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District Department of the Environment

Evaluation, Measurement, and Verification of Energy Efficiency and Renewable Energy Programs in the District of Columbia

FY2013 Annual Evaluation Report

Volume I

Final—September 29, 2014

DISTRICT DEPARTMENT OF THE ENVIRONMENT
green forward

DC SUSTAINABLE ENERGY UTILITY
Your Guide to Green

leidos

BAUMANN CONSULTING
Formerly Ebert & Baumann Consulting Engineers

GDS Associates, Inc.
Engineers and Consultants

District Department of the Environment

Evaluation, Measurement, and Verification of Energy Efficiency and Renewable Energy Programs in the District of Columbia

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ACKNOWLEDGEMENTS

This evaluation effort was performed by Tetra Tech, GDS Associates, Leidos[1], and Baumann Consulting[2] under the leadership of Tetra Tech.

This effort was supported by the provision of project data in the form of KITT data extracts, project files, memos, staff interviews, and responses to other requests for data and information by the DDOE, DC SEU, and VEIC Evaluation, Measurement, and Verification Services group.

The evaluation team thanks the DDOE, DC SEU, and VEIC teams for their timely and thorough responses to all data requests and follow-up questions. In particular, we thank Asa Parker, VEIC EM&V Services Group, for his tremendous support and responses to the many questions from the evaluation team as we conducted our impact evaluation activities.

The table below displays the role of each evaluation team member and report content contributor.

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[1] Formerly SAIC, International.
[2] Ebert and Baumann Consulting Engineers, Inc. d/b/a Baumann Consulting.

ACRONYMS

ACEEE	American Council for an Energy Efficient Economy
BER	Business Energy Rebates
Btu	British thermal unit
C&I	Commercial and institutional
CAT	Custom application tool
CBE	Certified business enterprise
CF	Coincidence factor
CEI	Comprehensive efficiency improvements
CFL	Compact fluorescent lamp
DI	Direct install
DC SEU	District of Columbia Sustainable Energy Utility
DDOE	District Department of the Environment
DHW	Domestic hot water
EC	Energy consultant
ECM	Energy conservation measure
EFI	Energy Federation Incorporated
EFLH	Equivalent full load hours
EM&V	Evaluation, measurement, and verification
FY	Fiscal year
GWh	Gigawatt hour
HERO	Home Energy Reporting Online
HPwES	Home Performance with ENERGY STAR®
HVAC	Heating ventilation and air conditioning
ICDI	Implementation contractor direct install
KITT	Knowledge Information Transfer Tool
kW	Kilowatt
kWh	Kilowatt hour
LED	Light emitting diode
LI	Low-income
LIMF	Low-income multifamily
mcf	1,000 cubic feet
MF	Multifamily

MMBtu	1 million British thermal unit
M&V	Measurement and verification
N	Population
n	Sample
NREL	National Renewable Energy Laboratory
NTG	Net-to-gross
PV	Photovoltaic
PY	Plan year
QA/QC	Quality assurance/quality control
RFP	Request for proposal
RR	Realization rate
SOME	So Others Might Eat
TRM	Technical reference manual
VEIC	Vermont Energy Investment Corporation
VFD	Variable frequency drive

1. EXECUTIVE SUMMARY

The District Department of the Environment (DDOE) has contracted with Tetra Tech (as the prime contractor), GDS Associates, Inc., Leidos, and Baumann Consulting to provide evaluation, measurement, and verification of the portfolio of energy efficiency and renewable energy initiatives offered in the District of Columbia (DC) along with the six performance benchmarks associated with these initiatives. The initiatives are implemented through the DC Sustainable Energy Utility (SEU, or DC SEU) partnership.

The DC SEU is led by the Sustainable Energy Partnership and under contract to the District Department of the Environment (DDOE). The Sustainable Energy Partnership includes the following organizations[3]:

- Vermont Energy Investment Corporation (VEIC) - Partnership Lead
- George L. Nichols & Associates
- Groundswell
- Institute for Market Transformation
- L. S. Caldwell and Associates, Inc.
- PEER Consultants
- PES Group / Stateline Energy Associates
- Skyline Innovations
- Taurus Development Group.

This report presents the evaluation and verification results for each initiative, or track, offered by the DC SEU as a part of the DC SEU Energy Efficiency and Renewable Energy Portfolio in the District of Columbia for fiscal year (FY) 2013. Overall portfolio results are also provided along with cross-sectional findings and evaluation team recommendations. The fiscal year is defined as October 1st through September 30th.

The independent evaluation and verification of the six performance benchmarks included within the DDOE contract with the DC SEU is reported separately. See the *District Department of the Environment Verification of the District of Columbia Sustainable Energy Utility Performance Benchmarks, F2013 Annual Evaluation Report*.

Detailed summaries of the portfolio overall and crosscutting evaluation findings are presented in Section 3. Section 4 provides detailed track level assessments.

[3] DC Sustainable Energy Utility website, http://www.DC SEU.com/.

1.1 EVALUATION VERIFIED SAVINGS SUMMARY

The evaluation team's verified, or ex-post, results of the KITT reported electric savings, demand reduction, and natural gas savings for each track, or initiative, and for the overall portfolio are presented in Table 1-1. These verified results reflect portfolio level realization rate estimates of 1.04, 1.07, and 1.00 for kWh, kW, and MMBtu respectively. This means that the evaluation team estimates that the actual portfolio electric savings result is 104 percent of the DC SEU reported electric savings, the demand reduction result is 107 percent of the DC SEU reported demand reduction, and the actual portfolio gas savings result is 100 percent of the DC SEU reported gas savings. This compares to realization rate estimates at the portfolio level of 0.92, 0.95, and 0.99 for kWh, kW, and MMBtu, respectively for the FY12 results.

Realization rates are the ratio of verified savings to the tracking system savings for a representative sample of projects reported within each track. Realization rates are typically calculated for each end-use category and then applied to the total end-use tracking system savings for a particular program, or track. The results are rolled up to develop program, or track, verified savings. The verified savings for all tracks are summed to obtain portfolio level verified savings.

These realization rate estimates are quite good-especially for programs in their second year of implementation. Comparatively, the Pennsylvania Act 129 Statewide Evaluator Annual Report for Plan Year 2,[4] reported that the utilities, overall, achieved a realization rate for of approximately 96 percent for electric savings in its second year of Act 129 Program operation. The EmPOWER Maryland 2012 statewide verified results are reported in the *Verification of Reported Impacts from 2012 EmPOWER Maryland Energy Efficiency Programs*[5] as 100.1 and 115.1 percent of reported values for electric savings and demand reduction, respectively.

As for FY12 results evaluation, these realization rates indicate that, overall, the tracking of the measures installed through the initiatives and the calculation of electric savings, demand reduction, and gas savings is accurate—although there are issues within individual initiatives as discussed in each track section, the adjustments to correct for over-reporting and under-reporting balance out across the portfolio. Tracking and calculation issues are not uncommon with energy efficiency program implementation, especially when programs are early in the implementation cycle.

[4] http://www.puc.pa.gov/electric/pdf/Act129/SWE_PY3-Annual_Report.pdf.

[5] *Verification of Reported Program Impacts from 2012EmPOWER Maryland Energy Efficiency Programs with Recommendations to Improve Future Evaluation Research*, June 4, 2013. http://neep.org/Assets/uploads/files/emv/emv-library/MDPSC_2012_Verification_Report_Compiled.pdf.

Table 1-1. DC SEU FY13 Energy Efficiency and Renewable Energy Portfolio Gross Verified Savings, Meter Level

Track	Description	kWh			kW			MMBtu - Gas Savings		
		Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
7110SHOT	Solar Hot Water	-	-	n/a	-	-	n/a	4,620.0	4,620.0	1.00
7120PV	Solar Photovoltaic	192,877	196,735	1.02	31.6	32.3	1.02	-	-	n/a
7420FHLB	Forgivable Loan for Home Efficiency Improvements	30,531	30,579	1.00	3.2	3.2	1.00	109.7	119.2	1.09
7420HPES	Home Performance with ENERGY STAR	171,098	158,549	0.93	16.9	15.3	0.91	606.2	616.9	1.02
7510BLTZ	T12 Lighting Replacement	3,644,922	4,212,011	1.16	826.9	1,029.7	1.25	-2,379.4	-2,039.4	0.86
7510CIRX	Business Energy Rebates	2,194,303	2,119,264	0.97	372.9	397.3	1.07	-435.9	-433.7	0.99
7510MTV	T12 Market Transformation Value	1,079,285	1,460,503	1.35	237.9	353.6	1.49	-717.9	-949.7	1.32
7520CUST	Custom Services	19,751,948	20,793,168	1.05	2,858.8	3,031.2	1.06	63,209.1	62,149.4	0.98
7520MARO	Custom Market Opportunity	636,671	566,420	0.89	55.1	56.7	1.03	-	-	n/a
7520NEWC	Custom New Construction	88,749	88,749	1.00	8.8	8.8	1.00	-	-	n/a
7610BLTZ	LI MF T12 Lighting Replacement for Low-income	471,730	388,781	0.82	151.4	143.5	0.95	-322.5	-247.2	0.77
7610ICDI	LI MF Implementation Contractor Direct Install	1,187,537	1,231,956	1.04	124.0	122.9	0.99	417.6	298.8	0.72
7620LICP	LI MF Comprehensive Efficiency Improvements	1,959,041	1,921,321	0.98	184.3	181.8	0.99	5,864.7	5,880.0	1.00
7710APPL	Retail Efficient Appliances	99,569	99,569	1.00	14.3	13.8	0.96	162.0	251.2	1.55
7710FBNK	Efficient Products at Food Banks	2,416,513	2,418,361	1.00	269.6	269.6	1.00	-3,989.5	-3,842.9	0.96
7710LITE	Retail Efficient Lighting	12,699,881	12,713,227	1.00	1,895.3	1,897.8	1.00	-17,317.3	-16,806.4	0.97
Total Reported (ex-ante) / Verified (ex-post)		**46,624,655**	**48,399,192**	**1.04**	**7,051.0**	**7,557.6**	**1.07**	**49,826.9**	**49,616.1**	**1.00**

Note: Table total may not add; difference due to rounding.

