evaluation Research Findings) bulbs sold through the program in PY3 or PY4 were estimated to have been installed in PY5. The estimated quantity of carryover bulbs installed in PY5 differs based on the two different estimates of installation rate in PY4 (Verified Savings and Evaluation Research)³² and the estimated percentage of bulbs that are assumed to never be installed in ComEd service territory (due to leakage, breakage, etc.).

The estimate of the number of PY3 bulbs installed in PY5 (for both Verified Savings and Impact Evaluation Research Findings) was reduced from prior evaluation report estimates due to the PY5 IL TRM requirement that the final lifetime in-service rate (ISR) be capped at 98%. In PY3, evaluation research estimated leakage to be 0.7%, and thus an additional 1.3% of PY3 sales were removed from the PY5 carryover bulb estimate in order to adjust the lifetime ISR in PY5 to the PY5 IL TRM deemed estimate of 98% ($10,973,905 / 11,197,862 = 0.98$).

Similarly, the Verified Savings estimate of the number of PY4 carryover bulbs installed in PY5 was calculated based on the PY5 IL TRM requirements that the final lifetime in-service rate be capped at 98% and the distribution of bulb sales installation across program years by bulb type.³³ In PY4, the Verified Savings (non-carryover) were estimated based on a first year installation rate of 73.7% (higher than the PY5 IL TRM first year installation rate) and thus the second and third year installation rates for PY4 program bulb had to be adjusted accordingly so that the lifetime ISR of 98% was achieved.

The PY4 Impact Evaluation Research Findings estimate of the number of PY4 carryover bulbs installed in PY5 was calculated based upon the PY4 evaluation estimated first-year installation rate of 70% and the final lifetime in service rate of 96.3% ($1 - 0.037$ (leakage estimate) = 96.3%).

Table 20. PY5 Carryover Bulb Estimates

Carryover Bulbs	PY3 Estimate	PY4 Verified Savings Estimate	PY4 Evaluation Research Estimate
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³² The PY4 Verified Savings installation rates were deemed by bulb type based on findings from the PY3 evaluation report (73% for Standard CFLs, 80% for Specialty CFLs and LEDs, and 89% for CFL and LED Fixtures). The PY4 Evaluation Research Findings installation rates were estimated based on analysis of the PY4 intercept survey data.

³³ First through third year installation rates: Standard CFLs - 69.5%, 15.4%, and 13.1%, Specialty CFL - 79.5%, 10%, and 8.5%, Interior Hardwired CFL Fixtures - 87.5%, 5.7%, and 4.8%, LED Downlights - 95.0%, 1.62%, and 1.38%.

Program Year Total Bulbs Sold	11,197,862	12,649,030	12,649,030
Installed During PY3	7,929,658	n/a	n/a
Installed During PY4	1,596,986	9,328,548	8,580,112
Installed During PY5	1,447,261	1,657,527	1,943,913

Source: Evaluation Team Analysis

As documented in a memo to ComEd and the ICC³⁴ the evaluation team recommends estimating carryover savings resulting from the installation of prior year program bulbs using the impact parameter estimates (HOU, DW, NTGR) from the year of sale as opposed to the year of installation. The PY5 IL TRM does not contain guidance on this issue (it is being addressed in Version 2.0 of the IL TRM which goes into effect in PY6) and hence this is the method of impact estimation we have used for estimating both Verified Savings and Impact Evaluation Research Findings.

Table 21 below provides estimates of energy and demand savings in PY5 resulting from the late installation of prior program year bulbs (PY3 and PY4) based on the Verified Savings parameter estimates from those program years.

Table 21. PY5 Verified Savings Estimate for Carryover Bulbs

PY5 Verified Savings Carryover Estimate	PY3 Program Bulbs	PY4 Program Bulbs	Total PY5 Carryover
Program Bulbs Installed During PY5	1,447,261	1,657,527	3,104,788
Average Delta Watts	48.8	48.1	48.5
Average Daily Hours of Use	2.60	3.17	2.90
Peak Load Coincidence Factor	0.10	0.13	0.11
Gross kWh Impact per unit	46.3	55.7	51.3
Gross kW Impact per unit	0.05	0.05	0.05
Installation Rate	100%	100%	100%
PY5 Carryover Gross Energy Savings (MWh)	66,958	92,393	159,351
PY5 Carryover Gross Demand Savings (MW)	70.6	79.8	150.4

³⁴ Memo to ComEd and ICC Residential Lighting Program Interested Parties Re: Calculation of CFL Carryover Savings. September 18th, 2012, from Navigant Evaluation Team.

PY5 Carryover Gross Peak Demand Savings (MW)	7.1	10.1	17.2
Energy Interactive Effects	1.02	1.03	1.03
Demand Interactive Effects	1.00	1.10	1.05
Net-to-Gross Ratio	0.71	0.59	0.65
PY5 Carryover Net Energy Savings (MWh)	48,647	56,724	105,371
PY5 Carryover Net Demand Savings (MW)	50.1	47.4	97.6
PY5 Carryover Net Peak Demand Savings (MW)	5.0	6.6	11.7

Source: Evaluation Team Analysis

Table 22 below shows similar savings estimates for PY5 based on the Impact Evaluation Research Findings parameter estimates from PY3 and PY4.

Table 22. PY5 Impact Evaluation Research Findings Estimate for Carryover Bulbs

PY5 Evaluation Research Findings Carryover Estimate	PY3 Program Bulbs	PY4 Program Bulbs	Total PY5 Carryover
Program Bulbs Installed During PY5	1,447,261	1,943,864	3,391,125
Average Delta Watts	48.4	48.7	48.6
Average Daily Hours of Use	2.98	3.17	3.09
Peak Load Coincidence Factor	0.12	0.13	0.12
Gross kWh Impact per unit	52.8	56.4	54.9
Gross kW Impact per unit	0.05	0.05	0.05
Installation Rate	100%	100%	100%
PY5 Carryover Gross Energy Savings (MWh)	76,351	109,661	186,012
PY5 Carryover Gross Demand Savings (MW)	70.1	94.7	164.8
PY5 Carryover Gross Peak Demand Savings (MW)	8.5	12.0	20.5
Energy Interactive Effects	1.02	1.03	1.03
Demand Interactive Effects	1.00	1.10	1.06
Net-to-Gross Ratio	0.71	0.54	0.61
PY5 Carryover Net Energy Savings (MWh)	55,283	60,921	116,204
PY5 Carryover Net Demand Savings (MW)	49.6	50.9	100.5
PY5 Carryover Net Peak Demand Savings (MW)	6.0	7.1	13.1

Source: Evaluation Team Analysis

The tables above show that the Impact Evaluation Research Findings estimates produced higher estimates of both gross and net energy, demand and peak demand savings than the Verified Savings estimate. The differences between the two sets of findings ranged from a high of a 19% increase in the gross peak MW estimate to a low of a 3% increase in the net MW estimate. The Impact Evaluation Research Findings were higher for a number of reasons including higher estimates of daily HOU and Peak CF, and a higher estimate of the quantity of PY5 carryover bulbs that was driven by a lower PY4 Impact Evaluation Research Findings installation rate estimate.