BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of The Dayton Power and Light Company's Portfolio Status Report	))	Case No. 14-738-EL-POR

THE DAYTON POWER AND LIGHT COMPANY'S
COMBINED NOTICE
OF FILING PORTFOLIO STATUS REPORT
AND APPLICATION TO ADJUST BASELINES

The Dayton Power and Light Company ("DP&L" or "the Company") hereby submits its annual Portfolio Status Report pursuant to Section 4901:1-39-05(C) of the Ohio Administrative Code ("O.A.C."), addressing the performance of all of DP&L's approved energy efficiency and peak demand reduction programs over calendar year 2013. As shown in the attached Portfolio Status Report, DP&L has met its statutory benchmarks for energy efficiency and peak demand reduction.

DP&L also makes application pursuant to Section 4928.66(A)(2)(c) of the Ohio Revised Code ("O.R.C.") and O.A.C. §4901:1-39-05(B) to adjust its sales and demand baselines to normalize for weather and changes in numbers of customers and sales. As described in the 2013 Benchmark Report, included within the Portfolio Status Report as Appendix A, the changes requiring adjustments to the baselines were outside of DP&L's reasonable control. Appendix A contains all assumptions, rationales, and calculations, and proposes methodologies and practices to be used in the proposed adjustments or normalizations to support DP&L's application to adjust baselines, as required by O.A.C. §4901:1-39-05(B).

1. DP&L is a public utility and electric light company as defined by Sections 4905.02 and 4905.03(C) of the O.R.C. respectively, and an electric distribution utility as defined by O.R.C. §4928.01(A)(6).

2. Pursuant to O.R.C §4928.66(A)(1)(a), DP&L is required to "implement energy efficiency programs that achieve energy savings equivalent to at least three-tenths of one per cent of the total, annual average, and normalized kilowatt-hour sales of the electric distribution utility during the preceding three calendar years to customers in this state. An energy efficiency program may include a combined heat and power system placed into service or retrofitted on or after the effective date of the amendment of this section by S.B. 315 of the 129th general assembly, or a waste energy recovery system placed into service or retrofitted on or after the same date, except that a waste energy recovery system described in division (A)(38)(b) of Section 4928.01 of the Revised Code may be included only if it was placed into service between January 1, 2002, and December 31, 2004. For a waste energy recovery or combined heat and power system, the savings shall be as estimated by the public utilities commission. The savings requirement, using such a three-year average, shall increase to an additional five-tenths of one per cent in 2010, seven-tenths of one per cent in 2011, eight-tenths of one per cent in 2012, nine-tenths of one per cent in 2013, one per cent from 2014 to 2018, and two per cent each year thereafter, achieving a cumulative, annual energy savings in excess of twenty-two per cent by the end of 2025."

3. O.R.C. §4928.66(A)(1)(b) requires that DP&L "implement peak demand reduction programs designed to achieve a one per cent reduction in peak demand in 2009

and an additional seventy-five hundredths of one per cent reduction each year through 2018."

4. O.R.C. §4928.66(A)(2)(a) provides: "The baseline for energy savings under division (A)(1)(a) of this section shall be the average of the total kilowatt hours the electric distribution utility sold in the preceding three calendar years, and the baseline for a peak demand reduction under division (A)(1)(b) of this section shall be the average peak demand on the utility in the preceding three calendar years, except that the commission may reduce either baseline to adjust for new economic growth in the utility's certified territory."

5. As more fully described, and supported in DP&L's 2013 Benchmark Report, included within the Portfolio Status Report as Appendix A, DP&L applies to make adjustments to its baselines to normalize for weather changes, and to reflect changes to DP&L's customer base and corresponding load, which fall outside of the realm of what would be expected in the ordinary course of natural business growth and contraction cycles. Specifically, DP&L seeks to make adjustments to account for both customer load growth and loss of at least 2 MW. This level of change would represent a greater loss or growth than would be counterbalanced under typical business conditions.

6. As more fully explained in the 2013 Benchmark Report, and supported by Schedule 1 and the corresponding Workpapers A, C, D, and E, DP&L's 2013 normalized energy efficiency baseline is 13,833,988 MWh and DP&L's 2013 incremental normalized energy efficiency reduction benchmark is 124,506 MWh. DP&L's cumulative energy efficiency reduction benchmark is 449,981 MWh.

7. DP&L's 2013 normalized peak demand reduction baseline, as fully explained in its 2013 Benchmark Report, and supported by Schedule 2 and the corresponding Workpapers B, C, D, and E is 2,767 MW and DP&L's 2013 normalized peak demand reduction benchmark is 110.7 MW.

8. DP&L's current energy efficiency and demand reduction programs, designed to achieve the required energy savings and demand reductions from 2013 through 2015, were filed as part of a comprehensive energy efficiency and peak-demand reduction program portfolio. A Stipulation and Recommendation in Case No. 13-0833-EL-POR, *In the Matter of the Application of The Dayton Power and Light Company for Approval of Its Energy Efficiency and Demand Reduction Program Portfolio Plan for 2013 through 2015* was approved by a Commission Order dated December 4, 2013.

9. O.A.C. §4901:1-39-05(C) provides: "by March fifteenth of each year, each electric utility shall file a portfolio status report addressing the performance of all approved energy efficiency and peak-demand reduction programs in its program portfolio plan over the previous calendar year. . ." DP&L sought, and was granted a waiver of O.A.C. § 4901:1-39-05(C) to permit DP&L to file its Annual Portfolio Status Report on or before May 15, 2014.[1]

10. DP&L timely submits the attached Portfolio Status Report ("Report") which includes the following components:

(1) A Compliance Demonstration which includes: (a) an update to DP&L's initial benchmark report (Report, Compliance Demonstration); (b) a comparison of the applicable benchmarks to

[1] Entry dated December 4, 2013 in, *In the Matter of the Application of The Dayton Power and Light Company for Approval of Its Energy Efficiency and Demand Reduction Program Portfolio Plan for 2013 through 2015*, Case Nos. 13-833-EL-POR, 13-837-EL-WVR.

the actual energy savings and peak demand reductions achieved (Report, Compliance Demonstration); and (c) an affidavit regarding compliance with the statutory benchmarks (Exhibit 2).

(2) A Program Performance Assessment, including: (a) a description of each approved energy efficiency or peak-demand reduction program implemented in the previous calendar year (Report, Residential Programs, Non-Residential Programs, Education, Awareness Building & Market Transformation); (b) an evaluation, measurement, and verification report by The Cadmus Group, Inc. ("Cadmus Report", Exhibit 1); and (c) a recommendation with respect to continuation, modification or elimination of each program (Report, Recommendations).

11. As described in the Report, and as attested to in the attached Affidavit of the President of DP&L, DP&L has met its 2013 statutory benchmarks for energy efficiency and peak demand reduction.

WHEREFORE, DP&L respectfully requests that the Commission issue an order finding that DP&L has complied with its 2013 statutory energy efficiency and peak demand reduction benchmark requirements and acknowledging DP&L compliance with the Program Portfolio Status Report requirements found in O.A.C. § 4901:1-39-05(C).

Respectfully submitted,

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Dayton Power and Light

May 15

2014

2013 Energy Efficiency and Demand Reduction/Response Portfolio Status Report

DP&L

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EXECUTIVE SUMMARY

OVERVIEW

In April 2013,The Dayton Power and Light Company (DP&L) filed a three-year Energy Efficiency and Demand Response Portfolio Plan in Case No. 13-0833-EL-POR and 13-0837-EL-WVR. A settlement agreement was reached with all of the intervening stakeholder groups, and the plan was approved by the Commission on December 4, 2013. The plan covers the years 2013 through 2015.

The approved plan continues DP&L's portfolio of business and residential programs that provide customers with a variety of energy efficiency choices. Specifically, DP&L is offering customers five residential programs, four business programs, a pilot program, an infrastructure program and an educational effort. Through the process, DP&L has kept the energy efficiency collaborative informed of its progress and is working directly with several collaborative members to either implement programs or market them to various customer groups.

It should be noted that actual energy and demand savings have been reported in each of the previous years as follows:

- 2009 Energy Efficiency and Demand Reduction/Response Portfolio Status Report filed on March 12, 2010, in Case No. 10-0303-EL-POR.
- 2010 Energy Efficiency and Demand Reduction/Response Portfolio Status Report filed on March 15, 2011, in Case No. 11-1276-EL-POR.
- 2011 Energy Efficiency and Demand Reduction/Response Portfolio Status Report filed on May 15, 2012, in Case No. 12-1420-EL-POR.
- 2012 Energy Efficiency and Demand Reduction/Response Portfolio Status Report filed on May 15, 2013, in Case No. 13-1140-EL-POR.

SAVINGS CALCULATIONS

The energy and demand savings calculations were based mainly on the State of Ohio Energy Efficiency Technical Reference Manual (TRM), filed August 6, 2010 under Case No. 09-0512-GE-UNC. However, there were exceptions for measures not included in the TRM or where evaluations resulted in a valid alternate calculation. A discussion of calculation methodology is included in the Cadmus EM&V report, attached as Exhibit 1.

COMPLIANCE SUMMARY

From 2009 through 2012, DP&L reported cumulative energy efficiency program savings of 634,578 MWh and mercantile program savings of 26,019 MWh. The 2013 energy efficiency programs generated 193,519 MWh and mercantile programs generated 9,972 MWh. Therefore, cumulative annualized energy savings for 2009 through 2013 are 864,088 MWh.

From 2009 through 2012, DP&L reported cumulative demand savings from energy efficiency programs of 94.3 MW and 8.4 MW of cumulative demand savings from mercantile commitments. The 2013 energy efficiency programs generated 34.3 MW and mercantile programs generated 4.7 MW of energy efficiency demand for integration with DP&L's program portfolio. Therefore, total 2013 cumulative demand savings are 141.7 MW.

Based on this performance, DP&L surpassed its 2013 cumulative benchmark targets of 449,981 MWh and 110.7 MW. A more detailed analysis is provided in the Compliance Demonstration portion of this report.

	MWh	**MW**
2009 Actuals	115,279	16.5
2010 Energy Efficiency Actuals	174,249	24.7
2010 Mercantile Commitments (EE only)*	4,957	1.5
2011 Energy Efficiency Actuals	164,039	24.2
2011 Mercantile Commitments (EE only)*	15,547	3.5
2012 Energy Efficiency Actuals	181,011	28.9
2012 Mercantile Commitments (EE only)*	5,515	3.4
2013 Energy Efficiency Actuals	193,519	34.3
2013 Mercantile Commitments	9,972	4.7
Cumulative 2009 - 2013 Total Savings	864,088	141.7
Cumulative 2013 Benchmarks	449,981	110.7

*Mercantile commitments for PJM Demand Response do not carry over from year to year. Therefore, 2010, 2011 and 2012 PJM Demand Response commitments have been removed from the cumulative total.

2013 PROGRAM SUMMARY

2013 Annualized Program Results

Program	***2013 Energy (MWh)***	***2013 Demand (MW)***
Residential Lighting	69,389	8.30
Residential HVAC Rebates	6,848	1.95
Residential HVAC Diagnostic & Tune Up	90	0.01
Residential Appliance Recycling	3,095	0.49
Residential School Education(1)	3,647	0.23
Residential Low Income Affordability	1,249	0.22
Non-Residential Prescriptive Rebates	59,238	11.01
Non-Residential Custom Rebates	16,816	3.43
Mercantile Customer Commitments	9,972	4.67
Non-Residential PJM Demand Response	0	0
Pilot Programs	0	0
T&D Infrastructure Improvements	33,147	8.69
Total	203,491	39.00

(1) 2013 savings are savings from the 2012/2013 school year.

BANKED ENERGY SAVINGS

DP&L plans to bank the excess energy savings achieved cumulatively through 2013 and apply the excess toward future benchmarks. The total amount of banked energy savings is 414,107 MWh and is calculated as follows:

2013 Actual Cumulative Energy Savings – 2013 Cumulative Benchmark = Banked Energy Savings

864,088 MWh – 449,981 MWh = 414,107 MWh

EVALUATION, COST EFFECTIVENESS

Attached to this report, as Exhibit 1, is the 2013 evaluation, measurement, and verification report produced by The Cadmus Group (Cadmus).

In addition, Cadmus performed cost effectiveness tests for each of the programs and for the portfolio as a whole. These are the Total Resource Cost Test (TRC), the Utility Cost Test (UCT), the Participant Cost Test (PCT), the Ratepayer Impact Measure (RIM), and the Societal Test (SCT). DP&L's portfolio was cost effective as measured by the TRC. A detailed review of the cost effectiveness tests and program-specific results can be found in the cost effectiveness section of the EM&V report, included as Exhibit 1.

	Primary	Secondary			
	Total Resource Cost Test	**Utility Cost Test**	**Ratepayer Impact Measure Test**	**Participant Cost Test**	**Societal Cost Test**
DP&L Portfolio	2.00	4.33	0.45	4.57	2.64

2013 PROGRAM COST SUMMARY

Program	2013 Filed	2013 Actual
Residential Lighting		
Incentive Costs	$2,294,833	$2,145,507
Marketing & Admin	$822,460	$497,089
Program Total	$3,117,293	$2,642,596
Residential HVAC Rebates		
Incentive Costs	$1,575,150	$1,259,085
Marketing & Admin	$754,799	$581,379
Program Total	$2,329,949	$1,840,464
Residential HVAC Tune Up		
Incentive Costs	$100,000	$19,640
Marketing & Admin	$204,676	$111,855
Program Total	$304,676	$131,495
Residential Appliance Recycling		
Incentive Costs	$105,000	$101,150
Marketing & Admin	$355,957	$330,416
Program Total	$460,957	$431,566
Residential Low Income Affordability		
Incentive Costs	$905,117	$885,507
Marketing & Admin	$229,906	$221,757
Program Total	$1,135,023	$1,107,264
Residential School Education		
Incentive Costs	$81,077	$78,298
Marketing & Admin	$201,062	$139,535
Program Total	$282,139	$217,833
Non-Residential Prescriptive Rebates		
Incentive Costs	$4,785,520	$2,919,659
Marketing & Admin	$956,049	$669,590
Program Total	$5,741,569	$3,589,249
Non-Residential Custom Rebates		
Incentive Costs	$1,580,251	$1,353,134
Marketing & Admin	$749,619	$571,635
Program Total	$2,329,870	$1,924,769

2013 PROGRAM COST SUMMARY CONTINUED

Non-Residential Mercantile Program		
Incentive Costs	$495,817	$818,745
Marketing & Admin	$129,481	$133,685
Program Total	$625,298	$952,430
PJM Demand Response		
Incentive Costs	$97,550	$0
Marketing & Admin	$7,200	$0
Program Total	$104,750	$0
Education		
General Energy Efficiency Education & Outreach	$773,428	$482,565
Marketing & Admin	$14,844	$35,000
Program Total	$788,272	$517,565
Pilot Program		
Incentive Costs	$188,084	$0
Marketing & Admin	$80,607	$0
Program Total	$268,691	$0
Evaluations, Measurement & Verification[(1)]	$692,963	$896,752
Total Program Costs	**$18,181,450**	**$14,251,983**

[(1)] EM&V costs include charges from Evergreen Economics and Cadmus.

COMPLIANCE DEMONSTRATION

BENCHMARK REPORT UPDATE

In accordance with O.A.C. Section 4901:1-39-05(C)(1)(a) DP&L is filing its 2013 Benchmark Report, included in this filing as Appendix A.

DP&L's 2013 cumulative energy and peak demand reduction benchmark targets are as follows:

Normalized Energy Reduction Benchmark (MWh)	449,981
Normalized Peak Demand Reduction Benchmark (MW)	110.7

For informational purposes, included below are Schedules 1 and 2 from DP&L's 2013 Benchmark Report.

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report
Energy Efficiency Baseline and Benchmark Calculation

		2010	2011	2012	2013
1	**Baseline Calculation Components**				
2	Retail MWh Sales [1]	14,282,324	14,127,719	13,936,670	
3					
4	**Normalizing Adjustments**				
5	Significantly Reduced Customer Sales [2]	(170,341)	(145,516)	(71,592)	
6	Significantly Expanded Customer Sales [3]	98,219	83,431	27,840	
7	Total Customer Sales Adjustment (5)+(6)	(72,122)	(62,085)	(43,752)	
8	Mercantile Customer Adjustment [4]	23,585	29,766	33,981	
9	Total Adjusted Retail Sales (2)+(7)+(8)	14,233,787	14,095,400	13,926,899	
10	Weather Normalization Factor [5]	0.96700	0.98666	0.99308	
11	Normalized Retail Energy Sales (9)*(10)	13,764,072	13,907,367	13,830,525	
12					
13	**2013 Normalized Energy Efficiency Baseline**				
14	3 Year Normalized Average (MWh)				13,833,988
15					
16	**Calculation of 2013 Energy Efficiency Reduction Benchmark**				
17	Normalized Preceding 3 Year Average Sales (14)				13,833,988
18	2013 Incremental Energy Efficiency Reduction Benchmark % [6]				0.90%
19	2013 Incremental Energy Efficiency Reduction Benchmark (17)*(18)				124,506
20	2011-2012 Energy Efficiency Reduction Benchmark [7]				325,475
21	**2013 Cumulative Energy Efficiency Reduction Benchmark (19)+(20)**				**449,981**

[1] Retail sales for the period 2010-2012 are reported in PUCO Form FE-D1 (Case No. 14-536-EL-
See Workpaper A, Column (6).

[2] Significantly reduced customer sales include those who ceased or reduced their operations
the period. See Workpaper C for details on load reductions.

[3] Significantly expanded customer sales include those who started or expanded their operations
the period. See Workpaper C for details on load expansions.

[4] See Workpaper D for calculation of Mercantile Customer Adjustment.

[5] See Workpaper F for calculation of the weather normalization factor.

[6] Energy Efficiency benchmark as established in O.R.C. §4928.66(A)(1)(a).

[7] 2012 Cumulative Energy Efficiency Reduction Benchmark as established in Case No. 13-1140-EL-POR, Schedule 1, line 21.

Schedule 2

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report
Peak Demand Baseline and Benchmark Calculation

		2010	2011	2012	2013
1	**Baseline Calculation Components**				
2	Peak MW Demand [1]	2,956	3,146	3,046	
3					
4	**Normalizing Adjustments**				
5	Significantly Reduced Customer Load [2]	(28)	(17)	(1)	
6	Significantly Expanded Customer Load [3]	16	8	(1)	
7	Total Customer Load Adjustment (5)+(6)	(12)	(9)	(2)	
8	Mercantile Customer Adjustment [4]	8	10	11	
9	Total Adjusted Peak Demand (2)+(7)+(8)	2,952	3,147	3,055	
10	Weather Normalization Factor [5]	0.91610	0.86364	0.94288	
11	Normalized Peak Demand (9)*(10)	2,704	2,718	2,880	
12					
13	**2013 Normalized Peak Demand Reduction Baseline**				
14	3 Year Normalized Average (MW)				2,767
15					
16	**Calculation of Normalized 2013 Peak Demand Reduction Benchmark**				
17	Normalized Preceding 3 Year Average Peak Demand (14)				2,767
18	2013 Peak Demand Reduction Benchmark % [6]				4.00%
19	**2013 Peak Demand Reduction Benchmark (17)*(18)**				**110.7**

[1] Peak demand for the period 2010-2012 is reported in PUCO Form FE-D3. See Workpaper B.

[2] Significantly reduced customer load include those who ceased or reduced their operations during the period. See Workpaper C for a complete list of customers.

[3] Significantly expanded customer load include those customers who started or expanded operations during the period. See Workpaper C for a complete list of customers.

[4] See Workpaper D for calculation of Mercantile Customer Adjustment.

[5] See Workpaper F for calculation of weather normalization factor.

[6] Peak Demand Reduction benchmark as established in O.R.C § 4928.66(A)(1)(b).

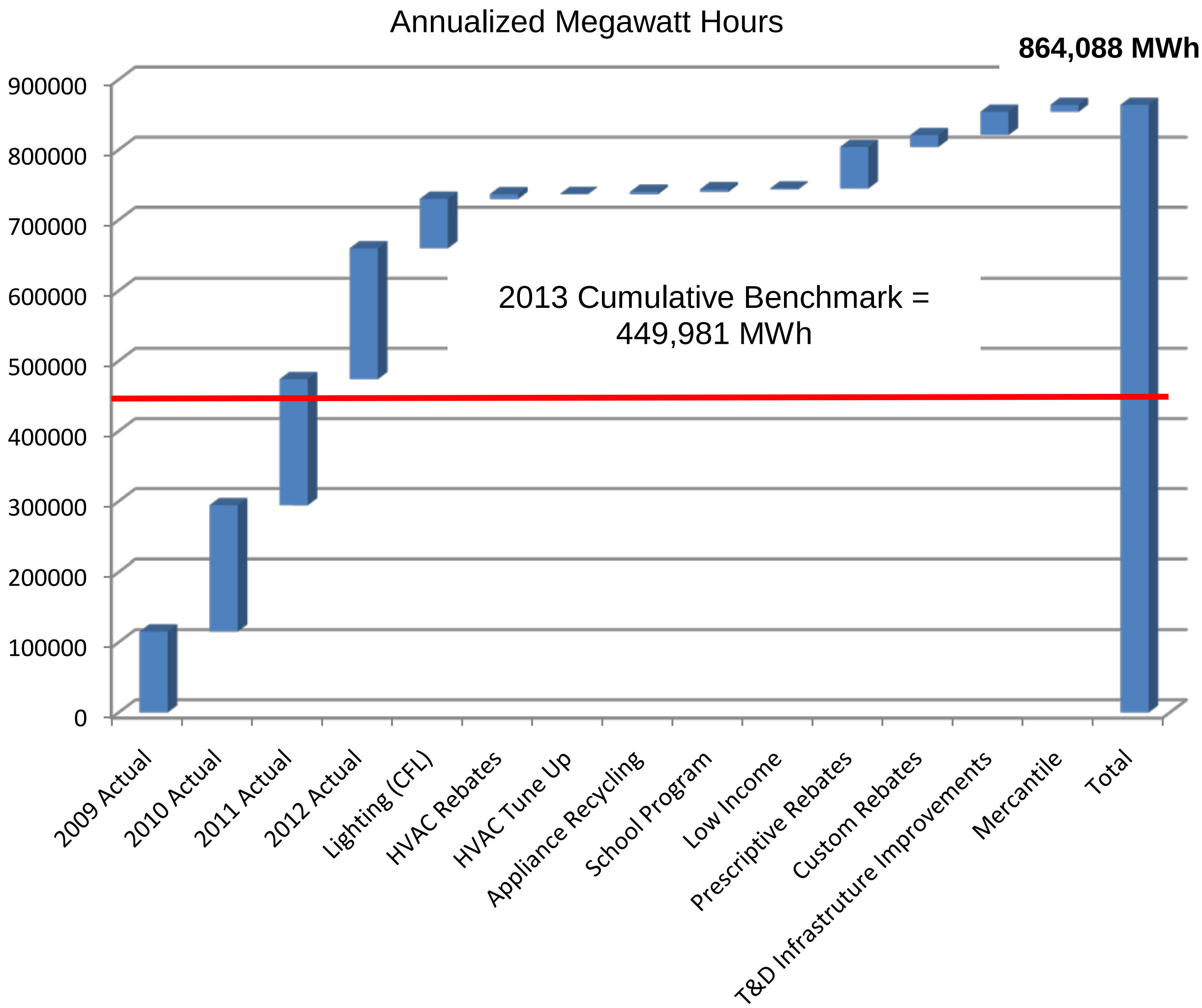
2013 FILED VERSUS ACTUAL ENERGY SAVINGS

Below, in tabular and graph form, are the programs' energy and demand savings as filed, as well as the corresponding energy and demand actual 2013 program performance. The actual performance is then compared to the 2013 energy and peak demand reduction benchmarks to demonstrate DP&L's compliance.

Program	Filed 2013 (MWh)	Annualized Actual 2013 (MWh)	Variance (MWh)
Residential Lighting	58,318	69,389	11,071
Residential HVAC Rebates	8,412	6,848	-1,564
Residential HVAC Diagnostic & Tune Up	472	90	-382
Residential Appliance Recycling	3,072	3,095	23
Residential School Education	2,476	3,647	1,171
Residential Low Income Affordability	1,118	1,249	131
Non-Residential Prescriptive Rebates	47,180	59,238	12,058
Non-Residential Custom Rebates	21,147	16,816	-4,331
Mercantile Customer Commitments[1]	6,862	9,972	3,110
Non-Residential PJM Demand Response	0	0	0
Pilot Programs	0	0	0
Transmission & Distribution Infrastructure Improvements	0	33,147	33,147
Total	**149,057**	**203,491**	**54,434**

[1] Mercantile Customer Commitments for energy represent those mercantile applications filed in 2013 and approved by the PUCO prior to the filing of this report.

2013 ENERGY ACTUALS COMPARED TO CUMULATIVE BENCHMARKS



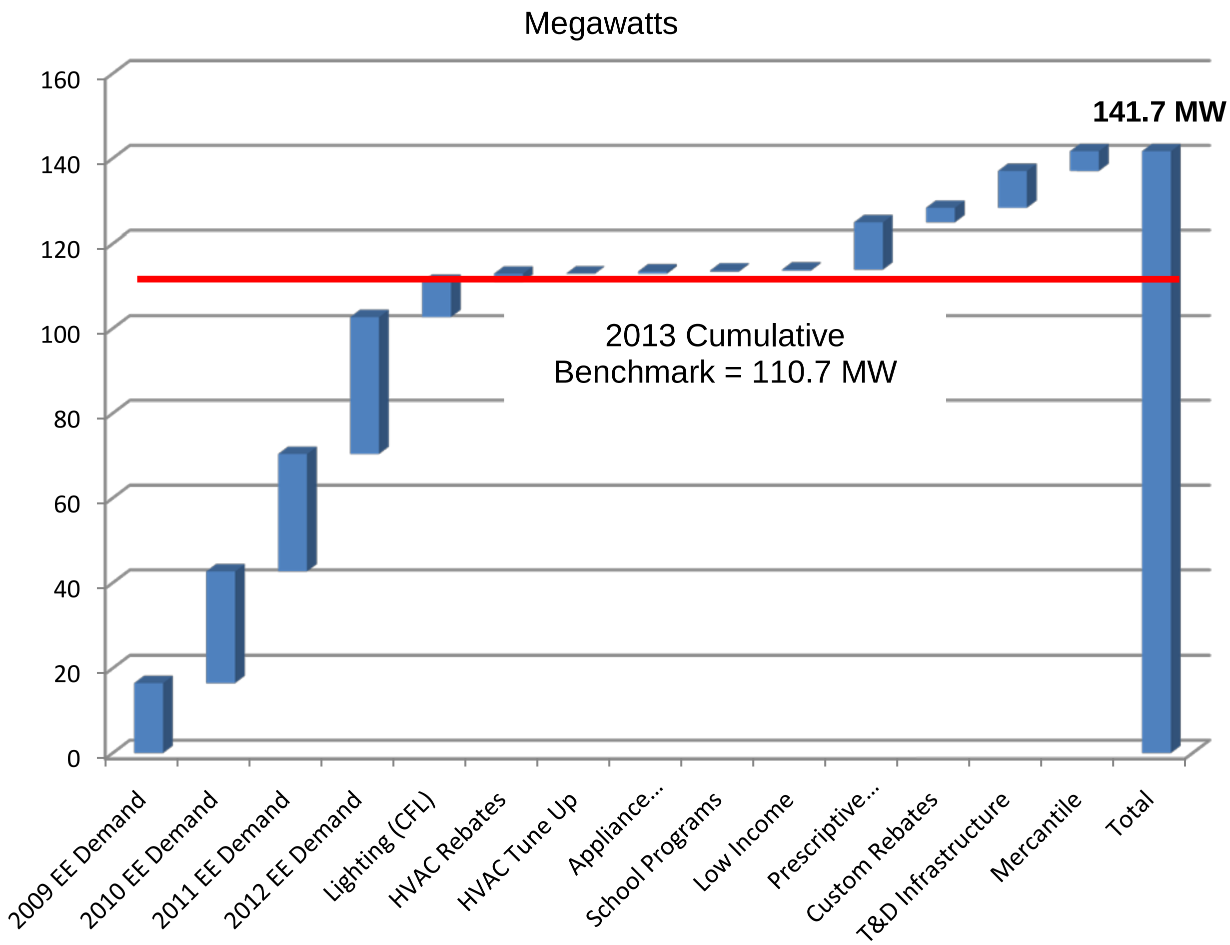
	MWh
2009 Actuals	115,279
2010 Energy Efficiency Actuals	174,249
2010 Mercantile Commitments	4,957
2011 Energy Efficiency Actuals	164,039
2011 Mercantile Commitments	15,547
2012 Energy Efficiency Actuals	181,011
2012 Mercantile Commitments	5,515
2013 Energy Efficiency Actuals	193,519
2013 Mercantile Commitments	9,972
Cumulative 2009-2013 Total Savings	864,088
Cumulative 2013 Benchmark	449,981

2013 FILED VERSUS ACTUAL DEMAND SAVINGS

Program	Filed 2013 (MW)	Annualized Actual 2013 (MW)	Variance (MW)
Residential Lighting	5.07	8.30	3.23
Residential HVAC Rebates	2.52	1.95	-0.57
Residential HVAC Diagnostic & Tune Up	0.18	0.01	-0.17
Residential Appliance Recycling	0.51	0.49	-0.02
School Education	0.02	0.23	0.21
Residential Low Income Affordability	0.14	0.22	0.08
Non-Residential Prescriptive Rebates	8.29	11.01	2.72
Non-Residential Custom Rebates	3.88	3.43	-0.45
Mercantile Customer Commitments[1]	3.21	4.67	1.46
Non-Residential PJM Demand Response	10.00	0.00	-10.00
Pilot Programs	0.00	0.00	0.00
Transmission & Distribution Infrastructure Improvements	0.00	8.69	8.69
Total	**33.82**	**39.00**	**5.18**

[1] Mercantile Customer Commitments for energy represent those mercantile applications filed in 2013 and approved by the PUCO prior to the filing of this report.

2013 DEMAND ACTUALS COMPARED TO CUMULATIVE BENCHMARKS



	MW
2009 Actuals	16.5
2010 Energy Efficiency Actuals	24.7
2010 Mercantile Commitments*	1.5
2011 Energy Efficiency Actuals	24.2
2011 Mercantile Commitments*	3.5
2012 Energy Efficiency Actuals	28.9
2012 Mercantile Commitments*	3.4
2013 Energy Efficiency Actuals	34.3
2013 Mercantile Commitments	4.7
Cumulative 2009-2013 Total Savings	141.7
Cumulative 2013 Benchmark	110.7

*Mercantile commitments for PJM Demand Response do not carry over from year to year. Therefore, 2010, 2011 and 2012 PJM Demand Response commitments have been removed from the cumulative total.

RESIDENTIAL PROGRAMS

RESIDENTIAL LIGHTING

PROGRAM DESCRIPTION

The Residential Lighting Program is an upstream, manufacturer buy-down of compact fluorescent light bulbs (CFL) sold at the retail level. No coupon or rebate form is required; the customer receives the discount at the register at the time of purchase.

The objective of the program is to increase the number of long-life, Energy Star qualified CFLs sold to DP&L customers by providing incentives to decrease consumer costs. The program increases consumer awareness and acceptance of energy-efficient lighting technology and also has an educational component to promote use, and proper disposal of, CFL bulbs.

The Residential Lighting Program is designed for all DP&L residential customers who purchase bulbs through retail channels. All customers taking delivery service from DP&L are eligible for this program regardless of their choice of generation supplier.

This program started in February 2009 and continued through 2013.

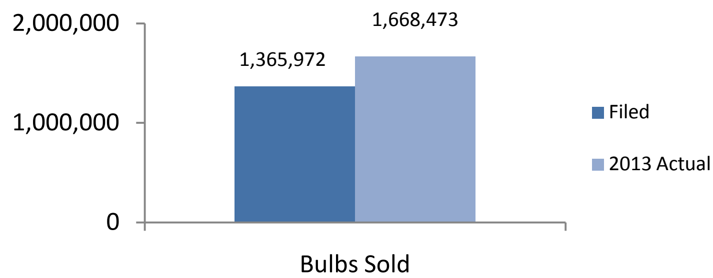
PERFORMANCE SUMMARY

During 2013, a total of 1,668,473 bulbs were sold throughout the DP&L service territory, resulting in gross annualized energy savings of 69,389 MWh and peak demand savings of 8.30 MW. Keys to the program's success include offering customers a wide variety of lighting choices with attractive discounts as well as a broad, and convenient, retail distribution network.

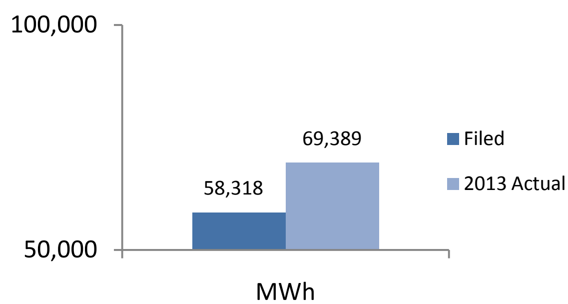
Program evaluations and national trends suggest that five percent of discounted CFLs were purchased by non-residential customers. As a result, five percent of savings and costs from the Residential Lighting Program have been reallocated to the Non-Residential Prescriptive Rebates Program. The metrics in this section reflect the 5% reallocation.

2013 Performance

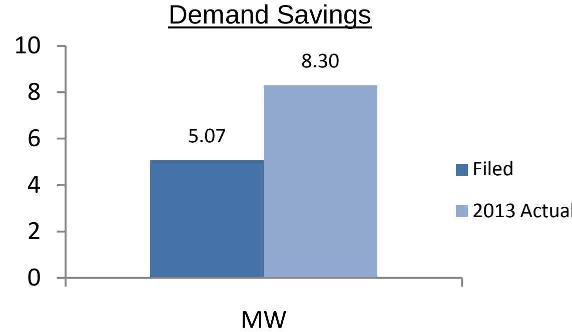
Units



Energy Savings



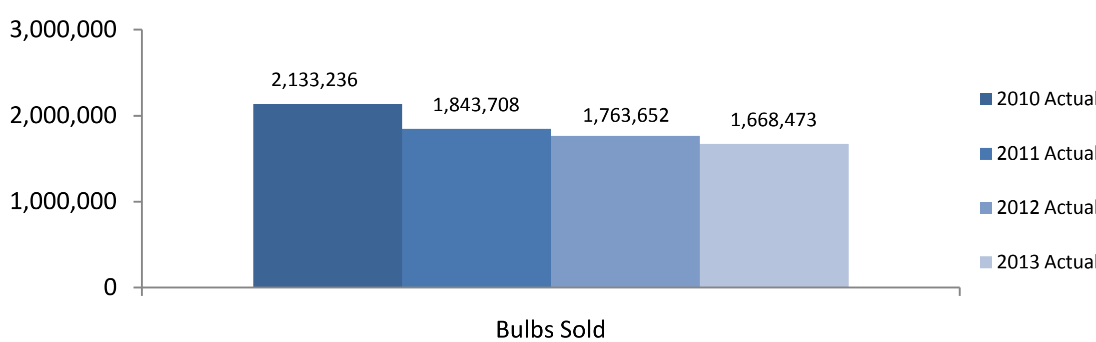
Demand Savings



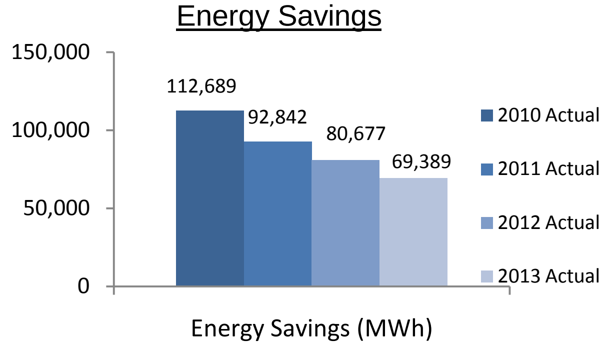
All “filed” numbers are taken from DP&L’s program portfolio filing; Case No. 13-0833-EL-POR

Four-Year Trend Analysis

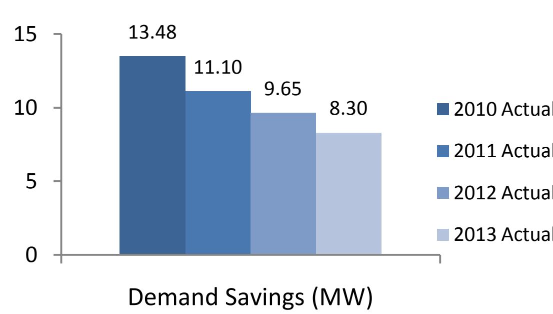
Units



Energy Savings



Demand Savings



Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$2,294,833	$2,145,507
Marketing & Admin	$822,460	$497,089
Total Costs	$3,117,293	$2,642,596

IMPLEMENTATION REVIEW

Implementation Strategy

With a CFL program, a third party implementation vendor offers significant value due to its experience running similar programs as well as existing lighting manufacturer and retailer relationships. As such, DP&L determined that program implementation would be most effectively managed by a third-party implementation partner.

At the conclusion of a request for proposal (RFP) process, Ecova (formerly Ecos IQ), based in Portland, Oregon, was selected as the implementation partner. In its proposal, Ecova demonstrated a sound process for quickly and effectively implementing programs based on its ten year track record of successfully implementing similar programs. Specifically, Ecova had experience implementing CFL programs for Arizona Public Service, the California Public Utilities Commission, Sierra Pacific Power, Puget Sound Energy, Nevada Power, and the Texas Statewide CFL Program.

Targeted Products

DP&L's residential lighting program was designed to provide customers with an extensive choice of products, so customers can select the types of bulbs that best meet their needs. In total, DP&L's program offers customers a choice of 69 different types of products. The most popular is the 13W twist bulb. Overall, DP&L offers soft white, bright white and daylight colored bulbs, 3-way, dimmable, globe, A-line, and flood bulbs, ranging from 9W to 55W. The average discount was $1.35 per bulb with discounts ranging from $0.25 to $2.10, depending on the type of bulb.

Products Types Offered

Product Name	Product Name
3-Way	9w Twist
3-Way 12/21/32	23W Twist Dim
3-Way 12/23/29	11W Globe
3-Way 13/20/25	12W Globe
3-Way 14/20/32	14W Globe
3-Way 15/26/40	15W Globe
3-Way 16/25/32	9W Globe
11W A-line	15W PAR30
13W A-Line	23W PAR30
14W A-Line	11W R20
15W A-Line	14W R20
19W A-Line	14W R30
9W A-Line	15W R30 Dim
14W BR30	16W R30 Dim
15W BR30	18W R40
15W R30	19W R40
16W BR30	20W R40 Dim
4w Candelabra	23W R40
7W A-Line	26W R40
9w Candelabra	16W R40 Dim
10W Twist	23W BR40
11W Twist	14W Twist
13W Globe	15W Twist
13W Twist	15W Twist Dim
14W Twist Dim	18W Twist
15 Twist Dim	19w Twist
16W R30	23W A-Line
19W 830 RP	23W Dim
20W Twist	26W Twist Dim
23W PAR38	27W Twist
23W Twist	42W Twist
26W PAR38	55W Twist
26W Twist	68W Twist
30W Twist	9W Torpedo
40W Twist	

Targeted Retailers, Locations

To make the program convenient and accessible for all customers, DP&L's program enlisted the participation of the traditional "big box" retailers as well as independent hardware and specialty locations. The big box retailers were the first selected to participate, given their previous experience with implementing similar buy-down programs in other regions and their ability to get the programs up and running quickly. Further, big box retailers sell significant volume, allowing the program to reach the largest number of DP&L customers as quickly as possible.

The first participating retail outlets selected were concentrated in the Dayton metropolitan area to match the location of the highest volume of DP&L residential customers. DP&L then expanded the program to outlying areas, giving all residential customers the opportunity to participate. In addition, an online retailer was added to the program to provide an additional convenient option for customers.

Retail locations were carefully selected to minimize the potential for participation from non-DP&L customers. The highest concentration of retailer locations coincides with geographic areas that have the highest concentration of DP&L customers. Retailer locations outside of the DP&L service territory were excluded. In communities served by municipal utilities or on the edge of the DP&L service territory, store locations were minimized.

Participating Retailers

Retailer	# of Locations
Ace	26
Batteries Plus	3
Bed Bath and Beyond	3
Dickmans	3
Goodwill	20
Habitat ReStore	6
Home Depot	7
Kroger	26
Lowes	12
Meijer	6
Menards	3
Online	1
Sam's	3
True Value	8
Walmart	17
Total	**156**

Staffing

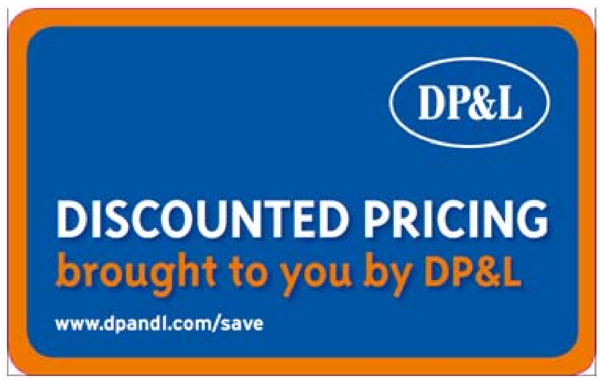
Two Ecova staff members managed the program locally and served as DP&L's direct point-of-contact. The local field staff was responsible for visiting participating retail outlets to ensure that discounted products were stocked on the shelves, priced and labeled correctly, so that customers received the discounts at the register. The local field staff was also responsible for promoting the program at a number of community events. This staff was supported by the experienced managers and support team located at the Ecova main office.

Marketing
In order to promote CFLs and the lighting program discounts to its customers, DP&L employed a breadth of marketing methods. Starting with the assumption that approximately 70 percent of purchasing decisions are made in the store at the time of purchase, the core of the marketing efforts focused on point-of-purchase (POP) materials. For instance, DP&L created a special sticker which is placed next to the standard price sticker to alert customers to program discounts. A “shelf wobbler” protrudes into the aisle and calls attention to the available discounts and the benefits of CFLs. A floor sticker is displayed on the floor next to the shelf to call extra attention to the available discount. And, Ecova works with store managers to position the discounted CFLs in highly visible areas whenever possible.

Point-of-Purchase Material Samples:

Shelf Wobbler

Shelf Sticker

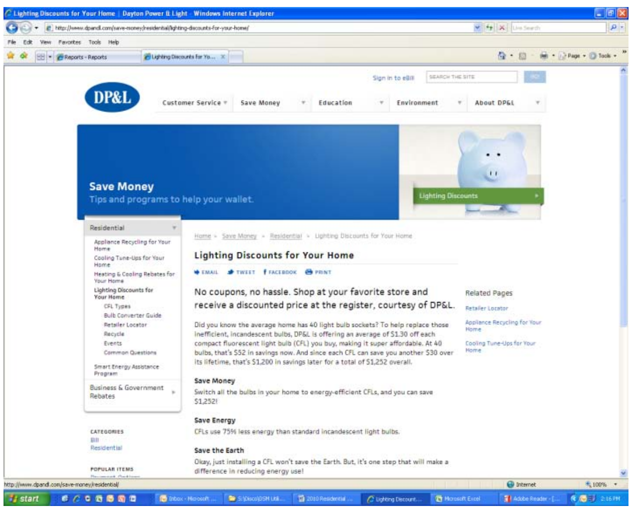


Floor Sticker

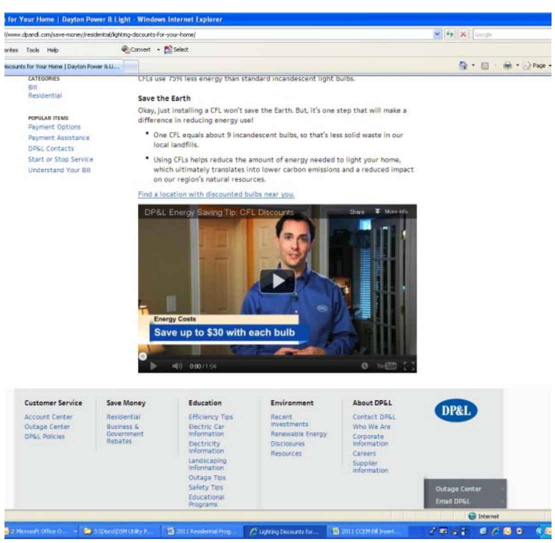
Beyond the POP materials, DP&L also promotes the residential lighting program to customers via a web site, bill inserts, presence at special events, and mass media advertising.

The CFL program web pages on the DP&L company web site provide a description of CFL bulb types and their applications, conversions of wattages from incandescent to CFL, and answers to frequently asked questions. A page of the web site is devoted to CFL recycling, educating customers about the small amount of mercury in CFLs, and how to properly dispose of a CFL (if broken), and where to recycle (if unbroken).

Customers can also access an online retailer to place an order of discounted bulbs, both traditional and specialty.



Web Site
The CFL program landing page gives a description of the residential lighting program and allows customers to navigate to other pages for more information.



YouTube Video
The YouTube video, produced by DP&L and posted on the CFL program landing page, educates customers about the benefits of switching to CFLs.

Bill Insert
Bill inserts were mailed to 450,000 residential customers in February.

Community Outreach Events
The Ecova local field staff attended 7 local community events to discuss the residential lighting program, CFLs, and their benefits.

Education, General Awareness

DP&L conducted a mass media education and general awareness campaign promoting the value of energy efficiency and the available residential programs. A complete discussion of this campaign can be found in the Education, Awareness Building & Market Transformation Activities section.

Community Partnerships

DP&L was able to utilize promotional benefits provided via existing corporate sponsorships of local organizations, like the minor league Dayton Dragons baseball team.

Customer Service

In all programs, customer service is a critical element of program success. As such, DP&L designed a number of customer service elements into its program, some of which have been previously discussed.

The program web pages (discussed in the Residential Lighting Program Marketing section) allow DP&L to provide a breadth of information for all customers with internet access. The web pages not only educate about CFLs, but also help customers to locate available discounts near their home.

For those without internet access, or who want to speak to a person, DP&L set up a program hotline number staffed by Ecova employees. The staff has been trained to answer detailed questions about the Residential Lighting Program and help customers locate available discounts.

DP&L maintains its own customer service center, accepting calls regarding all functions of DP&L. DP&L management staff continues to update customer service center staff regarding program details as needed.

The Ecova local field staff continues to be a large component of DP&L's customer service, ensuring the accuracy of prices and products in stores, which helps to meet customers' expectations. In a retail environment, it is possible for POP materials to be inadvertently removed or placed next to products that may or may not be discounted as restocking occurs. Regular, in-person store visits are an essential element of the program. In addition, the local field staff was in direct contact with customers at 7 local community events in 2013, answering questions and helping to educate customers about the program.

RESIDENTIAL HVAC REBATES

PROGRAM DESCRIPTION

The Residential HVAC Rebates Program offers rebates for the installation of new or replacement, high efficiency central air conditioning and heat pump systems. The customer receives an instant discount as a line item on the invoice from a participating HVAC contractor.

The objective of the program is to reduce energy consumption and peak demand savings by incentivizing customers to purchase efficient HVAC equipment that goes above and beyond the current minimum standard for efficiency.

This program is designed for any homeowner or landlord purchasing a new or replacement HVAC unit that will be installed at a residence within the DP&L service territory. All customers taking delivery service from DP&L are eligible for this program regardless of their choice of generation supplier.

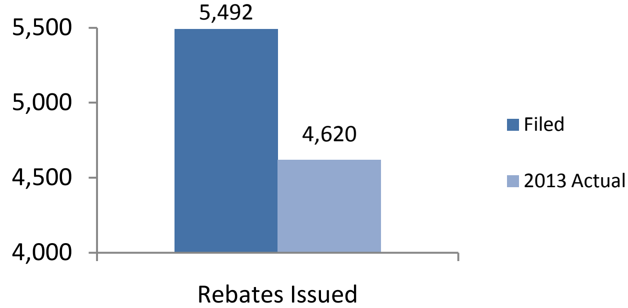
The program started in June 2009 with a core group of 23 participating contractors and has increased to 180 participating contractors by the end of 2013.

PERFORMANCE SUMMARY

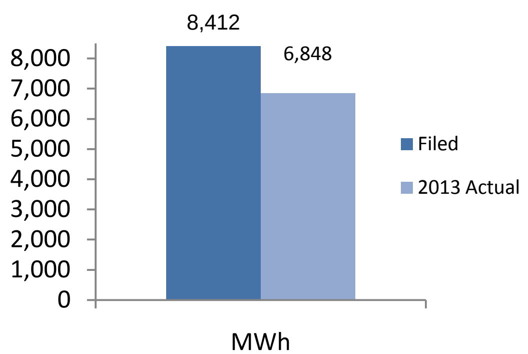
During 2013, a total of 4,620 HVAC rebates were issued throughout the DP&L service territory, resulting in gross annualized energy savings of 6,848 MWh and peak demand savings of 1.95 MW. Keys to the program's success include offering customer rebates on a wide variety of HVAC products through a widespread contractor network.

2013 Performance

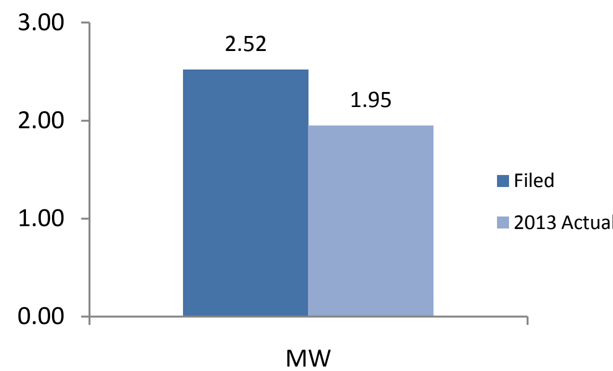
Units



Energy Savings



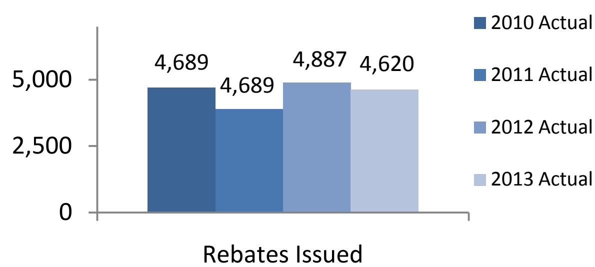
Demand Savings



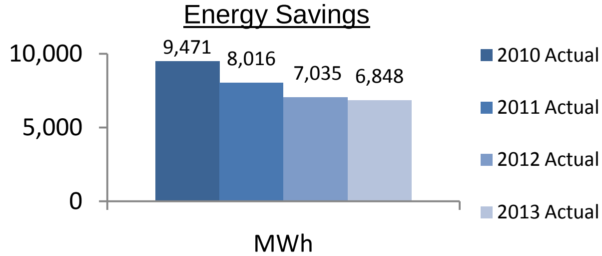
All “filed” numbers are taken from DP&L’s program portfolio filing; Case No. 13-0833-EL-POR.

Four-Year Trend Analysis

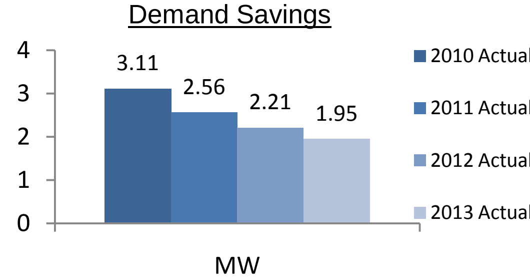
Units



Energy Savings



Demand Savings



Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$1,575,150	$1,259,085
Marketing & Admin	$754,799	$581,379
Total Costs	$2,329,949	$1,840,464

IMPLEMENTATION REVIEW

Implementation Strategy

With a Residential HVAC Rebate Program, it is of great value to have a third party implementation vendor with experience running similar programs that require building a network of HVAC contractors. Therefore, DP&L determined that program implementation would be most effectively managed by a third-party implementation partner.

At the conclusion of a RFP process, Conservation Services Group (CSG) was chosen as DP&L's implementation partner. CSG, based in Westborough, Massachusetts is a non-profit organization with a 25-year history of delivering energy efficiency programs. CSG's track record includes running successful programs for utilities such as Southern California Edison, San Diego Gas and Electric, NSTAR, Columbia Gas of Ohio, and National Grid. In addition, since the Residential HVAC Rebates Program is a logical extension of the HVAC Diagnostic and Tune-Ups Program, the most cost-effective approach is to utilize the same vendor to implement both programs.

Targeted Products

DP&L offered rebates for central HVAC systems in three categories: New Construction; Replacement; and Early Retirement, with tiers for higher efficiency levels. DP&L customers can select the system manufacturer and model of their choice, but are only eligible to receive a rebate if the system meets the Seasonal Energy Efficiency Rating (SEER) requirements, or the Energy Efficiency Ratio (EER) requirements for ground source heat pumps. DP&L also offers rebates for the installation of electronically commutated motors (ECM) used in high efficiency, gas furnaces. In 2013, the most popular central system rebate was for early retirement air conditioners at SEER 14/15, followed by early retirement air conditioners at SEER 16+. DP&L also issued more than 1,400 rebates for ECMs.

Rebates Offered

For Central Air Conditioning

SEER Efficiency Rating	New Construction	Replacement	Early Retirement
14-15	$100	$100	$200
16+	$150	$150	$300

For Air-Source Heat Pumps and Ductless Mini-Splits*

SEER Efficiency Ratio	New Construction	Replacement	Early Retirement
14-15	$200	$200	$400
16+	$300	$300	$600

*Mini-splits are not eligible for early retirement rebates.

For Ground-Source Heat Pumps

EER Efficiency Ratio	New Construction	Replacement	Early Retirement
16-18	$800	$800	$1,200
19+	$1,200	$1,200	$1,600

For Electronically Commutated Motors

AFUE	New Construction	Replacement	Early Retirement
95%+	$100	$100	$100

New Construction – High-efficiency, new equipment installed in new homes in a home or a home addition where there is no previously existing central air conditioning or heat pump system.
Replacement – High-efficiency, new equipment installed as a replacement for existing equipment not meeting early retirement eligibility requirements.
Early Retirement – High-efficiency, new equipment installed as a replacement for existing equipment that meets the following requirements:

Existing equipment is in working order, regardless of age OR
Existing equipment is less than or equal to 20 years old and is repairable for less than $1000.

Rebates Issued

Product	Rebates Issued 2013
Replacement or New Construction Air Conditioner SEER 14/15	216
Replacement or New Construction Air Conditioner SEER 16+	51

Replacement or New Construction Air Source Heat Pump SEER 14/15	60
Replacement or New Construction Air Source Heat Pump SEER 16+	32
Replacement or New Construction Ductless Mini-Split SEER 14/15	0
Replacement or New Construction Ductless Mini-Split SEER 16+	116
Replacement or New Construction Ground Source Heat Pump EER 16-18	41
Replacement or New Construction Ground Source Heat Pump EER 19+	28
Early Retirement Air Conditioner SEER 14/15	1,003
Early Retirement Air Conditioner SEER 16+	779
Early Retirement Air Source Heat Pump SEER 14/15	429
Early Retirement Air Source Heat Pump SEER 16+	359
Early Retirement Ground Source Heat Pump EER 16-18	31
Early Retirement Ground Source Heat Pump EER 19+	71
ECM	1,404

Targeted Contractors

CSG recruited a network of contractors to market, recommend, and install eligible HVAC equipment. Contractors must be certified by DP&L to participate in the program and must sign a partnership agreement. Certification qualifications include: a valid HVAC license; minimum levels of insurance; Environmental Protection Agency-certified technicians; and a Better Business Bureau rating higher than B-. Large contractors were targeted first, which allowed the program to reach the greatest number of DP&L customers as quickly as possible. Continually, smaller, independent contractors were recruited, so that by the end of 2013, the program had 180 participating contractors located throughout the DP&L service territory.

To make the program convenient and accessible for all customers, customers may purchase an eligible HVAC system from any certified contractor of their choice. If a customer's existing contractor is not already a certified contractor, CSG will work to recruit the contractor into the program so that the customer does not have to switch contractors.

When purchasing qualifying equipment, DP&L customers receive the rebate via an instant discount on the invoice total from the certified contractor. Participating contractors are then reimbursed for the total of the rebates issued, with proper support documentation. This approach allows customers to have a lower upfront out-of-pocket expense when making their purchase.

Staffing

CSG's local staff members manage the program and serve as DP&L's direct point-of-contact (This staff also manages the HVAC Tune-Up Program). The local field staff, consisting of a program manager, account manager, administrative coordinator, and part-time quality control auditor, is responsible for maintaining relationships with HVAC contractors to ensure that the program is mutually beneficial and successful. For contractors to be most successful in the program, they need to have a thorough understanding of program guidelines and buy-in to the DP&L program design and processes. CSG maintains regular contact with contractors to discuss program issues, potential solutions, and opportunities for improvement.

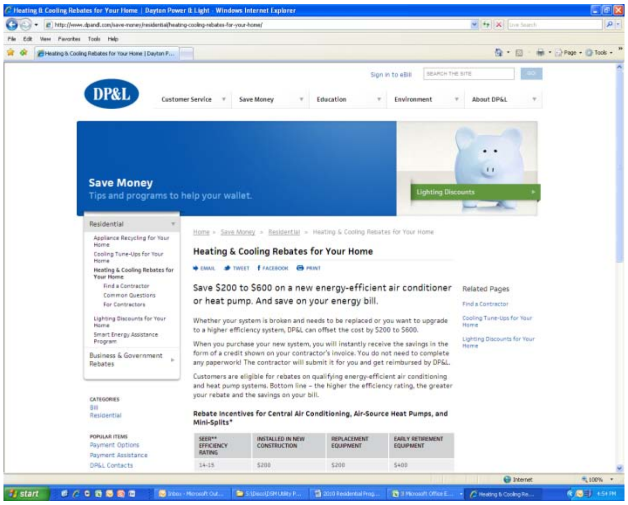
CSG closely monitors rebate applications for accuracy of rebate values and eligibility of equipment. CSG also performs quality control checks on a portion of all system installations and accompanying paperwork to ensure that contractors adhere to the program guidelines. Contractors who exhibit a track record of poor quality work or customer complaints are removed from the program. The local staff is supported by the experienced managers and support team located in the CSG main office.

Marketing

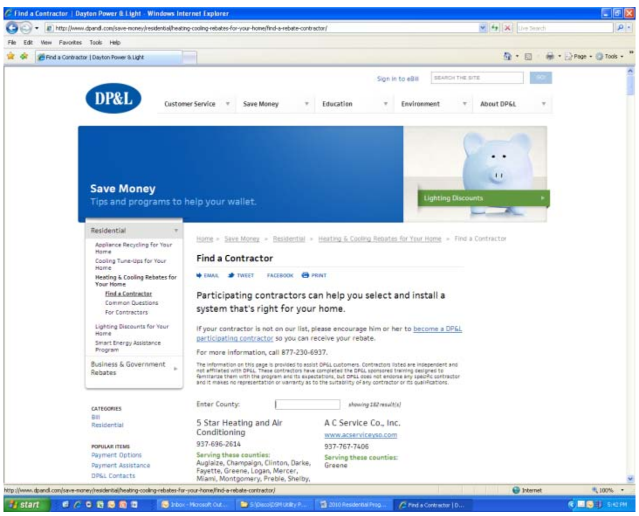
The program is designed to be marketed largely through participating HVAC contractors. Since contractors work directly with DP&L customers, they are able to offer rebates at the point-of-sale. Participating contractors are motivated to offer the rebates as a sales tool, providing a discount that non-participating contractors cannot. To support contractors and help advertise the program, DP&L created a series of marketing pieces including web pages, fliers, and bill inserts.

The HVAC rebate program web pages on the DP&L company web site provide an overview of the program, a list of eligible equipment, and answers to frequently asked questions. One page is dedicated to helping customers find a participating contractor. Customers can search by their home county and see a list of all contractors serving that area. This page also mentions the ability to recruit the customer's present contractor.

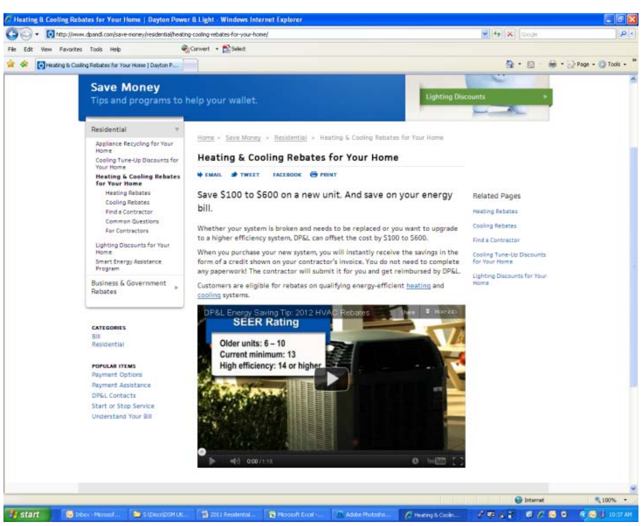
The web portal contains a special log-in section for participating contractors. The portal displays program news and answers to frequently asked questions.



Customer Web Pages
The HVAC program landing page gives a description of the residential HVAC rebates program and allows customers to navigate to other pages for more information.



Web Site Contractor Locator
The contractor locator allows customers to search for participating contractors by their home county.



YouTube Video
The YouTube video, produced by DP&L and posted on the HVAC rebates program landing page, educates customers about the benefits of upgrading to a high efficiency HVAC system.

Bill Insert
Bill inserts were mailed to 450,000 customers in August.

Flyer
Program fliers were distributed to customers at community outreach events attended by the residential lighting program field staff, creating promotional efficiencies among programs.

Newspaper Advertisements
DP&L ran a series of newspaper advertisements to promote the program in June, July, and August.

Education, General Awareness
DP&L conducted a mass media education and general awareness campaign promoting the value of energy efficiency and the available residential programs, including HVAC rebates. A complete discussion of this campaign can be found in the Education, Awareness Building & Market Transformation Activities section.

Customer Service
In all programs, customer service is a critical element of program success. As such, DP&L designed a number of customer service elements into its program, some of which have been previously discussed.

The web pages and contractor locator (discussed in the Residential HVAC Rebates Marketing section) allow DP&L to provide a breadth of information for all customers with internet access. The contractor locator allows customers to conveniently access a way to participate in the program.

For those without internet access, or who want to speak to a person, DP&L set up a program hotline number staffed by CSG employees. The staff has been trained to answer detailed questions about the Residential HVAC Rebates Program and help customers locate participating contractors in their area.

DP&L maintains its own customer service center, accepting calls regarding all functions of DP&L. DP&L management staff continues to update customer service center staff regarding program details as needed.

The large number of participating contractors is an important component of DP&L's customer service. The contractors were located throughout DP&L's service territory, making the rebates accessible to all customers. In addition, the ability to recruit a customer's current contractor is a large source of satisfaction for both the customer and the contractor.

The CSG local staff is another significant element of DP&L's customer service, serving both the contractors and the customers. For contractors to be most successful in the program, they need to have a thorough understanding of program guidelines and buy-in to the program design and processes. CSG maintains regular contact with contractors to discuss program issues, potential solutions, and opportunities for improvement.

In addition, CSG's quality control of contractors' work allows DP&L customers to receive their rebates, as promised. CSG performs quality control checks on five percent of all system installations and five percent of pre-installations for early retirement systems. Equipment is reviewed along with the accompanying paperwork to ensure that contractors adhere to the program guidelines. CSG's oversight ensures that the program's integrity is maintained and that customers are treated properly and fairly. Contractors who exhibit a track record of poor quality work or customer complaints are removed from the program.

Participating Contractors

5 Star Heating and Air Conditioning	Alternative Heating and Cooling
A C Service Co., Inc.	Anderson Mechanical Associates, LLC
AAA Professional Heating & Cooling	Apex Mechanical Systems
A-Abel Heating & Air Conditioning Inc.	Area Energy & Electric
Accurate Heating & Cooling	Area Heating & Air Conditioning, LLC
Advanced Mechanical Services	Arronco Comfort Air, Inc.
Aero Mechanical Systems	Arrow Mechanical Services
Air Authority Heating & A/C	Ayers Service Group DBA CW Service
Air Comfort Heating and Cooling	B & K Heating & A/C Inc.
Air Systems Div. PRD Corp. Inc.	Babb Sheet Metal
Aireawide Heating & Air Inc.	Bach Heating & Air, LLC
Airtron Heating & Air Conditioning	Barga Heating, A/C & Refrig., Inc.
All Home Improvement Heating & Cooling	Barker Heating and Air Conditioning Co.
Allied Services, Inc.	Barnard HVAC, LLC
All-Weather Heating & A/C Inc.	Beck Heating & Air Conditioning, LLC

Bolyard Heating & Cooling Inc.	Edington Heating & Cooling
Brockman Furnace Co.	Ed's HVAC, Plumbing, Electric
Burns Heating and Cooling LLC	Eisert Plumbing & Heating, Inc.
Buschur's Refrigeration Inc.	Environmental Doctor
Butler Heating and Air Conditioning Co.	Excel Heating & Cooling LLC
Carney's Heating & Cooling	Extreme's One Hour Heating & Air Conditioning
Childers H.V.A.C. Systems Inc.	Faller Mechanical, LLC
ChillTex, LLC	Farquhar Heating & Air
Choice Comfort Services	Favret Heating & Cooling
CJS Heating & Air	Fetz Plumbing, Heating & Air Conditioning
Clark's Air Conditioning and Heating	Franck Plumbing & Heating Co., Inc.
Climate Control Specialist	Future Air
Climate Control Systems, Inc.	Gagel Plumbing & Heating, Inc.
Climate Zone Heating & Air LLC	Gallion Heating & Cooling Inc.
Cloverleaf Mechanical	Grilliot's Heating & Cooling Inc.
Comfort Control Heating & Cooling, Inc.	H & M Heating & Cooling, Inc.
Comfort Solutions Heating & Air Conditioning LLC	Haines Heating & Cooling LLC
Comfort Solutions, Inc.	Hauck Bros., Inc.
Comfort Xpress, LLC	Hill-Air
Commercial Refrigeration Specialists	Houston's HVACR, Inc.
Consolidated Hunter Heating & Plumbing, Inc.	Howard Heating & A/C LLC
Cool Solutions	Howell Heating & Cooling
Cowboys Heating & Air LLC	J & M Heating & Cooling
Crabtree Heating & Air Conditioning	Jent Mechanical
Crane Heating & Air	John Boyd Heating & Cooling
Crawford & Son Htg and Clg Inc.	John P. Timmerman Co., LLC
Custom Air Conditioning	Johnson Mechanical, Inc.
Custom Heating & A/C, Inc.	Joseph's Heating & A/C, Inc.
Damon Whorton	K C Services, LLC
Danco Enterprises Inc.	Kelly Heating and Air
Dave's Services	Kenny Adams Heating & Cooling LLC
Davis Refrigeration Inc.	Kettering Heating and Air
Dawson Services	Kirkwood Heating & Cooling
Dayton AC & Heating Co., Inc.	Kogge Plumbing, Heating & A/C, Inc.
Deer Heating & Cooling Inc.	Kool-Ease, Inc.
Del's Heating & Air Conditioning Co.	Korrect Plumbing Co.
Dependable Heating & Air	Lifestyle Comfort Solutions
Detmer and Sons, Inc.	Logan Master Appliance
Drake Heating & Air	Logan Services
EcoEnvironments	Lowman Metal Shop

M. Bruns Plbg. HVAC & Elect	Service Experts Heating & Air Conditioning LLC
MAB Mechanical Inc.	Shafer Heating & Cooling LLC
Mark Sweitzer Htg. Clg. & Ref. Inc.	Shawnee Heating & Air, LLC
Mastertech Mechanical Services Inc.	Smarda Company
MC Heating & Cooling	Snyder's Heating & Cooling
Mike Logan Refrigeration/Appliance	Solar Flare Heating & Air
Minkner Services Corp	South Home Air, Inc.
Morland Heating & Air Conditioning	Southtown Heating, Cooling, Plumbing & Electrical
Morris Heating Cooling and Electrical Services Inc.	Southwestern Ohio Heating and Air Conditioning, Inc.
Nelson Comfort	Stanley Construction Services, LLC
New Comfort Heating & Cooling	Steven Brackman Htg & Cooling
Noll-Fisher Inc.	Summers of Dayton
North Star Plbg. Htg. & Clg.	Tanner Heating and Air Conditioning
Outstanding Heating & Air, LLC	Taylor Heating & A/C LLC
Peck Heating Air Conditioning	The Furnace Man Heating and Cooling
Pinnacle Heating & Cooling	The Problem Solvers LLC
Pro-Aire HVAC	The Wright Company
Quality Heating & Cooling Inc.	Townsend Heating & Air Conditioning
Quality Mechanical Services, Inc.	Townsend's Heating & Cooling, Inc.
R & R Service Plumbing	Trame Mechanical
R & W Heating, Inc.	Trenton Heating & Air Conditioning
R J Brothers Heating & Cooling	Wallace Heating & Air
R. E. Becker Builders, Inc.	Watkins Heating & Cooling
Raiff Heating and Cooling, LLC	WebbtoWebb Construction Services
Ray's Refrigeration, Inc.	Wellman Services LLC
Refrigeration Control	Wenig's, Inc.
Reliant Mechanical Inc.	West Jefferson Plumbing & Heating
Richard Sharp Heating & Air Conditioning	Westfall Plumbing and Heating
Rieck Services	Wind Bender & Associates
Riesen Plumbing & Heating	Wise Heating & Cooling LLC
RK Plumbing and Home Services LLC	Wm. Brockman & Sons
Roessner Energy Products Inc.	Wyatt's Heating & Cooling
Schmidt's Heating, Cooling & Refrigeration	Yutzy Heating & Cooling Inc.
Scott's Heating & Air Conditioning, Inc.	Zimmer Heating & Cooling
Seiter Services LLC	
Sentry Heating & Air	

RESIDENTIAL HVAC DIAGNOSTIC & TUNE-UP

PROGRAM DESCRIPTION

The Residential HVAC Diagnostic & Tune-Up Program offered rebates for tune-ups performed on residential central air conditioners and heat pumps. The customer received an instant discount as a line item on the invoice from a participating HVAC contractor.

The objective of the program was to reduce energy consumption and peak demand savings by incentivizing customers to purchase a tune-up of their HVAC system, performed by a participating contractor that is trained on tune-up best practices.

The program was designed for residential customers with central air conditioning or heat pump units in owner-occupied, single-family residential dwellings. All targeted customers taking delivery service from DP&L were eligible for the program regardless of their choice of generation supplier. This program was included in the Residential HVAC Rebates program in DP&L's 2013-2015 portfolio plan. However, the program will be described separately throughout this report.

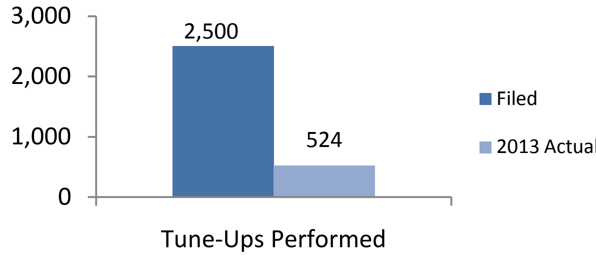
The program started in March 2010 with the training of a core group of 8 participating contractors. In total, 524 HVAC tune-ups were performed in 2013 through this program in DP&L residential customers' homes.

PERFORMANCE SUMMARY

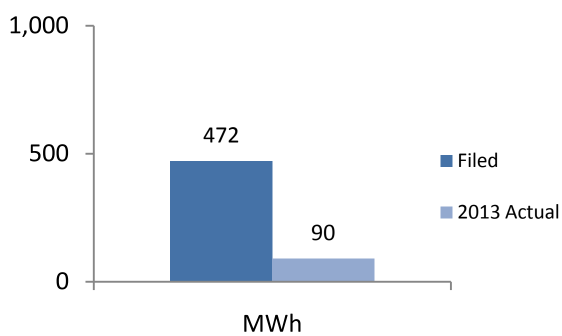
During 2013, 524 HVAC tune-ups were performed in residential customers' homes, resulting in gross annualized energy savings of 90 MWh and peak demand savings of 0.01 MW. After two years of low program participation, this program was redesigned in 2012 to be more simple and attractive both to contractors and customers. Participation increased over the 2012 program year; however, the performance was still less than anticipated. As a result, DP&L ramped down and discontinued the tune-up program in June of 2013.

2013 Performance

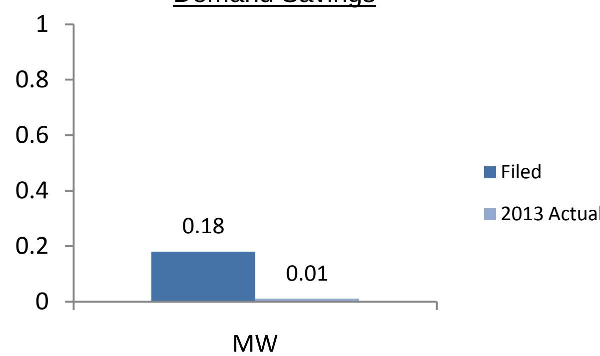
Units



Energy Savings



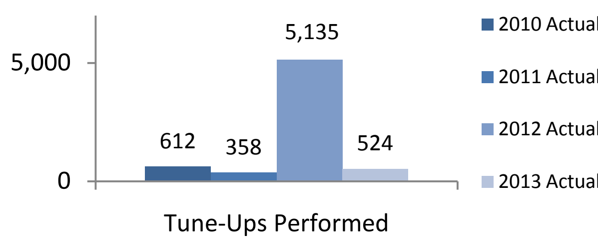
Demand Savings



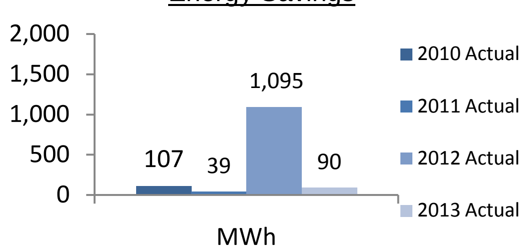
All “filed” numbers are taken from DP&L’s program portfolio filing; Case No. 13-0833-EL-POR.

Four-Year Trend Analysis

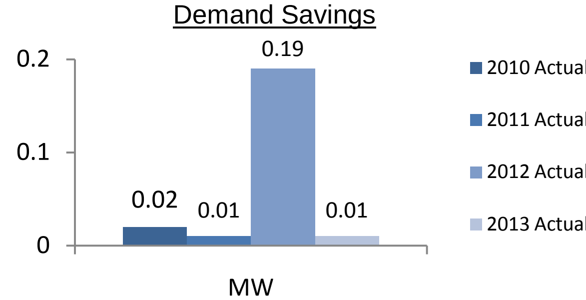
Units



Energy Savings



Demand Savings



Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$100,000	$19,640
Marketing & Admin	$204,676	$111,855
Total Costs	$304,676	$131,495

IMPLEMENTATION REVIEW

Implementation Strategy

At the conclusion of a RFP process, Conservation Services Group (CSG) was chosen as DP&L's implementation partner. CSG is the vendor selected to also manage the Residential HVAC Rebates Program. Since the Residential HVAC Diagnostic and Tune-Up Program is a logical extension of the HVAC Rebates Program, the most cost-effective approach was to utilize the same vendor to implement both programs.

Targeted Process

As a part of the redesigned tune-up program, the contractor completed a thorough evaluation of the HVAC system, following a 20-point checklist. The checklist focuses on the five major components of an HVAC system including air flow, evaporator coil, blower assembly, condenser coil, and refrigerant charge. The checklist is based on best practice maintenance guidelines, according to the Air Conditioning Contractors of America (ACCA) manual.

Incentives Offered

Participating customers received a $25 discount from a participating contractor. DP&L also paid participating contractors $15 per tune-up completed. DP&L's payment helped compensate the contractors for their additional time and training, which helped contractors provide customers with a high quality tune-up.

Tune-Ups Performed

System Type	Number of Tune-Ups Performed
Central Air Conditioner	417
Heat Pump	107

Targeted Contractors

The program was redesigned with the help of contractors that are members of the local ACCA chapter. DP&L's implementation vendor worked closely with ACCA to determine the program design that would yield the best tune-up results and facilitate buy-in from participating contractors. The 20-point checklist was based on the ACCA manual for maintenance. All participating tune-up contractors were members of ACCA and were top performers in the DP&L HVAC Equipment Rebates Program. All participants were required to undergo training on program guidelines and processes.

Staffing

The same local field staff hired by CSG for the HVAC Rebate Program performed the work associated with the tune-up program. The local field staff was responsible for maintaining relationships with HVAC contractors, ensuring that the program is mutually beneficial and successful. For contractors to be most successful in the program, they needed to have a thorough understanding of program guidelines and buy-in to the DP&L program design and processes. CSG maintained regular contact with contractors to discuss program issues, potential solutions, and opportunities for improvement. Despite CSG and DP&L's efforts, participating contractors did not all buy-in to the redesigned program. As a result, DP&L ramped down and discontinued the tune-up program in June of 2013.

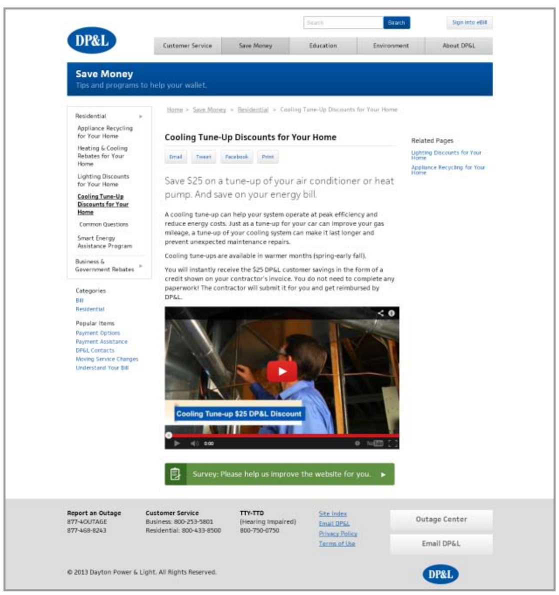
Due to the technical nature of this program, CSG worked closely with contractors to ensure the technical accuracy and quality of tune-ups performed. At the start of the program, CSG's staff regularly accompanied contractors to customers' homes to work alongside them and continue their training. Throughout the program year, CSG continued to perform quality control checks on a portion of all tune-ups to ensure that contractors adhere to program guidelines. Contractors who exhibit a track record of poor quality work or customer complaints are removed from the program.

The local staff was supported by the experienced managers and support team located at the CSG main office.

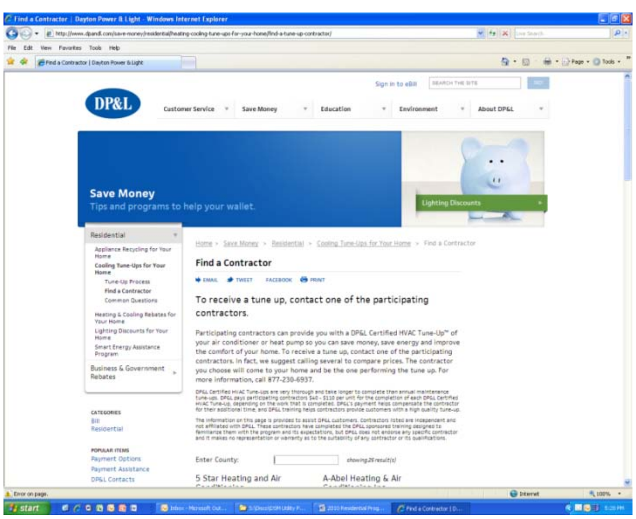
Marketing

The program was designed to be marketed largely through participating HVAC contractors. Since contractors worked directly with DP&L customers, they were able to offer tune-ups at the point-of-sale. Participating contractors could utilize the rebates as a sales tool, providing a discount that a non-participating contractor could not.

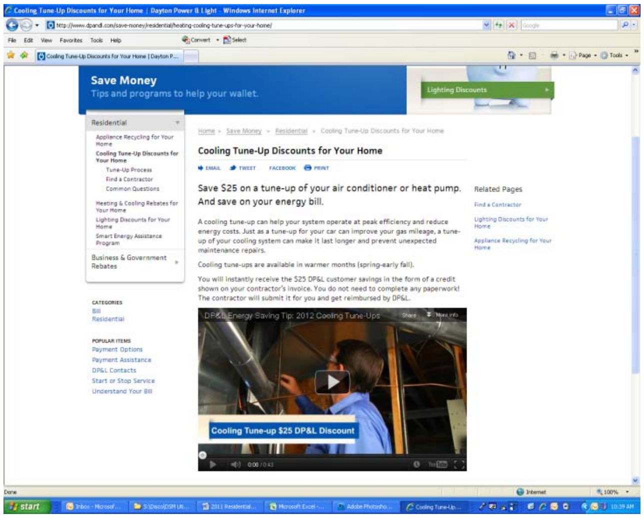
Since the program was scheduled to ramp down and end in 2013, program activities were limited. However, DP&L maintained program web pages on the company web site and continued to promote the program with printed marketing materials distributed to customers. The HVAC tune-up web pages on the DP&L company web site provided an overview of the program, a description of the tune-up process, and answers to frequently asked questions. One page was dedicated to helping customers find a participating contractor. Customers could search by their home county and see a list of all contractors serving that area.



Customer Web Pages
The HVAC tune-up program landing page gave a description of the Residential HVAC Tune-up Program and allowed customers to navigate to other pages for more information.



Web Site Contractor Locator
The contractor locator allowed customers to search for participating contractors by their home county.



YouTube Video
The YouTube video, produced by DP&L and posted on the HVAC Tune-Up program landing page, educated customers about the benefits of tuning up their A/C.

Flyer
Program fliers were distributed to customers at community outreach events attended by the Residential Lighting Program field staff, creating promotional efficiencies among programs.

Customer Service
In all programs, customer service is a critical element of program success. As such, DP&L designed a number of customer service elements into its program, some of which have been previously discussed.

The web pages and contractor locator (discussed in the Residential HVAC Rebates Marketing section) allowed DP&L to provide a breadth of information for all customers with internet access. The contractor locator allowed customers to conveniently access a way to participate in the program.

For those without internet access, or who wanted to speak to a person, DP&L set up a program hotline number staffed by CSG employees. The staff was trained to answer detailed questions about the Residential HVAC Tune-Up Program and help customers locate participating contractors in their area.

DP&L maintains its own customer service center, accepting calls regarding all functions of DP&L. DP&L management staff continued to update customer service center staff regarding program details as needed.

CSG recruited and trained a group of contractors that were located throughout DP&L's service territory, making the rebates accessible to all customers. However, it was important to keep the number of participating contractors limited in order to maintain the technical accuracy and quality of the tune-ups performed. There were 8 trained participating contractors in 2013.

The CSG local staff was another significant element of DP&L's customer service, serving both the contractors and the customers. For contractors to be most successful in the program, they needed to have a thorough understanding of program guidelines and buy-in to the program design and processes. CSG maintained regular contact with contractors to discuss program issues, potential solutions, and opportunities for improvement. As mentioned, despite CSG and DP&L's efforts, participating contractors did not all buy-in to the program redesign and processes. As a result, DP&L ramped down and discontinued the program in 2013.

In addition, CSG quality control of contractors' work allowed DP&L customers to receive a quality tune-up, as promised. CSG performed quality control checks on five percent of all tune-ups performed. Equipment was reviewed along with the accompanying paperwork to ensure that contractors adhere to the program guidelines. CSG's oversight ensured that the program's integrity was maintained and that customers were treated properly and fairly. Contractors who exhibited a track record of poor quality work or customer complaints were removed from the program.

Participating Contractors

Allied Services, Inc.	Drake Heating & Air
Anderson Mechanical Associates, LLC	Logan Services
Butler Heating and Air Conditioning Co.	Tanner Heating and Air Conditioning
Deer Heating & Cooling Inc.	Wm. Brockman & Sons

RESIDENTIAL APPLIANCE RECYCLING

PROGRAM DESCRIPTION

The Residential Appliance Recycling Program allows for the collection of working refrigerators and freezers. The appliances are picked up directly from customers' homes, at no cost, and are transported to a facility in Columbus, Ohio to be deconstructed and recycled according to the Environmental Protection Agency's (EPA) best practices. Customers participating in the program in 2013 received a $35 rebate check for each unit recycled.

The objective of the program is to promote the retirement and recycling of inefficient appliances from households by offering an incentive for working equipment as well as information and education on the cost of keeping an inefficient unit in operation.

The Residential Appliance Recycling Program is designed for any residential customer with working refrigerators or freezers. The appliances must be plugged in and in working condition. All targeted customers taking delivery service from DP&L are eligible for this program regardless of their choice of generation supplier.

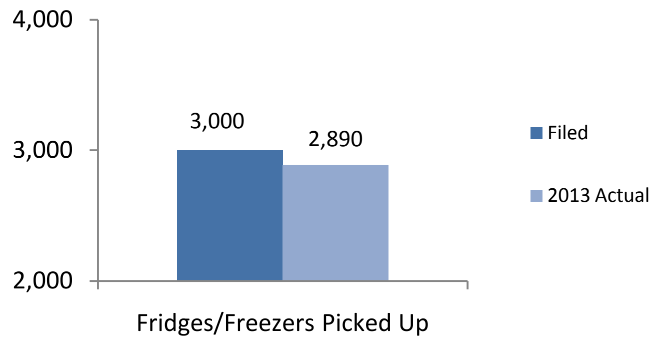
This program started in May 2009 and continued through 2013.

PERFORMANCE SUMMARY

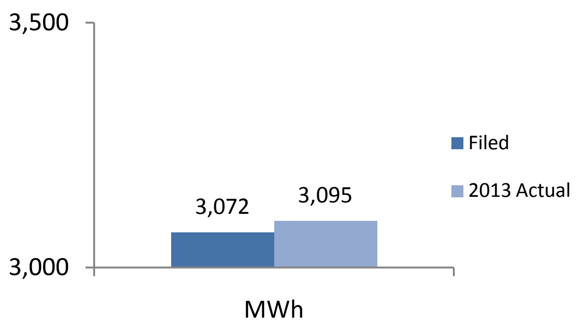
During 2013, 2,890 appliances were collected throughout the DP&L service territory, resulting in gross annualized energy savings of 3,095 MWh and peak demand savings of 0.49 MW.

2013 Performance

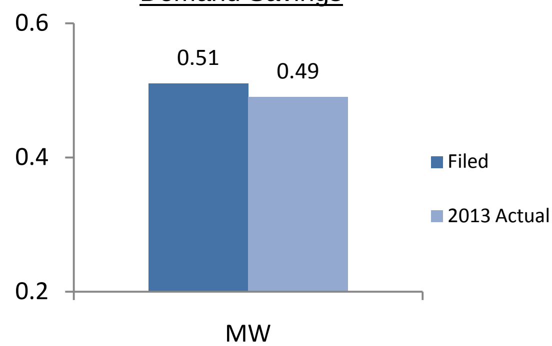
<u>Units</u>



<u>Energy Savings</u>



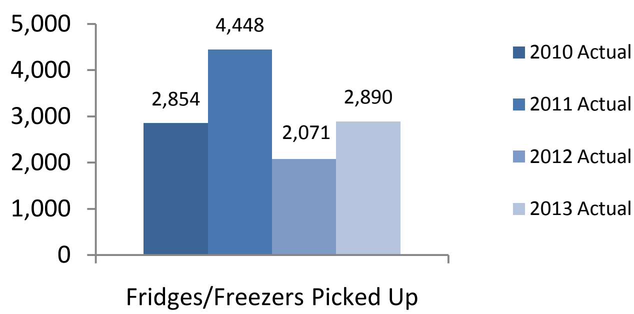
<u>Demand Savings</u>



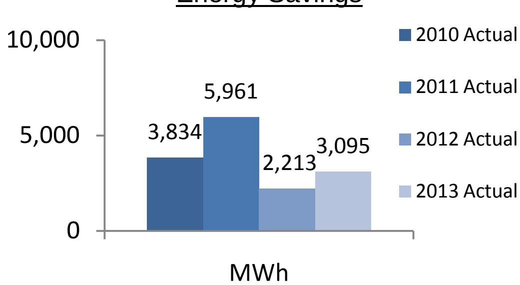
All “filed” numbers are taken from DP&L’s program portfolio filing; Case No. 13-0833-EL-POR.

Four-Year Trend Analysis

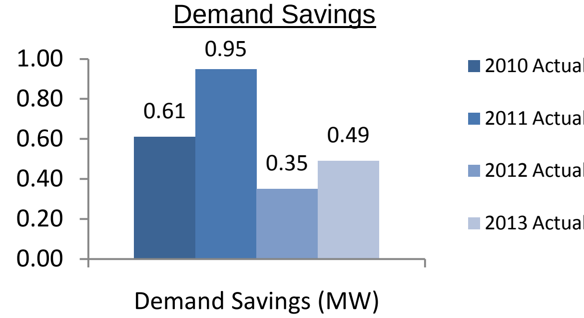
<u>Units</u>



<u>Energy Savings</u>



<u>Demand Savings</u>



Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$105,000	$101,150
Marketing & Admin	$355,957	$330,416
Total Costs	$460,957	$431,566

IMPLEMENTATION REVIEW

Implementation Strategy

Appliance recycling and proper disposal of materials require technical expertise, available recycling facilities, and qualified crews in the field. As such, DP&L determined that a third party implementation partner, specializing in this area, provided the best means of effectively managing the program.

At the conclusion of a RFP process, DP&L selected JACO Environmental as its implementation partner. In its proposal, JACO demonstrated a sound process for efficiently and properly collecting and deconstructing appliances, as well as the recycling and disposal of appliance components. JACO has experience running similar programs for more than 40 clients including PG&E, Southern California Edison, SMUD (California), PacifiCorp, and NJ Clean Energy.

In addition, JACO is being utilized by AEP Ohio and First Energy for their appliance recycling programs. Using the same vendor as AEP and First Energy creates efficiencies, lowering costs to DP&L, as well as other benefits. For instance, given the volume of recycling from DP&L and AEP, JACO decided to build a new recycling facility in Ohio rather than use the existing facility in Illinois. Also, by serving multiple companies, JACO has increased flexibility when scheduling crews, improving customer service.

Targeted Products

DP&L offers rebates for working refrigerators and freezers functioning both as secondary units and primary units, which are likely on their way to becoming secondary units in a garage or basement. The unit must be 10 to 30 cubic feet in size, which is the traditional size for units used in a residential setting.

Before an appliance is removed from the home, JACO inspects the appliance to ensure that it is in working condition and is plugged in. Non-working appliances or those that are unplugged are not eligible for removal.

Rebates Issued by Order Date

Month	Refrigerators	Freezers
January	96	17
February	60	18
March	135	32
April	136	48
May	185	39
June	266	84
July	319	129
August	346	111
September	264	75
October	177	38
November	126	27
December	133	29
Total	**2,243**	**647**

Of the 2,890 units collected in 2013, the average year the appliances were made was 1991.

The rebate amount was $35 per unit collected. Customers were paid via check mailed directly to their homes. Checks were processed and mailed an average of 21 days from the time the appliance was collected.

Targeted Locations

To make the Residential Appliance Recycling Program convenient and accessible to all residential customers, JACO crews were available to pick up appliances from every geographic area of the DP&L service territory. JACO scheduled pick-up dates and routes according to geography, targeting one region of the service territory each day. The average wait time for customers was 12 days from the time the appointment was scheduled, to when the JACO crew visited the customer’s home.