Table 1-2 provides a summary by track and for the overall portfolio after adjustments for line losses[6] and, in the case of the solar initiatives, an adjustment for spillover.[7] The free-ridership and spillover for all other tracks are assumed to be 1.00. This is a standard assumption for programs early in implementation.[8]

Table 1-2. DC SEU FY13 Net Verified Savings, Generator Level

Track	Description	kWh, Net		kW, Net	
		Ex-ante$_{generator}$	Ex-post$_{generator}$	Ex-ante$_{generator}$	Ex-post$_{generator}$
7110SHOT	Solar Hot Water	-	-	-	-
7120PV	Solar Photovoltaic	239,553	244,344	38.6	39.3
7420FHLB	Federal Home Loan	32,974	33,025	3.4	3.4
7420HPES	Home Performance	184,786	171,232	17.9	16.2
7510BLTZ	T12 Lighting	3,936,515	4,548,972	876.5	1,091.5
7510CIRX	Business Energy Rebates	2,369,847	2,288,806	395.3	421.2
7510MTV	T12 Market Transformation Value	1,165,628	1,577,343	252.2	374.9
7520CUST	Custom Services	21,332,104	22,456,621	3,030.3	3,213.0
7520MARO	Custom Market Opportunity	687,605	611,734	58.4	60.1
7520NEWC	Custom New Construction	95,849	95,849	9.4	9.4
7610BLTZ	LIMF T12 Lighting	509,468	419,883	160.4	152.1
7610ICDI	LIMF Direct Install	1,282,540	1,330,512	131.4	130.3
7620LICP	LIMF Comprehensive	2,115,764	2,075,027	195.3	192.7
7710APPL	Appliances	107,534	107,534	15.2	14.6
7710FBNK	Food Banks	2,609,834	2,611,830	285.8	285.8
7710LITE	Lighting	13,715,872	13,730,285	2,009.0	2,011.7
Total Reported / Verified		**50,385,873**	**52,302,998**	**7,479.1**	**8,016.2**

Note: Table total may not add; difference due to rounding.

[6] The reported and verified electric savings (kWh) and demand reduction (kW) results are adjusted for line losses (8 percent and 6 percent increases, respectively).

[7] The savings and demand for the Solar PV program are increased by an additional 15 percent to reflect spillover; reference DC SEU memorandum to the DDOE and Tetra Tech, *Screening assumptions for the DC SEU solar renewable energy program portfolio*, dated August 30, 2012

[8] The evaluation team conducted free-ridership and spillover analysis for several initiatives in this evaluation cycle; however, participation is not sufficient at this time to recommend net-to-gross values other than 1.00.

1.2 PORTFOLIO RESULTS EXAMINATION

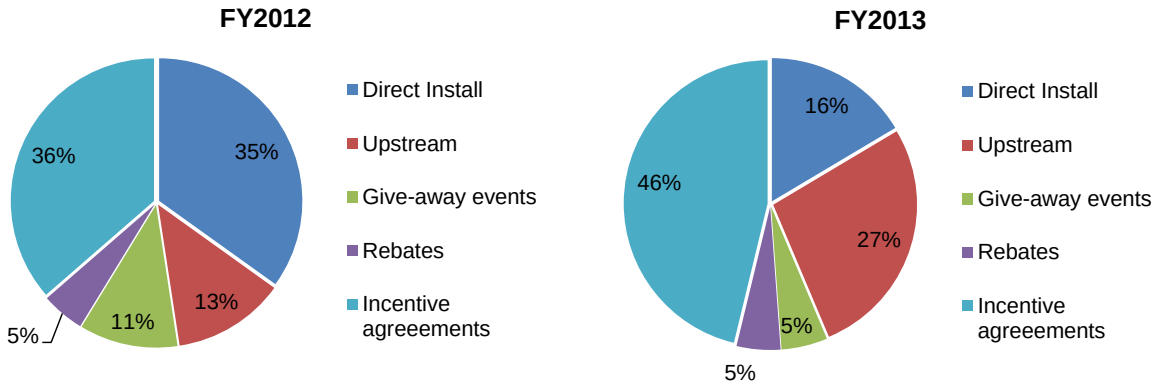
The DC SEU Portfolio of Energy Efficiency and Renewable Energy offerings gained 143 percent of MWh savings over the FY12 implementation period, while electric spend decreased by 2 percent in absolute terms. The overall acquisition cost, or MWh achieved (based on verified savings) per dollar spent[9] was $228 in FY13 compared to $549 in FY12—a 58 percent decrease. To achieve the minimum MWh performance benchmark for FY14 within the FY14 budget, the acquisition cost must remain about the same as the FY13 level.

The FY13 non-renewable savings for energy efficient gas measures increased by 867 percent while the expenditures increased by 160 percent. The acquisition cost, or dollars spent per MMBtu saved, decreased by 73 percent. To achieve the minimum performance benchmark for FY14 within the FY14 budget, the acquisition cost must decrease by 66 percent ($14 per MMBtu) over the FY13 results. The achieve the performance benchmark target, it must decrease to $7 per MMBtu. A reduction of these magnitudes is highly unlikely, indicating achievement of both the MWh adnmcf targets are not likely.

Please see the *District Department of the Environment, Verification of the District of Columbia Sustainable Energy Utility, FY13 Annual Evaluation Report for the Performance Benchmarks* report dated Spetember 23, 2014 for a detailed analysis and discussion of acquisition costs.

Since inception, the DC SEU plans have shifted from early "quick start" direct install initiatives to a combination of direct install and incentive-based initiatives consisting of upstream buy-downs, rebates, give-away events, and negotiated incentive agreements. A comparison of initiative design types FY12 to FY13 based on reported electric savings is present below. These charts illustrates the shift from direct install initiative design to a more "market-based" approach with 35 percent of portfolio savings associated with direct install initiatives in FY12 compared to only 16 percent in FY13.

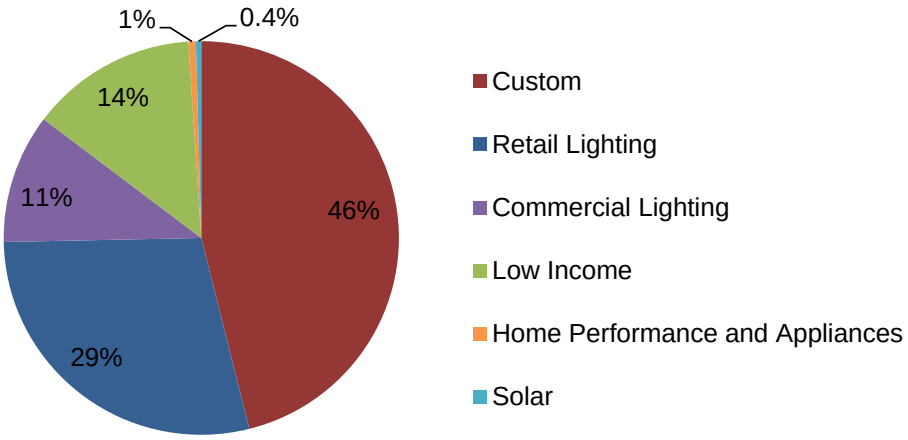
Figure 1-1. Portfolio Electric Savings by Initiative Design Type Comparison, Reported Savings



[9] Excludes renewable energy savings and expenditures.

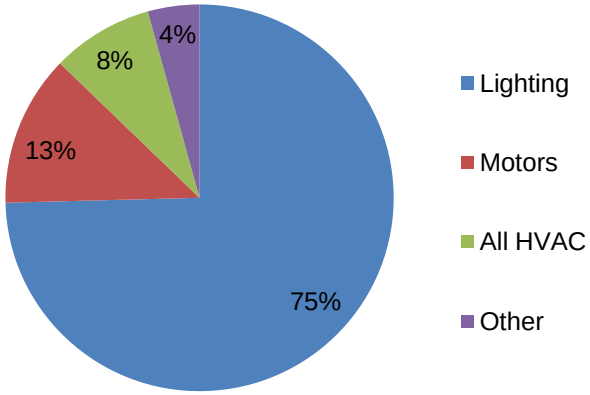
The following figure provide a summary of the contribution to the portfolio overall savings by measures and by sectors. The contribution to the overall electric savings by the type of initiative is dominated by the Custom initiatives targeted at commercial and institutional entities.

Figure 1-2. FY13 Portfolio Electric Savings by Initiative Measure Category, Reported Savings



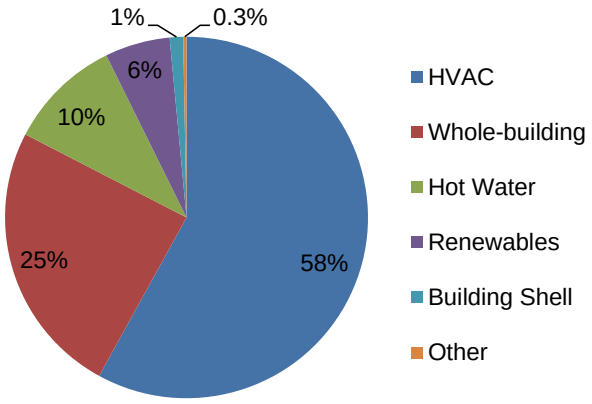
Lighting measures made up 75 percent of portfolio saving in FY13 compared to 80 percent in FY12 (Figure 1-3). This distribution of savings is typical for programs early in implementation. In particular, it is common for portfolios to rely upon lighting measures in the early years.

Figure 1-3. FY13 Portfolio Electric Savings by Measure Type, Reported Savings



The contribution to overall natural gas savings is due primarily to HVAC and whole-building improvement measures which contribute 58 percent and 25 percent, respectively. This compares to FY12 results of 50 percent for HVAC and 48 percent for water savings measures. This illustrates the movement toward a more comprehensive offering of natural gas savings measures within the District as well as a focus on targeting natural gas usage customers.

Figure 1-4. FY13 Portfolio Natural Gas Savings by Measure Type, Reported Savings



Commercial and institutional tracks contributed 59 percent to electric savings compared to 64 percent in FY12 (Figure 1-5). Eighty-four percent of gas savings were from the commercial and institutional sector (Figure 1-6).

Figure 1-5. FY13 Portfolio by Sector, Reported Electric Savings

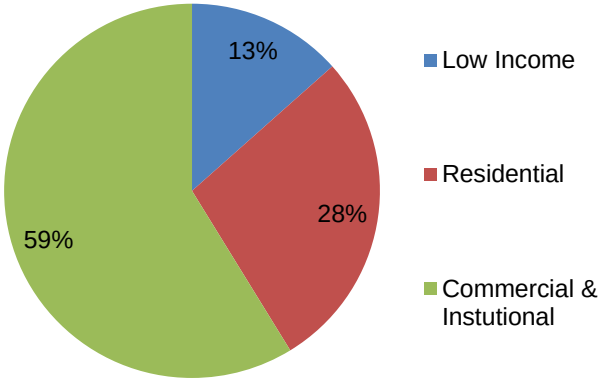
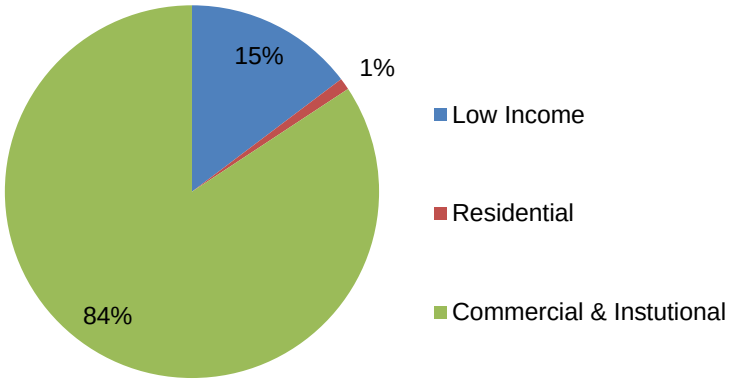


Figure 1-6. FY13 Portfolio by Sector, Reported Gas Savings



2. EVALUATION METHODOLOGY

The FY13 evaluation effort followed the evaluation guidance provided in the *District Department of the Environment Energy Efficiency Evaluation Plan for Portfolio of Programs Offered in the District of Columbia* submitted December 6, 2013.

The FY13 impact evaluation effort was focused primarily on the verification of the individual track and overall portfolio reported, or ex-ante, results for electric savings (kWh), demand reduction (kW), and natural gas savings (MMBtu, mcf). The effort was prioritized by track or initiative, based upon the contribution to the portfolio to ensure those tracks providing the most savings received more robust evaluation.

Process evaluation and net savings assessments are planned according to the "DC SEU Portfolio Evaluation Strategic Timeline" developed to plan evaluation activities over a four-year time period to maximize evaluation expenditures and to provide the DDOE, DC SEU, and other stakeholders with timely and useful data and information to support portfolio design and policy development. The evaluation strategic timeline is presented in Table 2-1.

Table 2-1. DC SEU Portfolio Evaluation Strategic Timeline, legend

Criteria Legend:			
Criteria	**H**	**M**	**L**
Contribution	high	medium	low
Complexity	high	medium	low
Criteria	**S**	**MS**	**MA**
Implementation Phase	start-up	mid-stream	mature

Evaluation Legend	
Level	**Activity**
Low	Desk review
Medium	Project file review or desk review with limited onsite verification and/or supplemental phone survey verification
High	Project file review with onsite verification and phone survey verification, market actor interviews
Expanded	Medium or High plus additional study to verify key savings algorithm assumptions or process issues

Table 2-1. Evaluation of DC SEU Portfolio Strategic Timeline (continued)

Track	Track Description	Criteria					Evaluation Effort & Timing (contract period)				
		Current Contr. to Portfolio (H, M, L)	Expected Contr. Over 3-years (H, M, L) (1)	Measure Complexity (H, M, L)	Impl'n Phase (S, MS, MA)	Typical Impl'n Maturity Year	Evaluation Budget Year	FY13	FY14	FY15	FY16
Crosscutting and Portfolio Level		n/a	n/a	H	S to MS	Year 3	Performance Benchmarks assessment	high-level	assess latest Performance Benchmark study and design evaluation effort for FY15-16	TBD	TBD
							Technical Reference Manual review	robust for existing measures	robust for new measures; robust assessment of high-contribution measures (res lighting)	robust for new measures	robust for new measures
							Data collection and savings estimation tools review	minimal	minimal	robust	FY15 results dependent
							Cost effectiveness of Portfolio and Initiatives	validate DC SEU model	robust assessment of externality adders reasonableness	robust assessment of other key assumptions	
							Marketing and outreach	minimal	minimal	robust	FY15 results dependent

Track	Track Description	Criteria					Evaluation Effort & Timing (contract period)				
		Current Contr. to Portfolio (H, M, L)	Expected Contr. Over 3-years (H, M, L) (1)	Measure Complexity (H, M, L)	Impl'n Phase (S, MS, MA)	Typical Impl'n Maturity Year	Evaluation Budget Year	FY13	FY14	FY15	FY16
							Workforce development and training	minimal	minimal	robust	FY15 results dependent
							Administrative operations	minimal	minimal	robust	FY15 results dependent
7110SHOT	Solar Hot Water	L	L	L	S	Year 2	Impact	not offered	low	low	low
							Process	not offered	low	low	high
							NTG	not offered	low-indicators	low-indicators	low-indicators
7120PV	Photovoltaic	L	L	L	S	Year 2	Impact	low	low	low	low
							Process	low	low	low	high
							NTG	none	low-indicators	low-indicators	low-indicators
7420FHLB	Federal Home Loan Bank	L	L	L	S	Year 3	Impact	medium	medium	high	medium
							Process	low	low	low	high
							NTG	none	low-indicators	low-indicators	low-indicators
7420HPES	Home Performance with ENERGY STAR®	L	L	M to L	S	Year 3	Impact	medium	medium	high	medium
							Process	low	low	low	high
							NTG	none	low-indicators	low-indicators	low-indicators

Track	Track Description	Criteria					Evaluation Effort & Timing (contract period)				
		Current Contr. to Portfolio (H, M, L)	Expected Contr. Over 3-years (H, M, L) [1]	Measure Complexity (H, M, L)	Impl'n Phase (S, MS, MA)	Typical Impl'n Maturity Year	Evaluation Budget Year	FY13	FY14	FY15	FY16
7510BLTZ	T12 Lighting Replacement	H	H	M	MS	Year 2	Impact	high	high	high	high
							Process	low	high	low	low
							NTG	none	full	low-indicators	low-indicators
7510CIRX	Business Energy Rebates	M	M	Mixed	S	Year 2	Impact	high	high	high	high
							Process	low	low	high	low
							NTG	none	low-indicators	full	low-indicators
7510MTV	12 Market Transformation	L	M	M	S	Year 3	Impact	not offered	medium	high	high
							Process		low	high	low
							NTG		low-indicators	low-indicators	full
7520CUST	Custom Services for C&I Customers	H	H	H to M	MS	Year 3	Impact	high	high	high	high
							Process	low	high	low	low
							NTG	none	full	full	full
7610BLTZ	Low Income T12 Lighting	L	L	L	Discont'd	Year 2	Impact	medium	Discont'd	Discont'd	Discont'd
							Process	low			
							NTG	none			
7610ICDI	Low Income Contractor Direct Install	L	L	L	MS	Year 2	Impact	medium	medium	medium	medium
							Process	low	low	high	low
							NTG	none	low-indicators	low-indicators	low-indicators

Track	Track Description	Criteria					Evaluation Effort & Timing (contract period)				
		Current Contr. to Portfolio (H, M, L)	Expected Contr. Over 3-years (H, M, L) [1]	Measure Complexity (H, M, L)	Impl'n Phase (S, MS, MA)	Typical Impl'n Maturity Year	Evaluation Budget Year	FY13	FY14	FY15	FY16
7620LICP	Low Income Comprehensive	L	L	M to L	MS	Year 3	Impact	medium	medium	medium	medium
							Process	low	low	low	high
							NTG	none	low-indicators	low-indicators	low-indicators
7710APPL	Energy Efficient Appliances	H (Res CFL lighting)	H	L	S	Year 2	Impact	medium	expanded	medium	medium
							Process	low	high	low	low
							NTG	none	full	low-indicators	low-indicators
7710FBNK	Food Bank Lighting	M	L	L	MS	Year 2	Impact	medium	medium	medium	medium
							Process	low	low	high	low
							NTG	none	none	low-indicators	low-indicators

2.1 SAMPLING METHODOLOGY

Tetra Tech conducted the sampling for each track as summarized in Table 2-2 based on the preliminary KITT extract results snapshot. The evaluation team considered each track's characteristics when approaching sampling. Some tracks have relatively few or no differences from one project to the next, while others can vary widely. The evaluation team took one of three approaches to sampling, determined by each track's characteristics.

1. For tracks with little variation in project savings, we selected a simple random sample. These are likely to have similar measures installed with less uncertainty and variability in the inputs to savings calculations.
2. For tracks with higher variation in project savings, we sampled the top ten percent of projects by electricity and/or gas savings (first stratum) with certainty (100 percent sample), and supplemented these projects with a random sample of other projects (second stratum). This approach allows us to include a larger portion of the savings in our sample to increase the level of precision and confidence in the results at the initiative level.
3. For tracks with differences in measure types, we stratified that track's sample by measure type and sample randomly within each stratum. Thus, we are able to calculate realization rates by end-use category and roll up the results to improve the accuracy of the overall track realization rate.

Table 2-2. Sampling Summary by Track[10]

Track	End Use	Total Measures	Population kWh	Population Gas Savings	Sampled Measures	Sampled % kWh	Sampled % Gas
7110SHOT	Solar Water Heating	12	0	4,620	12	n/a	100%
	Total	**12**	**0**	**4,620**	**12**	**n/a**	**100%**
7120PV	Solar PV	56	195,856	0	56	100%	n/a
	Total	**56**	**195,856**	**0**	**56**	**100%**	**n/a**
7420FHLB	Building Shell	13	733	132	9	64%	67%
	Heating	9	23	10	3	0%	29%
	Lighting	31	28,294	0	22	74%	n/a
	Other HVAC	7	5	5	5	0%	69%
	Water Heating	20	3,341	5	13	66%	98%
	Total	**80**	**32,396**	**152**	**52**	**73%**	**66%**

[10] Table 2-2 represents the original sample plan. As the evaluation effort progressed, the sample was adjusted for some programs to attempt greater onsite verification opportunity and to match replacement onsite evaluation with project file reviews. Table 2-3 provides a summary of the actual number of completed activities.