Staffing

JACO managed this program with staff located in the Portland, Oregon main office and at the recycling facility in Columbus, Ohio. A senior program manager in the main office served as the DP&L point-of-contact. The JACO program manager regularly communicated with the DP&L program manager to ensure that the program was on track to meet targets. The JACO program manager also coordinated all the project’s tasks and served as the hub of communication to JACO support staff in technical support, customer service, check processing, and operations.

The recycling facility in Columbus, Ohio was managed by an on-site facility manager who planned the crew's pick-up routes and managed the deconstruction and recycling processes. Crews of two were dispatched each day from the facility to the pick-up routes while additional staff members worked in the facility, deconstructing the appliances. JACO safely disposes of toxins and chlorofluorocarbon (CFC-11) gases from foam insulation. After capturing toxins (oils, mercury, PCBs) and other substances (CFC-11 and other foam insulation blowing agents and CFC-12 and other refrigerants), JACO recycles all the plastic, metals and glass in the appliances. Nearly 100 percent of a refrigerator's components are reused rather than going to the landfill. The facility manager is responsible for ensuring that all material handling processes comply with the best practices of the EPA.

Marketing

DP&L utilized a variety of marketing methods to promote the appliance recycling program to customers, including bill inserts, web pages, truck signs, and print advertisements. The program also significantly benefited from earned media coverage. The marketing collateral emphasized the cost of operating a second refrigerator or freezer and the rebate offered to program participants.

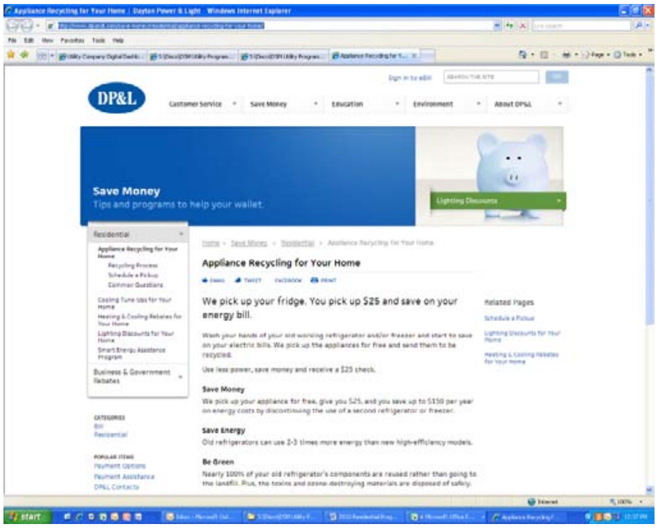
The customer web pages on the DP&L web site informed customers of program eligibility requirements, answers to frequently asked questions, and an overview of the recycling process. In addition, customers were able to register and schedule a pick-up via a web interface.

In 2013, DP&L also implemented a contest, in conjunction with AEP Ohio, First Energy, and other utility companies served by JACO, searching for the oldest refrigerator in each service territory, and in the state. The contest ran from May through July and was promoted through bill inserts and print ads. The winning entry for DP&L was a 1933 General Electric refrigerator.

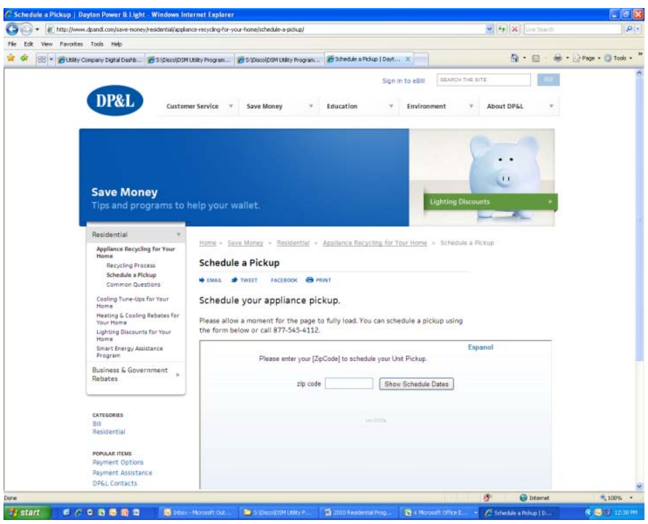
Sears Partnership

In 2013, DP&L continued its partnership with Sears retailers. Sears is a leading retailer of new refrigerators and freezers, and offers a home delivery service of customer's new appliances. JACO teamed up with Sears outlets across the country to offer a joint delivery of a new appliance along with a pick-up of an old appliance.

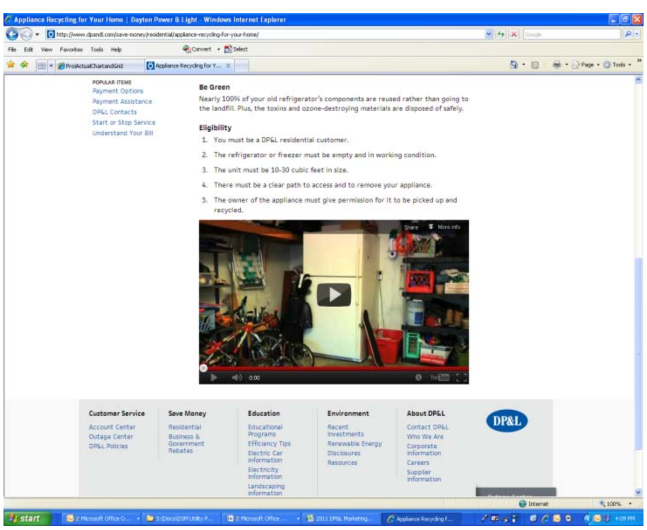
When a customer purchases a new refrigerator or freezer and is looking to get rid of an old appliance, the Sears sales representative will help him/her to register for participation in the DP&L appliance recycling program via an in-store computer kiosk. When the Sears crew member delivers the new appliance, he will confirm that the old appliance is working and meets the requirements of the DP&L program. The appliance will then be transported to a warehouse where it will be stored until JACO can perform a mass collection of appliances from the warehouse. This partnership offers an added convenience for customer participation. This service is marketed through signage on new appliances for sale in the Sears stores and mainly through Sears sales representatives. In 2013, 283 units were picked up through the Sears partnership.



Customer Web Pages
The appliance recycling program landing page gives a description of the program and allows customers to navigate to other pages for more information.



Online Registration
Online registration allows customers to schedule a pick-up at their home.



YouTube Video
The YouTube video, produced by DP&L and posted on the appliance recycling program landing page, educates customers about the savings opportunity from recycling an old fridge.

Bill Insert
Bill inserts were mailed to 450,000 customers in February and August.

Bill Insert
Bill inserts promoting the oldest refrigerator contest were mailed to 450,000 customers May through July.

Newspaper Advertisements
DP&L ran a series of newspaper advertisements to promote the oldest refrigerator contest May through July.

Flyer
Program fliers were distributed to customers at community outreach events attended by the residential lighting program field staff, creating promotional efficiencies among programs.

Truck Sign
This sign, 253' x 90', was displayed on the sides of each JACO truck which performed pick-ups in DP&L neighborhoods.

Education, General Awareness
DP&L conducted a mass media education and general awareness campaign promoting the value of energy efficiency and the available residential programs. A complete discussion of this campaign can be found in the Education, Awareness Building & Market Transformation section.

Customer Service
In all programs, customer service is a critical element of program success. As such, DP&L designed a number of customer service elements into its program, some of which have been previously discussed.

The web portal and online registration tool serves as a convenient way for customers to learn about the program and schedule a pick-up of their appliance. Customers are able to search for times when a JACO crew will be working in their area and select the date of their choice for a pick-up. In 2013, 26 percent of appointments were scheduled via the online registration tool.

For those without internet access, or for customers who wanted to talk to a representative, DP&L set up a program hotline number staffed by JACO employees. The staff has been trained to answer detailed questions about the Residential Appliance Recycling Program and to assist customers in scheduling appointments. Seventy-four percent of appointments were scheduled via the phone.

DP&L maintains its own customer service center, accepting calls regarding all functions of DP&L. DP&L management staff continues to update customer service center staff regarding program details as needed.

Customers' appliances were picked up an average of 12 days from the time the appointment was scheduled. In addition, JACO crews conveniently retrieved the appliances from hard-to-access locations, like basements; the customer needed only to clear a path to the appliance.

For the customer's convenience, JACO crews called 24 to 48 hours before the appointment date to confirm a four-hour window for the pick-up. On the day of the appointment, JACO crews called the customer 30 minutes prior to the expected arrival time.

The timeliness of the rebate check was a priority, with checks processed and mailed an average of 21 days from the appliance collection date. Customers were paid via check mailed directly to their homes. Check processing was managed by JACO.

The continuation of the partnership with Sears was an added customer service, increasing the convenience of customer participation. The Sears partnership is discussed in detail in the Marketing section.

RESIDENTIAL SCHOOL EDUCATION

PROGRAM DESCRIPTION

The School Education Program is designed to educate students about energy and energy efficiency, and reduce electricity use of program participants. Take-home energy savings kits are provided to students as well as accompanying classroom curriculum that is aligned with national and state education standards. Additional training events are held throughout the year for both teachers and students. This program is delivered jointly with the local gas company in order to educate students about using both gas and electricity efficiently.

The objectives of the program are to: 1) reduce electricity use of program participants in selected schools; 2) educate students and their families about energy, energy efficiency, and the effects of their energy usage decisions; and 3) create energy awareness among students that will promote energy efficient habits throughout their lives.

The Residential School Education Program is available to school districts in the DP&L service territory.

This portfolio status report discusses and reports savings for the 2012-13 school year only. Results for the 2013-14 school year will be presented in the 2014 annual portfolio status report.

PERFORMANCE SUMMARY

During the 2012-13 school year, 9,003 energy savings kits were distributed to teachers and taken home by students. Savings garnered via the installation of compact fluorescent bulbs, LED night lights, faucet aerators and energy efficient showerheads provided in students' take-home kits were gross annualized energy savings of 3,647 MWh and peak demand savings of 0.23 MW.

Since a central element of this program is educational, it is important to also measure the performance of the program based on participant feedback and educational impact. OEP conducted surveys of participating teachers. Survey results are as follows:

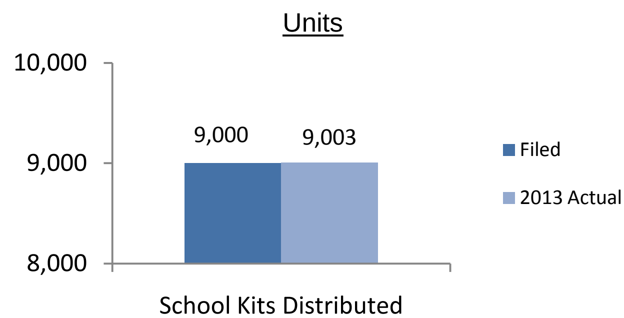
- Students' energy knowledge before and after the training showed a 75 percent average improvement in test scores.
- Teachers rated the overall quality of the program a 6.5 out of 7.
- Students rated the overall quality of the program a 6 out of 7.
- Teachers rating of the unit's ability to change student and family attitudes about energy conservation and efficiency: 6.3 out of 7.

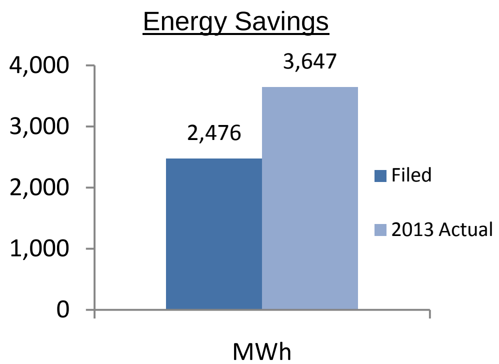
These are a few comments from participating teachers regarding the program:

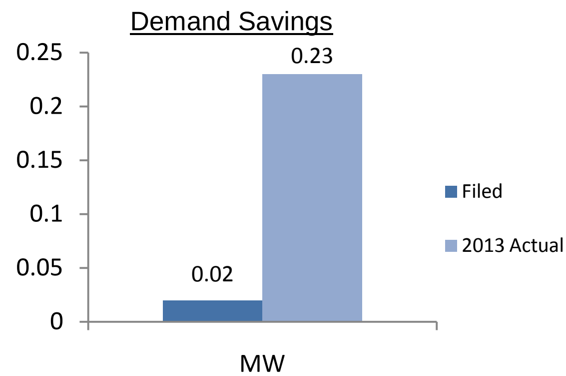
- Program is very worthwhile and organized.

- Very awesome program! Great people/staff to work with; materials and activities are great.
- I love every OEP/DPL program I've attended. I think this was a great experience for the students and teachers.
- DP&L is spending their money to support future energy leaders.
- Being customers of DP&L, I think this speaks well to their commitment to the community.
- We will use all of the materials! Love being able to show the students how to be stewards of the earth!

2013 Performance







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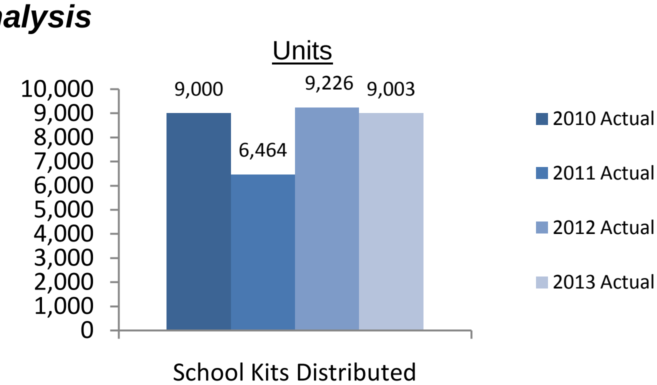
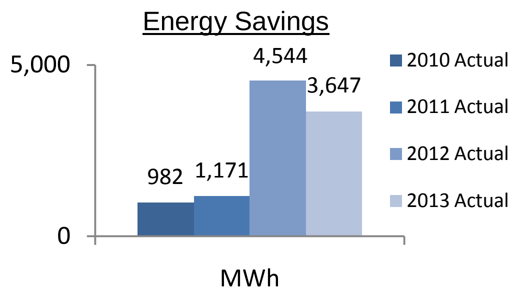
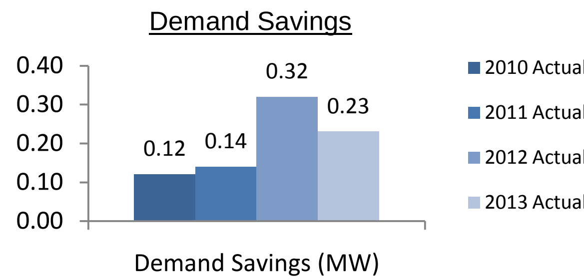
Four-Year Trend Analysis







Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$81,077	$78,298
Marketing & Admin	$201,062	$139,535
Total Costs	$282,139	$217,833

IMPLEMENTATION REVIEW

Implementation Strategy

Implementing a school education program requires expertise of education standards and teachers methods, as well as relationships with school district administrators and teachers. As such, DP&L determined that a third party implementation partner, specializing in this area, provided the best means of effectively managing the program.

DP&L selected Ohio Energy Project (OEP) as its implementation partner. OEP is uniquely qualified to provide energy efficiency education based on its existing relationships with school districts and experience delivering similar programs throughout Ohio. OEP is currently operating the same type of program for AEP Ohio.
DP&L has partnered with Vectren and OEP to deliver a school program which addresses both electric and natural gas savings. The joint effort with Vectren was pursued with the encouragement of DP&L's energy efficiency collaborative.

Targeted Products

Participating teachers were provided energy savings kits to be sent home with each participating student. Each component of the take-home kit was discussed in the classroom, informing students how to properly install and use the item, as well as the way it helps save energy. As a result of our partnership with Vectren, kit components address electric, gas, and water savings.

Each teacher was provided with a complete curriculum designed to accompany and educate students about the items contained in the take-home energy savings kit. The curriculum included classroom activities, experiments, and games, all meeting state of Ohio education standards. The curriculum also covered subjects like properties of energy, electric generation fuel sources, home energy audit suggestions, appliance energy usage comparisons, CFL versus incandescent cost comparisons, home temperature measurement exercises, and weatherization information.

In addition, teachers were given materials needed to complete experiments and activities, such as six Kill-A-Watt Meters, two radiometers, one canister of coal, two glow sticks, one pair of “Blaster Balls”, one circuit ball, and one flashlight.

Take-Home Kit Contents

Item	*Description*
1 14W Bright White CFL	Long-life light bulb with up to 75% energy savings. Lasts 10 times longer than an incandescent bulb. White color tone.
1 13W Soft White CFL	Long-life light bulb with up to 75% energy savings. Lasts 10 times longer than an incandescent bulb. Yellowish color tone.
Furnace Filter Whistle	Snap this product onto furnace filters to hear a whistle when the filter is full and needs replaced.
Foam Weather-Strip	Adhesive backed weather stripping, good for sealing out drafts in doors and windows.
Self-Stick Door Sweep	Adhesive-backed PVC door sweep. Seals door gaps and prevents drafts.
Flow Meter Bag	Test your water faucets to see how much water they use.
Earth Massage Showerhead	This product saves water and the energy required to heat the water.
2 Bathroom Sink Aerators	Consistent water pressure from a bathroom sink aerator. This product saves water and the energy required to heat the water.
1 Kitchen Sink Aerator	Consistent water pressure from a kitchen sink aerator. This product saves water and the energy required to heat the water.
Refrigerator Thermometer Card	Credit card-sized measuring device to determine whether refrigerator is at an efficient temperature.
LED Night Light	Light Emitting Diode (LED) technology creates suitable yet energy efficient light.
Self-Stick Energy Use Gauge Thermometer	Helps measure savings for heating and cooling costs.
Hot Water Temperature Card	Credit card-sized device measures the temperature of hot tap water. Card provides suggested range for setting water heater temperature to optimize efficiency.
DP&L Residential Energy Efficiency Programs Flier	Handout describing DP&L’s energy efficiency programs which can help save energy and money.
CFL Recycling Brochure	Brochure explaining the small amount of mercury in CFLs and proper disposal methods.

Sample In-Class Activity

LET'S COMPARE !
10,000 Hours of Light

CFL (Compact Fluorescent Lightbulb)	Incandescent Bulb
 23w	 100w
Amount of light = 1700 lumens	Amount of light = 1585 lumens
Power in watts = 23 watts	Power in watts = 100 watts
Lifespan = 10,000 hours	Lifespan = 750 hours
Bulbs needed for 10,000 hours? 1	Bulbs needed for 10,000 hours? 13
Cost per bulb = $ 2.50	Cost per bulb = $ .26
Total bulb cost for 10,000 hrs? **$ 2.50**	Total bulb cost for 10,000 hrs? **$ 3.38**
23 watts X 10,000 hours = 230,000 watthours	100 watts X 10,000 hours = 1,000,000 watthours
Kilowatthours (kWh)? 230 kWh	Kilowatthours (kWh)? 1000 kWh
Cost per kWh = $ .10	Cost per kWh = $ .10
230 kwh x $ .10 /kwh = $ 23.00	1000 kwh x $ .10 /kwh = $ 100.00
Cost of electricity for 10,000 hours **$ 23.00**	Cost of electricity for 10,000 hours **$ 100.00**
Total cost for 10,000 hours = $ 2.50 + $ 23.00 = **$ 25.50**	Total cost for 10,000 hours = $ 3.38 + $ 100.00 = **$ 103.38**

SAVINGS = $103.38 - $ 25.50 = $\boxed{\$77.88\ !}$

This Energy Efficiency Education Curriculum written by OHIO ENERGY PROJECT-Teacher Guide 16

Targeted Locations
The program was offered to school districts across DP&L's service territory, grades 5-12. One hundred and twenty four teachers participated from 80 schools in 46 school districts. Participating school districts were located in 16 counties in DP&L's service territory.

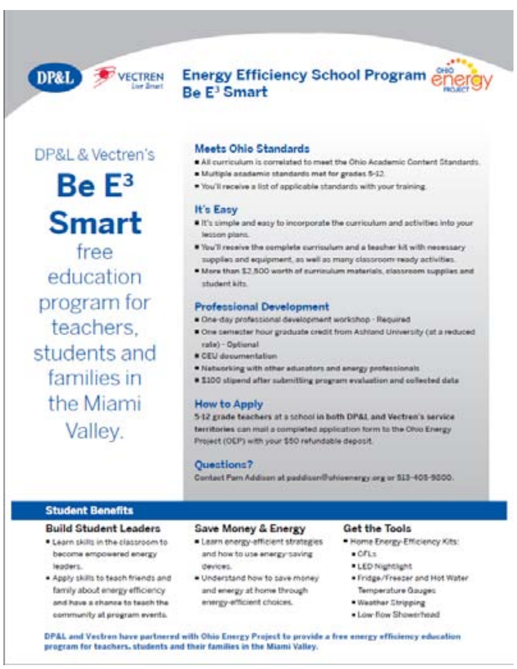
Staffing

The program is implemented by Ohio Energy Project. OEP maintains offices in Columbus and Cincinnati. One program manager, based in the Cincinnati office, served as DP&L's primary point-of-contact and program coordinator. The OEP program manager regularly communicated with the DP&L program manager to coordinate logistics and ensure that the program is on track to meet targets. The OEP program manager also coordinates all the project's tasks and serves as the hub of communication to all OEP staff in management, accounting, and program operations.

Marketing

For purposes of recruitment for program participation, limited marketing activities were performed by DP&L. OEP recruited participants by distributing a flyer and program application, produced by DP&L, to school administrators, curriculum coordinators, and teachers. OEP also promoted the program at workshops, tours, and conferences throughout the year. Recruitment efforts emphasized the educational value of the program as well as the availability of the energy savings materials.

DP&L worked with school districts to promote the activities and educational impacts of the program. Press releases were distributed throughout the year and media was invited to attend program events. DP&L also provided customizable news releases to teachers so that school districts could tell their specific educational story to their local newspaper.



Program Flyer/Application
OEP distributed program flyers and applications to school administrators, curriculum coordinators, and teachers.

Television Stories
Local media regularly responded to DP&L's invitations to attend school program events.

DP&L donates energy kits to ABMS

Submitted photo

Students in Nicki Bowser's seventh-grade Arcanum science class conducted a unit on energy. The program was called Be E3 Smart (energy efficiency education) and was funded by Dayton Power and Light. Bowser attended a training workshop to help assist students in meeting the state of Ohio energy science curriculum standards. During this unit, students learned how energy is produced and used. They also learned ways to conserve energy and increase energy efficiency in their own homes. With the help of Dayton Power and Light, Bowser was able to send home an energy saving kit with every seventh-grader. The kits contained four CFL light bulbs, an LED night light, an energy savings booklet, a hot water tester, room temperature tester, and refrigerator/freezer tester. All of the items were designed to help reduce electricity and fuel usage in their homes. The students conducted experiments at home with their parents in order to do this. Shown with kits are Maria Brehm, Austen Hittle, Alan Evans, Kate Summers and Kristin Moore. A special thank you goes to Dayton Power and Light for their generosity in helping try to save energy.

School District News Coverage
School districts submitted photos and students' names to their local newspaper.

Customer Service

In all programs, customer service is a critical element of program success. This program lends itself well to customer service due to the breadth and depth of program elements provided for customers, at no charge. More than 9,000 DP&L customer families were impacted by the free energy savings measures provided through the take-home energy savings kits. Students and their families were served through the educational lessons and take-home materials designed to help them know how to make smart energy usage decisions.

Participating teachers were provided with free teaching materials to use in the classroom. All materials were laminated and ready to use, which removed the legwork for teachers. Classroom activities help teachers to "bring science to life" and connect students to the material in new ways.

Hundreds of students and teachers were provided with unique opportunities to attend trainings sessions at DP&L, the University of Dayton, and other energy-related facilities throughout the region.

The OEP program manager was available to participating teachers as their direct point-of-contact for questions or issues with program materials or lessons.

RESIDENTIAL LOW INCOME AFFORDABILITY

PROGRAM DESCRIPTION

Through the Residential Low Income Affordability Program, home energy audits and inspections are conducted, and cost-effective efficiency measures are installed for qualifying customers. Two categories of eligible measures are available to customers, depending on whether their home is heated or cooled with electricity. A limited number of health and safety measures may also be addressed through the program.

The objective of the Low Income Affordability Program is to identify and implement energy efficiency measures for qualifying homes, reducing the home owners' electric bill and saving energy. The program has the secondary benefit of reducing customer arrearages, which can help save money for all customers.

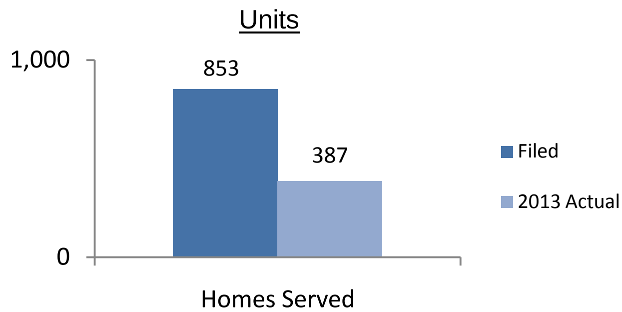
This program is available to low-income residential electric customers within the DP&L service territory with household incomes equal to or less than 200 percent of the federal poverty level or who are qualified and approved for one of the following: the Ohio Home Weatherization Assistance Program (HWAP), the Percentage of Income Payment Plan (PIPP), or the Home Energy Assistance Program (HEAP). Eligible households include single-family and multi-family homes. This program is available to all qualifying electric customers taking delivery service from DP&L, regardless of their choice of generation supplier.

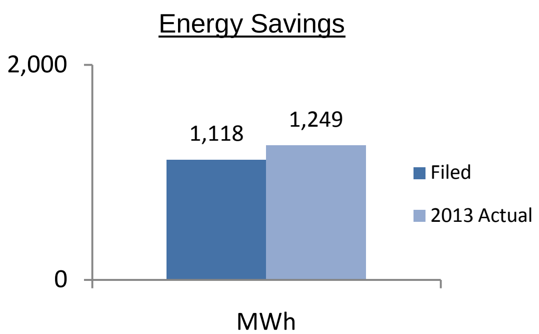
The program is implemented by the Ohio Partners for Affordable Energy (OPAE) through community action agencies located in DP&L's service area.

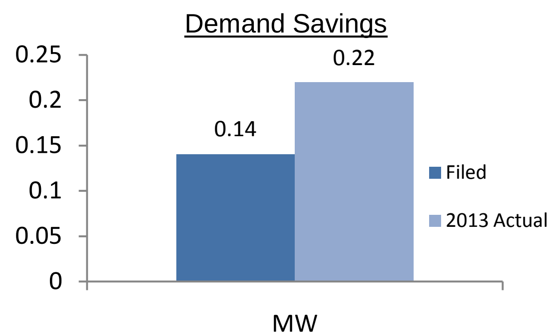
PERFORMANCE SUMMARY

During 2013, 387 customers' homes throughout the DP&L service territory were served through this program, resulting in gross annualized energy savings of 1,249 MWh and peak demand savings of 0.22 MW.

2013 Performance

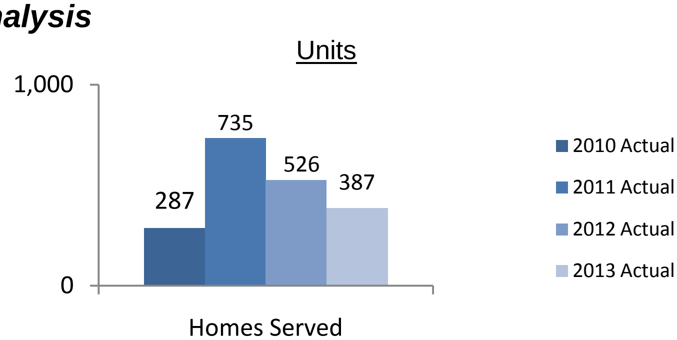


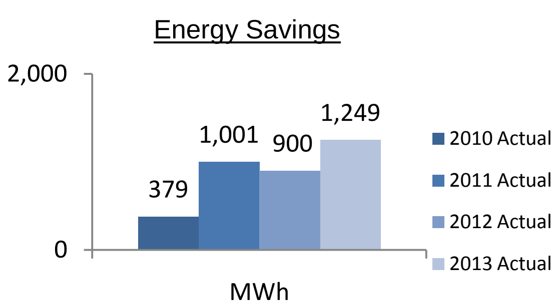


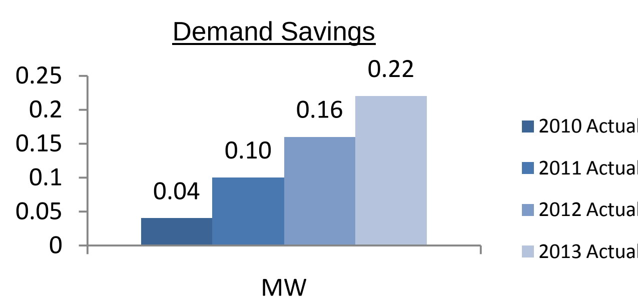


All “filed” numbers are taken from DP&L’s program portfolio filing; Case No. 08-1094-EL-SSO.

Four-Year Trend Analysis







Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$905,117	$885,507
Marketing & Admin	$229,906	$221,757
Total Costs	$1,135,023	$1,107,264

IMPLEMENTATION REVIEW

Implementation Strategy
DP&L has partnered with Ohio Partners for Affordable Energy (OPAE), based in Findlay, Ohio, to bring low-income customers the benefits of this program. OPAE implements this same type of program for FirstEnergy and AEP.

The program is provided to eligible customers at the same time (piggyback) as OPAE and subcontracting agencies deliver other state, utility, and community-based weatherization and energy efficiency services. The piggyback approach is designed to save administrative costs and provide more benefits in a timely, cost-effective manner.

Targeted Products
OPAE or subcontracting agencies may begin their work with a home audit to determine necessary measures. For the customers who heat or cool their homes with electricity, eligible measures may include ceiling and perimeter insulation and duct sealing or insulation. For all other customers, eligible measures may include: installation of energy efficient light fixtures and light bulbs, and metering and replacement of inefficient or inoperable refrigerators and freezers.

DP&L places a high priority on safety. We recognize that certain weatherization and energy efficiency measures cannot be completed or installed because of unsafe conditions like faulty outlets or overloaded circuits. Therefore, electrical safety and health measures are available to eligible customers, regardless of the fuel used as the primary heating source. Health and safety measures cannot exceed 15 percent of total program costs and may include: replacement of outlets, switches, fuse boxes, circuit breaker boxes, and wiring; repair or replacement of roofs, sump pumps, and well pumps; hot water tank replacement; and replacement of inefficient electric stoves and electric dryers.

The total cost of health and safety repairs may not exceed 15 percent of the overall program budget. The cost of the efficiency solutions funded through this program can be a maximum for any single family home of $5,000, and a multi-family home of $50,000.

Targeted Locations
OPAE delivers the program through the community action agencies located in the DP&L service area. These agencies include Community Action Program of the Greater Dayton Area; Clinton County Community Action Program; Community Action Agency of Delaware, Madison, and Union Counties; Community Action Commission of Fayette County; Highland County Community Action Organization; Pickaway County Community Action Organization; SOURCES; Tri-County Community Action Commission of Champaign, Logan, and Shelby Counties. This ensures that customers throughout the DP&L service area will be reached through the program.

Staffing
The program is managed by OPAE through the community action agencies. OPAE is responsible for managing the relationships with the agencies to ensure that eligible work is being performed in eligible customers' homes. Through the agencies, OPAE ensures that the participating contractors are trained and certified to complete work according to the Weatherization Program Standards. The OPAE staff processes the paperwork and documentation from contracted agencies regarding completed jobs and jobs in progress. OPAE is also responsible for monitoring and reporting program performance.

Marketing
This program is marketed and delivered to clients of the community action agencies. In 2013, DP&L performed no additional marketing.

Customer Service
Due to the unique nature of the program, OPAE, through the community action agencies, is responsible for delivering the program in a high quality and cost-effective manner. OPAE is responsible for ensuring that all services, materials, and supplies are of good quality and installed in a professional, workmanlike way, and that all contractors are trained and certified to complete work according to the Weatherization Program Standards.

Using the existing network of community action agencies allows program resources to be effectively administered. DP&L funds are used to piggyback with currently existing programs, creating efficiencies in program delivery.

DP&L maintains its own customer service center, accepting calls regarding all functions of DP&L. DP&L management staff continues to update customer service center staff regarding program details as needed.

NON-RESIDENTIAL PROGRAMS

NON-RESIDENTIAL PRESCRIPTIVE REBATES

PROGRAM DESCRIPTION

The Non-Residential Prescriptive Rebate Program (Rapid Rebates® Program) provides non-residential customers with incentives for new equipment purchases that reduce energy consumption and demand. Technologies that are covered in the program include energy efficient lighting, HVAC, motors, drives and compressed air.

The objective of the program is to help business and government customers overcome the upfront cost hurdle associated with energy efficient technologies.

The Rapid Rebates® Program is designed for all DP&L business and government customers who purchase new energy efficient equipment through a manufacturer, distributor or contractor. All business and government customers taking delivery service from DP&L are eligible for this program regardless of their choice of generation supplier.

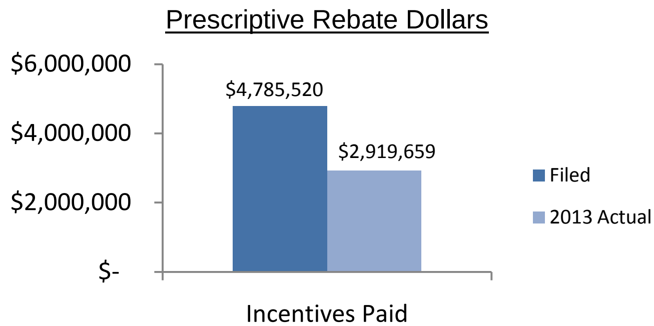
DP&L began accepting online Rapid Rebate® applications on April 1, 2009. In 2013, 129 unique measures were offered through the Rapid Rebates® Program. 97 of these were applied for and utilized by customers. In 2013, DP&L received 1,040 Rapid Rebate® applications, of which 597 were paid, 31 were denied approval or cancelled, and 412 applications were pending at the end of 2013.

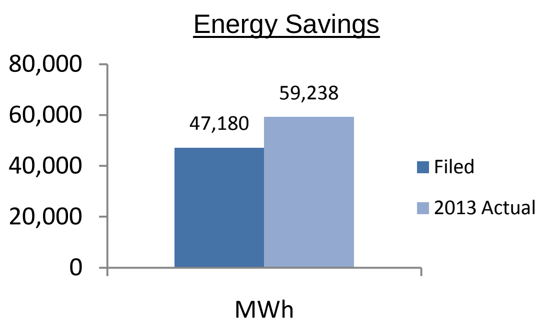
PERFORMANCE SUMMARY

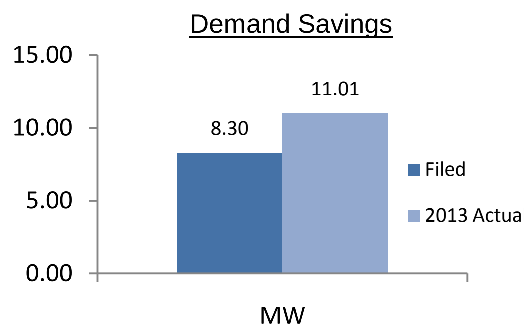
During 2013, DP&L paid $2,806,738 in Rapid Rebates® to business and government customers, resulting in gross annualized energy savings of 59,238 MWh and peak demand savings of 11.01 MW. Keys to the program's success include continued operation of a customer-friendly online application system, quality customer service and follow through, and strong relationships with Channel Partners.

It should be noted that five percent of savings and costs from the Residential Lighting Program have been reallocated to the Non-Residential Prescriptive Rebates Program. This is due to the fact that program evaluations and national trends suggest that five percent of bulbs in retail locations were purchased by non-residential customers. As such, all metrics in this section include a proportional five percent reallocation from the residential lighting program.

2013 Performance

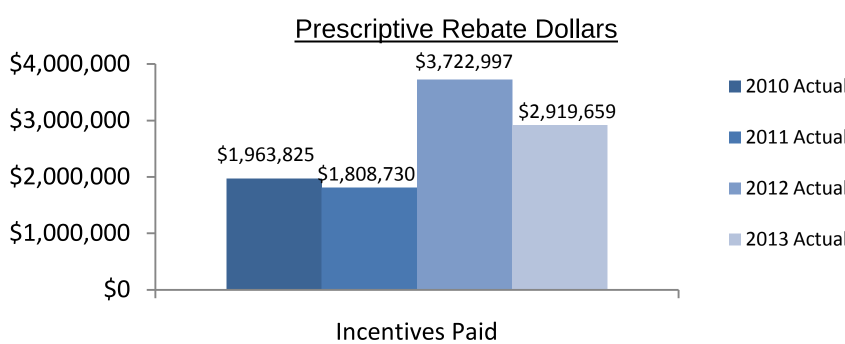


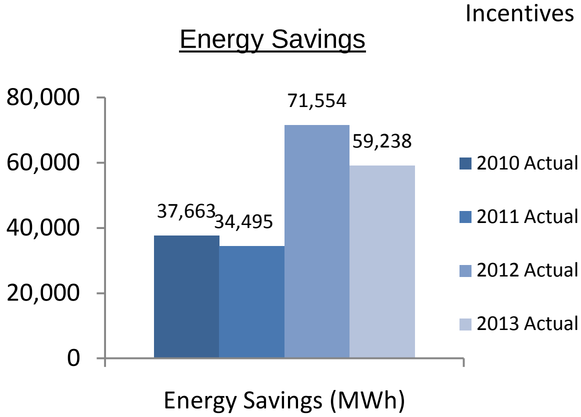


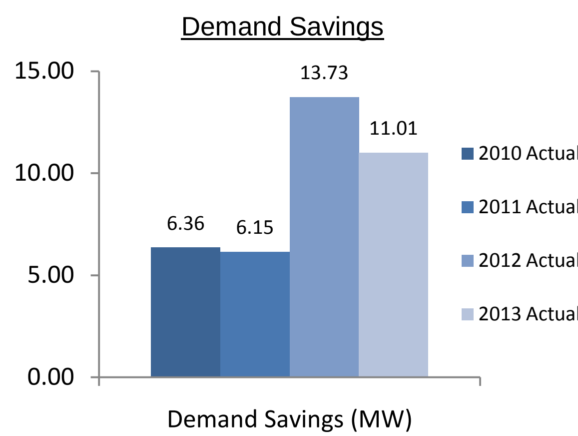


All "filed" numbers are taken from DP&L's program portfolio filing; Case No. 13-0833-EL-POR.

Four-Year Trend Analysis







Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$4,785,520	$2,919,659
Marketing & Admin	$956,049	$669,590
Total Costs	$5,741,569	$3,589,249

IMPLEMENTATION REVIEW

Implementation Strategy

Since 2009, DP&L has implemented and managed the prescriptive rebate program internally. DP&L chose this course of action, as opposed to hiring an outside implementer, for several reasons. First, implementing the program in-house significantly strengthens DP&L employee knowledge of energy efficiency programs and technologies. Second, it provides DP&L with the opportunity to build relationships with contractor networks and customers, leading to quality customer service. And third, unlike the residential programs, we do not believe that a third party rebate provider adds significant value at this point in the program lifecycle. Potential rebate volume for business customers is lower than for residential customers, and DP&L continues to be able to process this lower volume of rebates internally.

Targeted Products

DP&L's prescriptive rebate program was designed to provide business and government customers with an extensive choice of energy efficient, retrofit opportunities. In 2013, 129 unique measures were available for Rapid Rebates®. This extensive list broadens the number of customers who can potentially participate in programs. The list of measures was developed based on industry-accepted standards for high efficiency equipment and the associated energy and demand savings. Rebate checks disbursed to customers ranged from $6.75 to $77,620.

Prescriptive Rebate Allocation

Product Type	Rebate Dollars Paid	Energy Saved (MWh)	Demand Saved (MW)
Lighting	$2,034,273	44,855	8.35
HVAC	$419,679	5,175	1.24
Motors, Drives & Compressed Air	$454,402	9,195	1.42
Other	$11,305	13	0

DP&L does not endorse any equipment manufacturers or suppliers in the prescriptive rebate program. Business and government customers may purchase any brand of equipment from any supplier they choose, as long as the equipment is new and meets the eligibility requirements detailed on the measure lists. Additionally, equipment must use electricity as the fuel source and be replacing existing equipment or be installed as part of a retrofit project.

Application Process

DP&L's prescriptive rebate application process was designed to be customer friendly and comprehensive. The application is completely online which makes it convenient for customers and efficient for program control purposes. The application consists of three pages. The first page asks for basic customer information such as company name, address, installation address, DP&L account number, facility type and hours of operation, tax ID and contractor contact information. On the second page, customers choose from a drop-down list of measures, enter the manufacturer and model numbers, and input the appropriate quantities. The third page allows customers to upload supporting documentation to their application, such as specification sheets, engineering calculations and invoices. When the customer has entered all measures for which they are applying, they "submit rebate" and receive a confirmation number. When customers or contractors have questions, DP&L staff is available to guide them through the process.

The online Rapid Rebate® application is electronically submitted to DP&L for review. Applications must be complete and include the necessary contact information, equipment specification, and equipment costs. DP&L then reviews the application, verifies the information provided, and sends a confirmation email that the application has been approved. If the application has been approved, the funds will be reserved. Program guidelines request the customer or vendor provide DP&L with proof of purchase within 60 days of the approval notification. Proof of purchase may come in the form of an invoice, purchase order or other supporting document. If proof of purchase is not received, DP&L reserves the right to remove the fund reservations. Applicants can reapply for rebates but they will be placed in the back of the queue. The equipment should be installed and ready to operate within 120 days of application approval and DP&L must be notified of the installation. DP&L must be provided with a final invoice reflecting the true costs of purchasing and installing the energy savings measure (including all materials, labor, and equipment discounts) as well as equipment serial numbers. If the installation does not occur within 120 days, the customer may request an extension from DP&L using the Online Extension Request Form. Extension requests are handled on a case by case basis. DP&L releases the rebate funds to the customer or the assigned vendor within approximately 30 days of receiving the verification of installation.

DP&L reserves the right to inspect the installed measure(s) prior to releasing any funds to ensure compliance with the program terms and conditions. A verification audit is performed on every prescriptive rebate greater than $10,000. Additionally, DP&L audits a random sampling of rebates less than $10,000. In 2013, 8.5 percent of Rapid Rebates less than $10,000 were audited. The breakdown in the number of audits performed is as follows:

Rebate Value	Lighting	HVAC	Motors	Other
>$10,000	31	11	13	0
<$10,000	71	8	4	1
% audits	12.2%	16.0%	21.0%	12.5%

In addition to the internal staff, third party engineers and contractors are utilized to perform pre- and post-installation verification audits for a sampling of projects rebated through the prescriptive rebate program.

Staffing
DP&L has four program managers to manage the business rebate programs, including the prescriptive rebate program, and serve as DP&L's direct point-of-contact with customers. The internal staff is responsible for reviewing, approving and processing rebate applications. They track and report all incentive dollars as well as energy and demand savings. The staff is also responsible for promoting the program to customers through a variety of marketing tools and business and community events.

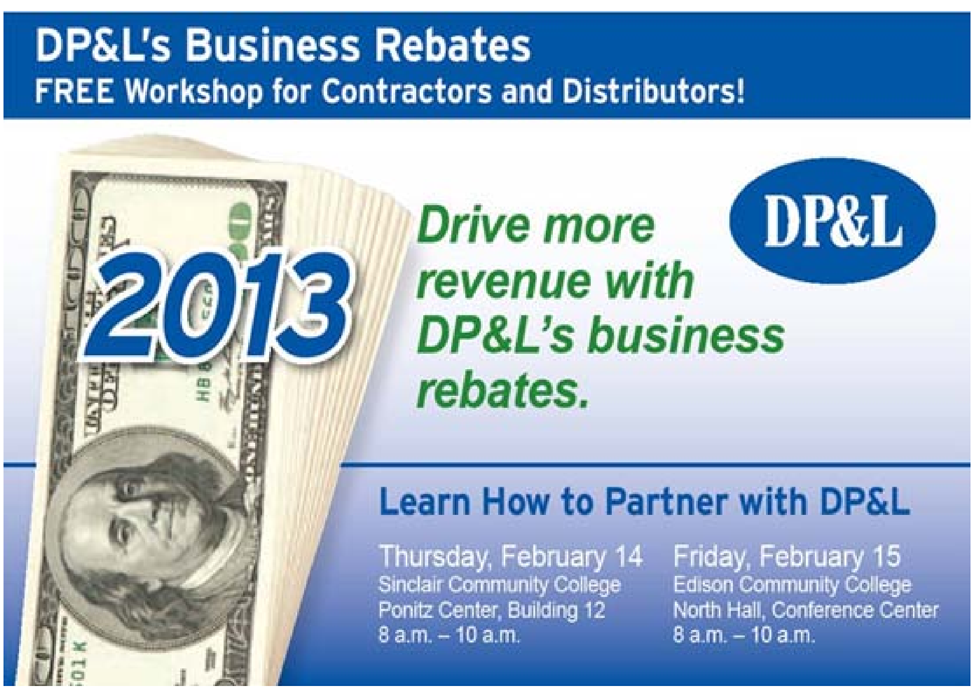
Marketing
In order to promote the prescriptive rebate program to business and government customers, DP&L employed a variety of marketing methods. These methods included publication of program information on the company website, print literature, bill inserts, inserts in local business journals, presentations at community- and vendor-sponsored events, one-on-one marketing by DP&L major account managers, and the continued utilization of a Channel Partner network.

Channel Partners are contractors, engineers and distributors with energy efficiency experience. They have participated in DP&L rebate workshops and are familiar with using DP&L rebate programs to help customers save money. Channel Partners are viewed as an invaluable third party "marketing extension" of DP&L's internal group of program managers. They have direct contact with customers on a daily basis and can influence the customer's purchasing decisions. Of the $2,807,738 in prescriptive incentives paid to customers in 2013, Channel Partners were involved in securing $1,590,476 or 57 percent of those dollars.

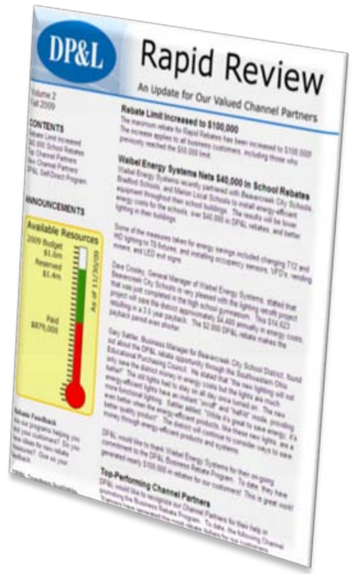
In 2013, DP&L also conducted a fall business ad campaign. Local businesses who had participated in the Rapid Rebate Program were featured in "Do the Math" ads. Featured businesses included an ice cream shop, a daycare center, a party supply store, a commercial high rise and an industrial paper company. The mass media campaign ran from October through December and consisted of print ads, radio ads, static and animated web ads, bill inserts, banners on the company web site, and targeted customer emails.

Concurrent with the business ad campaign, Channel Partners were offered 3X Channel Partner Rewards (see **Customer Service**) in the fourth quarter. To assist in the sales effort, Channel Partners were also given access to a micro-site where they could order co-branded print materials, free of charge, to distribute to their customer base.

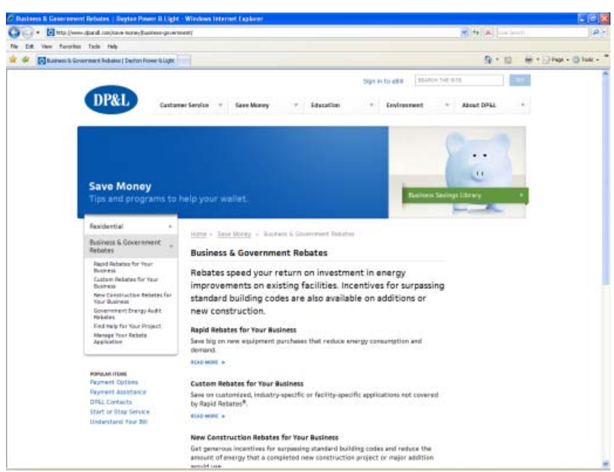
Fall 2013 Business Campaign Ran from October through December, 2013



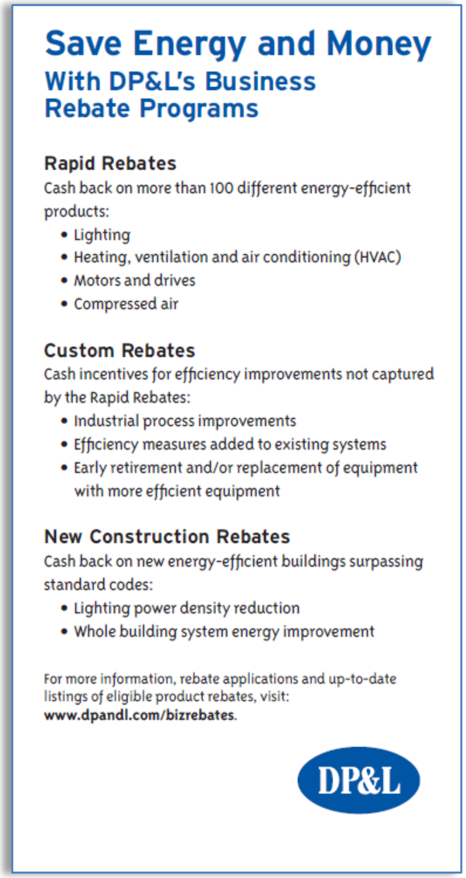
Channel Partners Channel Partners participate in DP&L rebate workshops and are familiar with using DP&L rebate programs to help customers save money.



Newsletter
Channel Partners are kept up-to-date on program news and changes through a quarterly Channel Partner newsletter, the “Rapid Review.”



Web Portal
The Business Rebates pages on the DP&L website give a description of the prescriptive rebate program and allow customers to navigate to other pages for more information or apply online for a rebate.


Save Energy and Money
With DP&L's Business Rebate Programs

Rapid Rebates
Cash back on more than 100 different energy-efficient products:
- Lighting
- Heating, ventilation and air conditioning (HVAC)
- Motors and drives
- Compressed air

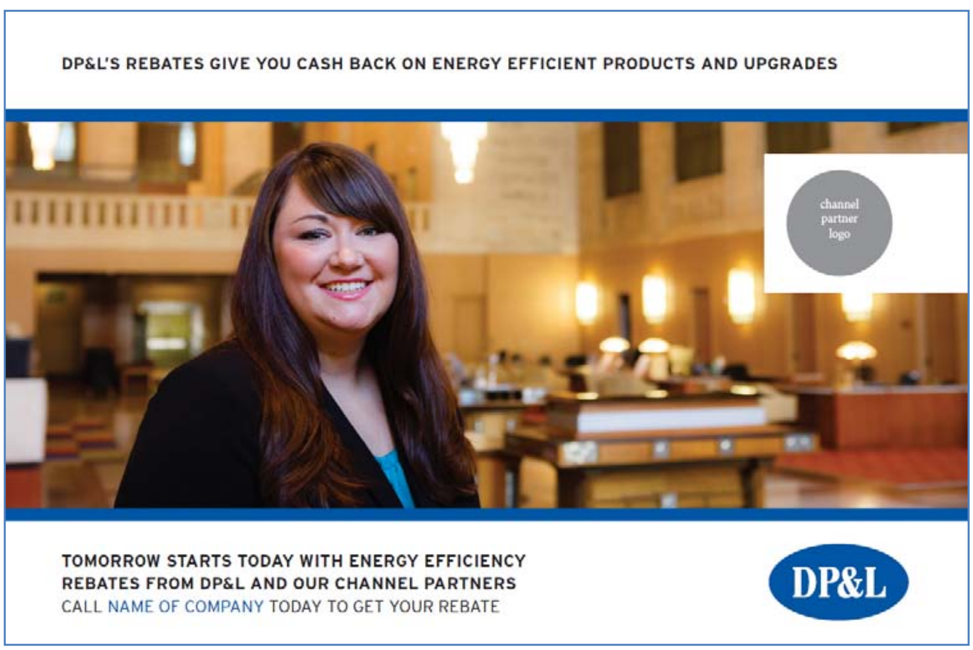
Custom Rebates
Cash incentives for efficiency improvements not captured by the Rapid Rebates:
- Industrial process improvements
- Efficiency measures added to existing systems
- Early retirement and/or replacement of equipment with more efficient equipment

New Construction Rebates
Cash back on new energy-efficient buildings surpassing standard codes:
- Lighting power density reduction
- Whole building system energy improvement

For more information, rebate applications and up-to-date listings of eligible product rebates, visit:
www.dpandl.com/bizrebates.

DP&L

Bill Insert
Bill inserts were mailed to 50,000 customers in April 2013.



Channel Partner Co-Branding
Channel Partners could order co-branded postcards, rack cards or flyers, free of charge, for distribution to their customers.

Print Ads

The Business Rebate programs were advertised through placement of ads in local and regional magazines and newspapers, including Dayton Daily News, which has a circulation of over 100,000.

Event Sponsorships

DP&L Business Programs frequently sponsor and participate in community- and vendor-sponsored events. Events in 2013 included: DRG3 Sustainability Coordinator Luncheons, Dayton Green Expo and numerous Channel Partner training and customer appreciation events.

Print Literature
DP&L used standard print materials for hand outs at meetings with customers and at a variety of speaking events.

OHIO HOSPITAL ASSOCIATION

Collaborative Partners
DP&L continues to work with its collaborative partners to promote programs. For instance, DP&L is working with the OHA to promote programs to area hospitals.

Customer Service
In all programs, customer service is a critical element for success. As such, DP&L designed a number of customer service elements into the Prescriptive Rebate Program, some of which have been previously discussed.

The Rapid Rebate® section of the DP&L website acts as the main information portal for customers, contractors, distributors and other program participants. It contains a listing of all eligible measures and the rebate amounts, as well as access to the online application. The online application process is akin to online shopping. When the customer has entered all measures for which they are applying, they "submit rebate" and receive a confirmation number. The confirmation number allows the customer access to their application's status, the ability to upload documents to their application, and the ability to assign their rebate to a vendor.

In addition to being an effective means of marketing the program, Channel Partners are also a valuable resource for delivering the program to customers in a quality manner. Channel Partners are trained on both the measures that are rebated through the program and on the application process. Many Channel Partners have taken the rebate programs and used them to offer a "turn-key" experience for the customer, including the approximate rebates in customer quotes and applying for the rebates on behalf of customers. Through this process, customers can have confidence the proposed equipment will be eligible while allowing DP&L to work with the Channel Partner to clarify any issues that may arise. In short, the Channel Partners are an effective "middleman" for the program with proper upfront training and ongoing program communication.

To encourage Channel Partners to continue to provide excellent service to customers, the Channel Partner Rebate Rewards program was launched in 2011. Channel Partners who are listed on the rebate application are automatically enrolled. Once a minimum of $10,000 in DP&L Rapid Rebates® have been attributed to a Channel Partner, they begin to earn a cash bonus equal to 5 percent of the DP&L rebates paid to the customer. This incentivizes the Channel Partner to complete the rebate application for the customer. In 2013, DP&L paid $113,894 in Channel Partner Rebate Rewards.

As a quality control measure, the auditing process ensures that contractors and vendors are not misrepresenting the program. From a customer service perspective, customers appreciate and welcome the audit process, as it gives them unbiased energy savings data. They can use this data in submitting positive post-analysis reports on their capital projects.

To make communication convenient for the customer, the Business Programs staff maintains an Energy Efficiency Inbox, energyefficiency@dplinc.com, a clearinghouse for general program questions that business and government customers may have.

DP&L staffs its own business call center, the Business Solutions Center, catering to DP&L business customers and their billing and other general inquiries. DP&L Business

Program management staff conducted training sessions for business solutions center staff regarding energy efficiency program details. This was to ensure that DP&L phone representatives had a basic understanding of the program, could assist customers in navigating the website or point them to the Energy Efficiency inbox.

NON-RESIDENTIAL CUSTOM REBATES

PROGRAM DESCRIPTION

The Non-Residential Custom Rebate Program provides business and government customers with incentives for equipment purchases and industrial process improvements that reduce energy consumption and demand. Custom Rebates are for equipment that is not covered by DP&L's prescriptive rebate program and is generally best suited for customized industry-specific or facility-specific applications.

The objective of the program is to help business and government customers overcome the upfront cost hurdle associated with energy efficient technologies and to promote innovative and emerging technologies.

The Custom Rebate Program is designed for all DP&L business and government customers who purchase new energy efficient equipment through a manufacturer, distributor or contractor. All business and government customers taking delivery service from DP&L are eligible for this program regardless of their choice of generation supplier.

DP&L began accepting online Custom Rebate applications on April 1, 2009. In 2013, DP&L received 195 Custom Rebate applications, of which 55 were paid, 10 were denied approval, and 130 applications were pending at the end of 2013.

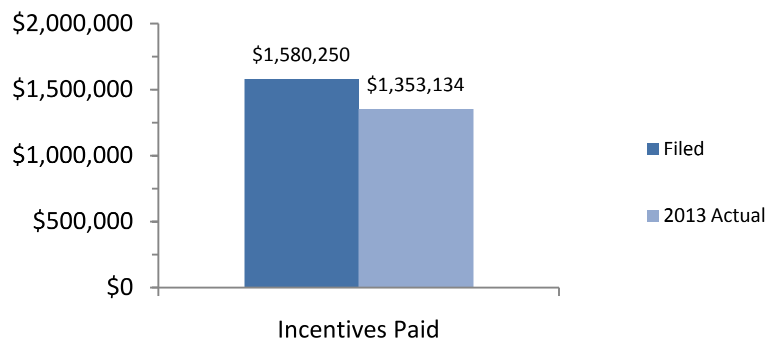
New Construction Rebates are included in the Custom Rebate Program. The New Construction Rebates promote energy efficient design strategies by incenting reductions in the amount of energy that a completed new construction project or major addition would use. In 2013, DP&L received 23 New Construction Rebate applications. These are in addition to the 29 New Construction Rebate applications received but not paid in 2010 through 2012. (New construction projects have lead times spanning multiple months.) Twenty of the outstanding 52 New Construction Rebates were paid in 2013, accounting for 4,395 MWh and 2.11 MW of annual savings.

The Government Audit Program is also funded through the Custom Rebate budget. All local governments with facilities served by DP&L are eligible to participate, including counties, municipalities, cities, villages, townships and public schools. The objective of the audit program is to help government customers understand how energy is being used, prioritize potential projects, calculate project paybacks and identify rebates for which they are eligible. DP&L reimburses 50 percent of the cost of the audit and will pay the remaining 50 percent if the customer implements electricity-saving projects within 1 year of the audit. DP&L does not supply the auditing services. Rather, customers can choose the third-party audit firm they would like to utilize. In 2013, eleven (11) entities applied for audits of 24 facilities. Since the program’s inception in September 2010, 92 facility audits have been completed.

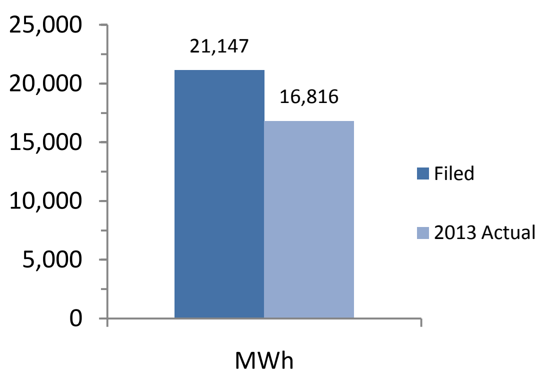
PERFORMANCE SUMMARY
During 2013, DP&L paid $1,353,134 in Custom Rebates to business and government customers, resulting in gross annualized energy savings of 16,816 MWh and peak demand savings of 3.43 MW. Keys to the program's success include continued operation of a customer-friendly online application system, quality customer service and follow through, and strong relationships with Channel Partners.

2013 Performance

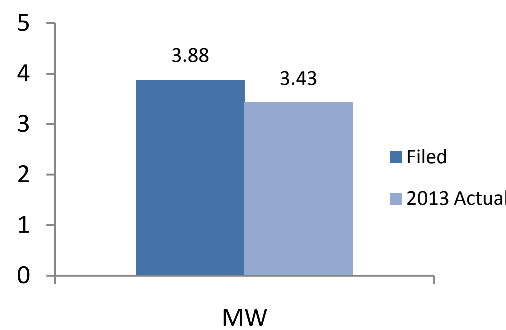
Custom Rebate Dollars



Energy Savings



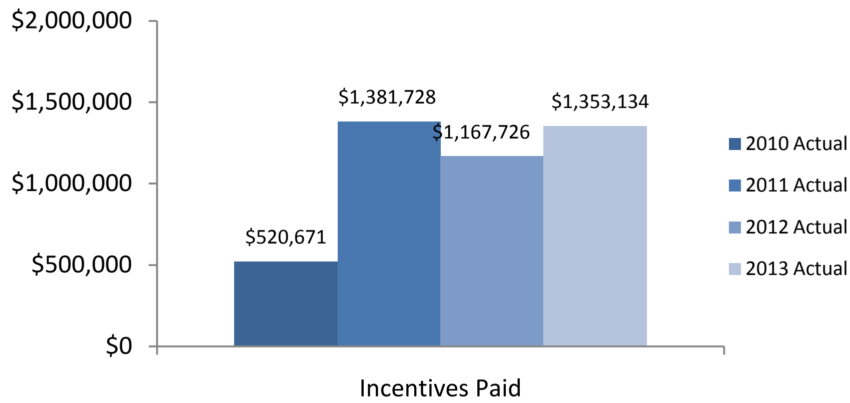
Demand Savings



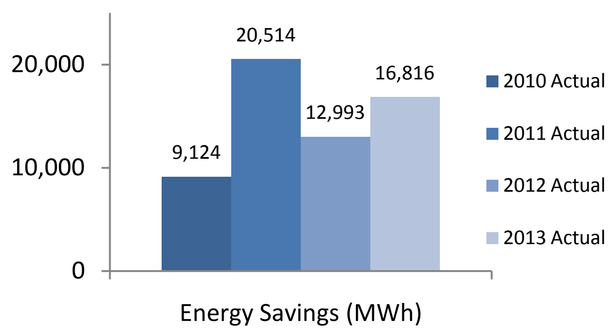
All "filed" numbers are taken from DP&L's program portfolio filing; Case No. 13-0833-EL-POR.

Four-Year Trend Analysis

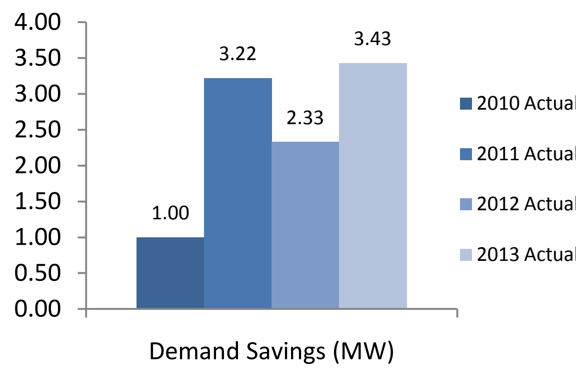
Custom Rebate Dollars



Energy Savings



Demand Savings



Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$1,580,250	$1,353,134
Marketing & Admin	$749,620	$571,635
Total Costs	$2,329,870	$1,924,769

IMPLEMENTATION REVIEW

Implementation Strategy

Since 2009, DP&L has implemented and managed the Custom Rebate Program internally. DP&L chose this course of action, as opposed to hiring an outside implementer, for several reasons. First, implementing the program in-house significantly strengthens DP&L employee knowledge of energy efficiency programs and technologies. Second, it provides DP&L with the opportunity to build relationships with contractor networks and customers, leading to quality customer service. And third, unlike with the residential programs, we do not believe that a third party rebate provider adds significant value at this point in the program. Potential rebate volume for business customers is lower than for residential customers, and DP&L continues to be able to process this lower volume of rebates internally.

Targeted Products

DP&L's Custom Rebate Program was designed to provide business and government customers with an opportunity to receive rebates for implementing innovative energy efficient emerging technologies and process improvements. Rebate checks disbursed to customers ranged from $117 to $124,415.

Custom Rebate Allocation

Product Type	Rebate Dollars Paid	Energy Saved (MWh)	Demand Saved (MW)
Lighting	$242,017	4,432	0.76
HVAC	$26,597	225	0.04
Other, includes: • Refrigeration measures • Multi-compressor compressed air systems	$555,528	7,764	0.52
New Construction	$528,992	4,395	2.11

In 2013, Custom Rebates were rebated per the following schedule:

Project Type	Rebate Calculation
Lighting	$0.05/kWh + $50/KW
HVAC	$0.10/kWh + $100/KW
Other	$0.08/kWh + $100/KW

DP&L does not endorse any equipment manufacturers or suppliers in the custom rebate program. Business and government customers may purchase any brand of equipment from any supplier they choose, as long as the equipment is new and meets the eligibility requirements. Equipment must use electricity as the fuel source and be replacing existing equipment or be installed as part of a retrofit project. Projects are required to have a payback of less than 7 years before rebates are applied. The 7-year maximum payback helps to promote cost effectiveness.

New Construction Rebates are calculated in one of two ways. The lighting power density (LPD) incentive encourages the inclusion or installation of lighting designs and equipment that provide quality lighting at lower installed wattages. The incentive is calculated on a per square foot basis for LPD performance exceeding ANSI/ASHRAE/IESNA Standard 90.1-2007.

$$\text{Incentive}_{\text{LPD}} = (\text{LPD}_{\text{baseline}} - \text{LPD}_{\text{actual}}) \times \text{area} \times \$0.30$$

Alternately, customers can choose to have their new building evaluated using the Whole Building Energy Performance Baseline Improvement method. This method incents customers who design their buildings to be more efficient than a baseline building constructed to ANSI/ASHRAE/IESNA Standard 90.1-2007. To be eligible for a whole building incentive, the customer must provide documentation of an energy model in accordance with ANSI/ASHRAE/IESNA Standard 90.1-2007, Appendix G. Incentives are calculated using the following incentive rate guidelines. To receive an incentive, a project must achieve an annual electric energy and demand savings of 5 percent or better than baseline.

Incentive Rate Guidelines		
First Year Annual Electric Reduction	**Energy Incentive Rate**	**Demand Incentive Rate**
5-10% over baseline	$0.05/kWh	$50/KW
>10% over baseline	$0.08/kWh	$75/KW
>20% over baseline	$0.10/kWh	$100/KW

Application Process

DP&L's custom rebate application process was designed to be customer friendly and comprehensive. The application is completely online which makes it convenient for customers and efficient for program control purposes. Customers must apply for a custom rebate prior to beginning their project. The pre-approval phase allows DP&L the opportunity to perform pre-installation auditing (in some cases, metering) of the affected systems. The application consists of three pages. The first page asks for basic customer information such as company name, address, installation address, DP&L account number, facility type and hours of operation, tax ID and contractor contact information. On the second page, customers enter a detailed project description, their baseline energy and demand usages, and their proposed energy and demand usages. The third page allows customers to upload supporting documentation to their application, such as specification sheets, engineering calculations and invoices. When the customer has input all their data, they "submit rebate" and receive a confirmation number. When customers or contractors have questions, DP&L staff is available to guide them through the process.

The customer or vendor completes the online Custom Rebate application and submits it electronically to DP&L for review. Applications must be complete and include the necessary contact information, equipment specifications, and equipment costs. Additionally, applicants must submit a full description of how the energy and demand savings were calculated. DP&L then reviews the application, verifies the information provided, and sends a confirmation email that the application has been approved. If the application has been approved, the funds will be reserved. Program guidelines suggest the customer or vendor provide DP&L with proof of purchase within 60 days of the approval notification. Proof of purchase may come in the form of an invoice, purchase order or other supporting document. If proof of purchase is not received, DP&L reserves the right to remove the fund reservation. Applicants can reapply for rebates but they will be placed in the back of the queue. The equipment should be installed and ready to operate within 120 days of application approval and DP&L must be notified of the installation. DP&L must be provided with a final invoice reflecting the true costs of purchasing and installing the energy savings measure (including all materials, labor, and equipment discounts) as well as equipment serial numbers. If the installation does not occur within 120 days, the customer may request an extension from DP&L using the Online Extension Request Form. Extension requests are handled on a case by case basis. DP&L releases the rebate funds to the customer or the assigned vendor within approximately 30 days of receiving the verification of installation.

DP&L reserves the right to inspect the installed measure(s) prior to releasing any funds to ensure compliance with the program Terms and Conditions. A verification audit is performed on every Custom Rebate greater than $10,000. Additionally, DP&L audits a random sampling of rebates less than $10,000. In 2013, 34.7 percent of rebates less than $10,000 were audited. The breakdown in the number of audits performed is as follows:

Rebate Value	Custom
>$10,000	31
<$10,000	26
% audits	53.8%

In addition to the internal staff, third party engineers and contractors are utilized to perform pre- and post-installation verification audits for a sampling of projects rebated through the custom rebate program.

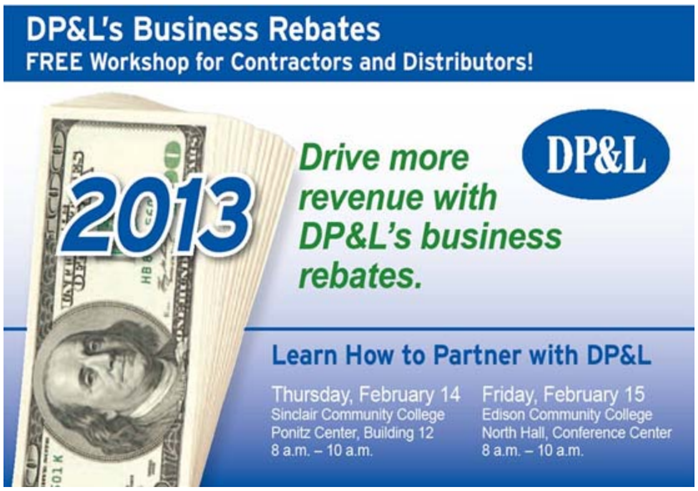
Staffing

DP&L has four program managers to manage the business rebate programs, including the Custom Rebate Program, and serve as DP&L's direct point-of-contact with customers. The internal staff is responsible for reviewing, approving and processing rebate applications. They track and report all incentive dollars as well as energy and demand savings. The staff is also responsible for promoting the program to customers through a variety of marketing tools and business and community events.

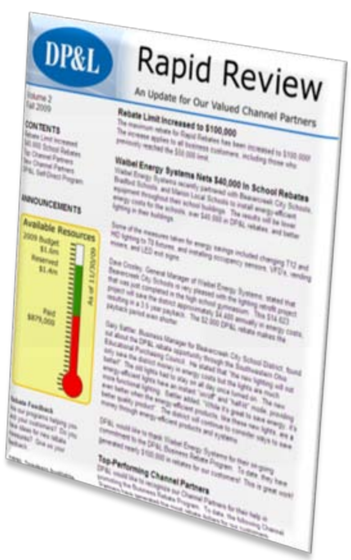
Marketing

For efficiency and cost-effectiveness purposes, DP&L often promoted the Custom Rebate Program as it promoted its Rapid Rebates. DP&L employed a variety of marketing methods, including publication of program information on the company website, print literature, bill inserts, inserts in local business journals, presentations at community- and vendor-sponsored events, one-on-one marketing through major account managers, and the creation of the Channel Partner network.

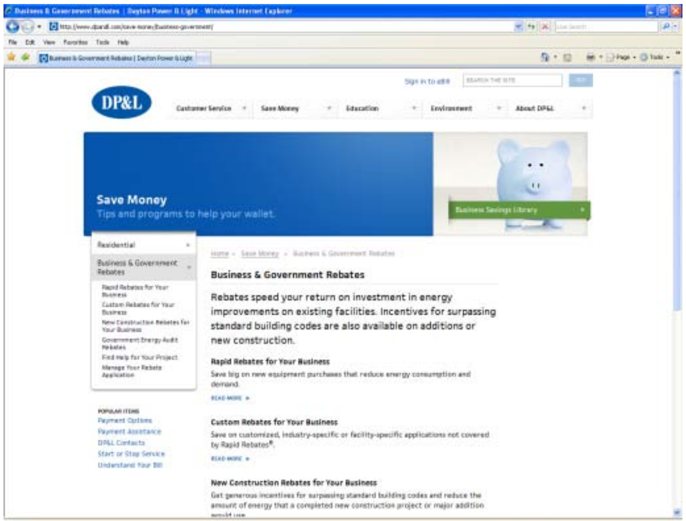
Channel Partners are contractors, engineers and distributors with energy efficiency experience. They have participated in DP&L rebate workshops and are familiar with using DP&L rebate programs to help customers save money. Channel Partners are viewed as an invaluable third party "marketing extension" of DP&L's internal group of program managers. They have direct contact with customers on a daily basis, and can influence the customer's purchasing decisions. Of the $1,353,134 in Custom incentives paid to customers in 2013, Channel Partners were involved in securing $593,299 or 43.8 percent of those dollars.



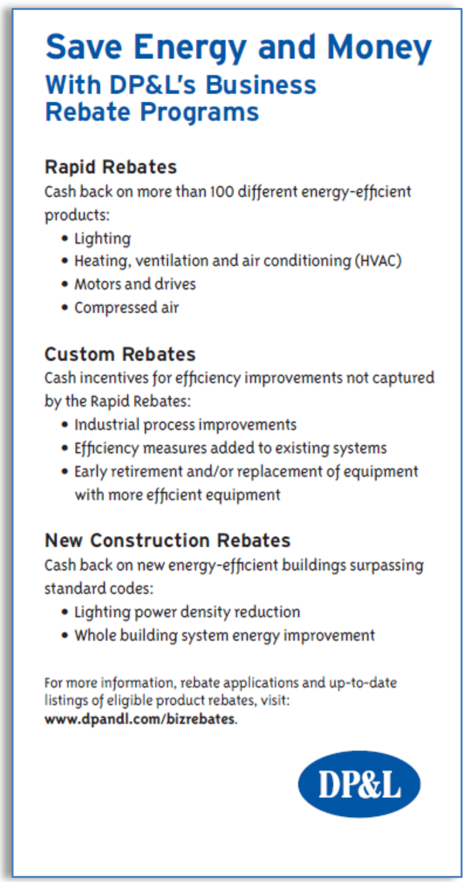
Channel Partners
Channel Partners have participated in DP&L rebate workshops and are familiar with using DP&L rebate programs to help customers save money.



Newsletter
Channel Partners are kept up-to-date on program news and changes through a quarterly Channel Partner newsletter, the "Rapid Review."



Web Portal
The Business Rebates pages on the DP&L website give a description of the Custom Rebate Program and allow customers to navigate to other pages for more information or apply online for a rebate.



Bill Insert
Bill inserts were mailed to 50,000 customers in April 2013.

Print Ads
The Business Rebate programs were advertised through placement of ads in local and regional magazines and newspapers, including <u>Dayton Daily News</u>, which has a circulation of over 100,000.

Event Sponsorships
DP&L Business Programs frequently sponsor and participate in community- and vendor-sponsored events. Events in 2013 included: DRG3 Sustainability Coordinator Luncheons, Dayton Green Expo and numerous Channel Partner training and customer appreciation events.

Print Literature
DP&L used standard print materials for hand outs at meetings with customers and at a variety of speaking events.

Collaborative Partners
DP&L continues to work with its collaborative partners to promote programs. For instance, DP&L is working with the OHA to promote programs to area hospitals.

OHIO HOSPITAL ASSOCIATION

Customer Service
In all programs, customer service is a critical element to success. As such, DP&L designed a number of customer service elements into the Custom Rebate Program, some of which have been previously discussed.

The Custom Rebate section of the DP&L website acts as the main information portal for customers, contractors, distributors and other program participants. The website contains all Custom Rebate eligibility requirements, as well as access to the online application. Customers receive a confirmation number when they submit an online custom rebate application. The confirmation number allows the customer access to their application's status, the ability to upload documents to their application, and the ability to assign their rebate to a vendor.

In addition to being an effective means of marketing the program, Channel Partners are also a valuable resource for delivering the program to customers in a quality manner. Channel Partners are trained on the custom rebate application process. Many Channel Partners have taken the rebate programs and used them to offer a "turn-key" experience for the customer, including the approximate rebates in customer quotes and applying for the rebates on behalf of customers. Through this process, customers can have confidence the proposed project will be eligible for a rebate while allowing DP&L to work with the Channel Partner to clarify any issues that may arise. In short, the Channel Partners are an effective "middleman" for the program with proper upfront training and ongoing program communication.

As a quality control measure, the auditing process ensures that contractors and vendors are not misrepresenting the program. From a customer service perspective, customers appreciate and welcome the audit process, as it gives them unbiased energy savings data. They can use this data in submitting positive post-analysis reports on their capital projects.

To make communication convenient for the customer, the Business Programs staff maintains an Energy Efficiency Inbox, energyefficiency@dplinc.com, a clearinghouse for general program questions that business and government customers may have.

Lastly, DP&L maintains its own customer service center, accepting calls regarding all functions of DP&L. DP&L Business Program management staff conducted training sessions for customer service center staff regarding program details. This was to ensure that DP&L phone representatives had a basic understanding of the energy efficiency programs, and could assist customers in navigating the website or point them to the Energy Efficiency Inbox.

MERCANTILE SELF-DIRECT PROGRAM

PROGRAM DESCRIPTION

Pursuant to O.R.C §4928.66, mercantile customers may commit their peak demand reduction, demand response and energy efficiency projects for integration with an electric utility's programs. DP&L's Self-Direct Program consists of the company allowing mercantile customers to commit their resources for integration in DP&L's programs in exchange for a one-time payment, a commitment payment or exemption from the Energy Efficiency Rider (EER). This Self-Direct Program is available to customers who consume 700,000 kWh or more per year or are part of a regional or national account and who commit their demand and energy savings to be integrated into DP&L's energy efficiency programs.

In 2013, consistent with the Commission's program for mercantile customers to commit energy efficient/peak demand reduction adopted in Case No.10-834-EL-EEC, DP&L's Self-Direct Program allows mercantile customers who have successfully identified and documented savings from energy efficiency projects since January 1, 2010 to apply for a one-time incentive payment or an exemption from the EER. If a customer provides all the necessary project documentation, DP&L will file a joint application with the customer, requesting PUCO approval of an incentive payment or exemption from the EER for a period of time. Rules also permit a customer to file directly with the PUCO.

The one-time payments are reduced to 75 percent of the incentive amount the customer could have received for the same project under the 2013 prescriptive or custom rebate programs. EER exemption requests are based on the percentage of demand and energy saved versus the overall customer demand and energy consumed. The EER exemption is proposed to last as long as the percentage of savings achieved by the customer exceeds the legislated demand and/or energy targets on an individual basis. Customers may participate as an individual facility or have the option to aggregate all facilities into a single application. All applications are filed at the PUCO individually and reviewed on a case-by-case basis.

All mercantile applications must be approved by the PUCO prior to taking effect.

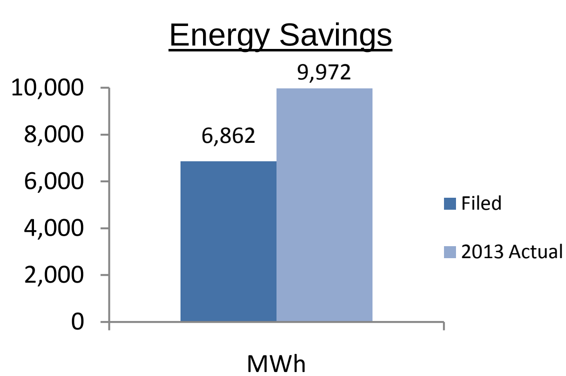
PERFORMANCE SUMMARY

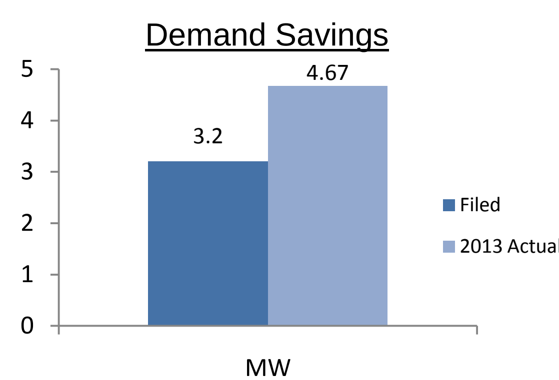
During 2013, DP&L jointly filed twenty-one applications with customers requesting a one-time incentive payment for historical energy efficiency projects. These applications were filed using the PUCO-issued mercantile template format and resulted in demand savings of 4.46 MW and energy savings of 8,748 MWh.

Savings continue to be claimed on a single energy efficiency rider exemption (10-2205-EL-EEC), which was filed in 2010 and approved by the Commission on December 7, 2011.

2013 Mercantile Program Summary		Approved by PUCO	Energy Savings (kWh)	Demand Savings (kW)	Incentive Payment
One-Time Incentive Payments for Energy Efficiency					
GNC	13-0910-EL-EEC	✓	35,395	6.5	$922.50
Goodwill	13-0596-EL-EEC	✓	104,383	41.0	$8,570.93
Gray America	13-0111-EL-EEC	✓	10,207	3.3	$1,236.75
Greeneview Local Schools	13-0238-EL-EEC	✓	216,992	218.3	$21,375.00
Greeneview Local Schools	13-1250-EL-EEC	✓	56,845	179.6	$15,601.69
Kroger Store #923	13-0267-EL-EEC	✓	540,896	200.8	$47,513.76
Miami Valley Hospital	13-0992-EL-EEC	✓	1,339,124	649.0	$129,022.73
Peak Foods	13-0987-EL-EEC	✓	368,815	49.8	$9,555.00
Plastipak Packaging	13-0114-EL-EEC	✓	599,123	48.8	$6,930.00
Silfex	13-0696-EL-EEC	✓	2,126,547	405.9	$158,035.32
Sycamore Hospital	13-1388-EL-EEC	✓	59,530	29.1	$7,800.00
University of Dayton	13-0661-EL-EEC	✓	423,159	171.2	$49,648.40
VA Hospital	13-0714-EL-EEC	✓	54,750	123.6	$15,000.00
Vandalia Butler Board of Education	13-1917-EL-EEC	✓	883,003	670.1	$115,818.24
Voss Auto Network	13-0625-EL-EEC	✓	737,861	33.0	$6,075.00
Wilson Memorial Hospital	13-0140-EL-EEC	✓	84,096	22.8	$3,600.00
Wilson Memorial Hospital	13-1774-EL-EEC	✓	310,768	23.1	$3,540.00
Wilson Memorial Hospital	13-0372-EL-EEC	✓	189,977	24.0	$3,792.00
Wright Patterson Air Force Base	13-0908-EL-EEC	✓	420,486	193.0	$72,832.50
Wright Patterson Air Force Base	13-2380-EL-EEC	✓	227,154	1,165.9	$95,953.31
Yaskawa Motoman	13-0113-EL-EEC	✓	542,722	204.1	$45,921.98
Subtotal Energy Efficiency Incentive Payments			**8,748,054**	**4,462.9**	**$818,745.11**
Energy Efficiency Rider Exemptions					
	10-2205-EL-EEC	✓	1,224,290	206.7	
TOTAL 2013 Mercantile Savings			**9,972,344**	**4,669.6**	**$818,745.11**

2013 Performance





All "filed" numbers are taken from DP&L's program portfolio filing; Case No. 13-0833-EL-POR.

Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$495,817	$818,745
Marketing & Admin	$128,482	$133,685
Total Costs	$625,299	$952,430

IMPLEMENTATION REVIEW

Implementation Strategy

DP&L is implementing this program in-house, utilizing business program managers. This provides a dedicated point of contact at DP&L to assist the customer through the process. It is the program manager's responsibility to understand program details, communicate the program to customers, and help customers manage their way through the mercantile process.

Targeted Customers

DP&L has determined that approximately 1,200 customers qualify for the Self-Direct Program based on the law's minimum usage criteria of 700,000 kWh per year, set forth in O.A.C. §4901:1-39(P).

Staffing

DP&L utilizes business program managers to manage the Self-Direct Program. These managers focus on managing all stages of the Self-Direct Program including program design, PUCO rule review, marketing and customer service.

Marketing

To promote the Self-Direct Program, DP&L worked with its major account managers to identify large customers who participate in PJM Demand Response as well as those who may have implemented past efficiency projects. Additionally, DP&L educated industry contractors and distributors about the availability of the program. Their knowledge about local efficiency projects was used to establish leads for potential customers that may have implemented projects in the 2010 to 2013 timeframe.

Customer Service

DP&L utilizes its business program managers to provide customers with a single point of contact to assist with the mercantile application process. DP&L's program managers are knowledgeable about program rules, requirements and procedures and can help customers with their initial analysis related to program savings and expected energy efficiency rider costs. Further, DP&L can provide the regulatory and legal support required to make initial filings and assist throughout the regulatory process.

PJM DEMAND RESPONSE

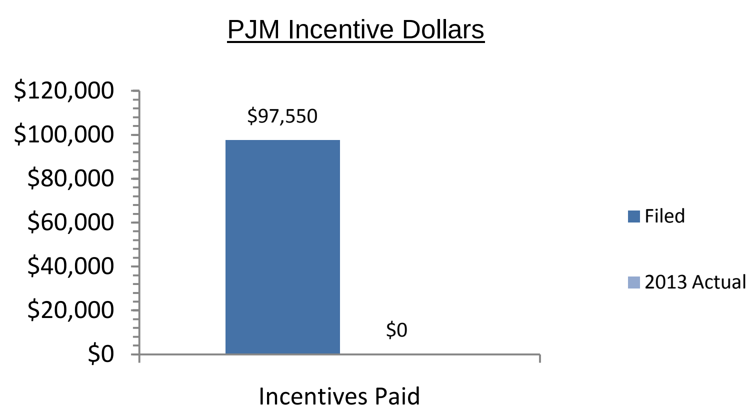
PROGRAM DESCRIPTION
The Non-Residential PJM Demand Response program allows mercantile customers to commit their PJM Demand Response attributes to DP&L.

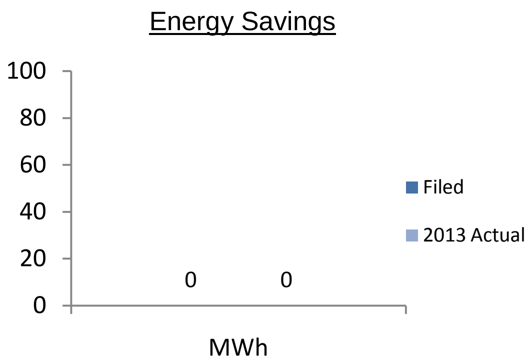
The objective of the program is to supplement the peak demand reductions achieved from energy efficiency programs in order to ensure compliance with the peak demand reduction benchmarks. Savings are claimed based on the actual peak demand response participating customers report into PJM's eLRS system in a given program year.

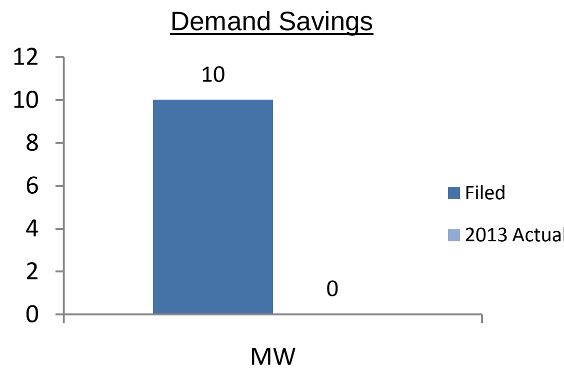
This program is available to customers who consume 700,000 kWh or more per year or are part of a regional or national account. All customers taking delivery service from DP&L are eligible for this program regardless of their choice of generation supplier. Qualifying customers must meet the requirements of the PJM Demand Response program and be participating in the program through a curtailment service provider.

PERFORMANCE SUMMARY
During 2013, DP&L was able to achieve compliance with the peak demand reduction benchmarks solely through its energy efficiency programs. As such, DP&L did not utilize the PJM Demand Response program in 2013.

2013 Performance







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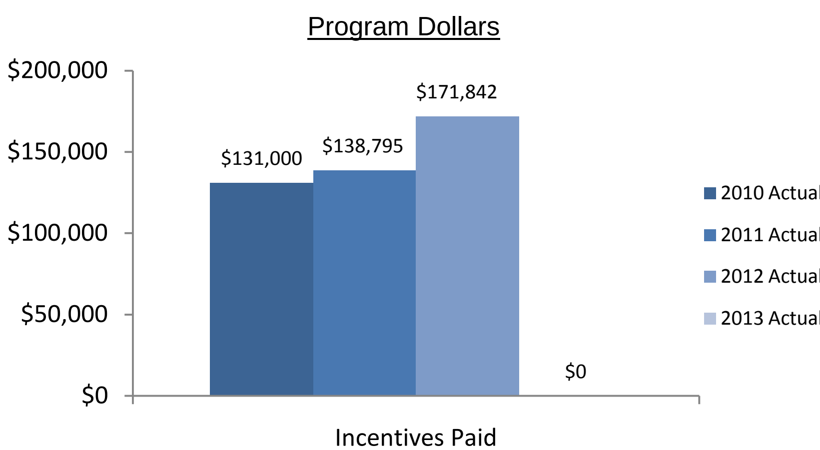
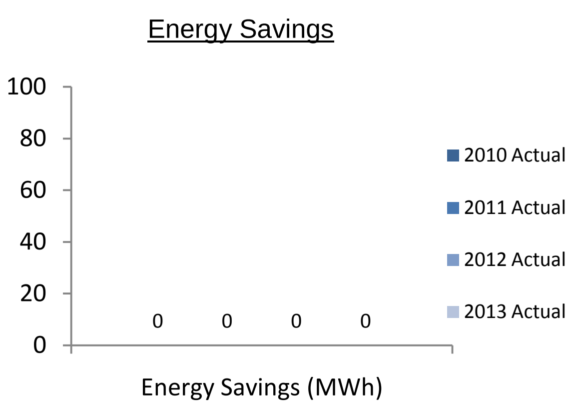
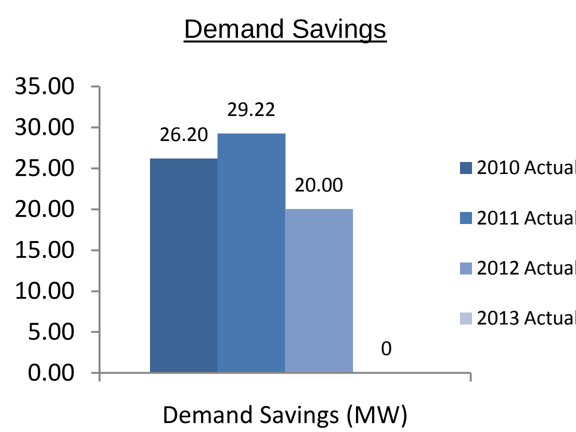
Four-Year Trend Analysis







Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$97,550	$0
Marketing & Admin	$7,200	$0
Total Costs	$104,750	$0

PILOT PROGRAM

PROGRAM DESCRIPTION
Pilot programs are intended to allow DP&L the flexibility to research or pilot programs to test their feasibility for cost-effective savings and potential inclusion in future portfolio plans. The objective of the Pilot Program is to develop and deploy new opportunities as they arise. Results of the pilot programs may also inform mid-stream adjustments to the current plan programs as needed.

The Pilot Program is intended to cover all DP&L customer segments, both residential and business. All customers taking delivery service from DP&L are eligible for participation in pilot programs regardless of their choice of generation supplier.

PERFORMANCE SUMMARY
DP&L's Pilot Program was newly introduced with the 2013-15 Energy Efficiency and Demand Response Portfolio Plan filed in Case No. 13-0833-EL-POR and 13-0837-EL-WVR on April 15, 2013. The portfolio plan was approved by the Commission on December 4, 2013. As such, DP&L did not undertake any pilot program activities in 2013.

Budget, Cost Summary

Budget Category	Filed, 2013	Actual, 2013
Incentive Costs	$188,084	$0
Marketing & Admin	$80,607	$0
Total Costs	$268,691	$0

TRANSMISSION AND DISTRIBUTION INFRASTRUCTURE IMPROVEMENTS

PROGRAM DESCRIPTION

Pursuant to O.R.C §4928.66(A)(2)(d), programs implemented by a utility to meet the statutory reduction requirements may include transmission and distribution infrastructure improvements.

In December, 2011, DP&L filed an application (11-6010-EL-POR) with the Public Utilities Commission of Ohio to include energy efficiency gains resulting from the upgrade of the company's distribution network from 4 kilovolt (kV) to 12 kilovolt distribution lines, for activities completed in the years 2010 and 2011. On August 7, 2013, the Commission approved the application, allowing DP&L to include those savings in the program portfolio plan covering 2009 through 2011.

In April, 2013, DP&L filed an updated portfolio plan (13-0833-EL-POR) for energy efficiency programs for years 2013 through 2015. Part of this plan included DP&L's intention to count savings toward its statutory benchmarks associated with infrastructure improvements. Increasing the operating voltage on the distribution system, as was done in the 4 kV to 12 kV project, is one example of an infrastructure improvement project cited in the plan. The plan was approved by the Commission on December 4, 2013. Therefore, DP&L is also including in this report the energy efficiency gains achieved by 4 kV to 12 kV conversions completed in 2012.

As stated in both 11-6010-EL-POR and 13-0833-EL-POR, DP&L is not seeking to recover 4 kV to 12 kV costs through the Energy Efficiency Rider.

PERFORMANCE SUMMARY

By increasing the distribution voltage from 4 kV to 12 kV, line losses are reduced, resulting in energy and demand savings. The 4 kV to 12 kV project converted approximately 119 miles of the existing 4 kV distribution system to 12 kV. The project involved replacing poles which were at the end of their useful life or unsuitable for the clearances required for operating at a higher voltage. The project also included replacing insulators, cutouts, cross arms, arrestors, transformers, and other associated hardware.

The 4 kV to 12 kV conversion program increased capacity of the power lines in the DP&L territory. These increases to capacity allow more power to flow throughout the system, thereby increasing DP&L's ability to meet customer demand. The conversion replaced a 4 kV distribution system to provide a more efficient delivery of power to DP&L customers.

The reduction of line loss on the distribution system has a positive impact on the distribution and transmission system. First, a reduction in line loss releases capacity on conductors, transformers, circuit breakers and other devices that are a part of the distribution system. Secondly, by releasing capacity, distribution equipment such as line conductors are less likely to be overloaded, which in turn helps extend the life of equipment and strengthens the system. Additional reliability benefits were realized by pole, transformer, insulator and hardware replacements, and standardizing to the rest of DP&L's 12 kV distribution system.

4 kV to 12 kV Conversion Summary				
	2010	**2011**	**2012**	**Total**
Miles Converted	30.12	32.74	56.41	119.27
Energy Savings (kWh)	9,808,329	8,532,174	14,806,067	33,146,570
Demand Savings (kW)	2,634.60	2,213.50	3,841.34	8,689.44

EDUCATION, AWARENESS BUILDING & MARKET TRANSFORMATION ACTIVITIES

In 2013, DP&L's education, awareness building and market transformation activities included customer education and awareness building through both mass media and DP&L's website.

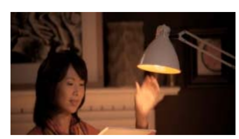
Budget, Cost Summary

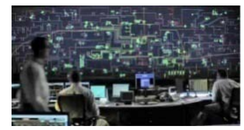
Budget Category	Filed, 2013	Actual, 2013
General Education, Awareness Building	$788,272	$517,565
Total Costs	$788,272	$517,565

DP&L's 2013 education, awareness building and market transformation activities included a mass media campaign targeted to all customers, a web-based resource library designed for business customers and a coordinated donation of Kill-A-Watt meters to local libraries through our community ambassadors.

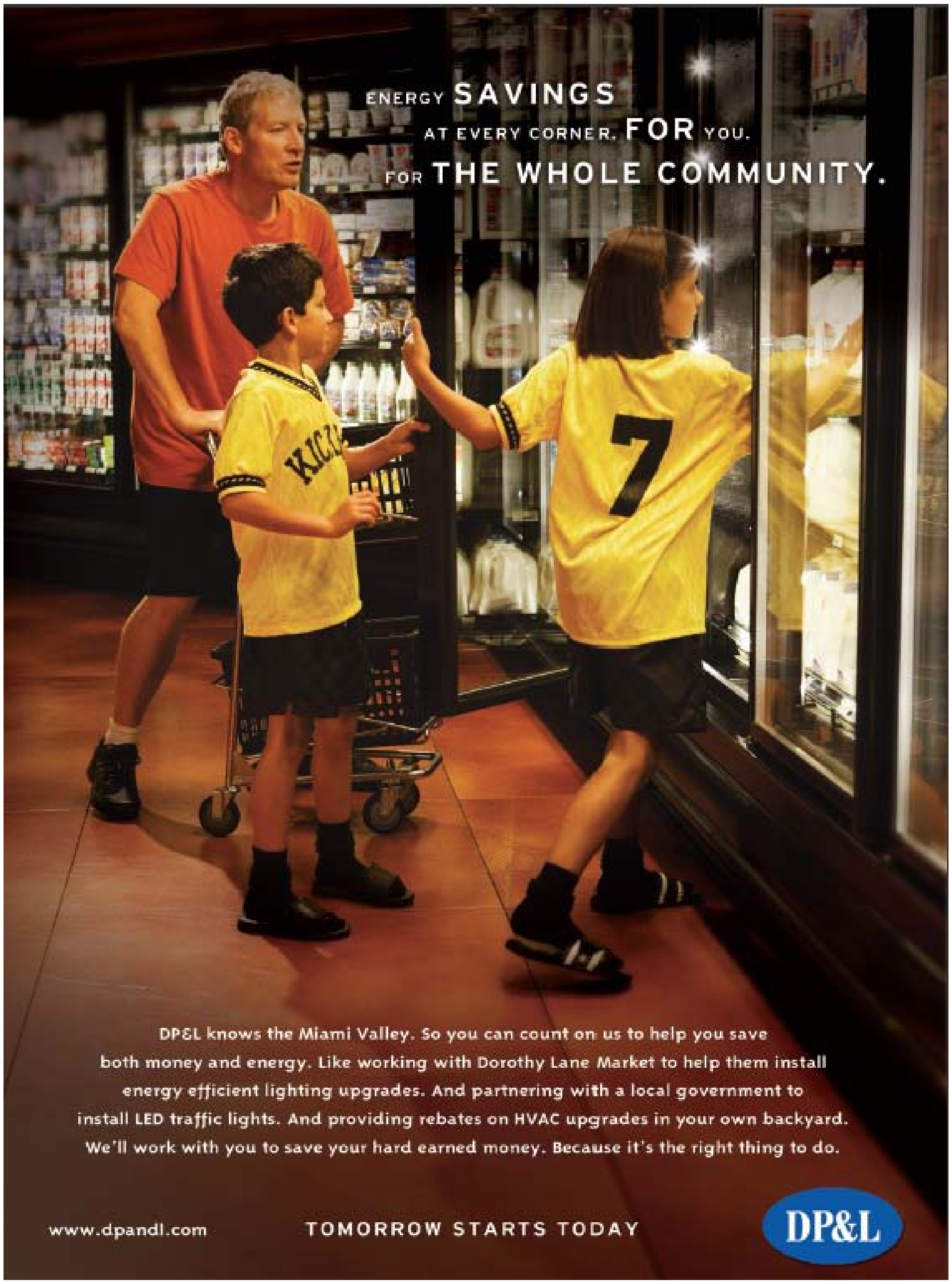
MASS MEDIA CAMPAIGN
During the course of 2013, DP&L aired a television and print campaign targeted to all of its customers. The goals of the campaign were to communicate the value of energy efficiency and increase the awareness of available energy efficiency programs. In addition, the campaign provided a general level of program marketing support, helping to promote the continued expansion of customer participation in energy efficiency programs. The campaign ran from the October through the end of the year.

Television Script

Announcer Voice Over	Visuals	
DP&L knows the Miami Valley. That's why you can count on us to help you save both money… and energy. From energy efficient lighting upgrades for a business. To LED traffic light rebates for a local government. To HVAC upgrades in your own backyard. We'll work with you to save your	Various scenes of the Dayton area. Scenes of people using energy in everyday settings. Visual of an LED application in a grocery store. Visual of LED traffic lights. Visual of a residential HVAC unit. Scenes of people in everyday settings as a business turns	   

hard earned money. Because it's the right thing to do. For all of us. DP&L – Tomorrow starts today.	lights off. DP&L system operating area. Logo and website address for customers to find more information about programs.	  

Print


ENERGY SAVINGS
AT EVERY CORNER. FOR YOU.
FOR THE WHOLE COMMUNITY.
DP&L knows the Miami Valley. So you can count on us to help you save both money and energy. Like working with Dorothy Lane Market to help them install energy efficient lighting upgrades. And partnering with a local government to install LED traffic lights. And providing rebates on HVAC upgrades in your own backyard. We'll work with you to save your hard earned money. Because it's the right thing to do.
www.dpandl.com
TOMORROW STARTS TODAY
DP&L

Print – June and July

WEB-BASED RESOURCE LIBRARY

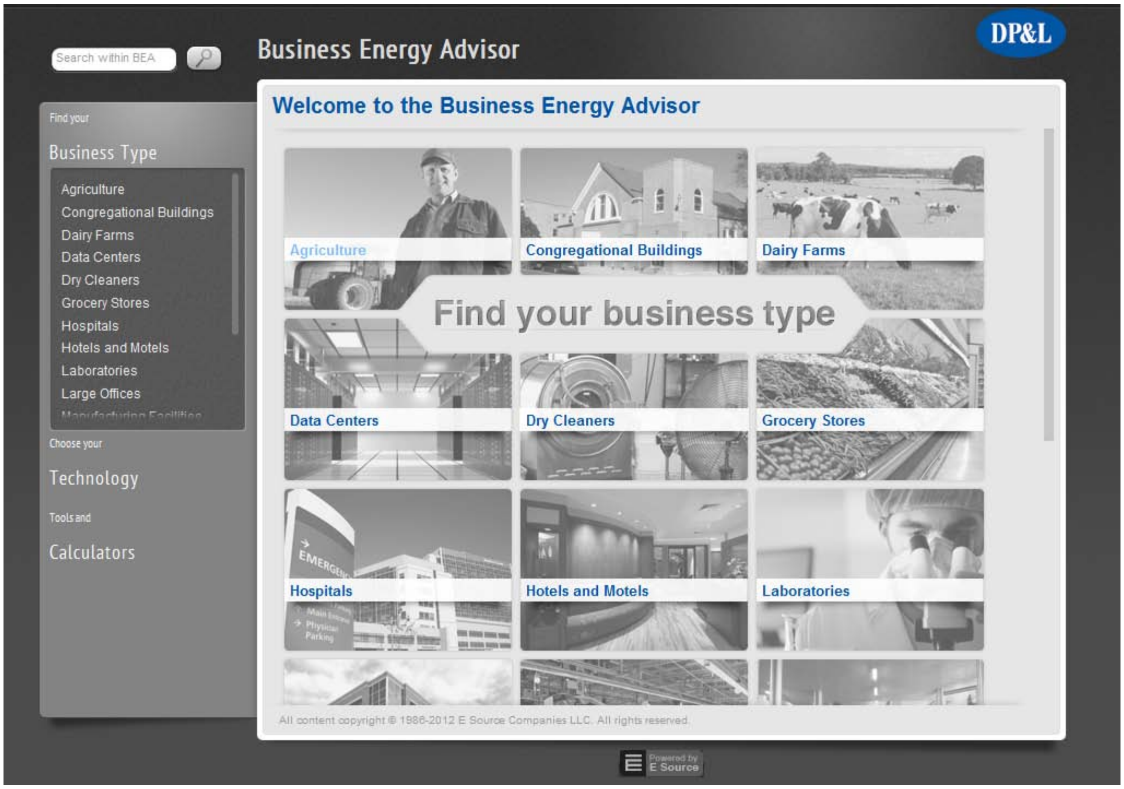
In 2013, DP&L continued to provide a resource library on its website for business customers which included a variety of energy efficiency information.

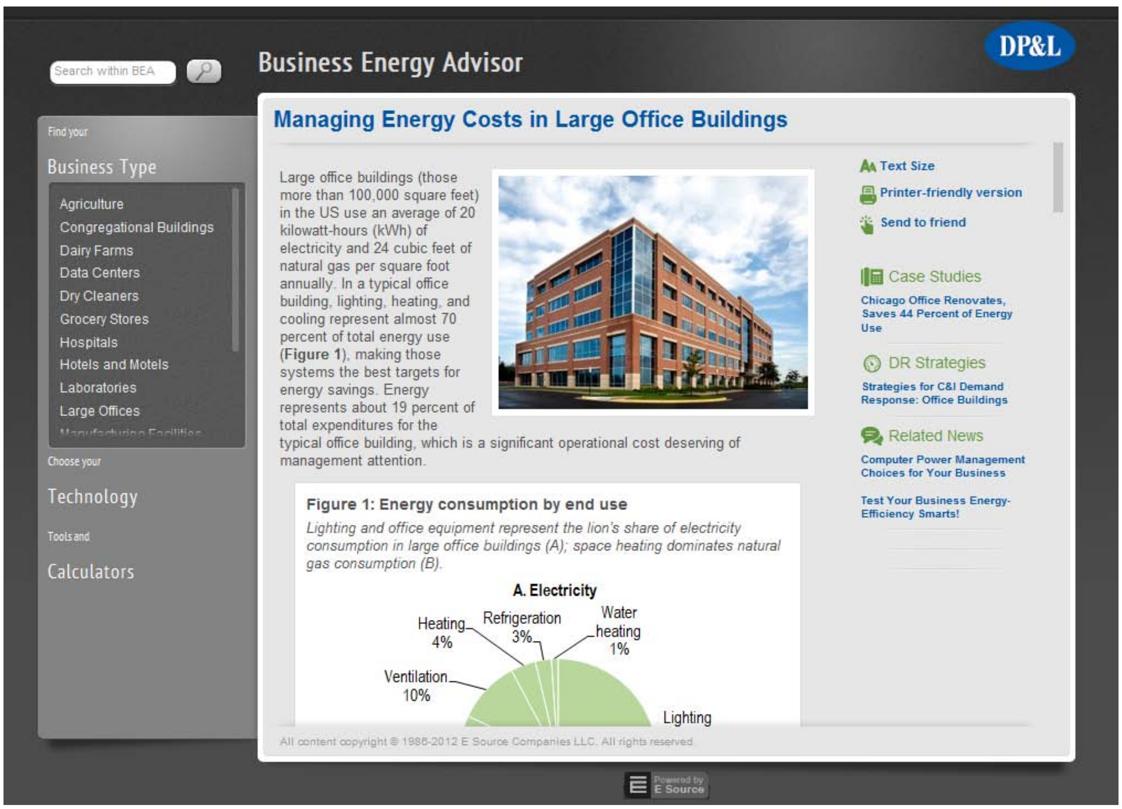
Topics in the library are divided into three main categories: Business Type, Technology, and Calculators. Each category is further broken down into specific topics to allow customers to research their area of interest. The site also includes an O&M Checklist, which provides more detail and guidance for a variety of retrofit projects.

Topics by Category

BUSINESS TYPE	TECHNOLOGY	SAVINGS CALCULATORS
Agriculture	Building Automation Systems	Duct Sealing
Congregations	Building Envelope	Track Lighting
Dairy Farms	Commissioning	High-Bay Lighting
Data Centers	Compressed Air	Gas Cooling
Dry Cleaners	Cooking	Gas Fired Water Heating
Groceries	Cooling	Harmonic Mitigation
Hospitals	Distributed Energy	Dimming Controls
Hotels & Motels	Drivepower	Indirect Lighting
K-12 Schools	Elevators & Escalators	Water Heater Comparison
Laboratories	Heating	Water Heater Fuel Cost
Large Offices	Lighting	
Manufacturing	Office Equipment	
Microbreweries	Power Quality & Reliability	
Multifamily Residences	Refrigeration	
Restaurants	Ventilation & Air Handling	
Retail	Water Heating	
Small & Midsize Offices		
Warehouses		

Sample Web Pages



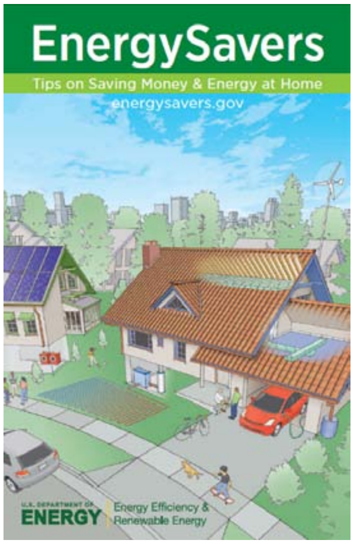


LIBRARY KILL-A-WATT METER DISTRIBUTION

In an effort to improve customer service and increase customer education about home energy use, DP&L provided customer service representatives with a supply of Energy Savers Booklets, published by the Department of Energy (DOE), to mail to customers who express interest in learning more.

DP&L also donated a supply of Kill-A-Watt Meters to local libraries through DP&L's community ambassadors, who are employees who serve as a liaison to local governments. DP&L offered these Kill-A-Watt meters, which allow customers to measure the energy usage of their appliances, along with a set of instructions. More than 80 watt meters were distributed to nine county/city library systems for their patrons to check out.

Library System	Number of Meters
Montgomery County	37
Greene County	20
Arcanum	2
New Madison	2
Greenville	3
Waynesville	4
Logan County	8
Marysville	3
Troy/Miami County	3
Total	**82**



Energy Savers Booklets
A supply of DOE Energy Savers Booklets was provided for DP&L customer service representatives to mail to interested customers.

Kill-A-Watt Meters
82 Kill-A-Watt meters were donated to nine city/county library systems for patrons to check out and measure the energy usage of their appliances.


DP&L

HOW MANY WATTS DOES YOUR TOASTER USE? FIND OUT.

Thanks for picking up a DP&L Kill-A-Watt meter. If you've ever wondered how much electricity appliances like a blow dryer, coffee maker, television and even a computer or phone charger use, now you'll know.

The DP&L Kill-A-Watt meter is easy to use:

1. Plug the Kill-A-Watt meter into a household outlet or power strip.
2. Plug the appliance or device you wish to monitor into the Kill-A-Watt meter.
3. Set the cost per kilowatt-hour (KWh). Looking at the electric section of your most recent bill and doing some simple math will give you your cost per KWh. Just take the total electric charge and divide it by the number of KWh. If you don't have a bill handy, you can use an estimate of $0.12/KWh.
4. You'll see a reading immediately. However, if you leave the meter plugged into appliances that don't use consistent amounts of energy (like a refrigerator) for a few hours, or even a day, you'll see the reading from its full cycle instead of an isolated reading at any given time.
5. To display the estimated cost of power the appliance or device consumes, press MENU repeatedly until the display reads COST.
6. Pressing the UP/DOWN key will display the estimated cost per HOUR, DAY, WEEK, MONTH or YEAR.

Instruction Sheet
Kill-A-Watt meters were packed in a DP&L tote bag with an instruction sheet for how to use the meters.

OTHER ACTIVITIES

Over the course of 2013, DP&L performed other education and awareness activities, some at the request of organizations and customers. These included:

- Sponsorship of and participation in various events and conferences including the Ohio Weatherization Conference, an energy fair at Wright-Patterson Air Force Base, Green Building workshop for Houses of Worship, Association for Energy Engineers Green Expo, and luncheons for the Dayton Regional Green Sustainability Initiative.

- Energy efficiency presentations to community groups, using a presentation created by DP&L called “Top Ten Ways to Save Energy in the Home.”

- Participation in Earth Day events hosted by some of our largest customers.

- Sponsoring an Energy Bike program. Teachers participating in our school education program can pick up the energy bike from a DP&L facility and use it for teaching and demonstrations in their classrooms.

- Various interviews with the news media about ways to reduce energy consumption.

RECOMMENDATIONS

The previous pages of this report contain a thorough description of each energy efficiency program, how it is being implemented and marketed, and the results produced to date. These recommendations are based, in part, on this program review, and as such, DP&L finds it unnecessary to duplicate that review in this section.

Further, DP&L undertook a comprehensive review of its programs as a part of developing its 2013-15 portfolio plan, which was filed in April of 2013 as PUCO Case No. 13-0833-EL-POR and 13-0837-EL-WVR. The programs in that plan were reviewed with stakeholder groups and a stipulation settlement was reached with all parties. The plan was approved by the Commission on December 4, 2103.

Overall, DP&L is pleased with the progress of its energy efficiency initiatives. The program spending in 2013 was 21 percent below filed budgets while program savings performance was 114 percent of 2013 filed targets.

As with any type of implementation, there is always opportunity to improve, including recommendations outlined in the Cadmus report (Exhibit 1). Over the course of the coming year, DP&L will continue to work with its implementation vendors, its collaborative members and its evaluations provider to make adjustments and improvements to its programs.

Consistent with DP&L's 2013-2015 Portfolio Plan filed April 15, 2013 (13-0833-EL-POR) and approved on December 4, 2013, DP&L recommends continuing all of the programs that are contained in the portfolio plan.

Filed Program	Recommendation
Residential Lighting	Continue
Residential HVAC Rebates	Continue
Residential Appliance Recycling	Continue
Residential School Education	Continue
Residential Low Income Affordability	Continue
Non-Residential Prescriptive Rebates	Continue
Non-Residential Custom Rebates	Continue
Non-Residential Mercantile	Continue
Non-Residential PJM Demand Response	Continue
Pilot Programs	Continue
T&D Infrastructure	Continue
Education, Awareness Building & Market Transformation	Continue

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report

The Dayton Power and Light Company ("DP&L" or "the Company") herewith submits its updated Benchmark Report ("Benchmark Report") pursuant to Section 4901:1-39-05(C)(1)(a) of the Ohio Administrative Code ("O.A.C"). In this report, DP&L identifies the energy and demand baselines for kilowatt-hour sales and kilowatt demand for reporting year 2013 based on the preceding three calendar years (2010, 2011, and 2012) as specified in Section 4928.66(A)(2)(a) of the Ohio Revised Code ("O.R.C."), along with DP&L's energy saving and peak demand reduction statutory benchmarks. In this report, DP&L also makes adjustments pursuant to O.R.C. §4928.66(A)(2)(c) and O.A.C §4901:1-39-05(B) to adjust its sales and demand baselines to normalize for weather and changes to DP&L's customer base related to mercantile opt-out applications, lost load, and load growth. DP&L's benchmarks and adjustments are supported by the descriptions shown below, including the method of calculating the baselines, supporting data, assumptions, rationales, and calculations as required by O.A.C. §4901:1-39-05(B).

<u>DP&L 2013 Energy Efficiency Baseline Calculation</u>

Consistent with the definition of "Energy baseline" pursuant to O.A.C. §4901:1-39-01(J), DP&L's Total Retail sales for the three preceding calendar years (2010, 2011, and 2012), which are shown below, were taken from DP&L's most recent long-term forecast report found on the Electric Utility Ohio Service Area Energy Consumption Forecast (PUCO FORM FE-D1) and included as Workpaper A.

2010: 14,282,324 MWh
2011: 14,127,179 MWh
2012: 13,936,670 MWh

<u>DP&L 2013 Peak Demand Baseline Calculation</u>

Consistent with the definition of "Peak-demand baseline" pursuant to O.A.C. §4901:1-39-01(S), DP&L's Peak Demands for the three preceding calendar years (2010, 2011, and 2012), which are shown below, were taken from DP&L's most recent long-term forecast report found on the Electric Utility Ohio Seasonal Peak Load Demand Forecast (PUCO FORM FE-D3) and included as Workpaper B.

2010: 2,956 MW
2011: 3,146 MW
2012: 3,046 MW

<u>Normalizing Adjustments</u>

Significant Loss/Growth of Customer Loads

O.A.C. §4901:1-39-05(B) permits an electric distribution utility to adjust its baselines for changes in the number of customers, sales, and peak demand that are outside of the electric distribution utility's control. DP&L adjusted its 2013 baselines to account for customers with significant load who reduced, ceased or expanded their operations during the reporting period. Because there will always be some customers lost over the course of time, which can be balanced against DP&L's natural load growth, the customers identified in this adjustment are only large customer loads that grew or were lost and which, due to size, are not expected to be replaced under ordinary growth and contraction business cycles. Specifically, DP&L's adjustments include only customers with load changes of 2 MW or greater.

Adjustments for lost customer loads are necessary and will continue to be necessary as the lost loads represent customers that will not be available to take advantage of DP&L's Energy Efficiency programs. These eliminated or soon to be eliminated loads should be excluded from the baseline calculation in order to more accurately reflect the potential energy savings, which can be reasonably expected from DP&L's customers in current and future years. In other words, lost customer loads will have the impact of decreasing both the Energy Efficiency and Peak Demand Reduction baselines.

For the sake of balance, when accounting for changes in number of customers, sales and peak demand, DP&L likewise adjusted its baselines to account for atypical growth in customer load. DP&L believes it is appropriate to adjust for extraordinary customer load growth, as these customers will be able to take advantage of DP&L's Energy Efficiency programs now and going forward. Customer load growth will have the effect of increasing both the Energy Efficiency and Peak Demand Reduction baselines. Adjustments for customer load changes are reported in Workpaper C.

Adjustment for Mercantile Customers

Pursuant to O.R.C §4928.66(A)(c), an electric distribution utility must adjust its baseline to exclude the effects of all energy efficiency or peak demand reduction programs that may have existed during the period used to establish the baseline. Therefore, in addition to the adjustment for customer load change, DP&L also adjusted its baseline to account for the energy efficiency and peak demand reduction that was realized in connection with the approval of mercantile opt-out applications. With the exception of two applications, such mercantile applications, which included energy efficiency projects for the 2009-2012 timeframe, were approved by the Commission under the 60 day automatic approval in 2010, 2011, 2012, and 2013, pursuant to the Commission's pilot program for Mercantile Customers as established in Case No. 10-834-EL-EEC. Two of the mercantile applications were approved by the Commission for exemption from DP&L's Energy Efficiency Rider as a result of implementation of energy efficiency projects. The adjustment for Mercantile Customers is shown in more detail in Workpaper D.

Weather normalization

Weather-normalization adjusts actual weather-sensitive retail sales by class (Residential, Commercial, and Public Authority) to account for the difference between actual and normal heating and cooling degree days based on historical use per customer per day per cooling degree day and heating degree day relationships for these classes.

Workpapers E1–E3 calculate the weather normalized retail sales and peak demands for the period. The weather normalization factor is the ratio of weather normalized values to actual values (sales or peak demands) and is calculated on Workpaper F.

The annual MWh sales adjusted for loss/growth in customer loads and mercantile opt out applications are multiplied by the Weather Normalization Factor to yield the Normalized Retail Energy Sales (MWh). The same process is applied to calculate Weather Normalized Peak Demands (MW).

DP&L 2013 Normalized Energy Efficiency Baseline Calculation

DP&L's 2013 Normalized Energy Efficiency baseline calculation is shown on Schedule 1. The methodology is consistent with O.A.C. §4901:1-39-01(J) and includes the adjustments described above. The normalized retail energy sales for 2010, 2011, and 2012 are averaged over the three years, to produce DP&L's 2013 Normalized Energy Efficiency Baseline of 13,833,988 MWh.

DP&L 2013 Energy Efficiency Reduction Benchmark Calculation

As described in O.R.C. §4928.66(A)(1)(a), beginning in 2009, an electric distribution utility shall:

> "Implement energy efficiency programs that achieve energy savings equivalent to at least three-tenths of one per cent of the total, annual average, and normalized kilowatt-hour sales of the electric distribution utility during the preceding three calendar years to customers in this state. The savings requirement, using such a three-year average, shall increase to an additional…nine-tenths of one per cent in 2013."

DP&L's 2013 Normalized Energy Efficiency Baseline of 13,833,988 MWh is multiplied by the 2013 Energy Efficiency Reduction Benchmark percentage of 0.90% pursuant to O.R.C. §4928.66(A)(1)(a). The result is DP&L's 2013 Incremental Energy Efficiency Reduction Benchmark of 124,506 MWh. DP&L's 2013 cumulative Energy Efficiency Reduction Benchmark is 449,981 MWh. The calculations are shown on Schedule 1.

DP&L 2013 Normalized Peak Demand Baseline Calculation

DP&L's 2013 Normalized Peak Demand Reduction baseline calculation is shown on Schedule 2. The methodology is consistent with O.A.C. §4901:1-39-01(S) and includes the adjustments described above. DP&L's Normalized Peak Demands for 2010, 2011, and 2012 are averaged over the three years, to produce DP&L's 2013 Normalized Peak Demand Baseline of 2,767 MW.

DP&L 2013 Peak Demand Reduction Benchmark Calculation

As described in O.R.C. §4928.66 (A)(1)(b), beginning in 2009, an electric distribution utility shall:

> "Implement peak demand reduction programs designed to achieve a one per cent reduction in peak demand in 2009 and an additional seventy-five hundredths of one per cent reduction each year through 2018."

DP&L's 2013 Normalized Peak Demand Reduction Baseline of 2,767 MW is multiplied by the 2013 Peak Demand Reduction Benchmark percentage of 4.00% pursuant to O.R.C. §4928.66 (A)(1)(b). The result is DP&L's 2013 Peak Demand Reduction Benchmark of 110.7 MW. The calculation is shown on Schedule 2.

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report
Energy Efficiency Baseline and Benchmark Calculation

		2010	2011	2012	2013
1	**Baseline Calculation Components**				
2	Retail MWh Sales [1]	14,282,324	14,127,719	13,936,670	
3					
4	**Normalizing Adjustments**				
5	Significantly Reduced Customer Sales [2]	(170,341)	(145,516)	(71,592)	
6	Significantly Expanded Customer Sales [3]	98,219	83,431	27,840	
7	Total Customer Sales Adjustment (5)+(6)	(72,122)	(62,085)	(43,752)	
8	Mercantile Customer Adjustment [4]	23,585	29,766	33,981	
9	Total Adjusted Retail Sales (2)+(7)+(8)	14,233,787	14,095,400	13,926,899	
10	Weather Normalization Factor [5]	0.96700	0.98666	0.99308	
11	Normalized Retail Energy Sales (9)*(10)	13,764,072	13,907,367	13,830,525	
12					
13	**2013 Normalized Energy Efficiency Baseline**				
14	3 Year Normalized Average (MWh)				13,833,988
15					
16	**Calculation of 2013 Energy Efficiency Reduction Benchmark**				
17	Normalized Preceding 3 Year Average Sales (14)				13,833,988
18	2013 Incremental Energy Efficiency Reduction Benchmark % [6]				0.90%
19	2013 Incremental Energy Efficiency Reduction Benchmark (17)*(18)				124,506
20	2011-2012 Energy Efficiency Reduction Benchmark [7]				325,475
21	**2013 Cumulative Energy Efficiency Reduction Benchmark (19)+(20)**				**449,981**

[1] Retail sales for the period 2010-2012 are reported in PUCO Form FE-D1 (Case No. 14-536-EL-FOR). See Workpaper A, Column (6).

[2] Significantly reduced customer sales include those who ceased or reduced their operations during the period. See Workpaper C for details on load reductions.

[3] Significantly expanded customer sales include those who started or expanded their operations during the period. See Workpaper C for details on load expansions.

[4] See Workpaper D for calculation of Mercantile Customer Adjustment.

[5] See Workpaper F for calculation of the weather normalization factor.

[6] Energy Efficiency benchmark as established in O.R.C. §4928.66(A)(1)(a).

[7] 2012 Cumulative Energy Efficiency Reduction Benchmark as established in Case No. 13-1140-EL-POR, Schedule 1, line 21.

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report
Peak Demand Baseline and Benchmark Calculation

		2010	2011	2012	2013
1	**Baseline Calculation Components**				
2	Peak MW Demand [1]	2,956	3,146	3,046	
3					
4	**Normalizing Adjustments**				
5	Significantly Reduced Customer Load [2]	(28)	(17)	(1)	
6	Significantly Expanded Customer Load [3]	16	8	(1)	
7	Total Customer Load Adjustment (5)+(6)	(12)	(9)	(2)	
8	Mercantile Customer Adjustment [4]	8	10	11	
9	Total Adjusted Peak Demand (2)+(7)+(8)	2,952	3,147	3,055	
10	Weather Normalization Factor [5]	0.91610	0.86364	0.94288	
11	Normalized Peak Demand (9)*(10)	2,704	2,718	2,880	
12					
13	**2013 Normalized Peak Demand Reduction Baseline**				
14	3 Year Normalized Average (MW)				2,767
15					
16	**Calculation of Normalized 2013 Peak Demand Reduction Benchmark**				
17	Normalized Preceding 3 Year Average Peak Demand (14)				2,767
18	2013 Peak Demand Reduction Benchmark % [6]				4.00%
19	**2013 Peak Demand Reduction Benchmark (17)*(18)**				**110.7**

[1] Peak demand for the period 2010-2012 is reported in PUCO Form FE-D3. See Workpaper B.

[2] Significantly reduced customer load include those who ceased or reduced their operations during the period. See Workpaper C for a complete list of customers.

[3] Significantly expanded customer load include those customers who started or operations during the period. See Workpaper C for a complete list of customers.

[4] See Workpaper D for calculation of Mercantile Customer Adjustment.

[5] See Workpaper F for calculation of weather normalization factor.

[6] Peak Demand Reduction benchmark as established in O.R.C § 4928.66(A)(1)(b).

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report

PUCO FORM FE-D1: ELECTRIC UTILITY OHIO SERVICE AREA ENERGY CONSUMPTION FORECAST
(Megawatt-Hours Per Year)

		(1)	(2)	(3)	(4)	(5)	(5a)	(6)	(7)	(8)
	YEAR	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	TRANSPORTATION (a)	OTHER (b)	ENERGY EFFICIENCY & DEMAND RESPONSE	TOTAL END USER CONSUMPTION 1+2+3+4+5-5a	LOSSES AND UNACCOUNTED FOR	NET ENERGY FOR LOAD 6+7
-5	2009	5,227,724	3,727,122	3,372,617	3,153	1,396,661		13,727,277	797,678	14,524,955
-4	2010	5,516,004	3,767,233	3,571,504	1,467	1,426,116		14,282,324	419,500	14,701,824
-3	2011	5,424,545	3,713,941	3,560,411	817	1,428,005		14,127,719	400,646	14,528,365
-2	2012	5,181,338	3,698,607	3,650,639	1,625	1,404,461		13,936,670	455,260	14,391,930
-1	2013	5,226,437	3,697,532	3,552,428	3,913	1,349,658		13,829,968	400,670	14,230,638
0	2014	5,155,994	3,722,821	3,555,880	3,913	1,359,142	(161,666)	13,636,084	526,378	14,162,463
1	2015	5,190,691	3,748,340	3,555,373	3,913	1,369,644	(320,199)	13,547,762	523,049	14,070,811
2	2016	5,240,541	3,773,536	3,553,340	3,913	1,382,454	(480,815)	13,472,969	520,229	13,993,198
3	2017	5,270,509	3,797,121	3,551,907	3,913	1,396,598	(643,569)	13,376,479	516,591	13,893,070
4	2018	5,317,222	3,817,721	3,547,783	3,913	1,412,373	(808,219)	13,290,794	513,361	13,804,154
5	2019	5,367,960	3,838,100	3,545,474	3,913	1,427,328	(974,512)	13,208,263	510,250	13,718,513
6	2020	5,419,107	3,858,894	3,547,157	3,913	1,440,607	(1,142,557)	13,127,121	507,190	13,634,312
7	2021	5,470,740	3,879,801	3,548,841	3,913	1,454,010	(1,312,084)	13,045,222	504,103	13,549,324
8	2022	5,522,866	3,900,821	3,550,526	3,913	1,467,537	(1,482,836)	12,962,828	500,997	13,463,824
9	2023	5,563,585	3,924,261	3,552,821	3,913	1,480,719	(1,654,814)	12,870,485	497,515	13,368,000
10	2024	5,609,776	3,947,685	3,552,860	3,913	1,494,506	(1,828,037)	12,780,702	494,130	13,274,833

(a) Transportation includes railroads & railways.
(b) Other includes Street & Highway Lighting, Public Authorities and Interdepartmental Sales.

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report

PUCO FORM FE-D3: ELECTRIC UTILITY OHIO SEASONAL PEAK LOAD DEMAND FORECAST
(Megawatts)

	Native Load					Internal Load			
	Year	Summer	Demand Response	Net Summer	Winter (a)	Summer	Demand Response	Net Summer	Winter (a)
-5	2009	2912			2436	2912			2436
-4	2010	2956			2474	2956			2474
-3	2011	3146			2329	3146			2329
-2	2012	3046			2424	3046			2424
-1	2013	2937			2777	2937			2777
0	2014	2923	55	2868	2499	2923	55	2868	2499
1	2015	2942	83	2859	2516	2942	83	2859	2516
2	2016	2962	110	2852	2533	2962	110	2852	2533
3	2017	2981	137	2844	2549	2981	137	2844	2549
4	2018	3000	165	2835	2565	3000	165	2835	2565
5	2019	3020	193	2827	2582	3020	193	2827	2582
6	2020	3040	220	2820	2599	3040	220	2820	2599
7	2021	3060	249	2811	2617	3060	249	2811	2617
8	2022	3081	277	2804	2634	3081	277	2804	2634
9	2023	3102	305	2797	2652	3102	305	2797	2652
10	2024	3123	306	2817	2670	3123	306	2817	2670

(a) Winter load reference is to peak loads which follow the summer peak load.

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report
Significant Change in Customer Loads

Ln	Customer	Consumption (MWh) 2010	Consumption (MWh) 2011	Consumption (MWh) 2012	Coincident Peak (MW) 2010	Coincident Peak (MW) 2011	Coincident Peak (MW) 2012
1	**REDUCTIONS/ELIMINATIONS**						
2	Customer 1	(16,723)	-	-	(3)	-	-
3	Customer 2	(153,618)	(145,516)	(71,592)	(25)	(17)	(1)
4	**TOTAL**	**(170,341)**	**(145,516)**	**(71,592)**	**(28)**	**(17)**	**(1)**
5							
6	**EXPANSIONS**						
7	Customer 3	14,006	2,045	2,123	5	1	-
8	Customer 4	6,748	18,673	(1,527)	5	4	-
9	Customer 5	31,325	16,287	2,591	1	(3)	(3)
10	Customer 6	22,435	21,472	10,370	3	3	-
11	Customer 7	12,667	14,016	3,355	1	2	1
12	Customer 8	11,038	10,938	10,928	1	1	1
13	**TOTAL**	**98,219**	**83,431**	**27,840**	**16**	**8**	**(1)**
14							
15	**TOTAL CHANGE**	**(72,122)**	**(62,085)**	**(43,752)**	**(12)**	**(9)**	**(2)**

THE DAYTON POWER AND LIGHT COMPANY
2013 Benchmark Report
Adjustment for Mercantile Customers

		Demand Savings (kW)			Energy Savings (kWh)		
Ln	Customer	2010	2011	2012	2010	2011	2012
1	**2010 Mercantile Customer Adjustment ***						
2	Customer A	499.4	499.4	499.4	1,914,690	1,914,690	1,914,690
3	Customer B	13.2	13.2	13.2	202,161	202,161	202,161
4	Customer C	294.5	294.5	294.5	959,998	959,998	959,998
5	Customer D	91.5	91.5	91.5	91,554	91,554	91,554
6	Customer E	261.5	261.5	261.5	261,565	261,565	261,565
7	Customer F	237.0	237.0	237.0	1,000,430	1,000,430	1,000,430
8	Customer G	97.1	97.1	97.1	526,864	526,864	526,864
9	**Total 2010 Adjustment**	**1,494.2**	**1,494.2**	**1,494.2**	**4,957,262**	**4,957,262**	**4,957,262**
10							
11	**2011 Mercantile Customer Adjustment ***						
12	Customer H	108.7	108.7	108.7	952,131	952,131	952,131
13	Customer I	120.5	120.5	120.5	620,513	620,513	620,513
14	Customer J	192.5	192.5	192.5	958,979	958,979	958,979
15	Customer K	-	8.1	8.1	1,310	40,600	40,600
16	Customer L	137.9	137.9	137.9	980,601	996,566	996,566
17	Customer M	-	275.2	275.2	4,410	229,417	233,127
18	Customer N	-	39.6	39.6	42,768	141,247	141,247
19	EER Exemption Applications	1,746.0	1,880.1	2,053.0	8,690,166	9,561,657	10,553,662
20	**Total 2011 Adjustment**	**2,305.6**	**2,762.6**	**2,935.5**	**12,250,878**	**13,501,110**	**14,496,825**
21							
22	**2012 Mercantile Customer Adjustment ***						
23	Customer O	-	57	57	83,276	499,656	499,656
24	Customer P	-	406	406	22,596	210,142	210,142
25	Customer Q	-	14	14	64,572	171,581	171,581
26	Customer R	2	2	2	44,856	44,855	44,855
27	Customer S	33	44	44	260,098	329,770	329,770
28	Customer T	158	158	158	785,861	785,861	785,861
29	Customer U	-	32	32	414	38,516	38,516
30	Customer V	1,720	1,720	1,720	1,120,905	1,120,905	1,120,905
31	Customer W	-	-	144	-	44,618	123,863
32	Customer X	517	517	517	982,219	2,269,477	2,269,477
33	Customer Y	-	-	162	-	19,191	209,352
34	Customer Z	313	313	313	201,505	201,505	201,505
35	Customer AA	-	-	-	37,727	43,277	43,804
36	Customer AB	365	365	365	300,316	300,316	300,316
37	**Total 2012 Adjustment**	**3,107.8**	**3,628.4**	**3,934.9**	**3,904,345**	**6,079,670**	**6,349,603**
38							
39	**2013 Mercantile Customer Adjustment ***						
40	Customer AC	-	-	8	-	5,330	86,204
41	Customer AD	-	-	8	-	-	127,922
42	Customer AE	-	3	49	3,207	39,991	599,123
43	Customer AF	23	23	23	84,096	84,096	84,096
44	Customer AG	-	-	3	-	82	10,207
45	Customer AH	-	204	204	-	292,468	542,722
46	Customer AI	-	-	24	-	69,842	189,623
47	Customer AJ	406	406	406	2,008,523	2,126,547	2,126,547
48	Customer AK	-	-	-	-	-	-
49	Customer AL	-	218	218	-	72,915	216,992
50	Customer AM	-	-	201	-	34,897	540,896
51	Customer AN	124	124	124	54,750	54,750	54,750
52	Customer AO	79	122	171	138,587	250,067	423,159
53	Customer AP	-	41	41	-	87,611	104,383
54	Customer AQ	5	49	50	89,907	362,266	368,815
55	Customer AR	-	-	-	-	-	22,615
56	Customer AS	-	7	7	5,995	35,395	35,395
57	Customer AT	10	89	89	15,380	62,977	170,839
58	Customer AU	-	-	-	-	-	-
59	Customer AV	-	-	19	-	13,213	250,906
60	Customer AW	-	-	670	-	296,710	883,003
61	Customer AX	-	649	649	71,996	1,339,124	1,339,124
62	**Total 2013 Adjustment**	**646.2**	**1,934.3**	**2,963.6**	**2,472,441.0**	**5,228,281.0**	**8,177,321.0**
63							
64	**Total 2010, 2011, 2012 & 2013 Adjustment**	**7,553.8**	**9,819.5**	**11,328.2**	**23,584,926.1**	**29,766,323.5**	**33,981,011.3**

* These Mercantile Applications (except the EER exemption applications) were approved by the Commission in 2010, 2011, 2012, and 2013 respectively under the 60 day automatic approval, pursuant to the Commission's pilot program for Mercantile Customers as established in Case No. 10-834-EL-EEC. These adjustments are prorated and based on the timeframe that the energy efficiency was achieved. The EER exemption applications were approved by the Commission in 2011 for exemption from DP&L's Energy Efficiency Rider.

DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report
2010 Weather Normalization

2010 Actual Calendar Retail Sales

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD	
Residential Non-Heating	354,522	258,858	263,664	203,306	245,866	353,434	428,783	479,014	243,507	199,042	246,067	340,943	3,617,006	
Residential Heating	314,486	234,210	169,658	97,379	97,539	116,261	140,235	129,590	93,722	98,488	142,356	270,668	1,904,592	**Peak**
Total Residential	**669,008**	**493,068**	**433,322**	**300,685**	**343,405**	**469,695**	**569,018**	**608,604**	**337,229**	**297,530**	**388,423**	**611,611**	**5,521,598**	MW
														August
Commercial	302,665	277,871	302,608	269,824	318,672	317,820	378,028	385,363	322,214	284,653	269,686	312,026	3,741,430	Actual
Industrial	254,217	271,670	274,023	299,991	319,337	352,685	305,353	306,694	317,996	309,254	302,290	268,483	3,581,993	**2956**
Public Authorities	94,835	116,238	107,316	104,585	124,228	112,401	131,524	130,471	118,374	109,601	99,925	112,041	1,361,539	
Street Railway	202	90	243	135	102	111	75	66	52	47	75	88	1,286	Load Factor[1]
Street Lighting	6,021	6,433	5,640	5,564	5,685	5,409	5,535	5,556	5,632	5,804	5,831	6,115	69,225	65.33%
Total Non-Residential	**657,940**	**672,302**	**689,830**	**680,099**	**768,024**	**788,426**	**820,515**	**828,150**	**764,268**	**709,359**	**677,807**	**698,753**	**8,755,473**	
Total Retail	**1,326,948**	**1,165,370**	**1,123,152**	**980,784**	**1,111,429**	**1,258,121**	**1,389,533**	**1,436,754**	**1,101,497**	**1,006,889**	**1,066,230**	**1,310,364**	**14,277,071**	

2010 Weather Normalized Retail Sales

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD	
Residential Non-Heating	347,836	242,522	273,403	206,303	225,285	298,401	377,019	399,263	206,555	199,921	248,281	320,566	3,345,355	
Residential Heating	301,603	200,335	189,078	122,271	93,516	104,210	128,870	112,021	85,562	108,390	147,494	227,097	1,820,447	
Total Residential	**649,439**	**442,857**	**462,481**	**328,574**	**318,801**	**402,611**	**505,889**	**511,284**	**292,117**	**308,311**	**395,775**	**547,663**	**5,165,802**	**WN Peak[2]**
														MW
Commercial	295,985	263,138	305,036	269,824	311,921	303,429	364,381	364,137	314,243	284,653	270,124	294,344	3,641,215	August
Industrial	254,217	271,670	274,023	299,991	319,337	352,685	305,353	306,694	317,996	309,254	302,290	268,483	3,581,993	WN
Public Authorities	93,023	112,924	107,316	104,585	123,580	111,007	130,209	128,436	117,525	109,601	99,925	108,285	1,346,416	**2708**
Street Railway	202	90	243	135	102	111	75	66	52	47	75	88	1,286	
Street Lighting	6,021	6,433	5,640	5,564	5,685	5,409	5,535	5,556	5,632	5,804	5,831	6,115	69,225	
Total Non-Residential	**649,448**	**654,255**	**692,258**	**680,099**	**760,625**	**772,641**	**805,553**	**804,889**	**755,448**	**709,359**	**678,245**	**677,315**	**8,640,135**	
Total WN Retail Sales	**1,298,887**	**1,097,112**	**1,154,739**	**1,008,673**	**1,079,426**	**1,175,252**	**1,311,442**	**1,316,173**	**1,047,565**	**1,017,670**	**1,074,020**	**1,224,978**	**13,805,937**	

All sales in MWh

[1] **Peak Load Factor is calculated by dividing peak month sales by the number of hours in the month then dividing the result by the peak demand [peak month sales / hours in month) / peak demand]**

[2] **Weather normalized peak is calculated by applying the peak load factor to the normalized peak month sales [(peak month sales / hours in month) / peak month load factor]**

DAYTON POWER & LIGHT COMPANY

2013 Benchmark Report

2011 Weather Normalization

2011 Actual Calendar Retail Sales

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD	
Residential Non-Heating	342,572	267,668	249,345	223,379	251,958	339,836	421,111	478,748	208,472	199,094	257,055	293,932	3,533,170	
Residential Heating	286,415	213,815	185,285	111,503	113,411	106,336	149,644	114,875	92,473	108,333	138,250	200,327	1,820,667	**Peak**
Total Residential	**628,987**	**481,483**	**434,630**	**334,882**	**365,369**	**446,172**	**570,755**	**593,623**	**300,945**	**307,427**	**395,305**	**494,259**	**5,353,837**	MW
														July
Commercial	319,462	282,583	288,681	263,869	294,243	329,869	388,778	356,272	308,971	292,237	274,516	290,478	3,689,959	Actual
Industrial	281,405	261,150	307,024	276,393	296,195	299,049	346,201	292,962	319,441	325,811	293,661	243,346	3,542,638	**3146**
Public Authorities	113,041	102,788	111,241	104,094	114,554	113,860	143,090	122,346	114,240	111,106	101,279	102,051	1,353,690	
Street Railway	78	58	90	33	64	49	61	63	69	69	72	81	787	Load Factor[1]
Street Lighting	5,958	5,773	5,777	5,582	5,650	5,524	5,571	5,417	5,584	5,915	5,683	5,985	68,419	62.14%
Total Non-Residential	**719,944**	**652,352**	**712,813**	**649,971**	**710,706**	**748,351**	**883,701**	**777,060**	**748,305**	**735,138**	**675,211**	**641,941**	**8,655,493**	
Total Retail	**1,348,931**	**1,133,835**	**1,147,443**	**984,853**	**1,076,075**	**1,194,523**	**1,454,456**	**1,370,683**	**1,049,250**	**1,042,565**	**1,070,516**	**1,136,200**	**14,009,330**	

2011 Weather Normalized Retail Sales

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD	
Residential Non-Heating	331,580	271,788	252,598	238,405	208,642	324,720	290,344	441,405	211,254	205,773	272,590	310,217	3,359,316	
Residential Heating	265,531	223,239	189,671	130,286	100,125	103,038	120,522	106,551	91,030	109,390	173,308	239,357	1,852,048	
Total Residential	**597,111**	**495,027**	**442,269**	**368,691**	**308,767**	**427,758**	**410,866**	**547,956**	**302,284**	**315,163**	**445,898**	**549,574**	**5,211,364**	**WN Peak[2]**
														MW
Commercial	308,106	285,646	289,592	263,869	288,549	326,185	353,863	346,299	319,240	294,204	276,059	300,383	3,651,995	July
Industrial	281,405	261,150	307,024	276,393	296,195	299,049	346,201	292,962	319,441	325,811	293,661	243,346	3,542,638	WN
Public Authorities	109,706	103,216	111,241	104,094	114,178	113,477	139,686	121,372	115,059	111,338	101,279	102,546	1,347,192	**2717**
Street Railway	78	58	90	33	64	49	61	63	69	69	72	81	787	
Street Lighting	5,958	5,773	5,777	5,582	5,650	5,524	5,571	5,417	5,584	5,915	5,683	5,985	68,419	
Total Non-Residential	**705,253**	**655,843**	**713,724**	**649,971**	**704,636**	**744,284**	**845,382**	**766,113**	**759,393**	**737,337**	**676,754**	**652,341**	**8,611,031**	
Total WN Retail Sales	**1,302,364**	**1,150,870**	**1,155,993**	**1,018,662**	**1,013,403**	**1,172,042**	**1,256,248**	**1,314,069**	**1,061,677**	**1,052,500**	**1,122,652**	**1,201,915**	**13,822,395**	

All sales in MWh

[1]**Peak Load Factor is calculated by dividing peak month sales by the number of hours in the month then dividing the result by the peak demand [peak month sales / hours in month) / peak demand]**

[2]**Weather normalized peak is calculated by applying the peak load factor to the normalized peak month sales [(peak month sales / hours in month) / peak month load factor]**

DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report
2012 Weather Normalization

2012 Actual Calendar Retail Sales

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD	
Residential Non-Heating	329,303	260,920	236,382	201,656	270,233	340,123	459,607	418,632	213,603	196,142	269,131	296,898	3,492,630	
Residential Heating	243,991	197,327	134,751	103,378	104,160	112,887	141,893	112,739	92,222	112,065	169,646	195,421	1,720,480	**Peak**
Total Residential	**573,294**	**458,247**	**371,133**	**305,034**	**374,393**	**453,010**	**601,500**	**531,371**	**305,825**	**308,207**	**438,777**	**492,319**	**5,213,110**	MW
														July
Commercial	314,708	284,805	279,806	278,358	318,225	341,967	371,142	351,883	303,745	300,496	272,913	291,068	3,709,116	Actual
Industrial	300,825	308,639	293,420	301,278	338,663	311,766	326,712	306,547	309,384	324,197	273,857	272,105	3,667,393	**3046**
Public Authorities	113,426	104,904	102,945	103,948	116,891	114,807	130,904	120,297	118,697	111,400	98,157	103,651	1,340,027	
Street Railway	110	161	144	131	135	145	126	133	134	130	149	137	1,635	Load Factor[1]
Street Lighting	6,156	5,695	5,639	5,488	5,620	5,417	5,273	5,477	5,466	5,802	5,571	5,910	67,514	55.55%
Total Non-Residential	**735,225**	**704,204**	**681,954**	**689,203**	**779,534**	**774,102**	**834,157**	**784,337**	**737,426**	**742,025**	**650,647**	**672,871**	**8,785,685**	
Total Retail	**1,308,519**	**1,162,451**	**1,053,087**	**994,237**	**1,153,927**	**1,227,112**	**1,435,657**	**1,315,708**	**1,043,251**	**1,050,232**	**1,089,424**	**1,165,190**	**13,998,795**	

2012 WN Calendar Retail Sales

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD	
Residential Non-Heating	343,285	275,532	254,842	209,117	210,663	292,106	323,008	402,351	213,966	193,718	265,049	319,630	3,303,267	
Residential Heating	274,576	232,396	215,869	110,804	92,445	102,468	111,216	109,073	90,846	105,733	159,815	250,812	1,856,053	
Total Residential	**617,861**	**507,928**	**470,711**	**319,921**	**303,108**	**394,574**	**434,224**	**511,424**	**304,812**	**299,451**	**424,864**	**570,442**	**5,159,320**	**WN Peak[2]**
														MW
Commercial	326,725	293,741	274,647	278,687	294,259	331,512	334,485	347,512	312,018	300,496	271,907	303,863	3,669,852	July
Industrial	300,825	308,639	293,420	301,278	338,663	311,766	326,712	306,547	309,384	324,197	273,857	272,105	3,667,393	WN
Public Authorities	115,910	105,368	102,945	103,948	114,712	113,622	127,316	119,869	119,304	111,400	98,157	103,651	1,336,202	**2872**
Street Railway	110	161	144	131	135	145	126	133	134	130	149	137	1,635	
Street Lighting	6,156	5,695	5,639	5,488	5,620	5,417	5,273	5,477	5,466	5,802	5,571	5,910	67,514	
Total Non-Residential	**749,726**	**713,604**	**676,795**	**689,532**	**753,389**	**762,462**	**793,912**	**779,538**	**746,306**	**742,025**	**649,641**	**685,666**	**8,742,596**	
Total WN Retail Sales	**1,367,587**	**1,221,532**	**1,147,506**	**1,009,453**	**1,056,497**	**1,157,036**	**1,228,136**	**1,290,962**	**1,051,118**	**1,041,476**	**1,074,505**	**1,256,108**	**13,901,916**	

All sales in MWh

[1]Peak Load Factor is calculated by dividing peak month sales by the number of hours in the month then dividing the result by the peak demand [peak month sales/hours in month)/peak demand]

[2]Weather normalized peak is calculated by applying the peak load factor to the normalized peak month sales [(peak month sales/hours in month)/peak month load factor]

THE DAYTON POWER & LIGHT COMPANY
2013 Benchmark Report
Weather Normalization Factors

Year	Actual Calendar Retail Sales[1]	Weather Normalized Retail Sales[2]	Energy Weather Normalization Factor[3]
	(a)	(b)	(c)
2010	14,277,071	13,805,937	0.96700
2011	14,009,330	13,822,395	0.98666
2012	13,998,795	13,901,916	0.99308

	Actual System Peak Demands[1]	Weather Normalized Peak Demands[2]	Demand Weather Normalization Factor[3]
2010	2,956	2,708	0.91610
2011	3,146	2,717	0.86364
2012	3,046	2,872	0.94288

[1] Workpaper E1-E3.

[2] Weather normalization sales and peaks are based on normal heating and cooling degree day adjustments (Workpaper E1-E3).

[3] Weather normalization factor (c)= (b)/(a).

2013 Evaluation, Measurement, and Verification Report

May 12, 2014

Dayton Power and Light
1900 Dryden Rd,
Dayton, Ohio 45439

The Cadmus Group, Inc.

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Prepared by:
Cadmus

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Executive Summary

In 2013, Dayton Power and Light (DP&L) filed a three-year Energy Efficiency and Demand Response Plan, which outlined a portfolio of residential and business programs in response to Senate Bill 221 (S.B. 221). This plan articulated the continuation of programs established in DP&L's first three-year portfolio plan, filed in 2010 and ultimately approved by the Public Utilities Commission of Ohio (PUCO) by Opinion and Order dated April 27, 2011.

DP&L selected Cadmus to evaluate its residential and commercial energy-efficiency portfolio for the 2013 program year. This represented a continuation of evaluation services Cadmus performed for program years 2009 through 2012. This document summarizes results from Cadmus' evaluation of DP&L's 2013 programs—the fifth such evaluation effort.

Primary impact evaluation objectives included:

- Assess the appropriateness of the programs' gross *ex ante* claimed savings;
- Calculate gross *ex post* saving estimates; and
- Determine program and portfolio cost-effectiveness.

Primary process evaluation objectives included:

- Assess overall satisfaction with the programs;
- Identify any program design and delivery changes that would improve performance;
- Assess the effectiveness of program marketing and outreach; and
- Identify barriers and assess how effectively the programs overcome them.

DP&L's 2013 annual kWh and peak demand reduction goals represent approximately 32% and 33%, respectively, of its three-year filed goals. Table 1 provides DP&L saving results by program; both as *ex ante* claimed and evaluated adjusted gross. DP&L exceeded its overall 2013 kWh and kW filed goals.

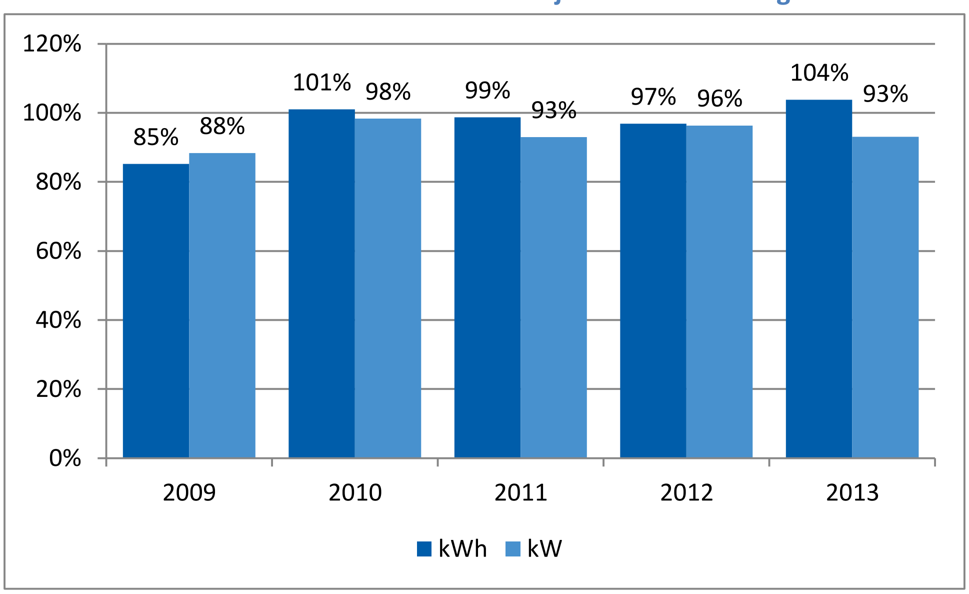
Table 1. Overall Evaluation Results

Program	2013 Program Goals*		*Ex Ante* Claimed Savings		Verified Gross Savings		Adjusted Gross Savings	
	kWh	kW	kWh	kW	kWh	kW	kWh	kW
Residential								
Lighting	58,317,636	5,075	69,388,980	8299	69,388,980	8,299	70,936,412	7,503
Appliance Recycling	3,072,452	505	3,094,504	494	3,094,504	494	2,556,001	408
Low-Income	1,118,222	147	1,249,044	223	1,308,106	183	1,286,599	164
HVAC Rebates and Diagnostic Tune-ups	8,883,567	2,699	6,937,760	1962	6,937,760	1962	6,893,788	1,374
Be E3 Smart	2,476,146	20	3,646,598	229	3,030,093	195	2,983,764	209
Commercial and Industrial								
Prescriptive	47,180,000	8,293	59,237,677	11,009	60,245,855	11,109	65,208,283	11,771
Custom	21,147,367	3,880	16,815,917	3,432	16,518,498	3,126	16,466,532	2,416
Total	**142,195,390**	**20,619**	**160,370,480**	**25,648**	**160,523,796**	**25,368**	**166,331,379**	**23,845**

*Goals filed in DP&L's 2013–2015 Energy-Efficiency and Demand Response Plan filed April 15, 2013 under case No. 13-0833-EL-POR.

Cadmus found portfolio-level realization rates to be 104% for energy savings and 93% for demand reductions compared to *ex ante* claimed. These rates are generally in line with realization rates observed in our previous evaluation efforts. Figure 1 provides additional detail.

Figure 1. Historical Portfolio-Level *Ex Ante* and Adjusted Gross Savings Realization Rates



In general, DP&L realization rates have been very close to a 100% for energy savings and just slightly under for demand in all years except 2009, which was the start of their programs. In general, differences between *ex ante* claimed and adjusted gross saving are the result of differences in calculation methodology, sources or data available at the time, or both. For example, the Residential Lighting Program, DP&L claimed kWh and kW savings from the Ohio TRM to estimate kWh and demand savings for residential lighting, whereas Cadmus used the Ohio TRM as a guiding document but updated the analysis to be more in line with more current calculation methodologies, such as the Unified Methods Protocol. For these situations, the difference is due to the use of different calculation sources and methods. Another example is with the lower than anticipated kW demand for the Nonresidential Custom program. Cadmus determined DP&L program consultants had appropriately modeled and estimated the savings with the best available data at that time. However, Cadmus had the benefit of billing data to refine the energy models where the third-party engineering firms were forced to predict the actual kWh and kW usage. In other instances, the difference is due to calculation errors as is the case with the Low Income Program.

Four portfolio programs achieved their 2013 kWh and kW filed savings goals (compared against adjusted gross savings). Exceptions included Residential Appliance Recycling (although it achieved its goal based on ex ante values), Heating and Cooling Rebate, and Nonresidential Custom programs. These programs produced less-than-expected savings primarily due to lower-than-anticipated participation. In the case of the Appliance Recycling program, the continued decrease in unit age and the energy standards of the early 1990’s is making a large impact in the decreased savings per unit.

The overall portfolio proved cost-effective, with a total resource cost (TRC) of 2.00.[1] Individual residential programs, however, fell below the 1.0 TRC benefit/cost ratio, including the residential HVAC programs (Heating and Cooling Rebate and Tune-Up) and the Low Income program. Both commercial and industrial programs proved cost-effective from a TRC perspective, while the Mercantile program fell short due to the high cost of a small number of projects. However, as outlined by the PUCO, the utility cost test (UCT) is the primary threshold used to determine cost-effectiveness for this program. The UCT for the Mercantile program is 5.65.

In a project spanning multiple years, DP&L converted approximately 119 miles of its 4 kV distribution system to 12 kV, reducing the current flowing through its system by roughly two-thirds. While this project was not part of the current evaluation plan, DP&L requested Cadmus review projected savings from this conversion. Cadmus estimates that over 34,800 MWh of savings were generated from this project. Specific details of this project and estimates are detailed later in this report.

DP&L improved data tracking for three key programs: Residential Low-Income, Nonresidential Prescriptive, and Nonresidential Custom. While these tracking systems were first implemented in 2012, 2013 is the first year they have been fully utilized. All three programs have moved to tracking data via an online database. Cadmus reviewed the databases. A few areas for improvement were identified in the program data tracking which were discussed with DP&L and other stakeholders and noted in the sections below.

Participants across all programs surveyed continue show high levels of satisfaction for most delivery elements, i.e., rebate amount, energy savings, incented equipment, and overall program experience.

[1] Note that in 2013 cost-effective results reflect *ex-ante* claimed savings, compared to previous evaluation years, where adjusted gross numbers were modeled.

Introduction and Purpose of the Study

For the impact evaluations, Cadmus assessed and documented program savings, including the gross savings relative to *ex ante* claimed saving values.

For the process evaluations, Cadmus sought to achieve the following:

- Document satisfaction and feedback from the perspectives of program and implementation staff, and of participant and market actors; and
- Provide timely feedback to enable program process improvements.

Table 2 provides this evaluation effort's general researchable questions and supporting activities. The various sections that follow present program-specific researchable questions.

Table 2. Overall Researchable Questions and Supporting Activities

Researchable Question	Activity Used to Address Question
What changes to design and delivery would improve program performance?	• Program and implementation staff interviews • Participant contractor/retailer and customer surveys • Program database review
How effective have the programs been in recruiting and training market actors?	• Program and implementation staff interviews • Participant contractor/retailer surveys
What barriers exist to increased customer participation, and how effectively do the programs address those barriers?	• Program and implementation staff interviews • Participant contractor/retailer and customer surveys
What gross and demand reductions did the programs achieve?	• Program database review • Data verification • Engineering analysis • Regression analysis
How satisfied were customer and market actors with the program?	• Participant contractor/retailer and customer surveys
Were the programs cost-effective? Was the portfolio cost-effective?	• Cost-effectiveness tests

Overall Evaluation Methodology

Cadmus evaluated each program using a unique set of techniques and activities. Primary evaluation activities included the following:

- Using engineering calculations to verify program *ex ante* claimed savings and to determine adjusted program gross kWh savings and kW reductions.
- Performing site visits to verify measure installations.
- Developing statistical regression models to determine adjusted gross program savings.
- Conducting a detailed review of project documentation, calculations, audit reports, and assumptions.

- Conducting telephone surveys with participants and market actors to evaluate program processes and to inform the impact evaluation.
- Benchmarking important metrics from each program evaluation against those from recent comparable programs to provide additional context in interpreting the results.

The tables below present the following:

- ***Ex Ante* Claimed Savings:** Savings based on *ex ante* participation and calculation assumptions. Dayton Power and Light (DP&L) used multiple sources for claimed savings—primarily the State of Ohio Energy Efficiency Technical Reference Manual (Ohio TRM),[2] and results from previous Cadmus evaluation work. Therefore, *ex ante* savings and adjusted gross savings may be similar when DP&L applies preliminary evaluation results. Appendix B: *Ex Ante* Measure-Level Savings provides a detailed summary of the sources of *ex ante* claimed savings by measure.
- **Verified Gross Savings:** Savings resulting from adjustments to *ex ante* participation, based on phone or on-site verification. The unit energy savings (UES) estimation approach (e.g., Ohio TRM or deemed savings) remained the same as *ex ante* claimed savings.
- **Adjusted Gross Savings:** Savings due to adjustments in *ex ante* participation, based on phone or on-site verification, and adjustments to UES and per-unit demand reduction estimates, based on engineering reviews of savings, statistical models, or other approaches.[3]

Adjusted gross savings represent final evaluated *ex post* gross saving estimates. Each program-specific section provides a detailed explanation of adjustments made to calculate verified and adjusted gross savings.

Threats to Validity

Known threats to this evaluation's validity, possible bias sources, and the methods used to address these issues follow:

- For the Appliance Recycling Program (ARP), Cadmus assessed sources of uncertainty and bias resulting from differences in the implementer's assessment of appliance characteristics, specifically the age and usage of units. Implementer staff may receive different training in regard to recognizing qualifying units (e.g., age, working condition), all of which would be uploaded into the tracking database, thus potentially causing bias.

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[2] The Ohio TRM was filed August 6, 2010, under Case No. 09-0512-GE-UNC.

[3] In several cases using Ohio TRM calculations or assumptions, Cadmus incorporated feedback from the Joint Objections and Comments to the August 6, 2010, *Technical Resource Manual* from Ohio Edison Company, the Cleveland Electric Illuminating Company, the Toledo Edison Company, Columbus Southern Power Company, Ohio Power Company, Duke Energy Ohio, Inc., DP&L, and Industrial Energy Users-Ohio, filed November 3, 2010, in PUCO Case No. 09-512-GE-UNC (*Ohio TRM Joint Objections and Comments*). Where appropriate, the text notes this.

- Across all programs, to address telephone survey non-response bias, Cadmus utilized survey best practices, including: calling at different times of day; calling on weekends; and scheduling callbacks.
- Across all programs, Cadmus weighted survey data, collected through stratified samples prior to analysis, to address possible sampling bias.
- In all cases using regression models, Cadmus made every attempt to guard against errors associated with omitted variables, improper functional forms, and inclusion of erroneous data.

Description of Programs Covered in Study

In 2013, DP&L offered five residential[4] and two commercial and industrial programs (the evaluation did not include mercantile customer participation or associated savings). Table 3 provides reported participation by program. For all programs, Cadmus encountered the number and mix of participants anticipated when developing the evaluation plans.

Table 3. Claimed Program Participants

Program	Reported Quantity	Unit Type
Lighting	1,585,049	Compact fluorescent lamps (CFLs) sold
Appliance Recycling	2,890	Recycled appliances
Low-Income	387	Homes
HVAC Rebates and Diagnostic Tune-ups	5,145*	Equipment rebated or tuned-up
Be E3 Smart	9,003	Energy education kits distributed
Prescriptive	1,044	Projects
Custom	115	Projects

*Includes 35 tune-ups that failed the test-out component of the measure. These tune-ups were not included in Cadmus' impact assessment.

The 2013 *DP&L Annual Portfolio Status Report* presents program overviews in the program-specific sections provided on pages 14 through 89.

4 In program year 2013, DP&L ramped down the Residential HVAC Diagnostic and Tune-Up program. The Residential HVAC Rebates program section includes program participants and claimed savings for the HVAC Tune-Up program.

Residential Lighting Program

This chapter describes the evaluation approach, detailed findings, conclusions, and recommendations for the Residential Lighting Program.

Evaluation Overview

Cadmus' evaluation of the 2013 Residential Lighting Program followed the researchable questions and evaluation activities outlined in the DP&L *2010-2012 Evaluation, Measurement, and Verification Plan* and the DP&L *2013 Evaluation, Measurement, and Verification Plans* documents. Table 4 identifies key researchable evaluation questions.

Table 4. Key Researchable Questions

Researchable Question	Activity Used to Address Question
What are the program's gross savings?	• Review of secondary sources, the Ohio TRM, and the program database
Are 100 watt and 75 watt incandescent bulbs available for purchase in DP&L territory stores?	• Retail inventory survey • Distributor and retailer interviews
What are the CFL saturation and installation rates?	• Lighting inventory of customer homes

Detailed Evaluation Findings

DP&L surpassed its savings goals of 58,317,636 kWh and 5,075 kW by achieving 70,936,412 kWh and 7,503 kW in adjusted gross savings. These adjusted gross savings represent realization rates of 102% and 90% against *ex ante* claimed energy and demand savings respectively. Overall, the energy realization rate is driven by updating the delta watts methodology and the demand realization rate by updating the demand waste heat factor input. Specifics on both are outlined below.

Through the inventory study Cadmus found a large increase in CFL saturation levels compared to the first inventory study performed in 2010 (15% to 28%)—a jump driven in-part by the continued success of the residential lighting program. However, even with this large increase in CFL saturation there still remains a high percent of sockets (approximately 40%) that are considered "low hanging fruit".

The program staff interviews, manufacturer interviews and point-of-purchase (POP) marketing review found similar conclusions related to topics such as satisfaction, LEDs and EISA. In general, manufacturers are very pleased with the program and support the inclusion of LEDs in the program in 2014. Lastly, the increased variety of bulb types and technologies that is driven in part by EISA requires continued and additional consumer education to ensure consumers are satisfied with their efficient lighting purchases.

The following key findings relate to the impact and process evaluation:

- Program *ex ante* claimed and adjusted gross savings and demand reduction are provided in Table 5.

Table 5. Residential Lighting Program Claimed and Achieved Energy Savings

Program	*Ex Ante* Claimed Savings		Verified Gross Savings		Adjusted Gross Savings		
	kWh	kW	kWh	kW	kWh	kW	Precision*
CFL	69,388,980	8,299	69,388,980	8,299	70,936,412	7,503	±15%

*Precision at 90% confidence.

- As shown in Table 5, *ex ante* demand reduction is lower than adjusted demand reduction. The slightly lower adjusted gross demand savings (compared to the *ex ante* demand) is due to using a waste heat factor for demand (WHF_D) of 1.06. The *ex ante* values use the Ohio TRM value of 1.21.
- Site visits revealed large increases in efficient lighting saturations levels. CFL saturations increased by almost 13%, from 15% to just under 28%, since the early stages of the Residential Lighting Program (with prior site visits conducted in mid-2010). Site visit findings also indicate significant opportunity remains for achieving efficient lighting in homes. Fifty-one percent of screw-based sockets still contained inefficient bulbs. Furthermore, 79% of these screw-based sockets offered high savings potential, as they are connected to on/off switches, which represent a good opportunity for the standard spiral CFL. This represents about 40% of total sockets (79% x 51% = 40%) that reasonably can be expected to receive efficient lighting installations.
- Through retail phone surveys, Cadmus found that 100 watt incandescent availability persisted approximately halfway through 2013, some 18 months after EISA standards took place. The same surveys found that the availability of 75 watt incandescent bulbs remained above 30% through 2013, some 12 months after EISA implementation. Cadmus found strong agreements between these results and other secondary sources. This persistent availability allowed Cadmus to adjust the baseline used in calculating the delta watts, thus phasing in impacts from EISA efficiency standards more gradually.
- Primary data collection conducted in 2011 by Cadmus in DP&L's territory found approximately 5% of incented CFLs purchased from retailers were installed in commercial applications. Thus, results in Table 5 reflect 95% of bulb sales, with 5% of the program sales shifted to the Nonresidential Prescriptive program.
- Process evaluation findings indicated that inclusion of light-emitting diode (LED) bulbs in the Residential Lighting program will be received well by manufacturers, retailers, and customers. Customers have asked for LEDs, and manufacturers believe the technology will grow to become a large piece of the efficient lighting market. DP&L's decision to add LEDs to the program in 2014 also proved timely, as most current LED technologies replace 60 watt and 40 watt incandescent equivalent bulbs, which EISA phases out in 2014.
- The process evaluation found EISA and the many efficient lighting options present new marketing challenges. The marketing review (and comments from several manufacturers)

revealed a need for marketing to play a role in educating consumers about which lighting types and technologies to purchase for different applications.

Evaluation Data Collection Methods

On-Site Lighting Inventory

Cadmus visited 77 residential homes to gather primary information to inform the evaluation and future program planning. During the inventory study, Cadmus collected the following lighting information from each home.

Table 6. Data Collected for Inventory Study

Inventory Study Field	Example
Room type	Living area, kitchen, bedroom
Fixture type	Table lamp, ceiling fixture, recessed fixture
Bulb type	CFL, incandescent, LED
Bulb shape	Spiral, A-lamp, globe
Bulb wattage	13, 100, 60
Specialty feature	Dimmable, three-way
Socket type	Medium screw base, pin-base, candelabra

Retailer Inventory

Using telephone surveys conducted quarterly, Cadmus determined the incandescent bulb inventories of retailers in DP&L’s territory. Cadmus conducted the surveys by calling the stores and inquiring as to purchase incandescent bulbs. The survey results informed the incandescent baseline wattages in the adjusted gross savings calculations.

Lighting Manufacturer Interviews

Cadmus conducted telephone interviews with six manufacturers to gain insights into how well the program worked, whether it met retailers’ expectations, and identification of possible program improvements. Interviews also explored purchasing, stocking, and sales trends for specialty CFLs and LEDs, and EISA’s impact on sales and inventories.

Point-of-Purchase Marketing Material Review

Cadmus reviewed 2013 POP material to assess strategy and implementation, and to identify program marketing gaps and/or opportunities.

Impact Evaluation Methodology and Findings

Cadmus analyzed the resulting data and calculated the saturations shown in Figure 2 from on-site surveys. Saturation equaled the proportion of total installed bulbs attributable to a particular bulb type.

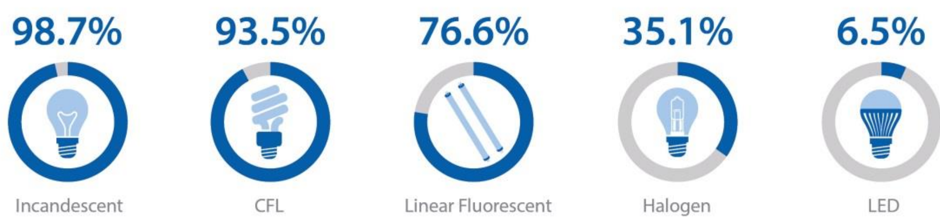
Figure 2. Bulb Saturation

Comparing these saturations to those found in the 2010 inventory study, as shown in Figure 3, revealed significant increases in LED and CFL saturation rates.

Figure 3. Growth in Saturation Levels

Figure 4 shows the calculated penetration rates, which represent the proportion of participating homes where at least one bulb of a specified type had been installed.

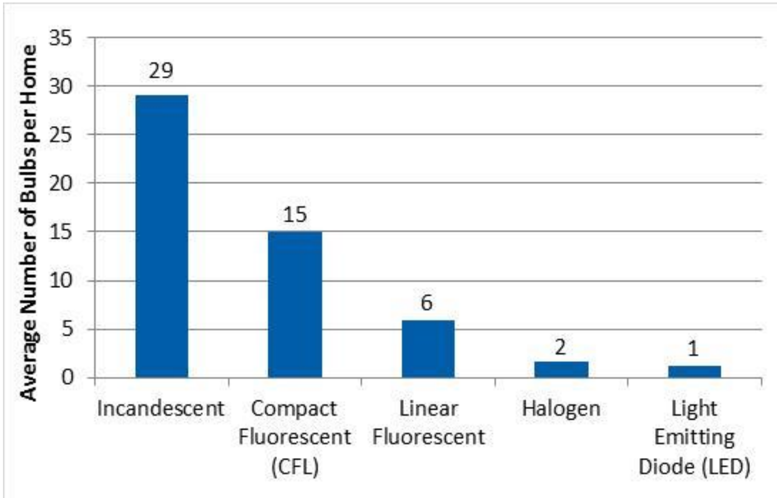
Figure 4. Bulb Penetration



Nearly all homes (98.7%) had incandescent bulbs installed, and almost as many homes (93.5%) had CFLs installed. Just over three-quarters (76.6%) of all homes had linear fluorescent bulbs, and 6.5% of the population had at least one LED installed.

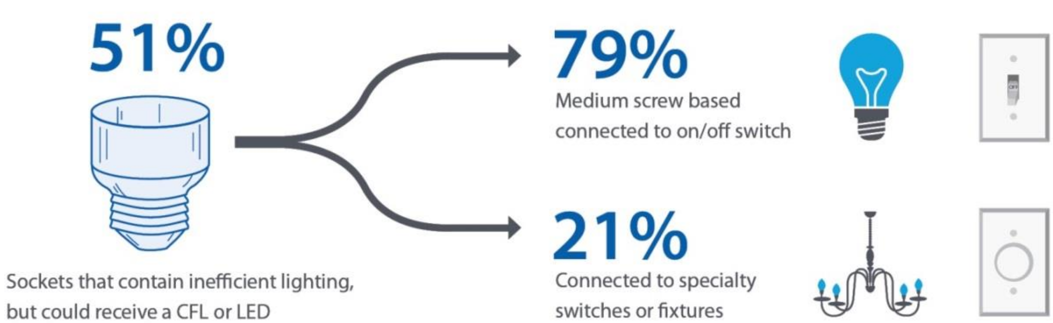
Figure 5 compares the average number of bulb types installed per home. Incandescent bulbs represented more than one-half of the bulbs installed in all socket types, with an average of 29 incandescent bulbs installed per site. CFLs were installed in 27.7% of all socket types, for an average of 15 CFLs per site. Though 6.5% of homes reported installing LEDs, these only made up 2.2% of all bulbs installed. The study found a typical home in DP&L’s service territory had 53.3 bulbs installed.

Figure 5. Average Bulbs per Home by Type



Combining the above light bulb inventory information provided a snapshot of the remaining opportunities for efficient lighting in DP&L's service territory. The percentages in Figure 6 show 51% of all sockets could receive a CFL or LED, and 79% of those sockets represent low-hanging fruit for DP&L's Residential Lighting Program: medium screw-based, inefficient lights attached to an on/off switch. Customers are far more likely to replace these standard bulbs with efficient lighting than they would fixtures and switches connected to specialty bulbs.

Figure 6. Remaining Opportunity



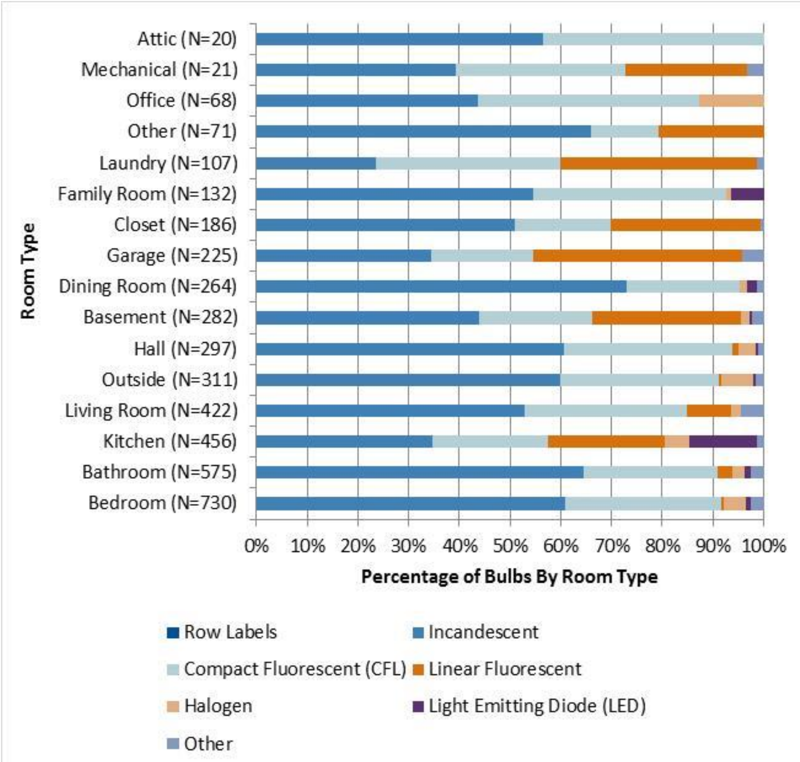
As shown by the dark blue bars in Figure 7, incandescent bulbs were most frequently installed in many rooms and represented at least 50% of installed bulbs in all rooms (except for mechanical rooms, offices, laundry rooms, garages, basements, and kitchens).

Significant bulb distributions installed in each room type included CFLs and linear fluorescents:

- CFLs constituted 13% to 44% of installed bulbs in all rooms.
- Linear fluorescents were most commonly used in garages, laundry rooms, closets and basements (41%, 39%, 30%, and 29%, respectively).

LEDs constituted a small percentage of overall bulbs per room, most commonly found in kitchens and family rooms (with 13% and 7% installed in these rooms).

Figure 7. Bulb Type Distribution By Room Type



Calculating Adjusted Gross Savings

Cadmus used the following approaches and algorithms to evaluate the 2013 Residential Lighting Program:

$$\Delta kWh = \frac{\Delta WM}{1,000} * ISR * HOU * 365 * WHF_e$$

$$\Delta kW = \frac{\Delta WM}{1,000} * ISR * WHF_d * CF$$

Where:

ΔWM	= delta watts multiplier
ISR	= in-service rate
HOU	= hours of use [hours/day]
WHF_e	= waste heat factor for energy
WHFd	= waste heat factor for demand
CF	= summer peak coincidence factor

Table 7 shows the values used to calculate energy and demand reduction for *ex ante*, verified, and adjusted gross savings. Additional details follow.

Table 7. 2013 Lighting Evaluation Inputs

Savings Algorithm Input	*Ex Ante* Inputs (Ohio TRM)	Verified Inputs (Ohio TRM)	Adjusted Residential Inputs
HOU	2.85	Same as *ex ante*	2.85
WHF_e	1.07	Same as *ex ante*	1.06
WHF_d	1.21	Same as *ex ante*	1.06
ISR	0.86	Same as *ex ante*	0.86*
ΔWM	3.25	Same as *ex ante*	3.20**
ΔWM (21W+)	2.06	Same as *ex ante*	3.20**
CF	0.11	Same as *ex ante*	0.11

*Residential ISR was used to calculate commercial savings.

**Calculated using the lumens equivalency method: this value reflected a weighted average of delta watts multipliers for all rebated bulbs, including CFLs, reflectors, three-ways, and candelabras. The weighted average *ex ante* DWM is 3.06.

Installation Rate

Cadmus calculated a 78% installation rate using data from the inventory study—a result similar to the 76% calculated from 2010 site visits and the 77% recommended by the Ohio TRM. Since statistical differences could not be detected between these results, Cadmus deferred to the Ohio TRM value, resulting in an 86% final installation rate after adjusting for installation of bulbs in storage over time.

Hours of Use

Cadmus used the Ohio TRM hours of use (HOU) value of 2.85 hours per day to calculate savings for residential bulbs sold through the program. In 2012, Cadmus estimated the HOU using a statistical model, utilizing a pooled set of light logger data from evaluations in various states, including Maryland, Missouri, Maine, and Michigan, and the 2009 DP&L evaluation. Cadmus modeled HOU as a function of: room type, existing CFL saturations, and the presence of children in a home. That model estimated 2.26 hours per day. In 2011, the same model, containing fewer pooled meters, estimated 2.39 hours.

Cadmus used the 2.85 hours per day value as a literature review, conducted for the previous evaluation, indicated it fell within the bounds of other HOU values. However, as Ohio CFL saturation levels increase due to the success of utility programs, CFL HOU estimates may need to be revisited. The preferred approach for revising the Ohio TRM HOU would be through a state-wide study, perhaps coordinated by the public utilities commission. This would likely provide the highest levels of precision and confidence through use of larger sample sizes than a single utility should support.

Waste Heat Factor

Cadmus used a 1.06 waste heat factor (WHF) when calculating energy and demand reduction—the same values as that used in the previous Cadmus evaluation, but, for 2013, updated with indoor/outdoor weighting to reflect the 2013 inventory study results. The inventory study found the exact same percentage of bulbs installed outside as that found in site visits conducted during 2009 (8%). Since the percentage of bulbs installed outdoors did not change, WHF values remained unchanged. Cadmus applied the Indoor/outdoor weighting after a review of the Ohio TRM WHF value of 1.07 indicated it did not consider bulbs installed outside.

Coincidence Factor

Consistent with the previous evaluations, Cadmus used a 0.11 coincidence factor to determine demand reduction. As the Ohio TRM used a coincidence factor of 0.11 and the Ohio TRM *Joint Objections and Comments* document suggested a coincidence factor of 0.16, Cadmus performed a high-level review of coincidence factors from other comparable TRMs. The 0.11 value fell in line with other TRM values. Given these comparisons, using the 0.11 value appeared reasonable.

Retail Inventory Survey

The EISA efficiency standards set in 2007 prohibited production (but not sale) of 100 watt and 75 watt incandescent bulbs in 2012 and 2013, respectively. Despite the new standards, most stores selling these bulbs before the efficiency standards took effect continued to sell them afterwards, due to existing inventories. The continued availability of these bulbs presents implications for the baseline of efficient bulbs sold through the Residential Lighting Program. EISA efficiency standards limited the wattage of 100 watt and 75 watt bulbs to 72 watts and 53 watts, respectively. Evaluating savings purely based on a Federal code baseline would require using 72 watts and 53 watts as the baseline for these bulbs. However, 100 watt and 75 watt bulbs remained widely available within DP&L's service territory. Cadmus quantified this availability through retail surveys and calculated a blended baseline reflecting this availability.

To quantify the availability of 100 watt and 75 watt incandescent bulbs, Cadmus implemented a quarterly survey of retail stores selling light bulbs in DP&L's service territory. The survey targeted stores that sold the most program bulbs, calling stores that represent 90% of the2012 program bulb sales. This amounted to calling just over 50 stores. Cadmus telephoned these stores quarterly, looking for 100 watt and 75 watt standard, incandescent bulbs.

Figure 8 and Figure 9 show the unweighted results of these quarterly surveys in dark blue. The plotted percentages represent the number of stores with inventories of the given bulbs: 100% indicated all stores carried the bulb, while 0% indicated none of the stores carried the bulb. The figures also compare results from several different studies (both retail phone surveys and shelf stockings studies).

Figure 8. Survey Results for 100 Watt Incandescent Bulb Availability

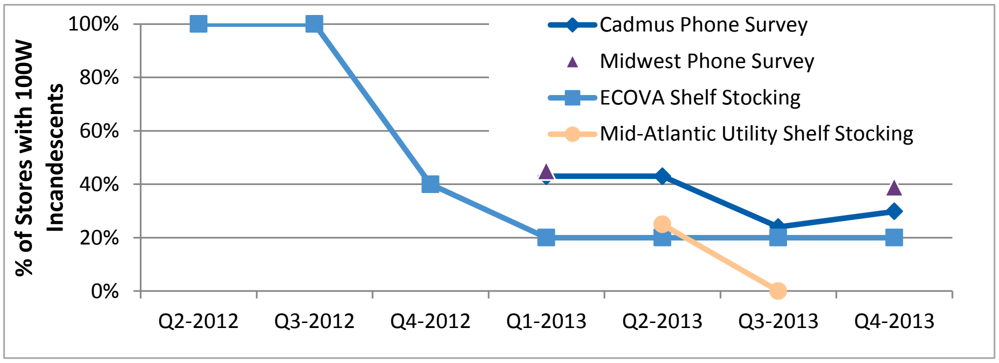
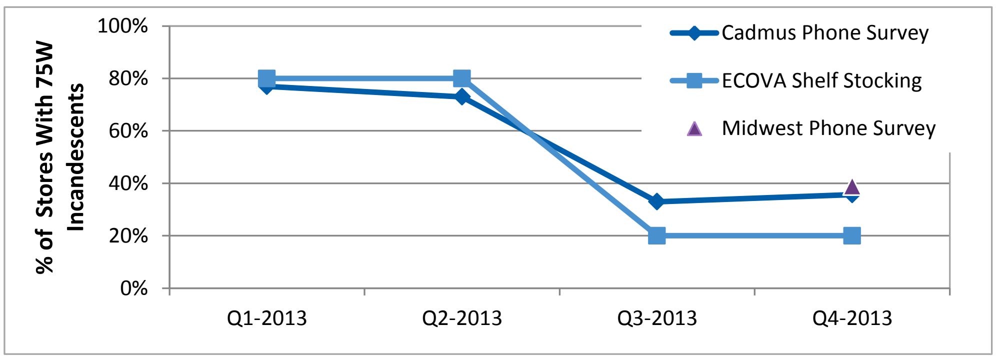


Figure 9. Survey Results for 75 Watt Incandescent Bulb Availability



As shown in Figure 8, Cadmus found 100 watt incandescent availability persisted above 40% halfway through 2013; 18 months after EISA standards took place. Figure 9 shows 75 watt incandescent availability above 30% persisted through 2013, 12 months after EISA implementation. The figures also strongly agree in tracking the availability between different sources.