Track	End Use	Total Measures	Population kWh	Population Gas Savings	Sampled Measures	Sampled % kWh	Sampled % Gas
7420HPES	Building Shell	27	4,525	712	17	89%	90%
	Heating	1	0	14	0	n/a	0%
	Lighting	223	117,311	0	144	68%	n/a
	Other HVAC	10	4,564	69	6	51%	96%
	Water Heating	192	60,297	4	118	67%	58%
	Total	**453**	**186,697**	**799**	**285**	**68%**	**89%**
7510BLTZ	Lighting	56	3,622,604	0	56	100%	n/a
	Total	**56**	**3,622,604**	**0**	**56**	**100%**	**n/a**
7510CIRX	Cooling	8	232,599	0	8	100%	n/a
	Lighting	42	1,240,682	0	42	100%	n/a
	Motors & Drives	4	685,612	0	4	100%	n/a
	Other	1	23,660	0	1	100%	n/a
	Refrigeration	9	69,095	0	9	100%	n/a
	Water Heating	2	0	2,008	2	n/a	100%
	Total	**66**	**2,251,648**	**2,008**	**66**	**100%**	**100%**
7510MTV	Lighting	39	1,093,119	0	39	100%	n/a
	Total	**39**	**1,093,119**	**0**	**39**	**100%**	**n/a**
7520CUST	Cooling	12	2,331,768	6,969	12	100%	100%
	Heating	8	14,639	34,421	8	100%	100%
	Lighting	59	11,438,909	0	59	100%	n/a
	Motors & Drives	19	4,983,760	0	19	100%	n/a
	Other	3	664,711	19,897	3	100%	100%
	Other HVAC	2	275,275	1,502	2	100%	100%
	Water Heating	2	0	3,049	2	n/a	100%
	Total	**105**	**19,709,061**	**65,839**	**105**	**100%**	**100%**
7520MARO	Cooling	2	585,423	0	2	100%	n/a
	Motors & Drives	2	51,248	0	2	100%	n/a
	Total	**4**	**636,671**	**0**	**4**	**100%**	**n/a**
7520NEWC	Other	1	88,749	0	1	100%	n/a
	Total	**1**	**88,749**	**0**	**1**	**100%**	**n/a**

Track	End Use	Total Measures	Population kWh	Population Gas Savings	Sampled Measures	Sampled % kWh	Sampled % Gas
7610BLTZ	Lighting	10	469,652	0	10	100%	n/a
	Total	**10**	**469,652**	**0**	**10**	**100%**	**n/a**
7610ICDI	Lighting	25	1,072,852	0	25	100%	n/a
	Water Heating	24	184,201	1,999	24	100%	100%
	Total	**49**	**1,257,053**	**1,999**	**49**	**100%**	**100%**
7620LICP	Appliances	9	110,507	46	9	100%	100%
	Building Shell	7	212,937	41	7	100%	100%
	Cooling	7	457,018	0	7	100%	n/a
	Heating	4	135,704	3,219	4	100%	100%
	Lighting	9	657,465	0	9	100%	n/a
	Motors & Drives	1	10,967	0	1	100%	n/a
	Other	1	491	0	1	100%	n/a
	Other HVAC	7	149,914	0	7	100%	n/a
	Water Heating	9	231,967	2,894	9	100%	100%
	Total	**54**	**1,966,969**	**6,200**	**54**	**100%**	**100%**
7710APPL	Clothes Washers	366	40,101	101	122	30%	29%
	Refrigerator	361	54,998	0	122	37%	n/a
	Total	**727**	**95,099**	**101**	**244**	**34%**	**29%**

Note: Table total may not add; difference due to rounding.

2.2 SUMMARY OF EVALUATION ACTIVITIES

The evaluation activities to support the impact, process, and net savings efforts for FY13 results are described below and a summary is presented in Table 2-3. Interview guides, survey instruments, and updated logic models can be found in Volume II of this report

DC SEU Program Staff Interviews: Staff interviews were conducted to ensure evaluators understood how the program operated in FY13 as well as to identify any changes for FY14 The FY12 program logic models were also reviewed at that time to update the characterization of the program resources and key activities, the outputs from those activities, and the expected short-term and long-term program outcomes.

Desk review: Project files were reviewed to ensure project file data and information support the reported, or ex-ante, savings. Typically, quantities of measures installed were identified and checked to reported quantities in tracking system and deemed measures were reviewed to ensure calculations were accurate and done in accordance with the DC SEU FY13 final Technical Reference Manual[11].

Project file review: In addition to a desk review, other documentation in the project files (invoices, applications, equipment specification sheets, quality assurance forms, etc.) were reviewed and cross-referenced to each other to ensure accuracy and consistency of data reported and used in the savings calculations for the project.

Onsite Verification: Evaluator onsite visits were conducted to verify such things as equipment installation and quantities, operating characteristics, hours of use, fuel sources, and location of equipment in facility.

Engineering analysis: Projects that contained measures that were not deemed savings measures in accordance with the DC SEU Technical Reference Manual were assessed through engineering analysis review and/or engineering modeling. The analysis was conducted to ensure reported, or ex-ante, savings are reasonable given completed project scope. Information collected during onsite verification was also used where appropriate to inform the review.

Participant survey: Participant surveys were conducted to understand how the program operated from the customer perspective to support process evaluation and/or to verify the installation of measures reported by the program to support impact evaluation. Additionally, net-to-gross questions (free ridership and spillover) were asked to support program design and to understand program attribution.

Market Actor Interviews: Market actor interviews were conducted with contractors to understand how the programs are operating from the market actor perspectives. Market actors are a key component of successful program implementation. It is critical to understand the barriers and challenges market actors face and document their ideas for improvements to drive more participation in programs.

[11] *DC SEU Technical Reference Manual (TRM)—Measure Savings Algorithms and Cost Assumptions Savings Verification, Fiscal Year 2013.*

Table 2-3. Evaluation Completed Activity Summary

Track	Track Description	Number of Projects/Units	Program staff interviews	Project File Reviews	Desk Audits	Engineering Analysis/Modeling	On-site Measure verification	Phone Participants Verification Survey	Participants Verification, Process and/or NTG Survey	Nonparticipant or partial participant surveys/interviews	Market actor interviews
7110SHOT	Solar Hot Water	12	1	6	0	0	2	9	Defer	Defer	Defer
7120PV	Solar Photovoltaic	56	1	15	0	0	2	17	Defer	Defer	Defer
7420FHLB	Federal Home Loan	40	1	0	3	0	0	10	Defer	Defer	Defer
7420HPES	Home Performance with ENERGY STAR	271	1	0	53	0	8	55	Defer	Defer	Defer
7510BLTZ	T12 Lighting Replacement	57	1	23	0	0	13	-	19	Defer	5
7510MTV	T12 Market Transformation	38	1	16	0	0	3	-	13	Defer	5
7510CIRX	Business Energy Rebates	54	1	14	0	0	10	-	19	Defer	Defer
7520CUST	Custom Services for C&I Customers	103	2	46	0	18	19	-	41	Defer	5

Track	Track Description	Number of Projects/Units	Program staff interviews	Project File Reviews	Desk Audits	Engineering Analysis/Modeling	On-site Measure verification	Phone Participants Verification Survey	Participants Verification, Process and/or NTG Survey	Nonparticipant or partial participant surveys/interviews	Market actor interviews
7510MARO	Market Opportunity Custom Services	4	2	1	0	0	0	-	2	Defer	1
7520NEWC	New Construction Custom Services	1	2	1	0	0	0	-	0	Defer	0
7610BLTZ	LI MF T12 Lighting	10	1	5	0	0	2	1	*	*	*
7610ICDI	LI MF Contractor Direct Install	25	1	0	22	0	12	5	Defer	Defer	Defer
7620LICP	LI MF Comprehensive	10	1	10	0	0	4	4	Defer	Defer	Defer
7710APPL	Retail Efficient Appliances	875	1	0	64	0	0	74	Defer	Defer	Defer
7710FBNK	Retail Lighting Food Bank CFL	49,581	1	0	100% TRM 6 invoices	0	0	0	Defer	Defer	Defer
7710LITE	Retail Lighting	224,957	1	0	100% TRM 12 reports	0	0	-	32	0	*16 store visits (no interviews)

2.3 PROCESS EVALUATION METHODOLOGY SUMMARY AND ACTIVITIES DESCRIPTION

Process evaluations are useful early in the program's, or initiative's, implementation, whenever program design is changed or modified, and especially when program issues arise. Process evaluations tell the story behind the impact evaluation results, net-to-gross assessments, and participation levels. Process evaluations examine factors such as program design and procedures, administration and delivery, customer satisfaction and/or response, marketing and education effectiveness, internal and external program barriers, market response, and non-energy benefits of the program (e.g., more money to spend on other needs, more comfortable living spaces).

A well-designed and implemented process evaluation serves as a basis for recommendations to program managers involved in program design and implementation. The evaluation team strongly believes that an evaluator must be independent, but also able to work openly and collaboratively with program staff and the program implementers so that findings from the process evaluation are most valuable and result in timely program improvements.

A. Methodology

The process evaluation effort began with a review of the FY13 DC SEU FY13 Annual Report and the DC SEU portfolio tracking data provided by the DC SEU followed by DC SEU staff interviews to understand how the tracks operated in FY13 including significant changes from FY12 and how the evaluation recommendations had been incorporated as well as to identify changes that have or would occur in FY14. The FY12 track logic models were reviewed and staff interview notes distributed for comment and review by the DC SEU staff to ensure accurate representation of operations.

The process evaluations will provide the DC SEU with timely and meaningful feedback to identify any necessary changes or improvements to help ensure the initiative's success.

Process evaluations were conducted for those initiatives, or tracks, contributing more savings to the overall DC SEU portfolio according to the Strategic Evaluation Timeline:

- 7510BLTZ: T12 Lighting Replacement
- 7510MTV: T12 Market Transformation
- 7520CUST: Custom Services for C&I Customers
- 7510MARO: Market Opportunity Custom Services
- 7710: Retail Lighting.

Key researchable issues and questions are identified through the initial meetings and interviews with the DC SEU staff and contractors, initiative documentation review, and participant database analysis. These researchable issues will include program performance and operations, effectiveness of program marketing collateral and outreach methods, how marketing and implementation processes can be revised to optimize cost-effectiveness, performance of newly selected implementation contractors, satisfaction of participants and

other market actors, barriers to participation and/or more effective implementation, means for overcoming those barriers, and the effectiveness of the initiative delivery mechanism. A sample of these cross-cutting researchable issues includes:

- Are the performance benchmarks reasonable and achievable in the short- and longer-terms? How does the Green Jobs performance benchmark impact the short and longer-term energy savings goals?
- What are the forecasted levels of gas savings, how are they expected to be achieved, and are the reasonable? Are there ways to increase gas savings (examples - targeting small businesses and C&I customers that have more gas energy efficiency improvement opportunities such as restaurants, laundry facilities, etc. that use significant gas water heating and cooking)?
- What energy efficiency and renewable programs not offered by the DC SEU are available to District residences and businesses and how do they influence the effect of the DC SEU initiatives? How do the DC SEU initiatives influence the effect of the other non-DC SEU programs?
- Are initiatives adequately staffed through DC SEU and contractors or partner resources?
- How does the September 30 cut-off for programs and projects affect the participation and ability to meet goals? How can the DC SEU overcome those barriers?
- To what extent do internal policies and procedures for institutional customers (federal facilities) affect the ability to participate in DC SEU initiatives? How can those barriers be mitigated?
- Are customers satisfied with the DC SEU initiatives? Are eligible measures appropriate? How effective are marketing efforts/channels? How appropriate are the incentives/financing options?
- Do KITT and CAT provide the DC SEU staff with the information they need to gauge progress of their initiatives and to make changes when needed to meet goals and objectives? Is sufficient data being tracked? Is data quality control adequate?