Table 8 provides unweighted and weighted results by quarter for each bulb type (the first and last rows, respectively). Cadmus weighted each store's results by the quantity of program bulbs the store sold in 2012. Weighted results provided a more representative snapshot of bulb availability in the territory.

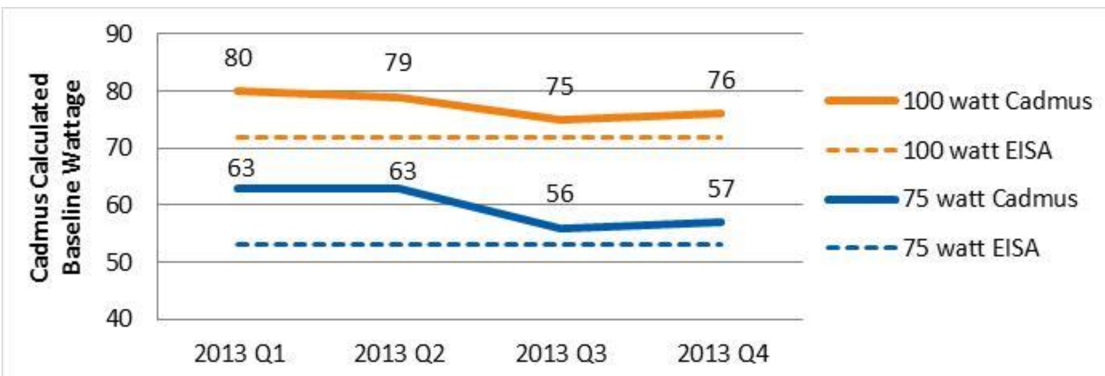
Table 8. Incandescent Bulb Availability

Question: "Do you have any 100/75 Watt incandescent bulbs in stock?"	100 Watt				75 Watt			
	2013 Q1	2013 Q2	2013 Q3	2013 Q4	2013 Q1	2013 Q2	2013 Q3	2013 Q4
Stores with inventory: any amount	43%	43%	24%	30%	77%	73%	33%	36%
Stores with inventory: 10 or more	42%	39%	24%	28%	77%	71%	31%	34%
Stores with inventory: fewer than 10	2%	4%	0%	2%	0%	2%	2%	2%
Stores with inventory: any amount; result weighted by number of bulbs store sold in 2012	28%	24%	10%	14%	47%	45%	15%	18%

Lighting Baseline and Delta Watts

Cadmus applied the lumens equivalency method,[5] coupled with results from the retail inventory surveys, to determine the appropriate baseline and watts for the 2013 Residential Lighting Program. The lumens equivalency method based the appropriate baseline on the light output (lumens) of the efficient bulb. Cadmus calculated delta watts for the adjusted savings using the baseline wattages shown in Figure 10.

Figure 10. Incandescent Baseline Shift for General Service Lamps



Incandescent baselines update each quarter, based on the weighted availability of bulbs (the last row of Table 8). For example, in 2013's fourth quarter, 14% of stores still sold 100 watt incandescents, putting the baseline at 76 watts, just above the EISA stipulated baseline of 72 watts. Cadmus used this incandescent baseline of 76 watts to calculate adjusted savings for 100 watt equivalent CFLs sold in the 4th quarter of 2013. Baselines for 60 watt and 40 watt equivalent bulbs do not change until 2014, when the EISA requirements for these bulbs take effect. Figure 10 shows incandescent equivalent bulbs, grouped by the bulb's lumens output, per the EISA standard as shown in Table 9. These lumen bins apply to general service lamps.

5 The method recommended by the Uniform Methods Project: http://www1.eere.energy.gov/wip/pdfs/53827-6.pdf

Table 9. Lumen Bins for General Service Lamps

Lumens Range (Lumens)	Incandescent Baseline (Watts)
310–749	40
750–1,049	60
1,050–1,489	75
1,490–2,600	100

Cadmus developed a separate baseline wattage table for reflector lamps, as shown in Table 10.[6]

Table 10. Lumen Bins for Reflector Lamps

Lumens Range (Lumens)	Incandescent Baseline (Watts)
0–419	30
420–560	45
561–837	65
838-1,203	75
1,204–1,681	90
1,682–2,339	120
2,340–3,075	175

EISA standards treat small screw-based, candelabra-type bulbs differently, with these bulbs receiving a maximum baseline of 60 watts. If lumens placed these bulb types in the 75 watt or 100 watt incandescent equivalent category in Table 9, the evaluation reduced the wattage to 60 watts.

Savings Shift to Nonresidential Prescriptive Rebate Program

Cadmus shifted 5% of bulb sales from the Residential Lighting Program to the Nonresidential Prescriptive Rebate program, an adjustment consistent with previous Cadmus evaluations[7] and reflecting results from surveys conducted in 2011. The 2011 survey found 5% of incented bulbs installed in commercial applications. Consistent with the previous evaluation, Cadmus used commercial lighting inputs based on an “office” building type. The only input not based on a commercial “office” type building was the installation rate. Cadmus used the same installation rate as the Residential program to reflect the upstream delivery mechanism for the commercial bulbs, whereas the Ohio TRM used a

[6] Based on the U.S. Department of Energy (DOE) *EERE Data Book*, Section 7.6: Efficiency Standards for Lighting: http://buildingsdatabook.eere.energy.gov/TableView.aspx?table=7.6.2

[7] Original recommendation based on the 2011 evaluation: Cofer, Albee, et al. 2012. *2011 Evaluation, Measurement, and Verification Report.* This evaluation suggested shifting 11% of bulb sales to commercial savings. When Cadmus revisited these findings during the 2012 evaluation, a 5% shift proved more accurate and consistent with upstream programs in other regions.

commercial installation rate of 1.[8] The "office" building type inputs drew upon the assumption that bulbs would most likely be installed in these types of buildings.

Process Evaluation Findings

The 2013 Residential Lighting Program evaluation's process component was informed by: interviews with six lighting manufacturers; an interview with program staff; and a review of point-of-purchase (POP) marketing material.

Process results follow by topic below.

Satisfaction

All six manufacturers interviewed expressed high satisfaction levels with the program. Specific factors interviewees cited for this satisfaction included: continual growth in sales, aggressive rebates, strong product variety, and well managed and reliable funding. One interviewee stated that DP&L "manage[s] the internal funding and programs well…." Another stated: "they've been creative and adaptive to the promotional calendar." One manufacturer that has been involved in the industry for many years and oversees over 70 other programs said that DP&L's lighting program is "one of the top two or three programs as far as productivity (sales volume and efficiency)." Another reported seeing bulb shipments to DP&L's territory increase 100%.

EISA

Consumer Awareness and Response

The evaluation found that a significant portion of consumers remained unfamiliar with the EISA law and with the implications for the law driving new and different lighting options. One manufacturer reported consumer reaction to EISA and the consumers' "feedback is all over the board, some are aware, some are not." One manufacturer said "there is a lot of confusion." Consumer awareness remains an important component to understanding as it could influence consumer satisfaction and purchasing habits. One manufacturer said, when 100 watt and 75 watt bulbs were phased out, he saw many customers switching to lower-wattage bulbs to continue buying incandescent bulbs. In another case of "bin jumping," an interviewee said she saw a large increase in 13 watt CFL sales (60 watt incandescent equivalents) in 2013. She expected to see a jump in 18 watt CFLs (the 75 watt incandescent equivalent) due to the phasing out of 75 watt incandescent bulbs. With customers switching to the incorrect equivalent wattage, this manufacturer saw many customers complaining that CFLs did not output sufficient light.

8 The Ohio TRM ISR of 1 reflects a direct install delivery method. Since these bulbs were purchased through retail outlets and installed by the customers themselves, the ISR should reflect an upstream delivery method which is less than 1.

Manufacturer Response

The manufacturer responses to EISA questions provided insights into incandescent stockpiling and customer preferences towards halogens, CFLs and LEDs. Implementation of EISA efficiency standards raised questions regarding how manufacturers and retailers would respond to the phase out of incandescent bulbs: would they switch to efficient options or would they stockpile incandescent inventories in anticipation of consumers resisting the new efficient options? One manufacturer reported many retailers stockpiled in 2012, when 100 watt incandescent bulbs were being phased out, and that some retailers "got burned" taking this stockpiling approach. Due to this, another manufacturer did not anticipate stores stockpiling 60 watt incandescent bulbs in anticipation of the 2014 phase out.

Most manufacturers interviewed anticipated customers would replace phased-out 60 watt incandescent bulbs with LED bulbs. Manufacturers thought CFLs would be purchased to replace some of these bulbs, as would, to a limited extent, halogen lamps, but they overwhelmingly placed their emphasis on LEDs.

Additional EISA-related findings included:

- In the utility interview, DP&L reported EISA efficiency standards impacting 75 watt and 100 watt lamps did not drive changes to rebates.
- DP&L's marketing efforts did not address EISA directly.
- As EISA standards phase out incandescents, most manufacturers said CFLs will be priced higher than halogens (in the absence of incentives). This supports the claim that halogens should represent the baseline bulb technology going forward.

LEDs

LED findings, combined with those concerning EISA, suggested LEDs should play a large role in the Residential Lighting Program, going forward.

In the utility interview, DP&L reported it would include LEDs in the 2014 Residential Lighting Program, and interviews with manufacturers indicated the inclusion of this bulb technology would be well received by manufacturers, retailers, and customers. Almost all manufacturers indicated they wanted LEDs to be presented as part of program offerings.

Manufacturer interviews revealed that determining rebate amounts for LEDs remained a challenge. One manufacturer noted that bulb quotes for stores typically lasted six months, but quotes for LEDs changed every few months, due to the rapid and "drastic" decline in LED prices. Several manufacturers said LEDs should be priced between $5 and $10 (with incentives) to remain cost-competitive with alternative lighting options.

Marketing and Awareness

Through the utility interviews, Cadmus found program and implementation staff considered education and awareness a challenge for increasing efficient lighting saturations and savings. The POP marketing review also found that POP material should educate consumers about the different lighting options

available, aiding consumers in differentiating between available types (reflector vs. general purpose) and technologies (LED and CFL). The variety of efficient options confused consumers, given that they based their conventional light bulb purchasing habits on wattages and not types and technologies.

The POP review also determined the following:

- Securing highly visible, in-store placements and meeting retailer guidelines proved critical to the success of marketing DP&L's lighting program.
- No formal marketing plan or communications structure had been established, which appeared to contribute to an inconsistent understanding of upcoming promotions, planned marketing, active POP in stores, and so on, between retailers, the utility, and manufacturers.
- Manufacturers identified a need for DP&L to drive customer education and engagement.

Recommendations

Drawn from the preceding findings, Cadmus offers the following recommendations:

- **Ascertain more details about bulbs purchased for commercial applications.** Future surveys and/or interviews should ask questions to determine types of commercial buildings in which bulbs will be installed and types of space within the commercial building where the bulbs will be used (e.g., closet, bathroom, desk, hallways, food prep). Precisely understanding where these bulbs have been installed will inform commercial savings inputs to be used in the evaluation.
- **DP&L should explore additional tactics to educate customers regarding: the wide range of lighting choices available; how and where to use these; and new technologies such as LEDs**. In doing so, DP&L can help customers make choices when faced with a variety of types of products on store shelves, which often proves very confusing for customers. Customer education should help overcome barriers and highlight choices, benefits, and applications. Neglecting this education and guidance could result in consumers choosing inappropriate energy-efficient lighting for their needs and becoming dissatisfied with efficient lighting in general.
- **The focus on LEDs should continue to grow, seeking to aid customers in understanding the best types of LEDs to purchase and the corresponding incentives to provide**. As LEDs grow to become a larger part of the program, these products may help drive efficient lighting saturation even higher by winning over customers who are unhappy with CFLs.

Residential Appliance Recycling Program

This chapter describes the evaluation approach, presents detailed findings, and offers conclusions and recommendations for the Residential Appliance Recycling Program (ARP).

Evaluation Overview

Cadmus' evaluation of the 2013 Residential ARP followed researchable questions and evaluation activities outlined in DP&L's *2013 Evaluation, Measurement, and Verification Plans*. Table 11 identifies key researchable evaluation questions.

Table 11. Key Researchable Questions

Researchable Questions	Discussion	Activity to Support Question
What average energy savings are associated with participating refrigerators and freezers?	To assess the appropriateness of *ex ante* claimed savings values and to generate an *ex post* value, the evaluator had to establish the program per-appliance energy impacts.	Regression model
How accurately and consistently are relevant appliance unit data collected?	As appliance characteristics provide a key input to appliance recycling energy consumption, these data must be tracked accurately.	Review of program database
Is this program cost-effective?	Use standard cost test and practices established by the Public Utilities Commission of Ohio.	Cost-effectiveness analysis

Detailed Evaluation Findings

DP&L fell short of its savings goals of 3,072,452 kWh and 505 kW, achieving 2,556,001 kWh and 408 kW in adjusted gross savings. These adjusted gross savings represent realization rates of 86% against *ex ante* claimed energy savings and demand reduction. Overall, the realization rate is driven by the continued decrease in unit age as the program matures and the increasing proportion of units manufactured after the energy standards of the early 1990s.

The following key findings relate to the impact evaluation:

- Program *ex ante* claimed and adjusted gross savings and demand reduction are provided in Table 12.

Table 12. Residential ARP Claimed and Achieved Energy Savings

Program	*Ex Ante* Claimed Savings		Verified Gross Savings		Adjusted Gross Savings		
	kWh	kW	kWh	kW	kWh	kW	Precision*
Refrigerators	2,541,319	404	2,541,319	404	2,092,943	336	±12.4%
Freezers	553,185	91	553,185	91	463,058	71	±24.0%
Total**	**3,094,504**	**494**	**3,094,504**	**494**	**2,556,001**	**408**	**±11.0%**

*Precision at 90% confidence

**Values in table may not exactly sum to 100% due to rounding.

Evaluation Data Collection Methods

In evaluating the 2012 program, Cadmus used the approaches detailed below.

Participant Telephone Survey

In January 2013, Cadmus surveyed 2012 ARP participants by appliance type, seeking to achieve: 90% confidence within 10% percent precision for refrigerators; and 90% confidence within 20% precision for freezers. As shown in Table 13, Cadmus surveyed 70 participating households reported to have recycled a refrigerator through the program and 70 participating households reported to have recycled a freezer. The JACO Environmental (JACO) program tracking database showed 77% of recycled units were refrigerators and 23% were freezers.

Table 13. Participant Survey Goals and Achievements

Total Participants Sampled	Total Planned Completes	Achieved Completes
Recycled Freezer	70	70
Recycled Refrigerator	70	70
Total	**140**	**140**

Results from this survey were used as inputs to the 2013 impact evaluation as Cadmus did not anticipate significant year-on-year shifts in these values.

In Situ Metering Data Set

Cadmus developed a multivariate regression model to estimate average unit energy consumption (UEC) for retired refrigerators and freezers. This model relied on an aggregated *in situ* metering dataset,[9] consisting of approximately 594 appliances, metered during evaluations conducted in California, Michigan, and Wisconsin between 2009 and 2013.

In greater detail, the Impact Evaluation Methodology and Findings section below explains: the refrigerator model specification and corresponding freezer model Cadmus developed and used in the 2013 evaluation.

[9] *In situ* metering takes place in the environment where appliances are typically used. This approach contrasts with lab testing, which meters units under controlled conditions.

Impact Evaluation Methodology and Findings

This section details the approaches Cadmus used in evaluating impacts associated with the 2013 program. As a preliminary evaluation step, the evaluation reviewed the program implementer's (JACO) participant database to test the reliability of program data, resulting in some 2,732 total participant records from January 2013 through December 2013. Some participants recycled more than one appliance through the program.

Table 14 shows distributions of refrigerators and freezers in the JACO database.

Table 14. Program Participation by Measure

Measure	Participation
Recycled Refrigerator	2,243
Recycled Freezer	647
Total	**2,890**

Table 15 shows typical refrigerator and freezer configurations identified in the database.

Table 15. Refrigerator and Freezer Configurations

Measure	Configuration
Refrigerator	Bottom Freezer
	Side-by-Side
	Single Door
	Top Freezer
Freezer	Chest
	Upright

Summary of Program Participation

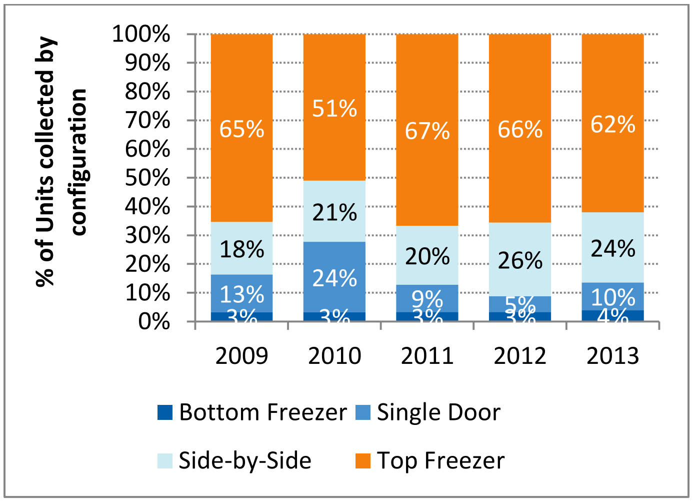
Cadmus analyzed JACO's tracking data for the 2013 DP&L ARP. Table 16 shows the average age and size of units collected in 2013.

Table 16. Average Unit Age and Unit Size

Appliance	Average Age (Years)	Average Size (ft^3)
Refrigerator	21	19
Freezer	24	16

Cadmus compared 2013 tracking data results to tracking data results from past years to determined trends in unit age, size, and configuration. As shown in Figure 11, the program realized a larger composition of side-by-side units than seen at the program's beginning. The 2010 program year appeared to be the outlier, with a much higher concentration of single-door units and a much lower concentration of top freezer units than typically seen. The 2013 program, however, appeared to follow the trend typically seen when other appliance recycling programs mature: increases in shares of units with side-by-side configurations; a consistently large share of top freezer units; and only a small share of bottom freezer and single-door units.

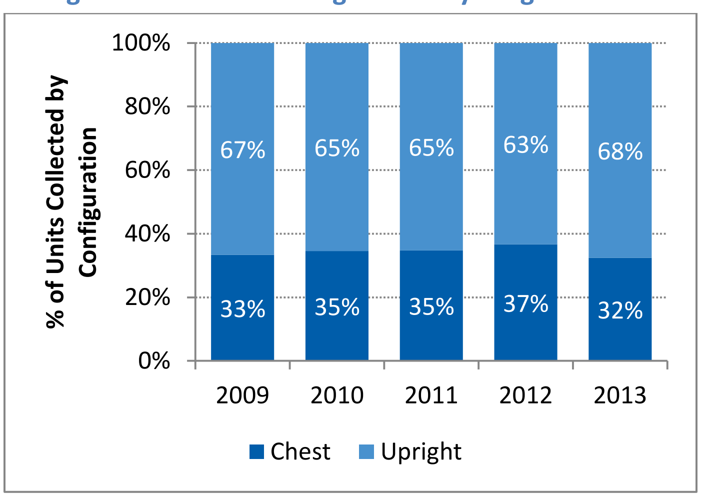
Figure 11. Refrigerator Configuration by Program Year*



*Unit configurations for previous years categorized as described above.

As shown in Figure 12, freezer configurations did not substantially change over the program's life.

Figure 12. Freezer Configuration by Program Year*

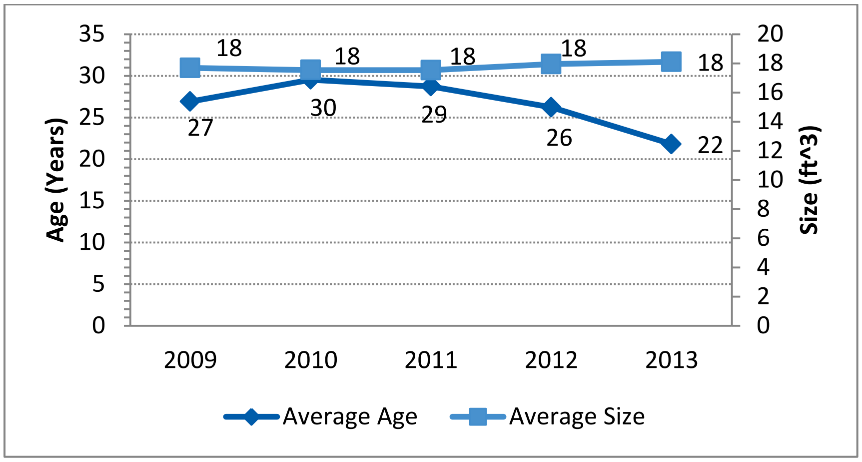


*Unit configurations for previous years categorized as described above.

In 2013, recycled appliances averaged 22 years old, with 18 ft^3 of internal capacity. As shown in Figure 13, the average appliance size did not change substantially since the program's inception, but average age has decreased steadily for the past two years. This is the primary driver of the decrease in UECs over the life of the program. This is particularly true this year, as the average unit was manufactured in 1991. This means that a typical unit was manufactured after the 1990 National

Appliance Energy Conservation Act (NAECA) standard and therefore consumed substantially less energy than pre-standard units. The Cadmus regression model estimates that the average refrigerator recycled after 1990 consumes approximately 375 kWh less per year than one manufactured prior to the standard change, and 200 kWh less for freezers. This is inclusive of subsequent standards as well (1993 and 2001).

Figure 13. Appliance Age and Size by Program Year



Determination of Average Annual Gross Energy Consumption

Cadmus developed a multivariate regression model to estimate the UEC for retired refrigerators and freezers; this involved estimating model coefficients using an aggregated *in situ* metering[10] dataset, composed of over 560 appliances (metered as part of evaluations in California, Michigan, and Wisconsin, conducted between 2009 and 2013).[11] Collectively, these evaluations offered a wide distribution of appliance ages, sizes, configurations, usage scenarios (primary or secondary), and climate conditions. The dataset's diverse nature provided an effective secondary data source for estimating energy savings when Ohio-specific metering could not be conducted.

For two reasons, Cadmus prefers using in-home metering data for estimating energy consumption, as opposed to the DOE testing protocols:

- First, metering an appliance in its original location captures impacts from critical external factors on appliance energy use (such as door openings, unit locations, and weather). Such factors cannot be accounted for when relying on DOE databases, which contain data on units metered under controlled conditions.

[10] *In situ* metering involves metering units in the environment in which they are typically used. This contrasts with lab testing, where units are metered under controlled conditions.

[11] Southern California Edison, Pacific Gas & Electric, San Diego Gas & Electric, DTE Energy, Consumers Energy, and Focus on Energy.

- Second, most existing DOE databases estimate energy consumption at the time of an appliance's manufacture, not by unit retirement.[12] Consequently, evaluations require devising and applying additional assumptions to incorporate appliance degradation. In-home metering data reflect observed usage of appliances actually participating in ARPs at the time of retirement, as used in the homes from which they were removed.

Each observation in the aggregated dataset represented an appliance metered for a minimum of 10 days, in a manner consistent with its preprogrammed use (e.g., in the same location, cooling food, used by the home's occupants). Cadmus mapped weather data to participating homes' ZIP code-specific National Oceanic and Atmospheric Administration (NOAA) weather stations, and collected additional on-site data regarding relevant appliance characteristics to ensure data consistency with administrator tracking databases.

Cadmus used regression models to estimate consumption for refrigerators and freezers (shown below in Table 18). Each independent variable's coefficient indicated that variable's influence on daily consumption, holding all other variables constant. A positive coefficient indicated an upward influence on consumption; a negative coefficient indicated a downward effect.

The coefficient's value indicated the marginal impact of a one-point increase in the independent variable on the UEC. For instance, a 1 cubic foot increase in refrigerator size resulted in a 0.059 kWh increase in daily consumption. In the case of dummy variables, the value of the coefficient represented the difference in consumption, if the given condition was true. For example, in the refrigerator model, the coefficient for the variable indicating a refrigerator as a primary unit was 0.560, indicating, all else being equal, a primary refrigerator consumed 0.560 kWh more per day than a secondary unit.

Table 17 details the final model specification used to estimate energy consumption of participating refrigerators.

[12] The California Energy Commission maintains such a database, which can be accessed online at: http://www.energy.ca.gov/appliances/database/historical_excel_files/Refrigeration/

Table 17. Refrigerator UEC Regression Model Estimates (Dependent Variable = Average Daily kWh, Adj. R2 = 0.30)

Independent Variables	Coefficient	p-Value	VIF
Intercept	0.805	0.537	0.00
Age (years)	0.021	0.010	2.03
Dummy: Manufactured Pre-1990	1.036	0.191	1.68
Size ($ft.^3$)	0.059	0.026	1.81
Dummy: Single Door	-1.751	0.339	1.23
Dummy: Side-by-Side	1.120	0.206	1.54
Dummy: Primary	0.560	0.190	1.56
Interaction: Unconditioned Space x HDDs	-0.040	0.011	1.25
Interaction: Unconditioned Space x CDDs	0.026	0.022	1.45

Table 18 provides the final model specifications used to estimate energy consumption of participating freezers; and model results.

Table 18. Freezer UEC Regression Model Estimates (Dependent Variable = Average Daily kWh, Adj. R^2 = 0.45)

Independent Variables	Coefficient	p-Value
Intercept	-0.955	0.796
Age (years)	0.045	0.017
Dummy: Unit Manufactured Pre-1990	0.543	0.421
Size ($ft.^3$)	0.120	0.035
Dummy: Chest Freezer	0.298	0.269
Interaction: Unconditioned Space x HDDs	-0.031	0.015
Interaction: Unconditioned Space x CDDs	0.082	0.036

After estimating the final regression models, Cadmus analyzed the corresponding characteristics (the independent variables) for participating appliances (as captured in the JACO database). Table 19 summarizes program averages or proportions for each independent variable.

Table 19. 2012 Participant Mean Explanatory Variables*

Appliance	Independent Variables	Participant Population Mean Value
Refrigerator	Age (years)	21.30
	Dummy: Manufactured Pre-1990	0.33
	Size (ft.3)	18.58
	Dummy: Single Door	0.09
	Dummy: Side-by-Side	0.24
	Interaction: Unconditioned Space x CDDs	0.76
	Interaction: Unconditioned Space x HDDs	4.15
	Dummy: Primary	0.54
Freezer	Age (years)	23.53
	Dummy: Unit Manufactured Pre-1990	0.51
	Size (ft.3)	16.42
	Dummy: Chest Freezer	0.32
	Interaction: Unconditioned Space x CDDs	1.64
	Interaction: Unconditioned Space x HDDs	9.23

*CDDs/HDDs are weighted average CDDs/HDDs from TMY3 data for weather stations mapped to participating appliance ZIP codes. TMY3 is a typical meteorological year, using median daily values for a variety of weather data collected from 1991–2005.

For example, using values from Table 18 and Table 19, the estimated annual UEC for freezers was calculated as:

$$Freezer\ UEC = 365.25\ days * -0.955 + 0.045 * 23.53 years\ old + 0.543 * 51\%\ units\ manufactured\ pre-1990 + 0.120 * 16.42\ ft.3 + 0.298 * 32\%\ units\ that\ are\ chest\ freezers + 0.082 * 1.64\ Unconditioned\ CDDs - -0.031 * 9.23\ Unconditioned\ HDDs = 842\ kWh/year$$

Figure 14 compares the distributions of estimated UEC values for refrigerators and freezers.

Figure 14. 2012 Distribution of Estimated Annual UECs by Appliance Type

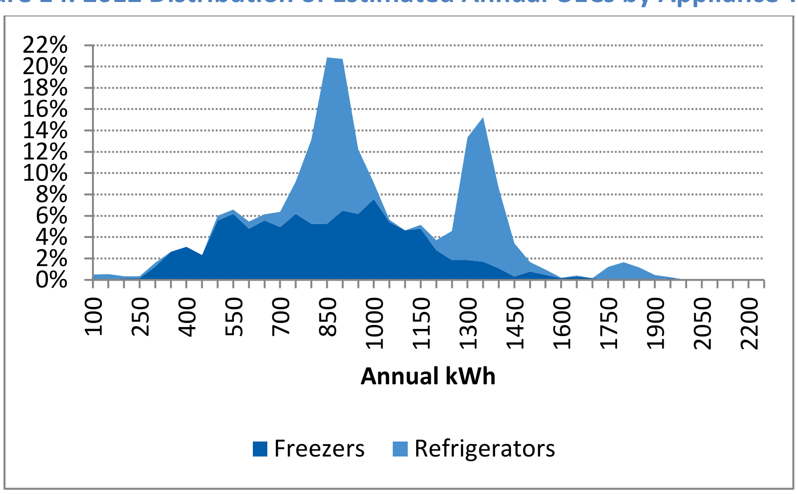


Table 20 presents estimated per-unit, average, annual energy consumption for refrigerators and freezers recycled by DP&L in 2012. The next section describes how Cadmus adjusted these estimates to arrive at gross per-unit saving estimates for participant refrigerators and freezers. Note that there was a substantial decrease in annual UEC for both appliance types. This is largely a function of the decrease in unit age and the increasing share of recycled units manufactured after the 1990 NAECA standard.

Table 20. Estimate of Per-Unit Annual Energy Consumption

Appliance	*Ex Ante* Annual UEC (kWh/year)	*Ex Post* Annual UEC (kWh/year)	Precision at 90% Confidence Interval
Refrigerators	1,242	1,085	6%
Freezers	1,063	842	14%

Part-Use Factor

To determine average, per-unit, gross energy savings for refrigerators and freezers, Cadmus applied the program's part-use factor, obtained from the 2012 participant survey; this accounted for participating appliances not plugged in year-round prior to participation. Retirement of appliances not previously in operation or operated for only a part of the year would not yield the full year of energy savings presented in Table 20.

Using the findings from the previous evaluation, part-use factors for refrigerators and freezers were 0.86 and 0.85, respectively.

Based on the part-use adjusted, per-unit gross annual energy savings presented in Table 21 (for 2013), Cadmus determined program-wide, annual, gross energy savings generated by DP&L's participation in 2013, as presented in Table 21.

Table 21. 2013 Adjusted Part-Use Gross Annual Energy Savings

Appliance	Adjusted Gross Energy Savings (kWh/Year)	Adjusted Gross Demand Reduction (kW/Year)*	2013 Participation	Total Program Gross Savings (kWh/Year)	Total Program Gross Demand (kW/Year)	Precision at 90% Confidence
Refrigerator	933	0.15	2,243	2,092,943	336	±12.4%
Freezer	716	0.11	647	463,058	71	±24.0%
Total			**2,890**	**2,556,001**	**408**	**±11.0%**

*Cadmus derived refrigerator and freezer summer coincident peak demand reduction by applying the Ohio TRM formula. Results from this evaluation determined the change in kWh input.

Recommendations

Drawing upon the preceding findings, Cadmus offers the following recommendation:

- **As ARPs mature, unit ages typically decline, meaning more recycled units were manufactured after the energy-efficiency standards of the early 1990s.** By replacing more efficient units in the future, the program will likely see its per-unit savings values decrease in the long term. Therefore, Cadmus recommends DP&L continue to track these metrics to anticipate future savings and cost-effectiveness.
- **To help offset the declining program savings, Cadmus agrees with DP&L with the inclusion of distributing CFL kits to ARP participants**. This is a new addition to the program that went into effect in 2014. These kits are delivered directly to program participants and include CFLs, efficient showerheads and aerators. Cadmus believes that this addition to the program will increase gross program energy savings in a cost effective manner.
- **Another mechanism to increase participation would be to provide a higher incentive**. Based on results from the review of 2011 JACO tracking data (and outlined in the 2012 evaluation), the higher incentive (done in 2011) increased program participation during the promotional period. Last year DP&L increased their incentive from $25 to $35 per unit. Seasonal promotions with increased incentives could help drive increased participation and motivate customers still holding on to those older units.

Residential Low-Income Program

This chapter describes the evaluation approach, detailed findings, and conclusions and recommendations for the Residential Low-Income Program.

Evaluation Overview

Cadmus' evaluation of the 2013 Residential Low-Income Program followed researchable questions and evaluation activities outlined in the DP&L *2013 Evaluation, Measurement, and Verification Plan*. Table 22 identifies key researchable evaluation questions.

Table 22. Key Researchable Questions

Researchable Question	Activity Used to Address Question
What gross electric savings and demand reductions did the program generate?	• Program database review • Engineering analysis • Participant surveys
Were participants satisfied? Were measures installed? Did participants experience decreases in bills? What other benefits, such as health improvements, did they experience?	• Participant surveys
Did customers know DP&L funds a portion of weatherization services?	• Participant surveys
Was the program cost-effective?	• Cost-effectiveness tests
How did the reporting and program tracking processes perform with the current system?	• Stakeholder interviews
What were the program's goals and objectives?	• Stakeholder interviews

Detailed Evaluation Findings

DP&L surpassed it savings goals of 1,118,222 kWh and 147 kW, achieving 1,286,599 kWh and 164 kW in adjusted gross savings. These adjusted gross savings represent realization rates of 103% and 74% against *ex ante* claimed energy and demand savings respectively. Overall, the energy realization rate is driven by adjusted gross savings calculated for measures where the *ex ante* claimed savings are zero. These measures are summarized in Table 28 and include: air sealing; duct insulation; duct sealing; foundation wall insulation; heat pump replacement; smart strips; wall insulation and water heater temperature setback.

The *ex ante* claimed demand reduction for attic insulation drives the demand realization rate. Table 23 shows ex ante demand reduction of 54.91 kW for attic insulation, compared to 0.78 kW for adjusted gross demand reduction. The method for calculating ex ante demand reduction drives this large discrepancy: the *ex ante* calculation uses both heating and cooling kWh savings to determine the kW demand reduction when it should be using only the cooling kWh savings.

The following key findings relate to the impact and process evaluation activities.

- Program *ex ante* claimed and adjusted gross savings and demand reduction are located in Table 23.

Table 23. Residential Low-Income Program Claimed and Achieved Energy Savings

Measure	*Ex Ante* Claimed Savings		Verified Gross Savings		Adjusted Gross Savings		
	kWh	kW	kWh	kW	kWh	kW	Precision*
Air Sealing	265	0.20	31,587	0.30	31,587	0.30	± 10%
Attic Insulation	70,356	54.91	70,763	0.78	70,763	0.78	± 10%
CFLs	254,860	28	292,559	44	246,776	26	± 15%
Duct Insulation	0	0.00	203	0.00	203	0.00	± 10%
Duct Sealing	0	0.00	11,120	0.18	11,120	0.18	± 10%
Faucet Aerator	7,963	1.00	7,963	1.00	16,725	1.73	± 13%
Foundation Wall Insulation	0	0.00	2,581	0.00	2,581	0.00	± 10%
Freezer Replacement	59,943	9.28	42,824	6.46	42,824	6.46	± 10%
Heat Pump Replacement	0	0.00	3,245	0.87	3,245	0.87	± 10%
HVAC Tune Up	1	0.00	933	0.17	933	0.17	± 10%
LED 0.5 W Nightlight	87	0.01	274	0.00	710	0.00	± 14%
Water Heater Pipe Insulation	3,733	0.43	1,317	0.15	1,317	0.15	± 14%
Refrigerator Replacement	814,401	124.99	814,401	125.25	814,401	125.25	± 10%
Energy-efficient Showerhead	36,724	4.11	22,426	2.87	37,504	2.08	± 16%
Smart Strip Power Outlet	0	0.00	1,457	0.20	1,457	0.20	± 10%
Wall Insulation	0	0.00	3,226	0.06	3,226	0.06	± 10%
Water Heater Temperature Setback	0	0.00	462	0.05	462	0.05	± 10%
Water Heater Wrap	711	0.08	766	0.09	766	0.09	± 12%
Total**	**1,249,044**	**223**	**1,308,106**	**183**	**1,286,599**	**164**	**± 11.1%**

* Precision at 90% confidence.

** Values in table may not sum to 100% exactly due to rounding.

- Two measures provided 83% of the program's energy savings: CFLs and refrigerator replacements. Freezer replacements and attic insulation measures also proved significant, contributing up to another 8% of savings.
- The program attained an energy savings realization rate of 103%, though this figure masks some complications with *ex ante* claimed savings. The evaluation found several database issues;

however, these did not significantly impact the realization rate due to smaller quantities and associated savings.

Despite these data tracking issues, substantial improvements in quality have been made to the program tracking database (known as the CC System) since the previous year. These improvements included:

1. Most attic insulation measures had *ex ante* claimed savings calculated in the database.
2. Homes with gas water heaters did not claim energy-efficient showerheads and faucet aerator savings—an issue identified in the 2012 evaluation.
3. Most pertinent database fields required to verify and calculate savings were populated.

- Interviews found that OPAE trainings helped drive these improvements, educating stakeholders on which fields to populate in the CC System and how to do so.
- The CC System improved over the previous year, though Cadmus identified several persisting database issues:
  1. Inaccurate and inconsistent collection of key assumptions used in the Ohio TRM savings algorithms; and
  2. Inconsistent savings calculations, including the following issues:

     Electric savings were calculated for measures in homes without electric heating or central cooling;

     Electric savings were not calculated for homes that should have received them; and

     In some instances, savings were incorrectly calculated.
- The issues noted in regard to program data tracking and reporting were not unique to DP&L: interviews with DP&L and FirstEnergy (First Energy administers the database) indicated these issues occurred across other low-income programs using this software.
- Through participant customer surveys, Cadmus identified a 97% measure-level CFL installation rate (including reinstallations). While higher than the Ohio TRM CFL direct-install rate of 81%, this installation rate remained consistent with 2012 program year evaluation findings. Participants reporting missing CFLs said units had not been received, had been left behind and never installed or the participants removed them.
- Seventy-one percent of respondents reported being more comfortable in their homes following weatherization work.
- Ninety-seven percent of respondents reported being “very satisfied” or “somewhat satisfied” with the program services.
- Both agencies and Ohio Partners for Affordable Energy (OPAE) reported that the program tracking database ultimately improved their data tracking and reporting, despite initial confusion regarding: changes in the information agencies had to track and report; and values agencies should provide as inputs to Ohio TRM savings calculations. Overall, understanding and

operation of the system improved due to agency training and subsequent communication from OPAE to the agencies.

- Agencies highlighted some difficulties in serving eligible homes due to constraints associated with available funding for health and safety (H&S) repairs and recent changes in ASHRAE standards resulting in increased costs.

Evaluation Data Collection Methods

To calculate program energy-saving impacts, Cadmus primarily relied on DP&L participant tracking data, along with savings algorithms provided in the Ohio TRM. Additionally, Cadmus conducted 120 participant phone surveys to evaluate program processes, determine participant benefits, and verify measure installations.

Program Database Review

As with the 2012 program year, FirstEnergy hosted a program tracking database (the CC System) that tracked project- and measure-level details and calculated *ex ante* claimed savings for utility low-income weatherization programs across Ohio. The CC System provided an electronic, centralized, web-based platform for standardized data collection and reporting, and represented a move to a more efficient data tracking system than the Excel-based C-3 data collection forms used in previous years. The community action agencies (CAAs) implementing the low-income weatherization program used this web-based system for tracking and directly reporting installation data.

In August 2013, Cadmus met with DP&L, FirstEnergy, and OPAE to discuss the database tracking recommendations made in the 2012 evaluation report. Among these recommendations, Cadmus suggested:

> *"Applying database controls (such as discrete ranges or required fields) will help improve the accuracy of savings calculations. Additionally, integrating information on heating, cooling, and water-heating fuels and equipment types with the savings calculations will help ensure electric savings are appropriately applied."*[13]

Through the meeting, Cadmus agreed to provide guidance in regard to constructing and implementing these database controls. Cadmus reviewed the CC System database and provided FirstEnergy with a list of required input fields for each measure, and suggested input values and constraints for the inputs (e.g., continuous range, constant, text input). Cadmus provided this analysis to DP&L and FirstEnergy in October 2013.

After all data from 2013 had been loaded into the CC System, Cadmus reviewed the tracking system database to determine whether all relevant fields for energy-savings calculations had been collected. The review then included examining the database integrity by checking for consistency and accuracy in

[13] Cadmus, *2012 Evaluation, Measurement, and Verification Report*. May 15, 2013. p. 49

the populated values. Finally, Cadmus reviewed the savings estimates calculated within the CC System and compared to savings calculated using the Ohio TRM algorithms.

Telephone Survey

In November 2013, Cadmus conducted a phone survey of 88 Residential Low-Income Program participants. Cadmus developed the participant survey (which Evergreen Economics reviewed prior to fielding), defining the sample and managing data collection through a contracted market research firm.

Table 24 provides details regarding the telephone survey planning and achieved completes.

Table 24. Participant Telephone Survey Sampling Plan

	Quantity
Total Participants	338
Eligible Participants in Call List	247
Screened out due to changes in occupancy or bad phone number	*27*
Sample Frame	*220*
Completed Surveys	88
Sample Size Goal	120

Cadmus selected a random sample of participants from the 2013 Q1 to Q3 participant population, available in November 2013 (247 eligible participants), seeking to attain 120 completed survey responses and to achieve findings with greater than ±10% precision at the 90% confidence level. Cadmus achieved 88 completes, and, although less than the target of 120 completes, this proved sufficient to achieve over ±10% precision at 90% confidence for impact-related questions . The survey achieved a high response rate in fielding, despite a smaller program population at the time of the survey's implementation, and Cadmus exhausted the sample frame.

The survey asked participants about their experiences with the program, addressing the following topics:

- Awareness of utility sponsorship;
- Measure verification;
- Non-energy benefits, including health and comfort;
- Levels of overall and measure satisfaction; and
- Household and demographic data.

Impact Evaluation Methodology and Findings

Engineering Analysis

Cadmus directly pulled *ex ante* claimed savings from the CC System database, with estimates reportedly based on the Ohio TRM algorithms.

Cadmus calculated verified gross savings, primarily using the Ohio TRM algorithms and inputs collected through the CC System or reported by the CAAs.[14] Verified savings were calculated by incorporating the following updates to the *ex ante* claimed savings:

1. Revisions to calculation assumptions, based on evaluation activities (e.g., CFL installation rate).
2. Corrections to inputs and savings calculations.

For CFLs, Cadmus updated the ISR from 81% (the Ohio TRM assumption) to 97%, based on the telephone survey results as shown in Table 37.

Cadmus applied different corrections when calculating verified gross savings. For shell measures (e.g., air sealing, insulation), Cadmus applied thresholds on specific input assumptions to limit unreasonably high savings. Specifically, this limited air-sealing improvements to 30% (some cases had improvements greater than 50%). For attic and wall insulation measures, Cadmus set savings thresholds, respectfully, at 50% and 20% of total home heating energy usage. Adjustments to pre- and post-R-values accounted for the insulating effect of roofs and wall structures, as shown in Table 25. These R-value adjustments drew upon Cadmus' modeling assumptions used in the 2012 DP&L Potential Study.[15]

Table 25. R-Value Adjustments to Account for a Structure's Insulating Effect

Insulation	R-Value Adjustment
Attic	1.81
Wall	4.37
Foundation Wall	2.32

Additionally, Cadmus removed savings from homes with gas heat and no central cooling, as shown in Table 27.[16] This affected savings for attic insulation, wall insulation, and air sealing.

Lastly, Cadmus calculated adjusted gross savings using Cadmus' engineering calculations for several measures not included in the Ohio TRM; these included: freezer replacements; water heater temperature setbacks; and duct insulation. Appendix E. Low-Income CC System Field Review, includes sources for all measure-specific algorithms.

For many measures, Cadmus' adjusted gross savings equaled verified gross savings, though Table 26 describes differences that occurred.

[14] The CC System did not include measure-level details (pre- and post-airflow) for the duct-sealing measures of cooling efficiency and capacity. Upon request, OPAE provided these data by e-mail.

[15] The 2012 DP&L Potential Study can be found in the DP&L 2013-2015 Portfolio Plan Filing.

[16] Cadmus did not calculate cooling savings for homes with window air conditioner units, based on the conservative assumption that these units may not be cooling the entire home.

Table 26. Sources for Adjusted Gross Savings Calculations

Measure	Source
CFLs	Residential Lighting program methodology: lumens equivalence and delayed EISA baselines based on retailer phone surveys.
Energy-efficient Showerhead	Engineering algorithms based on Cadmus 2012 Michigan water meter study.
Faucet Aerator	Engineering algorithms based on Cadmus 2012 Michigan water meter study.
LED Nightlight	2013 Indiana TRM.
Refrigerator Replacement	Ohio TRM Joint Objections and Comments.
Water Heater Pipe Insulation	ACEEE Report Number E093, p. 117, April 2009
Duct Insulation	Cadmus modeling analysis using National Renewable Energy Lab modeling software (BEopt) 2.0.0.4 (DOE2).
Smart Strip	Ohio TRM
Water Heater Temperature Setback	Cadmus analysis that assumes a 10°F temperature turn down and captures savings from standby losses, leaks and clothes washers.

Database Review Findings

Cadmus reviewed the CC System database and identified elements that worked well as well as issues with data integrity and savings calculations. The review identified several improvements in CC System data tracking relative to the previous year. These improvements included:

- Most attic insulation measures had *ex ante* claimed savings calculated in the database;
- Energy-efficient showerheads or faucet aerators were not installed in homes with gas water heaters; and
- Most of the pertinent database fields were populated.

The system was designed to provide a framework to collect all relevant inputs for calculating savings using the Ohio TRM algorithms, while ensuring clean, standardized data values. The Cadmus database review identified the following issues:[17]

- Savings inconsistent with participant heating and cooling;
- Incorrect key assumptions for estimating savings; and
- Inaccurate savings calculations.

First, the CC System did not incorporate fields identifying a customer's heating fuel and heating and cooling equipment when calculating savings. Consequently, electric savings were calculated for insulation or air sealing measures in homes with gas heating and without electric central cooling systems.

[17] While these issues affected DP&L program data tracking and reporting, they were not DP&L-specific. The same issues could similarly affect other Ohio utility low-income weatherization programs.

Second, some inputs fell outside of reasonable ranges. For example, a heat pump was recorded as achieving heating efficiencies of 99 and central air conditioner units achieving cooling efficiencies of 80. A typical heat pump has a heating efficiency of 7.5 HSPF and a typical central air conditioner has a cooling efficiency of 11 SEER.

Finally, several fields contained inaccurate savings estimates. For example:

- Electric savings were not calculated for some measures that appeared to have all required fields;
- Savings algorithms were applied incorrectly (for example, demand reduction for attic insulation should be calculated using cooling savings; the CC System calculated this using both heating and cooling savings);
- Inputs used in savings calculations were incorrect (e.g., water heater pipe insulation savings were calculated using an assumption of a heat loss coefficient of 90 instead of a more accurate value of 5, resulting in 1,515 kWh energy savings claimed); and
- Savings were calculated despite missing relevant inputs (e.g., air-sealing measures where cooling efficiency was not collected).

Measure-specific Findings

Similarly to 2012, the program installed a series of measures, paid for by DP&L, in homes with non-electric heating and no central cooling. In such cases, Cadmus did not attribute electric savings for these homes. The program only installed energy-efficient showerheads and faucet aerators in homes with electric water heaters. As shown in Table 27; this reflected an improvement over the 2012 program. The number of cases where attic insulation and air sealing measures were installed without electric heating or central cooling also dropped year over year, from eight to two and 10 to eight, respectively.

Table 27. Summary of Installed Measures with No Electric Sources

Measure	Quantity of Measures Installed		Quantity of Measure Installations with Incorrect Fuel Source	
	2012	2013	2012	2013
Attic Insulation	49	25	8	2
Wall Insulation	2	6	1	2
Air Sealing	53	39	10	8
Energy-efficient Showerhead	81	175	12	0
Faucet Aerator	124	325	8	0

As in the 2012 program evaluation, Cadmus found a number of measures that should have received electric savings, but for which the CC System did not claim *ex ante* savings. For attic insulation, of 23 homes that should have received electric savings, 21 homes in the database reported savings. Two homes not exhibiting *ex ante* claimed savings in the database indicates a significant improvement over the previous evaluation, where 29 attic insulation jobs did not have attributed *ex ante* savings.

This improvement most likely resulted from: the population of more database fields in general and specifically; 100% of heating efficiency fields containing values in 2013 compared to about 60% of fields in 2012. For the air sealing measure, of 31 homes that should have claimed electric savings, only nine had *ex ante* savings calculated. Additionally, the seven measures shown in Table 28 show zero *ex ante* claimed savings for all installations. The "notes" column in Table 28 provides additional detail on why some measures did not include *ex ante* savings.

Table 28. Summary of Installed Measures Without *Ex Ante* Savings

Measures Without *Ex Ante* Savings	Quantity Installed	Notes
Duct Insulation	1	Not in Ohio TRM.
Duct Sealing	4	*Ex ante* claimed savings of 0 caused by confusion over values to input into leakage rate fields.
Foundation Wall Insulation	3	The initial R-value is 0; this may cause calculated savings to be 0.
Heat Pump Replacement	1	The field "seer_air_source_heat_pump" was blank and could cause calculated savings of 0.
Smart Strip Power Outlet	31	Requires a deemed savings value.
Wall Insulation	6	The initial R-value 0 might have caused calculated savings of 0.
Water Heater Temperature Setback	5	Not in Ohio TRM.

Cadmus identified three fields in the database for inputting SEER values: "seer_unit_1"; "seer_unit_2"; and "seer_air_source_heat_pump." The last field may be redundant with one of the first two fields, which may confuse stakeholders inputting data and cause a disconnect between which fields have been populated and which fields the database used to calculate savings.

The table in Appendix B: *Ex Ante* Measure-Level Savings provides a comprehensive list of energy-saving measures (and quantities) installed through the program.

Process Evaluation Methodology and Findings

The process evaluation component included a telephone survey of participants, which Cadmus used to gather information on customers' experiences with the program and to verify installation and operation of incented measures. Cadmus also interviewed staff from DP&L, OPAE, and several CAA implementers. The interviews primarily sought to assess the data tracking and collection process and to gather insights regarding program goals, best practices, and delivery barriers.

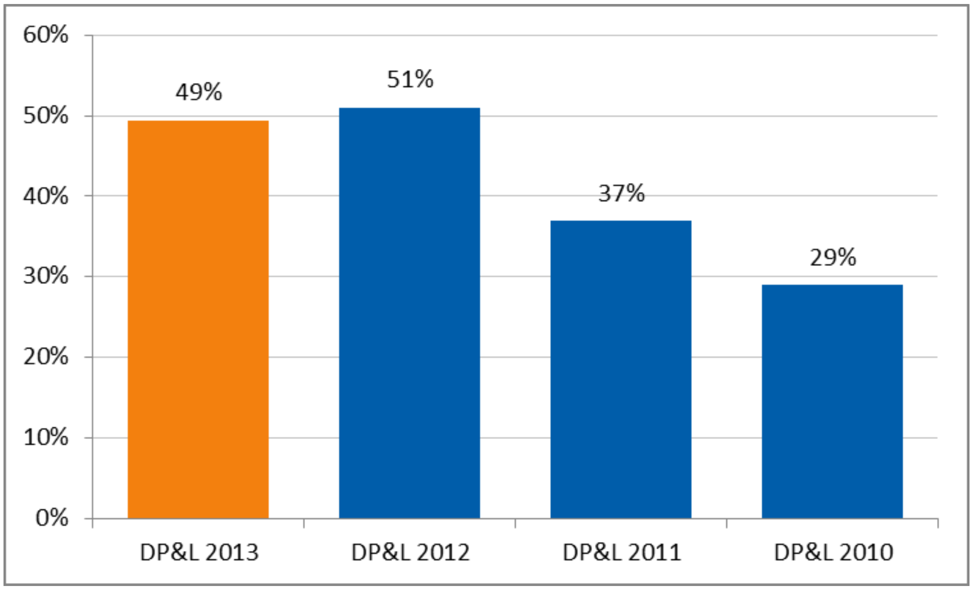
Participant Findings

Participant Awareness

Cadmus asked participants if they knew DP&L paid for part of the weatherization services: 49% responded in the affirmative. This aligned with the 51% reported in 2012. Participant awareness of

DP&L's contribution has climbed over the past four years. Figure 15 compares participant awareness results from this year's survey to results from the past three years.

Figure 15. Respondent Awareness of Utility Sponsorship (n=88)



Household Changes and Take-Back

Cadmus asked participants several questions designed to determine changes in household, energy usage, or behavioral characteristics occurring after the program. Such changes could affect the savings realized in a given home. Specifically, Cadmus looked at: changes in usage patterns (i.e., take-back); numbers of occupants; or household activities.

Thirty-six percent of respondents reported supplementing their primary heating with secondary systems, with electric room heaters the most common sources of secondary heat (19%). Fifty percent of respondents citing use of electric room heaters indicated using them less following performance of the weatherization; no respondents reported using them more.

Nearly all respondents indicated the number of people living in their homes or the number of rooms used changed since conducting the work. For those indicating changed living arrangements, no respondents reported family or roommates moving into the home, compared to 3% reporting an individual moving out. Similarly, 2% of respondents said they used more rooms, and 4% said they used fewer rooms following the work's completion.

Non-Energy Benefits[18]

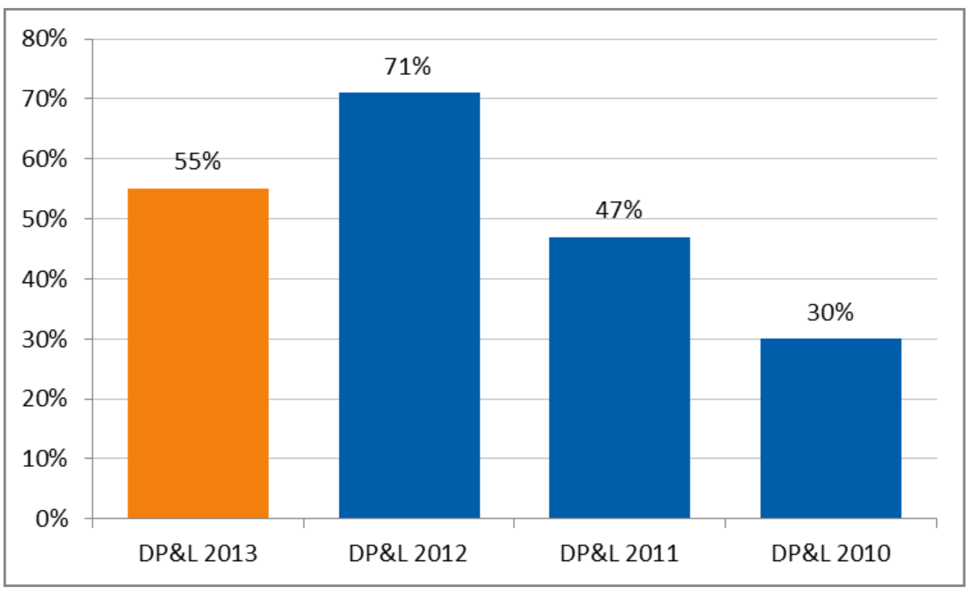
Respondents reported experiencing positive changes in their energy bills due to program activities. Table 29 provides a distribution of changes in participants' utility bill levels, with 55% reporting their energy bills decreased since receiving weatherization services and 15% reporting an increase. All 38 respondents noticing a decrease in their electric bills were "very satisfied" or "somewhat satisfied" with the savings.

Table 29. Changes in Utility Bill Levels (n=69)

Change in Utility Bill After Program	Frequency	Percent	Precision
Decreased by a lot	9	13%	±7%
Decreased some	29	42%	±10%
Stayed about the same	21	30%	±9%
Increased some	8	12%	±6%
Increased by a lot	2	3%	±3%

These results represented a statistically significant decrease from the average reported in last year's evaluation, though higher than in 2011 and 2010 (as shown in Figure 16).

Figure 16. Utility Bill Affordability Comparison (n=69)



Installing weatherization measures also could affect the health and comfort of participants. When asked about health changes, 40% of respondents identified improvements in their health or the health of their family members due to services provided through the program. Three survey respondents reported a decline in health due to participation—one was a personal health condition not likely linked to the

18 Non-energy benefit frequencies were calculated based on all survey respondents, rather than only on participants receiving shell measure installations in past years.

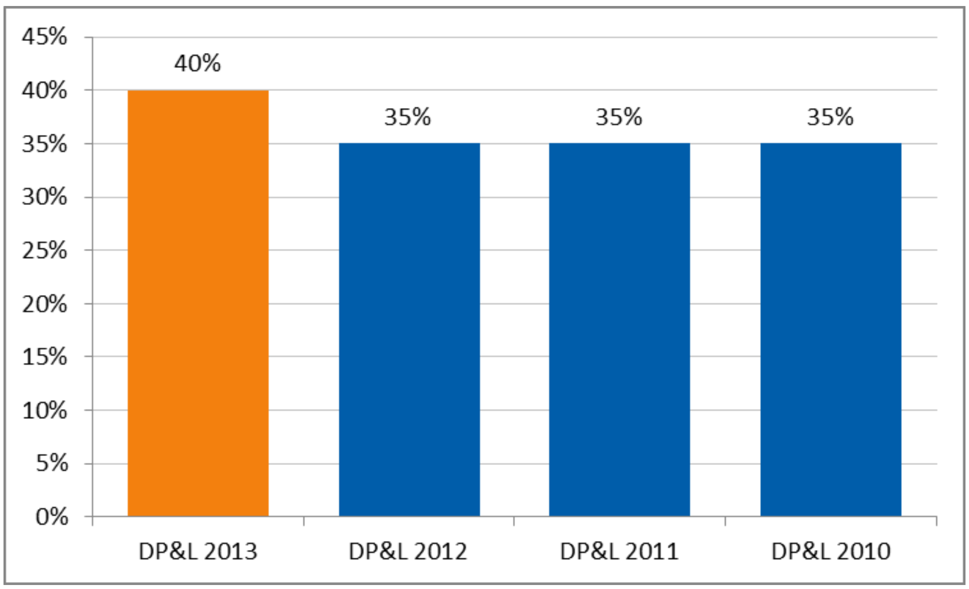
program; one was an equipment issue; and one may have been influenced by program measures, but it is doubtful. Table 30 provides additional details.

Table 30. Health Improvements (n=85)

Health Changes as a Result of Program Participation	Frequency	Percent	Precision
Positive Effect	34	40%	±9%
No Change	48	56%	±9%
Negative Effects	3	4%	±3%

Figure 17 compares the previous evaluations' program respondents' answers, indicating a positive health effect attributed to weatherization services.[19]

Figure 17. Health Improvements Comparison (n=85)



A higher percentage of respondents reported increases in their health or the health of their family members in 2013 (40%, n=85) than in 2012 (35%, n=118), though this difference is not statistically significant.

When asked how they experienced health improvements, participants reported a range of health impacts. Seventeen DP&L participant respondents reported their homes felt warmer, and four said they were "breathing better" due to the work. Five others said they experienced less trouble keeping food in the home due to new refrigerators or freezers. Another respondent said they could use the money saved on energy on other things, which increased their happiness.

19 Notably, many distinctions in programs contributed to participants' varying levels of perceived non-energy benefits.

Additionally, 9% of respondents said their households experienced fewer sick days from work or school due to the program (a finding similar to last year's [10% of respondents]).

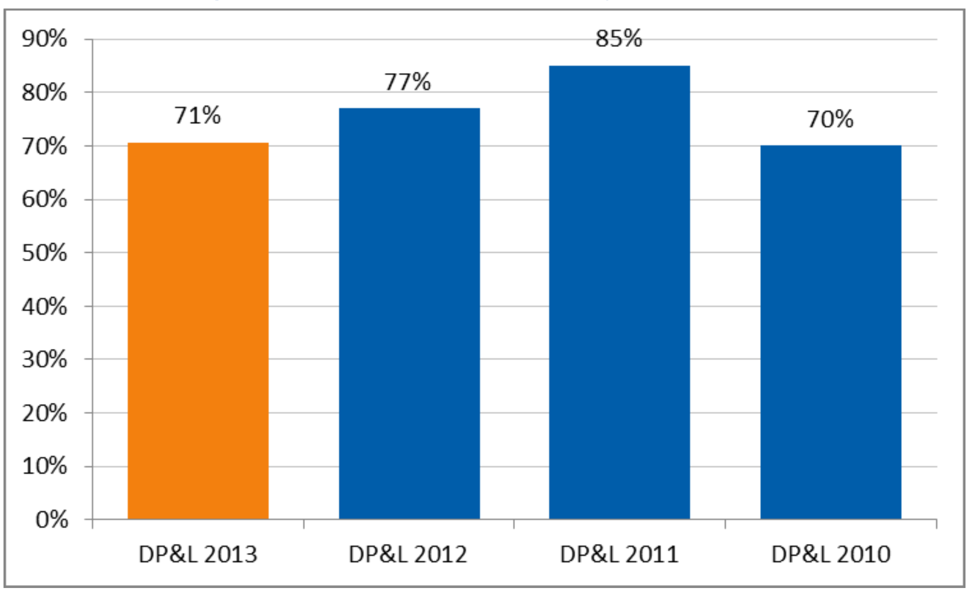
Another non-energy benefit program participants widely reported related to improvements in comfort resulting from the program. Table 31 shows the distribution of participant responses regarding changes in comfort levels.

Table 31. Changes in Comfort (n=85)

Comfort Changes Since Program Participation	Frequency	Percent	Precision
A lot more comfortable in your home	45	53%	±9%
Somewhat more comfortable in your home	15	18%	±7%
About the same level of comfort in your home	22	26%	±8%
Less comfortable in your home	3	4%	±3%

Seventy-one percent of respondents (n=85) reported feeling more comfortable in their homes following the work, a slight decrease from 2012 when 77% of respondents (n=118) reported improvements in comfort (though not statistically significant). Figure 18 shows this year's incidence of improved comfort compared to results from previous studies.

Figure 18. Increased Comfort Comparison (n=85)



Questions also addressed participants' forced mobility. Low-income households tend to move more frequently and face significant financial and emotional burdens when forced to do so.

As shown in

Table 32, 43% of respondents reported being less likely to move following completion of work to their homes, a response similar to the 38% of respondents in 2012, though not statistically significant.

Table 32. Changes in Mobility (n=83)

Are you any more or less likely to move now that this work has been done to your home?	Frequency	Percent	Precision
Less likely to move	36	43%	±9%
No change	44	53%	±9%
More likely to move	3	4%	±3%

Participant Satisfaction

Program Satisfaction

Table 33 provides the distribution of participant responses regarding overall satisfaction with services delivered though the program.[20]

Table 33. Overall Satisfaction with Program Services Provided (n=88)

Overall Satisfaction with Program Services	Frequency	Percent	Precision
Very satisfied	76	86%	±6%
Somewhat satisfied	10	11%	±6%
Neither satisfied nor dissatisfied	1	1%	±2%
Somewhat dissatisfied	1	1%	±2%

Ninety-seven percent of respondents reported being *"very satisfied"* or *"somewhat satisfied"* with the program services, while only two respondents expressed a neutral answer or dissatisfaction. The respondent reporting dissatisfaction did so as they had a 19-year old furnace, but the program did not replace it.

Cadmus asked participants to gauge the courtesy of agency staff working on their homes. Table 34 provides the distribution of their responses. Almost all respondents (99%) found agency staff courteous and respectful.

Table 34. Satisfaction with Agency Staff (n=86)

Courtesy of Contractors	Frequency	Percent	Precision
Very courteous	85	99%	±2%
Somewhat courteous	1	1%	±2%

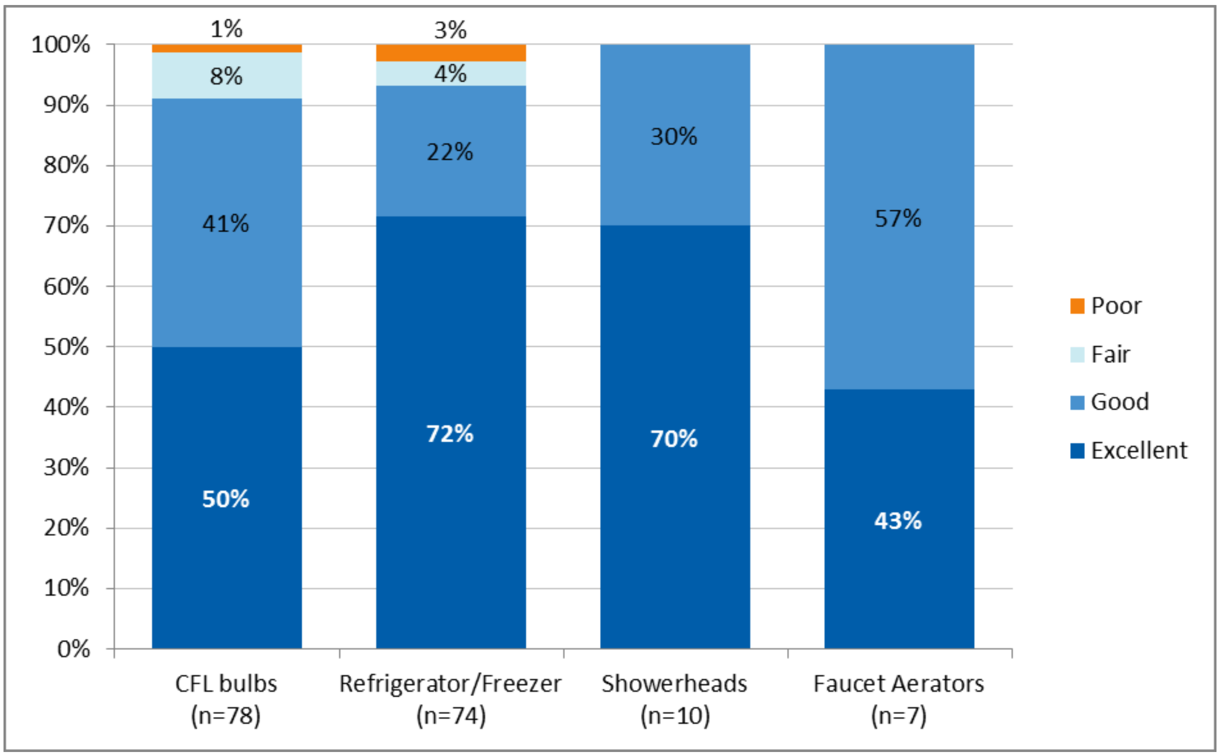
Respondents provided a variety of suggestions for program improvements. Several stressed a need for improved communication, particularly in returning phone calls and informing participants about wait list status and project timelines. Two suggested adding windows to the list of measures installed by the program.

[20] Measures were installed using multiple funding sources, and customers might not be able to distinguish between DP&L and another program. Therefore, satisfaction levels, complaints, and other respondent comments may reflect a more general attitude regarding the process and not just DP&L-funded measures.

Measure Satisfaction

Cadmus asked survey respondents a series of questions to elicit: a verbal confirmation that measures paid for by DP&L had been installed in their home; and respondents' satisfaction levels with those measures. While participants likely received other measure installations through non-DP&L funding sources, the survey questions did not extend beyond DP&L-funded measures. Cadmus also asked participants to rate the new measures on a four-point scale (e.g., excellent, good, fair, or poor). Figure 19 presents participant ratings for measures discussed with survey respondents. Overall, respondents rated their new equipment quite favorably, with the vast majority citing each item as "excellent" or "good."

Figure 19. Participant Satisfaction by Measure Type



Additional details regarding measure-specific satisfaction and installations follow.

CFL Ratings

Of respondents that recalled receiving light bulbs, 91% rated them as "excellent" or "good"—a slight decrease from the 93% (n=105) reported in 2012, though not a statistically significant difference. Table 35 provides the frequencies of participant opinions that support their ratings.

Table 35. CFL Installation Ratings (n=78)

Type of Response	Rationale for Response	Frequency	Percent	Precision
Positive (n=71)	They save energy	24	31%	±9%
	They give good light	22	28%	±8%
	They [will] save me money	11	14%	±7%
	I will not have to change the bulb frequently	9	12%	±6%
	They're better than the bulbs I had	8	10%	±6%
	They're just fine or I just like them	7	9%	±5%
	I like the way they look	3	4%	±4%
	I will not have to change the bulb in a hard-to-reach fixture	2	3%	±3%
	They were free	1	1%	±2%
Negative (n=7)	The light is too dim	4	5%	±4%
	I do not like the color of the light	1	1%	±2%
	They take too long to light up	1	1%	±2%
	They burn out quickly	1	1%	±2%

Respondents most commonly awarded positive reactions to CFLs for saving energy and providing good light. Conversely, bulbs perceived as too dim earned the highest negative responses.

Refrigerator/Freezer Replacement

Ninety-four percent (n=74) of respondents receiving refrigerators or freezers rated the new equipment as "excellent" or "good" (as shown in Figure 19)—findings very similar to those from 2012 and not a statistically significant difference. Five respondents rated their new refrigerator or freezer as "fair" and four rated them as "poor." Table 36 provides the frequencies of participant opinions that support their ratings.

Table 36. Refrigerator/Freezer Replacement Rating (n=73)

Type of Response	Rationale for Response	Frequency	Percent	Precision
Positive (n=68)	It works	18	25%	±8%
	The refrigerator is a good size	17	23%	±8%
	My old refrigerator stopped working/was not working well	15	21%	±8%
	It is just fine or I just like it	11	15%	±7%
	It keeps the food at the right temperature	9	12%	±6%
	It saves energy	7	10%	±6%
	I needed a new refrigerator/freezer anyway	4	5%	±4%
	It was free	2	3%	±3%
	I was glad not to have to clean out my old refrigerator	2	3%	±3%
Negative (n=5)	Too noisy/loud	4	5%	±4%
	Does not like the plastic racks	1	1%	±2%

Respondents expressed a higher percentage of positive comments about the refrigerators and freezers than the CFLs, with the most common positive response being appreciation that the new unit worked. Other common responses included: the units were a good size; they kept the food at the right temperature; and they saved energy. Four respondents said they did not like their refrigerators or freezers as they were too noisy, and one did not like the plastic racks inside.

CFL Installation Rate

Only one out of 82 participants receiving CFLs did not recall receiving new light bulbs. Of participants saying they received CFLs, 16 reported removing some installed program CFLs, with 38% of those removing bulbs (six of 16) reporting they replaced the CFLs with additional CFLs. Respondents most commonly removed program CFLs due to burn-outs.

While CFL distributions largely occurred through direct-installations, 12% of respondents receiving CFLs (10 of 82) also indicated the agency contractor left CFLs behind for the participant to install (in addition to CFLs the contractor installed), a number slightly less than in 2012, when 17% of respondents reported left bulbs for them to install. When asked whether they installed left-behind bulbs, all respondents said they had.

CFLs achieved a 97% installation rate, a statistically significant increase from the 96% rate in 2012. Table 37 provides details for the CFL installation rate calculation results.

Table 37. CFL Installation Rate

CFL Disposition	Respondents (n)	Bulbs
Bulbs given to survey participants	82	1,785
Never received bulbs	1	17
Removed bulbs	16	45
Replaced removed bulbs with CFLs	6	15
Uninstalled left-behind bulbs	0	0
Installation Rate (without reinstalled CFLs)	**79%**	**97%**
Installation Rate (with reinstalled CFLs)	**87%**	**97%**

A similar average number of CFLs were installed per customer between 2012 and 2013, although bulbs averaged a bit higher for phone survey respondents than for the total population for 2013, as shown in Table 38.

Table 38. Average Numbers of CFLs

Category	2012	2013
Survey respondents receiving CFLs	109	82
CFLs per respondent	18.67	21.77
Total number of DP&L customers receiving CFLs	405	349
CFLs per customer (total population)*	16.70	18.61

*Based on the inventory study performed as part of the residential lighting program.

Stakeholder Interview Findings

Program Goals and Objectives

OPAE and agency staff each reported their overall program goal as serving as many customers as possible with the funds available. To determine funding amounts for the program goals, OPAE allocated funding to agencies proportionally by the amount of Heating Energy Assistant Program (HEAP) customers in each agency's region. Funds could be reallocated from agencies running surpluses to agencies with demand exceeding initial funds. Overall, federal funding has fallen since ARRA funding ended in 2012.

Delivery Barriers

Several factors influenced the ability of agencies to fully spend allocated DP&L funding. First, agencies had to identify all H&S requirements and associated costs prior to conducting weatherization work. One agency reported only 15% of overall project costs for a specific location could be spent on H&S measures (e.g., repairs to roofs, ventilation, or electrical systems). If H&S costs exceeded the 15% of overall project costs (meaning a higher proportion of program costs went towards H&S as opposed to energy-related repairs), the agency might not be able to perform work and would have to walk away from the project entirely.

Additionally, agencies cited the new ASHRAE 62.2 ventilation standard as another barrier to serving participants through the program. This new standard mandated minimum requirements for ventilation systems and building envelopes in low-rise residential buildings. Though achieving these often required additional repairs in homes, additional funding (DP&L or federal) had not been allocated to address these repairs. One agency reported the change required them to test and analyze every home they worked on to see if upgrades had to be made to meet the new standard. Any work required to address these standards derived from H&S funding, which reduced overall H&S funding available for projects.

Information Systems and Data Collection

Agency staff reported that, in general, data collection and tracking using the CC System worked much better for them than the previous C3/C4 spreadsheet system. As agencies had to collect other participant data for each project, they continued to maintain paper files and only entered relevant data from these forms into the CC System during invoicing. Agencies reported continuing to use the C4 form to collect measure-specific data prior to entry in the CC System, as the C4 form included many details required for CC System fields.

Despite some initial obstacles in using the CC System, agency staff reported increased comfort with operations in 2013. One agency indicated a preference for the physical C4 form when initially documenting program information, as the usability of the web-based CC System interface presented some challenges. Specifically, the system required completing all information for a single project before calculating savings, and failing to address all required questions could result in losing data entered for a project. Due to the information required and the need to navigate to sections within the system to complete the data entry, agency staff found it easier to first compile all information on a separate form rather than electronically tracking the project while in the field. They also said data errors only became noticeably during end-of-the-month uploads, when their invoices would not process, and correcting them required combing through individual records.

While tracking electronic data through the CC System offered a key benefit in automatically calculating savings using the Ohio TRM algorithms, the agencies did not receive clear communications regarding this capability or on the process to track these savings inputs. Several agencies reported some initial confusion arose from the new input values required for collection (e.g., the circumference of water pipes), as the C4 forms excluded many of these fields.

Initial confusion also appeared regarding the appropriate guidance necessary for agencies to begin tracking these inputs. In discussions with FirstEnergy regarding the new, required fields, Cadmus found several required variables served as constants (i.e., standardized assumptions for energy-savings measure calculations that should not change between different projects). The agencies found these variables unnecessary and confusing: incorporation of the values into underlying savings calculations embedded in the CC System precluded entering them manually. Such constants included the pipe insulation heat transfer coefficient and electric baseboard heating efficiency. Trainings and further instructions from OPAE helped clarify this process for the agencies.

OPAE staff also suggested that the CC System could be improved by linking it to the Ohio Development Service Agencies' statewide "OCEAN" computer system (which compiles HEAP and Home Weatherization Assistance Program participant data). Linking these systems would allow those involved in delivering weatherization to the same participants to more easily share and access customer information. To date these systems have not been linked together.

Recommendations

Drawing upon the preceding findings, Cadmus offers the following recommendations:

- **CC System updates should be supported with updates to input forms.** Stakeholders said they still used forms such as the C4 to collect data for later entry into the CC System. Relevant data collection forms sent to CC System users should reflect additional improvements or added fields, to improve the quality of data and increase accuracy of *ex ante* claimed saving estimates in the CC System.
- **DP&L should encourage the adoption of the input controls provided in Cadmus' October 2013 database review document.** Applying database controls (such as discrete ranges or required fields) would help improve the accuracy of savings calculations. Integrating information on heating, cooling, and water-heating fuels and equipment types with savings calculations also would help ensure the appropriate application of electric savings.
- **Continue Information Systems Trainings and Informational Outreach:** Stakeholders reported seeing improvements in tracking and reporting using the CC System. As the year progressed and changes and updates were made to the system, stakeholders reported confusion regarding

requirements for invoicing their projects—especially for necessary Ohio TRM values. In response, OPAE updated agencies through trainings, which stakeholders found helpful. Providing ongoing trainings and sending CC System updates would help standardize processes across users and support best practices. Stakeholders found errors hard to track, not discovering them until trying to invoice at the end of the month. Providing training or tips could help users address errors earlier in the process. System updates should be promptly communicated to stakeholders, along with supporting tips or best practices associated with the updates.

- **Funding Electric-Saving Measures**: Program data showed a number of homes receiving insulation or air sealing measures where no electric savings could be claimed. DP&L should work with OPAE to ensure all agencies clearly understand eligible electric-savings measures that can be installed, given home heating and cooling fuel and equipment types.
- **Electric-Savings Potential in Electric Room Heaters**: Nineteen percent of phone survey respondents reported using electric room heaters as a supplemental heating source. While about one-half (48%) indicated reducing electric heater usage after completion of work, the program could achieve additional electric savings by addressing these measures. As with ARPs, DP&L could consider offering an incentive to customers that relinquish their electric room heaters following weatherization work.

Residential Heating and Cooling Rebate and Residential Diagnostic and Tune-Up Programs

This chapter describes the evaluation approach, detailed findings, and conclusions and recommendations for the Residential Heating and Cooling Rebate Program and the Residential Diagnostic and Tune-Up Program.

Program Design Changes

Due to limited uptake among contractors and customers in program years 2010 through 2012, DP&L ramped down and discontinued the HVAC tune-up measure offering, effective June 30, 2013. As a result, the HVAC Diagnostic and Tune-Up Program experienced lower participation numbers than those in DP&L's filed portfolio plan. All results and findings for the Diagnostic and Tune-Up program have been included in this report along with the Heating and Cooling Rebates program.

The Residential HVAC Diagnostic and Tune-Up program sought to reduce customer energy use and increase comfort levels in participating homes. The program achieved energy savings through cleaning and adjusting critical HVAC equipment components, such as:

- Evaporator and condenser coils;
- Blower wheels and motors;
- Refrigerant charge; and
- Duct connection seals.

Marketing and outreach efforts targeted local HVAC contractors and end-use customers using central air conditioning (CAC) or air-source heat pump units in owner-occupied, single-family, residential dwellings. To qualify for the program incentive, contractors had to perform a series of mandatory services using industry best practices. Contractors received a program incentive of $15, and homeowners received a $25 line-item reduction on their contractor's invoice. All residential customers with DP&L delivery service qualified for the program.

Evaluation Overview

Cadmus' evaluation of the 2013 Residential Heating and Cooling Rebate Program followed the researchable questions and evaluation activities outlined in the DP&L *2010–2012 Evaluation, Measurement, and Verification Plan* and the DP&L *2013 Evaluation, Measurement, and Verification Plans*. Table 39 identifies key researchable evaluation questions.

Table 39. Key Researchable Questions

Researchable Question	Activity Used to Address Question
What changes to program design and delivery would improve performance?	• Program and implementation staff interviews • Trade ally interviews • Participant customer surveys • Program database review
What is customer satisfaction with the program?	• Participant customer survey • Trade ally interviews
How effective has the program been in recruiting and training HVAC contractors?	• Program and implementation staff interviews • Participant customer surveys
How can the program increase its energy and demand reduction?	• Program and implementation staff interviews • Trade ally interviews
What are the barriers to increased customer participation, and how effectively does the program overcome those barriers?	• Trade ally interviews • Participant customer surveys
What were the gross electric savings and demand reductions achieved by the program?	• Engineering analysis • Analysis of participant customer billing data • Program database review • Participant customer surveys

Detailed Evaluation Findings

The program achieved 6,893,788 kWh savings and 1,374 kW in demand reduction. Compared against claimed *ex ante* claimed savings, the program achieved realization rates of 99% for energy savings and 70% for demand reductions. The program's 99% realization rate for energy savings primarily resulted from the slightly lower observed unit energy savings (UES) calculated for early replacement CAC and air-source heat pump measures—the program's largest savings sources. However, higher observed UES for electronically commutated furnace motor (ECM) measures—the most common program measure—offset most of these reduced savings.

The 70% program realization rate for demand reduction primarily resulted from differences in how Cadmus identified energy efficiency ratings (EER) for CAC and air-source heat pump measures. In *ex ante* estimates, these values were derived from SEER ratings in program tracking data and a conversion factor of 0.9 from the Ohio TRM. In this evaluation, Cadmus looked each model up in the AHRI certified products directory or, where necessary, applied a more conservative conversion algorithm. [21]

Overall, Cadmus found the program operated in 2013 as designed and experienced few implementation issues and very high participating contractor and customer satisfaction levels.

[21] http://www.ahridirectory.org/ahridirectory/pages/home.aspx

The combined programs residential HVAC programs did not achieve their filed goals for energy or demand.

Program *ex ante* claimed and adjusted gross savings and demand reduction are located in Table 40.

Table 40. Residential Heating and Cooling Rebate Program Claimed and Achieved Energy Savings

Measure	*Ex Ante* Claimed Savings		Verified Gross Savings		Adjusted Gross Savings		
	kWh	kW	kWh	kW	kWh	kW	Precision*
ER AC 14/15 SEER	1,137,082	598	1,137,082	598	1,092,205	444	2%
ER AC 16+ SEER	976,124	574	976,124	574	970,304	394	2%
NC AC 14/15 SEER	39,104	37	39,104	37	29,062	15	10%
NC AC 16+ SEER	13,965	11	13,965	11	13,930	6	10%
RP AC 14/15 SEER	6,932	8	6,932	8	6,863	4	7%
RP AC 16+ SEER	10,622	8	10,622	8	10,313	4	10%
ER GSHP 16/18 EER	222,447	11	222,447	11	219,842	11	10%
ER GSHP 19+ EER	481,409	32	481,409	32	480,848	32	10%
NC GSHP 16/18 EER	222,580	12	222,580	12	225,171	12	10%
NC GSHP 19+ SEER	124,189	9	124,189	9	127,046	10	10%
RP GSHP 16/18 EER	35,054	2	35,054	2	34,917	2	10%
RP GSHP 19+ EER	53,069	4	53,069	4	53,704	4	10%
ER HP 14/15 SEER	1,378,017	233	1,378,017	233	1,327,035	172	3%
ER HP 16+ SEER	1,181,381	258	1,181,381	258	1,185,074	160	3%
NC HP 14/15 SEER	31,767	9	31,767	9	29,366	4	10%
NC HP 16+ SEER	27,491	7	27,491	7	27,105	3	10%
RP HP 14/15 SEER	28,047	7	28,047	7	26,015	4	10%
RP HP 16+ SEER	18,017	5	18,017	5	18,902	2	10%
NC MS AC 16+ SEER	4,433	5	4,433	5	1,529	2	10%
RP MS AC 16+ SEER	168	0	168	0	78	0	10%
NC MS HP 16+ SEER	246,489	27	246,489	27	217,824	12	39%
ECM with New AC**	366,373	0	366,373	0	437,381	0	19%
ECM	242,833	93	242,833	93	269,108	63	13%
AC Tune-Up	33,501	11	33,501	11	33,501	11	1.76%
HP Tune-Up	56,663	2	56,663	2	56,663	3	5.97%
Total* **	**6,937,760**	**1,962**	**6,937,760**	**1,962**	**6,893,788**	**1,374**	**2.19%**

*Precision at 90% confidence.

**Electronically commutated motor

***Values in table may not sum exactly to total due to rounding.

Evaluation Data Collection Methods

Cadmus used the approaches detailed below in evaluating the 2013 program.

Program Participant Utility Bill Regression Analysis

Cadmus conducted two analyses of customer billing data. The first, conducted in October 2013, used the Princeton Scorekeeping Method (PRISM) analysis of billing data for customers receiving a DP&L-incented tune-up for their CAC or air-source heat pump system in 2013.

The second, conducted in February 2014, was a regression analysis of billing data for program participants. As significant changes did not occur between the 2009 and 2013 program years regarding program delivery, customers targeted, or required efficiency levels for most measure types, the analysis considered participating customers from all five years.

Cadmus used results from both analyses to evaluate measure-level, kWh savings estimates.

Data Tracking System Review

Cadmus reviewed the final 2013 program tracking database for input, accuracy, and completeness of data tracked. The review determined whether the tracking database contained:

- Data necessary to calculate savings collected;
- Reported savings estimates that matched measure types; and
- Existing and installed equipment types meeting measure requirements.

As previous evaluation efforts identified few tracking data issues for this program, Cadmus only conducted a brief review of tracking data elements that did not directly inform savings calculations in 2013.

Participant Customer Surveys

In November 2013, Cadmus surveyed participating customers, identified in a preliminary sample of the program tracking database.[22] Cadmus stratified the sample based on whether the participant received the following:

- Early and regular replacement CAC, air, or ground-source heat pump measures;
- Mini-split AC and heat pump measures; or
- ECM measures (installed without CAC).

These stratified targets ensured the survey would collect data from a broad range of program participants and feedback from measure groups with few participants (mini-split measures) and new measure groups (ECMs).

The new construction participant decision-making process differed significantly from early replacement and replace-on-burnout. Further, new construction replacements for CAC, air-, and ground-source heat pump measures represented just 7% of measures incented in 2013. Therefore, as in the 2010 and 2011 evaluations, the study did not include these participants. New construction participants with mini-split

[22] Data provided on October 10, 2013, contained program participants through September 2013.

measures were included in the survey as the number of available contacts with this measure type was very limited, and data collected through the participant survey were used to inform impact analyses (as described below).

Cadmus missed the target number of completes for two strata (Mini-Split AC and Air-Source Heat Pump, and ECM) due to the limited number of available contacts identified in program tracking data at the time of the survey. Table 41 also summarizes completed survey by strata.

Table 41. Residential Heating and Cooling Rebate Program Participant Customer Survey Summary

Strata	Final 2013 Population*	Completed Surveys
CAC, Air- and Ground-Source Heat Pumps	2,728	70
Mini-Split AC and Air-Source Heat Pump	101	16
ECM (installed without new CAC)	350	43
Total	**3,179**	**129**

*Unique participating customers identified using utility account numbers.

Results for the 2011 (the previous participant survey conducted for this program) and 2013 participant customer surveys, reported at the program-level, reflected post-stratification weighting. Survey weights, based on the distribution of participants across the strata, sought to remove possible sampling bias by ensuring the two populations could be compared regarding their respective annual program populations.

Participant Contractor Interviews

In December 2013, Cadmus surveyed participating contractors identified in tracking materials from the program implementer, Conservation Services Group (CSG).[23] Cadmus based the strata on the number of incented measures installed by the contractor in 2013, as identified in a preliminary sample of program tracking data.[24] Table 42 provides the strata, population, and number of completed surveys.

Table 42. Residential Heating and Cooling Rebate Program Participant Contractor Survey Summary

Strata	Percent of Total Rebated Measures	2013 Population	Achieved Completes
Large	50%	5	4
Medium	30%	17	10
Small	20%	106	21
Total	**100%**	**128**	**35**

Impact Evaluation Methodology and Findings

In evaluating the 2013 program, Cadmus used the approaches detailed below.

23 Data provided on October 31, 2013.

24 Data provided on October 10, 2013, and containing program participants through September 2013.

UES Estimates from PRISM Analysis of Participant Billing Data and Ohio TRM Assumptions

In October 2013, Cadmus conducted a PRISM analysis of program participants' billing data. PRISM is a statistical procedure used to produce a weather-adjusted index of energy consumption, and provides results in terms of base-load versus heating consumption and base-load versus cooling consumption, based on a selected reference temperature. Cadmus applied a 5% energy-saving estimate from the Ohio TRM to these usage estimates to calculate a UES for each equipment type (CACs and air-source heat pumps).

The PRISM analysis approach proved advantageous over traditional billing analysis techniques due to limited participation and post-period data, which would have resulted in unacceptably imprecise savings estimates.

Though considering all 2013 program participants for the analysis, Cadmus removed a limited number of accounts (representing 20 of 490 measures) with very low cooling usage, model problems, or insufficient billing data. Analysis only included pre-period consumption data (i.e., customer usage prior to the equipment tune-up). The analysis could be completed in October 2013, as the tune-up measure offering has been ramped down and terminated at the end of the 2013 cooling season, and final participant tracking data was available for analysis.

From NOAA stations, Cadmus obtained daily weather data, corresponding to participant ZIP codes listed in the program tracking data. Daily weather data allowed determination of the base 65 reference temperature CDDs and HDDs. Participant billing data could then be matched to the nearest weather station by ZIP code and aligned to each monthly billing period per the associated base 65 HDDs and CDDs.

Cadmus applied UES estimates, identified through the PRISM analysis, to the program population, deriving adjusted gross savings estimates for both equipment types. Table 43 provides the results.

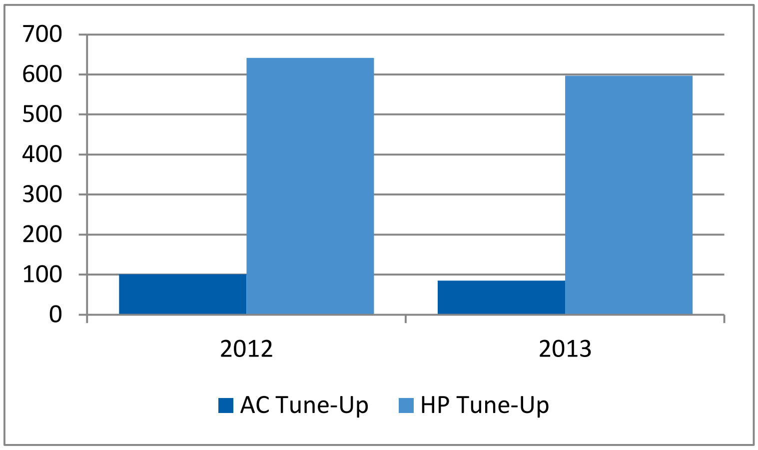
Table 43. Adjusted Gross Energy Savings (kWh) from PRISM Analysis of Participant Billing Data and Ohio TRM Assumptions

Measure	Incented Measures	Total Cooling Usage (PRISM)	Total Heating Usage (PRISM)	Average UES Estimate*	Total Adjusted Gross Savings
AC Tune-Up	395	1,696	N/A	84.81	33,501
HP Tune-Up	95	1,926	10,003	596.46	56,663
Total	**490**				**90,165**

*Total cooling and heating usage multiplied by 5% (TRM-deemed savings estimate).

As shown in Figure 20, CAC and air-source heat pump tune-ups produced lower UES than in 2012. This primarily resulted from an increase in the average efficiency of units in the program. Customers participating in 2013, on average, used CAC and air-source heat pumps that were appreciably more efficient (>1 SEER rating) and slightly smaller than in 2012. As these units used less energy overall, tune-ups resulted in lower savings.

Figure 20. Comparison of UES Estimates from PRISM Analysis 2012–2013



Program Participant Utility Bill Regression Analysis UES Estimates

Cadmus used a pre- and post-fixed effects modeling approach, allowing direct development of savings estimates for each program measure category.

Cadmus received billing data for program participants from October 2008 through January 2013, and paired monthly billing information pre- and post-installation of incented equipment. This ensured the same months would be used in the pre- and post-periods, preventing bias resulting from using mismatching months. The model using participants with 11 months of pre- and post-billing information provided the most accurate results.