B. Activities description

DC SEU Staff Interviews: Staff interviews were conducted to ensure evaluators understood how the initiatives operated in FY13 as well as to identify any changes for FY14. The draft logic models were also discussed to characterize the initiatives' resources and key activities, the outputs from those activities, and the expected short-term and long-term outcomes.

Participant survey: Participant surveys were conducted to understand how the DC SEU and contractors performed from the customer perspective

Market Actor Interviews: Market actor interviews were conducted with to understand how the programs are operating from the market actor perspectives. Market actors are a key component of successful program implementation. It is critical to understand the barriers and challenges market actors face and document their ideas for improvements to drive more participation in programs.

2.4 NET-TO-GROSS ASSESSMENT: RESULTS, RECOMMENDATIONS, AND METHODOLOGY

2.4.1 Results and recommendations

The evaluation team conducted the net-to-gross assessment using either a "full battery" or a "limited battery" of questions (see Section 2.4.2 for detailed discussion on the methodologies) to estimate the level of free-ridership and any associated like or unlike participant spillover attributable to the initiatives. Non-participant spillover was not assessed as a non-participant study was not conducted as a part of this evaluation effort. Due to limited participation in some tracks, caution may be warranted when interpreting the net-to-gross results on a track, or measure level basis. NTG was determined for electric and gas measures and NTG values are presented in this report as the percent of savings attributable to the track. For example, a net-to-gross value of 100 percent indicates that all program savings are attributable to the initiative.

The evaluation team recommends that this research be used for future program planning and design-including inclusion in cost effectiveness (CE) screening as qualitative data when research data is robust, or as qualitative data when small samples warrant caution. Due to the limited participation and, thus, data available for analysis, we do not recommend that this research be used to adjust verified savings. A recent paper from the ACEEE titled *Examining the Net Savings Issue: A National Survey of State Policies and Practices in Evaluation of Ratepayer-Funded Energy Efficiency Programs,*[12] provides a review of how net savings research and results are used across the United States and discusses the disparity among evaluation researchers on the usefulness of net savings research.

Table 2-4. Net-to-gross Results Summary by Track

Track	NTG, electric	NTG, gas	Application for CE	Survey Battery	Comment
7110SHOT	n/a	100%	qualitative	limited	Results are based on nine unique premises that had one decision maker and therefore only one interview was conducted. Caution warranted when interpreting results.
7120PV	85.4%	n/a	qualitative	limited	This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results. Additionally, reason would suggest that it is unlikely that limited income program participants would be able to fund projects with these considerable costs; therefore, a NTG value of 100% is more likely.
7420FHLB	87.6%	99.6%	qualitative	limited	This track had limited participation and

[12] Kushler, Martin, Nowak, Seth, and Witte, Patti, Report Number U1401, January 2014, http://www.aceee.org/research-report/u122.

Track	NTG, electric	NTG, gas	Application for CE	Survey Battery	Comment
					therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.
7420HPES	77.0%	100.2%	qualitative	limited	The gas NTG value is based upon only 4 surveys warranting caution for the interpretation of results.
7510BLTZ	86.7%	n/a	qualitative	full	These two tracks offer the same equipment, but 7510BLTZ operated as "free" DI while 7510MTV requires customer contribution. The detailed results in Section 4.5.4 illustrate that FR and SO are higher for the MTV track with overall NTG values similar, an interesting finding. However, caution is warranted when interpreting results due to the small sample.
7510MTV	88.8%	n/a	qualitative	full	
7510CIRX	84.1%	n/a	qualitative	limited	This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.
7520CUST	63.4%	80.9%	qualitative	full	End-use measures within the custom tracks had limited participation and, therefore, there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results. The single participant in the 7520NEWC track did not respond to the survey.
7520MARO	83.3%	n/a	qualitative	full	
7520NEWC	n/a	n/a	n/a	n/a	
7610BLTZ	62.5%	n/a	qualitative	limited	This track had only one survey respondent warranting caution in interpreting results.
7610ICDI	93.1%	132.4%	qualitative	limited	This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.
7620LICP	82.5%	n/a	qualitative	limited	This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.
7710APPL	48.3%	57.0%	quantitative	limited	The track had high free-ridership rates for both kWh and MMBtu measures for clothes washers and refrigerators. Higher free-ridership is common for appliance rebate programs.
7710FBNK	n/a	n/a	n/a	deferred	A net-to-gross assessment was not conducted for this track in this evaluation cycle.

Track	NTG, electric	NTG, gas	Application for CE	Survey Battery	Comment
7710LITE	50.8%	n/a	qualitative	full	This is an upstream buy-down initiative; customers are not always aware of the initiative's influence. NTG value is in the range of other studies; however, caution in interpreting results is warranted due to low sample.

The following table presents summary benchmarking comparisons for net-to-gross values in other states. Net-to-gross values vary widely and the science to assess free-ridership and spillover is not perfect, nor is it conducted similarly. However, when values tend to merge for similar programs regardless of the research methodology we can conclude that the net-to-gross values are reasonable. Detailed benchmarking data and information is located in Volume II, Appendix P.

Table 2-5. Net-to-gross Benchmarks Summary

Category	NTG Ratio	Inputs	Source
Nonresidential Retrofit	56–200%	Evaluation verified	NV Energy Benchmarking Report
Nonresidential Retrofit	65%	Evaluation verified	PA Act 129 Pennsylvania Utilities
C&I Prescriptive	72%	Evaluation verified	Maryland Statewide 2011
C&I Prescriptive	23–78%	Evaluation verified	PA Act 129 Pennsylvania Utilities
C&I Custom	73%	Evaluation verified	Maryland Statewide 2010
C&I Custom	52%	Evaluation verified	PA Act 129 PPL PY4
C&I Direct Install	74%	Evaluation verified	Maryland Statewide 2010
Solar Thermal Water Heaters	100%	Assumed	NV Energy Benchmarking Report
Appliances and Electronics	49–72%	Evaluation verified	PA Act 129 Pennsylvania Utilities
Residential Lighting (Standard CFL)	34–85%	Evaluation verified, Deemed	NV Energy Benchmarking Report
Residential Lighting (Specialty CFL)	60–105%	Deemed	NV Energy Benchmarking Report
Residential Lighting (LED)	85–100%	Evaluation verified, Deemed	NV Energy Benchmarking Report
Residential Lighting	51%	Evaluation verified	Maryland Statewide 2011
Residential HVAC	46–98%	Deemed, evaluation verified	NV Energy Benchmarking Report
Residential HVAC	58%	Evaluation verified	PA Act 129 FirstEnergy PA PY4 (Met Ed)
Residential HVAC	44%	Evaluation verified	Maryland Statewide 2011
Residential Retrofit	75–88%	Evaluation verified	PA Act 129 Pennsylvania Utilities

2.4.2 Methodology

This section describes the methodologies used to assess free-ridership and spillover for the determination of the net-to-gross value.

$$NTG = 100\% - FR\% + SO\%$$

The evaluation team conducted the net-to-gross assessment using either a "full battery" or a "limited battery" of questions—full batteries were employed for those tracks contributing greater savings to the DC SEU portfolio in FY13 and the limited batteries were used for the other tracks as described in Table 1-1.

A. Free-rider methodology

A program's *free-ridership rate* is the percentage of program savings attributed to free-riders. A *free-rider* refers to a program participant who received an incentive or other assistance through an energy efficiency program who would have installed the same high efficiency end use[13] on their own at that same time if the program had not been offered. For free-riders, the program is assumed to have had no influence or only a slight influence on their decision to install or implement the energy efficient end use. Consequently, none or only some of the energy savings from the energy efficient measure installed or performed by this group of customers should be attributable to the energy efficiency program.

Free-ridership varies from pure free-riders to non-free-riders. A pure free-rider (100 percent) is someone who would have adopted the exact the same energy efficient end use at that time without the program. Partial free-riders (1–99 percent) are customers who would have installed some end use on their own, but of a lesser efficiency or quantity, or at a later time. Thus, the program had some impact on their decision. Non-free-riders (0 percent) are those who would not have installed or implemented any energy efficient end use (within a specified period of time) without program services.

For programs that offer monetary incentives for multiple measure categories (e.g., hot water heating, HVAC), it is important to estimate free-ridership by specific end use. Category-specific estimates produce feedback on the program at the level at which it actually operates and allows for cost-effectiveness testing by end use. In addition, for commercial and industrial incentive programs, free-ridership has often been found to be highly variable among measure categories, making it essential to produce measure specific estimates. The ability to provide reliable estimates by end use is dependent on the number of installations within that end use—the fewer installations, the less reliable the estimate.

Once calculated, each individual's free-ridership rate is then applied to the measure savings associated with that project. The total free-ridership estimates in this report include pure, partial, and non-free-riders.

[13] For purposes of this discussion, an "energy efficient measure type" includes high efficiency equipment, an efficiency measure type such as building envelope improvements, or an energy efficient practice such as boiler tune-ups.

Note that program total free-ridership (pure and partial) rates discussed in this report are weighted by end use kwh or therm savings as well as the disproportionate probability of being surveyed. Weighting by kwh or therm savings ensures that overall measure savings are considered in the overall results. Weights are calculated based on positive savings values, so negative values (or the penalties) have been removed. In addition, any gas savings for lighting end use have been removed. For programs where we were unable to complete any interviews for a given end use, we were unable to weight by all end uses for that program. In these situations, results do not include those end uses.

In addition to weighting by kwh and therm savings weighting by the disproportionate probability of being surveyed accounts for any oversampling of a specific end use as part of our calling effort. When reviewing the end use free-ridership rates it is important to consider the number of survey completions that the estimate is based upon.

Two different free-ridership batteries were utilized for this project, depending on the track. Below we outline the methodology for each of those batteries.

i. Full battery

The methodology used for tracks running through the full net-to-gross battery follows the standardized methodology developed in 2010 and 2011 for the Massachusetts PAs[14] for use in situations where end-users are able to report on program impacts via self-report methods. The scope of this study only included telephone surveys with program participants while design professionals and equipment vendors feedback was considered out of scope.

Identifying and surveying the key decision-maker(s) is critical for collecting accurate information on free-ridership and spillover. Therefore, the initial part of the survey is devoted to identifying the appropriate decision-maker within the organization by asking if participants were involved in the decision to purchase the incentivized equipment and asking about the roles of others within or outside the organization that may have been involved. If the decision-maker was a vendor or contractor, the call was terminated as interviewers with contractors were not in scope.

Once the appropriate respondent was identified, they were assured their responses would be kept confidential.

The flowchart diagram detailing this free-ridership calculation has been included in Volume II, Appendix A.

Initial free-ridership questions

The instrument then asks what influence, if any, the program had on the decision to install equipment through the program. As there are several dimensions to the decision to purchase

[14] "Cross-Cutting C&I Free-Ridership and Spillover Methodology Study Final Report," prepared for the Massachusetts Program Administrators by Tetra Tech, KEMA, and NMR, May 20, 2011.

and install new equipment[15], the battery discusses the timing of the installation, the quantity and efficiency level of the equipment installed. These questions reference both the overall effect of the program (including staff recommendations and any technical assistance) and the specific effect of the financial incentive. These questions are measure-specific and were asked for only one end use.

Consistency check questions

The instrument also included questions that would identify and correct inconsistent responses. For example, if participants reported that they were likely to install the equipment without the program but also reported that they would not have installed the energy efficient equipment within four years, the interviewer asked them to confirm which statement was more accurate.

As inputs into the algorithm, Tetra Tech constructed a scoring system based on the influence and consistency check questions. The scoring calculates two scores: quantity and efficiency. The quantity score represents the percentage of the incentivized equipment that would have been installed in absence of the program. The efficiency score is the percentage of savings *per unit installed* that would have occurred without the program.

For equipment that is reported to be more efficient than standard but less efficient than what was installed through the program, we assume 50 percent of the savings for those measures. Multiplying these two scores together gives the percent of the incentivized savings that would have occurred without the program.

The product of these two scores is then adjusted by a timing factor. The timing factor adjusts the raw free-ridership estimate downward for all or part of the savings that would have occurred without the program, but not until much later. By doing so, the program is given credit for accelerating the installation of energy efficient equipment. For example, if the participant states that he or she would have installed equipment at the same time regardless of the program, the quantity-efficiency factor is not adjusted. However, if the participant states that, without the program, they would have completed the project more than six months later than they actually did, any free-ridership identified in the quantity-efficiency factor is adjusted downward[16]. The degree of the adjustment depends on the program.

This adjusted score is reviewed for consistency based on an open-ended question asking the respondent to describe in his/her own words what impact, if any, the equipment, financial incentive, or technical assistance had on their decision to install the amount of energy efficient equipment at the time they did.

A flowchart diagram detailing these calculations is included in Volume II, Appendix A.

[15] The instrument is designed to handle both rebated equipment (e.g., HVAC equipment) and rebated services (e.g., boiler tune-ups). However, as this study only addresses equipment, the memo does not include any references to rebated services.

[16] Projects that were accelerated by fewer than 6 months are not adjusted. As installation timelines are subject to shifting, we assume these projects are just as likely to have been installed at the same time.

Influence of past program participation

If a participant has previously participated in the program, they are asked about the influence of that past participation on their perceptions and behaviors. Participants are asked to state whether they agree or disagree with four statements about the effect past participation has had on their decision-making. Based on the number of statements with which they agree, their free-ridership is reduced by 75 percent, 37.5 percent, or not reduced at all. This reduction is done to account for the influence positive program experiences have had on participants' purchasing decision—with the program administrators, implementers, or the equipment incented.

ii. Limited battery

The methodology used for tracks using the limited net-to-gross battery follows the standardized methodology developed by Research Into Action and the Energy Trust of Oregon for downstream programs, typically using some incentive or direct installation.

Similar with the full free-ridership batter, identifying and surveying the key decision-maker(s) is critical for collecting accurate information on free-ridership and spillover. Therefore, the initial part of the survey was devoted to identifying the appropriate decision-maker within the organization by asking if participants were involved in the decision to purchase the incentivized equipment and asking about the roles of others within or outside the organization that may have been involved. If the decision-maker was a vendor or contractor, the call was terminated as interviewers with contractors were not in scope.

Once the appropriate respondent was identified, they were assured their responses would be kept confidential.

The limited battery includes two components of free-ridership: intention and influence.

A flowchart diagram detailing these calculations has been included in Volume II, Appendix B.

Intention

Intention is calculated based on several questions asking about how the project would have occurred without the receipt of program assistance. Those customers who would have postponed (longer than one year) or cancelled the project if program assistance was not received receive an intention score of 0. Customers who indicate they would not have changed the scope of the project and would have paid the additional cost receive the maximum intention score of 50.

Influence

Influence is calculated based on several questions asking about how much the program influenced them to do the project the way it was done. Customers are asked to rate how influential program aspects such as the incentive, program staff, and contractor or retailer recommendations on a one to five scale. The program's influence is equal to the maximum influence rating for any of the program aspects. This calculation is based on the logic that if any aspect of the program was highly influential in the decision making process, then the

program should get credit.

Free-ridership

The free-ridership score is calculated as the intention score added to the influence score multiplied by 0.1 to convert it into the proportion for application to gross savings values.

While we also included an open-ended question asking the respondent to describe in his/her own words what impact, if any, the equipment, financial incentive, or technical assistance had on their decision to install the amount of energy efficient equipment at the time they did no adjustments were made to the free-ridership score based on this response. It was just used as a review item.

B. Spillover methodology

Spillover refers to the purchase of additional energy efficient equipment by a customer because of program influences, but without any financial or technical assistance from the District. *Participant "like" spillover* refers to the situation where a customer installed energy efficient measures through the program, and then installed additional equipment of the same type due to program influences. *Participant "unlike" spillover* is where the customer installs other types of energy efficient equipment than those offered through the program, but are influenced by the program to do so.

A flowchart diagram detailing these calculations has been included in Volume II, Appendix A.

i. Full spillover battery

The full free-ridership battery survey questions were followed by questions designed to estimate "like" and "unlike" spillover. These questions asked about recent purchases (since program participation in 2012/2013) of any additional energy-efficient equipment that were made without any additional technical or financial assistance from the District. In addition, early "unlike" spillover indicators are included as qualitative information. Non-participant spillover was not assessed as a non-participant study was not conducted as a part of this evaluation effort.

ii. Limited spillover battery

The limited free-ridership battery survey questions were followed by questions designed to estimate both "like" and "unlike" spillover, but did not differentiate between the two. These questions asked about recent purchases (since program participation in 2012/2013) of any additional energy-efficient equipment that were made without any additional technical or financial assistance from the District. These results are reported at the track level and not by end use.

A flowchart diagram detailing these calculations has been included in Volume II, Appendix B.

2.4.3 Activities description

Participant survey: Participant surveys were conducted to assess free ridership and spillover to support program design and to begin to understand program attribution within the District.

2.5 IMPACT EVALUATION METHODOLOGY SUMMARY AND ACTIVITIES DESCRIPTION

A. Methodology

The impact evaluation reviews the energy savings and demand reduction claimed through the initiatives for reasonableness and accuracy to determine the savings attributable to the initiatives. This effort results in verified, or ex-post, savings. Because it is very expensive to review 100 percent of initiative activity and projects, a sample of projects and other initiative documentation is selected. Refer to section 2.1 for detail on sampling.

B. Activities

Desk review: Project files were reviewed to ensure project file data and information support the reported, or ex-ante, savings. Typically, quantities of measures installed were identified and checked to reported quantities in tracking system and deemed measures were reviewed to ensure calculations were accurate and done in accordance with the DC SEU FY13 TRM.

Project file review: In addition to a desk review, other documentation in the project files (invoices, applications, equipment specification sheets, quality assurance forms, etc.) were reviewed and cross-referenced to each other to ensure accuracy and consistency of data reported and used in the savings calculations for the project.

Onsite Verification: Evaluator onsite visits were conducted to verify such things as equipment installation and quantities, operating characteristics, hours of use, and location in facility.

Engineering analysis: Projects that contained measures that were not deemed savings measures in accordance with the DC SEU Technical Reference Manual were assessed through engineering analysis review and/or engineering modeling. The analysis was conducted to ensure reported, or ex-ante, savings are reasonable given completed project scope. Information collected during onsite verification was also used where appropriate (such as technical data, hours of use, equipment nameplate data, location of equipment in facility, etc.).

Participant survey: Participant surveys were conducted to verify the installation of measures reported by the track to support impact evaluation.

2.6 DC SEU TRACKING SYSTEM AND ESTIMATION TOOL REVIEW

The DC SEU uses the following tools to track program and project data and information and to estimate electric savings, demand reductions, and natural gas savings at the measure, project, program and portfolio levels.

KITT: tracks and calculates prescriptive measures and savings by project status (opportunity, cancelled, in-progress, completed) and by program track; KITT also tracks measures, status, and savings for completed custom projects.

CAT: the Comprehensive Analysis Tool is the interface with the cost-effectiveness screening tool and is used to calculate the savings associated with custom projects and associated measures. Project results and key information for completed projects are uploaded to KITT for reporting.

HERO: a web based savings tool used by contractors performing work for the Home Performance with ENERGY STAR® (HPwES) program. HERO tracks key project parameters, estimates savings, and interfaces with KITT for reporting.

2.6.1 KITT Database Extract

The VEIC Evaluation, Measurement and Verification Services group provided the evaluation team with the final FY13 program results dataset from KITT as an Access database file (KITT, KITT extract) on November 22, 2013.

The table below lists the fields used for the verification of reported, or ex-ante, electric savings, demand reduction, and gas savings.

Table 2-6. Impact and Process Evaluation Completed Activity Summary

Field Name	Table Name(s)	Description
Track	Project	Code used to identify the project's program
ProjectID	Project, ActionSummary	Unique system ID for a project, used to link a project with its measures and site location
MAS90Project	Project	Public project identifier used to locate project files and HERO records
MeasureID	ActionSummary, ActionSave	Unique system ID for a measure installation, used to link the installation record with the savings record
MeasureCode, MeasureDesc	ActionSummary	Measure description text
ItemCode, Description	ItemCode	Additional measure description
Qty	ActionSummary	Quantity of measure installed

Field Name	Table Name(s)	Description
KWHTotal	ActionSave	Gross kWh savings
KWReductionSummer	ActionSave	Gross summer peak kW reduction
SaveNGas	ActionSave	Gross natural gas savings (MMBtu)
ReportDate	ActionSummary	Date when savings are claimed

2.6.2 Comprehensive Analysis Tool (CAT)

For evaluation of the FY13 program results, CAT files associated with the sampled projects for relevant programs were reviewed by evaluation team members to ensure data entered into CAT was consistent with project file records, calculations of savings were accurate, and savings were accurately reflected in KITT.

2.6.3 Home Energy Reporting Online (HERO)

The HERO tool was reviewed for Home Performance with ENERGY STAR projects to ensure agreement with other project files and KITT.