Similarly to the described PRISM analysis, Cadmus obtained daily data from NOAA stations corresponding to program participant ZIP codes. The daily weather data allowed the evaluation to base 65 reference temperature HDDs and CDDs, and then matched participant billing data to the nearest weather station by ZIP code and each monthly billing period to the associated base 65 HDDs and CDDs.

Model Specifications

Cadmus used a fixed-effects modeling method, employing pooled monthly time-series (panel) billing data. The approach corrected for differences between pre- and post-weather as well as for differences in the magnitude of usage between participants. The fixed effects component was characterized by normalization of variations across the range of participants via including a separate intercept for each customer. This ensured unusually high-usage or low-usage participants would not skew the model savings estimates.

Data Screening

Cadmus used the following criteria to screen customer billing data prior to analysis:

- Removing of participants with fewer than 11 paired months in the pre- or post-period: This screen removed most 2013 program participants from analysis.

- Excluding participants with expected deemed savings over 70% of the pre-usage from analysis. In effect, this eliminated low-usage accounts, where expected savings from measure installations would be too large in reference to the total pre-period usage.
- Excluding accounts changing usage from the pre- to post-period by more than 70%.
- Removing participants using less than 1,825 kWh in the pre- or post-year, and participants using less than 5 kWh per day in the pre- or post-period from the analysis, which would indicate insufficient cooling or heating usage or unoccupied participant homes.

These screens eliminated 23% of the 2009–2012 program participants and 100% of 2013 program participants.

Model Results

Table 44 summarizes UES estimates calculated through the participant billing analysis, with acceptable precision levels. Generally, per-unit adjusted gross savings estimates were slightly lower than *ex ante* estimates provided by DP&L and the program implementer.[25] Realization rates greater than one for ECM measures reflected different calculation approaches used to quantify savings. Due to limited post-period data in 2012, Cadmus used engineering calculations to quantify savings for ECM measures.

Table 44. Measure Savings Estimates (kWh)

Measure	Accounts in Analysis	*Ex Ante* UES Estimate	Adjusted Gross UES Estimate	Realization Rate
ER AC 14/15 SEER	3,315	1,134	1,089	96%
ER AC 16+ SEER	2,287	1,253	1,246	99%
RP AC 14/15 SEER	117	198	196	99%
ER HP 14/15 SEER	1,152	3,212	3,093	96%
ER HP 16+ SEER	793	3,291	3,301	100%
ECM with New AC	205	349	417	119%
ECM	205	684	758	111%

When applying results from the participant billing analysis for ECM measures, Cadmus only included heating savings for ECMs installed with new CACs. When a ECM is installed with a new HVAC system, that system's AHRI SEER rating may be based on the furnace with an ECM motor installed (i.e., the SEER rating accounts for cooling savings would attributable to the ECM's presence). Cadmus 2012 *EM&V Report* provides a more thorough discussion of this issue.

To verify the screening process outlined above and including participants from previous program years did not introduce bias, and the billing analysis sample population remained comparable to the overall 2013 program population for these measure categories, Cadmus compared the two groups in the following areas:

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25 For several measures, CSG used results from the 2012 Cadmus evaluation report (2012 *EM&V Report*), filed May 15, 2013 under docket number 13-1140-EL-POR.

- Average SEER rating of incented equipment;
- Average size (tons) of incented equipment;
- Average SEER rating of replaced equipment; and
- Average size (tons) of replaced equipment.

Table 45 and Table 46 compare these populations (with data tracking errors removed). As ECMs were new measures, added in 2012, and the program tracking database did not contain detailed data on equipment specifications, Cadmus could not conduct a similar comparison for ECM measures.

Table 45. Comparison of Billing Analysis Sample to Program Population: Incented Equipment

Measure	Average SEER		Average Size (Tons)	
	Sample	Population	Sample	Population
ER AC 14/15 SEER	14.4	14.4	2.7	2.7
ER AC 16+ SEER	16.2	16.3	2.7	2.8
RP AC 14/15 SEER	14.4	14.6	2.7	2.6
ER HP 14/15 SEER	15.0	14.9	2.7	2.7
ER HP 16+ SEER	16.7	16.8	2.9	3.0

Table 46. Comparison of Billing Analysis Sample to Program Population: Replaced Equipment

Measure	Average SEER		Average Size (Tons)	
	Sample	Population	Sample	Population
ER AC 14/15 SEER	9.6	9.9	2.7	2.7
ER AC 16+ SEER	9.7	10.0	2.6	2.7
RP AC 14/15 SEER	9.3	10.0	2.8	2.7
ER HP 14/15 SEER	10.5	10.4	2.6	2.6
ER HP 16+ SEER	10.5	10.8	2.7	2.8

This comparison revealed several minor differences in the characteristics of incented and replaced equipment. While some of these differences were statistically significant, they tended to be small, with limited impact on the UES estimates. Therefore, Cadmus concluded the populations proved sufficiently similar to justify applying UES estimates, identified through the billing analysis, to the 2013 population.

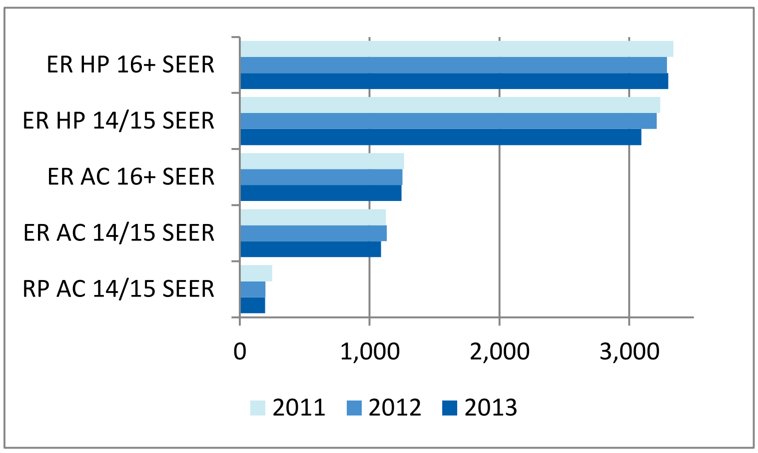
Cadmus applied the UES estimates to the program population to derive adjusted gross savings for the selected measures. Table 47 provides the results.

Table 47. Adjusted Gross Energy Savings from Participant Billing Analysis

Measure	Incented Measures	Adjusted Gross UES Estimate	Total Adjusted Gross Savings
ER AC 14/15 SEER	1,003	1,089	1,092,205
ER AC 16+ SEER	779	1,246	970,304
RP AC 14/15 SEER	35	196	6,863
ER HP 14/15 SEER	429	3,093	1,327,035
ER HP 16+ SEER	359	3,301	1,185,074
ECM with New AC	1,049	417	437,381
ECM	355	758	269,108
Total	**4,009**		**5,287,971**

Overall, billing analysis results aligned with expectations. UES estimates calculated through the 2013 billing analysis were similar to findings from the 2011 and 2012 analyses. Figure 21 compares the results. As this was the first year ECM savings could be quantified through a billing analysis, the comparison did not include the UES estimate for this measure.

Figure 21. Comparison of UES Estimates from Billing Analysis 2011–2013



UES Estimates from Ohio TRM Calculations

Cadmus deferred to the Ohio TRM when calculating adjusted gross UES estimates for all measures, except: mini-split air-source heat pumps (which were not included); and measures included in the participant billing analysis (shown in Table 44 and Table 47). Though the Ohio TRM did not address some variations of common measures (specifically early replacement heat pumps), savings calculations and assumptions for these measures could be adapted from information provided for similar measures.

Cadmus applied the Ohio TRM energy savings equations and assumptions to 2013 program participants, resulting in the annual energy-savings estimates provided in Table 48.

Table 48. Adjusted Gross Energy Savings from Ohio TRM Calculations

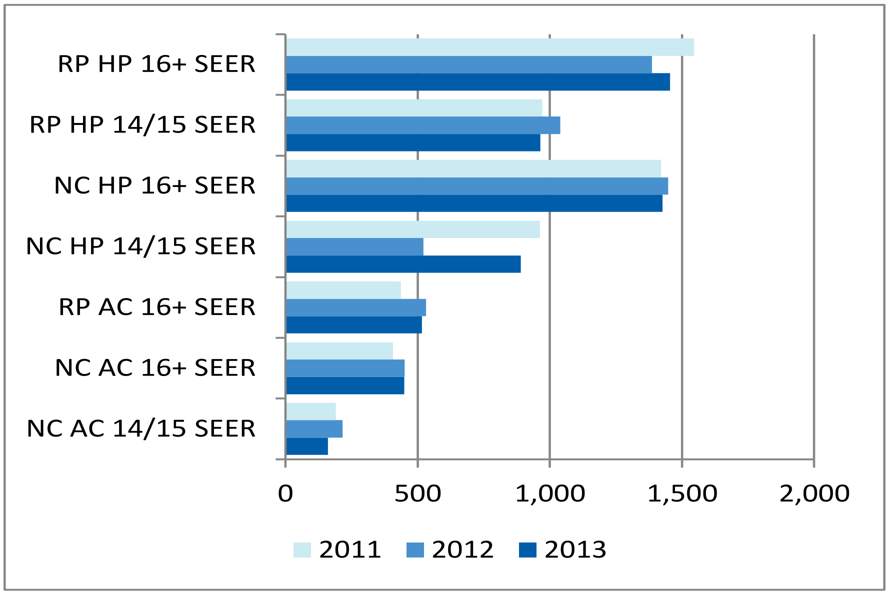
Measure	Incented Measures	Adjusted Gross UES Estimate	Total Adjusted Gross Savings
NC AC 14/15 SEER	181	161	29,062
NC AC 16+ SEER	31	449	13,930
RP AC 16+ SEER	20	516	10,313
ER GSHP 16/18 EER	31	7,092	219,842
ER GSHP 19+ EER	71	6,773	480,848
NC GSHP 16/18 EER	36	6,255	225,171
NC GSHP 19+ SEER	20	6,352	127,046
RP GSHP 16/18 EER	5	6,983	34,917
RP GSHP 19+ EER	8	6,713	53,704
NC HP 14/15 SEER	33	890	29,366
NC HP 16+ SEER	19	1,427	27,105
RP HP 14/15 SEER	27	964	26,015
RP HP 16+ SEER	13	1,454	18,902
NC MS AC 16+ SEER	17	90	1,529
RP MS AC 16+ SEER	1	78	78
Total	**495**		**1,297,828**

As shown in Figure 22, adjusted gross UES estimates, calculated using the Ohio TRM, generally aligned with values observed in previous program evaluations.

The appreciable decrease in UES for the new construction heat pump 14/15 SEER measure in 2012 resulted from a significant decrease in the average size of incented units installed. The observed reduction in average size for this measure resulted from a single large contractor installing these measures in numerous apartment units. Given this decrease, DP&L used the evaluated UES estimate identified in the 2011 evaluation as the *ex ante* claimed savings for this measure.

The comparison did not include ground-source heat pump UES estimates due to changes in measure efficiency tiers in 2012 and the implementation of a revised energy-savings calculation methodology in 2013. Additional details follow. Similarly, as the mini-split AC measure realized very limited participation, comparisons to previously evaluated UES estimates proved inappropriate.

Figure 22. Comparison of UES Estimates from Ohio TRM 2011–2013



When calculating energy savings, Cadmus adhered to all savings equations and assumptions articulated in the Ohio TRM, with the exceptions described below.

CAC and Air-Source Heat Pump

- The Ohio TRM listed 631 as full-load cooling hours for the Dayton, Ohio, area. This estimate, however, included a 33% reduction for oversizing newly installed equipment. Cadmus found this oversizing correction not applicable for this program, based on discussions with participating contractors and program staff. Therefore, the evaluation used full-load cooling hours from the ENERGY STAR Calculator (947). Results from the participant customer billing analysis supported this decision.
- The Ohio TRM did not include early-replacement air-source heat pump measures. To calculate energy savings and demand reductions for these measures, Cadmus adapted the appropriate time-of-sale air-source heat pump calculations to include the size and efficiency of the replaced equipment.
- Program tracking data lacked the SEER rating of the replaced equipment for seven early-replacement CACs and seven early replacement air-source heat pump measures. When calculating savings for these measures, the evaluation used the average-size SEER ratings of equipment replaced from the same incented measure category as proxies.

Ground-Source Heat Pump

According to program tracking data and the AHRI-certified products directory, approximately 95% of ground-source heat pumps incented through the DP&L Residential Heating and Cooling program in 2013 were multistage equipment. Therefore, Cadmus adapted the algorithm provided in the Ohio TRM to capture savings from part-and full-load equipment operation. Appendix F. Ground-Source Heat Pump Part-and Full-Load Savings Adjustments provide a detailed summary of the update.

Cadmus also deviated from the Ohio TRM in the following areas:

- As with the CAC and air-source heat pump calculations described above, Cadmus used full-load cooling hours from the ENERGY STAR Calculator (947).
- The Ohio TRM did not include early replacement, ground-source heat pump measures. To calculate energy savings and demand reductions, Cadmus adapted the appropriate ground-source heat pump time-of-sale calculations to include the size and efficiency of the replaced equipment.
- The Ohio TRM energy savings algorithm for replace-on-burnout, ground-source heat pump measures lacked the equation's "/1,000" component, which the gross savings calculations included.
- The program tracking database did not capture the Heating Seasonal Performance Factor (HSPF) of the replaced unit; so Cadmus assumed the federal minimum standard, between 1992 and 2006 (included in the footnote on page 28 of the Ohio TRM in the residential HVAC Diagnostic and Tune-Up section).
- The program tracking database only contained five entries for coefficient of performance (COP) of the existing unit (out of the 102 incented early replacement units). Therefore, Cadmus used the HSPF value from page 28 of the Ohio TRM and the HSPF-to-COP conversion factor from page 84 of the Ohio TRM as a proxy.
- Ground-source heat pumps tend to be sized for heating rather than cooling. In an area such as Dayton, Ohio, this generally leads to oversized equipment on the cooling side. Ohio TRM savings equations used a unit's overall capacity to determine savings. This could overstate cooling savings for a unit. To correct for oversizing when calculating cooling savings for early replacement and replace-on-burnout units, Cadmus used the capacity of the replaced unit. For new construction, this adjustment could not be made; hence, analysis reverted to the capacity of the newly installed unit.

Mini-Split ACs

The Ohio TRM did not provide savings equations or assumptions for mini-split ACs, and too few participants could be included in the billing analysis to provide precise savings estimates. However, a review of participant customer survey data and interviews with CSG staff confirmed most of these measures were used for space cooling—much like a window or portable AC. Therefore, Cadmus applied the Ohio TRM energy savings equation and assumptions for time-of-sale, ENERGY STAR room ACs to the 2013 program participants.

UES Estimates from Ohio TRM and Engineering Calculations

As with mini-split ACs, the Ohio TRM did not provide savings equations and assumptions for mini-split air-source heat pumps, and too few participants could be included in the billing analysis to provide precise savings estimates. Therefore, to determine adjusted gross energy savings for these measures, Cadmus followed the same general approach used for the 2010, 2011, and 2012 evaluations—relying on engineering calculations informed by the Ohio TRM and on primary and secondary source data.

To determine the energy savings these measures achieved while cooling, Cadmus applied the Ohio TRM energy savings equation and assumptions for time-of-sale ENERGY STAR room ACs to 2013 program participants. To calculate energy savings for air-source heat pump mini-split measures used for heating, Cadmus utilized the following equation and assumptions:

$$\Delta kWh = Hcap * \left(\frac{1}{3.413} - \frac{1}{Installed\ HSPF}\right) * \frac{1}{A} * \ Heating\ Savings * Adjustment\ Factor$$

Where:

Hcap	= Size of the installed unit in tons, multiplied by 12
A	= 0.171 (identified in KEMA's mini-split study)[26]
Heating Savings	= 135.0 (identified in KEMA's mini-split study)[27]
Adjustment Factor	= 69.7%[28]

Table 49 presents the annual savings estimates this approach produced.

Table 49. Adjusted Gross Energy Savings from Engineering Calculations Based on Secondary Sources

Measure	Incented Measures	Adjusted Gross UES Estimate	Total Adjusted Gross Savings
NC MS HP 16+ SEER	98	2,223	217,824
Total	**98**		**217,824**

Given the low participation in these measure categories since 2010 and that they included measure specifications that varied considerably, comparisons to previously evaluated UES estimates were not appropriate.

26 KEMA. 2009. *Ductless Mini Pilot Study.* http://www.env.state.ma.us/dpu/docs/electric/09-64/12409nstrd2ac.pdf

27 Ibid.

28 The percentage of mini-split heat pumps installed to replace electric resistance space heating were determined using results from surveys with mini-split air-source heat pump participants, as conducted in by CSG staff in 2010 and Cadmus in 2013.

Demand Reduction Estimates from Ohio TRM Calculations

Cadmus used the Ohio TRM to calculate adjusted gross demand reduction estimates for all measures in the 2013 participant database, except ECM measures. This did not deviate from the Ohio TRM equations or assumptions when calculating demand reduction for these measures, except the following:

- To determine EER ratings for all incented and replaced equipment, Cadmus identified equipment in the AHRI certified products directory using the AHRI certified reference numbers provided in program tracking data. If a measure could not be located in the directory, Cadmus applied the following algorithm: $-0.02 \times SEER^2 + 1.12 \times SEER$ to the measure's SEER rating.
- The Residential HVAC Diagnostic and Tune-Up program tracking database did not include the size of two CAC and three air-source heat-pump measures. Therefore, the evaluation used the average size of installed CACs and air-source heat pumps, identified in the tracking data, as proxies for the missing data.
- The Residential HVAC Diagnostic and Tune-Up program tracking database did not include the SEER rating of seven CACs and one air-source heat-pump measure. Therefore, Cadmus used the average SEER rating of installed CACs and air-source heat pumps, identified in the tracking data, as proxies for these missing data.
- The Ohio TRM did not include early replacement air- or ground-source heat pump measures. To calculate energy savings and demand reductions for these measures, the evaluation adapted the appropriate time-of-sale calculations to include the size and efficiency of the replaced equipment.
- To calculate demand reductions for mini-split ACs or air-source heat pumps, Cadmus applied the Ohio TRM demand reduction equation and assumptions for time-of-sale ENERGY STAR room ACs to the 2013 program participants.

Table 50 provides the resulting annual demand reduction, identified using Ohio TRM algorithms and assumptions.

Table 50. Adjusted Gross Demand Reductions from Ohio TRM Calculations

Measure	Incented Measures	Adjusted Gross Unit Demand Reduction Estimate	Total Adjusted Gross Demand Reduction
ER AC 14/15 SEER	1,003	0.58	443.89
ER AC 16+ SEER	779	0.71	394.44
NC AC 14/15 SEER	181	0.09	15.31
NC AC 16+ SEER	31	0.26	5.65
RP AC 14/15 SEER	35	0.15	4.41
RP AC 16+ SEER	20	0.30	4.27
ER GSHP 16/18 EER	31	0.35	11.00
ER GSHP 19+ EER	71	0.45	32.17
NC GSHP 16/18 EER	36	0.32	11.60
NC GSHP 19+ SEER	20	0.48	9.64

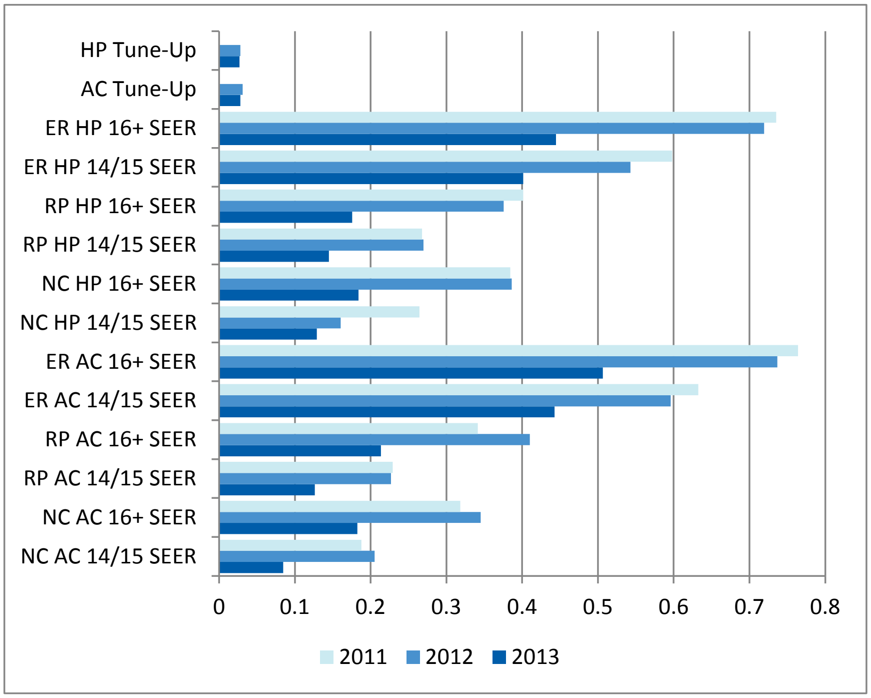
Measure	Incented Measures	Adjusted Gross Unit Demand Reduction Estimate	Total Adjusted Gross Demand Reduction
RP GSHP 16/18 EER	5	0.36	1.81
RP GSHP 19+ EER	8	0.51	4.11
ER HP 14/15 SEER	429	0.51	172.14
ER HP 16+ SEER	359	0.67	159.60
NC HP 14/15 SEER	33	0.16	4.26
NC HP 16+ SEER	19	0.30	3.50
RP HP 14/15 SEER	27	0.19	3.91
RP HP 16+ SEER	13	0.30	2.28
NC MS AC 16+ SEER	17	0.23	1.56
RP MS AC 16+ SEER	1	0.17	0.08
NC MS HP 16+ SEER	98	0.28	11.81
AC Tune-Up	395	0.03	11.20
HP Tune-Up	95	0.03	2.59
Total	**3,706**		**1,311.24**

As shown in Figure 23, per-unit demand reduction estimates for most measures generally were much lower than values observed in 2011 and 2012. The observed decrease largely resulted from the implementation approach to identifying EER ratings for incented and replaced equipment. This calculation change resulted from being able to confirm EER through the AHRI database. Upon doing this, Cadmus found the Ohio TRM method (multiplying SEER by 0.90) overestimated EER, especially with the higher SEER values.

The difference in gross demand reduction estimated between 2011 and 2012 almost entirely resulted from rounding issues in *ex ante* per-unit demand reduction estimates for the CAC and air-source heat pump measures. The *ex ante* per-unit demand reduction estimates for these measures were derived from values included in the 2011 Cadmus evaluation report. However, the evaluation report only provided gross values for each measure accurate to one decimal point. The appreciable decrease in per-unit demand reductions for the new construction heat pump 14/15 SEER measure in 2012 resulted from a significant decrease in the average size of incented units installed—as discussed above.

Due to low participation in the mini-split measure categories and widely varying measure specifications, comparisons to previously evaluated unit demand reduction estimates proved inappropriate. Similarly, as DP&L significantly changed the requirements of the tune-up measures in 2012 (transitioning from a more comprehensive test-in/test-out to a checklist-based program), comparisons did not include per-unit demand reductions from 2011.

Figure 23. Comparison of Per-Unit Demand Reduction Estimates from Ohio TRM 2011–2012



ECM Demand Reduction Estimates

To calculate demand reductions for ECM measures, Cadmus divided cooling energy savings (kWh) identified through the billing analysis (discussed above) by the full-load cooling hours for the Dayton Ohio area listed in the ENERGY STAR calculator (947) and multiplied by the result of the 0.5 peak coincidence factor identified in the Ohio TRM. Due to a difference in calculation methodology, these demand reductions were not comparable to previous evaluation results.

Table 51. Adjusted Gross Demand Reduction (kW) from Engineering Estimates

Measure	Incented Measures	Adjusted Gross UDR Estimate	Total Adjusted Gross Demand Reduction
ECM with New AC	1049	0.00	0.00
ECM	355	0.18	63.24
Total	**1,404**		**63.24**

Data Tracking System Review

Similar to evaluation findings from previous years, the 2013 Residential Heating and Cooling Rebate program generally collected complete and accurate tracking data, which provided the necessary information to calculate informed energy savings and demand reduction estimates. The few identified data tracking issues included minor omissions in size and efficiency fields for some replaced equipment in a limited number of database entries, as noted in this report's energy savings and demand reduction methodology sections.

Process Evaluation Methodology and Findings

The following section summarizes findings from the process evaluation activities.

Program Design and Implementation

The Heating and Cooling Rebate was established in DP&L's *2010-2012 Portfolio Plan*[29] and began offering incentives in 2009. Program implementation has since remained relatively unchanged, though DP&L adjusted and added measure offerings over time. Recent additions included ECMs and increased efficiency requirements for ground-source heat pump measures. In addition, as the Residential HVAC Diagnostic and Tune-Up program ramped down and discontinued in Summer 2013, program budgets, participants, and savings estimates changed. DP&L contracted with CSG for program implementation activities (e.g., contractor trainings, rebate processing, program tracking), awarding the contract in 2009 and renewing it in 2013, following a competitive bidding process.

According to program and implementation staff, established program processes were effective, with only minor updates, specifically a staffing change in the CSG team, during the 2013 program year . In 2014, DP&L anticipates working with CSG to develop and implement several contractor outreach activities (e.g., trainings, branded marketing collateral), changing the rebate structure from line-item reductions on contractor invoices to DP&L-branded checks, mailed directly to customers, and transitioning to an online internal tracking system.

Program Delivery

The DP&L Heating and Cooling Rebate program adopted a midstream focus, leveraging local HVAC contractors to market the program to their customers and to move the market toward higher-efficiency HVAC equipment. In 2013, 137 unique contractors participated in the program, with only 11% new to the program. Most contractors (70%) have participated since 2010, which is when contractor names were first included in data tracking. Table 52 provides additional detail.

Table 52. Distribution of Program Contractors by Duration of Participation

	1 Year	2 Years	3 Years	4+ Years
Duration of Participation	11% (n=15)	8% (n=11)	11% (n=15)	70% (n=96)

Low turnover rates among participating contractors in 2013 resulted in few quality assurance issues, as most contractors knew of program requirements, allowing implementation staff to focus on newer contractors and those requiring additional support. The majority of contractors surveyed (19 of 31) reported their participation began in 2009.

In 2013, as in previous years, the implementation approach encouraged participation throughout DP&L's service territory. Urban areas produced the highest participation levels, but rural areas also experienced modest participation levels.

[29] Filed October 10, 2008, under docket number 08-1094-EL-SSO.

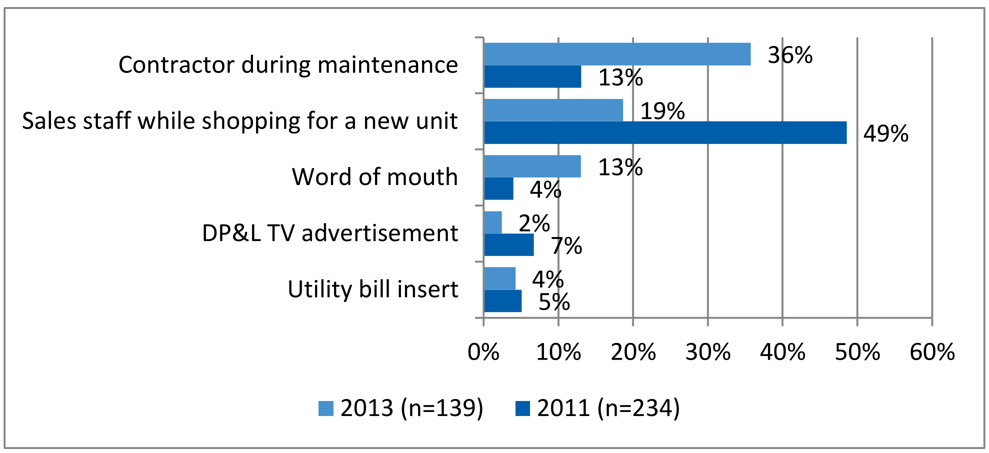
Program Marketing and Participant Awareness

DP&L and CSG both played roles in marketing the program in 2013. DP&L promoted the program to end-use customers through limited use of television and radio advertising. CSG focused on marketing the program to contractors using one-on-one meetings, telephone calls, and other direct-contact methods. Although DP&L does market to end-use customers, participating contractors are expected to generate most customer awareness.

Participating customers and contractors confirmed the effectiveness of this approach. Among interviewed contractors who could recall, contractors most commonly learned of the program through CSG (nine of 24). The second most common way contractors reported learning of the program was from a trade association (five of 24).

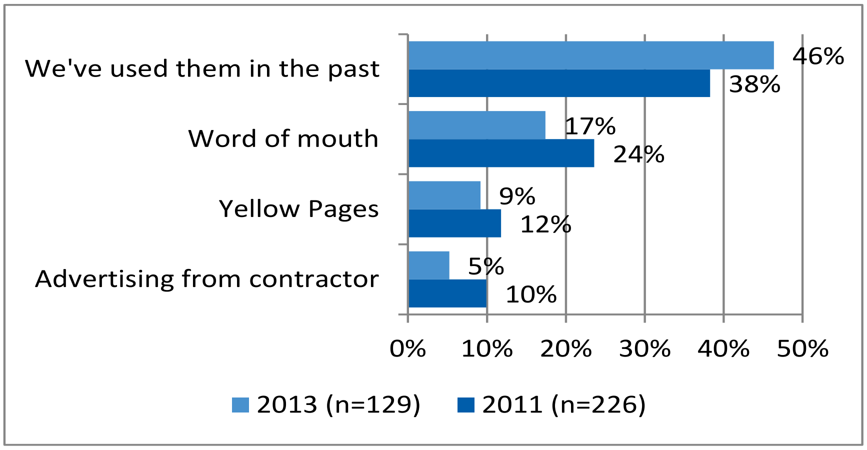
Thirty-six percent of respondents first learned of the program from their contractor during scheduled maintenance on existing equipment—a sharp increase over findings from the customer survey conducted in 2011 (36%, as compared to 13%). The 2011 survey found appreciably higher levels of HVAC sales staff informing customers of the program while shopping for new equipment (19% compared to 49%). This may have resulted from stronger relationships between contractors and customers observed in 2013 compared to 2011 (Figure 25). Both results proves significant with 90 percent confidence.

Figure 24. Ways Participating Customers Learned of Program



Nearly one-half (46%) of participating customers surveyed in 2013 had existing relationships with their contractors prior to participating in the program. As shown in Figure 25, customers in 2011 more likely had first-time relationships with their contractors. This result is significant with 90% confidence.

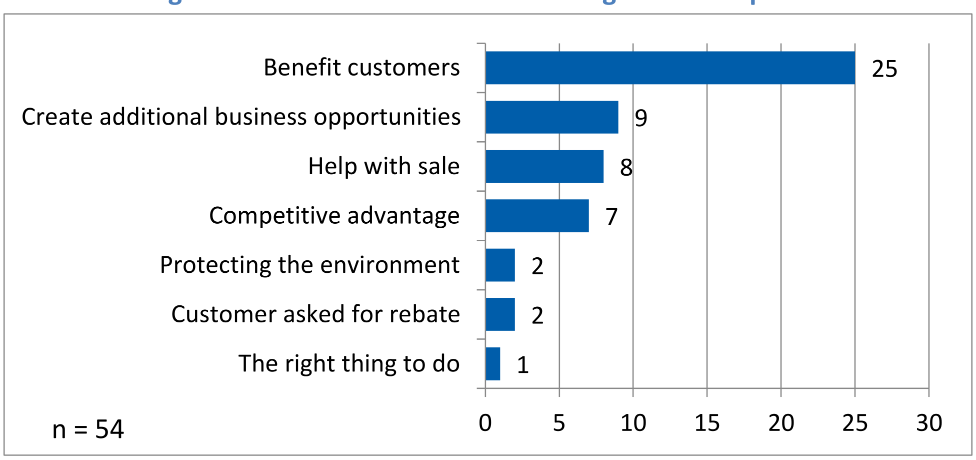
Figure 25. How Participating Customers Identified their Contractors



Program Participation Decisions

Surveys with participating contractors and customers found contractors effective, informative program representatives, whose reasons for participating aligned with program design. Of the 35 contractors surveyed, most reported participating to benefit their customers (25) and for various business reasons, including: creating additional business opportunities (nine); helping with sales (eight); and increasing their competitive advantage (seven). Figure 26 provides additional reasons.

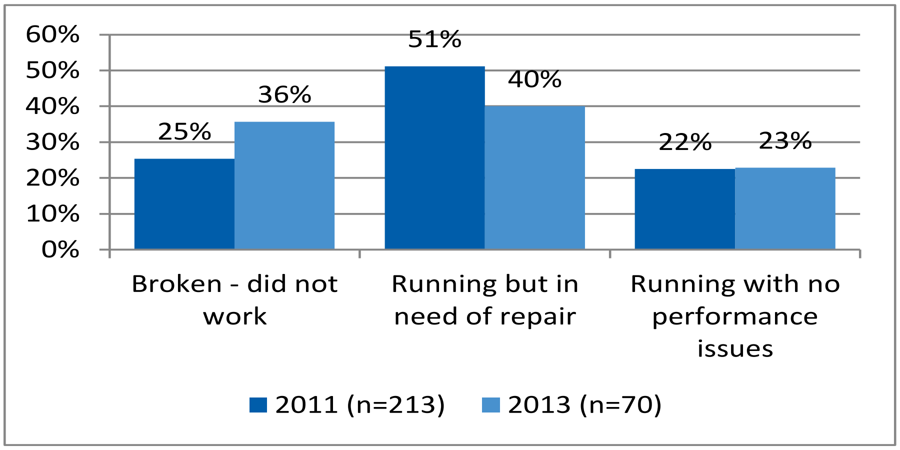
Figure 26. Reasons for Contractor Program Participation



Though 58% of all measures and 83% of all non-ECM measures incented in 2013 were early replacements, most customers reported participating in the program due to issues with existing equipment. As shown in Figure 27, 76% of participating customers reported their existing equipment did not work or exhibited performance issues when they replaced it. In 2013, a higher proportion of customers reported their existing equipment did not work when they chose to participate in the program than did customers in 2011. This result is significant with 90% confidence and may reflect the increase in the percent of regular replacement measures incented in 2013 (10%), compared to 2011 (4%).

Customers with fully functioning HVAC equipment most commonly replaced existing equipment due to: environment concerns (three); a desire to save money (three); and fear the equipment would cease functioning in the near future (three).

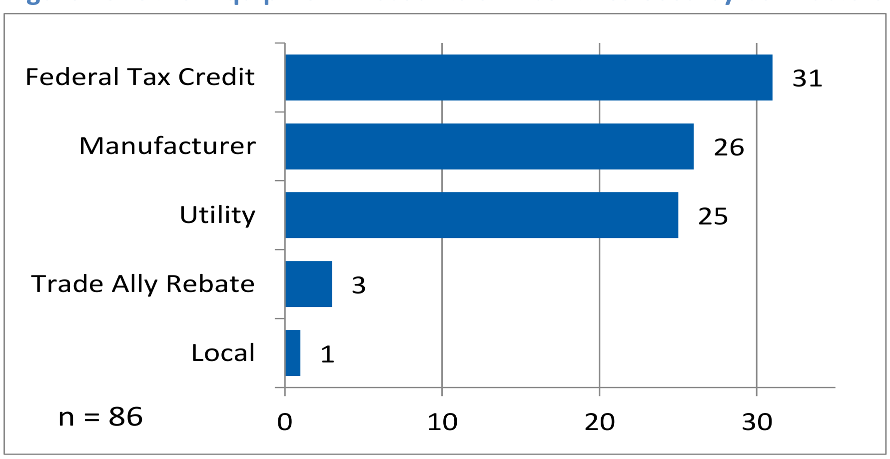
Figure 27. Condition of Replaced Customer HVAC Equipment



Program Incentives

All 35 contractors interviewed reported leveraging rebates, discounts, or other incentives when selling high-efficiency equipment to their customers, with most (32) listing discounts individually and showing these discounts' impacts on overall project costs. As shown in Figure 28, contractors reported using the following incentives in addition to the DP&L program rebate: federal tax credit (31); manufacturer rebates (26); other utility rebates (25); trade ally rebates (three); and other local rebates (one).

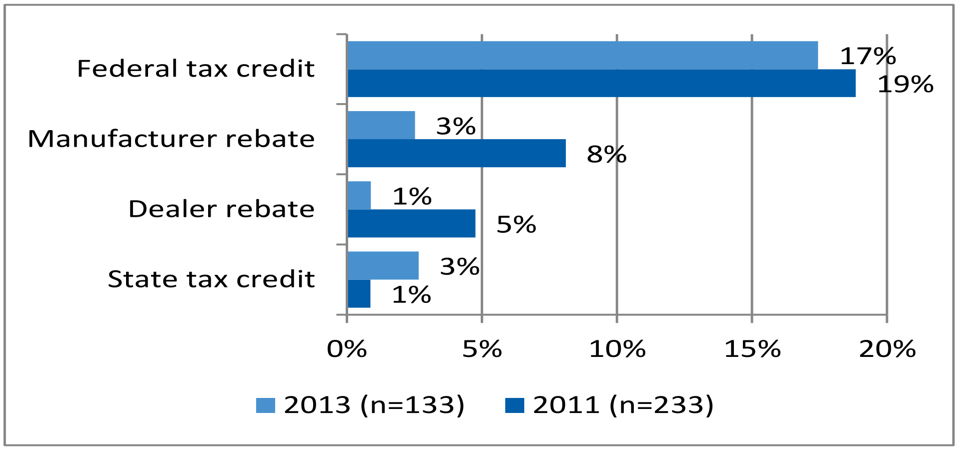
Figure 28. Other Equipment Discounts or Incentives Used by Contractors



Participating customers knew discounts or incentives could be used—in addition to the rebate from DP&L—to offset the costs of their HVAC improvements. When asked, 25% of participating customers surveyed in 2013 reported using discounts or incentives in addition to the DP&L rebate.

Customers using other discounts or incentives most commonly chose federal tax credits. Figure 29 summarizes all participant customer responses. Differences between 2011 and 2013 survey responses for manufacturer and dealer rebates are statistically significant at the 90% confidence level.

Figure 29. Other Equipment Discounts or Incentives Used by Customers



Program Participation Experience

In addition to promoting higher-efficiency HVAC equipment, contractors explained the DP&L Heating and Cooling Rebate program to their customers and disseminated information on additional ways for customers to save energy in their homes. Of participating customers surveyed in 2013 that did not learn of the program from their contractor, 86% reported their contractor explained the DP&L rebate to them, and all but one reported their contractors clearly listed the DP&L program rebate on their invoices.

Fifty-two percent of participating customers surveyed in 2013 reported receiving additional information from their contractors regarding ways to reduce energy use in their homes. While still a majority result, this represents a statistically significant decline at 90% confidence from the 67% observed in 2011 and may indicate the need to review this topic with participating contractors.

While most 2013 participating contractors operated in the program for four or more years, application paperwork continued to present challenges for some. Thirty respondents did not find the program administrative and application requirements overly burdensome, but eight reported difficulty in securing all information necessary to complete the paperwork. These contractors found completing requirements for equipment information (such as the AHRI number) time consuming, and multiple individuals collaborated to complete applications, which made it easy to overlook some elements. One respondent indicated a contractor incentive (i.e., spiff) would help offset application printing and processing costs.

Program Trainings

Few contractors interviewed (nine) reported participating in program trainings, but attendees generally found them helpful. Seven of these nine trade allies found the trainings very effective in helping them understand program requirements.

Participant Contractor and Customer Satisfaction

All participating contractors expressed high overall satisfaction levels with the program: 29 contractors interviewed reported being "very satisfied" with the program; and the remaining six reported being "somewhat satisfied" with the program. No contractors reported dissatisfaction.

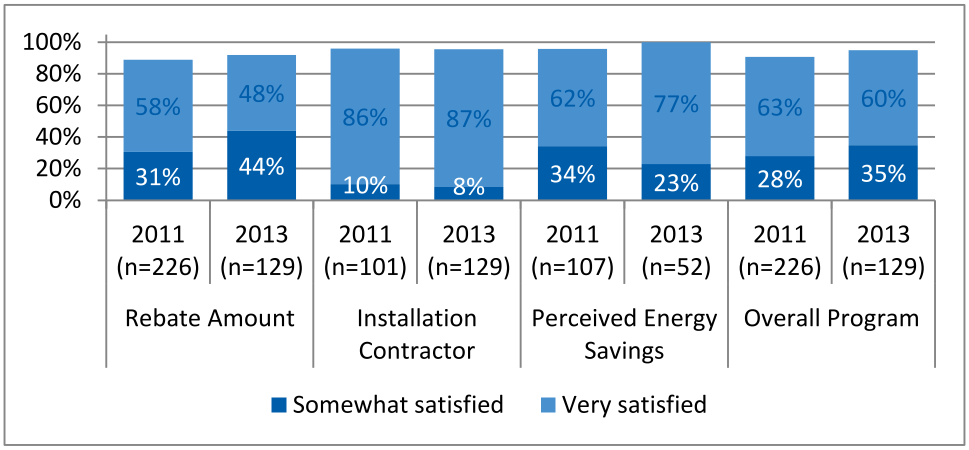
When asked how the program could be improved, contractors offered the following suggestions:

- Identify ways to reduce application paperwork (four respondents).
- Transition to an online application portal (four respondents).
- Increase program marketing to customers (three respondents).
- Increase rebates amounts on all measures (three respondents).
- Add a contractor rebate (two respondents).
- Increase the CAC rebate to match the air-source heat-pump rebate (one respondent).
- Follow-up on incomplete or erroneous application fields by phone rather than through e-mail (one respondent).

All contractors interviewed expressed satisfaction regarding communication levels with CSG staff, and many (28 of 35) reported regularly communicating with staff. Communication generally centered on issues or questions on submitted application materials (15 of 28) and program changes (10 of 28). When asked the best ways for CSG to contact them, respondents favored e-mail (24 of 35) and telephone (23 of 35).

Participating customers expressed satisfaction with the program. As shown in Figure 30, survey respondents expressed high satisfaction levels with program elements and with the program overall. Nearly every customer surveyed indicated they were "somewhat" or "very" satisfied with program rebate amounts, participating contractors, perceived energy savings resulting from program participation, and the program overall, producing general findings nearly identical to those from the 2011 survey.

Figure 30. Customer Satisfaction in Various Program Elements and the Program Overall



Every participating customer included in the 2013 survey who could provide a definitive response (i.e., not “don’t know” or “refuse”) indicated they would recommend the DP&L Residential Heating and Cooling Program to a friend or family member.

When asked for recommendations regarding program improvements, respondents most commonly suggested increasing rebate amounts (12 of 26). One respondent, however, suggested considering higher rebates for senior citizens, and one suggested offering rebates to renters.

While the rebate amount emerged as a common theme in participant customer responses, several respondents (seven of 26) encouraged additional program marketing. Comments included:

- “Advertise the rebates are available… I didn’t know [about the rebates] until the contractor told me.”
- “Make sure that everyone is more aware of the programs.”
- “Let more people know about it.”
- “Put the word out more; I had signed the contract with my contractor before I heard about the rebate.”

Recommendations

Drawn from the preceding findings, Cadmus offers the following recommendations:

- **The Ohio TRM includes a 0.9 SEER to EER conversion factor. As program data do not track EER ratings for most equipment, this conversion factor often is used in calculating per-unit demand reductions.** The 0.9 conversion factor generally proves accurate for lower-efficiency HVAC equipment, but consistently overstates EER ratings for higher-efficiency equipment. When quantifying demand reductions in 2014, Cadmus recommends using equipment EER ratings from the AHRI database when quantifying demand reductions.

- **The program does not consistently use mass-marketing (e.g., television and radio advertisement) of program offerings to end-use customers as a central component of the program marketing strategy**. Consequently, participating customers cited lower awareness of the program as a common theme. Cadmus recommends reviewing program marketing strategies and considering more aggressively marketing the program directly to customers.

Residential Energy Education (Be E^3 Smart) Program

This chapter describes the evaluation approach, detailed findings, and conclusions and recommendations for the Residential Energy Education Program.

Evaluation Overview

Cadmus' evaluation of the 2013 Residential Be E^3 Smart program followed the researchable questions and evaluation activities outlined in DP&L's *2013 Evaluation, Measurement, and Verification Plans*. Table 53 identifies key researchable evaluation questions, and Table 54 lists the evaluated measures included in the Be E^3 Smart kit.

Table 53. Key Researchable Questions

Researchable Questions	Activity Used to Address Question
How many schools, teachers, and students participated in the program?	• Review of database and documentation
What are the program's gross energy and demand impacts?	• Analysis of student-returned surveys • Engineering analysis • Follow-up parent surveys
Which program kit measures proved useful? Which measures proved less useful?	• Stakeholder interviews • Follow-up parent surveys
How long do participants wait to install measures? What is the removal rate for kit measures?	• Analysis of student-returned surveys • Follow-up parent surveys
Are parents of children participating in the Be E^3 Smart program more satisfied with DP&L's service? Are they more likely to participate in other programs?	• Analysis of student-returned surveys • Follow-up parent surveys
What school and teacher participation barriers does the program face? How effectively does the program overcome those barriers?	• Follow-up parent surveys • Stakeholder interviews
Does the Be E^3 Smart program promote increased participation in DP&L's other energy-efficiency programs?	• Follow-up parent surveys • Stakeholder interviews
Is the program cost-effective?	• Cost-effectiveness analysis.

Table 54. Be E^3 Smart Evaluated Kit Measures

Kit Measures	Quantity in Kit
13 watt CFL	2
LED Night Light	1
Bathroom Faucet Aerator	2
Kitchen Aerator	1
Energy Efficient Showerhead	1

Detailed Evaluation Findings

DP&L realized its participation goal of distributing 9,000 kits. With the 9,003 kits distributed, the program achieved 2,983,764 kWh savings and 209 kW in demand reduction. The program achieved both kWh and kW goals as well. Compared against claimed *ex ante* savings, the program had realization rates of: 81.8 % for energy savings; and 90.9% for demand savings. The major driver for these differences is the inclusion of the 2013 follow-up parent survey. The *ex ante* savings used install rates from the 2012 evaluation report. While some measures (like CFLs) saw an increase in the installation rate compared to last year's results, water measures saw a decline in the installation rate.

Moreover, DP&L did meet its four program objectives of:

- Promoting energy education;
- Promoting customer satisfaction;
- Help families save energy; and
- Promoting awareness of DP&L's energy efficiency programs

The follow-up parent survey (n=70) showed the majority of participants (over 70%) were highly satisfied with the offered kit measures and the program, as a whole. Additionally, participant survey results strongly suggest student involvement in the program does significantly increase both energy-related conversations and conservation actions in the household: over 75% of respondents now discuss energy topics more than once a week even 6-12 months after program completion. In terms of saved energy, approximately 57% of surveyed participants noticed a drop in the electric bill as a result of installing kit measures. Lastly, although 77% of survey respondents did not participate in other energy programs, participants who *did* noted Be E^3 Smart did have a moderate to strong influence in their participation decision.

The following key findings relate to the impact and process evaluations:

- Program claimed *ex ante* claimed and adjusted gross savings and demand reduction are located in Table 55.

Table 55. Residential Be E^3 Smart Program Claimed and Achieved Energy Savings

Measure	*Ex Ante* Claimed Savings		Verified Gross Savings		Adjusted Gross Savings		
	kWh	kW	kWh	kW	kWh	kW	Precision*
13 watt CFL	640,176	68	657,530	70	731,453	77	±16%
LED Night Light	21,576	0	41,341	0	41,341	0	±13%
Bathroom Faucet Aerator	477,895	27	414,819	24	316,946	22	±38%
Kitchen Faucet Aerator	1,073,219	61	654,270	37	654,270	45	±29%
Efficient Showerhead	1,433,732	73	1,262,134	65	1,239,754	65	±24%
Total**	**3,646,598**	**229**	**3,030,093**	**195**	**2,983,764**	**209**	**±17%**

*Precision at 90% confidence. ** Values in table may not sum to 100% exactly due to rounding.

- CFL and the LED night light measures realized higher installation rates than in the 2012 evaluation results. However, all water heating measures (aerators and efficient showerheads) exhibited lower installation rates. Common reasons cited for not installing or removing the water heating devices included improper fit and lower water pressure. These are unsurprising results given the variety of faucet fixtures in the market. It should also be noted that DP&L added water heating devices due to evaluator recommendations. Even with these decreases, the program still met its goals and was cost-effective.
- Follow-up parent survey participants installing the measures were asked to rate their satisfaction with each device installed, on a scale from 0–10. Kit measures were viewed with high satisfactory ratings, with bathroom faucet aerators receiving the lowest average score of 8.5.
- Few customers removed lighting measures after installation. Kitchen faucet aerators experienced the highest removal rates (58%). Except for showerheads, all measures realized lower persistence rates than identified in the 2012 program evaluation. Bathroom faucet aerators experienced the largest percent change between 2012 and 2013 (17%).
- Approximately 57% (40 of 70 respondents) of surveyed participants saw their electric bills reduced due to program participation. Of these respondents, 93% (37) were very satisfied with the amount saved.
- Ninety-two percent of participants in follow-up parent surveys expressed moderate or very high satisfaction with the program. No respondents reported dissatisfaction.
- The Be E^3 Smart Program minimally impacted participation in other DP&L energy-efficiency programs. Most follow-up parent survey respondents (54 of 70 respondents; 77%) did not participate in other DP&L programs.

Evaluation Data Collection Methods

Cadmus used the approaches detailed below in evaluating the 2013 program.

Program Database Review

The program relied on responses from a student take-home survey (the family home installation survey) to estimate the number of measures installed from kits provided by the Ohio Energy Project (OEP).[30] After presenting the energy education lesson, teachers provided students with instructions on how to complete an online survey, and encouraged them to complete the survey after one to two weeks.

Through the survey, students reported how many kit measures they installed and if they adopted recommended behavioral changes (such as adjusting thermostat settings) since receiving the kits and education. The survey also collected basic household and demographic information, such as: heating and cooling system types; family size; and type of home (e.g., single-family, multifamily). The survey realized a 76% response rate, with 6,847 of the participating 9,003 households completing the online

30 OEP implements the program.

version. It should be noted that a 76% response rate is high. Response rates witnessed at three peer Midwest utilities ranged from 41% to 75%.

Stakeholder Interviews

Cadmus interviewed program staff at DP&L and OEP in October 2013. The interviews covered: participation expectations, marketing tactics, teacher trainings, kit components, and general program changes.

Follow-up Parent Telephone Survey

To evaluate measure installation lags and persistence, Cadmus fielded a follow-up phone survey with a sample of 70 parents of participating students. Completed in November 2013, the survey occurred six to 12 months after students completed the online family home installation survey. In addition to measure installation, the follow-up survey included: questions addressing parents' experiences and satisfaction with the program; and general household demographics.

Cadmus selected a sample from the population of participants completing the online Family Installation Survey and offered their phone numbers as contacts for a follow-up survey: this resulted in 1,070 families providing their phone numbers for the follow-up survey, a 658% increase from the previous evaluation year. Cadmus offered $20 gift cards for respondents, which likely contributed to the large increase in willing survey participants.

Survey implementation realized 70 completes, meeting the sampling targets of results with 90% confidence and 10% precision.

Impact Evaluation Methodology and Findings

Cadmus calculated *ex ante* claimed savings using a range of sources, primarily relying on the Ohio TRM, but also using engineering algorithms from other Cadmus evaluation work.

Verified gross savings used the same algorithms and inputs as *ex ante* claimed savings, with one exception—verified gross savings reflected installation rates collected from the follow-up parent surveys. The following section describes the methods and findings from Cadmus' adjusted gross savings calculations. Table 56 summarizes the components of adjusted gross savings.

Table 56. Adjusted Gross Savings

Measure	Units Distributed	Installation Rate	Percent Electric*	Per - Unit Savings		Adjusted Gross Savings	
				kWh	kW	kWh	kW
13 watt CFL	18,006	78%	100%	52	0.006	731,453	77
LED Night Light	9,003	34%	100%	14	0.000	41,341	0
Efficient Bathroom Faucet Aerator	18,006	40%	49%	90	0.006	316,946	22
Efficient Kitchen Faucet Aerator	9,003	33%	49%	451	0.031	654,270	45
Efficient Showerhead	9,003	48%	49%	592	0.031	1,239,754	65
Total						**2,983,764**	**209**

*For aerators and showerheads, this represented the saturation of electric water heaters, as indicated by OEP's Family Home Installation survey.

Cadmus calculated adjusted gross savings by multiplying the total number of units installed by the share of units applied to electric end uses and by the per-unit savings, thus determining adjusted gross savings for each measure.

Measure Installation Rates

Follow-Up Survey (ISR)

Cadmus' verified and adjusted gross savings to reflect installation rates for CFLs, night lights, aerators, and showerheads—calculated using results from the follow-up parent survey. Cadmus surveyed participants six to 12 months after they received their kits, asking if the measures remained installed. By surveying participants several months after receiving the measures, Cadmus captured installations occurring after participants completed the Family Home Installation survey. In addition, the phone survey captured data on measure persistence and on participants removing a measure after initially installing it.

Table 57 compares installation rates calculated from the family home installation survey and from the follow-up parent survey.

Table 57. Comparison of ISRs from Online Family Survey and Follow-Up Phone Survey

Measure	Family Home Installation Survey Installation Rate*	Follow-Up Parent Survey Installation Rate (n = 70)	% Increase: Family Home to Follow-up Parent Survey
CFLs	62%	88%	42%
LED Night Light	31%	38%	22%
Bathroom Faucet Aerators	33%	46%	40%
Kitchen Faucet Aerator	39%	38%	-4%
Efficient Showerhead	43%	54%	27%

*This installation rate was not used in the calculation of *ex ante* claimed savings, which used 2012 Evaluation Year's ISR.

Table 57 also indicates Cadmus observed higher ISRs, calculated from data collected in the follow-up phone surveys, then calculated from data collected through the online Family Home Installation surveys for four of five measures. ISRs increased the most for CFLs and bathroom faucet aerators, which rose 42% and 40%, respectively. LED night lights and efficient showerheads exhibited more modest increases. Approximately the same percentage of respondents installed the kitchen aerator during the two survey efforts.

Non-Respondent Adjustment

Calculating an ISR required corrections for bias inherent in the student survey. Specifically, it can be argued students completing and returning surveys would be more likely to install CFLs than those failing to complete the survey. Further, it did not prove practical to verify whether nonrespondents received or installed a measure. Therefore, Cadmus assumed nonrespondents installed kit measures at rates equal to 50% of respondents. In other words, this assumed one-half of nonrespondents did not install the measures, and the other half of nonrespondents installed the measures at a rate equal to respondents.

As a follow-up, the parent survey sample drew from customers responding to the Family Home Installation survey; Cadmus made the nonrespondent adjustment to the ISR, as calculated from the phone survey. Table 58 shows final ISRs after adjusting for nonresponse to the Family Home Installation Survey.

Table 58. Nonrespondent Installation Rate Adjustment

Measure	Unadjusted In-Service Rate	In-Service Rate Adjusted for Nonrespondents
CFL	88%	78%
LED Night Light	38%	34%
Bathroom Aerator	46%	40%
Kitchen Aerator	38%	33%
Showerhead	54%	48%

Benchmarking Installation Rates

Cadmus compared ISRs for each measure to ISRs from the 2012 evaluation and to results from evaluations of similar utility-sponsored programs. Figure 31 presents installation rate benchmarking results, and Table 59 shows the percentage difference in ISRs from the 2012–2013 evaluation year.

Figure 31. ISR Comparisons

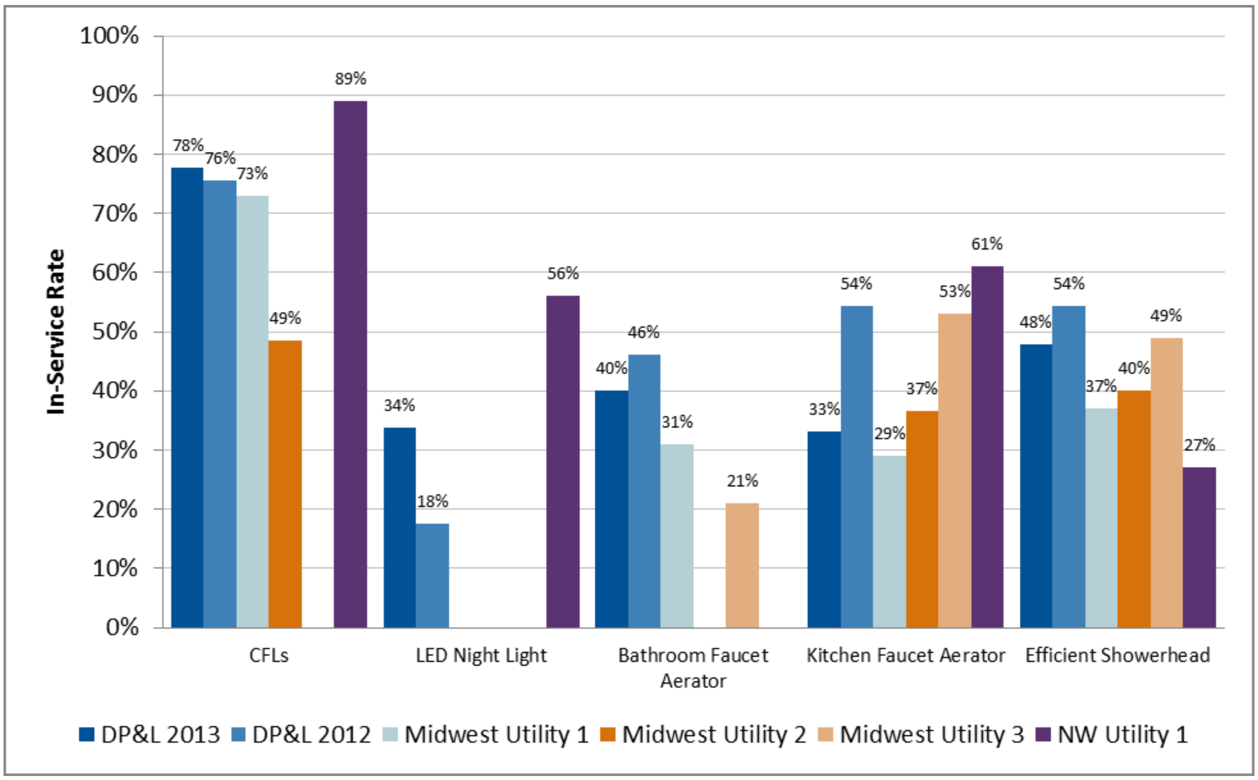


Table 59. DP&L's 2012 and 2013 ISR Comparison

Measure	DP&L 2012 Evaluation Year	DP&L 2013 Evaluation Year	% Difference
CFLs	76%	78%	3%
LED Night Light	18%	34%	92%
Bathroom Faucet Aerators	46%	40%	-13%
Kitchen Faucet Aerator	54%	33%	-39%
Efficient Showerhead	54%	48%	-12%

The BE E^3 Smart program's overall CFL installation rate increased modestly, from 76% to 78%. The 2012 ISR results fell between those reported by comparable utilities: 73%, 49%, and 89% ISRs were realized by Midwest Utility 1, Midwest Utility 2, and NW Utility 1, respectively. DP&L likely realized a lower ISR than the Northwest utility as that company's energy-efficiency kits contained a single CFL. LED night light installations also increased significantly, compared to 2012 results (92%).

Installation rates for bathroom and kitchen aerators and for showerheads decreased by 13%, 39%, and 12%, respectively. However, ISRs for showerheads and bathroom aerators in DP&L's program aligned with ISRs for similar utility programs.

Kitchen aerator installation rates were somewhat lower than those observed for other utilities. Additionally, as shown previously in Table 57, little difference occurred in ISRs between the family home installation survey and the follow-up parent survey. Results indicated low installation rates for this measure—even over the long term, for reasons explained in the process section.

TRM Deemed Savings Review

Cadmus reviewed TRM-deemed savings algorithms and inputs for each kit measure. The following sections describe deemed savings used in Cadmus' adjusted gross calculations.

CFLs

Cadmus used the savings calculations outlined in the Ohio TRM and the following assumptions to calculate adjusted gross energy savings and demand reduction for CFLs:

$$\Delta kWh = \frac{\Delta Watts * ISR * HOURS * WHFe}{1{,}000}$$

$$\Delta kW = \frac{\Delta Watts * ISR * HOURS * WHFd * CF}{1{,}000}$$

Table 60 shows inputs and assumptions for the 13 watt CFL calculation.

Table 60. CFL Energy Savings and Demand Reduction Calculation

Input	Assumption	Source
Δ Watts Multiplier	3.62	http://www.bulbrite.com/eisa.php. 13 watt CFL with 900 lumen ratings translates into a 60 watt baseline assumption. [60-13W]/13W = 3.62
Δ Watts	47.0	Ohio TRM. Calculated as bulb wattage multiplied by delta watts of 3.62.
ISR	78%	Be E3 Family Installation Survey.
HOURS	1,040	Ohio TRM.
WHFe	1.07	Ohio TRM. Assumed installations were indoors.
WHFd	1.07	Ohio TRM, Ohio TRM Joint Objections and Comments.
Summer Peak CF	0.11	Ohio TRM.

Cadmus estimated 13,985 installations of 13 watt CFLs, leading to savings of 731,453 kWh, and summer coincident peak savings of 77 kW.

LED Night Lights

Cadmus used savings calculations outlined in the Ohio TRM and the following assumptions to calculate adjusted gross energy savings and demand reduction for LED night lights:

$$\Delta kWh = \frac{ISR * (Demand_{base} - Demand_{LED}) * HOURS}{1{,}000}$$

Table 61 provides inputs and assumptions used in LED night light savings calculations.

Table 61. LED Night Light Deemed Savings Calculation Inputs

Input	Assumption	Source
$Demand_{base}$ (watts)	5	Ohio TRM, typical C7 lamp
$Demand_{LED}$ (watts)	0.33	Ohio TRM
ISR	34%	Family Installation Survey
Hours	2,920	Ohio TRM, on 8hrs/day 365 days/yr.

Cadmus estimated installations of 3,032 LED night lights, with adjusted gross energy savings of 41,341 kWh. LED night lights did not produce demand reductions as hours of operation did not coincide with DP&L's peak.

Bathroom and Kitchen Faucet Aerator

Cadmus used the following approach to calculate energy savings and demand reduction for faucet aerators:

$$\Delta kWh = (GPM_{Base} - GPM_{Low}) * \frac{People}{Home} * \frac{min}{day} * \frac{days}{year} * \frac{1}{\frac{F}{home}} * 8.33 * (T_{FT} - T_{MAINS}) * \frac{1}{1{,}000{,}000} * \frac{1}{EF} * \frac{1}{0.003412}$$

Table 62 provides the inputs used to calculate bathroom faucet aerator adjusted gross savings. Cadmus updated Ohio TRM assumptions for the average number of people per household, using self-reported household sizes from the program's family home installation survey. In addition, Cadmus used the follow-up parent survey to revise the number of bathroom faucets in the home.

Finally, the evaluation updated assumptions on the minutes of use per person, per day and the assumed temperature of water used by the faucet, based on a water metering study Cadmus conducted for Consumers Energy and DTE Energy in Michigan.[31]

Table 62. Bathroom and Kitchen Faucet Aerator Savings Calculation Inputs

Variable	Variable Definition	Bathroom Faucet Aerator	Kitchen Faucet Aerator	Source
GPMBASE	Gallons per minute of baseline faucet	2.2	2.2	Cadmus water metering study
GPMLOW	Gallons per minute of low-flow faucet	1	1.5	Bathroom sink aerator 1.0 GPM Niagara N3210N, kitchen sink aerator 1.5 GPM Niagara N3115
#people	Average number of people per household	4.45	4.45	DP&L OEP Be E3 smart family installation survey
min/day	Minutes of use per person, per day	1.6	4.5	Cadmus water metering study
days/yr.	Days faucet used per year	365	365	Ohio TRM Assumption
F/home	Average number of faucets in the home	2.51	1.00	Follow-up parent survey
8.33	Constant to convert gals to lbs.	8.33	8.33	Adjusted TRM Assumption
1	Constant to convert lbs. and of Water to BTU	1	1	Ohio TRM Assumption
TFT	Assumed temperature of water used faucets	86	93	Cadmus water metering study
TMAINS	Assumed temperature of water entering house	57.7	57.7	Temperature data for Dayton, Ohio. Averaged monthly water main temperature calculated using the methodology provided in Building America Research Benchmark Definition, updated December 2009. Pg.19-20. http://www.nrel.gov/docs/fy10osti/47246.pdf
1,000,000	Unit Conversion	1,000,000	1,000,000	

31 Michigan Water Meter Study. March 2013 Power Point presentation to Michigan Evaluation Working Group.

Variable	Variable Definition	Bathroom Faucet Aerator	Kitchen Faucet Aerator	Source
Recovery Energy Factor		0.98	0.98	Review of AHRI Directory
.003412	MMBtuh to kWh	.003412	.003412	Ohio TRM Assumption

Using the above inputs, Cadmus determined bathroom faucet aerators saved 90 kWh/unit annually and kitchen faucet aerators saved 451 kWh/unit annually. Cadmus used the Ohio TRM algorithm to calculate peak savings, which equated to 0.0062 kW per bathroom faucet aerator installed and 0.031 kW per kitchen faucet aerator installed.

Efficient Showerheads

Cadmus used the following approach to calculate adjusted gross energy-savings and demand reduction for showerheads:

$$\Delta kWh = (GPM_{Base} - GPM_{Low}) * \frac{People}{Home} * \frac{min}{shower} * \frac{shower}{days} * \frac{days}{year} * \frac{1}{\frac{F}{home}} * 8.33 * (T_{FT} - T_{MAINS}) * \frac{1}{1{,}000{,}000} * \frac{1}{EF} * \frac{1}{0.003412}$$

Table 63 lists inputs and assumptions used for calculating efficient showerhead savings.

Table 63. Efficient Showerhead Savings Calculation Inputs

Variable	Variable Definition	Input	Cadmus Source
GPMBASE	Gallons per minute of baseline faucet	2.5	Minimum federal GPM allowed
GPMLOW	Gallons per minute of low flow faucet	1.25	Showerhead 1.25 GPM Niagara N2912
#people	Average number of people per household	4.45	DP&L OEP Be E3 smart family installation survey
min/shower	Minutes of use per person per shower	7.8	Cadmus water metering study
days/yr.	Days faucet used per year	365	Ohio TRM Assumption
shower/day	Showers per day	0.61	Cadmus water metering study
F/home	Average number of showers in the home	1.77	Follow-up parent survey
8.33	Constant to convert gals to lbs.	8.33	Adjusted TRM Assumption
1	Constant to convert lbs. and of Water to BTU	1	Ohio TRM Assumption
TFT	Assumed temperature of water used	101	Cadmus water metering study
TMAINS	Assumed temperature of water entering house		Used Vectren's temperature data for Dayton, Ohio. Averaged monthly water main temperature calculated using the methodology provided in Building America Research Benchmark Definition, updated December 2009. Pg.19-20. http://www.nrel.gov/docs/fy10osti/47246.pdf
1,000,000	Conversion	1,000,000	

Variable	Variable Definition	Input	Cadmus Source
Recovery Energy Factor	0	0.98	Review of AHRI Directory.
.003412	MMBtuh to kWh	.003412	Ohio TRM Assumption

As with efficient aerators, Cadmus used average household sizes from OEP's family home installation survey and the number of showerheads in the home from the follow-up parent survey to inform savings. Cadmus calculated per unit annual energy savings of 592 kWh, resulting in adjusted gross energy savings of 1,239,754 kWh.

Cadmus used peak demand reduction calculations consistent with the Ohio TRM. Peak demand reduction equated to 0.031 kW per unit installed and total demand reduction of 65kW.

Process Evaluation Methodology and Findings

In Fall 2013, Cadmus interviewed DP&L and OEP program staff about program participation expectations, marketing tactics, teacher trainings, kit components, and general program changes. Interview results follow.

DP&L and OEP expect to distribute approximately 9,000 kits each school year for the near future. On average, the program distributes 75 student kits per participating teacher and approximately 120 teachers participate each year (including new and returning teachers). All schools and districts within DP&L's territory qualify for Be E^3 Smart.

OEP tracks the number of "repeat teachers," estimating 20% to 25% of teachers participating in the 2012–2013 program year had participated since the program's inception. Approximately 65% of teachers participating in the 2011–2012 program year went on to participate in 2012–2013, a somewhat higher return rate than the 57% observed for the 2011–2012 school year. OEP noted that teachers choosing not to continue participating often did so for the following reasons:

- Retirement;
- District and state-level changes in curriculum requirements; and
- Teachers, although interested, sometimes remained more concerned with mandatory testing, leaving little time for the energy material.

Supplies and ready-made activities/curriculum drew teachers' participation. In addition, teachers found the materials relevant to their lessons, covering reading, science, and math. OEP received teachers' feedback indicating the program's strengthened the connection between the classroom and home.

Word-of-mouth provided the most valuable tactic for marketing the Be E^3 Smart program. Participating teachers simply spoke of the energy program during the school year, thus increasing interest among their peers. DP&L and OEP also attended professional workshops and meetings to promote the

program. Further, DP&L and OEP e-mailed teachers, superintendents, and principals to spread awareness of the program on an as-needed basis.

Over the years, OEP has streamlined the teacher training process. New teachers must attend a yearly training, which reviews lesson plans, class activities, and instructions for the online family survey. At this time, existing teachers also shared their implementation practices with new participants. Major issues did not arise regarding the training sessions or teachers not understanding/retaining the material. OEP staff also made themselves available year-round to address questions.

DP&L and OEP regularly evaluated the mix of measures included in kits. When assessing measures for inclusion in kits, they considered the following elements:

- The measure's safety;
- Tying measures to curriculum; and
- Cost-effectiveness.

This approach allowed DP&L and OEP to respond to measure issues as they arose. For example, the program removed outlet gaskets for safety reasons, and, although desired kit measures, LEDs currently remain cost-prohibitive.

The program's general design did not change since its inception, though Be E^3 Smart came to include the following student engagement activities:

- A youth energy summit;
- Two bike programs (with one geared toward middle school girl bike building); and
- An energy fair.

DP&L and OEP noted these activities have been popular and successful with students, teachers, and schools.

According to program and implementation staff, the program sought to achieve four primary objectives:

- **Promote energy education:** DP&L and OEP sought to help students and parents learn about energy issues, including energy efficiency. The program taught students energy fundamentals, including science, technology, and economics.
- **Promote customer satisfaction:** The program served DP&L's goal of promoting corporate social responsibility. In addition to energy education and energy savings, DP&L sponsored the program to increase customer satisfaction.
- **Save energy:** DP&L and OEP encouraged families to employ what they learned of energy efficiency and conservation. Teachers provided families with energy-saving kits and presented lessons on energy-saving behaviors.

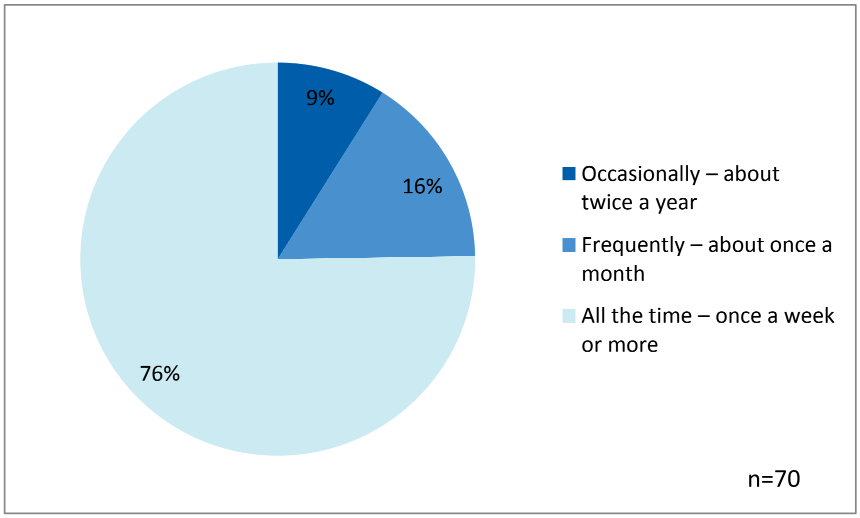
- **Promote awareness of DP&L's energy-efficiency programs:** The Be E^3 Smart program also provided a platform for informing families about the DP&L's suite of energy-efficiency programs.

To evaluate how Be E^3 met these objectives, Cadmus fielded a participant survey and reviewed OEP's teacher evaluation materials. A discussion follows regarding how these process evaluation methodology results informed program objectives.

Energy Education Promotion

Participant survey results strongly suggested student involvement in the program significantly increased energy-related conversations and conservation actions in the household. Figure 32 shows over 75% of respondents discussed energy topics more than once a week, even six to 12 months after program completion.

Figure 32. Frequency of Discussions about Energy in Participant Homes



As shown in Table 64, the most popular household topics included: turning off lights, turning off electronics, and water conversation.

Table 64. Energy-Efficiency Topics Discussed in Participant Homes

Household Energy Conservation Topics	Participant Count*
Turn off lights	60
Ask questions about saving or conserving energy	50
Turn off electronics and/or appliances	49
Use less water	49
Walk or bike more	42
Ask questions about energy sources	37
Look for energy information online	20

*n=70, multiples responses allowed

In addition, one-half (35 of 70 responses) of the open feedback from the parent survey directly related to increased energy education and awareness. Three parents remarked:

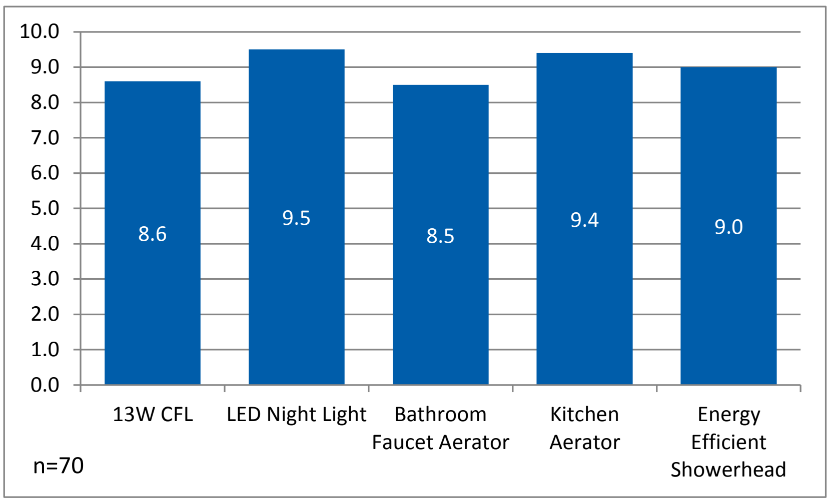
- "I just wish [I received] more information through mail and e-mail so I would have updated information on a daily basis."
- "I just think it's a great program and it educates kids so they can tell their [families]."
- "[It's a] good educational experience, and it lets my child and I learn something new together and spend some time together."

Customer Satisfaction

Satisfaction with Kit Measures

When asked to rate their satisfaction with each measure on a scale from 0 to 10, with 10 being extremely satisfied, participants consistently rated measures ratings 8, 9, or 10. Figure 33 provides average satisfaction scores for each kit measure, with all kit measures receiving high satisfaction ratings.

Figure 33. Participant Satisfaction with Measures in Kit (Scale 0-10)

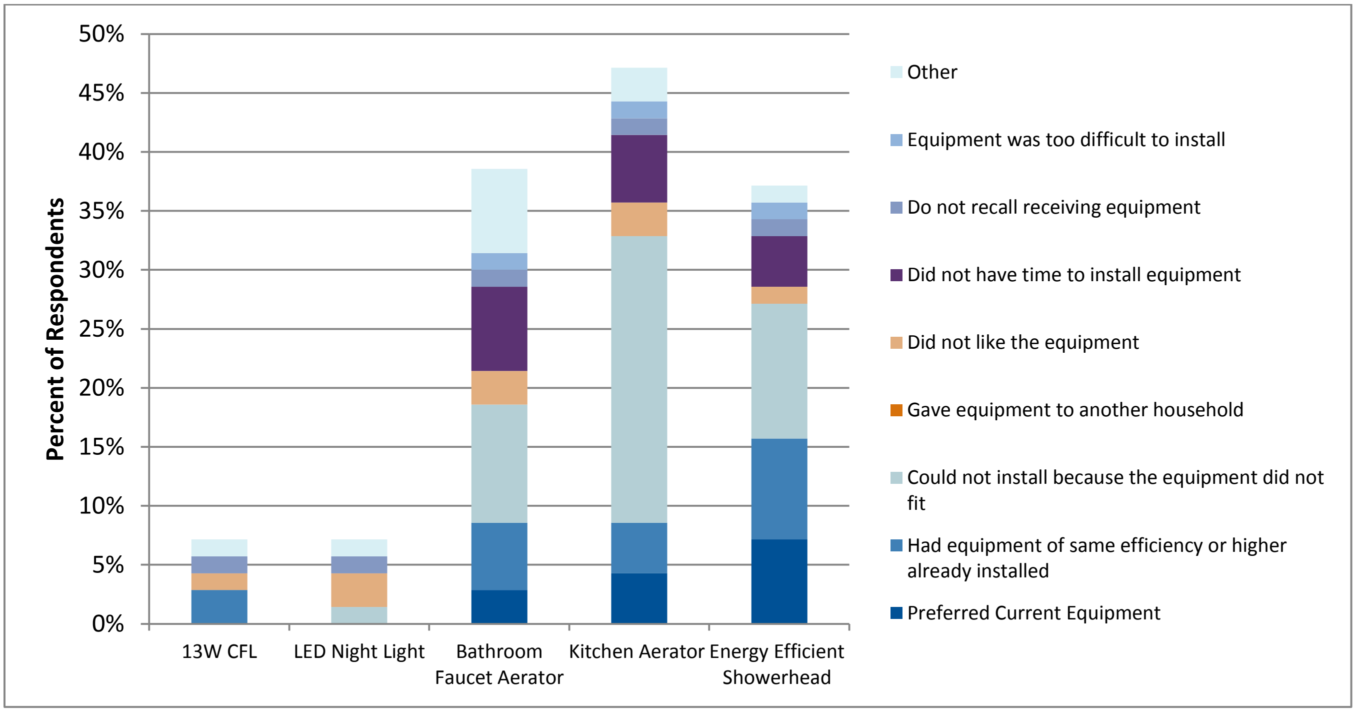


Eleven percent of participants reported dissatisfaction with CFLs, mostly due to insufficient light output and light colors. Only one participant reported a less-than-satisfactory rating for LED night lights, finding the measure "really bright."

In terms of water-savings measures, all participants claimed satisfaction with kitchen aerators. Participants expressing dissatisfaction with bathroom faucet aerators (11%) and showerheads (5%) most commonly cited lower water flow/pressure prompting low satisfaction ratings.

Additionally, Cadmus asked customers why they did not install measures. Figure 34 shows the survey results.

Figure 34. Reasons for Not Installing Measures*

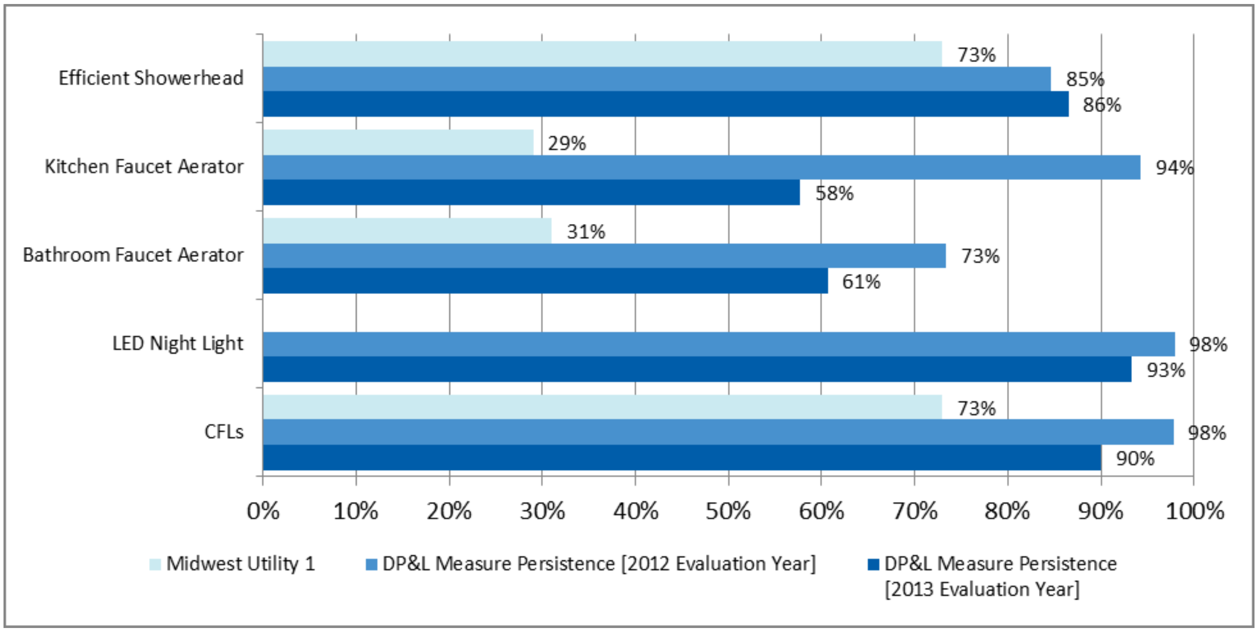


*The survey asked participants this question if their quantity of units *currently* installed were less than the number provided in the kit due to participants never installing the kit measures.

As shown in Figure 34, of five participants never installing a LED night light, two did not like the equipment. Participants most commonly did not install CFLs as they already had a CFL (or a more efficient light bulb) installed (3% of surveyed participants). Frequently mentioned reasons for not installing aerators included: improper fit (10% and 24% for bathroom and kitchen aerators, respectively); or the participant did not have time for installation (7% and 6% for bathroom and kitchen aerators, respectively). Respondents also cited improper fit as a reason for not installing the showerhead (11% of surveyed participants).

To capture measure persistence, Cadmus asked participants if they installed and later removed a measure. Figure 35 compares measure persistence from 2013 DP&L's Be E^3 Smart program results to 2012 results and to a similar program sponsored by another Midwest utility.

Figure 35. Reported Measure Persistence (n=70)



Satisfaction with Overall Program Experience and Suggested Program Improvements

Ninety-two percent of survey participants were moderately or very satisfied with the program. No respondent expressed dissatisfaction. Table 65 provides additional detail.

Table 65. Overall Satisfaction in Be E3 Smart Program

Satisfaction Category	Follow-up Parent Survey Count*	Percent of Total
Very satisfied	51	73%
Somewhat satisfied	14	20%
Neither satisfied nor dissatisfied	5	7%
Somewhat dissatisfied	0	0%
Very dissatisfied	0	0%

*n=70

In addition, 68 of 70 respondents (97%) reported being just as satisfied or more satisfied with DP&L directly due to the program. Two respondents could not provide a response to this question.

Only 13 parents (20% of respondents) suggested program improvements, which included the following:

- Having better-fitting equipment;
- Making the kit available to more grade levels; and
- Sending additional program information about energy conservation and how to install the measures.

Due to the program's success, many parents suggested making the kit and class lessons available to a wider audience.

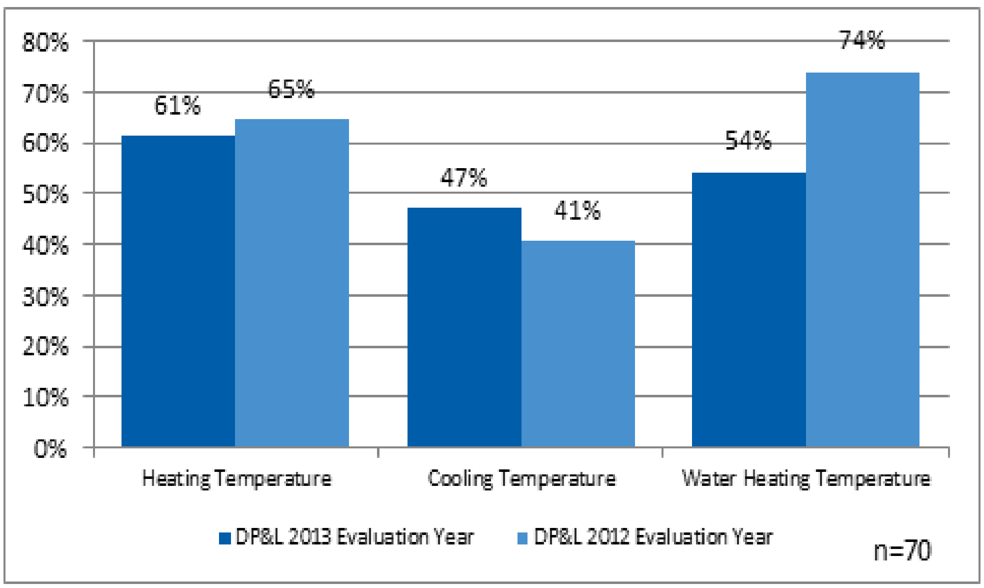
Energy Conservation

To evaluate the program's effectiveness in promoting energy conservation beyond the evaluated kit measures, Cadmus asked participants about energy-saving behaviors adopted due to program participation, specifically:

- If households adjusted temperature settings to DOE-recommended setting for several end uses, including heating, cooling, and water heating.
- If they used the weather stripping, door sweep, or furnace filter whistle in the kit.
- If program participation noticeably affected family electric bills.

Program kit and curriculum material recommended certain temperatures for HVAC and water heaters. Figure 36 shows the percentage of surveyed participants that appropriately adjusted temperature settings to recommended levels *and* participants not having to make a change as temperatures already were at the recommended setting.

Figure 36. Energy Saving Behavior: Temperature Adjustments



Overall, fewer participants in 2013 adjusted their heating and water heating temperatures compared to 2012. In 2013, however, more participants adjusted their cooling temperature settings. Surveys also asked participants if they installed the weather stripping, door sweep, or furnace filter whistle provided in the kits. Table 66 presents the results.

Table 66. Additional Non-Evaluated Kit Measures: Installation Rate (n=70)

Kit Measures	Install Rate
Weather Stripping	57%
Door Sweep	54%
Furnace Filter Whistle	34%

Over 50% of respondents installed the weather-stripping device and door sweep. However, only 34% of respondents installed the furnace filter whistle. Cadmus asked respondents installing the devices, on a scale of 0-10, if the measure proved useful (a score of 6 or higher). Overall, these measures received very high ratings: 8.8 for weather stripping; 8.6 for the door sweep; and 7.7 for the furnace whistle.

The culminating goal of evaluated and non-evaluated kit measures installed, in addition to adopting energy-awareness actions (such as adjusting HVAC and water heating temperatures), was for participating families to realize reductions in their electric bills. Approximately 57% (40 of 70 respondents) of surveyed participants saw such reductions. Of those 40 respondents, 37 (93%) were very satisfied with the amount saved.

DP&L's Energy Efficiency Program Promotion

The Be E^3 kit contains a list of DP&L energy-efficiency programs and DP&L brands materials, where possible; the company, however, did not officially monitor whether participation in the school education program increased participation in DP&L's overall energy-efficiency portfolio. In assessing this question, Cadmus asked survey respondents if they participated in other DP&L energy-efficiency programs since participating in Be E^3 Smart. Most respondents (54 of 70 respondents; 77%) did not participate in other programs, meaning Be E^3 Smart minimally impacted DP&L's total 2013 participation rate. Surveys asked respondents participating in other programs if Be E^3 Smart influenced, on a scale of 0-10, their decision to partake in other programs.

Table 67 provides additional details. Be E^3 Smart did exert a moderate to strong influence for those participating in other energy-efficiency programs.

Table 67. Participation in DP&L's Other Energy-Efficiency Programs and Influence of Be E^3 Smart (n=70, Multiple Responses Allowed)

Other DP&L Energy Efficiency Programs	Participation Count*	Influence of Be E^3 Smart
None	54	N/A
Lighting (purchased CFLs)	11	6.4
Other (Specify)**	4	7.5
Refrigerator/freezer recycling	3	6.0
Air conditioner or heat pump tune-up	3	8.7
Weatherization; Smart Energy Assistance Program	3	7.7
Efficient heating and/or cooling system rebates	1	10.0

*n=70, multiple responses allowed.

**Non-DP&L programs listed.

Recommendations

Drawn from the preceding findings, Cadmus offers the following recommendations:

- **Include instructions on how to install kit measures (primarily for efficient water saving measures).** Not only did the follow-up parent surveys suggest this, but, general installation rates were lower than for the previous year. Added instructions on how to properly and safely install measures may decrease cited problems, such as improper fit and low water pressure. Additionally, a large portion of survey participants did not install the non-evaluated measures (43%, 46%, and 66% for weather stripping, door sweep, and furnace whistle, respectively); instructions for these less commercially common measures may improve installation rates.
- **Include four 13 watt CFLs in the kit.** Eighty-eight percent[32] of participants installed the two CFLs within six to 12 months of participating in the program. This installation rate did not differ from the previous year's evaluation results, which incorporated four CFLs: Cadmus' 2012 follow-up parent survey showed 87%[33] of participants installed all four CFLs within six to 12 months of participating in the program. In addition, even with four CFLs, the program proved quite cost-effective (TRC = 4.85). As the program realized high ISRs and cost-effectiveness results, it seems appropriate to include four CFLs.
- **Offer a referral reward for teachers.** Word-of-mouth provides the most valuable marketing tactic for Be E^3 Smart. A direct-referral reward would further incentivize participant teachers to promote the program to their peers. New teachers can input the referral teacher's name in the application form.
- **Send a mass e-mail to school superintendents, detailing the program's success and high satisfactory ratings.** Superintendents were contacted once during the Be E^3 Smart's history. Another contact attempt would likely increase school board interest in the program and energy education, thus trickling down to affect the number of participating teachers.
- **Present the engagement activities at energy conferences.** DP&L and OEP offer a wider range of student/teacher/school engagement activities, including:
    - A youth energy summit
    - Energy bike programs
    - Energy Fair
    - Energy tour of Western Ohio

  Typically, peer education programs do not include varied activities. Presenting these activities at conferences would inform other utilities about the success of DP&L's activities and present DP&L/OEP as a leader in energy-education engagement.

32 Does not include the 50% install rate adjusted for nonrespondents.

33 Ibid.

Nonresidential Prescriptive Rebate Program

The following sections describe the evaluation approach, detailed findings, and conclusions and recommendations for the nonresidential Prescriptive Rebate Program.

Evaluation Overview

Cadmus' evaluation of the 2013 nonresidential Prescriptive Rebate Program followed researchable questions and evaluation activities outlined in the DP&L 2013 Evaluation, Measurement, and Verification Plans document. Table 68 identifies key researchable evaluation questions.

Table 68. Key Researchable Questions

Researchable Question	Activity Used to Address Question
How do Ohio TRM deemed savings compare with validated program savings?	• Site visits. • Engineering analysis. • Database review.
What were the program's gross electric savings and demand reductions?	• Engineering analysis. • Database review.
What have been the administrator's experiences with program processes?	• Program staff interview.
What have been the channel partner's experiences with program processes?	• Participant channel partner interview.
Is this program cost-effective?	• Cost-effectiveness analysis.

Cadmus conducted channel partner (trade ally) interviews to inform the 2013 evaluation. These interviews were designed to provide insights into trade ally business practices, influence on customer participation, decision making, trends, and overall experience with the program, as well as feedback on DP&L's recent marketing campaign, bonus rebate offerings, and newly adopted commercial lighting standards.