3. PORTFOLIO AND CROSSCUTTING EVALUATION

Process evaluations are useful early in the program's implementation, whenever program design is changed or modified, and especially when program issues arise. Process evaluations tell the story behind the impact evaluation results, net-to-gross assessments, and participation levels. Process evaluations examine factors such as program design and procedures, administration and delivery, customer satisfaction and/or response, marketing and education effectiveness, internal and external program barriers, market response, and non-energy benefits of the program (e.g., more money to spend on other needs, more comfortable living spaces). Process evaluations also address crosscutting strategic and policy issues related to organizational structure, resources to conduct programs, regulatory requirements, reasonableness of program goals and objectives, brand identity, and other factors that affect overall program portfolio performance.

As a part of the impact evaluation implementation, several crosscutting process-related improvement opportunities were identified and are summarized in this section along with recommendations to address.

3.1 KEY FINDINGS

Evaluation of the DC SEU portfolio reported savings and delivery is in its second year. Since inception, the DC SEU plans have shifted from early "quick start" direct install initiatives to a combination of direct install and incentive-based initiatives consisting of upstream buy-downs, rebates, give-away events, and negotiated incentive agreements.

Many of the key findings mirror those of the FY12 Results evaluation effort.

3.1.1 Key Findings—Strengths

The Evaluation Team noted during interviews that program staff were generally very knowledgeable about their initiatives. In addition, the VEIC evaluation lead was very helpful in responding in a timely manner to numerous requests from the evaluation team for program data, reviews, and other information requests.

A. The portfolio of energy efficiency initiatives is cost effective and the DC SEU cost effective results are accurate.

The evaluation team's review of the cost effectiveness of the programs and overall portfolio per the Societal Cost Test indicates that the portfolio was cost effective for FY13.[17] In addition, the comparison of test results using a third-party independent cost benefit model indicated that the results are accurate.

[17] For detailed discussion on the cost effectiveness assessment, see *District Department of the Environment Verification of the District of Columbia Sustainable Energy Utility Performance Benchmarks, F2013 Annual Evaluation Report*.

B. Acquisition costs are declining as the DC SEU builds the infrastructure for managing and delivering the suite of energy efficiency and renewable energy programs.

The acquisition costs per MWh declined by 59 percent from FY12 to FY13 while reports savings increased by 117 percent. The acquisition costs per MMBtu declined by 52 percent with savings increasing by more than a thousand percent. Although acquisition costs remain high compared to Pennsylvania, they are headed in the right direction.

C. Results are generally reported accurately.

Twelve of the 16 track verified results, or ex-post savings, determined by the evaluators fall within 10 percent of the reported savings and the overall portfolio level realization rate estimate is 104 percent for electric savings, 107 percent for demand, and 100 percent for natural gas savings. Although the overall results are quite good, there were both cases of over-reporting and under-reporting with the net result evening out. Specific discussion on reporting reviews by track are covered in detail within Section 4.

D. The DC SEU tracking and estimation tools are transparent and robust with some exceptions.

KITT was able to provide all key metrics required by the evaluation team and estimation tools were found to be intuitive and transparent. Additionally, the project documentation for non-prescriptive projects showed improvement from FY12 and during FY13, indicating that processes for tracking and reporting are improving with time. However, as discussed in the *3.1.1 Key Findings—Weaknesses and Barriers* section, there remains room for improvement, especially as the projects become more complex.

E. The DC SEU Technical Reference Manual (TRM) provides a good foundation for energy savings calculations but has opportunity for expansion in order to more accurately calculate and report on achievements.

The DC SEU TRM is easy to follow and clearly documents key assumptions, algorithms and sources of data and information. In this initial evaluation effort, the evaluators found the assumption reasonable and generally applicable within the District. However, there are opportunities for the TRM to provide more accurate estimates for District specific projects as discussed further in the *3.1.1 Key Findings—Weaknesses and Barriers* section. These assumptions will continue to be reviewed as evaluation efforts progress.

F. Participants and contractors in the custom and commercial lighting tracks are very satisfied.

Satisfaction is high across all key program components. For custom tracks, 26 of 31 respondents rate the overall experience as an 8, 9, or 10 on a scale of 1 to 10 where 1 is very dissatisfied and 10 is extremely satisfied; and for “interactions with DC SEU staff,” 25 of 28 respondents provide a score of 8, 9, or 10. For commercial lighting, 12 of 15 and 6 of 7 respondents for the direct install and market value transformation tracks, respectively, rate satisfaction with the overall experience an 8, 9, or 10.

"They're experts at what they do and they do all of the researching for you and what I liked about it is they're not biased to one product or another. They bring you a wealth of knowledge and through working with them you determine what product is best for the environment you work in. They're just great to work with."

This speaks to the success of the DC SEU efforts to become the "trusted energy advisor" for commercial and institutional customers in the District.

G. DC SEU reporting improved in FY13.

The DC SEU submits written monthly, quarterly, and annual reports to the DDOE. The written reports provide the key information and data required to understand how the programs are progressing in terms of meeting overall benchmark goals. There remains some opportunity for additional reporting enhancements such as reporting and tracking on key tactics to achieve each of the six performance benchmarks. Having accurate key performance data by program on a regular basis will allow the DC SEU staff and evaluation team to identify any potential problems or a need for quick evaluation to develop and implement solutions early on.

H. The movement toward a market-based portfolio appears to be gaining momentum.

Although it is very early in this transition and participation is not sufficient for robust quantitative analysis, an interesting case study once data is more robust will be the comparison of the 7510BLTZ and 7510MTV tracks—7510BLTZ operates as a direct install initiative, while 7510MTV requires customer contribution toward the cost of the project. Current data indicates little meaningful difference in participant satisfaction ratings between the direct install and market transformation models.

3.1.2 Key Findings—Weaknesses and Barriers

It is worthwhile to note that many of these key findings are common to program implementation efforts, both new and more mature. At the same time, these issues should be assessed and addressed for more effective operations and, ultimately, more effective and efficient acquisition of energy savings.

A. The DC SEU Technical Reference Manual (TRM) provides a good foundation for energy savings calculations but there is opportunity for expansion to more accurately calculate and report on achievements.

The DC SEU TRM currently includes many measure algorithms that estimate savings based on a fully deemed approach, but that approach may or may not accurately reflect the project or the District. An example of this is the found in the commercial lighting algorithms. The TRM currently deems commercial indoor lighting space based on a per unit value calculated using the "Commercial Indoor Lighting-Blended" loadshape. However, it is unclear if this is the best overall loadshape to apply within the District. In fact, initial evaluation efforts suggest that it may over-estimate savings. Furthermore, the data and information gathered on the application and verified during contractor installation would not add excessive cost to the project and the use of this key data would result in more accurate savings estimates at the project, program, and portfolio levels.

The evaluation team conducted an assessment to determine the impact of the using the "Commercial Indoor Lighting - Blended" loadshape compared to using site specific loadshapes to estimate savings for the 7510CIRX track. The results of the project file reviews and on-site inspections of the 7510CIRX track for the FY13 evaluation effort indicate the "Commercial Indoor Lighting - Blended" loadshape is not representative of the likely hours of use for the population in the 7510CIRX track. This was a similar finding of the FY12 results evaluation for commercial and institutional prescriptive tracks with energy efficient lighting equipment replacement. In summary, using site-specific loadshapes reduces the realization rates from 0.97, 1.07, and 0.99 to 0.78, 0.74, and 0.44 for MWh, MW, and MMBtu respectively for the FY13 evaluation.[18]

B. Complete and accurate project files and better file organization will result in more efficient evaluation efforts.

Although there was some improvement of FY12, project file data was incomplete and inconsistent for many projects. Supporting project information is essential to ensuring confidence in reported savings. Required supporting documentation varies by program, but should include items such as: detailed invoices, program applications, contractor installation reports, detailed quality assurance reports when performed, equipment specification sheets, and project communications with contractors and participants (emails, notes on phone calls, etc.). Program applications should include all data and information required for review and approval along with other key information needed to calculate savings and to complete program evaluations, such as facility and water heating fuel types, facility type, hours operation, customer contact information, and location of equipment installations.

In addition, project files contained multiple versions of key files and were not always marked as final. In some cases, there were several “final’ files that were needed to verify reported savings and it was not always clear that this was the case.

C. For larger, more complex projects, it was not always clear how savings were estimated or what the baseline was.

For larger complex projects is essential to have a well-documented baseline, key assumptions and inputs identified, and the algorithms transparent.

D. Participant satisfaction in the Solar PV track is a concern.

Fifteen of the program participants participated in the phone surveys and four of them report issues with the installed equipment. Some instances of failure can occur but the remarks conveyed by the participants indicated the equipment has never worked since installed. And some report damage to their household.

[18] Please see memorandum from Tetra Tech to the DC SEU titled, *DC SEU Impact Evaluation Results: Effect of Site-Specific Loadshapes on 7510CIRX Results*, March 7, 2014 for more information.

E. The onsite quality assurance documentation reviews require some improvement.

The DC SEU staff conduct a significant number of onsite quality assurance reviews but needed data and information required for verification is not always checked or documented. Examples include facility and water heating fuel types, location of incentivized equipment within the facility, and the number of bedrooms in multifamily housing facilities. Also important is documenting the changes from what was in project file to what was found onsite so that the appropriate adjustments can be made to claimed savings.

F. Recruitment of onsite verification participants for the evaluation effort was challenging.

The timeframe for the evaluation effort was one contributing factor; however, some participants expressed frustration at the number of contacts made by multiple parties in relation to the energy efficiency project indicating customer fatigue with the process.

3.2 FY2013 RESULTS EVALUATION RECOMMENDATIONS

A. Complete a baseline study to identify and validate and/or update the potential study results performed in FY13.

A baseline and market potential study is a key foundation on which to identify and build energy efficiency programs. The evaluation team has not yet seen the results from the potential study but understands that effort was somewhat compromised by the lack of District specific baseline data. However, updating the potential study with District baseline data is a feasible task.

B. Revise the TRM and tracking system to accommodate additional loadshapes more reflective of the projects completed.

Due to the large effects that changing the loadshape can have on the savings results for both individual projects and the overall program, the evaluation team recommends using the available additional loadshapes from the TRM for the lighting algorithms. It is typical in comprehensive evaluations for site-specific loadshapes to be used in the verified savings as opposed to applying a general loadshape in the claimed savings—even for prescriptive programs. The site-specific loadshapes represent a better estimate of the savings for those individual projects, which leads to a better savings estimate for the overall population.