In evaluations of 2010 and 2011 programs, Cadmus conducted telephone surveys with randomly selected samples of DP&L's program population (stratified by measure category). These surveys examined process issues such as how participants became aware of the program and their program experiences, and initial satisfaction levels. Survey results did not change significantly from year to year. Therefore, as there have not been significant program design or implementation changes, Cadmus decided after consultation with DP&L not to perform customer telephone surveys in 2013.

Detailed Evaluation Findings

The 2013 program year achieved 65,208,283 kWh in savings and 11,771 kW in demand reduction. The program experienced realization rates of 110% for energy savings, and 107% for demand when compared to *ex ante* claimed savings. Savings exceeded *ex ante* values largely due to higher than expected lighting project savings. Cadmus metered 16 sites to verify lighting hours of operation. The verified hours of operation for majority of these sites were 40% (average) higher than reported in the DP&L database. This resulted in large impact on the evaluated gross savings for lighting projects at these sites.

Cadmus found the new online database very user friendly and note it has improved the overall efficiency of the application process. The channel partner survey provided an insight into how the rebate program structure and offerings were perceived by channel partners. Overall, program satisfaction remains high among channel partners.

Key findings from the impact evaluation include the following:

Table 69. Nonresidential Prescriptive Rebate Program Claimed and Achieved Energy Savings

Measure	*Ex Ante* Claimed Savings		Verified Gross Savings		Adjusted Gross Savings		
	Gross kWh	Gross kW	Gross kWh	Gross kW	Gross kWh	Gross kW	Precision*
HVAC	5,175,482	1,239	5,210,631	1,236	6,176,724	1,162	17%
Lighting	44,854,485	8,347	45,962,353	8,449	50,398,596	9,180	8%
Motors	8,139,621	1,352	8,083,681	1,354	7,906,435	1,361	2%
Other	12,683	5	11,080	4	8,428	4	15%
Compressed Air	1,055,406	66	978,110	66	718,100	63	15%
Total**	**59,237,677**	**11,009**	**60,245,855**	**11,109**	**65,208,283**	**11,771**	**6%**

* Precision at 90% confidence.
** Values in table may not sum to 100% exactly due to rounding.

- DP&L transferred an additional 13.14 million in kWh savings from the Residential Lighting program to the nonresidential Prescriptive Rebate Program due to customers purchasing CFLs at retailers such as hardware and big box stores and installing them in commercial applications. The 2011 Residential Lighting Program participant survey and secondary research indicated approximately 5% of customers purchasing incented CFLs installed them in commercial applications.
- Overall, Cadmus found minimal discrepancies during on-site verification work, with notable discrepancies isolated to a limited number of projects.
- Program participation (1,044) declined slightly, compared to 2012 (1,268). The number of lighting projects decreased compared to last year, likely due to the decrease in lighting

incentives for T12 replacements. DP&L lowered incentive levels due to lower savings caused by EISA regulations. However, this decline did not prevent DP&L in achieving their savings goals.

- Cadmus conducted a telephone survey of existing channel partners to determine overall satisfaction. A strong majority of the channel partners (82%) were very satisfied with DP&L's rebate program's overall structure and offerings. A few channel partners were somewhat dissatisfied with the online application process (3%) and provided program materials (3%). Reasons given are provided in detail in the sections below.
- According to channel partners, initial cost remains the major barrier for customers, although a large majority (71%) of survey participants agreed that DP&L's current rebate program effectively addressed these barriers.
- Cadmus interviewed DP&L's rebate program staff to understand major changes to the program's structure or offerings. The evaluation found no significant changes made to the overall program structure. DP&L discussed new marketing strategies to promote higher participation through channel partner bonus incentives, print sheets, and television advertisements as part of the general awareness campaign.
- Looking at the total combine accomplishments from all four years, the program has consistently achieved near 100% realization rates.

Impact Evaluation Data Collection Methods

Cadmus designed the impact evaluation to verify reported measure installations and to estimate gross energy and demand reductions. This included collecting impact evaluation data from the following sources:

- The DP&L program tracking database;
- Online application forms;
- DP&L pre-and post-audit inspection reports;
- On-site visits conducted by Cadmus; and
- Metering lighting operating hours on selected projects.

As part of the evaluation, Cadmus reviewed and referenced the Ohio TRM and utility Joint Objections and Comments regarding the Ohio TRM.

Project and Site Review

Cadmus proposed to evaluate a statistically valid sample of projects, based on a 90% confidence interval with a 10% precision level, through on-site visits. All application materials for projects selected for site visits were thoroughly reviewed by Cadmus engineers.

Cadmus performed two rounds of site visits: in September 2013, and in February 2014. Both rounds involved verification of prescriptive and custom measures. For prescriptive measure verification, the first round consisted of site visits to 25 unique locations (by account number) and the second round included site visits to 32 unique locations. Several sites fit multiple measure categories.

Table 70 shows total projects evaluated through site visits, by project category, for each round.

Table 70. Prescriptive 2013 Site Visit Breakdown by Measure Category—By Project ID*

Measure Category	Number of Site Visits Conducted			Total Number of Reported Projects
	September	February	Total	
Large Lighting	0	6	6	10
Medium Lighting	6	6	12	59
Small Lighting	16	6	22	766
HVAC	1	2	4	120
Motors	2	7	9	60
Compressed Air	0	3	3	21
Other	0	2	1	8
Total	**25**	**32**	**57**	**1,044**

*This table represents total projects where each customer account could have more than one project.

To account for the wide range in project sizes, Cadmus divided lighting projects into large, medium, and small subcategories, based on *ex ante* claimed savings in the DP&L database. Cadmus prioritized analysis of large, high-impact projects due to their disproportionate effect on overall program savings. Consequently, the sample included all prescriptive large lighting projects (10) in the program population. Cadmus successfully verified six out of ten projects. Table 71 provides detail regarding the number of measure types (iterations)[34] for each strata evaluated.

Table 71. Prescriptive 2013 Project, Measure Type, Site Visit Breakdown by Subcategory

Measure Category (By Project ID)*	Program Project Count*	Program Measure Type Count	Sample Project Count	Sample Measure Type Count
Large Lighting >500,000 kWh	10	66	6	37
Medium Lighting <500,000 kWh, >100,000 kWh	59	247	12	38
Small Lighting <100,000 kWh	766	1607	22	48
HVAC	120	233	4	6
Motors	60	118	9	21
Compressed Air	21	21	3	3
Other	8	8	1	1
Total	**1,044**	**2,300**	**57**	**154**

* This table represents total projects, where each customer account could have more than one project.

34 Measure type iterations represented the number of line items within the tracking database where a project could have multiple types of lighting technologies installed.

Baseline Assumptions

Baseline assumptions typically involved data obtained on site, and included replaced fixture types and quantities as well as parameters such as original operation hours and temperature set points. Where data could not be obtained on site (such as HVAC equivalent full-load hours or baseline motor efficiency), Cadmus used assumptions provided in the Ohio TRM.

Impact Evaluation Methodology

Cadmus collected baseline data through interviews with facility staff at each site, and utilized the program implementation and tracking data. On-site visits verified measure installations and identified changes in operating parameters occurring since measure installations. On-site data served to inform the savings impact calculations.

Site Verification Visits and Document Review

After selecting projects to verify through on-site verification activities, Cadmus downloaded project documentation from DP&L's administrative website. In preparation for each site visit, Cadmus reviewed documentation and other relevant program information. The review focused on calculation procedures and energy-savings estimate documentation.

Cadmus also reviewed the DP&L tracking spreadsheet and online application data, comparing entries to original application materials for consistency and accuracy.

On-site visits enabled Cadmus to conduct three primary tasks:

- Verify the implementation, installation, and characteristics of incented equipment;
- Collect additional, detailed data (such as ballast factors) needed to calculate energy savings; and
- Install light loggers on selected projects to determine hours of operation.

Appendix K: Non-Residential Site Visit Summary provides detailed site visit findings.

Database Tracking Review

In addition to reviewing each on-site project file, Cadmus reviewed DP&L's entire final tracking database that contained:

- Participating customers submitting their applications in 2010, 2011 and 2012, but not completing the project until 2013; and
- All 2013 applications and completed projects.

Engineering Analysis and Savings Verification

For each project in the site visit sample, Cadmus performed an engineering analysis using data verified on site, supplemented by project documentation, to validate energy savings and demand reductions.

Procedures used to validate savings depended on the type of measure analyzed, with major measure groups including:

- Lighting measures;
- HVAC measures;
- Motors and Variable Frequency Drives (VFD); and
- Other.

Generally, the review methodology used industry-standard algorithms, the Ohio TRM, secondary research, and engineering experience. The following sections describe procedures used to validate savings from the first three measure categories. Calculations for the *"other"* category typically followed algorithms outlined in the Ohio TRM.

Lighting Measures

Lighting measures included retrofits of existing fixtures, lamps, and/or ballasts with energy-efficient models as well as lighting control technologies. Cadmus generally assumed fixtures operated in the same way (i.e., the same duration of time) pre- and post-retrofit.

Analyzing lighting fixture measure savings required specific fixture data, including:

- Wattage before and after the retrofit;
- Hours of operation after the retrofit; and
- Number of fixtures affected by the measure.

For the past evaluations Cadmus used two sources to calculate the hours of operation for lighting fixtures. Cadmus engineers verified the lighting hours of operation during the site visits or, in cases where hours could not be verified, we used the Ohio TRM. For this evaluation, Cadmus recommended installations of light loggers to accurately determine hours of operation for a sample of projects. During the site visit scheduling call, Cadmus asked the site contacts about hours of operation for the retrofitted lighting. If these hours of operation varied by more than ±10% of the reported values (from the DP&L database), the site was selected for light metering. Schedulers used this criterion to select sites that required light metering.

Cadmus identified 16 sites that met our light metering criterion, as shown in Table 72, as well as the number of light loggers installed.

Table 72. Light Logger Installation Summary

	Number of Sites Selected for Light Metering	Number of Light Loggers Installed
Round 1	9	44
Round 2	7	49
Total	**16**	**93**

These metering sites represented a variety of building types: school, university, foundry, restaurant, warehouse, and retail space. As the reported hours of operation in DP&L's database only represented each fixture type and not space type, Cadmus installed loggers on lighting fixtures in different space types (e.g., restroom, break room, storage and office space).

Cadmus analyzed hours of operation for each fixture by day type: weekday, Saturday, Sunday and holiday. In cases, when the metering period did not include a public holiday (Round 2), Cadmus assumed six federal holidays for businesses. For buildings following a special schedule (e.g., schools, universities), Cadmus discussed annual holidays with site contacts. Cadmus field staff installed at least two loggers for large spaces to ensure redundancy. Where multiple loggers were installed in the same space, Cadmus averaged hours recorded by the loggers. Appendix J: Non-Residential Light Logging Summary provides a memo Cadmus issued to inform DP&L about the light logger installation and retrieval protocol for round 1.

In addition to lighting fixture retrofit measures, Cadmus analyzed savings for wall, ceiling and fixture mounted occupancy sensors using the following data:

- Total connected lighting load;
- Space type;
- Facility operating hours (light metering where applicable); and
- Any operational characteristics identified through the on-site survey.

Calculations used wattages reported on applications, unless these deviated significantly from published databases or manufacturers' claims.

During on-site visits, Cadmus verified the parameters discussed above, conducting interviews with facility personnel to verify operating hours and to determine locations where measures had been applied. Light meters were installed if a significant discrepancy in reported and verified hours was found. When on site, field engineers collected lamp information (such as actual fixture and ballast details) and performed a fixture count.

For the additional CFL upstream lighting savings where customers purchased CFLs at retailers and installed them in commercial applications, Cadmus conducted the analysis as part of the Residential Lighting program, and attributed the savings to the Nonresidential Prescriptive Rebate program lighting measure category. Analysis used the Ohio TRM to account for differences between sectors. Cadmus made adjustments in the hours of operation, waste heat factors, and demand coincidence factors for small commercial applications.

As the Ohio TRM provides a specific baseline for fixtures, based on the high-efficiency replacements for lighting measures, Cadmus used, where applicable, baseline wattages found in the Ohio TRM for the savings calculations.

HVAC Measures

HVAC measures represent a variety of technologies, including:

- Unitary air conditioners
- Chillers
- Ground-source heat pumps
- Programmable thermostats
- Energy recovery ventilators
- HVAC VFDs
- HVAC occupancy sensors

Cadmus analyzed each of the measures using the Ohio TRM as a guide, and verified HVAC savings through site verification results and reviews of application materials.

For this evaluation, Cadmus assumed values to quantify loads controlled by the devices, basing these values on the Ohio TRM and on engineering experience. This analysis accepted the Ohio TRM values for equivalent full load hours (EFLH), as these had been reviewed by the various evaluation contractors supporting development of the Ohio TRM.

Motors and HVAC Variable Frequency Drives

Motor measures included:

- Premium-efficiency motors;
- Air compressors less than 100 HP (load control and variable speed); and
- VFDs[35] less than 250 HP.

Cadmus analyzed each measure using the methodology defined in the Ohio TRM, and verified motor and VFD gross savings through site-verification results and reviews of application materials.

For high-efficiency motor replacements, parameters included:

- Efficiency of the old and new motors;
- Load factors;[36] and
- Usage factors.

When conducting a site visit of a motor project, Cadmus engineers collected information such as nameplates and motor applications (e.g., pump, fan, process). Where applicable, the evaluation also verified motor operating hours by interviewing facility contacts. When data could not be obtained,

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35 In some cases, this category included HVAC VFDs.

36 The load factor serves as a critical parameter for air compressor and VFD installations, and often is determined through pre- and post-installation metering. Due to the time and cost involved, however, metering often may not be feasible in prescriptive programs. Therefore, Cadmus calculated savings using load factor estimates, based on Ohio TRM values and engineering experience.

Cadmus estimated these parameters, based on an Internet search of equipment specification data, professional experience, and deemed values from the Ohio TRM.

Compressed Air Systems

As part of DP&L's new online tracking database, prescriptive compressed air systems break out into a new category. Compressed air measures included air compressors less than 100 HP (load control and variable speed). Similarly to motors, load factor serves as a critical parameter for air compressor systems. Cadmus calculated savings using load factor estimates, based on Ohio TRM values and engineering experience.

Other Measures

The Other Measures category included window film installation projects. Cadmus analyzed each measure using the Ohio TRM as a guide, verifying savings through site visit results and reviews of application materials.

Calculating Realization Rates

Cadmus derived program-level end-use savings and demand reductions through realization rates, calculated for each major measure type (e.g., HVAC, lighting, motors, compressor air, other). Similarly to the sample selection process, the study broke lighting measure types into three categories: large, medium, and small lighting projects. This method included:

- Calculating adjusted gross savings for the sample of site visit projects.
- Calculating a realization rate, based on *ex ante* claimed and adjusted gross savings, for the total sample within each measure group.
- Applying sample realization rates to the program population for each measure group to calculate total program verified and adjusted gross savings. Cadmus divided lighting into the following kWh strata: small (0–100,000); medium (100,000–500,000); and large (500,000 plus). Realization rates, developed for each stratum, could then be applied across that population subgroup.
- Inclusion of 13.14 million kWh from the Residential Lighting program to the Nonresidential Prescriptive Rebate program.

Cadmus acknowledges several limitations resulting from this approach. The study developed realization rates for all non-lighting measures (e.g., HVAC, motors, compressed air, other). Applying realization rates to a heterogeneous population of measures using small samples can present issues. However, lighting measures dominated claimed *ex ante* program savings (70%).[37] Cadmus determined the size, variability, confidence, and precision associated with the lighting sample provided the most significant influence on overall realization rates, reducing impacts of small sample sizes in other measure groups.

[37] This percentage does not include the residential upstream lighting program savings that was transferred to the nonresidential program.

Detailed Impact Findings

Gross Savings Results

Table 73 and Table 74 summarize sample verified and adjusted results by major measure group. The 57 projects sampled within the program consisted of 10,921,704 kWh and 1,566 kW *ex ante* claimed savings. Adjusted energy and demand savings resulted in 11,929,882 kWh and 1,665 kW, respectively.

Table 73. Sample Gross *Ex ante* Claimed and Adjusted Gross *Ex Post* Energy Savings

Measure	Number of Projects	*Ex ante* Gross Energy Savings (kWh)	Verified Energy Savings (kWh)	Adjusted Energy Savings (kWh)	Realization Rate*
Large Lighting	6	5,218,703	6,151,727	6,151,727	118%
Medium Lighting	12	2,684,947	2,802,845	2,802,845	104%
Small Lighting	22	637,024	693,969	693,969	109%
HVAC	4	181,686	216,835	216,835	119%
Motors	9	1,952,621	1,896,682	1,896,682	97%
Compressed Air	3	242,334	165,038	165,038	68%
Other	1	4,389	2,786	2,786	63%
Total	**57**	**10,921,704**	**11,929,882**	**11,929,882**	**N/A**

* Program level realization rates are in weighted by total measure sizes and are rounded to the nearest whole number

Table 74. Sample Gross *Ex ante* Claimed and Adjusted Gross *Ex Post* Demand Savings

Measure	Number of Projects	*Ex ante* Gross Demand Savings (kW)	Verified Demand Savings (kW)	Adjusted Demand Savings (kW)	Realization Rate*
Large Lighting	6	723.80	780.20	780.20	108%
Medium Lighting	12	378.44	423.96	423.96	112%
Small Lighting	22	103.68	103.18	103.18	100%
HVAC	4	49.30	46.24	46.24	94%
Motors	9	296.70	298.83	298.83	101%
Compressed Air	3	11.85	11.84	11.84	100%
Other	1	1.71	0.99	0.99	58%
Total	**57**	**1,565.48**	**1,665.24**	**1,665.24**	**N/A**

*Program level realization rates are in weighted by total measure sizes and are rounded to the nearest whole number

A summary follows of the major differences, by measure category, between *ex ante* claimed savings and adjusted savings.

Lighting Savings

Lighting projects represented approximately 70% of *ex ante* (excluding residential CFL savings) claimed energy savings. Consequently, 70% of Cadmus' site visits focused on lighting projects. Overall for lighting projects, the evaluation validated a higher-than-reported realization rate for energy savings and demand reductions.

DP&L tasked Cadmus to investigate the feasibility and practicality of using T12 lamps as baseline for the 2013 program evaluation and savings projections. Cadmus recomemded DP&L maintain the baseline of T12 lamps after reviewing other utility offerings in the region and conferring with DP&L channel partners. At least for the 2013 evaluation, federally compliant linear flourescent T12s and existing T12 stock remain available. While Cadmus researched this topic, attention should continue as the market changes.

For many projects, Cadmus found few or no discrepancies. The primary differences between reported and adjusted values resulted from differences in fixture quantities, fixture types, operating hours, or fixture wattages, verified from manufacturer's specification sheets.

From past evaluations, Cadmus found that reported hours of operation for lighting projects (especially for large lighting category) can significantly differ from actual hours of operation. Cadmus installed light loggers at several sites to verify the hours of operation for the lighting fixtures. Sites were selected for light metering using a selection criterion (explained above). Cadmus installed light loggers in different areas of each site to monitor difference in usage by space types. Table 75 shows a summary of the light metering study results categorized by space type.

Table 75. Light Logger Results by Space-Type

Space Type	Realization Rate - Hours of Operation	Number of sites
Retail	108%	4
School Auditorium	266%	1
School Hallway	150%	1
School Classroom	58%	1
Manufacturing	143%	3
Storage/Warehouse	195%	2
Industrial	119%	1
Restaurant	89%	1

Cadmus analyzed the light metering data and extrapolated the results to annual usage. The metering analysis shows the claimed hours of operation of the lighting fixtures was 41% (average) lower than actual across all space types. Table 75 does not include results for lighting fixtures controlled by occupancy sensors. Cadmus installed light loggers at two schools as well as confirmed actual annual school schedule to appropriately extrapolate the results to annual usage. The first school found that the auditorium lighting hours of operation were significantly higher than claimed in DP&L database. At the second school Cadmus found the lighting hours of operation for classrooms were 42% lower than claimed. Cadmus predicts that this may be due to good behavioral practices by teachers and students to switch off lights when not needed. In some cases, the reported hours of operation represent the daily timing when the site is open for business which does not necessarily account for areas like storage/warehouses, assembly etc. that might be occupied after hours. It should be noted that in the DP&L database, the hours of operation are claimed by fixture type and contractors rarely break out fixture types by each space type. So if the same fixture is installed in multiple space types with varying occupancy, the claimed hours can be misleading. Cadmus acknowledges that asking for lighting hours of operation at a space type level would increase the time and effort needed to file a rebate application and may add to some customer frustration during the filing process.

Other observed discrepancies included the following:

- DP&L rebates retrofitting T12 lamps with low-watt T8 fixtures. For one project visited, Cadmus found discrepancy between fixture wattages for claimed and evaluated savings. Cadmus used the Ohio TRM for the baseline T12 fixture wattage (144 W) while DP&L used 112 W. For the proposed case, Cadmus verified fixture wattage based on specification sheets provided in the project documentation (83 W) while DP&L used 85 W. These discrepancies in fixture wattages resulted in higher consumption savings (kWh) realization rate of 225% for this measure.

  Cadmus evaluated a lighting measure – *LED or Induction (operating hours < 8,760) replacing 251W to 400W*, for the same project and found discrepancy in the baseline fixture (400 W Metal Halide) wattage used by DP&L. Cadmus used the Ohio TRM (458 W) while DP&L used 400 W to calculate the savings. Cadmus corrected the baseline fixture wattage as per Ohio TRM and awarded a realization rate of 120 % for this measure.

- Cadmus evaluated the wall or ceiling mounted occupancy sensors measure, offered under Lighting Fixtures and Controls measure category. Each sensor must control at least 125 Watts of lighting power, in order to qualify for the rebate. DP&L savings calculations as advised by Cadmus in previous evaluations assumed each occupancy sensor controlled 658 watts of associated lighting load. Cadmus evaluated eight projects related to this measure and found low connected watts for some projects. The number and types of lighting fixtures controlled by occupancy sensor varied significantly for different space types at these project sites. While this wattage assumption may be suitable for a row of high-bay lighting fixtures in a warehouse for example, it does not seem applicable for certain office space types such as offices, bathrooms, and smaller spaces. For example, at one of the sites Cadmus visited occupancy sensors were installed in office spaces. These sensors controlled two T8 lamp lighting fixtures.

- During a site inspection, Cadmus found a different verified count (16) of lighting fixtures than reported (30). The realization rate for this measure was 52%. Notably, Cadmus metered the lighting fixtures at the site and found verified hours of operation 11% lower than reported. This proved to be an anomaly, and the majority of projects reported accurate counts of lighting fixtures.

- DP&L rebates de-lamping of T12 lamps, assuming baseline wattage of 72 watts for the measure. Although the baseline wattage assumption proved reasonable for high bay (high output) applications, Cadmus found the assumption inaccurate for projects involving de-lamping in low-bay fixtures. Cadmus followed the Ohio TRM value for standard T12 baseline wattage of 60 watts for non-high bay applications.

- Cadmus changed demand savings for several projects due to incorrect allocations of summer coincident peak assumptions. The Ohio TRM provides coincident peak factors by building type. DP&L assumed an average coincident peak factor for all buildings. As this average did not represent some larger lighting projects, Cadmus changed peak demand savings using the appropriate factor from the Ohio TRM.

HVAC Savings

Similarly to findings from the 2012 program evaluation, verification of HVAC projects incented in 2013 resulted in the highest realization rates in the group of sampled projects. For most prescriptive HVAC projects, Cadmus applied the EFLH proposed in the Ohio TRM, as these represented reasonable estimates of usage for the region.

Cadmus found no differences in measure quantities from the site visits. However, performance specifications found on site and through savings analysis identified differences between *ex ante* claimed and adjusted gross savings. Cadmus evaluated two projects that involved installation of VFD on HVAC fans. The verified hours of operation (5,658 hours/year) for the unit were higher than reported (4,250 hours/year).

Motors and HVAC Variable Frequency Drive Savings

Motor savings represent the second-largest measure type, comprising approximately 14% of the nonresidential Prescriptive Rebate program ex ante claimed savings. This measure achieved an overall realization rate close to 100%. Cadmus noted the following differences, related to calculation methodologies and specific projects:

- For motor VFD installation measures, Cadmus planned to use the Ohio TRM hours of operation to calculate savings. The study verified installation of VFDs on motor measures for five out of nine projects selected in the sample. These projects would be better served under the Custom program and not the prescriptive program. As these applications (e.g., tank agitator, paint mixing, sewer plant, pool water pumping) were process-specific motors, the Ohio TRM did not accurately represent them. Cadmus relied on facility staff to provide annual hours of operation for these various applications. In addition, motor efficiencies and other project specific data were collected on site to inform project savings. Like Custom projects pre- and post- metering would be best to determine savings for these unique applications, but this was not a possibility for these prescriptive projects.
- For one project, the site visit verified the motor VFDs had not been installed. Cadmus followed up with the customer after the visit and was told the VFDs would be installed by the end of April 2014.
- Cadmus verified air compressor VFD measure at three sites, finding small discrepancies in the reported and verified hours.

Compressed Air

The compressed air sample included three prescriptive compressed air projects, and determined discrepancies between reported and verified hours of operation. The overall sample realization rate for these three projects was 68% for energy savings and 100% for demand savings.

For one of the projects, Cadmus verified that the compressor operates for 24 hours per day and 5 days per week based on a conversation with the site contact. DP&L savings were based on 24 hours per day and 7 days per week operation schedule. This discrepancy resulted in 29% difference between ex ante claimed and verified in annual hours of operation and consequently reduced the consumption (kWh) realization rate for the project to 71%.

Cadmus evaluated a project involving replacement of a constant speed compressor with a new variable speed compressor. During the site visit, Cadmus verified the hours of operation for the compressor to be based on 12 hours per day and 5 days per week operating schedule. DP&L reported annual hours of operation for the compressor were 6,000 hours. The overall realization rate for this project was 52% due to discrepancy in hours of operation of the compressor.

Other Technologies

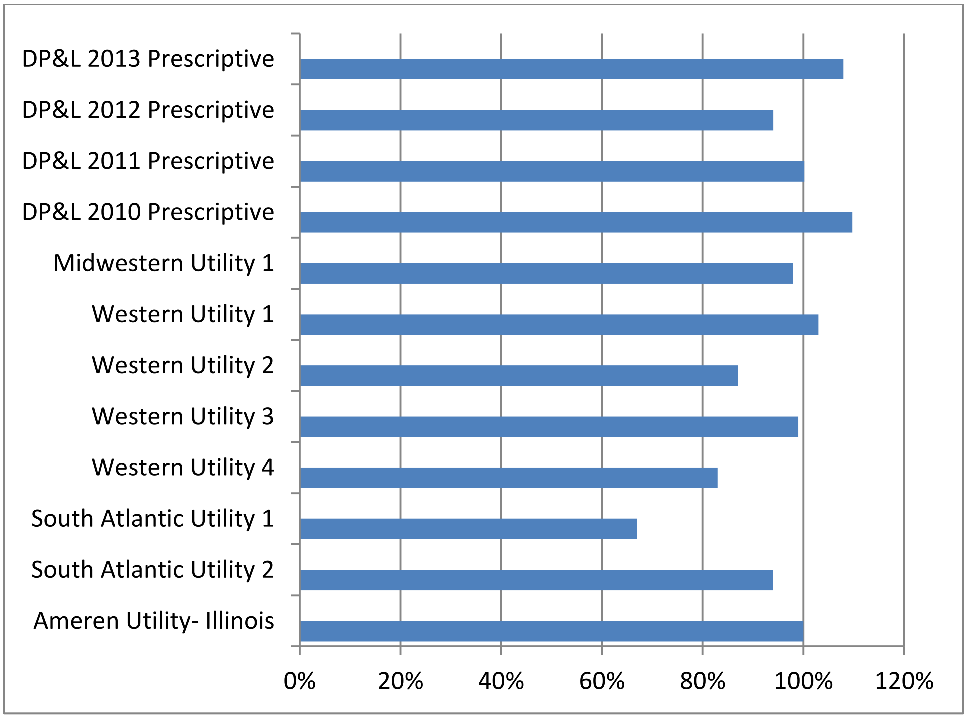
Cadmus verified two window film projects.

- For one project, the verified square feet of window film installation was 30% lower than reported.
- The second project was incorrectly categorized under prescriptive HVAC.

Realization Rate Comparison

Figure 37 compares evaluated energy realization rates for the nonresidential Prescriptive Rebate program to similar utility-funded commercial programs across the country. Though slightly higher than in previous evaluation years, DP&L's 108% overall realization rate still ranks at the higher end of utility variations. When examining realization rates by measure category, lighting and HVAC achieved realization rates higher than 100%, while motors, air compressors, and other measure categories all resulted in realization rates lower than 100%. HVAC and motor projects served as the main drivers increasing the overall realization rate.

Figure 37. Commercial Prescriptive Program Realization Rate Comparison to Other Utilities



Realization rates tend to be driven by the accuracy of a utility's engineering assumptions for its programs. A 100% realization rate would be the best scenario for a program, as it would indicate energy-savings estimates neither overstated nor understated achievements, making planning for future program years less burdensome for program staff. DP&L's 108% realization rate indicated DP&L has succeeded in planning which engineering assumptions to use for program reporting. Furthermore, DP&L has consistently come close to a 100% realization rate over the past four years.

Process Evaluation Methodology and Findings

The process evaluation tasks Cadmus performed for the 2012 program evaluation included conducting telephone interviews with DP&L staff.

Program Design

As shown in Table 76 and Table 77, program participation declined in 2013 compared to 2012, but remained higher than the 2009, 2010, and 2011 program years. Table 78 provides further details on the frequency of installed measure types.

Table 76. Program Participation by Year

Program Year	Number of Individual Customer Projects	% Change From Prior Year
2009	331	0%
2010	622	188%
2011	736	118%
2012	1,268	172%
2013	1,044	82%

Table 77. Program Participation by Year

Measure Category	Total Number of Reported Projects 2013	Total Number of Reported Projects 2012	Total Number of Reported Projects 2011	Total Number of Reported Projects 2010
Large Lighting	10	13	9	11
Medium Lighting	59	76	50	61
Small Lighting	766	1,001	487	386
HVAC	120	74	79	68
Motors	60	84	89	82
Compressed Air	21			
Other	8	20	22	14
Total	**1,044**	**1,268**	**736**	**622**

Table 78. Frequency of Major Measure Types Installed

Measure Type	Frequency				
	2009	2010	2011	2012	2013
Lighting	231	458	539	1,090	1,920
HVAC	42	68	79	74	233
Motors	43	82	88	84	118
Other Technologies	15	14	23	20	8
Compressed Air*					21
Total	**331**	**622**	**729**	**1,268**	**2,300**

*Compressed Air category only in 2013. For previous years, these projects were included in the motors category.

Overall for the prescriptive program, participation decreased by 18% compared to 2012. However, as observed in

Table 78 individual customer projects saw more measure iterations. Lighting projects saw the largest decline compared to 2012, with 255 fewer lighting projects. The Other Technologies program subcategory saw the largest percentage decline of 60%.

Participation primarily fell due to the following reasons:

- In 2012, the Other Technologies program category included four types of measures: barrel wraps, vending equipment controller, commercial clothes washer, and window film. In 2013, this program category only included window film projects. DP&L still offers incentives for the other three measures but under different program categories. Moving forward all measures within the Other Technologies program category will move to other categories and the Other Technologies category will be removed for future program years.
- In 2012, Motors category included projects involving installation of premium motors, variable frequency drives, and air compressors. In 2013, a separate category: Compressed Air has been developed to include air compressor related projects.
- For 2013, DP&L changed the incentives for lighting projects from those of 2012, to accommodate new lighting federal standards. This reduction in incentives likely resulted in lower lighting program participation.

Program Staff Interview

Cadmus interviewed DP&L program staff to identify major program changes between 2012 and 2013. Staff highlighted minimal changes to program marketing, administration, and overall design. Program marketing remained consistent, with very little change from year to year. DP&L promoted the program using the following mechanisms:

- DP&L's website;
- Television campaigns;
- Presentations to various community and business groups; and
- Major account representatives working directly with customers.

In addition to these marketing strategies, Channel Partners can co-brand with DP&L in their advertisements, magazines, and other promotional materials. Channel Partners receive up to a 5% bonus reward for providing energy-efficiency equipment to participants totalling more than a $10,000 in incentives annually. According to DP&L staff, this encourages Channel Partners to recruit more program participants, especially in the last quarter of the year when Channel Partner rewards were increased to 15%.

Starting 2013, DP&L began using an online database to track progress of all rebate applications. The new database, as reported by DP&L, provides an opportunity for quicker application processing, faster Channel Partner reward outlay, and detailed project-related information, such as baselines and proposed equipment model numbers and specifications.

DP&L Channel Partner Feedback

DP&L maintains a network of active contractors and vendors that provide services for DP&L's nonresidential energy-efficiency rebate programs. Contractors and vendors signing up to become

Channel Partners can attend DP&L events and receive program materials and regular e-mail updates to assist with promoting the business rebate programs. Channel Partners receive other benefits for actively participating in DP&L's business rebate program, such as bonuses for sales of over $10,000 in customer rebates.

Channel Partner Surveys

For the 2013 process evaluation, Cadmus conducted surveys with channel partners and gathered feedback about their experiences with DP&L's business rebate programs. The surveys addressed the following key research topics:

- How Channel Partners learned of DP&L's business rebate programs and their motivations for participating.
- Impressions of customer awareness and strategies for program promotion and outreach.
- Barriers to program participation and methods for DP&L to overcome these barriers.
- Program satisfaction and suggestions for improvements.
- Channel Partners' interest in midstream programs.
- Response to DP&L's marketing campaigns.
- Response to EISA's commercial lighting standards.
- Channel Partners' characteristics (as business type and size).

DP&L provided Cadmus with contact information for 59 Channel Partners. To schedule interviews, Cadmus reached out to all Channel Partners via e-mail and followed up with phone calls. Throughout December 2013 and early January 2014, Cadmus completed 39 phone interviews, averaging 20 minutes each. Channel Partners included those participating in the prescriptive and custom programs. The following findings include both types of contractors.

Channel Partner Survey Findings

Channel Partner Profile

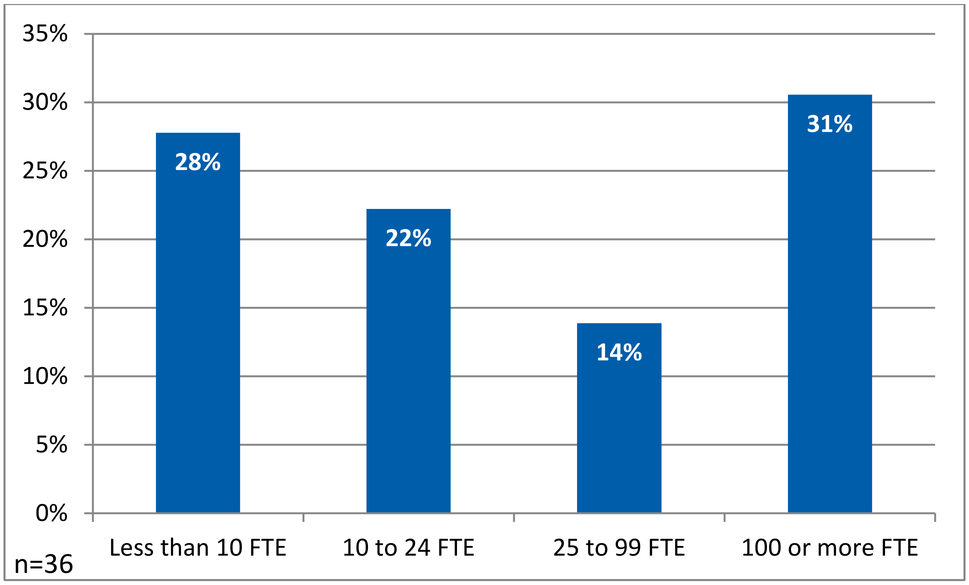
Channel Partners primarily characterized themselves as lighting or electrical contractors, distributors, or energy and engineering consultants. To a lesser extent, they specialized in motors, general mechanical contracting, or building design. Channel Partners reported offering the following types of services:

- Energy retrofits
- Indoor and outdoor lighting design, consulting, and upgrades
- Energy audits
- HVAC and plumbing
- Lighting and other equipment distribution and sales
- Building design

- Compressed air service and sales

DP&L Channel Partners ranged in size from sole proprietors to a few nationwide firms employing more than 1,000 workers. Figure 38 shows the distribution of employees, from small (less than 10 employees) to large (firms with more than 100 employees or with multiple locations).

Figure 38. Channel Partner Range of Full-time Employees

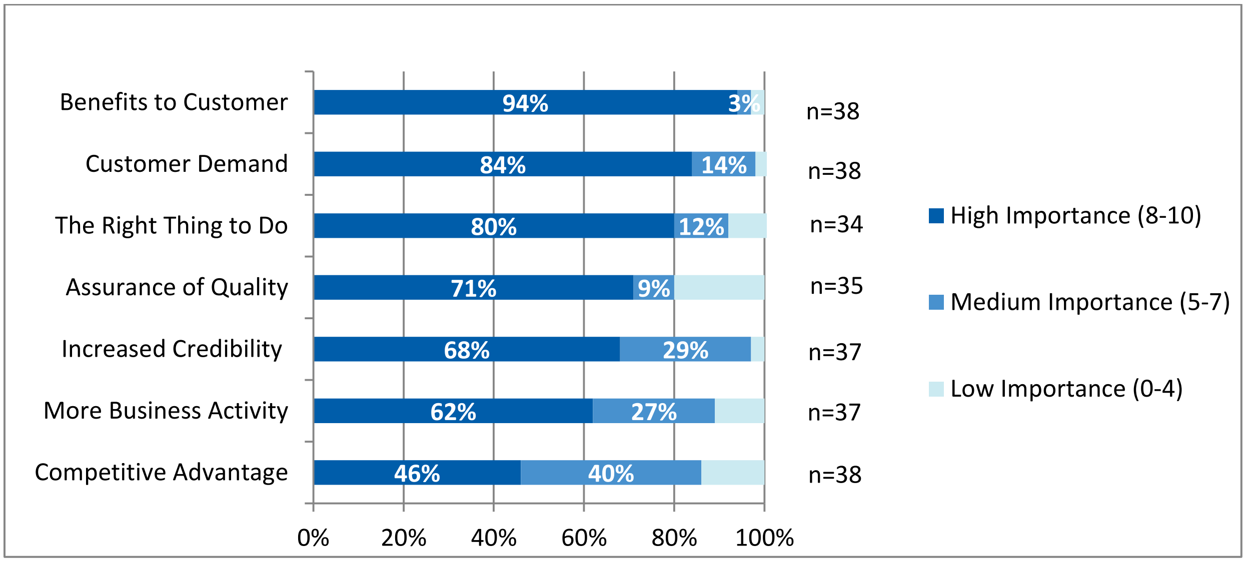


Communication Preferences and Reasons for Participation

Many Channel Partners reported working with DP&L for so long that they could not remember how they learned of the business rebate programs. For those able to recall, Channel Partners learned of the programs through DP&L representatives, direct contacts with the company, or through word of mouth. Channel Partners preferred to receive updates via e-mail or telephone.

Using a scale of 0 to 10 where 0 means low and 10 means high, Channel Partners rated the reasons they participated in DP&L programs. Respondents rated the leading factors for participating as: benefits the program provides to customers (94%) and customer demand (84%). Figure 39 shows additional reasons Channel Partners participated, in order of importance.

Figure 39. Factors Important for Participating in DP&L's Programs



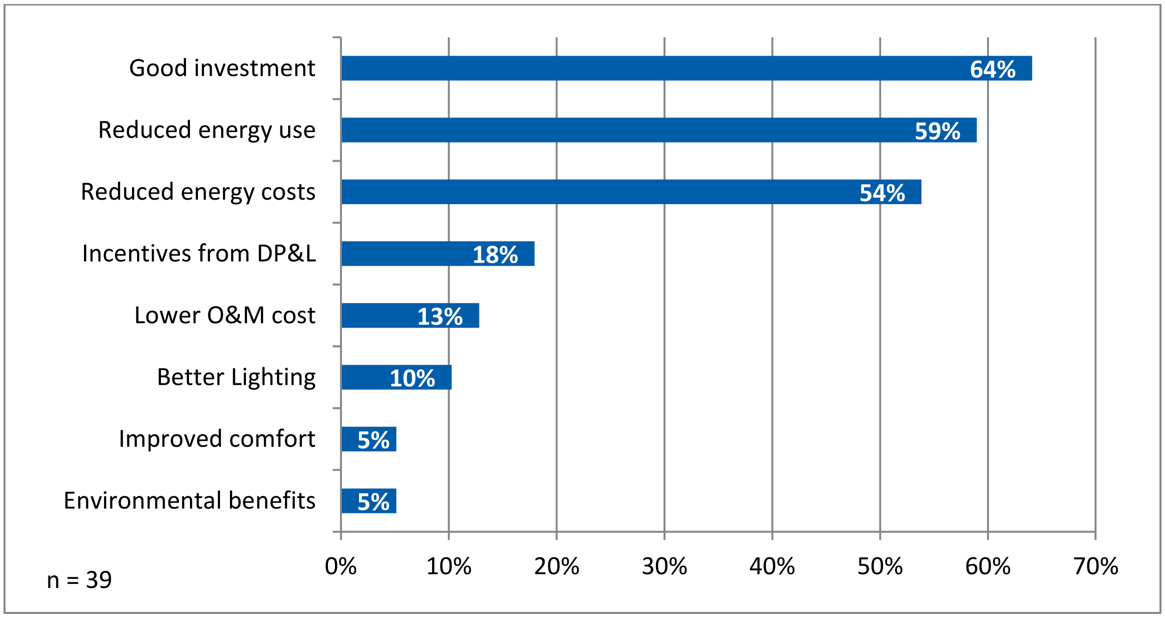
Customer Awareness and Strategies for Promotion

Surveys asked Channel Partners how aware they thought business customers were of DP&L rebate programs, with 13% of Channel Partners characterizing customers as very aware of the program and nearly 38% characterizing them as somewhat aware. The remaining respondents characterized customers as not too aware (13%) or not at all aware (5%) of the rebate programs.

All but one Channel Partner reported routinely marketing high-efficiency equipment to DP&L customers. Most Channel Partners (87%) always or often promoted DP&L business rebate programs. Channel Partners promoted the program through in-person meetings, customer cost proposals, word of mouth, or general customer education (e.g., through e-mail, the Internet, facility walk-throughs).

As shown in Figure 40, Channel Partners primarily promoted the benefits of good investments, reduced energy use, and reduced costs.

Figure 40. Benefits of High-Efficiency Equipment



Surveys asked Channel Partners what materials, guidelines, or instructions DP&L could provide to help them promote the program. More than one-half of respondents (62%) said they had sufficient materials or guidelines needed to promote the programs. The remaining respondents offered the following suggestions:

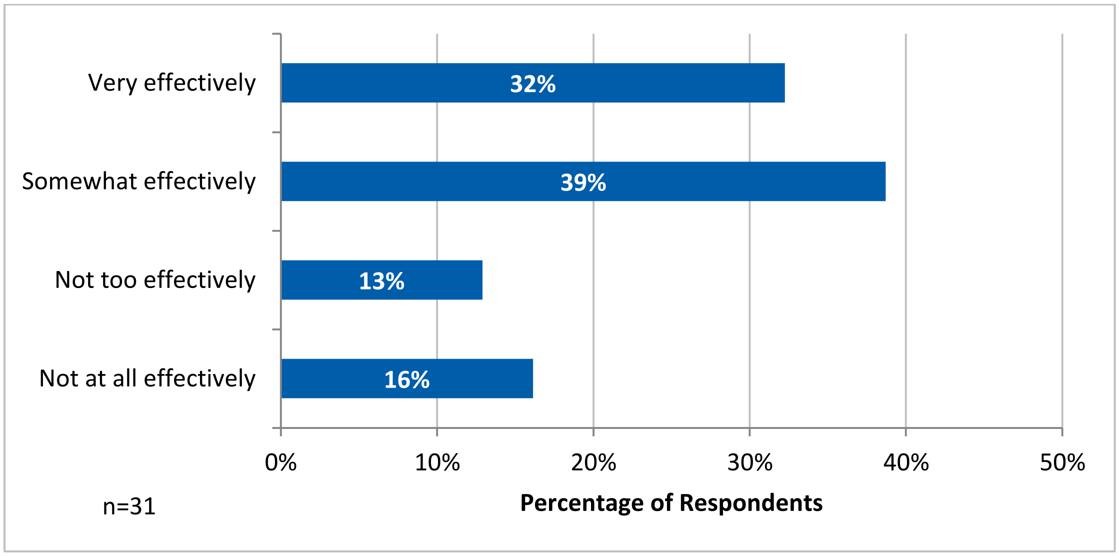
- Clarify or define custom rebates and literature to reduce the program's case-by-case nature;
- Develop a calculator to enable Channel Partners to provide customers with quick project savings estimates before beginning to complete an application; and
- Provide additional flyers, brochures, or handouts, and update these yearly to reflect program changes.

Barriers to Participation

The majority of Channel Partners (78%) cited availability of capital as the biggest adoption barrier to implementing energy-efficient technologies for commercial buildings and industrial customers.

Surveys asked Channel Partner respondents how effectively the DP&L business rebate program addressed these barriers. As shown in Figure 41, the majority responded very effectively (32%) or somewhat effectively (39%).

Figure 41. Effectiveness of DP&L Rebates in Addressing Barriers



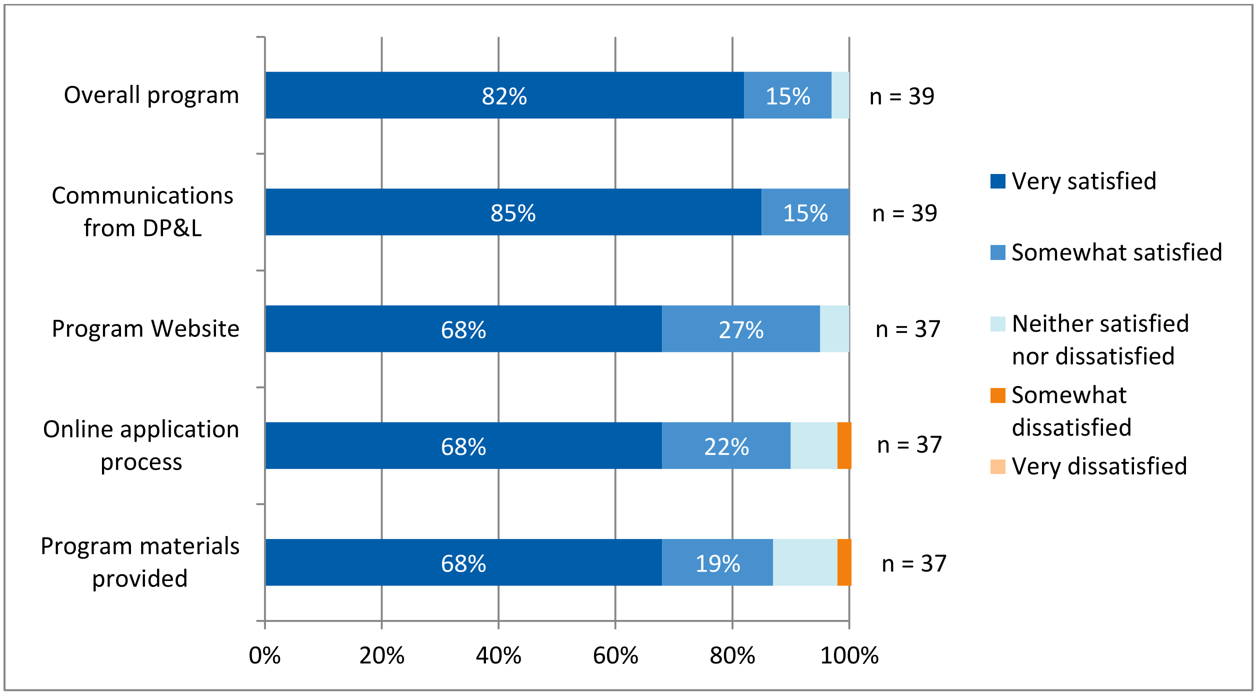
Channel Partners provided the following feedback regarding the ability of DP&L's rebate programs to overcome customer barriers:

- "Rebates contribute a lot if there's less money involved to begin with."
- "Rebates help but sometimes they are not enough to tip the decision-making scale."
- "Rebates are sometimes not enough to overcome cheap energy prices."
- "Customers are often hesitant to spend money, even with the rebate."
- "It's sometimes hard for Channel Partners to overcome skepticism about purchasing high-cost efficiency equipment to save money on energy costs."
- "If customers don't have the money, they won't do energy-efficiency projects."
- "It's easier to promote the high-efficiency measures to schools and governments than it is for commercial businesses."

Program Satisfaction

Over the years, program customer satisfaction has remained consistently high. This has also translated Channel Partner responses for this year's survey which found the majority very satisfied (82%) or somewhat satisfied (15%) with the overall program. Figure 42 shows satisfaction responses for several rebate program components: communications with DP&L; the website; the online application process; and program materials.

Figure 42. Program Satisfaction



Many Channel Partners reported they liked DP&L's business programs, and considered rebates good but could be improved. A few Channel Partners were somewhat dissatisfied with the online application process (3%) and program materials provided (3%). Reasons for dissatisfaction included the following:

- "The application process can be tedious with too many applications to fill out for each measure."
- "Some of the information on the application or website is out of date."
- "The application process often has errors."
- "Program materials were limited and were not replenished."

When asked for recommendations to improve DP&L's rebate programs, Channel Partners suggested adding more measures or increasing rebates. Channel Partners offered the following recommendations:

- "Strengthen the program by increasing rebates, and using custom incentives based on formulas for savings estimates."
- "Consider more creative custom options through new and innovative programs, renewable energy, and an audit program."
- "Improve the custom incentives for energy management systems."
- "Consider rebates for air compressor audits and leak detection."
- "Increase options for outdoor lighting."
- "Increase rebates or provide Rapid Rebates for LEDs."

- "Improve the rebates for T12s."
- Make the energy calculator more accessible for public use.
- Provide more leads to the Channel Partners.

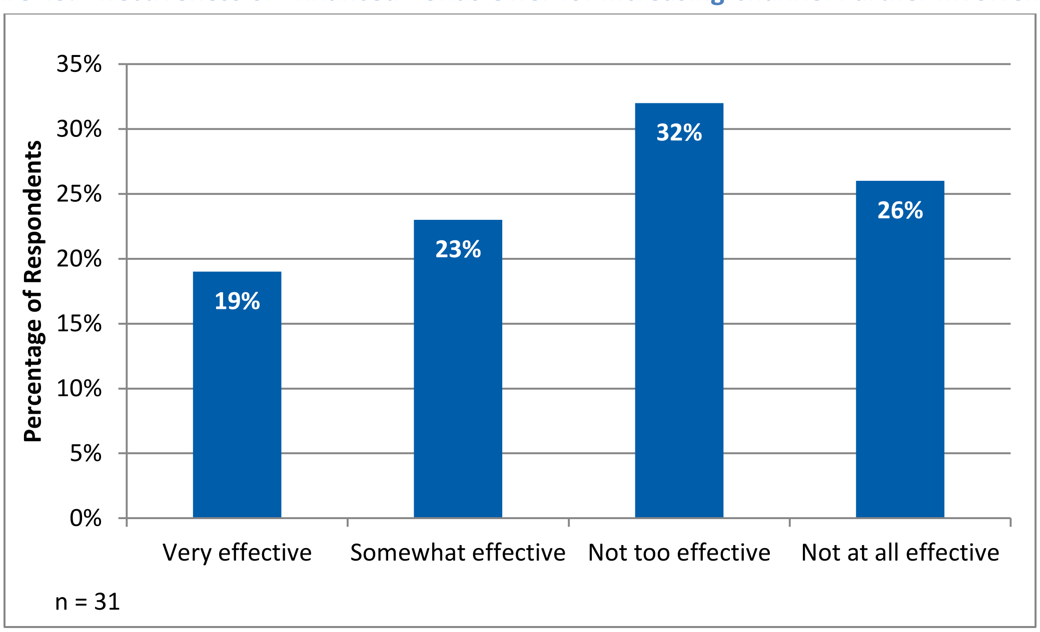
Response to Fall Business Marketing Campaign

In the fourth quarter of 2013, DP&L sponsored a fall marketing campaign to increase program participation and to encourage Channel Partners to recruit more projects. The marketing campaign consisted of two parts: enhanced bonuses for Channel Partners; and program promotion through customer testimonials. The enhanced bonus provided an increase of three times the normal offer, with a 15% cash incentive to Channel Partners for selling at least $10,000 in business customer rebates. The customer testimonials were presented as case studies, promoted on television and print advertisements, and posted on DP&L's website. Channel Partners received printed case studies to give to customers.

The majority of Channel Partners learned of the enhanced bonus offer through email (72%). The remaining Channel Partners learned of the enhanced bonus offer from DP&L representatives (11%) or from DP&L's newsletter (8%).

Surveys asked Channel Partners how effective they considered the enhanced bonus was at increasing their program involvement. As shown in Figure 43, slightly more Channel Partners found the enhanced bonus not very effective.

Figure 43. Effectiveness of Enhanced Bonus Offer for Increasing Channel Partner Involvement



Channel Partners provided the following feedback about the enhanced bonus offer:

- "It was somewhat effective but more of a good reminder about the program."
- "It was a nice offer and makes a difference, but would also like the bonus to go to customers."
- "It's necessary to work just as hard for either the standard or the enhanced bonus offer."
- "The enhanced bonus was a short-term offer and didn't allow enough time to react."
- "It is tougher for the smaller businesses to make the quota."
- "The enhanced bonus offer doesn't help to increase customer involvement."

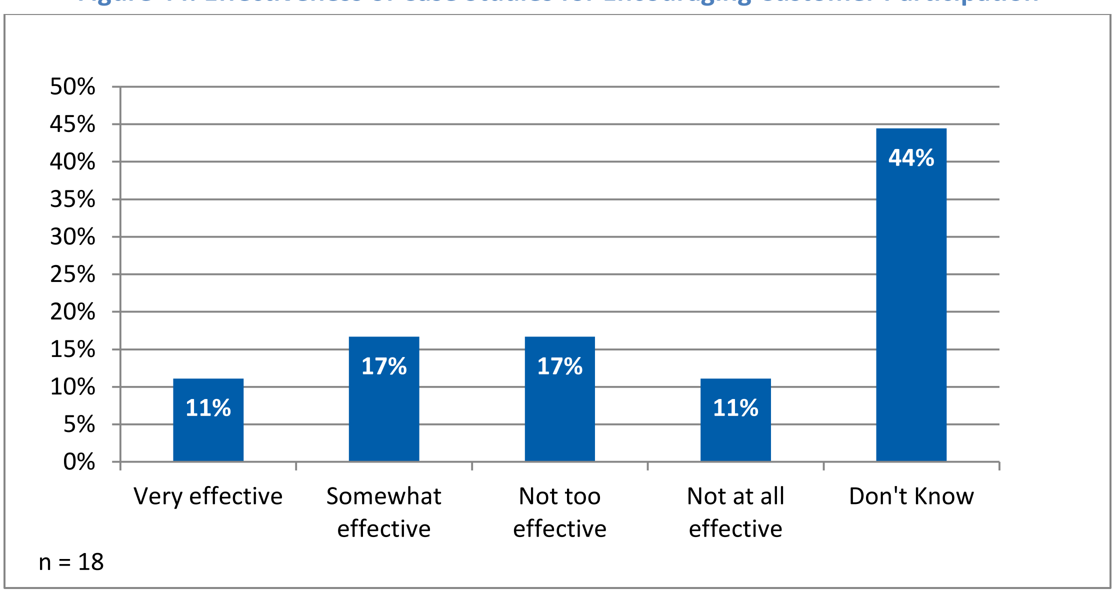
Customer Case Studies

More than one-half of the Channel Partners (54%) learned of the case studies featuring customers during DP&L's fall marketing campaign, although the majority had not used the materials in their customer outreach efforts.

Channel Partners learned of the case studies through the newsletter, e-mail, or at meetings with DP&L representatives. The Channel Partners learned of it through advertising campaigns, such as television and radio.

When asked how effectively the case studies encouraged more customer participation in the Rapid Rebate Program, many Channel Partners did not know (44%). Figure 44 shows Channel Partners split their thinking about case studies.

Figure 44. Effectiveness of Case Studies for Encouraging Customer Participation



Channel Partners provided the following feedback about the customer case studies:

- "Case studies can provide good selling points to show potential customers how others have benefited."
- "Channel Partners mostly use the case studies internally to learn about project opportunities."
- "Information in the case studies can be helpful in teaching someone just getting into the business to sell rebates."
- "Case studies can only be used in specific situations where the information is relevant."
- "Channel Partners are hesitant to promote competitor projects."

Response to EISA Lighting Standards

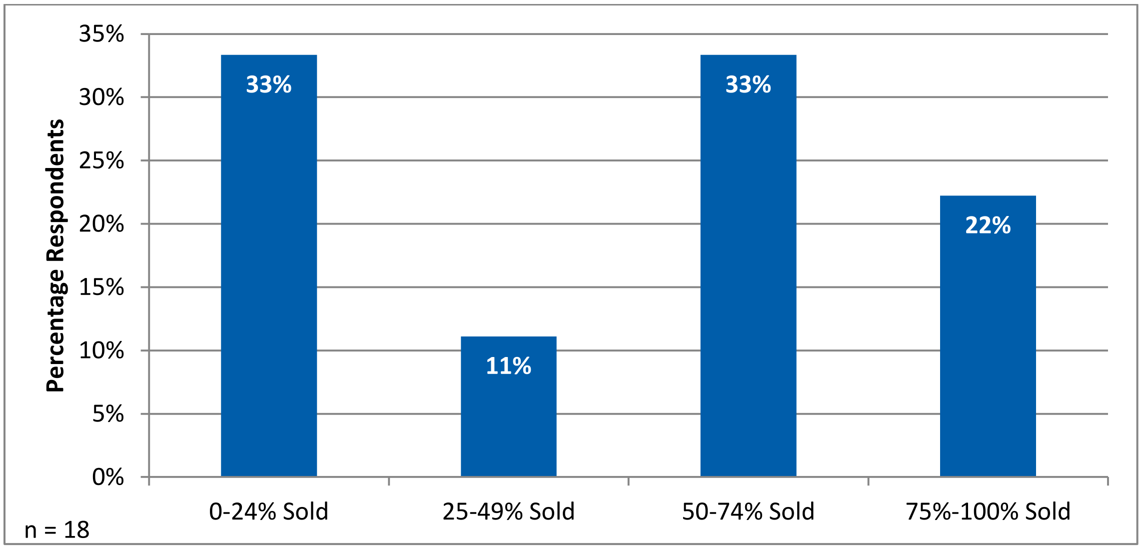
The majority of Channel Partners spoke with their customers about the new EISA lighting standards. Most Channel Partners (83%) reported their customers replaced T12s with EISA-exempt T12s.

The Channel Partners provided the following feedback about the discussions they had with customers and about the new lighting standards:

- "Most customers have been expecting a change, though many don't understand the differences in the new lighting standards."
- "Customers don't really care for the new standards, but knowing about the change gives Channel Partners more credibility for selling energy efficient lighting."
- "Some think that the fluorescent lamps are becoming obsolete without any suitable alternatives."
- "Most customers with T12s are replacing them, but it is slow."
- "The old T12s are still available and some are still buying these."
- "Larger businesses and contractors don't have issues with the new standards, but households and farms find it harder to deal with."

Surveys asked Channel Partners to estimate the percentage of EISA-exempt lighting sold. Figure 45 shows a wide range of responses, with about one-half of Channel Partners selling 50% or more of facility lighting with EISA-exempt T12s.

Figure 45. Percentage of Linear Fluorescent Lighting Sold with EISA-Exempt T12s.



Program Tracking Database

Starting in 2013, DP&L switched to a web-based database, where customers or contractors completed applications. Documents such as invoices, audits, and specification sheets could be attached to electronic applications. DP&L provided Cadmus with complete access to the database to download program participant lists and project-related documentation. The database also provided algorithms used to calculate reported savings.

Notably, some findings cited below have already been discussed with DP&L staff. Cadmus downloaded the rebated project list from DP&L's online database website. During the review process, Cadmus focused on the following:

- *Algorithms:* Cadmus reviewed and verified reported savings by confirming the calculation methods used in the 2012 program tracking system (an Excel database) translated correctly into the current online database. For example, for Rapid Rebate projects, Cadmus separately calculated *ex ante* claimed savings based on the Ohio TRM to confirm *ex ante* claimed savings.
- *Data Entry:* Cadmus reviewed project information, such as company name, vendor name, and installation address provided in the database to check consistency and accuracy.
- *Audit Report Review:* Cadmus reviewed audit reports for several sites to check accuracy of reported savings at a measure level. This included comparing database savings to the audit reports published by DP&L's third-party contractors.

Cadmus found consistency between 2012 tracking system and the current online database. The new tracking system also offered additional benefits and improvements, such as additional data fields (e.g., installed equipment model number, equipment efficiency, and project details). The major improvements included the reporting features and year-over-year tracking compared to the previous system. One drawback for the database was the lack of transparency in how savings were updated for certain projects with site-specific inputs. While not a common occurrence, there were certain prescriptive projects which required custom calculations to incorporate site specific application data. DP&L knows of this and currently is undertaking updates to provide detailed source information and flags where calculations deviated from the Ohio TRM.

Cadmus categorized the database review findings into "high" and "low" priority sections.

High Priority:

- Cadmus observed that for two projects, database savings for multiple unique measures had been listed under one measure. Other measures had 0 consumption and demand savings associated with them. While on a program level, savings were recorded correctly, this method of reporting will create issues if categorizing savings at a measure level.
- Cadmus observed that one project audit report included measure "De-lamping T8" savings, which were not rebated by DP&L, but savings were reported in the database.
- One project sampled for site visits was incorrectly categorized under the measure name "VFDs for Air Compressor." Cadmus conducted the site visit and verified the VFD was installed on a water pump. Such issues can create errors in measure level savings estimates.

Low Priority:

- The project database spreadsheet included two columns that list installation addresses for all projects. Cadmus observed that the information presented in these columns was inconsistent for some sites.
- Cadmus observed that, for some sites (with the same installation address), where multiple projects were implemented, had slightly different company names. If this data entry issue is not corrected, issues can result if using the database to take a company participation count.
- Cadmus observed two columns in the DP&L database: project types and serial numbers, were blank (not populated) for program participants. These columns could be removed as it is unnecessary for savings calculations or start recording the data for documentation purposes going forward.

Recommendations

Based on our impact evaluation findings and Channel Partner survey responses, Cadmus offers the following recommendations:

- **Revisit the wall/ceiling mounted occupancy sensor savings estimate.** Based on Cadmus's field verification, the controlled wattage associated with each sensor varies significantly with space type. The number of fixtures and type of lighting technology depends on the square footage and type of space. DP&L should consider revising the connected load assumption used in the occupancy sensor savings calculation based on space type and all four years of evaluations. This should provide a connected load assumption for future program tracking.

- **Revise bonus incentive structure.** Cadmus found the bonus incentive program structure, aimed at encouraging Channel Partner project recruitment efforts, has room for improvement. Channel Partners suggested their project recruitment efforts would have continued even without the incentive and extension of incentive offering period will help them. Some Channel Partners suggested offering a share of this bonus incentive to potential customers might increase participation.
- **Revise enhanced bonus incentive structure.** Many Channel Partners reported the enhanced bonus program did not effectively increase their involvement in the rebate programs, given the offer’s short duration. DP&L increased the duration of the enhanced bonus offer to allow Channel Partners to learn about it and to test reaction in the market. DP&L also should consider providing advance notification about the enhanced business offer through multiple outlets, such as e-mail updates and website notifications directed at Channel Partners.
- **Continue providing case studies as a resource to Channel Partners and customers.** Customer case studies provided a great resource for Channel Partners and customers to learn about DP&L’s energy-efficiency rebate project opportunities. Channel Partners, however, expressed concerns about promoting competitors’ projects, and the majority did not use them for customer outreach. If feasible, consider also developing additional customer-facing materials that Channel Partners can use to promote their projects. For example, these might include: standardized project examples, frequently asked questions, and materials providing information about energy-efficiency project opportunities.
- **Conduct research and education to customers regarding T12 baseline.** Channel Partners reported many customers are replacing their facility lighting with EISA-compliant or exempt T12s. Some customers may replace T12s with non-compliant lighting while supplies remain available. If feasible, consider conducting additional research to determine a more accurate T12 baseline directly from customers. The research also may provide an opportunity for educating Channel Partners and customers about program impacts of the new lighting standards. DP&L may consider providing frequently asked questions about the EISA lighting standards on the business rebate program website.

Nonresidential Custom Rebate Program

The following sections describe the evaluation approach, detailed findings, and conclusions and recommendations for the nonresidential Custom Rebate Program.

Evaluation Overview

Cadmus' evaluation of the 2013 nonresidential Custom Rebate program followed researchable questions and evaluation activities outlined in DP&L's *2013 Evaluation, Measurement, and Verification Plans* document. Table 79 identifies key researchable evaluation questions.

Table 79. Key Researchable Questions

Researchable Question	Activity
What have been the program administrator's and Channel Partner's experiences with program processes?	• Program staff interviews • Participant Channel Partner interviews
What gross electric savings and demand reductions resulted?	• Engineering analysis • Database review • Site visits
Is this program cost-effective?	• Cost-effectiveness analysis

Detailed Evaluation Findings

The 2013 program year achieved energy savings of 16,466,532 kWh and demand savings of 2,416 kW. The program achieved an energy savings realization rate of 98% for energy savings and 70% for demand savings when compared to *ex ante* claimed savings. The largest contributing factors to the low demand realization rate are the New Construction-Whole Building Performance project category. Cadmus calibrated the simulation models used to calculate the reported savings, using utility billing data provided by DP&L. The original model savings predictions were based on assumed annual schedules and equipment loading.

Similar with the prescriptive program, the process and impact evaluation found the new online database very user friendly and it will likely improve the overall efficiency of the application process. The Channel Partner survey provided an insight into how the rebate program structure and offerings were perceived by Channel Partners. Like in previous years, the Channel Partners' satisfaction for the program remains high.

DP&L divides its Custom Rebate offering into two separate categories: Custom and New Construction (NC). The following key findings apply for each of these categories:

Table 80. Nonresidential Custom-Rebate Program Claimed and Achieved Energy Savings

Measure	*Ex Ante* Claimed Savings		Verified Gross Savings		Adjusted Gross Savings		
	Gross kWh	Gross kW	Gross kWh	Gross kW	Gross kWh	Gross kW	Precision*
Custom	12,420,871	1,321	12,254,746	1,327	12,501,877	1,402	5%
NC	4,395,046	2,111	4,263,752	1,799	3,964,655	1,014	18%
Total	**16,815,917**	**3,432**	**16,518,498**	**3,126**	**16,466,532**	**2,416**	**5%**

* Precision at 90% confidence.

- For a NC project we found a mathematical error that resulted in approximately 30% error in reported savings calculation. This site was the largest NC lighting power density reduction site we evaluated and therefore had a large impact.
- The 2013 program year evaluation indicated that DP&L's independent energy consulting firms exhibited thorough and well-documented installed equipment, spot meter readings, and data logging information for most projects evaluated. However, there were several air compressor projects where the data logging practices used could be modified to improve the consistency of power metering methodology and accuracy of the savings predictions.

  Looking at the total combine accomplishments from all four years, the program has consistently achieved near 100% realization rates

Evaluation Data Collection Methods

Cadmus selected a sample for on-site verification activities using the nonresidential Custom Rebate program database.

This required subdividing Custom projects into three group populations, according to project type: Custom Rebate, New Construction Rebate (NC) building performance, and New Construction Rebate (NC-LPD)[38] lighting power density reduction projects.

Cadmus proposed evaluating a statistically valid sample of projects, based on a 90% confidence interval with a 10% precision level, through on-site visits. For projects selected in the sample, Cadmus engineers thoroughly reviewed rebate application materials. For NC building performance projects selected in the sample, Cadmus evaluated project savings by calibrating to utility usage data the simulation models provided as part of the project documentation.

38 LPD, expressed in watts per square foot, represents the amount of electrical power (watts) used to provide lighting to an area (square foot).

Project and Site Review

The 28 projects visited represented 49% of the program's overall reported savings. Of 115 custom projects, twenty two represented relatively large savings levels (greater than 300,000 kWh per year). Cadmus verified twelve of these twenty two projects.

Cadmus performed two rounds of site visits, in September 2013 and February 2014. The first round consisted of site visits to four unique locations (by account number) and the second consisted of site visits to twenty four unique locations.

Table 81 shows total projects evaluated through site visits, by project category, for each round.

Table 81. Custom 2013 Site Visit Breakdown by Measure Category—By Project ID

Measure Category	Number of Site Visits Conducted			Total Number of Reported Projects
	September	February	Total	
Custom	4	18	22	95
Custom NC	0	6	6	20
Total	**4**	**24**	**28**	**115**

Baseline Assumptions

Baseline assumptions typically involved data obtained on site, and included replaced fixture types and quantities as well as parameters such as original operation hours, pressure settings, and baseline equipment power draws. In some cases, DP&L's third-party engineering firms conducted monitoring to obtain baseline consumption. In such cases, Cadmus verified the operating conditions remained valid on site and used logged data to inform the baseline conditions. When data could not be obtained on site or through project documentation (such as baseline motor efficiencies or fixture wattages), Cadmus used the assumptions provided in the Ohio TRM. For new construction projects, baseline conditions were based on the 2009 International Building Code, which included references to the International Energy Conservation Code and ASHRAE 90.1-2007.

Impact Evaluation Methodology and Findings

Site Verification Visits and Documentation Review

After selecting projects to verify through on-site activities, Cadmus downloaded project documentation from DP&L's administrative website. In preparation for each site visit, Cadmus reviewed documentation and other relevant program data. The review focused on calculation procedures and energy-savings estimate documentation.

On-site visits enabled Cadmus to accomplish four primary tasks:

- Verify the implementation, installation, and characteristics of incented equipment.

- Collect additional detailed equipment data (such as ballast factors) needed to calculate energy savings.
- If applicable, collect available Energy Management Systems data to inform the savings analysis.
- For new construction projects, verify and collect additional building characteristic data to inform the building simulations.

Appendix K: Non-Residential Site Visit Summary provides detailed site-visit findings.

Database Tracking

In addition to reviewing on-site project files, Cadmus conducted a thorough review of DP&L's final tracking database that contained:

- Participating customers that submitted applications in 2010, 2011, and 2012, but did not complete the projects until 2013; and
- All 2013 applications and completed projects.

Engineering Analysis and Savings Verification

Cadmus collected baseline data from the program tracking system, reviewing available documentation for all completed projects (e.g., audit reports, application forms, and invoices), and focusing on energy-saving and demand reduction calculation procedures. The evaluation reviewed the original analyses used to calculate expected savings, and verified the measures' operating and structural parameters (to the extent possible, based on documentation). Specific engineering analysis and saving verification methods that applied are discussed below.

By major measure group, Table 82 and Table 83 summarize verified and adjusted results for the sample.

Table 82. Gross *Ex Ante* Claimed and Adjusted Gross *Ex Post* Savings for Sampled Projects*

Measure	Number of Projects	*Ex Ante* Gross Energy Savings (kWh)	Verified Energy Savings (kWh)	Adjusted Energy Savings (kWh)	Realization Rate
Custom	22	6,820,208	6,654,083	6,654,083	98%
NC	6	1,340,744	1,209,449	1,209,449	90%
Total	**28**	**8,160,952**	**7,863,532**	**7,863,532**	**N/A***

*Program level realization rates are weighted by total measure savings

Table 83. Gross *Ex Ante* Claimed and Adjusted Gross *Ex Post* Demand Savings for Sampled Projects*

Measure	Number of Projects	*Ex Ante* Gross Demand Savings (kW)	Verified Demand Savings (kW)	Adjusted Demand Savings (kW)	Realization Rate
Custom	22	577.30	583.51	583.51	101%
Custom NC	6	600.69	288.56	288.56	48%
Total	**28**	**1177.99**	**872.07**	**872.07**	**N/A***

*Program level realization rates are weighted by total measure savings

Custom Savings

Lighting

Measures included retrofits of existing fixtures, lamps, and ballasts with energy-efficient models. Typically, these retrofits reduced demand. The evaluation assumed fixture operating hours to be the same, pre- and post-retrofit. Measures involved a variety of project types, including those in which:

- Baseline fixtures differed from the deemed approach; or
- The number of removed and installed fixtures differed.
- Nonresidential Rapid Rebates program did not address certain measures (such as linear LEDs).

Cadmus reviewed each project's approved online application for:

- Wattage levels before and after retrofit;
- Hours of operation after retrofit; and
- The number of fixtures affected by the retrofit.

Cadmus field personnel verified the number of fixtures, and adjusted savings based on operating hours and actual fixture types. Cadmus determined appropriate wattage levels through manufacturer specification sheets, Ohio TRM lighting wattage tables, and other published databases.[39]

Cadmus evaluated a lighting project which involved retrofitting older technology fixtures with energy efficient ones. Cadmus reviewed the project documentation submitted by one of DP&L's energy consulting firms. The site received separate rebates for lighting retrofit under the custom program and occupancy sensors installed under the prescriptive program. The custom reported savings calculations appear to have double counted the savings for the occupancy sensor. Cadmus calculated a realization rate of 36% and 91% for the energy and demand savings respectively.

Cadmus evaluated another lighting project that involved replacement of metal halide with LED lamps in a car parking lot. The metal halide fixtures were replaced with two types of LED fixtures with different

[39] See: Including the California *2009 Table of Standard Fixture Wattages*: http://www.sce.com/business/ems/customized-solutions/procedures-manual-archives.htm

wattage ratings. Cadmus found more low wattage LED lamps and calculated the savings for each fixture type separately. Cadmus also found this project was partially implemented and only considered the portion of the project that was incented for savings calculations. DP&L third party consulting firm published a memo and adjusted the original savings accounting for the partial implementation of the project by assuming all LED fixtures were of the same kind. Since the LED fixtures had two different wattage ratings, Cadmus re-calculated savings resulting in a realization rate of 66% for the energy savings estimate.

Air Compressor

Cadmus evaluated five custom air compressor installations, collecting parameters on-site to inform the savings analysis. The evaluation also used pre- and post-metered data provided in the project document to confirm baseline and measure conditions. We found the compressor staging and operating parameters mentioned in the metering report were accurate, however we found lack of consistency in power metering practices. Industry best practices recommend metering all three legs for accurate power measurements. We found on some projects that DP&L third party consulting firms only metered one leg. This method assumes all three legs use the same power as one leg which is not always true especially in older machinery (baseline).

Also, power factor was theoretically calculated for some projects. This is not a recommended practice and metering voltage in addition to current will eliminate this problem.

Motors

In 2013, Cadmus performed on-site verification for two refrigeration ECM fan retrofit and one process specific motor projects.

For one of the projects, Cadmus found the ECM fan retrofit savings to be very conservative. The savings calculation methodology for the report savings had minimal documentation and could not be verified. Cadmus revised them based on unit savings calculated using data from previous year's evaluation where one project had power metering data.[40] Grocery store case loads are fairly similar from site to site, we used the per unit savings results from the 2012 project as a better representation of the savings.

HVAC

Cadmus evaluated one custom HVAC project— Thermal Control Solution (TCS) Radiant heat bands[41]— installed in a manufacturing facility. DP&L contracted with a third-party engineering firm (Go Sustainable Energy) to audit the measures, with the audit including:

- On-site verification;
- Data logging; and

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40 The power metering data was conducted by 'Go Sustainable' in FY 2012 and installed on ECM fans in a grocery store.

41 TCS radiant heat band system uses radiant heat for injection molding machines that goes directly into the barrel, resulting in energy reduction.

- Calibration to typical meteorological data.

Cadmus's audit report and program documentation review did not find discrepancies.

New Construction Projects

In the 2013 program year, thirteen new construction projects received whole building performance incentives. Cadmus visited three sites that represented 48% of the reported savings. Each project's energy savings were based on a TRACE700 computer simulation model, provided for documentation. Prior to conducting a site visit, Cadmus reviewed the major model inputs affecting energy savings. On site, we verified the as-built model's major inputs and/or updated these, based on findings. There were no substantial differences identified between the as-built model, report findings from either of the third-party engineering firms, and the verification site visits. Cadmus concludes Heapy Engineering and Go Sustainable had appropriately modeled and estimated the savings with the best available data at that time. Cadmus evaluated these projects by calibrating the TRACE700 simulation models using the utility billing data[42]. As best fit possible, the model's monthly consumption was aligned to the monthly billing usage which was achieved by adjusting equipment schedules, process or base loads, and equipment characteristics. Cadmus had the benefit of billing data to refine the energy models where the third-party engineering firms were limited to predict the actual kWh and kW usage.

Analysis of the simulation models resulted in a realization rate of 101% for energy and 48% for demand savings. Cadmus found one project exhibited higher energy savings than reported, while the other two exhibited fewer savings. In each case, demand savings proved lower than originally claimed based on the billing data and adjustments to the model simulation based on annual building occupancy schedules verified during the site visit.

The largest savings project (approximately 456,000 kWh) resulted in a 97% realization rate for energy and 37% for demand, based on the billing data provided for the site. This project involved construction of a new school. Cadmus compared the peak demand (kW) in the original model with the utility billing data and found the model predictions were 40% higher than actual billing data. Hence the model was over-predicting the peak loads. This is a common issue with simulation models that are built before buildings are commissioned and billing data is available. Also, the outdoor air quantities for the HVAC system were revised to 15 cfm/person. Other minor adjustments included lighting and occupancy hourly schedules.

The second largest project (approximately 416,000 kWh) resulted in 110% realization rate for energy and 65% for demand. The model was calibrated to the annual billing data and minor iterative adjustments were made to plug loads.

42 Historical monthly billing data was provided by DP&L. The monthly billing data contained at least 12 months of data in all three projects.

The third new construction site that Cadmus visited, exhibited a demand realization rate of 59%. The demand (kW) for this project was primarily driven by a supply fan. The fan did not operate on a fixed schedule. Without a predictable schedule, variations in saving predictions can be expected.

New Construction Lighting Power Density Savings

The NC LPD reduction for interior lighting projects required thorough, room-by-room audits of lighting systems. The watts-reduced value, derived from LPD in watts per square foot, was calculated as savings for new lighting, as obtained from baseline LPD values listed in the ASHRAE 90.1-2007, Space-by-Space Method, for various building types. We collected lamp wattage and room square footage for each room type. If Cadmus could not access all rooms at a facility, we compared a sample of rooms to project documentation.

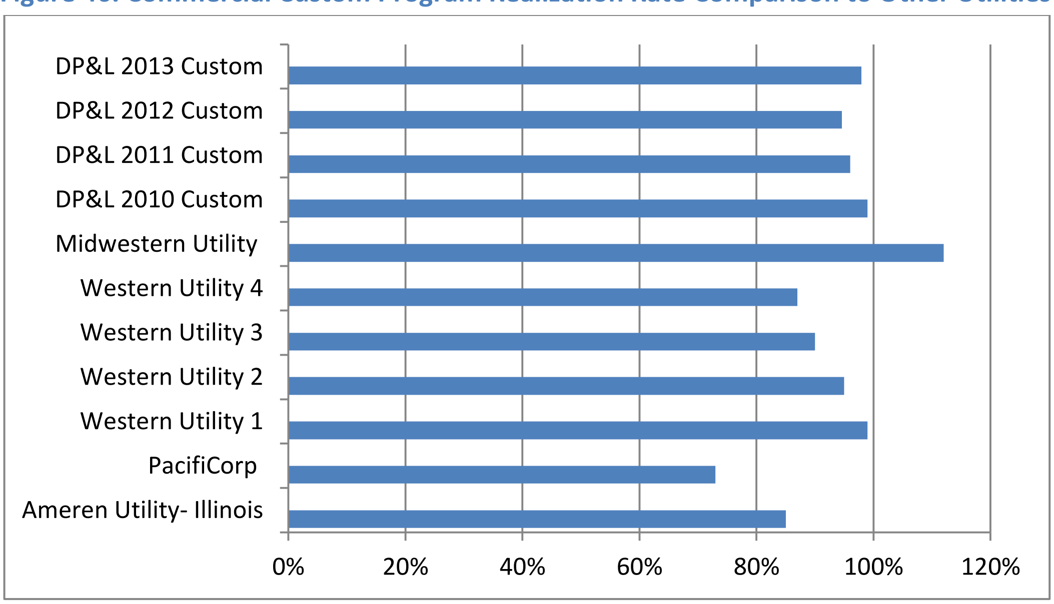
Seven projects participated in the NC LPD program in 2013. Cadmus verified three projects by conducting site visits and reviewing project documentation. For the largest project that represented 27% of the total program savings, we found discrepancies in the savings estimates. We reviewed the project documentation and found a mathematical error in the reported savings calculation. Due to this error the realization rate for the project dropped to 66% for energy and 69% for demand savings.

For another LPD project, Cadmus found discrepancy between reported (3 lamp) and verified (4 lamp) type of lighting fixture. We calculated 46% and 50% realization rates for energy and demand savings.

Realization Rate Comparison

Cadmus found evaluated energy realization rates for the nonresidential Custom Rebate program comparable to evaluation findings from other utility-sponsored custom programs across the country (as shown in Figure 46).

Figure 46. Commercial Custom Program Realization Rate Comparison to Other Utilities



DP&L's program exhibited a 96% realization rate. Realization rates from evaluations of other utility-sponsored custom programs across the country ranged from 87% to 112%, averaging 98%. Realization rates tend to be driven by the accuracy of a utility's engineering assumptions for its programs. For any one program, a 100% realization rate is considered the best scenario, as it indicates energy savings estimates neither overstate nor understate achievements made, reducing program staff's burdens for future program year planning. The 2013 DP&L evaluation results fell within this range

Process Evaluation Methodology and Findings

Cadmus used the approaches detailed below in evaluating the 2013 program.

Program Design

As shown in Table 84, program participation increased from 2009 through 2013 except a slight decrease in 2012. Table 85 provides greater detail regarding the frequency of measure types installed in 2013.

Table 84. Program Participation by Year

Program Year	Number of Individual Custom Projects
2009	20
2010	65
2011	93
2012	86
2013	115

Table 85. Frequency of Custom Measures

Measure Type	Frequency
Custom	130
NC*	20

*This includes 13 building performance and 7 LPD projects

In general, 2013 program measure offerings remained consistent with 2012 offerings. The larger number of participants for 2013 over 2012 resulted in a 21% increase of reported energy impacts. However, the average savings per project did drop by 10%.

Channel Partner Survey

As noted in the Prescriptive Rebate section, Cadmus interviewed a sample of DP&L Channel Partners that promote the Custom and prescriptive rebate programs to determine the program's effectiveness and to develop suggestions to better program offerings. This survey sought to identify major challenges in increasing program participation and ways the current incentives address these challenges.

Cadmus asked some Custom program-specific questions during the Channel Partner interviews to determine how DP&L Channel Partners perceive and understand the program. Summaries of Channel Partner responses follow with more detail provided above in the prescriptive program section.

DP&L currently markets the Custom rebate program using customer testimonials and application-specific data. When asked about new strategies to promote the program, some suggested clarifying or defining custom rebates and providing literature to reduce the program's case-by-case nature. This can prove challenging as Custom projects are very site/application specific, although, typical results can be averaged for more common measures, such as air compressors, and lighting by space type.

When asked to suggest improvements to the current rebate program offerings, Channel Partners recommended the following:

- "Consider more creative custom options through new and innovative programs, renewable energy, and an audit program."
- "Improve custom incentives for EMS."

Recommendations

Based on the preceding findings, Cadmus offers the following recommendations for program improvements:

- **Develop a comprehensive power metering strategy for compressed air systems.** Although we agree that motors are typically a balanced load, it's strongly recommended to meter all three legs of air compressors since it's fairly common to come across unbalanced loads especially on relatively older equipment. Also, metering voltage in addition to current draw will provide much more accurate consumption results and will eliminate the need for theoretically calculating power factor rates for each relevant compressor.

  If feasible make a consistent analysis protocol throughout the whole program. This includes the power metering strategy (number of legs metered) and power metering period (a minimum of two weeks are strongly recommended).

- **Revise bonus incentive structure.** Similar to the prescriptive program Channel Partner interviews, Cadmus found the bonus incentive program structure aimed at encouraging project participation has room for improvement. Half of the Channel Partners interviewed suggested that the bonus incentive did not change their project recruitment practices. These Channel Partners also suggested that a portion of the incentive should be directed towards the customer to encourage program participation.

Cost-Effectiveness

Cost-Benefit Scenarios

The primary method used to determine program and portfolio cost-effectiveness is the TRC test. The TRC derives from the ratio of lifecycle benefits of the portfolio over lifecycle incremental costs. The TRC determines whether energy efficiency proves more cost-effective overall than supplying energy. The TRC does not provide the necessary information to determine whether the portfolio or program is cost-effective from the perspective of an individual program participant, DP&L, or ratepayers. Therefore, Cadmus calculated additional tests, based on the California Standard Practice Manual for the portfolio of programs and for each individual program implemented in 2013. Those tests, in addition to the TRC, are: the Societal Cost Test (SCT), the Utility Cost Test (UCT) (also known and the Program Administrator Cost Test [PAC]), the Ratepayer Impact Measure (RIM) Test, and the Participant Cost Test (PCT).

We did not include non-energy benefits in this analysis; therefore, the SCT is only differentiated from the TRC by the discount rate.

The SCT uses a 10-year Treasury bill (T-bill) rate of 3.31% to discount future benefits.[43] The 10-year T-bill rate used as a discount rate for the SCT recognizes benefits accrue to society in general rather than solely to a utility or participants. Generally, utilities experience high weighted capital costs, reflecting the cost of borrowing money and the associated risk. For society as a whole, the risk level is low or almost nonexistent, making the T-bill rate more appropriate for a total resource perspective.

The UCT is a valuation of the costs and benefits directly accrued by the utility. In some ways, the UCT provides for a more even comparison between demand and supply side resources as they both include the utility cost only.

The RIM, a valuation of program net benefits as perceived by ratepayers, is measured by: electric avoided costs; incentive costs (i.e., utility measure costs); administrative costs associated with the program; and lost revenues (equal to participant energy savings benefits).

Table 86 shows discount rate applied to each benefit-cost test.

43 The SCT discount rate was updated for the program year 2013: Discount rates of 2.68% and 3.56% were used in 2012 and 2011, respectively.

Table 86. Discount Rates

Benefit-Cost Test	Discount Rate
TRC	8.78%
SCT	3.31%
UTC	8.78%
RIM	8.78%
PCT	10.00%

Program Benefit Components

Benefits counted through the TRC, UCT, RIM, and SCT include:

- The full value of time and seasonally differentiated avoided generation costs;
- Avoided transmission and distribution costs; and
- Avoided capacity costs.

For each energy-efficiency measure included in a program, Cadmus adjusted the hourly (8,760) system-avoided costs by the hourly load shape of the end use affected by the measure, capturing the full value of time and seasonally differentiated impacts of the measure.[44]

Table 87 shows five years of avoided costs estimates starting in 2013.[45]

Table 87. Summary of Avoided Costs

Year	Average Hourly Energy Cost ($/MWh)	Capacity ($/kW)
2013	$34.13	$7.72
2014	$35.38	$25.07
2015	$36.93	$47.30
2016	$38.75	$51.31
2017	$40.06	$57.84

Ex-ante claimed energy and demand savings were used to perform the benefit-cost calculations. In previous evaluation years, DP&L's cost-effective results reflected adjusted gross savings results. However, *ex-ante* values are used for Ohio compliance purposes. In general, there is not much difference between *ex-ante* and adjusted gross savings.

We did not factor non-energy benefits, such as water savings, into the calculation. We did apply line loss—the percentage of energy lost during transmission and distribution—to measure level savings that reflect total savings from the point of generation. Table 88 specifies line-loss assumptions.[46]

[44] As hourly end-use load shapes were unavailable for the DP&L service area, Cadmus developed them using available data from similar regions, adjusting for weather conditions in DP&L's service territory.

[45] Appendix H includes a detailed review of the cost-effectiveness analysis inputs.

Table 88. Line Loss Assumptions Used in Cost-Effectiveness Calculations

Sector	Energy Line Losses	Demand Line Losses
Residential	7.37%	8.37%
Commercial/Industrial	4.06%	5.21%

Program Cost Components

For the analysis' cost component, we considered incremental measure costs or project costs depending on the data available and direct utility costs.

Incremental measure costs are incremental expenses associated with installation of energy-efficiency measures, and ongoing operation and maintenance costs, where applicable. These costs include the incentive as well as the customer contribution. Cadmus used data provided by DP&L as well as secondary sources to calculate the incremental cost for each measure within each program.

Utility costs include any customer payments, and expenses associated with: program development; marketing; delivery; operation; and evaluation. Table 89 summarizes DP&L's implementation and administrative costs. All utility costs were provided by DP&L.

Table 89. Implementation and Administrative Costs

Cost Category	Level	Description
Implementation Vendor and Marketing Costs	Program Level	Incremental costs associated with performing program implementation tasks, including customer service, application processing, marketing, customer outreach, etc.
Incentive Costs	Program Level	Rebates and incentives paid to customers by DP&L.
Direct Measure Costs	Program Level	Costs associated with paying for program measures, including measures installed through the Low Income Weatherization program.
DP&L Staff Costs	Program Level/ Portfolio Level	Costs to administer energy-efficiency programs, including DP&L's fully-loaded incremental personnel costs. Activities associated with market research outside of EM&V.
External Vendor Evaluations	Portfolio Level	Activities associated with the determination and evaluation of current and potential energy-efficiency programs. Activities include: benefit-cost ratio analysis, impact and process analysis, cost per kWh analysis, customer research, and all other analyses necessary for program evaluation.
Education, Awareness, and Building and Market Transformation	Portfolio Level	Cost to increase awareness of energy efficiency.

[46] The line losses in Table 88 represent the percentage loss in energy and demand from the point of generation to the meter.

In terms of program specific incremental costs, for the Prescriptive Rebates program, Cadmus relied on the Ohio TRM and the Database for Energy Efficient Resources (DEER) database, as well as other secondary sources to calculate the incremental cost for several measures such as lighting, HVAC units and motors.

For the Custom and Nonresidential Prescriptive programs, some projects had missing incremental cost data. As such, the ratio between reported gross kWh and incremental measure cost for projects *with* data was applied to projects without incremental costs to determine total incremental costs for cost-effective reporting.

For the new construction components of the nonresidential Custom Rebate program, as well as the Self-Directed Mercantile program, Cadmus relied on secondary research to calculate incremental costs. Secondary research confirms that the incremental cost of constructing a LEED Certified school is 1.65% and 2% for non-school “green” buildings. Thus Cadmus applied these percentages to total project costs to calculate a proxy incremental cost for new construction projects.

Energy Independence and Security Act of 2007 Adjusted Baseline and Avoided Maintenance Costs

Cadmus accounted for Energy Independence and Security Act of 2007 (EISA) for the commercial and residential lighting applications. The EISA efficiency standards prohibit production (but not sale) of certain incandescent bulbs. As described in the Residential Lighting section above, despite the new standards, most stores selling these bulbs before the efficiency standards took place continued to sell them afterwards, due to existing inventories. The continued availability of these bulbs presents implications for the baseline of efficient bulbs sold. Therefore, the cost-effectiveness results take into account these “shifting” baselines for years 2013, 2014, and 2015 in DP&L’s Residential Upstream Lighting and Commercial Prescriptive programs, as well as Low Income and Be E^3 Smart.

Additionally, Cadmus included avoided maintenance costs for the above lighting measures. These costs are the average bulb price of the baseline lighting types; because the energy efficient lighting installed through DP&L’s programs have longer measure lives than the comparative baseline incandescent and halogens, customers no longer have to purchase new bulbs every few years. Therefore, these prices represent the “avoided maintenance cost” to the customer and are accordingly modeled as benefits in the TRC, SCT, and PCT.

Overall Portfolio Cost-Effectiveness Results

Full Portfolio Results

Table 90 summarizes energy savings, demand impacts, and costs for DP&L’s entire energy-efficiency portfolio, utilizing ex ante savings. The portfolio includes:

- DP&L's five residential sector programs: Lighting, Appliance Recycling, Low-Income Weatherization, Heating and Cooling Rebate and HVAC Diagnostic & Tune-Up, and Be E^3 Smart;
- DP&L's three nonresidential programs: Prescriptive Rebate, Custom Rebate, and Self-Directed Mercantile;
- Portfolio costs for education and awareness; and
- EM&V costs.

The portfolio passes the TRC test with a benefit-cost ratio of 2.00. All other tests have a benefit-cost ratio above 1.0, except for the RIM test. Most programs do not pass the RIM test due to the adverse effects of savings on revenue, an important component of the RIM test. Table 91 shows benefits, costs, and benefit/cost ratios for each test.

Table 90. DP&L Energy Impacts and Costs: 2013 Portfolio

Benefit/Cost Component	2013 Values
Gross Savings (MWh)	169,118
Capacity Savings (kW)	30,101
Total TRC Costs	$34,603,116
Direct Participant Costs	$29,162,309
Direct Utility Costs	$14,251,983
Incentives	$8,616,920
Direct Measure Costs	$963,805
DP&L Staff Costs	$867,146
Implementation Vendor & Marketing	$2,554,161
External Vendor Evaluations	$767,385
Education, Awareness Building & Market Transformation	$482,565

Table 91. DP&L Cost Effective Test Results: 2013 Portfolio

Cost Effective Test	Present Value Benefits	Present Value Costs	Benefit-Cost Ratio
Total Resource Cost	$69,226,838	$34,603,116	**2.00**
Utility Cost	$61,656,925	$14,251,983	**4.33**
Participant Cost	$133,219,181	$29,162,309	**4.57**
Ratepayer Impact Measure	$61,656,925	$136,879,993	**0.45**
Societal Cost	$92,148,142	$34,898,522	**2.64**

Residential Portfolio Results

Table 92 summarizes energy savings, demand impacts, and costs for DP&L's residential programs. The residential portfolio proves cost-effective overall, with a TRC of 2.82. The Lighting program is the most cost-effective program in the portfolio, with a benefit/cost ratio of 9.75. The HVAC Diagnostic & Tune-Up program and the Heating and Cooling Rebate program did not pass the TRC test as stand-alone programs. Additionally, the Residential Low-income Weatherization program did not pass the TRC test; however, this program provides numerous non-energy benefits, such as better health and safety for low-income customers.

As noted above, avoided maintenance costs are included in the residential portfolio's Lighting, Low Income, and Be E^3 Smart programs. Because the Lighting program contributes to the majority of the residential portfolio's net benefits, the TRC ratio *without* these avoided maintenance costs were modeled to compare results. Without the avoided maintenance costs, the Lighting program's TRC ratio is 6.94.

A couple notes regarding Table 92.

- Federal incentives are available to customers who participate in the Heating and Cooling Rebate program. These federal incentives are subtracted from the program's TRC costs, but added to PCT benefits.
- The incentives for the Appliance Recycling Program are treated as an administration/marketing cost and are therefore included in the TRC test.
- Total energy and demand savings may not match the executive summary due to rounding.

Table 92. Residential Portfolio

Benefit/Cost Component	Lighting	HVAC Diagnostic & Tune-Up	Heating and Cooling Rebate*	Appliance Recycling**	Low Income	Be E^3 Smart	Total***
Gross *Ex Ante* Savings (MWh)	69,388	90	6,848	3,095	1,249	3,647	84,316
Ex Ante Capacity Savings (kW)	8,292	13	1,949	494	222	229	11,200
Total TRC Costs	$2,567,623	$149,830	$6,235,797	$431,566	$1,107,264	$217,833	$10,709,913
Direct Participant Costs	$2,070,534	$37,975	$5,949,824	$0	$0	$0	$8,058,333
Direct Utility Costs	$2,642,596	$131,495	$1,840,464	$431,566	$1,107,264	$217,833	$6,371,218
Incentives	$2,145,507	$19,640	$1,259,085	$101,150	$0	$0	$3,525,382
Direct Measure Costs	$0	$0	$0	$0	$885,507	$78,298	$963,805
DP&L Staff Costs	$50,890	$23,716	$43,480	$36,616	$42,270	$16,631	$213,603
Implementation Vendor & Marketing	$446,199	$88,139	$537,899	$293,800	$179,487	$122,904	$1,668,427
Benefit-Cost Ratios							
TRC							
Present Value Benefits	$25,024,556	$18,166	$2,955,152	$941,343	$470,188	$753,597	$30,163,002
Present Value Costs	$2,567,623	$149,830	$6,235,797	$431,566	$1,107,264	$217,833	$10,709,913
Benefit-Cost Ratio	**9.75**	**0.12**	**0.47**	**2.18**	**0.42**	**3.46**	**2.82**
Utility							
Present Value Benefits	$17,824,798	$18,166	$2,955,152	$941,343	$441,481	$692,652	$22,873,593
Present Value Costs	$2,642,596	$131,495	$1,840,464	$431,566	$1,107,264	$217,833	$6,371,218
Benefit-Cost Ratio	**6.75**	**0.14**	**1.61**	**2.18**	**0.40**	**3.18**	**3.59**
Participant							
Present Value Benefits	$56,314,011	$70,036	$7,732,285	$2,535,296	$1,039,504	$2,158,633	$69,849,764
Present Value Costs	$2,070,534	$37,975	$5,949,824	$0	$0	$0	$8,058,333
Benefit-Cost Ratio	**27.20**	**1.84**	**1.30**	**-**	**-**	**-**	**8.67**
RIM							
Present Value Benefits	$17,824,798	$18,166	$2,955,152	$941,343	$441,481	$692,652	$22,873,593
Present Value Costs	$51,665,240	$182,925	$8,363,180	$2,949,458	$2,161,599	$2,368,437	$67,690,839
Benefit-Cost Ratio	**0.35**	**0.10**	**0.35**	**0.32**	**0.20**	**0.29**	**0.34**
Societal							
Present Value Benefits	$30,846,213	$20,181	$4,163,026	$1,128,756	$626,293	$863,548	$37,648,016
Present Value Costs	$2,567,623	$149,830	$6,531,203	$431,566	$1,107,264	$217,833	$11,005,319
Benefit-Cost Ratio	**12.01**	**0.13**	**0.64**	**2.62**	**0.57**	**3.96**	**3.42**

Nonresidential Portfolio Results

A summary of the energy savings, demand impacts, and costs for DP&L's commercial and industrial programs are reported in Table 93. The nonresidential portfolio is cost-effective overall, with a TRC of 1.74.

Self-Directed Mercantile proved not cost effective from a TRC perspective in 2013. Four new construction projects, with total construction costs of over $294,000,000, significantly impacted the results.

Table 93. Nonresidential Portfolio

Benefit/Cost Component	Prescriptive Rebates	Custom Rebate	Self-Directed Mercantile	Total*
Gross Ex Ante Savings (MWh)	59,238	16,816	8,748	84,802
Ex Ante Capacity Savings (kW)	11,006	3,432	4,463	18,901
Total TRC Costs	$7,175,498	$6,252,685	$9,050,703	$22,478,886
Direct Participant Costs	$6,505,908	$5,681,050	$8,917,018	$21,103,976
Direct Utility Costs	$3,589,249	$1,924,769	$952,431	$6,466,448
Incentives	$2,919,659	$1,353,134	$818,745	$5,091,538
Direct Measure Costs	$0	$0	$0	$0
DP&L Staff Costs	$251,545	$165,243	$72,388	$489,176
Implementation Vendor & Marketing	$418,045	$406,392	$61,298	$885,734
Benefit-Cost Ratios				
TRC				
Present Value Benefits	$25,349,624	$8,337,413	$5,376,799	$39,063,835
Present Value Costs	$7,175,498	$6,252,685	$9,050,703	$22,478,886
Benefit-Cost Ratio	**3.53**	**1.33**	**0.59**	**1.74**
Utility				
Present Value Benefits	$25,069,120	$8,337,413	$5,376,799	$38,783,331
Present Value Costs	$3,589,249	$1,924,769	$952,431	$6,466,448
Benefit-Cost Ratio	**6.98**	**4.33**	**5.65**	**6.00**
Participant				
Present Value Benefits	$42,458,914	$14,148,973	$6,761,530	$63,369,417
Present Value Costs	$6,505,908	$5,681,050	$8,917,018	$21,103,976
Benefit-Cost Ratio	**6.53**	**2.49**	**0.76**	**3.00**
RIM				
Present Value Benefits	$25,069,120	$8,337,413	$5,376,799	$38,783,331
Present Value Costs	$45,086,514	$15,455,177	$7,233,146	$67,774,837
Benefit-Cost Ratio	**0.56**	**0.54**	**0.74**	**0.57**
Societal				
Present Value Benefits	$35,518,767	$11,539,162	$7,442,197	$54,500,126
Present Value Costs	$7,175,498	$6,252,685	$9,050,703	$22,478,886
Benefit-Cost Ratio	**4.95**	**1.85**	**0.82**	**2.42**

*Total energy and demand savings may not match the executive summary due to rounding.

4 kV to 12 kV Distribution Project

In a project spanning multiple years, DP&L converted approximately 205 miles of its 4 kV distribution system to 12 kV, reducing the current flowing through its system by roughly two-thirds. As losses are proportional to the square of current, the affected conductors exhibit kW and kWh transmission loss reduction on the order of 8/9 or 89%. DP&L began this conversion in 2009.

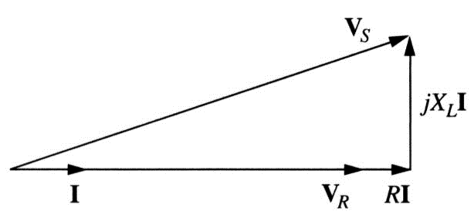
This section reviews and calculates the savings from 119 miles of transmission lines, and provides Cadmus' calculations, assumptions, and estimated peak demand and energy loss reductions.

Technical Assumptions

To calculate peak demand and energy losses, Cadmus followed standard savings equations for short transmission lines (less than 50 miles and with voltage less than 20 kV). Due to relatively short line lengths and low voltages, Cadmus assumed small and therefore neglected capacitance effects, and the equation only factored in the resistance portion of the impedance. Cadmus reviewed reactance values for all conductor types, but did not use these in savings calculations. We assumed equivalent sending and receiving end currents:

$$I_s = I_R$$

Cadmus assumed a 0.95 power factor across the conductors affected by the conversion and did not obtain specific power factors for the affected conductors. A value of 0.95, however, served as a conservative assumption, meaning the actual power factor could be lower and actual savings higher.



Cadmus used impedance and resistance values based on an 80°C conductor temperature and a 35°C (95°F) ambient temperature.

The analysis did not include transformer losses, as specific details about transformers involved in the voltage conversion were not readily available. Cadmus suspects, however, that savings would increase on the order of 5%, if considered.

Based on DP&L experience, the study estimated the single-phase current at 50% of the three-phase current.

Review of Calculations

Current remains the main parameter of interest in determining savings, with peak current estimated using the following information:

- Known peak MW from SCADA [47];
- The summation of kVA from all connected transformers of the lines converted to 12 kV; and
- The summation of all the connected transformer KVA on the entire circuit:

$$\text{MW}^{48} = \text{Peak MW}\frac{\text{kVA converted lines}}{\text{kVA entire circuit}}$$

To determine peak current, MVA is divided by voltage, according to the circuit's configuration:

- Single-phase: 2.4 kV (old) or 7.2 kV (new) total voltage.
- Three-phase: 4.16kV (old) or 12.47 kV (new) total voltage.

The following equation calculates peak power loss:

$$P_{\text{loss}} = 3 \times I^2 R$$

To determine resistance (R), one multiplies the transmission line length by the unit impedance of the conductor type (though impedance varies for single-phase and three-phase configurations).

When directly estimating peak loss for 4kV and 12kV, the peak power loss reduction converts to average power loss and total energy consumption for the entire year:

$$\text{Energy Loss Reduction} = \text{Peak Loss Reduction} \times 8760 \text{ hrs} \times \text{Average Circuit Load Factor}$$

The load factor derives from the average load for each hour for an entire year, divided by the peak hourly load from the year, as based on 365 days of SCADA interval data. DP&L uses a circuit load factor as the average of all circuits converted to 12kV rather than the individual load factor of the circuit converted. Savings vary significantly between circuits; so it proves technically more accurate to use the individual load factor of each circuit.

Cadmus calculated savings using individual line load factors and reviewed several hourly interval data sets to determine average and peak power values matched the summary values used to calculate savings.

Results

Table 94 shows calculated savings by Line # (conversion project). Most updated energy savings remained close to original estimates savings, except for a couple of lines. Specifically:

[47] Supervisory Control and Data Acquisition – data acquisition system used to transmit power and energy use data

[48] The DP&L calculation tool calls this ratio MVA, but it is actually MW with a unity power factor.

- "Line 25" – the load factor for that line is reported at 7%, while the average of the system used in DP&L's calculations is 44%.
- "Line 59" – the load factor was reported at 27%, while DP&L's calculations used a system average of 44%. Peak loss reduction savings did not change.

Overall, estimated savings increased due to use of 0.95 as a power factor. Cadmus anticipates that including transformer savings would increase the savings by 5%.

Table 94. 4kV to 12kV 2012 Project Savings

Line	Conductor Feet Converted	Peak KW Loss at 4kV	Peak KW Loss at 12kV	Peak Loss Reduction (kW)	DPL Estimated Savings (kWh)	Savings with Updated Load Factor (kWh)
Line 1	9,877	75.7	8.4	67.3	250,633	272,890
Line 2	2,493	0.8	0.1	0.7	2,563	2,882
Line 3	1,867	0.7	0.1	0.6	2,174	2,444
Line 4	2,827	1.9	0.2	1.7	6,262	7,041
Line 5	1,854	0.3	0.0	0.3	967	1,187
Line 6	3,285	0.4	0.0	0.4	1,412	1,732
Line 7	3,262	1.8	0.2	1.6	5,945	8,756
Line 8	15,955	716.0	79.6	636.4	2,369,410	2,625,385
Line 9	8,749	105.6	11.7	93.8	349,308	387,045
Line 11	1,303	0.9	0.1	0.8	3,122	3,460
Line 12	2,542	1.2	0.1	1.1	3,975	4,989
Line 13	12,284	338.4	37.6	300.8	1,119,944	1,373,463
Line 14	1,957	0.9	0.1	0.8	3,013	3,813
Line 15	25,449	469.6	52.2	417.4	1,554,097	1,938,716
Line 16	12,147	615.7	68.4	547.3	2,037,338	2,243,598
Line 17	10,260	57.0	6.3	50.7	188,664	223,778
Line 18	12,810	32.4	3.6	28.8	107,223	97,686
Line 19	11,524	109.8	12.2	97.6	363,378	396,983
Line 20	10,097	160.0	17.8	142.2	529,358	654,443
Line 21	2,614	2.1	0.2	1.9	6,949	8,591
Line 22	5,895	272.8	30.3	242.4	902,593	1,029,916
Line 25	9,719	165.1	18.3	146.7	565,524	104,641
Line 26	15,051	353.5	39.3	314.2	1,211,106	1,415,665
Line 27	6,624	49.3	5.5	43.8	168,786	186,874
Line 28	13,329	140.6	15.6	125.0	481,636	578,931
Line 29	3,872	10.1	1.1	9.0	34,545	40,380
Line 30	2,866	1.7	0.2	1.5	5,713	6,678
Line 31	3,966	28.7	3.2	25.5	98,296	114,899
Line 32	3,039	3.4	0.4	3.0	11,611	13,572
Line 33	3,943	28.4	3.2	25.2	97,253	113,679
Line 34	5,280	18.1	2.0	16.1	62,032	72,509
Line 35	4,523	60.0	6.7	53.3	205,592	240,317
Line 36	15,210	260.6	29.0	231.6	892,860	988,544
Line 37	13,923	123.3	13.7	109.6	422,502	468,146
Line 38	7,522	23.6	2.6	20.9	80,713	89,432
Line 39	18,176	336.1	37.3	298.7	1,151,373	1,275,759

Line	Conductor Feet Converted	Peak KW Loss at 4kV	Peak KW Loss at 12kV	Peak Loss Reduction (kW)	DPL Estimated Savings (kWh)	Savings with Updated Load Factor (kWh)
Line 40	10,888	158.2	17.6	140.6	541,915	521,590
Line 41	16,380	499.7	55.5	444.2	1,712,094	1,345,061
Line 42	6,505	67.2	7.5	59.7	230,218	274,652
Line 43	10,520	127.2	14.1	113.1	435,966	475,410
Line 44	1,552	35.7	4.0	31.8	122,438	169,530
Line 45	5,948	4.71	0.52	4.18	16,122	16,700
Line 46	4,549	4.00	0.44	3.56	13,708	14,199
Line 47	7,606	107.23	11.91	95.32	367,386	330,185
Line 48	6,973	19.06	2.12	16.94	65,298	67,801
Line 49	3,461	2.16	0.24	1.92	7,408	6,658
Line 50	12,108	62.87	6.99	55.89	215,411	249,771
Line 51	9,647	40.34	4.48	35.86	138,220	143,520
Line 52	7,854	164.30	18.26	146.05	562,924	584,509
Line 53	15,164	165.11	18.35	146.77	565,696	720,365
Line 54	10,466	154.32	17.15	137.17	528,724	673,284
Line 55	6,676	5.79	0.64	5.15	19,836	35,101
Line 56	18,491	60.47	6.72	53.75	207,176	366,615
Line 57	9,137	951.84	105.76	846.08	3,261,126	3,762,632
Line 58	13,473	75.88	8.43	67.45	259,979	460,055
Line 59	26,996	1,154.08	128.23	1,025.85	3,954,031	2,669,395
Line 60	-	-	-	-	-	-
Line 61	-	-	-	-	-	-
Line 62	14,867	27.58	3.06	24.52	94,508	167,240
Line 63	5,296	4.06	0.45	3.61	13,926	24,644
Line 64	42,371	690.97	76.77	614.20	2,367,358	2,621,055
Line 65	3,910	9.97	1.11	8.86	34,168	36,842
Line 66	2,266	1.69	0.19	1.50	5,778	5,039
Line 67	1,676	0.61	0.07	0.55	2,102	2,267
Line 68	14,935	158.03	17.56	140.47	541,416	533,752
Line 69	6,241	32.87	3.65	29.22	112,620	145,819
Line 70	9,967	37.47	4.16	33.31	128,375	186,165
Line 71	3,044	3.01	0.33	2.68	10,312	8,993
Line 72	3,352	8.76	0.97	7.78	29,998	26,163
Line 73	11,236	272.21	30.25	241.96	932,614	914,748
Line 75	3,070	1.95	0.22	1.74	6,695	6,935
Line 76	5,676	31.84	3.54	28.30	109,085	112,993
Line 77	2,316	1.72	0.19	1.53	5,882	6,093
Line 78	9,069	66.60	7.40	59.20	228,186	212,154
Total	**629,780**			**8,689**	**33,146,569**	**34,896,759**

Appendix A: Measure-Level Savings Table

Program	Measure	Verified Gross Savings		Adjusted Gross Savings	
		kWh	kW	kWh	kW
Residential					
Lighting	CFL	69,388,980	8,299	70,936,412	7,503
Appliance Recycling	Recycled Refrigerator	2,541,319	404	2,092,943	336
	Recycled Freezer	553,185	91	463,058	71
Low-Income	CFM Reduction	31,587	0	31,587	0
	Attic Insulation	70,763	1	70,763	1
	Compact Fluorescent Light Bulbs	292,559	44	246,776	26
	Duct Insulation	203	0	203	0
	Duct Sealing	11,120	0	11,120	0
	Faucet Aerator	7,963	1	16,725	2
	Foundation Wall Insulation	2,581	0	2,581	0
	Freezer Replacement	42,824	6	42,824	6
	Heat Pump Replacement	3,245	1	3,245	1
	HVAC Tune Up	933	0	933	0
	LED 0.5 W Nightlight	274	0	710	0
	Water Heater Pipe Insulation	1,317	0	1,317	0
	Refrigerator Replacement	814,401	125	814,401	125
	Energy-efficient Showerhead	22,426	3	37,504	2
	Smart Strip Power Outlet	1,457	0	1,457	0
	Wall Insulation	3,226	0	3,226	0
	Water Heater Temperature Setback	462	0	462	0
	Water Heater Wrap	766	0	766	0
HVAC Rebate	ER AC 14/15 SEER	1,137,082	598	1,092,205	444
	ER AC 16+ SEER	976,124	574	970,304	394
	NC AC 14/15 SEER	39,104	37	29,062	15
	NC AC 16+ SEER	13,965	11	13,930	6

Program	Measure	Verified Gross Savings		Adjusted Gross Savings	
		kWh	kW	kWh	kW
	RP AC 14/15 SEER	6,932	8	6,863	4
	RP AC 16+ SEER	10,622	8	10,313	4
	ER GSHP 16/18 EER	222,447	11	219,842	11
	ER GSHP 19+ EER	481,409	32	480,848	32
	NC GSHP 16/18 EER	222,580	12	225,171	12
	NC GSHP 19+ SEER	124,189	9	127,046	10
	RP GSHP 16/18 EER	35,054	2	34,917	2
	RP GSHP 19+ EER	53,069	4	53,704	4
	ER HP 14/15 SEER	1,378,017	233	1,327,035	172
	ER HP 16+ SEER	1,181,381	258	1,185,074	160
	NC HP 14/15 SEER	31,767	9	29,366	4
	NC HP 16+ SEER	27,491	7	27,105	3
	RP HP 14/15 SEER	28,047	7	26,015	4
	RP HP 16+ SEER	18,017	5	18,902	2
	NC MS AC 16+ SEER	4,433	5	1,529	2
	RP MS AC 16+ SEER	168	0	78	0
	NC MS HP 16+ SEER	246,489	27	217,824	12
	ECM with New AC	366,373	0	437,381	0
	ECM	242,833	93	269,108	63
	AC Tune-Up	33,501	11	33,501	11
	HP Tune-Up	56,663	2	56,663	3
Be E3 Smart	CFL (two 13W)	657,530	69.546	731,453	77.365
	LED Night Light	41,341	0	41,341	0
	Bathroom Faucet Aerator (2 per kit)	414,819	23.604	316,946	21.694
	Kitchen Faucet Aerator	654,270	37.230	654,270	44.783
	Efficient Showerhead	1,262,134	64.684	1,239,754	64.684
Non-Residential					
Non-Residential Prescriptive	HVAC	5,210,631	1,236	6,176,724	1,162

Program	Measure	Verified Gross Savings		Adjusted Gross Savings	
		kWh	kW	kWh	kW
	Lighting	45,962,353	8,449	50,398,596	9,180
	Motors	8,083,681	1,354	7,906,435	1,361
	Compressed Air	978,110	66	718,100	63
	Other	11,080	4	8,428	4
Non-Residential Custom	Custom	16,518,498	3,126	16,466,532	2,416
Total		**160,523,796**	**25,368**	**166,331,379**	**23,844**

Appendix B: *Ex Ante* Measure-Level Savings

Program	Measure	Verified Participation Count	Ex Ante Per Unit kWh Impact	Ex Ante Per Unit kW Impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings
Residential						
Lighting	CFL	1,585,049	43.78	0.01	69,388,980	8,299
Appliance Recycling	Refrigerator Replacement	2,243	1,133.00	0.18	2,541,319	404
	Freezer Replacement	647	855.00	0.14	553,185	91
Low-Income*	CFL 15 watt dimmable	8	48.26	0.01	386	0
	CFL 15 watt globe	726	48.26	0.01	35,039	4
	CFL 15 watt or less outdoor	23	41.83	0.00	962	0
	CFL 16-20 watt floodlight	4	35.64	0.00	143	0
	CFL 16-20 watt outdoor	84	39.60	0.00	3,326	0
	CFL 16-20 watt spiral	913	35.64	0.00	32,539	4
	CFL 21 watt or above floodlight	4	50.99	0.01	204	0
	CFL 21 watt or above outdoor	5	46.91	0.01	235	0
	CFL 21 watt or above spiral	213	50.99	0.01	10,860	1
	CFL 3-way spiral	218	39.71	0.00	8,658	1
	CFL 7-9 watt candelabra	798	25.74	0.00	20,541	2
	CFL 9 watt globe	292	28.96	0.00	8,456	1
	CFL 9-15 watt spiral	3,192	41.83	0.00	133,513	15
	CFM Reduction	31	8.56	0.01	265	0
	Attic Insulation	23	3,058.97	2.39	70,356	55
	Duct Insulation	1	0.00	0.00	0	0
	Duct Sealing	4	0.00	0.00	0	0
	Faucet Aerator	325	24.50	0.00	7,963	1
	Foundation Wall Insulation	1	0.00	0.00	0	0
	Freezer Replacement	53	1,131.00	0.18	59,943	9
	Heat Pump Replacement	1	0.00	0.00	0	0
	HVAC Tune Up	6	0.09	0.00	1	0
	LED 0.5 W Nightlight	54	1.61	0.00	87	0
	Water Heater Pipe Insulation	12	311.07	0.04	3,733	0

Program	Measure	Verified Participation Count	Ex Ante Per Unit kWh Impact	Ex Ante Per Unit kW Impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings
	Refrigerator Replacement	651	1,251.00	0.19	814,401	125
	Energy-efficient Showerhead	173	212.28	0.02	36,724	4
	Smart Strip Power Outlet	31	0.00	0.00	0	0
	Wall Insulation	4	0.00	0.00	0	0
	Water Heater Temperature Setback	5	0.00	0.00	0	0
	Water Heater Wrap	9	79.00	0.01	711	0
HVAC Rebate	ER AC 14/15 SEER	1,003	1,133.68	0.60	1,137,082	598
	ER AC 16+ SEER	779	1,253.05	0.74	976,124	574
	NC AC 14/15 SEER	181	216.05	0.21	39,104	37
	NC AC 16+ SEER	31	450.49	0.35	13,965	11
	RP AC 14/15 SEER	35	198.05	0.23	6,932	8
	RP AC 16+ SEER	20	531.12	0.41	10,622	8
	ER GSHP 16/18 EER	31	7,175.72	0.36	222,447	11
	ER GSHP 19+ EER	71	6,780.42	0.45	481,409	32
	NC GSHP 16/18 EER	36	6,182.78	0.32	222,580	12
	NC GSHP 19+ SEER	20	6,209.46	0.47	124,189	9
	RP GSHP 16/18 EER	5	7,010.85	0.36	35,054	2
	RP GSHP 19+ EER	8	6,633.62	0.51	53,069	4
	ER HP 14/15 SEER	429	3,212.16	0.54	1,378,017	233
	ER HP 16+ SEER	359	3,290.75	0.72	1,181,381	258
	NC HP 14/15 SEER	33	962.64	0.26	31,767	9
	NC HP 16+ SEER	19	1,446.89	0.39	27,491	7
	RP HP 14/15 SEER	27	1,038.76	0.27	28,047	7
	RP HP 16+ SEER	13	1,385.95	0.38	18,017	5
	NC MS AC 16+ SEER	17	260.78	0.27	4,433	5
	RP MS AC 16+ SEER	1	168.00	0.17	168	0
	NC MS HP 16+ SEER	98	2,515.19	0.27	246,489	27
	ECM with New AC	1,049	349.26	0.00	366,373	0
	ECM	355	684.04	0.26	242,833	93
	AC Tune-Up	395	84.81	0.03	33,501	11

Program	Measure	Verified Participation Count	Ex Ante Per Unit kWh Impact	Ex Ante Per Unit kW Impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings
	HP Tune-Up	95	596.46	0.03	56,663	2
Be E3 Smart	13W CFLs (2 Bulbs in each kit)	13,985	45.77	0.00	640,176	68
	Nightlights (1 in each kit)	3,032	7.12	0.00	21,576	0
	Bathroom Faucet Aerators (2 in each kit)	7,215	66.23	0.00	477,895	27
	Kitchen Faucet Aerators (1 in each kit)	2,986	359.39	0.02	1,073,219	61
	Efficient Showerheads (1 in each kit)	4,312	332.49	0.02	1,433,732	73
Non-Residential						
Non-Residential Prescriptive: HVAC	Air cooled chiller - any size	7	45,430.36	14.63	318,013	102
	Air source heat pump < 65,000 BTUH (single package)	2	1,281.68	0.97	2,563	2
	Air source heat pump < 65,000 BTUH (split)	11	827.98	0.45	9,108	5
	Air source heat pump > 240,000 BTUH	2	10,334.78	5.55	20,670	11
	Air source heat pump 136,000 - 240,000 BTUH	2	4,465.36	2.26	8,931	5
	Air source heat pump 65,000 - 135,000 BTUH	3	1,482.94	0.64	4,449	2
	Energy recovery ventilation > 450 CFM	2	963.41	0.76	1,927	2
	Ground-Coupled Heat Pumps (Closed Loop) < 135,000 BTUH	3	2,132.11	1.03	6,396	3
	Heat pump water heater < 80 gallon tank	1	10,327.00	2.83	10,327	3
	Outside air economizer with two enthalpy sensors	3	10,472.00	2.88	31,416	9
	Packaged terminal air conditioning and heat pumps	2	13,461.50	13.63	26,923	27
	Unitary and split system A/C 65,000 - 135,000 BTUH (5.4-11.25 tons)	36	1,342.35	1.05	48,325	38
	Unitary and split system A/C < 65,000 BTUH (<5.4 tons)	38	581.03	0.46	22,079	17
	Unitary and split system A/C 136,000 - 240,000 BTUH (11.33-20 tons)	38	3,506.28	2.75	133,239	105
	Unitary and split system A/C 241,000 - 760,000 BTUH (20-63.33 tons)	14	11,641.33	9.14	162,979	128
	Variable frequency drive up to 250 HP	46	65,266.82	10.25	3,002,274	471
	Water cooled chiller > 300 tons	4	330,058.75	72.38	1,320,235	290
	Water cooled chiller 150 - 300 tons	1	23,406.97	11.49	23,407	11

Program	Measure	Verified Participation Count	Ex Ante Per Unit kWh Impact	Ex Ante Per Unit kW Impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings
	Window film	18	1,234.64	0.48	22,224	9
Non-Residential Prescriptive: Lighting	Central lighting control	4	13,472.98	0.00	53,892	0
	CFL screw-in bulb > 32W replacing incandescent	1	52,933.00	16.30	52,933	16
	CFL screw-in bulb or pin-based fixture > 32W replacing incandescent	8	12,487.02	3.70	99,896	30
	CFL screw-in bulb or pin-based fixture 21W to 32W replacing incandescent	9	3,687.41	0.98	33,187	9
	CFL screw-in bulb or pin-based fixture up to 20W replacing incandescent	8	11,560.62	1.94	92,485	15
	CFL screw-in bulb or pin-based fixture up to 32W replacing incandescent	61	12,552.68	2.74	765,714	167
	CFL screw-in bulb up to 32W replacing incandescent	8	37,341.74	12.46	298,734	100
	Delamping HID	12	84,651.13	13.95	1,015,814	167
	Delamping T12 (# linear feet)	106	37,312.86	7.62	3,955,163	808
	Delamping T8 (# linear feet)	33	12,649.93	2.74	417,448	91
	Fixture-mounted daylight sensor	4	3,337.57	0.42	13,350	2
	Fixture-mounted occupancy sensor	30	22,576.98	0.79	677,309	24
	LED 4-ft 1-lamp tube	1	11,133.96	1.27	11,134	1
	LED 4-ft 2-lamp tubes	6	6,574.13	1.86	39,445	11
	LED 4-ft 4-lamp tubes	9	5,099.82	0.83	45,898	7
	LED case lighting sensor controls	1	11,765.15	0.00	11,765	0
	LED lighting in reach-in freezer/cooler case	36	9,574.84	1.22	344,694	44
	LED luminaires up to 18 watts (replacing incandescent)	229	10,596.92	2.88	2,426,694	659
	LED or Electroluminescent exit sign	81	815.90	0.10	66,088	8
	LED or Induction (8,760 operating hours) replacing 175 W or less	5	16,517.86	1.89	82,589	9
	LED or Induction (8,760 operating hours) replacing 176W to 250W	2	5,010.72	0.57	10,021	1
	LED or Induction (8,760 operating hours) replacing 251W to 400W	1	4,204.80	0.48	4,205	0

Program	Measure	Verified Participation Count	Ex Ante Per Unit kWh Impact	Ex Ante Per Unit kW Impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings
	LED or Induction (operating hours < 8,760) replacing 175W or less	50	4,995.93	0.00	249,797	0
	LED or Induction (operating hours < 8,760) replacing 176W to 250W	104	12,060.68	0.00	1,254,311	0
	LED or Induction (operating hours < 8,760) replacing 251W to 400W	4	88,931.52	4.87	355,726	19
	LED pedestrian walk/don't walk sign	2	17,795.00	5.50	35,590	11
	LED recessed downlight luminaires up to 18 watts or screw-in base lamps	5	40,815.27	5.07	204,076	25
	LED traffic signal - green	4	67,366.48	7.69	269,466	31
	LED traffic signal - red	1	1,345.92	0.19	1,346	0
	LED Traffic Signal (Arrow)	6	4,899.72	0.95	29,398	6
	Low-watt T8 4-foot 1 lamp fixture replacing T12	17	2,603.69	0.64	44,263	11
	Low-watt T8 4-foot 1 lamp fixture replacing T8	51	7,472.02	1.54	381,073	79
	Low-watt T8 4-foot 2 lamp fixture replacing T12	86	14,754.18	3.03	1,268,860	260
	Low-watt T8 4-foot 2 lamp fixture replacing T8	6	3,905.99	0.90	23,436	5
	Low-watt T8 4-foot 3 lamp fixture replacing T12	27	28,587.23	5.00	771,855	135
	Low-watt T8 4-foot 3 lamp fixture replacing T8	68	5,170.04	1.19	351,562	81
	Low-watt T8 4-foot 4 lamp fixture replacing T12	79	12,342.77	3.18	975,079	252
	Low-watt T8 4-foot 4 lamp fixture replacing T8	11	24,678.50	4.61	271,464	51
	Relamping 25 watt or less	49	13,384.43	2.56	655,837	125
	Relamping 28 watt	1	0.00	0.00	0	0
	Remote-mounted daylight sensor	2	22,545.00	0.00	45,090	0
	Res CFL Lighting Moved to Commercial	1	10,787,007.00	2,548.00	10,787,007	2,548
	Switching controls for multilevel lighting	2	727.23	0.11	1,454	0
	T5 2 lamp fixture replacing T12	1	4,304.66	0.44	4,305	0
	T5 4 lamp fixture replacing T12	1	6,128.74	1.72	6,129	2
	T5 high-output 1 lamp fixture replacing T12	1	328.50	0.11	329	0
	T5 high-output 3 lamp fixture replacing T12	2	959.05	0.13	1,918	0
	T5 high-output 4 lamp fixture replacing T12	5	254,986.34	48.87	1,274,932	244

Program	Measure	Verified Participation Count	Ex Ante Per Unit kWh Impact	Ex Ante Per Unit kW Impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings
	T5 high-output high-bay 10 lamp fixture replacing HID	1	45,957.41	5.91	45,957	6
	T5 high-output high-bay 3 lamp fixture replacing HID	25	123,076.75	17.19	3,076,919	430
	T5 high-output high-bay 4 lamp fixture replacing HID	23	23,554.46	3.49	541,752	80
	T5 high-output high-bay 6 lamp fixture replacing HID	3	27,904.63	5.74	83,714	17
	T5 high-output high-bay 8 lamp fixture replacing HID	5	350.99	0.09	1,755	0
	T8 (BF < 0.78) 4-foot 1 lamp fixture replacing T12	50	2,743.50	0.58	137,175	29
	T8 (BF < 0.78) 4-foot 2 lamp fixture replacing T12	47	3,644.58	0.97	171,295	46
	T8 (BF < 0.78) 4-foot 2 lamp fixture replacing T8	10	8,773.36	2.08	87,734	21
	T8 (BF < 0.78) 4-foot 3 lamp fixture replacing T12	6	8,799.29	2.60	52,796	16
	T8 (BF < 0.78) 4-foot 3 lamp fixture replacing T8	59	5,267.58	1.01	310,787	60
	T8 (BF < 0.78) 4-foot 4 lamp fixture replacing T12	53	12,983.24	2.82	688,112	149
	T8 4 foot 2 lamp replacing T12 HO only	20	24,608.76	6.29	492,175	126
	T8 4 foot 4 lamp replacing T12 HO only	7	3,297.60	0.42	23,083	3
	T8 4-foot 2 lamp fixture replacing T12	7	5,913.24	1.20	41,393	8
	T8 4-foot 3 lamp fixture replacing T12	7	2,419.06	0.60	16,933	4
	T8 4-foot 4 lamp fixture replacing T12	1	4,640.06	0.50	4,640	1
	T8 high-bay 4-foot 2 lamp fixture replacing HID	28	48,870.13	8.35	1,368,364	234
	T8 high-bay 4-foot 4 lamp fixture replacing HID	124	42,073.79	7.49	5,217,150	929
	T8 high-bay 4-foot 6 lamp fixture replacing HID	2	21,924.75	5.30	43,850	11
	T8 high-bay 4-foot 8 lamp fixture replacing HID	6	43,216.70	6.09	259,300	37
	T8 high-output 8-foot 2 lamp fixture replacing T12 HO only	5	3,868.42	0.00	19,342	0
	Vending equipment controller	114	17,399.14	0.75	1,983,502	86
	Wall or Ceiling-mounted occupancy sensor	77	5,246.73	0.00	403,998	0
Non-Residential	Air compressor 1 - 100 HP Load/No Load	5	24,847.11	2.49	124,236	12
	Air compressor 1 - 100 HP Variable Speed	12	52,979.74	4.12	635,757	49

Program	Measure	Verified Participation Count	Ex Ante Per Unit kWh Impact	Ex Ante Per Unit kW Impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings
Prescriptive: Motors, Drives & Compressed Air	Barrel wraps	1	205,920.00	33.00	205,920	33
	CEE premium efficiency motor 10HP	1	1,313.82	0.06	1,314	0
	CEE premium efficiency motor 15HP	2	1,737.41	0.08	3,475	0
	CEE premium efficiency motor 1HP	6	198.30	0.01	1,190	0
	CEE premium efficiency motor 20HP	2	1,554.94	0.10	3,110	0
	CEE premium efficiency motor 2HP	1	231.01	0.01	231	0
	CEE premium efficiency motor 30HP	1	2,625.42	0.12	2,625	0
	CEE premium efficiency motor 3HP	1	520.35	0.05	520	0
	CEE premium efficiency motor 40HP	1	787.66	0.11	788	0
	CEE premium efficiency motor 5HP	2	598.71	0.04	1,197	0
	CEE premium efficiency motor 60HP	2	3,900.65	0.20	7,801	0
	CEE premium efficiency motor 7.5HP	1	729.47	0.10	729	0
	NEMA premium efficiency motor 10HP	1	935.87	0.06	936	0
	NEMA premium efficiency motor 125HP	1	4,356.69	0.27	4,357	0
	NEMA premium efficiency motor 30HP	1	2,047.83	0.12	2,048	0
	NEMA premium efficiency motor 50HP	2	6,273.96	0.36	12,548	1
	Variable frequency drive up to 250 HP	72	98,413.25	17.36	7,085,754	1,250
	VFDs on Air Compressors 1-100 HP	3	15,028.31	1.37	45,085	4
Non-Residential Prescriptive: Compressed Air	Air compressor 1 - 100 HP Load/No Load	6	6,803.80	0.74	40,823	4
	Air compressor 1 - 100 HP Variable Speed	14	66,466.70	3.95	930,534	55
	VFDs on Air Compressors 1-100 HP	1	84,049.33	6.14	84,049	6
Non-Residential Prescriptive: Other	Window film	8	1,585.36	0.62	12,683	5
Total Non-Residential Prescriptive Rebate					**59,237,677**	**11,009**
Non-Residential Custom	Custom NC	13	234,990.61	148.05	3,054,878	1,925
	Custom NC-LPD	7	191,452.63	26.65	1,340,168	187
	Custom-Air Compressor	7	491,736.14	22.80	3,442,153	160

Program	Measure	Verified Participation Count	Ex Ante Per Unit kWh Impact	Ex Ante Per Unit kW Impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings
	Custom-HVAC	2	112,435.50	20.55	224,871	41
	Custom-Lighting	70	63,314.38	10.78	4,432,007	755
	Custom-Other	51	84,741.96	7.15	4,321,840	365
Total Non-Residential Custom Rebate					**16,815,917**	**3,432**

*Participant count for the Low Income program represents measure count. The exception to this is the insulation and CFM reduction measures where it represents participants

Appendix C: Program-Measures Table

Program	Measure	Participation Count
Residential		
Lighting	Non-specialty CFLs*	$0.56 - $2.25
	Specialty CFLs	$1.00 - $3.00
Appliance Recycling	Recycled Freezer	$25.00
	Recycled Refrigerator	$25.00
Low-Income	Compact Fluorescent Light Bulbs	Cap of $5,000 in measure costs per home. In addition, agencies can charge 15 percent of the admin cost for total installations.
	Photo Cell for Light	
	Refrigerator Replacement	
	Freezer Replacement	
	Insulation (Attic, Wall, and Foundation)	
	Air Sealing / CFM Reduction	
	Energy-efficient Showerhead	
	Faucet Aerator	
	Water Heater Wrap	
	Central AC Replacement	
	Heat Pump Replacement	
	Dryer Replacement	
	Dishwasher Replacement	
	Ductless Mini-Split	
HVAC Rebate	ER AC 14/15 SEER	$200
	ER AC 16+ SEER	$300
	NC AC 14/15 SEER	$100
	NC AC 16+ SEER	$150
	RP AC 14/15 SEER	$100
	RP AC 16+ SEER	$150
	ER GSHP 16/18 EER	$1,200
	ER GSHP 19+ EER	$1,600
	NC GSHP 16/18 EER	$800
	NC GSHP 19+ SEER	$1,200
	RP GSHP 16/18 EER	$800
	RP GSHP 19+ EER	$1,200
	ER HP 14/15 SEER	$400
	ER HP 16+ SEER	$600
	NC HP 14/15 SEER	$200
	NC HP 16+ SEER	$300
	RP HP 14/15 SEER	$200
	RP HP 16+ SEER	$300
	NC MS AC 16+ SEER	$300
	RP MS AC 16+ SEER	$300

Program	Measure	Participation Count
	NC MS HP 16+ SEER	$300
	ECM with New AC	$100
	ECM	$100
	AC Tune-Up	$40 ($25 to customer, $15 to contractor)
	HP Tune-Up	$40 ($25 to customer, $15 to contractor)
Be E3 Smart	CFLs	Provided at no cost to customer
	LED Night Light	
	Bathroom Faucet Aerator	
	Kitchen Faucet Aerator	
	Efficient Showerhead	
Commercial		
Non-Residential Prescriptive	Low Watt Fluorescent Lighting	$4.50-$30 per fixture
	High Performance Fluorescent Lighting	$1.50-$27 per fixture
	T5 Lighting Replacing T12	$7.50-$19.50 per fixture
	High-Bay and High Output Lighting Replacing HID	$25-$80 per fixture
	T8 Replacing T12 HO	$12-$21 per fixture
	Permanent Lamp Removal (De-lamping)	$1.20-$2.25 per linear foot (Fluorescent) or $0.05 per watt (HID)
	Re-lamping	$1-$1.50 per bulb
	CFL Lighting	$1.50-$4 per bulb (screw in) or $20 per fixture (pin based)
	Sensors and Controls	$15-$60 per sensor or $0.04 per connected watt
	Exterior or Garage HID to LED/Induction Lighting	$50-$200 per fixture
	LED Exit Signs	$10 per sign
	LED Pedestrian Walk/Don't Walk Sign	$50 per sign
	LED Lighting in Reach-in Freezer or Cooler Case	$50 per door
	LED Case Lighting Sensor Controls	$10 per sensor
	LED Recessed Down Light Luminaries up to 18 watts or screw-in base lamps	$10 per lamp
	LED Traffic Signal — Red or Green	$25 per sign
	Light Tube	$35 per sign
	Packaged Terminal Air Conditioning and Heat Pumps	$50 per unit
	Unitary and Split System Air Conditioning	$200 per unit or $40 per ton
	Air Source Heat Pumps	$400 per unit or $40 per ton
	Ground Water-Source Heat Pumps (Open Loop)	$80 per ton
	Ground-Coupled Heat Pumps (Closed Loop)	$60 per ton

Program	Measure	Participation Count
	Air Cooled Chillers	$40 per ton
	Water Cooled Chillers	$40 per ton
	Heat Pump Water Heaters	$1,000-$2,500 per unit
	Thermal Storage	$100.00 per kW shifted
	Variable frequency drives up to 250 HP	$40 per hp
	Outside Air Economizer Using Two Enthalpy Sensors	$250 per unit
	Energy Recovery Ventilation (ERV) with a Minimum of 450 CFM and as part of an Electric-Powered System	$1 per CFM
	Programmable Setback Thermostat	$20 per unit
	HVAC Occupancy Sensor	$30 per unit
	Premium Motors	$10-$25 per hp
	Variable Frequency Drives	$40 per hp
	Air Compressors	$45-$125 per hp
	Air Compressor Storage Requirements	$1.50 per gallon
	Variable Frequency Drives on Air Compressors	$40 per hp
	Window Film	$2 per square foot
	Vending Equipment Controller	$50 per unit
	Prescriptive Clothes Washer and Electric Dryer	$50 per unit
	Barrel Wraps (for injection molding and extruding applications)	$1 per ton
	Engineered Nozzle	$20 per nozzle
	Plug Load Occupancy Sensor	$20 per sensor
Non-Residential Custom	Lighting	$0.05 per kWh and $50 per kW
	HVAC	$0.10 per kWh and $100 per kW
	Other	$0.08 per kWh and $100 per kW

Appendix D: Energy and Demand Savings Calculation Sources

Program	Measure	Source
Residential		
Residential Lighting	CFLs	Ohio TRM. Joint Utility Comments were used to update the waste heat factor for demand. Adjusted savings use weighted waste heat factors to account for 8% of bulbs installed outside. Savings reflect 95% of bulbs sold to account for 5% of the bulbs sold being installed in commercial applications. Baseline wattages account for store inventories of incandescent bulbs based on the results of the retail phone survey. See Comment 1 below.
Appliance Recycling	Refrigerator	Regression model and participant survey.
	Freezer	Regression model and participant survey.
Low-Income	Attic Insulation	Ohio TRM. When the existing R-value was input as zero, adjustments were made to the database R-values to account for the insulating effect of the roof. We limited savings by applying a cap of 50% of the energy use of a typical DP&L low income home.
	CFM Reduction	Ohio TRM. Savings for CFM reduction were not calculated for cases where the CFM reduction improved more than 30%.
	Compact Fluorescent Light Bulbs	Ohio TRM. Joint Utility Comments were used to update the waste heat factor for demand. Updated with ISR from participant surveys for verified and adjusted gross calculations. Delta Watts input was based on lumens equivalence method and used data from the Residential Lighting program. See Comment 1 below.
	Duct Insulation	This measure does not exist in the Ohio TRM. We developed savings using inputs from the database and modeling software (BEopt2.0.0.4, DOE2)
	Duct Sealing	Ohio TRM. We limited savings by applying a cap of 30% of the energy use of a typical DP&L low income home.
	Energy-efficient Showerhead	Ohio TRM. Adjusted gross calculations were calculated using internal engineering algorithms and 2012 water metering data. See Comment 2
	Faucet Aerator	Ohio TRM. Adjusted gross calculations were calculated using internal engineering algorithms and 2012 water metering data. See Comment 2

Program	Measure	Source
	Foundation Wall Insulation	Foundation insulation savings were calculated based on internal engineering algorithms for basement wall and band joist savings used in other evaluations. We limited savings by applying a cap of 20% of the energy use of a typical DP&L low income home.
	Freezer Replacement	The calculation for freezer replacement savings is not included in the Ohio TRM. The TRM provided an algorithm for freezer early retirement, from which we took the baseline assumption for usage (1,244 kWh). We matched consumption estimates for the efficient freezer by size and type, assuming replacement with an ENERGY STAR® unit. We calculated a weighted average usage estimate for the efficient unit based on the distribution of installations through the program.
	Heat Pump Replacement	Ohio TRM.
	HVAC Tune Up	Ohio TRM.
	LED 0.5 W Nightlight	Night light ex ante savings were calculated based on Ohio TRM assumptions for CFL lights. Adjusted gross savings were based on internal engineering algorithms from other evaluations and using DP&L wattage and hours of use assumptions.
	Refrigerator Replacement	The Joint Utility Comments on the Ohio TRM presented alternative unit energy consumption measures for the existing unit part-use factor and for Energy Star refrigerators. The main assumption they make is that for low-income families, these refrigerators are primary units that are being replaced so they should be modeled as running full time. The adjusted gross calculations use these alternative inputs in the TRM deemed savings formula.
	Smart Strip Power Outlet	Ohio TRM.
	Wall Insulation	Ohio TRM.
	Water Heater Pipe Insulation	Ohio TRM. Adjusted gross savings were calculated based on an internal engineering algorithm from other evaluations that is based on the number of people per home in the LIWx program and the temperature of the ground water in Dayton.

Program	Measure	Source
	Water Heater Temperature Setback	Ohio TRM. Adjusted gross savings were calculated based on internal engineering algorithms from other evaluations. The algorithm calculates savings primarily from standby losses, leaks and clothes washers and is based on the average amount of hot water used by LIWx participants
	Water Heater Wrap	Ohio TRM.
HVAC Rebate and Tune-Up	AC Early Retirement (all SEERs)	Participant billing analysis, kW calculated using Ohio TRM. See comment 5 below.
	AC Std Replacement SEER 14/15	Participant billing analysis, kW calculated using Ohio TRM. See comment 5 below.
	AC Std Replacement SEER 16+	kWh and kW calculated using Ohio TRM. See comment 5 below.
	AC New Construction (all SEERs)	kWh and kW calculated using Ohio TRM. See comment 5 below.
	GSHP Early Retirement/Std/New Construction (all EERs)	kWh and kW calculated using Ohio TRM. See comment 5 below.
	HP Early Retirement (all SEERs)	Participant billing analysis, kW calculated using Ohio TRM. See comment 5 below.
	HP New Construction and Std Replacement (all SEERs)	kWh and kW calculated using Ohio TRM. See comment 5 below.
	Mini-split AC Std Replacement (all SEERs)	kWh and kW calculated using Ohio TRM. See comment 5 below.
	Mini-split AC New Construction (all SEERs)	kWh and kW calculated using Ohio TRM. See comment 5 below.
	Mini-split HP New Construction (all SEERs)	kWh and kW calculated using Ohio TRM and secondary sources. See comment 6 below.
	ECM	Participant billing analysis, kW calculated using Ohio TRM. See comment 5 below.
	AC and HP Tune-up	PRISM analysis of participant billing data and OH TRM, kW calculated using Ohio TRM.
Be E3 Smart	CFLs	Ohio TRM, ISR from participant phone survey.
	LED night lights	Ohio TRM dated October 15, 2009. This was the utility-defined TRM. ISR from participant phone survey.
	Bathroom Faucet Aerator	Ohio TRM. Adjusted gross calculations were calculated using internal engineering algorithms and 2012 water metering data. See Comment 2. ISR from participant phone survey.

Program	Measure	Source
	Kitchen Faucet Aerator	Ohio TRM. Adjusted gross calculations were calculated using internal engineering algorithms and 2012 water metering data. See Comment 2. ISR from participant phone survey.
	Efficient Showerhead	Ohio TRM. Adjusted gross calculations were calculated using internal engineering algorithms and 2012 water metering data. See Comment 2. ISR from participant phone survey.
Commercial		
Non-Residential Prescriptive	HVAC	See comment 7 below.
	Lighting	See comment 7 below.
	Motors	See comment 7 below.
	Other	See comment 7 below.
Non-Residential Custom	Lighting	See comment 8 below.
	Other	See comment 9 below.

Comments

1) We applied the results of the retail phone survey (part of the Residential Lighting program) to calculate baseline wattages that change each quarter of the year. These baseline wattages account for the availability of inefficient incandescent bulbs that are phased out by the EISA law.

2) We used an algorithm that better accounts for DP&L specific variables, such as: number of people per home, number of faucets per home, and the temperature of the ground water. Other variables were taken from a Cadmus water metering study done in Michigan in 2012 and include: baseline flow rates, length of showers and faucet usage, number of showers taken per day and shower and faucet point of use temperatures.

3) The adjusted gross savings calculation was based on Cadmus engineering calculations. In addition to general water heater efficiency standards, the algorithm accounted for the number of people per household (based on results from the participant survey) and for local weather, resulting in a slightly higher estimated savings than the TRM.

4) The ex ante calculation was based on a Cadmus engineering algorithm used in the 2010 DP&L Residential HVAC evaluation. This algorithm was based on a metering study of single-family homes, reflecting slightly higher square footage assumptions than appropriate

for low-income program participants. Adjusted gross savings calculations were based on a more conservative algorithm from the Pennsylvania TRM, using an equipment capacity more suitable for smaller homes

5) Minor adjustments were made to TRM equations and assumptions. See report section for details.
6) Mini-split HP kWh saving calculated using the Ohio TRM (for cooling) and engineerign calculations informed by data from the following study: and http://www.env.state.ma.us/dpu/docs/electric/09-64/12409nstrd2ac.pdf.
7) We based our calculations on algorithms outlined in the Ohio TRM. We based our baseline conditions on the Ohio TRM, except when the site visit indicated a different baseline than deemed by measure type. Cadmus calculated the retrofit equipment wattage and operating parameters through site visit results and product specification sheets.
8) Cadmus calculated baseline and retrofit equipment wattage and operating parameters through site visit results and product specification sheets.
9) DP&L contracted with a third-party engineering firm to conduct pre and post installation metering to calculate energy savings. Cadmus reviewed the engineering reports and made revisions as necessary to evaluate savings.

Appendix E. Low-Income CC System Field Review

Table 95. Low-Income CC System Review

Measure	Input Fields	Input Type	Input Values	In C4 Form?	Notes
AIR SEALING	Pre Measure CFM	Continuous range	1,000 through 6,000		
	Post Measure CFM	Continuous range	1,000 through 6,000		
A-R-C INSULATION	Attic - Existing R Value	Discretized range	0 through 25		Input based on actual insulation*
	Attic - New R Value	Discretized range	10 through 60		Input based on actual insulation*
	Side Wall - Existing R Value	Discretized range	0 through 11		Input based on actual insulation*
	Side Wall - New R Value	Discretized range	5 through 19		Input based on actual insulation*
	Foundation - Existing R Value	Discretized range	0 through 11		Input based on actual insulation*
	Foundation - New R Value	Discretized range	9 through 21		Input based on actual insulation*
CENTRAL AC	Capacity Existing (BtuH)	Discretized range	8,000 through 60,000		
	Capacity New (BtuH)	Discretized range	8,000 through 60,000		
	SEER Existing	Continuous range	5 through 13		
	SEER New	Continuous range	12 through 32		Input values based on ENERGY STAR products
	EER Existing	Continuous range	5 through 12		
	EER New	Continuous range	12 through 19		Input values based on ENERGY STAR products
	Model Number Existing	Text and numbers	*no limits on inputs*		
	Model Number New	Text and numbers	*no limits on inputs*		

Measure	Input Fields	Input Type	Input Values	In C4 Form?	Notes
CFL	CFL Wattage	Continuous range	8 through 26	YES	
	Installed Indoor/Outdoor	Binary	Indoor or Outdoor	YES	
DUCT SEALING	Pre Measure CFM Envelope	Continuous range	100 through 10,000		
	Pre Measure CFM Whole House	Continuous range	100 through 10,000		
	Post Measure CFM Envelope	Continuous range	100 through 10,000		
	Post Measure CFM Whole House	Continuous range	100 through 10,000		
FAUCET AERATOR	Pre measure flowrate [gpm]	Continuous range	2.0 through 4.0		
	Post measure flowrate [gpm]	Continuous range	0.5 through 1.5		
	Installed Bathroom/Kitchen	Binary	Bathroom or Kitchen		
FREEZER	Volume	Discretized range	5 through 21	YES	Input values based on PY3 CC System projects
	Model Number Existing	Text and numbers	*no limits on inputs*		
	Model Number New	Text and numbers	*no limits on inputs*		
HEAT PUMP, HVAC (tune up)	Capacity Existing (BtuH)	Discretized range	8,000 through 60,000		
	Capacity New (BtuH)	Discretized range	8,000 through 60,000		
	SEER Existing	Discretized range	5 through 13		
	SEER New	Discretized range	12 through 32		Input values based on ENERGY STAR products

Measure	Input Fields	Input Type	Input Values	In C4 Form?	Notes
	EER Existing	Discretized range	5 through 12		
	EER New	Discretized range	12 through 19		Input values based on ENERGY STAR products
	HSPF Existing	Discretized range	6.5 through 8		Based on reference table: http://www.larsonairaz.com/pages/page/services/heating-repair/what-does-hspf-mean/
	HSPF New	Discretized range	8 through 16		Input values based on ENERGY STAR products
	Model Number Existing	Text and numbers	*no limits on inputs*		
	Model Number New	Text and numbers	*no limits on inputs*		
PIPE INSULATION	Pipe Heat Loss Coefficient Existing	Constant	1		
	Pipe Heat Loss Coefficient New	Constant	5		Suggest input of "insulation type" to capture R-value
	Pipe Circumference	Constant	0.196		
	Pipe Length Insulated	Discretized range	3 through 6		
	Average Temperature Difference	Constant	65		
REFRIGERATOR	Volume	Discretized range	14 through 26	YES	
	Model Number Existing	Text and numbers	*no limits on inputs*		
	Model Number New	Text and numbers	*no limits on inputs*		
SHOWERHEAD	Pre Measure Flowrate [gpm]	Continuous range	2.0 through 5.0		
	Post Measure	Continuous range	1.0 through 2.5		

Measure	Input Fields	Input Type	Input Values	In C4 Form?	Notes
	Flowrate [gpm]				
WALL INSULATION	Existing R Value	Continuous range	0 through 11		Input based on actual insulation, does not include assumed R-value of building materials
	New R Value	Continuous range	5 through 21		Input based on actual insulation, does not include assumed R-value of building materials
WH REPLACEMENT	WH Capacity Old (gallons)	Discretized range	30 through 60		
	WH Capacity New (gallons)	Discretized range	30 through 60		
	Pre Measure Energy Factor	Continuous range	0.85 through 0.93		Currently only 1 field for Energy Factor, there are not "old" and "new" fields
	Post measure Energy Factor	Continuous range	0.93 through 0.98		Currently only 1 field for Energy Factor, there are not "old" and "new" fields
	Model Number Existing	Text and numbers	*no limits on inputs*		
	Model Number New	Text and numbers	*no limits on inputs*		
WH WRAP	WH Model Number	Text and numbers	*no limits on inputs*		

* Does not include assumed R-value of building materials

Blue highlight = Field currently in CC System

- All shell measure savings calculations also require heating and cooling types.
- All water heater measures require water heater efficiency.
- Model Number information is listed for some measures as an alternative to requiring other inputs.

Table 96 provides the various input types.

Table 96. Input Types

Input Types	Description
Continuous Range	Only lower and upper bound is limited, decimal values may be entered
Discretized Range	Lower and upper bound is limited, integer values only
Binary	Two options only
Constant	No input needed
Text and Numbers	No limits on inputs

Appendix F. Ground-Source Heat Pump Part- and Full-Load Savings Adjustments

Single-stage ground-source heat pumps operate only at one heating and one cooling capacity to maintain home comfort. Multistage or variable-capacity ground-source heat pumps operate at a lower heating and cooling capacity than full-load units if requiring less heating or cooling output. When multistage ground-source heat pumps run at lower capacity, they typically operate for longer periods of time, but do so more efficiently, using less energy than single-stage ground-source heat pumps.

The energy-savings algorithms provided in the Ohio TRM quantified energy savings by comparing efficiency at the high-stage capacity of an installed ground-source heat-pump to the baseline efficiency. This approach did not accurately represent the actual efficiency of ground-source heat pumps with multistage functionality as ground-source heat pumps run at low capacity (high-efficiency) for part of the time.

To determine if installed equipment would likely operate in part- and full-load capacities, Cadmus modeled[49] energy usage for 13 high-efficiency, multistage ground-source heat pump models, functioning in part- and full-load. DP&L's 2012 Residential Heating and Cooling Rebate Program tracking data (the only data readily available when completing modeling work in August 2013) only identified multistage models. To identify part- and full-load capacities and the efficiencies for these units, Cadmus referred to data published by the AHRI. The model also included regional weather data, obtained from NOAA weather stations, as weather greatly affects determining how much of the heating and cooling season a ground-source heat pump must operate in high-stage versus low-stage.

Table 97 shows the model results.

Table 97. Percent of Full-Load Usage Observed in Part-Load

Season	Total Hours	Part-Load		Full-Load	
		Hours	Percent	Hours	Percent
Heating	5,151	2,581	50%	2,570	50%
Cooling	3,609	3,161	88%	448	12%

Note: The model output identified required heating and cooling loads. It did not calculate full-load hours. Heating and cooling output were used to determine the time required during the season for full-load operation.

These results reflected the following assumptions about ground-source heat pump operations:

- Ground-source heat pumps were sized to the building's heating load; and
- The system operated at full-load capacity when the building load was higher than part-load capacity.

49 Cadmus used Building Energy Optimization to generate energy models, applying Dayton TYM3 weather data. The model's design represented a typical residential home in Dayton, and the energy model's building envelope was calibrated to Ohio TRM FLH heat hours of 1,438 hours per year.

Using results from modeling work, Cadmus revised the Ohio TRM savings algorithm as follows:

$$\Delta kWh = FLHcool * BtuH * \left[88\% * \frac{\frac{1}{SEERbase} - \left(\frac{1.02}{EERee_{part-load}}\right)}{1{,}000} + 12\% * \frac{\frac{1}{SEERbase} - \left(\frac{1.02}{EERee_{full-load}}\right)}{1{,}000} \right] + FLHheat * BtuH \left[50\% * \frac{\frac{1}{HSPFbase} - \left(\frac{0.293}{COPee_{part-load}}\right)}{1{,}000} + 50\% * \frac{\frac{1}{HSPFbase} - \left(\frac{0.293}{COPee_{full-load}}\right)}{1{,}000} \right]$$

The revised equation assumed that, in cooling mode, the ground-source heat pump operated: 88% of the time at a (more efficient) partial load; and 12% of the time at a (less efficient) full load. The algorithm assumed that, in heating mode, the ground-source heat pump operated at 50% during partial load (more efficient) and 50% of the time during full-load (less efficient).

Ground-source heat pumps produce higher cooling capacities than heating capacity. A four-ton ground-source heat pump might produce 50,000 BTUs of cooling, but only produced 37,400 BTUs of heating at peak cooling and heating conditions. In Dayton, homes demand more heating than cooling. Consequently, ground-source heat pumps must run longer at full-load to heat a home, but can meet a home's cooling load with less capacity. As a result, the part-load adjustment has a proportionally larger impact on cooling season usage.

The efficiency adjustments (new inputs) in the equation above are: $EERee_{part-load}$, $EERee_{full-load}$, $COPee_{part-load}$, and $COPee_{full-load}$. Cadmus identified these terms for the 2013 evaluation using AHRI reference numbers, provided in the program tracking data and in the AHRI certified products directory. Cadmus located 68 of 85 unique AHRI models incented in 2013 in the AHRI database.

Appendix G: Cost-Effectiveness Analysis Inputs

Utility Assumptions

Utility assumptions apply to all programs and measures, including the assumptions that follow.

Avoided Costs are the full value of time and seasonally differentiated generation, transmission and distribution, and capacity costs. For each energy-efficiency measure included in a program, hourly (8,760) system-avoided costs are adjusted by the hourly load shape of the end use affected by the measure, capturing the full value of time and seasonally-differentiated impacts of the measure. Avoided costs, provided by DP&L, were updated for the 2013 program year evaluation.

Line Loss is the percentage of energy lost during transmission and distribution. In DSM Portfolio Pro, both energy and capacity line losses are applied to measure-level savings to reflect total savings from the point of generation. Table 98 presents line loss assumptions for the 2013 Evaluation Measurement and Verification Report.[50]

Table 98. Line Loss Assumptions Used in Cost-Effectiveness Calculations

Sector	Energy Line Losses	Demand Line Losses
Residential	7.37%	8.37%
Commercial/Industrial	4.06%	5.21%

Retail Rates, provided by DP&L, include electric rates for all customer classes eligible for DSM programs. Table 99 provides retail rate assumptions for the 2013 Evaluation Measurement and Verification Report.

Table 99. Retail Rates Used in Cost-Effectiveness Calculations

Sector	Retail Rate	Escalator
Residential	$0.134	0%
Residential Heating	$0.122	0%
Commercial	$0.095	0%
Industrial	$0.085	0%

Load Shapes show hourly energy use over a year for each end use included in DSM Portfolio Pro. Hourly end-use load shapes were not available for the 2013 cost-effectiveness analysis. Therefore, Cadmus developed load shapes using available data from similar regions, and adjusting for weather conditions in DP&L's service territory.

Discount Rates are used to determine the net present value of benefits for each program.
Table 100 shows the discount rates used in 2013. The TRC, UTC, and RIM test discount rates are based on DP&L's weighted cost of capital; SCT discount rate is based on a 10-year T-bill rate; and the PCT rate

[50] The line losses in Table 185 represent the percentage loss in energy and demand from the point of generation to the meter.

represents a hurdle rate. Cadmus will update discount rates in subsequent years, as new data are provided.

Table 100. Discount Rates

Benefit-Cost Test	Discount Rate
TRC	8.78%
SCT	3.31%
UTC	8.78%
RIM	8.78%
PCT	10.00%

Peak Definitions are used to determine any time or seasonal differentiation between rates and avoided costs. Additionally, to calculate peak load impacts from energy-efficiency measures, end-use load shapes are used to identify the average reduction in demand over the DP&L system's top 100 peak demand hours.

Externalities and Indirect Benefits are additional, non-energy benefits associated with installing energy-efficiency measures. For the 2013 analysis, we did not include non-energy benefits.

Program Assumptions

Sectors/Segments identify the customer class to which participants from each program belong. Sectors for DP&L include: residential, commercial, and industrial. Examples of segments used in DSM Portfolio Pro include: single-family, multifamily, small office, large retail, and schools (these are tailored to DP&L's service territory). Sectors and segments dictate which retail rates and load shapes are used during analysis.

Utility Administrative Costs include any expenses associated with: program development; marketing; delivery; operation; and EM&V. These costs are not measure-specific, and are assessed at the program or portfolio level. Costs categories used in the 2013 Evaluation Measurement and Verification Report are shown in Table 101 and will be updated in subsequent cycles.

Table 101. Implementation and Administrative Costs

Cost Category	Level	Description
Implementation Vendor and Marketing Costs	Program Level	Incremental costs associated with performing program implementation tasks, including customer service, application processing, marketing, customer outreach, etc.
Incentive Costs	Program Level	Rebates and incentives paid to customers by DP&L.
Direct Measure Costs	Program Level	Costs associated with paying for program measures, including measures installed through the Low Income Weatherization program.
DP&L Staff Costs	Program Level/ Portfolio Level	Costs to administer energy-efficiency programs, including DP&L's fully-loaded incremental personnel costs. Activities associated with market research outside of EM&V.
External Vendor Evaluations	Portfolio Level	Activities associated with the determination and evaluation of current and potential energy-efficiency programs. Activities include: benefit-cost ratio analysis, impact and process analysis, cost per kWh analysis, customer research, and all other analyses necessary for program evaluation.
Education, Awareness, and Building and Market Transformation	Portfolio Level	Cost to increase awareness of energy efficiency.

Measure Assumptions

Measure Life is used during the calculation of total lifetime benefits for each measure. The life of each measure is based on information from the Ohio TRM, program-supported documentation, and secondary research.

End Use is used to assign each measure to a specific load shape. Examples of end uses in DSM Portfolio Pro include water heating, HVAC, and lighting.

Savings are annual kWh savings associated with installation of each energy-efficiency measure. Savings used in DSM Portfolio Pro are the *ex ante* gross savings.

Incremental Cost is the expense associated with the installation of energy-efficiency measures and ongoing operation and maintenance costs, where applicable. These costs include the entire cost of installing the measure, and do not net out incentive payments to the customer. The incremental cost is based on data provided by DP&L and secondary research.

Incentive Level is the dollar amount of the rebate paid to a customer by DP&L. The incentive amount for each measure is provided by DP&L.

Freeridership is the percent of participants who would have taken the same action/installed the same measure in the program's absence. Cadmus assumed a net-to-gross ratio of 1.0 for the 2013 analysis.

Spillover is the percent of participants who installed additional energy-savings measures without incentives due to their participation in the program. Spillover was not calculated for the 2013 analysis.

Participation is the number of customers who participated in the program or quantity of measures verified by Cadmus.

Appendix H: Participant Telephone Survey Call Demographic Results

Table 102. Low-Income Program Participant Demographics

Home Characteristics	Low-Income (n=88)
Dwelling Type	
Single-family house	76%
A unit in a multifamily apartment	16%
Manufactured home	1%
Mobile home	5%
Refused	2%
Square Footage of Dwelling (Above Ground)	
Less than 1,000 square feet	9%
1,001-2,000 square feet	20%
2,001-3,000 square feet	3%
3,001-4,000 square feet	1%
4,001-5,000 square feet	0%
Greater than 5,000 square feet	1%
Do not know	61%
Refused	3%
Square Footage of Dwelling (Below Ground)	
Less than 1,000 square feet	16%
1,001-2,000 square feet	4%
2,001-3,000 square feet	0%
3,001-4,000 square feet	0%
4,001-5,000 square feet	0%
Greater than 5,000 square feet	2%
Do not know	62%
Refused	16%
Years Home was Constructed	
Before 1960	24%
Between 1960 and 1969	7%
Between 1970 and 1979	10%
Between 1980 and 1989	2%
Between 1990 and 1999	7%
Between 2000 and 2005	3%
2006 or Later	0%
Do not know	43%
Refused	3%
Ownership Type	
Own	57%
Rent	41%
Other	0%

Home Characteristics	Low-Income (n=88)
Do not know	0%
Refused	2%

Table 103. Residential Heating and Cooling Rebate Program Participant Demographics

Home Characteristics	HVAC Rebate (n=129)
Dwelling Type	
Single-family home, detached construction	91%
Single-family factory manufactured or modular home	2%
Single-family, mobile home	0%
Row house	0%
Two or three family attached residence	0%
Apartment building with four or more families	0%
Condominium	1%
Other	0%
Do not know	3%
Refused	3%
Square Footage of Dwelling (Above Ground)	
Less than 1,000 square feet	2%
1,001-2,000 square feet	30%
2,001-3,000 square feet	25%
3,001-4,000 square feet	9%
4,001-5,000 square feet	2%
Greater than 5,000 square feet	4%
Do not know	27%
Refused	3%
Square Footage of Dwelling (Below Ground)	
Less than 1,000 square feet	42%
1,001-2,000 square feet	27%
2,001-3,000 square feet	16%
3,001-4,000 square feet	10%
4,001-5,000 square feet	2%
Greater than 5,000 square feet	0%
Do not know	3%
Refused	0%
Years Home was Constructed	
Before 1960	29%
1960-1969	17%
1970-1979	11%
1980-1989	6%
1990-1999	23%
2000-2005	3%

Home Characteristics	HVAC Rebate (n=129)
2006 or later	4%
Do not know	4%
Refused	3%

Table 104. Energy Education Program Participant Demographics

Home Characteristics	Energy Education (n=70)
Dwelling Type	
Single-family home, detached construction	86%
Single-family home, factory manufactured/modular	3%
Single-family, mobile home	0%
Row house	0%
Two or three family attached residence—traditional structure	1%
Apartment (4+ families)—traditional structure	7%
Condominium—traditional structure	0%
Do not know	1%
Refused	1%
Square Footage of Dwelling	
Less than 1,000 square feet	3%
1,001-2,000 square feet	29%
2,001-3,000 square feet	29%
3,001-4,000 square feet	6%
4,001-5,000 square feet	3%
Greater than 5,000 square feet	0%
Do not know	29%
Refused	3%
Years Home was Constructed	
Before 1960	23%
1960-1969	14%
1970-1979	17%
1980-1989	7%
1990-1999	11%
2000-2005	11%
2006 or later	4%
Do not know	10%
Refused	1%
Ownership Type	
Own	66%
Rent	33%
Do not know	0%
Refused	1%

Appendix I: Energy and Demand Savings Confidence and Precision

Residential

Cadmus used a multifaceted approach to construct error bounds for final kWh savings estimates due to methods varying across programs, and, in some cases, within individual programs. To determine the uncertainty level, two types of error were considered: measurement (or modeling) error; and sampling error. Measurement error refers to the uncertainty level around engineering parameters derived from simulation or professional judgment. Sampling error refers to uncertainty introduced by the use of sampled data to infer characteristics of the overall population.

For engineering calculations using simulated or assumed parameters, measurement error was assumed to have a relative precision of ±10%. This accuracy level is regarded a minimum for results in the evaluation industry, and results taken from outside evaluations or based on engineering analysis would likely be reliable within these bounds.

An example of this would be the effective full-load hours (EFLH), used in many of the HVAC savings calculations. These values come from simulations conducted by the U.S. Environmental Protection Agency and, as such, have no sampling error. They are not, however, deterministic (average EFLH presumable deviates from these values). Absent documentation on this uncertainty level, Cadmus assumed they were accurate within the industry standard threshold of ±10% relative precision with 90% confidence.

Sampling error was calculated for parameters estimated through some form of sampling. These data included: survey results, meter data, and secondary sources. Sampled data were used in the evaluation of several programs to estimate parameters to be utilized in per-unit savings calculations (such as installation rates) or in consumption of specific equipment types (such as in billing analysis).

In some cases, uncertainty of estimates derived from multiple sources. For example, for summed estimates (such as those for total program savings), the root of the sum of the squared standard errors was calculated to estimate the confidence interval:[51]

$$Confidence\ Interval_{\bar{X}+\bar{Y}} = (\bar{X}+\bar{Y}) \pm 1.645 * \sqrt{\left(\frac{s^2{}_{\bar{X}}}{n_{\bar{X}}}\right)+\left(\frac{s^2{}_{\bar{Y}}}{n_{\bar{Y}}}\right)}$$

In some cases, Cadmus multiplied estimates. For example, evaluating ARP gross per-unit savings calculations involved combining full-year gross estimates from a regression-based metering analysis, with average annual running times estimated from participant surveys. For these results, Cadmus

[51] This approach to aggregation errors follows methods outlined in Appendix D from Schiller, Steven et. al. “National Action Plan for Energy Efficiency”. Model Energy Efficiency Program Impact Evaluation Guide. 2007. www.epa.gov/eeactionplan.

calculated combined standard errors for the final estimates. In cases where the relationship was multiplicative, Cadmus used the following formula:[52]

$$Confidence\ Interval_{\bar{X}*\bar{Y}} = \bar{X} * \bar{Y} \pm 1.645 * \sqrt{\bar{Y}^2\left(\frac{s^2{}_{\bar{X}}}{n_{\bar{X}}}\right) + \bar{X}^2\left(\frac{s^2{}_{\bar{Y}}}{n_{\bar{Y}}}\right) + \left(\frac{s^2{}_{\bar{X}}}{n_{\bar{X}}}\right)\left(\frac{s^2{}_{\bar{Y}}}{n_{\bar{Y}}}\right)}$$

Table 105. Residential Energy Savings Precision

Program	Precision at 90%	Sources of Uncertainty
Lighting	14.6%	TRM algorithms and assumptions
Appliance Recycling	±11.0%	Model analysis, 2012 part-use survey inputs, TRM algorithms and assumptions
Low-Income	± 11.1%	TRM algorithms and assumptions, CFL ISR, showerhead and aerator measure inputs from Cadmus 2012 Michigan water study
HVAC Rebate and Tune-Up	3.81%	Secondary meter data, participant survey, and TRM algorithms and assumptions.
Be E3 Smart	17%	Follow-up parent survey, TRM algorithms and assumptions

Nonresidential

For commercial and industrial programs, DP&L provided Cadmus with a project database that included calculated and deemed (*ex ante*) claimed savings values for each nonresidential project. Cadmus performed site visits and engineering desk reviews to calculate adjusted gross savings for a sample of projects. This included using these activities to estimate realization rates, which could then be applied to projects outside of the samples to obtain realized savings estimates. Cadmus divided projects selected for site visits and desk review samples into Prescriptive and Custom Rebate programs, and performed the analyses separately.

For the Prescriptive Rebate program, Cadmus first estimated savings, standard errors, and precision levels by measure type, and aggregated these results into the program-level savings estimate, standard error, and precision. As lighting projects spanned an especially wide range of *ex ante* savings values (from 57 kWh to over 3.1 million kWh), Cadmus divided prescriptive lighting savings by strata, according to the aggregate reported *ex ante* claimed savings for each project, then allocated each project to each strata according to the proportional representation across the population.

Further, given the heterogeneity in measure-level energy savings for other prescriptive measures beyond lighting, such as HVAC and Motors, Cadmus designed two additional strata to capture the variance for these measures, and finally one "Other" strata for the remaining prescriptive projects. Table 106 reports the cut points and the distribution of sites for each strata.

[52] Goodman, Leo. "The Variance of the Product of K Random Variables." Journal of the American Statistical Association. 1962.

Table 106. C&I Prescriptive Lighting Stratification

Statistic	Small	Medium	Large
kWh Range	<100,000	100,000-500,000	>500,000
Number of Projects	766	59	10
Total ex ante kWh	14,087,651	12,129,405	7,850,422

Cadmus also separated custom projects into three strata: large custom, small custom, and new construction.

Table 107. Custom Stratification

Statistic	Small	Large	NC
kWh Range	<100,000	>100,000	N/A
Number of Projects	68	27	20
Total ex ante kWh	1,738,100	10,682,770	4,395,046

The remaining project types were: prescriptive HVAC, prescriptive motors, and prescriptive other; Cadmus treated each as a single stratum.

Verification samples targeted projects in the large strata. This emphasis reduced uncertainty in overall savings estimates by directly verifying a large proportion of savings. Cadmus obtained total savings estimates and precision levels with 90% confidence, as shown in the Table 108.

Table 108. Nonresidential Gross Energy Savings, Custom and Prescriptive

Prescriptive Program Savings		Custom Program Savings	
Total Estimated Savings (KWh)	Precision at 90% Confidence	Total Estimated Savings (KWh)	Precision at 90% Confidence
52,072,638	5.9%	16,466,532	5.4%

Energy-savings estimates for individual measure categories follow. Precision at the 90% confidence is provided for each estimate. Categories with large kWh savings totals have tighter precision than those with small savings totals. This is because we allocated evaluation resources with the goal of producing efficient program-level estimates.

Table 109. Nonresidential Summary of Energy Savings Precision Estimates

Measure Type	Reported Savings (kWh)	Estimated Savings (KWh)	Realization Rate	Precision at 90% Confidence
Large Lighting	7,850,422	9,253,959	118%	10.4%
Medium Lighting	12,129,405	12,662,015	104%	13.5%
Small Lighting	14,087,651	15,346,977	109%	16.1%
P-Motors	8,139,621	7,906,435	97%	2.3%
P-HVAC	5,175,482	6,176,724	119%	17.4%
P-Other	1,068,089	726,528	68%	14.5%
Large Custom	10,682,770	10,364,562	97%	4.6%
Small Custom	1,738,100	2,137,315	123%	23.8%
NC	4,395,046	3,964,655	90%	18.3%

Appendix J: Non-Residential Light Logging Summary

In order to accurately calculate the savings for prescriptive lighting projects, Cadmus recommended installation of light loggers to record the actual hours of use (HOU). The memo summarizes light logger specifics (such as logger location, number of loggers, time of installation etc.) for each site. Information provided in the appendix should be used by DP&L to retrieve the loggers.

Cadmus installed 93 light loggers to record the HOU at sixteen different sites.

Table 110. Non-Residential Number of Light Loggers Installed by Project

#	DP&L Project ID	Project #	Number of Light Loggers Installed
1	DP&L-R1-1	2O11ZU8I	7
2	DP&L-R1-2	DT1RMRJ2	4
3	DP&L-R1-11	5Z2FDA7U	10
4	DP&L-R1-17	H15L6124	2
5	DP&L-R1-12	NVWQG8SP	2
6	DP&L-R1-17	G5BIVYJC and 1MOXGM28	9
7	DP&L-R1-15	MJ5MV20I	6
8	DP&L-R1-22	JFHRI1EE	2
9	DP&L-R1-23	5X4ZS8BM	2
10	DP&L-R2-1	BCDCJHJM	6
11	DP&L-R2-18	OVK2DNP0	6
12	DP&L-R2-23	X8PMOKLY	10
13	DP&L-R2-28	Q5DUTSJM	8
14	DP&L-R2-34	BXJP2BPT	3
15	DP&L-R2-39	58DUQ6WU	6
16	DP&L-R2-42	EPV4HPX8	10
Total			**93**

While conducting phone calls to schedule site visits, Cadmus verified the reported lighting HOU for each project. We selected any project that reported a discrepancy of more than +/- 10%. Based on this criterion, 16 sites were selected for metering.

DP&L Database

DP&L gave Cadmus access to the rebate program database in order to select a sample for the site visits and review project documentation. The database provides information such as customer contact, confirmation number (project ID), claimed energy and demand savings, lighting HOU, project date of completion, rebate status, and vendor name. The database also contains supporting documentation such as invoices, rebate application forms, and new lighting specification.

Since this was a prescriptive program, project specifics such as location of new fixtures, space types, lighting controls, and where new fixtures were installed were not available.

Logger Installation Protocol

During the site visit, Cadmus inspectors decided the quantity and location of logger installation based on space types (locker room, office, restroom, etc.). For example, one of the selected sites selected was a school. While on site, we verified that the lighting HOU reported for the project was not applicable to all the space types: classrooms, hallways, and auditorium. Since these spaces each had different lighting schedule, we installed loggers.

The number of loggers installed in each space ensured redundancy. The recorded HOU for the redundant logger will be averaged and applied to all of the fixtures in the respective space type. Light loggers were calibrated on-site before installation, to ensure correct operation. Logger data collection period will be 2 weeks.

At each site, we installed Onset HOBO light loggers (model # UX-90). Loggers were installed inside the lighting fixture, with direct exposure to the lamp and hidden from natural light.

Logger Retrieval Protocol

Once the data collection period is over, the loggers will be retrieved and returned to Cadmus by DP&L. A detailed description of locations and special instructions to access each logger (site contact, ladder/scissor lift required, etc.) is provided to DP&L. Personnel retrieving the loggers should follow the following steps:

- Before scheduling the visit, identify loggers that need ladder/scissors lift/harness for access as indicated on the logger data collection form for that site. Any special equipment needed should be prearranged.
- Once on site, survey and locate all rooms/spaces where loggers are installed before starting retrieval procedure.
- Once logger locations have been identified, retrieve loggers and note the data and time in the data collection sheets.
- If logger(s) are missing/damaged/relocated, please notify the Cadmus contact before leaving the site.
- When loggers from the seven sites are retrieved, mail them to Cadmus's Portland office (720 SW Washington St, Suite 400, Portland 97205)

Analysis

Data from the loggers will be filtered and analyzed, and the HOU for each space type will be determined. The recorded HOU will be extrapolated to annual HOU for each space type considering whether the space is occupied on weekends and annual holidays. Cadmus will determine the total project energy

(kWh) savings by calculated HOU and the number of fixtures and lamp wattages verified during the site visit. We will calculate peak demand (kW) savings by following the Ohio TRM methodology for determining the appropriate peak coincidence factors.

Appendix K: Non-Residential Site Visit Summary

September 2013 Site-Specific Findings

The following projects were verified during the September 2013 site visits:

Table 111. September 2013 Nonresidential FY13 Site Visit Summary

#	DP&L Project ID	Verified Sampled Project #	Verified Non - Sampled Project #
1	DP&L-R1-1	2O11ZU8I	
2	DP&L-R1-2	DT1RMRJ2	
3	DP&L-R1-3	R97CGHPG	
4	DP&L-R1-4	HXGXLRA0	
5	DP&L-R1-5	2XCLD4R0	
6	DP&L-R1-6	CXXFG30N	
7	DP&L-R1-7	9A9I8YVH	
8	DP&L-R1-8	QZK32E35	
9	DP&L-R1-9	BIO06W2L	
10	DP&L-R1-10	C158LXG1	
11	DP&L-R1-11	5Z2FDA7U	
12	DP&L-R1-12	NVWQG8SP	
13	DP&L-R1-13	H5LLAX74	
14	DP&L-R1-14	2M41W6AC	
15	DP&L-R1-15	6OAG61BV	
16	DP&L-R1-16	MJ5MV2OI	
17	DP&L-R1-17	H15L6124	
18	DP&L-R1-18	G5BIVYJC	1MOXGM28
19	DP&L-R1-19	WG03HXT7	
20	DP&L-R1-20	9DTXILAJ	
21	DP&L-R1-21	7U901S3K	EIW0V1L9
22	DP&L-R1-22	JFHRI1EE	
23	DP&L-R1-23	5X4ZS8BM	
24	DP&L-R1-24	XD0LKPLH	AZMF5BKZ
25	DP&L-R1-25	WE9LZT14	
26	DP&L-R1-26	G5KVCA8H	

Also, as part of the FY 2013 year evaluation, light loggers were installed at some sites to verify hours of operation for the lighting fixtures. This was done because hours of operation historically had the biggest impact on overall program realization rate. Cadmus provided a separate memo outlining light logger installation locations, protocols and retrieval procedures. Table below provides list of sites where light logger were installed:

Table 112. September 2013 Sites Selected for Light Metering

#	DP&L Project ID	Project #	# of Light Loggers Installed
1	DP&L-R1-1	2O11ZU8I	7
2	DP&L-R1-2	DT1RMRJ2	4
3	DP&L-R1-10	5Z2FDA7U	10
4	DP&L-R1-16	H15L6124	2
5	DP&L-R1-11	NVWQG8SP	2
6	DP&L-R1-17	G5BIVYJC and 1MOXGM28	9
7	DP&L-R1-15	MJ5MV20I	6
8	DP&L-R1-22	JFHRI1EE	2
9	DP&L-R1-23	5X4ZS8BM	2
Total			**44**

Site visit project summaries for September 2013

Table 113. DP&L-R1-1 (Project Number: 2O11ZU8I)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PM- Lighting	LED luminaires up to 18 watts (replacing incandescent)	400	400	0
PM- Lighting	LED luminaires up to 18 watts (replacing incandescent)	831	831	0

Notes: Cadmus verified 400 12W and 831 17W lamps. An additional 15 12W and 50 17W lamps were also counted on site but did not appear on DP&Ls rebate documentation. The entire store's track light lamps installed were verified by Cadmus to be exclusively LED lamps. The store's posted hours of operation indicated 3,744 annual hours as compared to the project's stated annual hours of 2,744. Due to the discrepancy in operating hours, Cadmus deployed seven light loggers randomly around the store to measure the hours of operation for one month. The manager indicated to Cadmus that all of the lights are on the same schedule.

Table 114. DP&L-R1-2 (Project Number: DT1RMRJ2)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PS-Lighting	LED luminaires up to 18 watts (replacing incandescent)	822	822	0

Notes: Cadmus verified the quantity of lamps to match the reported value. The entire store's track light lamps installed were verified by Cadmus to be exclusively LED lamps. The store's posted hours of operation indicated 3,744 annual hours as compared to the project's stated annual hours of 4,380. Due to the discrepancy in operating hours, Cadmus deployed four light loggers randomly around the store to measure the hours of operation for one month. The manager indicated to Cadmus that all of the lights are on the same schedule.

Table 115. DP&L-R1-3 (Project Number: R97CGHPG)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PM-Lighting	T8 high-bay 4-foot 6 lamp fixture replacing HID	112	112	0
PM-Lighting	Delamping T12 (# linear feet)	40	40	0
PM-Lighting	Low-watt T8 4-foot 4 lamp fixture replacing T12	24	24	0
PM-Lighting	Low-watt T8 4-foot 2 lamp fixture replacing T12	2	2	0

Notes: Cadmus verified the quantity of lamps to match the reported value. The hours were verified by a facility manager and did not deviate by more than 10% from the project's claimed annual hours of 7,500. Light loggers were not installed.

Table 116. DP&L-R1-4 (Project Number: HXGXLRA0)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PM-Lighting	T5 high-output high-bay 6 lamp fixture replacing HID	81	88	+7
PM-Lighting	T5 high-output high-bay 6 lamp fixture replacing HID	51	29	-22

Notes: Cadmus verified 88 6-lamp T5 fixtures in the aluminum area where there were 81 reported fixtures. In the zinc west area Cadmus verified 29 6-lamp T5 fixtures, and in the zinc east area Cadmus verified 29 of the original Metal Halide fixtures. The project indicated 51 6-lamp T5 fixtures would be present. The aluminum area is a high bay area with machining equipment and an overhead crane. The zinc area is a medium bay area with machining equipment. The contractor electrician and house technician indicated to Cadmus that the zinc area was going to have the east area's equipment re-laid out, such that the lighting fixture upgrades will not be implemented until the final location of the equipment and light fixtures is determined. Cadmus confirmed that both areas operate 24/7 which matched reported hours of operation. Light loggers were not installed.

Table 117. DP&L-R1-5 (Project Number: 2XCLD4R0)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Motors	Variable frequency drive up to 250 HP	1	1	0
P-Motors	Variable frequency drive up to 250 HP	1	1	0

Notes: Cadmus verified one 40 hp pump motor and one 10 hp pump motor to have VFD installed which matched reported values. The pumps feed two large recreational slides that enter the pool. The facility manager indicated to Cadmus the facility operates 12 hours per day from May 1st until the week after Labor Day. Cadmus estimates 1572 annual hours of operation, which is lower than the reported 2760 annual hours of operation. Cadmus collected no information regarding Hz or kW under operation due to the pools being empty.

Table 118. DP&L-R1-6 (Project Number: DT1RMRJ2)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-HVAC	Variable frequency drive up to 250 HP	4	4	0
P-HVAC	Variable frequency drive up to 250 HP	4	4	0

Notes: Cadmus verified fan motor VFD counts to match reported values in the penthouse air-handler rooms. In each penthouse there is a supply fan motor VFD and a return fan motor VFD. Each supply fan motor is 30 HP, while each return fan motor is 15 hp. Cadmus verified the supply fan VFDs were averaging 39.7 Hz and the return fan VFDs were averaging 39.8 Hz while on-site. The facility manager indicated to Cadmus operation of 15.5 hours per day plus 24/7 operation when the temperature is above 80F or below 15F. Cadmus estimates annual hours of operation to be higher than the 4250 reported annual hours.

Table 119. DP&L-R1-7 (Project Number: 9A9I8YVH)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Custom	Evaporator Motor ECM Freezer	3	3	0
Custom	Evaporator Motor ECM Cooler	8	8	0

Notes: Cadmus verified motor counts matched reported values and fans operate continuously.

Table 120. DP&L-R1-8 (Project Number: QZK32E35)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Custom	Evaporator Motor ECM Freezer	3	2	-1
Custom	Evaporator Motor ECM Cooler	8	8	0

Notes: Cadmus verified motor counts matched reported values and fans operate continuously. The district facility technician indicated to Cadmus that one of the freezer ECM motors failed. The original model is reinserted until a replacement ECM is installed.

Table 121. DP&L-R1-9 (Project Number: BIO06W2L)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Motors	Variable frequency drive up to 250 HP (13 HP effluent)	4	4	0
P-Motors	Variable frequency drive up to 250 HP (13 HP intermediate lift)	3	3	0
P-Motors	Variable frequency drive up to 250 HP (13 HP intermediate lift)	1	1	0
P-Motors	Variable frequency drive up to 250 HP (30 HP influent)	1	1	0
P-Motors	Variable frequency drive up to 250 HP (30 HP influent)	1	1	0

Notes: Cadmus verified (2) 30 hp influent pumps with VFDs run (1) 24/7 and (1) 75% of time. Cadmus verified (4) 13 hp submersible effluent pumps with VFDs operate only during an emergency (250 annual hours). Cadmus verified (4) 13 hp submersible intermediate lift pump with VFD run 24/7 one at a time and operate lead/lag by the week. A facility technician indicated to Cadmus a second (sometimes) or third (rarely) pump will vary depending on flow. The pump in operation was verified at 40 Hz while on-site. In additional, Cadmus verified (4) 50 hp aerators with VFDs run 24/7, (2) are fixed at 40 Hz, the other (2) vary and ran at 53.3 Hz on-site. The VFDs on the 50 hp aerators are not in the reported count.[53]

Table 122. DP&L-R1-10 (Project Number: 5Z2FDA7U)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PM-Lighting	Relamping 28 watt	2,572	2,572	0
PM-Lighting	Delamping T8 (# linear feet)	1,204	1,204	0
PM-Lighting	T8 high-bay 4-foot 6 lamp fixture replacing HID	28	28	0
PM-Lighting	Low-watt T8 4-foot 3 lamp fixture replacing T8	142	142	0
PM-Lighting	Low-watt T8 4-foot 2 lamp fixture replacing T8	159	159	0

Notes: Cadmus verified fixture and lamp counts matched reported values. Cadmus installed ten light loggers (five in classrooms, five in halls) for one month to verify the reported 3,510 annual hours.

Table 123. DP&L-R1-11 (Project Number: NVWQG8SP)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	T8 high-bay 4’ 6-lamp fixtures replacing metal halide fixtures	50	50	0

Notes: Cadmus verified fixture count matched reported values. The site contact reported to Cadmus a 34% difference in annual lighting hours compared to reported hours. Cadmus installed two light loggers in the facility to monitor the lighting runtime for one month. The site contact operated a scissor lift so that the Cadmus technician could install the loggers at the fixtures using magnet connections. Cadmus could not verify total fixture wattage on site since the fixtures could not be safely disassembled in the lift to record the ballast information. Cadmus verified bulb wattage at 32 watts.

All fixtures operate in the same space and were confirmed by the site contact to Cadmus to operate on the same schedule. The second logger is installed to act as redundancy in case of logger failure.

[53] It is likely that these VFDs are a part of another project.

Table 124. DP&L-R1-12 (Project Number: H5LLAX74)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	14W LED Luminaires replacing 75W Incandescent bulbs	71	63	-8
P-Lighting	11W LED Luminaires replacing 35W Incandescent bulbs	35	37	2

Notes: The store manager indicated to Cadmus that all upgraded lighting was in the dining area. The Cadmus technician confirmed LED lighting is only in the dining area. The upgrade included 14W LED flood lamps in recessed fixtures and 11W LED flood lamps on track fixtures. Cadmus could not confirm the wattage of the bulbs but noted the difference in style/size and assumed the larger track bulbs to be 14W and the smaller bulbs in the recessed fixtures to be 11W. Cadmus verified two additional 11W fixtures than reported, and verified eight less 14W fixtures than were reported.

Cadmus was unable to verify annual hours of operation because the store manager and corporate site contact requested that no light logger be installed in the dining area.

Table 125. DP&L-R1-13 (Project Number: 2M41W6AC)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	11W LED replacing incandescent	50	50	0

Notes: Cadmus verified the fixture count and wattage matched the reported values. The site contact confirmed to Cadmus the operating hours matched the reported value. Cadmus counted 94 total 11W LEDs in the building. The store manager informed Cadmus that the 94 bulbs were installed in several phases during 2013, indicating that the additional 44 were supplemented from other store locations or purchased without the rebate program.

Table 126. DP&L-R1-14 (Project Number: 6OAG61BV)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	Delamping HID	16	16	0
P-Lighting	T8 high-bay 4’ 6-lamp fixtures replacing metal halide fixtures	14	14	0

Notes: The site contact confirmed to Cadmus the annual operating hours matched the reported value. Cadmus was unable to verify bulb and ballast wattages due to no on-site lift or ladder for this high bay manufacturing shop. Cadmus confirmed that 14 T8-4F-6L fixtures were installed, but the site contact asserted that 30, not 16, metal halide fixtures were de-lamped in the bay. Cadmus confirmed that the adjacent metal halide bays in the shop contained a higher concentration of fixtures than the upgraded bay, indicating that the project required a higher ratio of fixture de-lamping to efficient fixture installs. DP&L de-lamping qualifications require the total number of lamps claimed for de-lamping cannot be more than the number of replacement lamps installed. Since count of the T8 fixtures equals 14, it appears an additional 2 de-lamped HIDs were over reported.

Table 127. DP&L-R1-15 (Project Number: MJ5MV20I)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	18W LED luminaires replacing incandescent	1,166	1,166	0
P-Lighting	13W LED luminaires replacing incandescent	247	247	0

Notes: Cadmus determined the size difference between the 18W LED bulbs and the 13W LED bulbs before performing the inventory on the sales floor. Cadmus verified the wattage of both bulbs with a spot check of installed bulbs and replacement bulbs. The site contact indicated to Cadmus that some bulbs were non-incented 17W bulbs. The 17W bulbs were very hard to distinguish from the 18W bulbs during the verification. Cadmus recorded a count of 1,331 18W/17W bulbs, the 165 excess were attributed to the 17W bulbs. Cadmus then counted 240 of the 13W bulbs, but noted that some of the high bay track lighting bulbs could have been mistaken for an 18W or 17W bulb. Taking into account this uncertainty, Cadmus determined the claimed count of 247 was accurate.

The site contact reported to Cadmus that the annual hours of lighting differed by more than 10% compared to reported hours. Cadmus installed six lighting loggers throughout the store in order to monitor the lighting runtime for one month. Metered bulbs were selected to represent a variation in bulb wattage, space type, fixture type (recessed vs. track), and redundancy in case of failure. All store lighting share the same schedule so no variation in hours of use was necessary.

Table 128. DP&L-R1-16 (Project Number: H15L6124)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	7W LED luminaires replacing incandescent	27	27	0
P-Lighting	17W LED luminaires replacing incandescent	22	22	0

Notes: The upgraded lighting space for this site was the school auditorium. On the day of the scheduled visit, access to the auditorium was limited due to a school function. Access was restricted to the balcony, where the 17W LED wattages and quantity were be verified. The 7W LEDs are located beneath the balcony in the entrance way to the auditorium main seating. With limited access to the entry, Cadmus was able to confirm all 27 of the 7W LEDs.

The site contact reported to Cadmus the lighting annual hours to be ten times that of the reported hours. Cadmus installed two lighting loggers in order to monitor the auditorium lighting use for one month. Cadmus was only able to meter the balcony; the main hall ceiling was too high to access and the entry way lighting had to remain off for the remainder of the site-visit (installing the light loggers requires the light source to be switched on).

The 2 lighting loggers installed will represent the 17W LEDs, and act as a proxy to estimate the 7W LEDs. The two lighting groups are on different controls, but the site contact maintained that the run hours are similar.

Table 129. DP&L-R1-17 (Project Numbers: G5BIVYJC and 1MOXGM28)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	Wall-mounted occupancy sensors (motion)	39	39	0
P-Lighting	Wall-mounted occupancy sensors (dual)	9	9	0

Notes: The 39 motion-activated sensors rebated for this site use infrared technology to detect occupancy, and the 9 dual technology sensors use both infrared and audio sensors to detect occupancy.

The campus electrician reported to Cadmus that all rebated occupancy sensors were installed in either locker room or bathroom spaces on campus with no records detailing which rooms the sensors were placed. Cadmus had the electrician tour across a sample of 3 dormitories, 2 office buildings and the gymnasium. Cadmus was unable to visually differentiate between the two types of occupancy sensors or survey every locker room and bathroom on campus to count all occupancy sensors installed. In six buildings, all 34 bathrooms and locker rooms Cadmus surveyed contained an occupancy sensor. Cadmus determined that the rest of the reported occupancy sensors were installed in other buildings on campus. Cadmus installed nine loggers to monitor the runtime controlled occupancy sensors for one month. The different space types varied between office men/women's bathrooms, dormitory men/women's bathrooms, and men/women's locker rooms.

Table 130. DP&L-R1-18 (Project Number: WG03HXT7)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	LED luminaires replacing metal halide bulbs	4	4	0

Notes: Cadmus verified the count of outdoor LED spot lights to match reported values. Cadmus was unable to verify wattage of fixtures due to fixtures not being labeled. Cadmus verified that fixtures are controlled by photo sensor through interviews with the business owner and site contact.

Table 131. DP&L-R1-19 (9DTXILAJ)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	LED red traffic signal	198	198	0
P-Lighting	LED green traffic signal	198	198	0
P-Lighting	LED pedestrian walk/don't walk signal	113	113	0
P-Lighting	LED turn traffic signal	48	48	0

Notes: Cadmus verified 13 of 22 intersections matched reported fixture counts with the aid of Go Sustainable Energy's June 2013 installation verification memo. Cadmus determined that Go Sustainable Energy's counts for the remaining 9 intersections were also accurate, due to zero discrepancies on the 13 verified intersections. Cadmus had no access to the signal bulbs to verify the wattages; however, the Go Sustainable Energy's memo has photos of nameplates and wattages for all measures for which they had access to a bucket truck and permission to remove signal covers.

Table 132. DP&L-R1-20 (Project Number: C158LXG1)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	Replacing 250W fixtures with 26W LEDs	30	45	15

Notes: Cadmus verified a total of 45 fixtures were installed. The site contact indicated to Cadmus all fixtures were installed through the rebate program.[54] Cadmus could not verify bulb wattages due to fixtures not having nameplates. The site contact was able to confirm to Cadmus that reported hours of use were accurate.

Table 133. DP&L-R1-21 (Project Numbers: 7U901S3K and EIW0V1L9)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	LED or Induction (operating hours < 8,760) replacing 251W to 400W	12	12	0
P-Lighting	LED luminaires up to 18 watts (replacing incandescent)	12	12	0

Notes: Cadmus verified fixture counts matched reported values. The parking lot 400 W metal halide were upgraded to 78 W LED. Cadmus was unable to verify fixture wattage in the parking lot, but the owner confirmed fixture wattage matched reported values. The parking lot lights are activated by photocell and are turned off when the store closes. The store is open until 11 PM from Memorial Day to Labor Day and until 10 PM the rest of the year. Above the service window is a roof overhang containing the second lighting upgrade. Cadmus verified the LEDs are 17 Watts. These lights are activated by photocell and run all night, 365 days a year. No HVAC factors were taken into account as all of the lighting is outdoors.

Table 134. DP&L-R1-22 (Project Number: JFHRI1EE)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	LED lighting in reach-in freezer/cooler case	18	18	0

Notes: The Cadmus technician verified that 16 fixtures in the coolers and 2 fixtures in the freezers have been upgraded to LED strips. Cadmus was unable to find product numbers to verify fixtures. Cadmus noted that fixtures in coolers measured 66” with a single row of 12 LEDs and fixtures in freezers measured 45” with two rows of 5 LEDs. Light loggers were installed in the top corner of each reach-in cooler sections.

[54] Cadmus will confirm if there were multiple projects rebated at this site.

Table 135. DP&L-R1-23 (Project Number: 5X4ZS8BM)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	LED 4-ft 4-lamp tubes	17	17	0
P-Lighting	T8 (BF < 0.78) 4-foot 4 lamp fixture replacing T12	12	N/A	N/A
P-Lighting	T8 (BF < 0.78) 4-foot 2 lamp fixture replacing T12	1	1	0

Notes: The owner was unfortunately not available to meet with Cadmus during the site visit. The Cadmus technician was unable to locate the T8 4-foot 4 lamp fixtures. There is a car wash on the premises that is closed for construction. The station attendant was unable to confirm to Cadmus if this was the location of the unverified fixtures. Cadmus confirmed 17 LED fixtures inside the station. These were 4-foot 2 lamp LED fixtures which replaced 4-foot 4 lamp linear fluorescent fixtures. The attendant notified Cadmus that only 4 fixtures located above the register run 24/7 on an emergency circuit, the remaining fixtures are on only when the store is open, which differs from the reported 8760 annual operating hours for all fixtures. Cadmus installed two light loggers (one above the register, one at other end of store) to determine hours of operation.

Table 136. DP&L-R1-24 (Project Numbers: XD0LKPLH and AZMF5BKZ)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	LED/Induction (op. < 8,760) replacing 175W	18	18	0
P-Lighting	LED up to 18 watts (replacing incandescent)	277	277	0

Notes: This upgrade encompassed a large cafeteria, the central hallways of each floor, and the loading dock for the building. The site contact confirmed to Cadmus the hours of operation reported are accurate. The facilities manager also noted that the 187 fixtures in the cafeteria are run by a dimming panel and during the day they operate at 50%. During events or at night they operate at 100%. Cadmus confirmed that 14 W LED flood lamps were installed in both the cafeteria and hallways, while 26 W LED A-lamps were installed by the loading dock.

Table 137. DP&L-R1-25 (Project Number: WE9LZT14)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	T8 high-bay 4-foot 6 lamp fixture replacing HID	20	20	0

Notes: The site is currently switching all lighting from HID to T8 high-bay fixtures. Cadmus verified the existing fixtures as 400W metal halide and the upgrade fixtures as T8 high-bay 4-foot 6 lamp. The site contact showed Cadmus that they have been replacing fixtures as needed or as accessible without order to the installation. A total of 139 T8 4-ft 6L fixtures were verified and the site contact and facilities manager both claim they have all been installed in 2013. The rebates for these have been filed more recently and may not show up in this sample. Cadmus verified a separate area in the back of the factory has all 20 fixtures replaced. The hours of operation were confirmed to be accurate to Cadmus by the site contact.

Table 138. DP&L-R1-26 (Project Number: G5KVCA8H)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Lighting	LED lighting in reach-in freezer/cooler case	9	16	7

Notes: Cadmus verified the fixture model reported with 4 fixtures installed in the reach-in coolers and 12 fixtures installed in the reach-in freezers. The store contact confirmed to Cadmus the hours of operation reported are accurate.

January 2014 Site-Specific Findings

The following projects were verified during the January 2014 site visits:

Table 139: January 2014 Nonresidential FY13 Site Visit Summary

#	DP&L Project ID	Verified Sampled Project #	Verified Non - Sampled Project #
1	DP&L-R2-1	BCDCJHJM	6DUTT41A 10X311ZJ G8M5KP62
2	DP&L-R2-2	1IYXG3VQ	
3	DP&L-R2-3	7EE9CSKM	
4	DP&L-R2-4	29CFDCWN	
5	DP&L-R2-5	7KG3S662	
6	DP&L-R2-6	RC2VYIUF	
7	DP&L-R2-7	WK0IA8FX	
8	DP&L-R2-8	NC-3	
9	DP&L-R2-9	T9X8R0C4	2X1G6P1L
10	DP&L-R2-10	F85YGGN3	EXXQM4NL
11	DP&L-R2-11	NC-8	
12	DP&L-R2-12	NC-6	
13	DP&L-R2-13	1KOJE2KS	
14	DP&L-R2-14	59VVDI6GV	
15	DP&L-R2-15	O6QEL844	
16	DP&L-R2-16	F76LTI7E	
17	DP&L-R2-17	IFTJNJNW	
18	DP&L-R2-18	OVK2DNP0	
19	DP&L-R2-19	H0877AJX	
20	DP&L-R2-20	YPHOP892	8H504VKJ XCXHFU0V
21	DP&L-R2-21	H8EHHSPY	
22	DP&L-R2-22	IBZ9SZE6	
23	DP&L-R2-23	X8PMOKLY	
24	DP&L-R2-24	7UZSLVNY	
25	DP&L-R2-25	63R3JXB9	
26	DP&L-R2-26	NUKXW0YX	

#	DP&L Project ID	Verified Sampled Project #	Verified Non - Sampled Project #
27	DP&L-R2-27	C8B62495	
28	DP&L-R2-28	Q5DUTSJM	
29	DP&L-R2-29	7FAKDTZR	
30	DP&L-R2-30	V2X66K7Z	
31	DP&L-R2-31	84A8RRSI	
32	DP&L-R2-32	ED04HFJF	
33	DP&L-R2-33	6ZQM06UC	C0H91WBF
34	DP&L-R2-34	BXJP2BPT	
35	DP&L-R2-35	5HU93I46	4761FF6F F2EIWRVA
36	DP&L-R2-36	YN6AN5JB	
37	DP&L-R2-37	2CH7AMFS	
38	DP&L-R2-38	N3ZIHUEO	S24JKCF2
39	DP&L-R2-39	58DUQ6WU	UZJ0NDDE
40	DP&L-R2-40	AM7CWQ49	
41	DP&L-R2-41	CS4907D0	
42	DP&L-R2-42	EQV4HPX8	
43	DP&L-R2-43	YFO7QZVX	
44	DP&L-R2-44	JC2JGWTH	

Also, as part of the FY 2013 year evaluation, light loggers were installed at some sites to verify hours of use (HOU) for the lighting fixtures.

Table 140: January 2014 Sites Selected for Light Metering

#	DP&L Project ID	Project #	# of Light Loggers Installed
1	DP&L-R2-1	DCDCJHJM	6
2	DP&L-R2-18	OVK2DNP0	6
3	DP&L-R2-23	X8PMOKLY	10
4	DP&L-R2-28	Q5DUTSJM	8
5	DP&L-R2-34	BXJP2BPT	3
6	DP&L-R2-39	58DUQ6WU	6
7	DP&L-R2-42	EPV4HPX8	10
Total			**49**

Site visit project summaries for January 2014

Table 141 shows the reported and verified measures at this site. Lighting upgrade projects were implemented in different space types. Cadmus verified lighting measure implementation by inspecting a sample of lighting fixtures in these spaces. Due to discrepancy in reported and verified hours of use (HOU), this site was selected for light metering. Cadmus installed six light loggers randomly around the facility to measure HOU.

We verified installation of 2 VFDs on wash pumps and 1 VFD on the combustion air blower for dryer. The new variable speed drives replaced on/off starters.

Table 141: DP&L-R2-1 (Project Number: BCDCJHJM; 6DUTT41A; 10X311ZJ; G8M5KP62)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Project Confirmation # BCDCJHJM				
PS-Lighting Fixtures and Controls	Low-watt T8 4-foot 3 lamp fixture replacing T12*	40	40	0
PS-Lighting Fixtures and Controls	Low-watt T8 4-foot 3 lamp fixture replacing T12*	75	75	0
PS-Lighting Fixtures and Controls	Delamping T12 (# linear feet)	760	760	0
PS-Lighting Fixtures and Controls	Low-watt T8 4-foot 2 lamp fixture replacing T12*	21	21	0
Project Confirmation #6DUTT41A				
PM-Lighting Fixtures and Controls	Relamping 28 watt	781	781	0
PM-Lighting Fixtures and Controls	Delamping T8 (# linear feet)	796	796	0
PM-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	69	69	0
PM-Lighting Fixtures and Controls	Low-watt T8 4-foot 2 lamp fixture replacing T8	48	48	0
PM-Lighting Fixtures and Controls	Low-watt T8 4-foot 3 lamp fixture replacing T8	113	113	0
PM-Lighting Fixtures and Controls	Delamping T8 (# linear feet)	456	456	0
PM-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	12	12	0
PM-Lighting Fixtures and Controls	Low-watt T8 4-foot 2 lamp fixture replacing T8	57	57	0
Project Confirmation #1OX3I1ZJ				
C-Lighting Fixtures and Controls	Replace (10) 150W HPS fixtures with (9) Lithonia LED OLW31 fixtures	9	9	0
C-Lighting Fixtures and Controls	Replace (12) 150W HPS fixtures with (9) New, Lithonia FSW4 3 32 S1X20 MVOLT 1/3 GEB10ISL	9	9	0
C-Lighting Fixtures and Controls	Replace (1) 150W HPS fixture w/ (1) Lithonia DMW 2 32 MVOLT GEB10IS	1	1	0
C-Lighting Fixtures and Controls	Replace (6) 150w HPS fixtures with (6) Lithonia 2WRT G 4 17 A12125 MVOLT 1/4 GEB10IS	6	6	0
C-Lighting Fixtures and Controls	Replace (4) 100W MH recessed can with (4) new, ICO-40/50-6AR-	4	4	0

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
	60-277			
C-Lighting Fixtures and Controls	Replace (4) 250W MH recessed can fixtures with (4) New, ICO-40/60-6AR-60-277	4	4	0
Project Confirmation # G8M5KP62				
P-Motors	Variable frequency drive (VFD) up to 250 HP	1	1	0
P-Motors	Variable frequency drive up to 250 HP	2	2	0

Notes: Cadmus verified installation of 4 separate projects (3 lighting upgrades & 1 motor VFD) at this site.

Table 142: DP&L-R2-2 (Project Number: 1IYXG3VQ)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Other Technologies	Replace two 100 HP modulating type air compressors with two 150 HP variable speed compressors, holding tank, and control valve	1	1	0

Notes: Cadmus verified the installation of one 150HP variable speed Ingersoll Rand air compressor. Table 142 shows the reported and verified measures at this site. The new compressor replaced an older 100 HP modulating type compressor. We found the new compressor can handle the entire plant load and the second existing 100 HP compressor is used as backup.

Table 143: DP&L-R2-3 (Project Number: 7EE9CSKM)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PS-Lighting Fixtures and Controls	Delamping T12 (# linear feet)	520	520	0

Notes: Cadmus verified more than the 65 fixtures that had been converted from T12 4 lamp 4 foot fixtures to T8 2 lamp 4 foot fixtures. There was an excess of lamps that had been delamped and converted. The delamping is accomplished by reducing from 4 bulbs to 2 in each fixture.

Table 144: DP&L-R2-4 (Project Number: 29CFDCWN)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Heating, Ventilation and Air Conditioning	Window film	1,912	1,912	0

Notes: Cadmus verified the installation of 1,912 square feet of window film (type-DR15) installed. Upgraded windows are located on 2 floors of classrooms facing west, 1 floor of classrooms facing east and the ends of 4 hallways. Table 144 shows the reported and verified measures at this site.

Table 145: DP&L-R2-5 (Project Number: 7KG3S662)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
NC-LPD	Lighting in new warehouse, manufacturing and office.	1	1	0

Notes: Cadmus verified lighting installations in this newly constructed building. The measure under review was reduction of lighting power density (LPD). We found the reported lighting fixture count to be accurate. The lighting in this building consists of 449 various fluorescent fixtures and 41 various LED fixtures.

Table 146: DP&L-R2-6 (Project Number: RC2VYIUF)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Heating, Ventilation and Air Conditioning	Unitary and split system A/C 136,000 - 240,000 BTUH (11.33-20 tons) 17.5 Tons	1	1	0
P-Heating, Ventilation and Air Conditioning	Unitary and split system A/C 136,000 - 240,000 BTUH (11.33-20 tons) 12.5 Tons	1	1	0

Notes: Cadmus verified the installation of 1 Trane 17.5 ton packaged unitary gas/electric unit and 1 Trane 12.5 ton packaged unitary gas/electric unit.

Table 147: DP&L-R2-7 (Project Number: WK0IA8FX)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Motors	Variable frequency drive up to 250 hp - 15 hp	15	15	0
Motors	Variable frequency drive up to 250 hp - 25 hp	1	1	0
Motors	Variable frequency drive up to 250 hp - 30 hp	2	2	0
Motors	Variable frequency drive up to 250 hp - 40 hp	7	7	0
Motors	Variable frequency drive up to 250 hp - 50 hp	2	2	0
Motors	Variable frequency drive up to 250 hp - 60 hp	2	2	0

Notes: Cadmus verified installation of VFDs at this site. As shown in Table 147 below, we found the reported counts are accurate.

Table 148: DP&L-R2-8 (Project Number: NC-3)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
NC-LPD	New Construction Building - 16,600 SF church	1	1	0

Notes: Cadmus verified lighting installations in this newly constructed building. The measure under review was reduction of lighting power density. We found the reported lighting fixture count to be accurate. Lighting in this building consists of 111 various fluorescent fixtures, 126 various CFL fixtures and 3 halogen fixtures.

Table 149: DP&L-R2-9, DP&L-R2-10 (Project Number: T9X8ROC4 & F85YGGN3 & 2X1G6P1L & EXXQM4NL)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Project Confirmation # EXXQM4NL				
C-Other Technologies	Energy reduction extrusion machines (L47). Line #47	1	1	0
Project Confirmation #2X1G6P1L				
C-Other Technologies	Duct air compressor	5	5	0
Project Confirmation # T9X8ROC4				
C-Other Technologies	Energy reduction extrusion machines (L44). Line #44	1	1	0
Project Confirmation # F85YGGN3				
C-Other Technologies	Airleader, air compressor controller and air storage tank.	1	1	0

Notes: Cadmus verified two new controllers on plastic extruder heaters/coolers for lines #44 and #47. Cadmus also verified the installation of 5 outside air inlets for the compressors and a new 10,000 gallon air storage tank. Table 149 shows the reported and verified measures at this site.

Table 150: DP&L-R2-11 (Project Number NC-8)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
NC	New Construction - Wayne HS (291,881 SF)	1	1	0

Notes: Cadmus verified the mechanical equipment, lighting and schedule information for the operation of the newly constructed high school. The mechanical equipment verified includes 5 boilers, chiller with ice storage, chilled water pumps, hot water pumps, 4 air handling units, water heater and heat recovery chiller. Lighting was verified on a sample basis. The scheduled temperatures are controlled by a building management system that controls space temps based on summer/winter status and occupied/unoccupied status, with overrides possible that reset with a timer.

Table 151: DP&L-R2-12 (Project Number: NC-6)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
NC	New Construction - K-12 school (217,000 SF)	1	1	0

Notes: Cadmus verified the mechanical equipment, lighting and schedule information for the operation of the new PK-12 school. The equipment verified was 4 boilers, 3 primary chilled water pumps, 2 secondary chilled water pumps, 2 secondary hot water pumps, VAV air handling units and 3 Trane chillers with 10 ice storage units. Various lighting areas were also verified. Space temperatures are controlled by a building automation system that controls temperatures in various areas based on occupied/unoccupied status.

Table 152: DP&L-R2-13 (Project Number: 1KOJE2KS)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Motors	Air compressor 1 - 100 HP Variable Speed	1	1	0

Notes: Cadmus verified the installation of a 25 hp variable speed air compressor. Table 152 shows the reported and verified measures at this site.

Table 153: DP&L-R2-14 (Project Number: 59VVDI6GV)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Compressed Air Systems	Air compressor 100 HP Variable Speed	1	1	0

Notes: Cadmus confirmed the installation of a 100 hp variable speed air compressor, air dryer and air receiver.

Table 154: DP&L-R2-15 (Project Number O6QEL844)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Compressed Air Systems	Air compressor 1 - 100 HP Variable Speed	1	1	0

Notes: Cadmus verified the installation of a 35 hp variable speed air compressor.

Table 155: DP&L-R2-16 (Project Number F76LTI7E)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Other Technologies	Replacement of failing inlet modulation air compressor with variable speed air compressor	1	1	0

Notes: Cadmus verified the installation of a new 150 hp variable speed air compressor and a new air dryer. This compressor operates 24/7.

Table 156: DP&L-R2-17 (Project Numbers IFTJNJNW)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Lighting Fixtures and Controls	Replacing (221) 400w MH with (221) Lithonia IBL LED High Bays	221	221	0

Notes: Cadmus verified the installation of high bay lighting. We found the reported quantity to be accurate.

Table 157: DP&L-R2-18 (Project Number: OVK2DNP0)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PM-Lighting Fixtures and Controls	T8 high-bay 4-foot 6 lamp fixture replacing HID	235	235	0
PM-Lighting Fixtures and Controls	T8 high-bay 4-foot 4 lamp fixture replacing HID	16	16	0
PM-Lighting Fixtures and Controls	Fixture-mounted occupancy sensor	445	445	0
PM-Lighting Fixtures and Controls	T5 high-output high-bay 6 lamp fixture replacing HID	37	37	0

Notes: Cadmus verified the installation of the new lighting and occupancy sensors in these warehouse areas. Table 157 shows the reported and verified measures at this site. In order to accurately verify lighting HOU, six light loggers were installed at this site.

Table 158: DP&L-R2-19 (Project Number: H0877AJX)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
NC	New Construction - 17,814 SF Firing Range Building	1	1	0

Notes: Cadmus verified new mechanical installation and lighting equipment at this location.

Table 159: DP&L-R2-20 (Project Number: YPHOP892 & 8H504VKJ & XCXHFU0V)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Project Confirmation # YPHOP892				
P-Motors	VFDs on Air Compressors 1-100 HP - 15 hp	1	1	0
Project Confirmation #8H504VKJ				
P-Motors	Variable frequency drive up to 250 HP - 7.5 hp	1	1	0
Project Confirmation # XCXHFU0V				
P-Heating, Ventilation and Air Conditioning	Air cooled chiller - any size60 hp	1	1	0

Notes: The maintenance engineer accompanied the Cadmus technician to verify the installations of one 15 hp variable frequency drives on the MI199 agitator, one 7.5 hp variable frequency drive on a chilled water pump, and the air cooled York chiller.

Table 160: DP&L-R2-21 (Project Numbers: H8EHHSPY)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
NC	New construction 5,229 sq ft McDonalds restaurant	1	1	0

Notes: Cadmus was able to verify the lighting as specified except the (27) T8 3-lamp 4-foot fixtures were actually T8- 4 lamp 4-foot fixtures. This location is open 24/7.

Table 161: DP&L-R2-22 (Project Number: IBZ9SZE6)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Compressed Air Systems	Air compressor 1 - 100 HP Load/No Load	1	1	0

Notes: The Cadmus technician verified the installation of a 25 hp load/no load compressor.

Table 162: DP&L-R2-23, DP&L-R2-24 (Project Number: X8PMOKLY & 7UZSLVNY)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Project Confirmation # X8PMOKLY				
PM-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	108	108	0
Project Confirmation # 7UZSLVNY				
P-Motors	Variable frequency drive up to 250 HP - 40 hp	1	1	0
P-Motors	Variable frequency drive up to 250 HP - 25 hp	1	1	0

Notes: Cadmus verified the 108 occupancy sensors. Ten light loggers were installed at various locations. Two variable frequency drives were purchased for installation on supply fans, but installation was postponed due to emergency repairs required due to inclement weather which occurred during the possible unoccupied time. Installation is tentatively scheduled for spring break. Cadmus call after spring break to verify installation and confirmed installation was in process. Table 162 shows the reported and verified measures at this site.

Table 163: DP&L-R2-25 (Project Numbers: 63R3JXB9)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PM-Lighting Fixtures and Controls	T5 high-output high-bay 10 lamp fixture replacing HID	91	91	0

Notes: Cadmus verified the T5 10-lamp fixtures that replace 100 watt fixtures. This facility operates 24/7.

Table 164: DP&L-R2-26 (Project Number: NUKXW0YX)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Motors	Air compressor 1 - 100 HP Variable Speed 100hp	1	1	0

Notes: Cadmus verified the installation of 100 hp variable speed air compressor that replaced two 60 hp and one 75 hp air compressors. The Cadmus technician was told that the plant operated 24 hours per day 5 to 6 days a week depending to demand.

Table 165: DP&L-R2-27 (Project Number: C8B62495)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Other Technologies	Variable Speed Drives	1	1	0

Note: Cadmus verified the two variable speed drives for 400 hp quench fans. These operate 24 hours per day 5 days a week (sometimes 6 days per week).

Table 166: DP&L-R2-28 (Project Number: Q5DUTSJM)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PL-Lighting Fixtures and Controls	LED or Electroluminescent exit sign	4	4	0
PL-Lighting Fixtures and Controls	T5 high-output high-bay 4 lamp fixture replacing HID	57	57	0
PL-Lighting Fixtures and Controls	T5 high-output high-bay 8 lamp fixture replacing HID	10	10	0
PL-Lighting Fixtures and Controls	Low-watt T8 4-foot 4 lamp fixture replacing T12	38	38	0
PL-Lighting Fixtures and Controls	T8 (BF < 0.78) 4-foot 2 lamp fixture replacing T12	38	38	0
PL-Lighting Fixtures and Controls	T8 (BF < 0.78) 4-foot 4 lamp fixture replacing T12	136	136	0
PL-Lighting Fixtures and Controls	Low-watt T8 4-foot 2 lamp fixture replacing T12	8	8	0
PL-Lighting Fixtures and Controls	Delamping T12 (# linear feet)	1,744	1,744	0
PL-Lighting Fixtures and Controls	Relamping 28 watt	456	456	0
PL-Lighting Fixtures and Controls	T8 high-bay 4-foot 6 lamp fixture replacing HID	203	203	0
PL-Lighting Fixtures and Controls	T8 high-bay 4-foot 4 lamp fixture replacing HID	7	7	0

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PL-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	15	15	0
PL-Lighting Fixtures and Controls	Fixture-mounted occupancy sensor	61	61	0

Notes: Cadmus verified the lighting installations and occupancy sensor installations by sampling various areas. Table 166 shows the reported and verified measures at this site.

The hours of operation vary for different areas. The office area operates 10 hours per day 5 days a week. The plant areas operate 24 hours per day either 5 or 7 days per week depending on the area. Eight light loggers were installed throughout the facility.

Table 167. DP&L-R2-29 (Project Number: 7FAKDTZR)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Lighting Fixtures and Controls	LED Track Lighting	1	1	0

Notes: The facility has replaced all of the track lighting for the produce section in their retail store. A Cadmus technician verified the installation of all 67 LED track mounted fixtures replacing existing track lighting in a 1 for 1 replacement. Through visual inspection and examination of the invoices submitted by company, the fixtures were determined to be Cooper L806-HO-SP-8030-AH. While speaking to the facilities engineer, we learned that this building's lighting is run by a control panel. The track lighting is on from 6 AM to 10 PM every day. This matches up with the claimed hours of 5,840. In order to calculate lighting/HVAC interaction factors, Cadmus noted that the store was heated using a gas-fired forced warm air system and cooled with rooftop air conditioning units.

Table 168: DP&L-R2-30 (Project Number: V2X66K7Z)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Lighting Fixtures and Controls	High Wattage LED Parking Lot Fixture 851W	20	20	0
C-Lighting Fixtures and Controls	Medium Wattage LED Parking Lot Fixture 426W	50	44	-6
C-Lighting Fixtures and Controls	Medium Wattage LED Parking Lot Fixture 168W	31	27	-4
C-Lighting Fixtures and Controls	Low Wattage LED Parking Lot Fixture 102W	12	0	-12

Notes: The original reported measure name was "Lighting Type: LED 20 at 851 Watts, 50 at 426 Watts, 31 at 168 Watts, 12 at 102 Watts. Replacing existing HID parking lot fixtures." The names were updated in Table 168 to show differences in quantity.

Cadmus met with a manager who confirmed notes from Go Sustainable Energy that the project was not yet completed as a new building was still under construction. Upon completion the existing building will be torn down for more parking spaces and the remaining fixtures from the rebate will be installed. The manager also informed Cadmus that DP&L had withheld part of the rebate until the project is completed. The withheld amount was $3,000 of an original $16,000 rebate.

The lighting upgrade pertains to all parking lot fixtures. Cadmus confirmed the updated quantities of twenty 851W LED fixtures, forty-four 426W LED fixtures, and twenty-seven 168W LED fixtures. All fixture types and wattages were confirmed through the project documentation. The 851W fixtures are replacing light poles with two 1000W MH and two 400W MH fixtures. The manager confirmed that light poles were left intact and fixtures were replaced with the exception of the footprint of the new building. The 426W and 168W fixtures came in a combination of single lamp and double lamp fixtures, but the manager stated that the old fixtures were all two 1000W MH per pole. This gave a count of (120) 1000W MH fixtures replaced by the combination of 426W and 168W fixtures.

The manager confirmed that the parking lot lights are turned on by a photocell at night and are shut off at 10 PM. No HVAC factors were taken into account because the lighting fixtures are all outdoors.

Table 169: DP&L-R2-31 (Project Number: 84A8RRSI)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Lighting Fixtures and Controls	LED Track Lighting Manufacturer: Cooper Model #s: TR17 and TR18	1	1	0

Notes: The facility has replaced all of the track lighting throughout several sections of their retail store. A Cadmus technician verified through visual inspection and examination of the invoices of the installation of Cooper Lighting L806-SP-8030-AH and L806-HO-SP-8030-AH fixtures designated as TR17 and TR18, respectively. The technician confirmed thirty-nine TR17 LED and sixty-four TR18 LED track mounted fixtures replacing existing track lighting. Invoices show the removal of one hundred 79W fixtures. While speaking to the store manager, it was learned that the track lighting does not match the store hours of 6 AM to 1 AM. She indicated these lights are normally on from around 7:30 – 8:00 AM to 11:00 – 11:30 PM. This matches up with the claimed hours of 5,840. In order to calculate lighting/HVAC interaction factors, Cadmus noted that the store was heated using a gas-fired forced warm air system and cooled with rooftop air conditioning units.

Table 170: DP&L-R2-32 (Project Numbers: ED04HFJF)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
P-Other	Window film	25	25	0

Notes: Cadmus engineer met with a representative from the property management company. This company manages the property, including maintenance and buildings renovations. It was noted that not all of the building space is occupied by tenants. The window film was installed at each point of entrance to the front, south facing wall of the building. Each entrance includes a 57” X 82” window and a door with a 25” X 69” glass pane.

Cadmus verified all 25 of these entrances received a window film treatment, but only 9 of the 25 are currently being used by tenants. Of the 25 entrances that were treated, it was noted that 23 of them are to areas with gas heating while the remaining 2 are to an area with electric heating.

Table 171: DP&L-R2-33 (Project Number: 6ZQM06UC & C0H91WBF)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Project Confirmation # 6ZQM06UC				
C-Lighting Fixtures and Controls	F28 T5 2-Lamp	544	544	0
C-Lighting Fixtures and Controls	F28 T5 1-Lamp	108	108	0
C-Lighting Fixtures and Controls	F28 T5 2-Lamp Dimmable	46	46	0
C-Lighting Fixtures and Controls	CFL Recessed Downlight	38	38	0
C-Lighting Fixtures and Controls	F28 T5 2-Lamp (Quiet Room)	11	11	0
C-Lighting Fixtures and Controls	6W PAR16 (Copy Room)	12	12	0
Project Confirmation # C0H91WBF				
PS-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	60	60	0
PS-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	11	11	0
PS-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	5	5	0
PS-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	3	3	0
PS-Lighting Fixtures and Controls	LED or Electroluminescent exit sign	70	70	0

Notes: This location recently remodeled the entire office space of “Building 1” in Miamisburg, OH. This included an upgrade of all of their lighting as well as the installation of occupancy sensors in all offices and conference rooms. Table 171 shows the reported and verified measures at this site. While on site Cadmus verified the different fixture types and occupancy sensors matched invoices and confirmed a sampled section of the building matched building drawings. From the drawings provided an accurate count of fixtures and sensors was taken. F28 T5 2-Lamp fixtures cover the majority of floor space for cubicles, conference rooms and, offices. The lighting in each conference room and office is controlled by an occupancy sensor. Dimmable F28 T5 2-lamp fixtures were installed in training room and small auditorium. F28 T5 1-lamp fixtures were installed in corridors. CFL recessed downlights were installed

near main entrance and 6W PAR16 LED fixtures were installed in copy rooms. LED exit signs were installed throughout. Lighting in main areas is on from 6 AM to 6 PM Monday through Friday, while all rooms are controlled by occupancy sensors. Employees frequently stay later and keep certain lights on later in the day and over weekends.

In order to calculate lighting/HVAC interaction factors, Cadmus noted that the upgraded lighting space is heated and cooled by a gas-fired forced warm air system and cooled with rooftop air conditioning units.

Table 172: DP&L-R2-34 (Project Number: BXJP2BPT)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PS-Lighting Fixtures and Controls	LED 4-ft 2-lamp tubes	30	16	-14
PS-Lighting Fixtures and Controls	Delamping T12 (# linear feet)	124	124	0

Notes: This project upgraded all lighting in their store except for bathrooms and closets. On site Cadmus took a count of sixteen 4-ft 2-lamp LED fixtures which replaced sixteen 4-ft 4-lamp T12 fixtures.

As a prescriptive measure, it is 1 for 1 replacement of 16 4-ft 2-lamp fixtures going from T12 to LED. The hours of operation claimed did not match the hours explained by store owner and it was decided to install time of use light loggers to verify.

Table 173: DP&L-R2-35 (Project Number: 5HU93I46, 4761FF6F, & F2EIWRVA)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Project Confirmation # 5HU93I46				
C-Other Technologies	Installation of an L75RS variable speed air compressor and flow controller	1	1	0
Project Confirmation # 4161FF6F				
PM-Lighting Fixtures and Controls	T8 high-bay 4'- 6 lamp fix replacing HID	36	36	0
PM-Lighting Fixtures and Controls	T8 high-bay 4'- 6 lamp fix replacing HID	57	57	0
PM-Lighting Fixtures and Controls	T8 high-bay 4'- 6 lamp fix replacing HID	44	44	0
PM-Lighting Fixtures and Controls	LED or Induction (operating hours < 8,760) replacing 251W to 400W	17	17	0
Project Confirmation # F2EIWRVA				
PM-Lighting Fixtures and Controls	T8 high-bay 4'- 6 lamp fix replacing HID	2	2	0

PM-Lighting Fixtures and Controls	T8 high-bay 4'- 6 lamp fix replacing HID	92	92	0

Notes: Cadmus technician met with a facilities engineer and was able to view the LR75 variable speed air compressor. All equipment was installed as specified in the report by Go Sustainable Energy. With a visual inspection of the fixtures and invoices, Cadmus was able to confirm the installation of T8 high-bay 4-foot 6 lamp fixtures using 32W T8 bulbs and the installation of LED wall packs. A walkthrough of the meat packing facility verified the installation of the 137 T8 fixtures from rebate 4761FF6F in the production floors. This space is conditioned with gas heat and AC. The LED wall packs are mounted outside and operated by a photocell. The 94 T8 fixtures from rebate F2EIWRVA were located in a bay of the car refurbishing building. Table 173 shows the reported and verified measures at this site

In order to calculate lighting/HVAC interaction factors, Cadmus noted that the store was heated using a gas-fired forced warm air system and cooled with rooftop air conditioning units.

Table 174: DP&L-R2-36 (Project Number: YN6AN5JB)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PL-Lighting Fixtures and Controls	T5 high-output high-bay 4 lamp fixture replacing HID	109	233	124
PL-Lighting Fixtures and Controls	Low-watt T8 4-foot 2 lamp fixture replacing T12*	191	191	0
PL-Lighting Fixtures and Controls	Fixture-mounted occupancy sensor	152	276	124
PL-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	27	27	0
PL-Lighting Fixtures and Controls	LED luminaires up to 18 watts (replacing incandescent)	16	16	0
PL-Lighting Fixtures and Controls	Low-watt T8 4-foot 4 lamp fixture replacing T12*	81	81	0
PL-Lighting Fixtures and Controls	LED or Induction (8,760 operating hours) replacing 251W to 400W	2	2	0
PL-Lighting Fixtures and Controls	Delamping T8 (# linear feet)	8	8	0
PL-Lighting Fixtures and Controls	Delamping T12 (# linear feet)	88	88	0

Notes: A Cadmus technician was escorted around by the facilities manager to verify a sample of fixture types, wattages, and counts. It was determined that their reported quantities were correct. These values differed from the values in DP&L's database however our values matched Go Sustainable findings. There were an additional (124) T5HO 4-ft 4-lamp high-bay fixtures installed with fixture-mounted occupancy sensors. These values agree with a work order from the installation contractor. No light loggers were installed as it was confirmed that the facility operates 24/7 and only fixtures with occupancy sensors will turn off.

In order to calculate lighting/HVAC interaction factors, Cadmus noted that offices are heated using a gas-fired forced warm air system and cooled with rooftop air conditioning units. The industrial areas of the premises are heated with a combination of infrared heat and make-up air units and have no air conditioning. The lights installed at Dock 5 are exposed to the outdoors and have no heating or cooling.

Table 175: DP&L-R2-37 (Project Number: 2CH7AMFS)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Lighting Fixtures and Controls	Replace (241) 8' T12 HO strip fluorescent lights with)59) 4' 6 lamp T8 fluorescent high bay lights	1	1	0

Notes: The fixtures were confirmed as e-conolight T8 4-ft 6-lamp using 32W bulbs. An on-site count showed 62 new fixtures were installed and this was confirmed on the invoices. These lights replaced 241 T12 8-ft 2-lamp fixtures. These fixtures are still installed but were delamped and had their ballasts disconnected. The area of the lighting upgrade is all warehouse and storage with gas heat and no air conditioning. It was confirmed that the lights are on 15 to 16 hours per day for 6 days a week.

Table 176: DP&L-R2-38 (Project Number: N3ZIHUEO & S24JKCF2)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Project Confirmation # N3ZIHUEO				
C-Lighting Fixtures and Controls	Upgrade Lighting in 134001 sq ft building. Using LPD method per warehouse.	1	1	0
Project Confirmation # S24JKCF2				
PS-Lighting Fixtures and Controls	Low-watt T8 4-foot 4 lamp fixture replacing T12	30	30	0
PS-Lighting Fixtures and Controls	Low-watt T8 4-foot 4 lamp fixture replacing T12	6	6	0
PS-Lighting Fixtures and Controls	Low-watt T8 4-foot 4 lamp fixture replacing T12	7	0	-7
PS-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	4	4	0
PS-Lighting Fixtures and Controls	Wall or Ceiling-mounted occupancy sensor	4	4	0
PS-Lighting Fixtures and Controls	LED or Electroluminescent exit sign	3	3	0
PS-Lighting Fixtures and Controls	LED or Electroluminescent exit sign	11	11	0
PS-Lighting Fixtures and Controls	LED or Induction (operating hours < 8,760) replacing 251W to 400W	8	8	0
PS-Lighting Fixtures and Controls	LED or Induction (operating hours < 8,760) replacing 251W to 400W	9	9	0

PS-Lighting Fixtures and Controls	LED or Induction (operating hours < 8,760) replacing 251W to 400W	2	2	0
PS-Lighting Fixtures and Controls	LED or Induction (operating hours < 8,760) replacing 251W to 400W	1	1	0

Notes: The two rebates at this location were split between their offices and the warehouse attached to them. Cadmus verified that the footprint of the warehouse is 134,001 sq. ft. and all lighting was replaced following the LPD method. There are a total of 352 T8 4-ft 6-lamp high-bay fixtures installed replacing 400W MH fixtures 1 for 1. The lights are controlled by ceiling mounted occupancy sensors in groups of 12. The warehouse has gas heating and no air conditioning. The lights are operable 24/7, but are controlled by the occupancy sensors. The hours at the warehouse are 7 AM to 3:30 PM on weekdays.

The second rebate covers the lighting upgrades done in their offices and on the exterior of the building. Cadmus was able to verify all lighting fixtures and counts except for 7 Low-watt T8 4-foot 4-lamp fixtures. Each room in the office is controlled by an occupancy sensor. The office operates on the same schedule as the warehouse and has gas heating and air conditioning. 3 of the LED exit signs are located in the office and the other 11 are located in the warehouse. All of the LED wall packs are on the exterior of the building and are controlled by a photocell. Cadmus was unable to visually verify the wattage or model number of these fixtures.

Table 177: DP&L-R2-39 (Project Number: 58DUQ6WU & UZJ0NDDE)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
Project Confirmation # 58DUQ6WU				
PL-Lighting Fixtures and Controls	Delamping T12 (# linear feet)	3,520	3,520	0
Project Confirmation # UZJ0NDDE				
PS-Lighting Fixtures and Controls	T5 high-output high-bay 6 lamp fixture replacing HID	78	78	0
PS-Lighting Fixtures and Controls	T5 2 lamp fixture replacing T12	17	17	0
PS-Lighting Fixtures and Controls	T5 4 lamp fixture replacing T12	18	18	0
PS-Lighting Fixtures and Controls	LED or Electroluminescent exit sign	6	6	0

Notes: The Cadmus technician was able to verify the fixture types from the rebate and took a count of all fixtures. A section of their manufacturing space referred to as the barn was demolished and completely rebuilt. This building contained 220 T12 4-ft 4-lamp fixtures and accounts for all of the T12 delamping. Cadmus installed 6 light loggers in the facility to verify hours of operation for the lighting.

In order to calculate lighting/HVAC interaction factors, Cadmus noted that the building has gas heating and air conditioning.

Table 178: DP&L-R2-40 (Project Number: AM7CWQ49)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PL-Lighting Fixtures and Controls	T5 high-output high-bay 4 lamp fixture replacing HID	1,171	1,171	0
PL-Lighting Fixtures and Controls	Fixture-mounted occupancy sensor	41	41	0
PL-Lighting Fixtures and Controls	Delamping HID (Watts)	68,672	68,672	0

Notes: Cadmus verified the installation of 1171 T5 HO 4-ft 4-lamp high-bay fixtures throughout the production floor. The fixtures were verified to use F54W-T5-841-ECO bulbs and GE 54MVPS90-G ballasts. The lighting upgrade was rebated as a 1 for 1 replacement of 400W MH fixtures. Building drawings indicate 148 fixtures were delamped and not replaced. Cadmus also verified 41 fixture mounted occupancy sensors located near loading docks. The maintenance manager confirmed that they currently operate from 8 PM to 4 PM Monday through Saturday or 20 hours per day at 6 days a week. This matches the claimed hours of 6240, but he noted that they may increase hours up to 24/7 depending on demand.

In order to calculate lighting/HVAC interaction factors, Cadmus noted that the facility uses gas heat tempered air and cooling towers.

Table 179: DP&L-R2-41 (Project Number: CS4907D0)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PL-Lighting Fixtures and Controls	Low-watt T8 4-foot 3 lamp fixture replacing T12*	865	865	0
PL-Lighting Fixtures and Controls	Low-watt T8 4-foot 2 lamp fixture replacing T12*	161	161	0
PL-Lighting Fixtures and Controls	Fixture-mounted occupancy sensor	50	50	0
PL-Lighting Fixtures and Controls	Delamping T12 (# linear feet)	516	516	0

Notes: Cadmus verified a sample of fixtures based on the room breakdown provided by Go Sustainable Energy. After confirming the sample it was decided their numbers were correct. The fixture types were also verified as T8 4-ft 2 or 3-lamp. All fixtures located in milling areas or mechanical rooms are vapor tight. The site contact confirmed that all fixtures located in production areas, control rooms, or mechanical rooms run 24/7. Lighting in the offices is on from 6 AM to 8 PM on weekdays and runs on a fairly tight schedule as security makes rounds to turn lights on and off. Lights in the warehouse are operable 24/7, but half are set to fixture mounted occupancy sensors.

In order to calculate lighting/HVAC interaction factors, Cadmus noted that the complex uses electric heating throughout the facility. The office locations have air conditioning.

Table 180: DP&L-R2-42 (Project Number: EPV4HPX8)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
PL-Lighting Fixtures and Controls	T8 4 foot 4 lamp replacing T12 HO only	487	487	0
PL-Lighting Fixtures and Controls	T5 high-output high-bay 10 lamp fixture replacing HID	210	210	0
PL-Lighting Fixtures and Controls	Low-watt T8 4-foot 4 lamp fixture replacing T12*	33	33	0
PL-Lighting Fixtures and Controls	T5 high-output high-bay 4 lamp fixture replacing HID	226	226	0
PL-Lighting Fixtures and Controls	Fixture-mounted occupancy sensor	184	184	0
PL-Lighting Fixtures and Controls	T8 4-foot 2 lamp fixture replacing T12	9	9	0

Notes: Cadmus verified a sample of fixtures based on the room breakdown provided by Go Sustainable Energy. Cadmus also verified the type of fixtures per area. Occupancy sensors were installed on all fixtures in the warehouse and they are operable 24/7. The hours of operation very throughout the facility so time of use light loggers were installed to verify hours of operation.

In order to calculate lighting/HVAC interaction factors, Cadmus noted that the offices use electric heating and air conditioning. Throughout the rest of the facility gas heat is used, although it runs very low due to the heat put off by the equipment.

Table 181: DP&L-R2-43 (Project Number: YFO7QZVX)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Lighting Fixtures and Controls	Replace (113) 250w Metal Halide Hi Bay fixtures with (113) New Industrial LED Hi Bay fixtures	113	113	0
C-Lighting Fixtures and Controls	Replace (27) 400w Metal Halide fixtures with (27) Industrial LED Hi Bay fixtures	27	27	0

Notes: Cadmus was able to visually verify all new light fixtures as 4-ft 2-lamp LED high-bay fixtures. The technician confirmed 113 fixtures installed throughout the production area as replacing 250W MH fixtures. The other 27 fixtures were located by the loading docks with a much higher ceiling and replaced 400W MH fixtures. The hours of operation were verified as 24/6 with no major holidays.

In order to calculate lighting/HVAC interaction factors, Cadmus noted that the facility uses gas heating and air conditioning throughout.

Table 182: DP&L-R2-44 (Project Number: JC2JGWTH)

Measure Type	Reported Measure	Reported Quantity	Verified Quantity	Difference
C-Other Technologies	Replacing electric forced air thermoforming oven with infrared oven	1	1	0

Notes: Cadmus was able to verify the installation of a custom electric infrared thermoforming oven replacing an electric forced air thermoforming oven. This site is still using one forced air oven, allowing the technician to verify the upgrade. The old oven works off of a transformer converting 480V to 208V and operated in 2 stages. The new oven operates at 480V on an 180A max. It operates in 3 stages. Our on-site contact confirmed that the facility and equipment are currently running 24/7 although they plan to back down to 24/5 in the near future.

Appendix L: Ex Ante Measure-Level Savings Documentation

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
Residential					
Lighting	CFL	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 11 - 16.	Calculated using the inputs and algorithms in the 2010 draft Ohio TRM	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 11 - 16.	Calculated using the inputs and algorithms in the 2010 draft Ohio TRM
Appliance Recycling	Refrigerator Replacement	Cadmus UEC model	Estimates calculated by Cadmus by using the UEC model per unit savings from the 2012 program year. Calculation methodology provided on pages 24 - 29 of Cadmus Annual EM&V Report filed March 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 23-25	2010 Ohio draft TRM Summer Peak Demand Savings
	Freezer Replacement	Cadmus UEC model	Estimates calculated by Cadmus by using the UEC model per unit savings from the 2012 program year. Calculation methodology provided on pages 24 - 29 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 23-25	2010 Ohio draft TRM Summer Peak Demand Savings
Low-Income	CFL 15 watt dimmable CFL 15 watt globe CFL 15 watt or less outdoor CFL 16-20 watt floodlight CFL 16-20 watt outdoor CFL 16-20 watt spiral CFL 21 watt or above floodlight CFL 21 watt or above outdoor CFL 21 watt or above spiral CFL 3-way spiral CFL 7-9 watt candelabra CFL 9 watt globe	The CC database performs these calculations. It's our understanding that Ex Ante savings are based on algorithms and inputs in the 2010 draft Ohio TRM under Case No. 09-0512-GE-UNC.	2010 draft Ohio TRM	The CC database performs these calculations. It's our understanding that Ex Ante savings are based on algorithms and inputs in the 2010 draft Ohio TRM under Case No. 09-0512-GE-UNC.	2010 draft Ohio TRM

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	CFL 9-15 watt spiral				
	CFM Reduction				
	Attic Insulation				
	Duct Insulation				
	Duct Sealing				
	Faucet Aerator				
	Foundation Wall Insulation				
	Freezer Replacement				
	Heat Pump Replacement				
	HVAC Tune Up				
	LED 0.5 W Nightlight				
	Water Heater Pipe Insulation				
	Refrigerator Replacement				
	Energy-efficient Showerhead				
	Smart Strip Power Outlet				
	Wall Insulation				
	Water Heater Temperature Setback				
	Water Heater Wrap				
HVAC Rebate	ER AC 14/15 SEER	Cadmus post-fixed effects model.	Estimates calculated by Cadmus using a post-fixed effects model. Calculation methodology provided on pages 53 - 56 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 78 - 81.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	ER AC 16+ SEER	Cadmus post-fixed effects model.	Estimates calculated by Cadmus using a post-fixed effects model. Calculation methodology provided on pages 53 - 56 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 78 - 81.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	NC AC 14/15 SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 30 - 32.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 30 - 32.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	NC AC 16+ SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 30 - 32.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 30 - 32.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	RP AC 14/15 SEER	Cadmus post-fixed effects model.	Estimates calculated by Cadmus using a post-fixed effects model. Calculation methodology provided on pages 53 - 56 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 30 - 32.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	RP AC 16+ SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 30 - 32.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 30 - 32.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	ER GSHP 16/18 EER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 82 - 85.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	ER GSHP 19+ EER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 82 - 85.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	NC GSHP 16/18 EER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 82 - 85.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
			Report filed May 15, 2013 under Case No. 13-1140-EL-POR.		Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	NC GSHP 19+ SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 82 - 85.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	RP GSHP 16/18 EER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 82 - 85.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	RP GSHP 19+ EER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 82 - 85.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	ER HP 14/15 SEER	Cadmus post-fixed effects model.	Estimates calculated by Cadmus using a post-fixed effects model. Calculation methodology provided on pages 53 - 56 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	ER HP 16+ SEER	Cadmus post-fixed effects model.	Estimates calculated by Cadmus using a post-fixed effects model. Calculation methodology provided on pages 53 - 56 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	NC HP 14/15 SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	NC HP 16+ SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	RP HP 14/15 SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	RP HP 16+ SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 56 - 59 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 33 - 35.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	NC MS AC 16+ SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 67 - 69.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 59 - 62 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 67 - 69.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	RP MS AC 16+ SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 67 - 69.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 59 - 62 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 67 - 69.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	NC MS HP 16+ SEER	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 67 -69 and engineering calculations based on secondary data.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 59 - 62 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	Engineering calculations and secondary data.	Estimates calculated by Cadmus using engineering algorithms and secondary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	ECM with New AC	Engineering calculations based on secondary data.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 59 - 62 of Cadmus Annual EM&V	Engineering calculations and secondary data.	Estimates calculated by Cadmus using engineering algorithms and secondary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
			Report filed May 15, 2013 under Case No. 13-1140-EL-POR.		Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	ECM	Engineering calculations based on secondary data.	Estimates calculated by Cadmus using draft Ohio TRM and primary data. Calculation methodology provided on pages 59 - 62 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.	Engineering calculations and secondary data.	Estimates calculated by Cadmus using engineering algorithms and secondary data. Calculation methodology provided on pages 62 - 65 of Cadmus Annual EM&V Report filed May 15, 2013 under Case No. 13-1140-EL-POR.
	AC Tune-Up	PRISM analysis and assumptions from page 26 - 29 of the 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	Estimates calculated by Cadmus using PRISM analysis of 2013 program tracking data and assumptions from page 26-29 of the 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 26 - 29.	Estimates calculated by Cadmus using 2013 program tracking data.
	HP Tune-Up	PRISM analysis and assumptions from page 26 - 29 of the 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	Estimates calculated by Cadmus using PRISM analysis of 2013 program tracking data and assumptions from page 26-29 of the 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 26 - 29.	Estimates calculated by Cadmus using 2013 program tracking data.
Be E3 Smart	13W CFLs (2 Bulbs in each kit)	Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year; 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 11 - 16.	Calculated using the inputs and algorithms in the 2010 draft Ohio TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 11 - 16.	Calculated using the inputs and algorithms in the 2010 draft Ohio TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.
	Nightlights (1 in each kit)	Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year. ; 2013 Indiana TRM filed January 10, 2013. Pages 28-29.	Calculated using the inputs and algorithms in the 2013 Indiana TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.	2013 Indiana TRM filed January 10, 2013. Pages 28-29.	Calculated using the inputs and algorithms in the 2013 Indiana TRM.
	Bathroom Faucet Aerators (2 in each kit)	Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year. ; 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC Pages 89-92; Potential Study; Cadmus and Opinion Dynamics Showerhead and Faucet	Calculated using the algorithm listed in the 2010 draft Ohio TRM. Algorithm inputs stems from potential study, Cadmus and Opinion Dynamics metering study, and the draft 2010 Ohio TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 89-92.	Calculated using the algorithm listed in the 2010 draft Ohio TRM. Algorithm inputs stems from potential study, Cadmus and Opinion Dynamics metering study, and the draft 2010 Ohio TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
		Aerator Meter Study Memorandum Pages 1-16.			
	Kitchen Faucet Aerators (1 in each kit)	Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year. ; 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC Pages 89-92; Cadmus and Opinion Dynamics Showerhead and Faucet Aerator Meter Study Memorandum Pages 1-16.	Calculated using the algorithm listed in the 2010 draft Ohio TRM. Algorithm inputs stems from potential study, Cadmus and Opinion Dynamics metering study, and the draft 2010 Ohio TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 89-92.	Calculated using the algorithm listed in the 2010 draft Ohio TRM. Algorithm inputs stems from potential study, Cadmus and Opinion Dynamics metering study, and the draft 2010 Ohio TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.
	Efficient Showerheads (1 in each kit)	Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year. ; 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC Pages 93-96; Potential Study; Cadmus and Opinion Dynamics Showerhead and Faucet Aerator Meter Study Memorandum Pages 1-16.	Calculated using the algorithm listed in the 2010 draft Ohio TRM. Algorithm inputs stems from potential study, Cadmus and Opinion Dynamics metering study, and the draft 2010 Ohio TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 93-96.	Calculated using the algorithm listed in the 2010 draft Ohio TRM. Algorithm inputs stems from potential study, Cadmus and Opinion Dynamics metering study, and the draft 2010 Ohio TRM. Participation rate determined using Family-Online Study Survey distributed during the September 2012-May 2013 Ohio School Year.
Non-Residential Prescriptive					
Non-Residential Prescriptive: HVAC	Air cooled chiller - any size	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 146 - 148.	Estimates calculated by DP&L using draft Ohio TRM and primary data. Estimated equivalent full load hours from the TRM are averaged across all system types with and without economizers (1,645 EFLH).	2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 146 - 148.	Estimates calculated by DP&L using draft Ohio TRM. Summer Peak Coincidence Factor (CF) from the TRM is used for this measure.
	Air source heat pump < 65,000 BTUH (split or single package)	2010 draft Ohio TRM pages 197 - 200.	Baseline efficiencies from TRM. Efficient SEER of 14.0 and efficient HSPF of 8.2 used in calculation. Full load cooling hours are 942 and full load heating hours are 810.	2010 draft Ohio TRM pages 197 - 200.	Baseline efficiencies from TRM. Efficient SEER of 14.0 and efficient HSPF of 8.2 used in calculation.
	Air source heat pump > 240,000 BTUH	2010 draft Ohio TRM pages 197 - 200.	Baseline efficiencies from TRM. Efficient EER of 10.0 and efficient COP of 2.0 used in calculation. Full load cooling hours are 942 and full load heating hours are 810.	2010 draft Ohio TRM pages 197 - 200.	Baseline efficiencies from TRM. Efficient EER of 10.0 and efficient COP of 2.0 used in calculation.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	Air source heat pump 136,000 - 240,000 BTUH	2010 draft Ohio TRM pages 197 - 200.	Baseline efficiencies from TRM. Efficient EER of 10.8 and efficient COP of 2.0 used in calculation. Full load cooling hours are 942 and full load heating hours are 810.	2010 draft Ohio TRM pages 197 - 200.	Baseline efficiencies from TRM. Efficient EER of 10.8 and efficient COP of 2.0 used in calculation.
	Air source heat pump 65,000 - 135,000 BTUH	2010 draft Ohio TRM pages 197 - 200.	Baseline efficiencies from TRM. Efficient EER of 11.0 and efficient COP of 2.2 used in calculation. Full load cooling hours are 942 and full load heating hours are 810.	2010 draft Ohio TRM pages 197 - 200.	Baseline efficiencies from TRM. Efficient EER of 11.0 and efficient COP of 2.2 used in calculation.
	Energy recovery ventilation > 450 CFM	October 2009 draft Ohio TRM page 137.	No changes from TRM.	October 2009 draft Ohio TRM page 137. Measure was not included in 2010 draft Ohio TRM	No changes from TRM.
	Ground-Coupled Heat Pumps (Closed Loop) < 135,000 BTUH	2010 draft Ohio TRM pages 197 - 200.	Base efficiency of 14.1 EER and new efficiency based on the unit. COP base 3.1, new based on unit.	2010 draft Ohio TRM pages 197 - 200.	Base efficiency of 14.1 EER and new efficiency based on the unit. COP base 3.1, new based on unit.
	Heat pump water heater < 80 gallon tank	Cadmus engineering analysis, assuming 500 gallons per day.	The savings from HPWHs vary by building application, design, internal loads, and climate and water consumption. Typically savings varies with HPWHs but typically save between 30 and 40 percent over standard heating sources with proper storage and piping configurations. Energy savings of 10,327 kWh per year.	Cadmus engineering analysis, assuming 500 gallons per day.	The savings from HPWHs vary by building application, design, internal loads, and climate and water consumption. Typically savings varies with HPWHs but typically save between 30 and 40 percent over standard heating sources with proper storage and piping configurations. Demand savings of 2.83 kW.
	Outside air economizer with two enthalpy sensors	Cadmus engineering analysis, assuming 12% energy savings.	The savings from economizers will vary by building application, loads and climate. Typically a 12 percent savings can be achieved. Assumed 10 ton unit, 11 EER, and 1,000 cooling load hours. Energy savings of 1,309 kWh per year.	Cadmus engineering analysis, assuming 12% energy savings.	The savings from economizers will vary by building application, loads and climate. Typically a 12 percent savings can be achieved. Assumed 10 ton unit and 11 EER. Demand savings of .36kW.
	Packaged terminal air conditioning and heat pumps	Technical Reference Manual 2010 for Pennsylvania Act 129 Energy Efficiency and Conservation Program pages 55 - 59	Baseline values from ASHRAE 90.1-2007. Energy savings of 247 kWh per ton.	Technical Reference Manual 2010 for Pennsylvania Act 129 Energy Efficiency and Conservation Program pages 55 - 59	Baseline values from ASHRAE 90.1-2007. Demand savings of 0.25 per ton.
	Unitary and split system A/C 65,000 - 135,000 BTUH (5.4-11.25 tons)	2010 draft Ohio TRM, pages 194 - 196.	Baseline efficiencies from TRM unless otherwise known. Efficient EER of 11.0 used in calculation. Full load cooling hours are 942.	2010 draft Ohio TRM, pages 194 - 196.	Baseline efficiencies from TRM unless otherwise known. Efficient EER of 11.0 used in calculation.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	Unitary and split system A/C < 65,000 BTUH (<5.4 tons)	2010 draft Ohio TRM, pages 194 - 196.	Baseline efficiencies from TRM unless otherwise known. Efficient SEER of 14.0 used in calculation. Full load cooling hours are 942.	2010 draft Ohio TRM, pages 194 - 196.	Baseline efficiencies from TRM unless otherwise known. Efficient SEER of 14.0 used in calculation.
	Unitary and split system A/C 136,000 - 240,000 BTUH (11.33-20 tons)	2010 draft Ohio TRM, pages 194 - 196.	Baseline efficiencies from TRM unless otherwise known. Efficient EER of 10.8 used in calculation. Full load cooling hours are 942.	2010 draft Ohio TRM, pages 194 - 196.	Baseline efficiencies from TRM unless otherwise known. Efficient EER of 10.8 used in calculation.
	Unitary and split system A/C 241,000 - 760,000 BTUH (20-63.33 tons)	2010 draft Ohio TRM, pages 194 - 196.	Baseline efficiencies from TRM unless otherwise known. Efficient EER of 10.0 used in calculation. Full load cooling hours are 942.	2010 draft Ohio TRM, pages 194 - 196.	Baseline efficiencies from TRM unless otherwise known. Efficient EER of 10.0 used in calculation.
	Variable frequency drive up to 250 HP	Engineering calculations based on primary and secondary data, including the 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 207-209.	Estimates calculated by Cadmus using primary data, secondary data, and the draft Ohio TRM. Application information of the existing motor efficiency, brake horsepower and application type are not collected. Estimated efficiency of the motor that is driven by the VFD is assumed to 91%. An overall percent savings of 30% is used as an average where the TRM percent savings range from 9.2% to 53.5% depending on baseline conditions. Instead of brake horsepower, nominal motor horsepower and 85% load factor is assumed.	Engineering calculations based on primary and secondary data, including the 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 207- 209.	Estimates calculated by Cadmus using primary data, secondary data, and the draft Ohio TRM. Application information of the existing motor efficiency, brake horsepower and application type are not collected. Estimated efficiency of the motor that is driven by the VFD is assumed to 91%. An overall percent savings of 30% is used as an average where the TRM percent savings range from 3% to 34.8% depending on baseline conditions. Instead of brake horsepower, nominal motor horsepower and 85% load factor is assumed.
	Water cooled chiller > 300 tons	2010 draft Ohio TRM, pages 147 - 148.	EFLH is an average of the 3 system types for Dayton, resulting in 1,645 EFLH.	2010 draft Ohio TRM, pages 147 - 148.	No changes from TRM.
	Water cooled chiller 150 - 300 tons	2010 draft Ohio TRM, pages 147 - 148.	EFLH is an average of the 3 system types for Dayton, resulting in 1,645 EFLH.	2010 draft Ohio TRM, pages 147 - 148.	No changes from TRM.
	Window film	2010 draft Ohio TRM, pages 214 - 217.	ΔkWh is average of "light industrial, small office and small retail" resulting in 266.	2010 draft Ohio TRM, pages 214 - 217.	ΔkW is average of "light industrial, small office and small retail" resulting in .14.
Non-Residential Prescriptive: Lighting	Central lighting control	2010 draft Ohio TRM with specific project HOU assumptions. Pages 149-152	2010 draft Ohio TRM with specific project HOU assumptions. Pages 149-152	2010 draft Ohio TRM. Pages 149-152	No demand savings are collected.
	CFL screw-in bulb > 32W replacing incandescent	2010 draft Ohio TRM, pages 153 - 156.	Assume 68 watts of savings. HOU is application specific.	2010 draft Ohio TRM, pages 153 - 156.	Assume 68 watts of savings. Coincidence factor is the average of the first 13 building type measures .732.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	CFL screw-in bulb or pin-based fixture > 32W replacing incandescent	2010 draft Ohio TRM, pages 153 - 156.	Assume 68 watts of savings. HOU is application specific.	2010 draft Ohio TRM, pages 153 - 156.	Assume 68 watts of savings. Coincidence factor is the average of the first 13 building type measures .732.
	CFL screw-in bulb or pin-based fixture 21W to 32W replacing incandescent	2010 draft Ohio TRM, pages 153 - 156.	Assume 20 watts of savings. HOU is application specific.	2010 draft Ohio TRM, pages 153 - 156.	Assume 20 watts of savings. Coincidence factor is the average of the first 13 building type measures .732.
	CFL screw-in bulb or pin-based fixture up to 20W replacing incandescent	2010 draft Ohio TRM, pages 153 - 156.	Assume 20 watts of savings. HOU is application specific.	2010 draft Ohio TRM, pages 153 - 156.	Assume 20 watts of savings. Coincidence factor is the average of the first 13 building type measures .732.
	CFL screw-in bulb or pin-based fixture up to 32W replacing incandescent	2010 draft Ohio TRM, pages 153 - 156.	Assume 20 watts of savings. HOU is application specific.	2010 draft Ohio TRM, pages 153 - 156.	Assume 20 watts of savings. Coincidence factor is the average of the first 13 building type measures .732.
	CFL screw-in bulb up to 32W replacing incandescent	2010 draft Ohio TRM, pages 153 - 156.	Assume 20 watts of savings. HOU is application specific.	2010 draft Ohio TRM, pages 153 - 156.	Assume 20 watts of savings. Coincidence factor is the average of the first 13 building type measures .732.
	Delamping HID	2010 draft Ohio TRM, pages 169 - 172.	Actual lamp wattage removed including ballast is used. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Actual lamp wattage removed including ballast is used. Coincidence factor is the average of the first 13 building type measures .732.
	Delamping T12 (# linear feet)	2010 draft Ohio TRM, pages 169 - 172.	72 watts per 4-foot lamp is used to calculated savings. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	72 watts per 4-foot lamp is used to calculated savings. Coincidence factor is the average of the first 13 building type measures .732.
	Delamping T8 (# linear feet)	2010 draft Ohio TRM, pages 169 - 172.	23 watts per 4-foot lamp is used to calculated savings. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	23 watts per 4-foot lamp is used to calculated savings. Coincidence factor is the average of the first 13 building type measures .732.
	Fixture-mounted daylight sensor	2010 draft Ohio TRM method with adjusted controlled wattage on Cadmus engineering assumptions. Pages 149 - 152 2010 draft Ohio TRM.	Assumed controlled wattage is 204 watts. Assumed 200 sqft controlled to roughly have 1.0 watts/square foot lighting load.	2010 draft Ohio TRM method with adjusted controlled wattage on Cadmus engineering assumptions. Pages 149 - 152 2010 draft Ohio TRM.	Assumed controlled wattage is 204 watts. Assumed 200 sqft controlled to roughly have 1.0 watts/square foot lighting load.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	Fixture-mounted occupancy sensor	2010 draft Ohio TRM method with adjusted controlled wattage on Cadmus engineering assumptions. Pages 149 - 152 2010 draft Ohio TRM.	Assumed controlled wattage is 204 watts. Assumed 200 sqft controlled to roughly have 1.0 watts/square foot lighting load.	2010 draft Ohio TRM method with adjusted controlled wattage on Cadmus engineering assumptions. Pages 149 - 152 2010 draft Ohio TRM.	Assumed controlled wattage is 204 watts. Assumed 200 sqft controlled to roughly have 1.0 watts/square foot lighting load.
	LED 4-ft 1-lamp tube	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage with specific HOU.	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage
	LED 4-ft 2-lamp tubes	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage with specific HOU.	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage
	LED 4-ft 4-lamp tubes	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage with specific HOU.	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage
	LED case lighting sensor controls	2010 draft Ohio TRM, pages 180 - 182.	Fixture savings is averaged between 5 and 6 foot lamps resulting in 52 watts of savings per door. Waste heat factor savings is averaged and results in .465. These savings are multiplied by a factor of 0.43.	2010 draft Ohio TRM, pages 180 - 182.	No demand savings are collected.
	LED lighting in reach-in freezer/cooler case	2010 draft Ohio TRM, pages 180 - 182.	Fixture savings is averaged between 5 and 6 foot lamps resulting in 52 watts of savings per door. Waste heat factor savings is averaged and results in .465.	2010 draft Ohio TRM, pages 180 - 182.	Fixture savings is averaged between 5 and 6 foot lamps resulting in 52 watts of savings per door. Waste heat factor savings is averaged and results in .465.
	LED luminaires up to 18 watts (replacing incandescent)	Simple savings formula using specific project HOU assumptions.	Assume baseline of 75 watts and efficient wattage of 18 watts, or actual wattages if known.	Simple savings formula.	Assume baseline of 75 watts and efficient wattage of 18 watts, or actual wattages if known.
	LED or Electroluminescent exit sign	2010 draft Ohio TRM, pages 183 - 184.	No changes from TRM.	2010 draft Ohio TRM, pages 183 - 184.	No changes from TRM.
	LED or Induction (8,760 operating hours) replacing 175 W or less	Simple savings formula using 8760 hours.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage
	LED or Induction (8,760 operating hours) replacing 176W to 250W	Simple savings formula using 8760 hours.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	LED or Induction (8,760 operating hours) replacing 251W to 400W	Simple savings formula using 8760 hours.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage
	LED or Induction (operating hours < 8,760) replacing 175W or less	Simple savings formula using 4380 hours.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage
	LED or Induction (operating hours < 8,760) replacing 176W to 250W	Simple savings formula using 4380 hours.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage
	LED or Induction (operating hours < 8,760) replacing 251W to 400W	Simple savings formula using 4380 hours.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage	Simple savings formula.	Efficient fixture wattage is subtracted from baseline fixture including ballast wattage
	LED pedestrian walk/don't walk sign	2010 draft Ohio TRM, pages 185 - 188.	Baseline and efficient wattages are averaged between the two sizes resulting in 109.5 baseline watts and 10.5 efficient watts.	2010 draft Ohio TRM, pages 185 - 188.	Baseline and efficient wattages are averaged between the two sizes resulting in 109.5 baseline watts and 10.5 efficient watts.
	LED recessed downlight luminaires up to 18 watts or screw-in base lamps	Simple savings formula using specific project HOU assumptions.	Assume baseline of 75 watts and efficient wattage of 18 watts, or actual wattages if known.	Simple savings formula.	Assume baseline of 75 watts and efficient wattage of 18 watts, or actual wattages if known.
	LED traffic signal - green	2010 draft Ohio TRM, pages 185 - 188.	No changes from TRM.	2010 draft Ohio TRM, pages 185 - 188.	CF is averaged between "Man" and "Hand" signals resulting in .48.
	LED traffic signal - red	2010 draft Ohio TRM, pages 185 - 188.	Baseline and efficient wattages are averaged between the two sizes resulting in 109.5 baseline watts and 6.5 efficient watts.	2010 draft Ohio TRM, pages 185 - 188.	Baseline and efficient wattages are averaged between the two sizes resulting in 109.5 baseline watts and 6.5 efficient watts.
	LED Traffic Signal (Arrow)	2010 draft Ohio TRM, pages 185 - 188.	Baseline wattage of 116; new wattage of 40.	2010 draft Ohio TRM, pages 185 - 188.	Baseline wattage of 116; new wattage of 40.
	Low-watt T8 4-foot 1 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 43W and new efficiency 22W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 43W and new efficiency 22W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 1 lamp fixture replacing T12*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 43W and new efficiency 22W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 43W and new efficiency 22W. Coincidence factor is the average of the first 13 building type

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
					measures .732.
	Low-watt T8 4-foot 1 lamp fixture replacing T8	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 31W and new efficiency 22W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 31W and new efficiency 22W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 2 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 42W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 42W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 2 lamp fixture replacing T12*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 42W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 42W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 2 lamp fixture replacing T8	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 59W and new efficiency 42W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 59W and new efficiency 42W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 2 lamp fixture replacing T8*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 59W and new efficiency 42W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 59W and new efficiency 42W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 3 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 64W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 64W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 3 lamp fixture replacing T12*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 64W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 64W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 3 lamp fixture replacing T8	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 89W and new efficiency 64W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 89W and new efficiency 64W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 3 lamp fixture replacing T8*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 89W and new efficiency 64W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 89W and new efficiency 64W. Coincidence factor is the average of the first 13 building type measures .732.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	Low-watt T8 4-foot 4 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 85W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 85W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 4 lamp fixture replacing T12*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 85W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 85W. Coincidence factor is the average of the first 13 building type measures .732.
	Low-watt T8 4-foot 4 lamp fixture replacing T8	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 112W and new efficiency 85W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 112W and new efficiency 85W. Coincidence factor is the average of the first 13 building type measures .732.
	Relamping 25 watt or less	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 31W and new efficiency 24W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 31W and new efficiency 24W. Coincidence factor is the average of the first 13 building type measures .732.
	Relamping 28 watt	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 31W and new efficiency 27W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 31W and new efficiency 27W. Coincidence factor is the average of the first 13 building type measures .732.
	Remote-mounted daylight sensor	2010 draft Ohio TRM method with adjusted controlled wattage on Cadmus engineering assumptions. Pages 149 - 152 2010 draft Ohio TRM.	Assumed controlled wattage is 658 watts. Assumed conference room and classroom to have (10) 2 lamp fixtures or warehouse application to have (5) 4 lamp fixtures.	2010 draft Ohio TRM method with adjusted controlled wattage on Cadmus engineering assumptions. Pages 149 - 152 2010 draft Ohio TRM.	Assumed controlled wattage is 658 watts. Assumed conference room and classroom to have (10) 2 lamp fixtures or warehouse application to have (5) 4 lamp fixtures.
	Switching controls for multilevel lighting	2010 draft Ohio TRM with specific project HOU assumptions. Pages 149-152	2010 draft Ohio TRM with specific project HOU assumptions. Pages 149-152	2010 draft Ohio TRM. Pages 149-152	No changes from TRM.
	T5 2 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 65W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 65W. Coincidence factor is the average of the first 13 building type measures .732.
	T5 4 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 116W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 116W. Coincidence factor is the average of the first 13 building type measures .732.
	T5 high-output 1 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 80W and new efficiency 61W. HOU is application	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 80W and new efficiency 61W. Coincidence factor is the

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
			specific.		average of the first 13 building type measures .732.
	T5 high-output 3 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 211W and new efficiency 181W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 211W and new efficiency 181W. Coincidence factor is the average of the first 13 building type measures .732.
	T5 high-output 4 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 262W and new efficiency 234W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 262W and new efficiency 234W. Coincidence factor is the average of the first 13 building type measures .732.
	T5 high-output high-bay 10 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 1,080W and new efficiency 585W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 1,080W and new efficiency 585W. Coincidence factor is the average of the first 13 building type measures .732.
	T5 high-output high-bay 3 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 295W and new efficiency 181W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 295W and new efficiency 181W. Coincidence factor is the average of the first 13 building type measures .732.
	T5 high-output high-bay 4 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 458W and new efficiency 234W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 458W and new efficiency 234W. Coincidence factor is the average of the first 13 building type measures .732.
	T5 high-output high-bay 6 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 458W and new efficiency 351W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 458W and new efficiency 351W. Coincidence factor is the average of the first 13 building type measures .732.
	T5 high-output high-bay 8 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 1,080W and new efficiency 468W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 1,080W and new efficiency 468W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 1 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 43W and new efficiency 25W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 43W and new efficiency 25W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 1 lamp fixture replacing T12*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 43W and new efficiency 25W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 43W and new efficiency 25W. Coincidence factor is the average of the first 13 building type measures .732.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	T8 (BF < 0.78) 4-foot 2 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 48W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 48W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 2 lamp fixture replacing T12*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 48W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 48W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 2 lamp fixture replacing T8	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 59W and new efficiency 48W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 59W and new efficiency 48W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 3 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 73W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 73W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 3 lamp fixture replacing T12*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 73W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 73W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 3 lamp fixture replacing T8	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 89W and new efficiency 73W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 89W and new efficiency 73W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 4 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 96W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 96W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 (BF < 0.78) 4-foot 4 lamp fixture replacing T12*	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 96W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 96W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 4 foot 2 lamp replacing T12 HO only	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 131W and new efficiency 74W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 131W and new efficiency 74W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 4 foot 4 lamp replacing T12 HO only	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 262W and new efficiency 144W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 262W and new efficiency 144W. Coincidence factor is the average of the first 13 building type

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
					measures .732.
	T8 4-foot 2 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 59W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 72W and new efficiency 59W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 4-foot 3 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 89W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 115W and new efficiency 89W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 4-foot 4 lamp fixture replacing T12	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 112W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 144W and new efficiency 112W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 high-bay 4-foot 2 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 190W and new efficiency 77W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 190W and new efficiency 77W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 high-bay 4-foot 4 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 295W and new efficiency 151W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 295W and new efficiency 151W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 high-bay 4-foot 6 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 458W and new efficiency 226W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 458W and new efficiency 226W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 high-bay 4-foot 8 lamp fixture replacing HID	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 458W and new efficiency 288W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 458W and new efficiency 288W. Coincidence factor is the average of the first 13 building type measures .732.
	T8 high-output 8-foot 2 lamp fixture replacing T12 HO only	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 227W and new efficiency 136W. HOU is application specific.	2010 draft Ohio TRM, pages 169 - 172.	Baseline efficiency 227W and new efficiency 136W. Coincidence factor is the average of the first 13 building type measures .732.
	Vending equipment controller	2010 draft Ohio TRM, pages 274 - 275.	Assumed all equipment was for refrigerated vending machines at 400 watts baseline and an ESF of 46%.	2010 draft Ohio TRM, pages 274 - 275.	No demand savings are collected.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	Wall or Ceiling-mounted occupancy sensor	2010 draft Ohio TRM method with adjusted controlled wattage on Cadmus engineering assumptions. Pages 149 - 152 2010 draft Ohio TRM.	Assumed controlled wattage is 658 watts.	2010 draft Ohio TRM method with adjusted controlled wattage on Cadmus engineering assumptions. Pages 149 - 152 2010 draft Ohio TRM.	Assumed controlled wattage is 658 watts.
Non-Residential Prescriptive: Motors, Drives & Compressed Air	Air compressor 1 - 100 HP Load/No Load	2010 draft Ohio TRM with specific project HOU assumptions. Pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 10%.	2010 draft Ohio TRM, pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 10%.
	Air compressor 1 - 100 HP Variable Speed	2010 draft Ohio TRM with specific project HOU assumptions. Pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 26%.	2010 draft Ohio TRM, pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 26%.
	Barrel wraps	Deemed savings based on a custom engineering study.	Controlled tons multiplied by .0075 and HOU.	Deemed savings based on a Custom Rebate engineering study.	Controlled tons multiplied by .0075.
	CEE premium efficiency motor 10HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 15HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 1HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 20HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 2HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 30HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 3HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 40HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	CEE premium efficiency motor 5HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 60HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	CEE premium efficiency motor 7.5HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	NEMA premium efficiency motor 10HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	NEMA premium efficiency motor 125HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	NEMA premium efficiency motor 30HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	NEMA premium efficiency motor 50HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.	2010 draft Ohio TRM, pages 265 - 268.	Assumed baseline efficiency based on 1800 RPM ODP; actual efficiency based on NEMA required standard.
	Variable frequency drive up to 250 HP	Engineering calculations based on primary and secondary data, including the 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 207-209.	Estimates calculated by Cadmus using primary data, secondary data, and the draft Ohio TRM. Application information of the existing motor efficiency, brake horsepower and application type are not collected. Estimated efficiency of the motor that is driven by the VFD is assumed to 91%. An overall percent savings of 30% is used as an average where the TRM percent savings range from 9.2% to 53.5% depending on baseline conditions. Instead of brake horsepower, nominal motor horsepower and 85% load factor is assumed.	Engineering calculations based on primary and secondary data, including the 2010 draft Ohio TRM filed August 6, 2010 under Case No. 09-0512-GE-UNC. Pages 207- 209.	Estimates calculated by Cadmus using primary data, secondary data, and the draft Ohio TRM. Application information of the existing motor efficiency, brake horsepower and application type are not collected. Estimated efficiency of the motor that is driven by the VFD is assumed to 91%. An overall percent savings of 30% is used as an average where the TRM percent savings range from 3% to 34.8% depending on baseline conditions. Instead of brake horsepower, nominal motor horsepower and 85% load factor is assumed.
	VFDs on Air Compressors 1-100 HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 26%.	2010 draft Ohio TRM, pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 26%.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
Non-Residential Prescriptive: Compressed Air	Air compressor 1 - 100 HP Load/No Load	2010 draft Ohio TRM with specific project HOU assumptions. Pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 10%.	2010 draft Ohio TRM, pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 10%.
	Air compressor 1 - 100 HP Variable Speed	2010 draft Ohio TRM with specific project HOU assumptions. Pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 26%.	2010 draft Ohio TRM, pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 26%.
	VFDs on Air Compressors 1-100 HP	2010 draft Ohio TRM with specific project HOU assumptions. Pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 26%.	2010 draft Ohio TRM, pages 272 - 273.	Use nominal hp; assumed 90% motor efficiency and ESF of 26%.
Non-Residential Prescriptive: Other	Window film	2010 draft Ohio TRM, pages 214 - 217.	ΔkWh is average of "light industrial, small office and small retail" resulting in 266.	2010 draft Ohio TRM, pages 214 - 217.	ΔkW is average of "light industrial, small office and small retail" resulting in .14.
Non-Residential Custom	Custom NC	Custom engineering calculation	A full impact analysis report is completed. Specific to each project, as-built building simulations are developed and used to determine electric kWh savings.	Custom engineering calculation	A full impact analysis report is completed. Specific to each project, as-built building simulations are developed and used to determine electric kW savings.
	Custom NC-LPD	Custom engineering calculation	A full impact analysis report is completed. Specific to each project, lighting power density calculations are used to determine electric kWh savings.	Custom engineering calculation	A full impact analysis report is completed. Specific to each project, lighting power density calculations are used to determine electric kW savings.
	Custom-Air Compressor	Custom engineering calculation	Depending on project size and scope, a full impact analysis report is completed. Specific to each project, the impact analysis may include pre- and post-metering, billing analysis, and custom engineering calculations.	Custom engineering calculation	Depending on project size and scope, a full impact analysis report is completed. Specific to each project, the impact analysis may include pre- and post-metering, billing analysis, and custom engineering calculations.
	Custom-HVAC	Custom engineering calculation	Depending on project size and scope, a full impact analysis report is completed. Specific to each project, the impact analysis may include pre- and post-metering, billing analysis, and custom engineering calculations.	Custom engineering calculation	Depending on project size and scope, a full impact analysis report is completed. Specific to each project, the impact analysis may include pre- and post-metering, billing analysis, and custom engineering calculations.
	Custom-Lighting	Custom engineering calculation	Depending on project size and scope, a full impact analysis report is completed. Specific to each project, the impact analysis may include pre- and post-metering, billing analysis, and custom engineering calculations.	Custom engineering calculation	Depending on project size and scope, a full impact analysis report is completed. Specific to each project, the impact analysis may include pre- and post-metering, billing analysis, and custom engineering calculations.

Program	Measure	Ex Ante kWh Savings Documentation	Ex Ante kWh Savings Documentation Detail	Ex Ante kW Savings Documentation	Ex Ante kW Savings Documentation Detail
	Custom-Other	Custom engineering calculation	Depending on project size and scope, a full impact analysis report is completed. Specific to each project, the impact analysis may include pre- and post-metering, billing analysis, and custom engineering calculations.	Custom engineering calculation	Depending on project size and scope, a full impact analysis report is completed. Specific to each project, the impact analysis may include pre- and post-metering, billing analysis, and custom engineering calculations.

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of The Dayton Power and Light Company's Portfolio Status Report.	)))	Case No. 14-738-EL-POR

Affidavit of Derek Porter

State of Ohio	)	
	)	SS:
County of Montgomery	)	

I, Derek Porter, being first duly cautioned and sworn, do hereby swear and affirm the following to the best of my knowledge and belief:

1. I have attained the age of eighteen and have personal knowledge of the matters set forth herein.

2. I am the President and Chief Executive Officer of The Dayton Power and Light Company ("DP&L"). As part of my overall responsibilities, I am responsible for ensuring DP&L's compliance with statutorily imposed energy efficiency and peak demand reduction requirements.

3. DP&L has met its statutory benchmarks for energy efficiency and peak demand reduction as set forth in the Portfolio Status Report being filed contemporaneously with this Affidavit.

FURTHER AFFIANT SAYETH NAUGHT.

Derek Porter

Sworn to and subscribed in my presence on this 13th day of May, 2014.

Notary Public

JUDI L. SOBECKI
NOTARY PUBLIC, State of Ohio
My Commission Has No Expiration Date
Section 147.03 R.C.