Alternatively, collect needed data each year for all projects completed to conduct analysis to update the "Commercial Indoor Lighting - Blended" loadshape annually. The results of comparing the "Commercial Indoor Lighting - Blended" to site-specific loadshapes based on the evaluation effort indicated the population for the initiative is not representative of the Blended loadshape.

C. Establish a "Final Project Documentation" folder within each project file that contains consistently named files critical for the evaluation effort.

Keeping the project files current and organized provides DC SEU with a clear paper trail that is easy to defend. Critical files vary based on track or project type, but typically include:

- customer application
- documented baseline condition (including facility energy management system pre-condition data when available)
- savings estimates tools files (such as CAT)
- inspection form
- DC SEU check request
- photos of equipment and name plates
- projects plans and equipment specifications
- detailed project invoices
- customer satisfaction survey.

D. Improve quality assurance review documentation.

This includes documenting all differences between the project file and what is found onsite- and then submitting changes to be incorporated within the tracking and reporting system so that the claimed savings values can be adjusted to reflect the actual occurrence.

E. Coordinate third-party onsite evaluation efforts with the DC SEU quality assurance onsite reviews.

The evaluation effort will be conducted independently of the DC SEU quality assurance review ensuring a third-party objective effort. However, coordinating the onsite visit will reduce the number of contacts and site visits the customer will experience. Additionally, the evaluation effort will occur much closer to the completion of the project which will improve data and information gathering as customer recall will likely be sharper.

4. TRACK EVALUATION REPORTS

This section presents the individual track evaluation results based on the activities summarized in Section 2 and described in detail within this section. A summary of the realization rates estimated through the impact evaluation are presented in Table 4-1.

These results reflect realization rate estimates at the portfolio level of 1.04, 1.07, and 1.00 for kWh, kW, and MMBtu, respectively. This means that the evaluation team estimates that the actual portfolio electric savings result is 104 percent of the DC SEU reported electric savings, the demand reduction result is 107 percent of the DC SEU reported demand reduction, and the actual portfolio gas savings result is 100 percent of the DC SEU reported natural gas savings.

Realization rates are the ratio of verified savings (ex-post) to the tracking system savings (ex-ante) for a representative sample of projects in each track. Realization rates are typically calculated for each end-use category and then applied to the total end-use tracking system savings for a particular track. The results are then rolled up to develop track-level verified savings. The verified savings for all tracks are summed to obtain portfolio verified savings.

Table 4-1. Track Level Realization Rates Summary

Track	Description	kWh	kW	MMBtu
		RR	RR	RR
7110SHOT	Solar Hot Water	n/a	n/a	1.00
7120PV	Solar Photovoltaic	1.02	1.02	n/a
7420FHLB	Forgivable Loan for Home Efficiency Improvements	1.00	1.00	1.09
7420HPES	Home Performance with ENERGY STAR	0.93	0.91	1.02
7510BLTZ	T12 Lighting Replacement	1.16	1.25	0.86
7510CIRX	Business Energy Rebates	0.97	1.07	0.99
7510MTV	T12 Market Transformation Value	1.35	1.49	1.32
7520CUST	Custom Services	1.05	1.06	0.98
7520MARO	Custom Market Opportunity	0.89	1.03	n/a
7520NEWC	Custom New Construction	1.00	1.00	n/a
7610BLTZ	LI MF T 12 Lighting Replacement for Low-income	0.82	0.95	0.77
7610ICDI	LI MF Implementation Contractor Direct Install	1.04	0.99	0.72
7620LICP	LI MF Comprehensive Efficiency Improvements	0.98	0.99	1.00
7710APPL	Retail Efficient Appliances	1.00	0.96	1.55
7710FBNK	Efficient Products at Food Banks	1.00	1.00	0.96
7710LITE	Retail Efficient Lighting	1.00	1.00	0.97
Reported (ex-ante) / Verified (ex-post)		**1.04**	**1.07**	**1.00**

4.1 7110SHOT SOLAR HOT WATER SYSTEMS

4.1.1 Track description

The solar thermal track targets solar domestic hot water systems in low-income multifamily buildings and commercial and institutional facilities with high hot water demand. The track is designed to replace existing inefficient hot water heating systems.

The DC SEU provides support in this developing market through the development of contractor capacity and capability-sometimes directly to implementation contractors, which allows for greater control over materials and methods. Other contractor development activities include contractor training for market-based activities, focusing specifically on both sales training and technical training. When DC SEU incentives are used, whether directly through contracting or indirectly by customer payments, quality control and quality assurance protocols are implemented to mentor contractors in the field and ensure best-practice installations. The incentive funds are not offered as incentives to the open market, because of the limited budget and the expected number of projects.

Table 4-2. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	0	0	n/a
kW	0.0	0.0	n/a
MMBtu	4,620.0	4,620.0	1.00

4.1.2 Overall sampling methodology

The DC SEU completed twelve projects under this track. The projects show relatively little variation in savings and there is only one type of measure installed by this track. The project files were randomly sampled for desk reviews and onsite verification.

Table 4-3. FY13 Population and Sample Summary

	Project File Evaluation Sample							
Measure	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Solar Hot Water	12	6	0	0.0	2,116.0	-	-	45.8%
Total	**12**	**6**	**0**	**0.0**	**2,116.0**	**-**	**-**	**45.8%**

4.1.3 Process evaluation

A process evaluation was not done for this track in this evaluation cycle; a staff interview was conducted November 25, 2013, to understand how the track is intended to work.

Table 4-4. FY13 Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth interviews	1	1	

A. Summary of key findings

Not applicable.

4.1.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and full spillover battery was used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-5. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth interviews	1	1	
Participant phone surveys	6	9	Exceeds target due one respondent who was knowledgeable about and willing to answer the survey for 9 separate projects

B. Summary of results

This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results. Additionally, results are based upon a single decision maker for nine unique premises and, therefore, only one interview was conducted.

Table 4-6. Net-to-Gross Results Summary—Gas

End Use	N	n	Population MMBtu	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Solar Water Heating	12	9	4,620.0	0.0%	0.0%	0.0%	0.0%	100.0%
Total	**12**	**9**	**4,620.0**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**100.0%**

C. Drivers net-to-gross results

The natural gas free-ridership rate for the 7100SHOT track is 0 percent and with no spillover for an overall net-to-gross of 100 percent.

4.1.5 Impact evaluation

The initial task for the impact evaluation was to review and verify the variables used to calculate claimed savings for FY13. Using a standard solar hot water algorithm, the evaluation team calculated program MMBtu savings using measure data from the tracking

system. Once this was completed realization rates were calculated by dividing verified savings by reported savings. The evaluation team was unable to determine actual MMBtu savings based on the project files.

Reported savings for the SHOT projects are based on the Polysun modeling tool, used by the program implementation contractor. Variables that were available from the Polysun model were input into the Pennsylvania TRM algorithm used to estimate project MMBtu savings. Not all variables used in the Polysun model were available to the evaluator in the project documentation; therefore, the evaluator used standard algorithm default values, which resulted in lower than expected estimated MMBtu savings. The Polysun model seems to be more robust and fully encompassing than a simple algorithm analysis. Based on the review of the Polysun software, the evaluator is comfortable with a 100 percent realization rate for the SHOT program based on the Polysun model output. Physical site inspections were unable to be performed based on the small sample size and the unresponsiveness of participants. Multiple voice messages were left with participants selected for site visit verifications but without any response.

A. Impact sampling methodology for onsite measurement and verification

The onsite sample was drawn from the overall project sample list. A random number generator was applied to the list, which was then sorted from the smallest to largest number, and the first three projects on the list were selected for site visits. Ultimately, the evaluation team was able to schedule and conduct two onsite verification visits due to customer availability.

Table 4-7. FY13 Onsite M&V Sample Summary

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Solar Hot Water	12	2	0	0.0	477.0	-	-	10.3%
Total	**12**	**2**	**0**	**0.0**	**477.0**	-	-	10.3%

B. Verification of impacts

The evaluation team conducted reviews of the DC SEU savings estimates for reasonableness but was unable to input actual data into the verification models. The project contractors used the Polysun modeling tool to perform the original savings estimates. The data output from those models are not documented in the SHOT project files or database but those variables that were visible in the model were made available to the evaluator. Because the entire variable set was not available, the realization rate using standard algorithms was lower than expected; however, as described above, the MMBtu savings output from the Polysun model was deemed appropriate.

Table 4-8. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Solar Hot Water	0	0	n/a	0.0	0.0	n/a	4,620.0	4,620.0	1.00
Track Total	**0**	**0**	**n/a**	**0.0**	**0.0**	**n/a**	**4,620.0**	**4,620.0**	**1.00**

C. Impact evaluation planned activities and completed activities comparison

Table 4-9. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct desk audits	6	6	
Conduct onsite Verification	3	2	Difficulty in recruitment due to small sample
Conduct phone verification	6	9	

D. Summary of key findings describing adjustments to ex-ante savings

- Project file documentation was not always complete. The data collection process was difficult based on the number of variables required to verify the ex-ante savings and the difficulty in verifying where the data variables were coming from. The project contractors used Polysun modeling estimated the MMBtu savings. The variable they used in the model was unavailable to the evaluator. Based on this situation, the evaluator used default values, which appears to underestimate the reported savings.

4.1.6 Recommendations

A. To improve design, operations, customer experience, and recruitment

This track was not scheduled for a process evaluation in this evaluation cycle; however, process-related findings and recommendation were identified as a part of the impact evaluation effort.

i. **For improved ease in locating pertinent project files for evaluation, the evaluation team recommends that a "Final Project Documentation" folder contain consistently named files critical for the evaluation effort.** It is important to stay up-to-date on the project files and include all documentation. For example, the installation contractor in a shared Google document files provides energy savings but those files were not in the project files. Keeping the project files current provides DC SEU with a clear paper trail that is easily defend. The electronic project files that were reviewed had various levels of documentation.

Critical files include:

- CAT file
- Inspection form
- DC SEU check request
- Photos of equipment and name plates

- Plans and specifications
- Polysun output files
- QC work orders
- Google document files
- Detailed project invoices
- Customer satisfaction survey.

B. To improve impact evaluation results

i. **Develop a final annual report that provides all variables used to calculate savings in Polysun.** The report should also include all project identification numbers, premise data, participant date, and the ex-ante savings from installing the SHOT system. This report will aid the evaluators in verifying the ex-ante savings.

ii. **Document all variables required to determine savings within project files.** For future evaluations, it will important to document the variables used in the Polysun model to be able to verify the reported savings.

iii. **Document all calculations used to determine MMBtu savings.** It is important to understand how savings are calculated to be able to determine their accuracy and appropriateness for the measures.

iv. **When QA/QC inspections are done, it is important to document all equipment and locations.** The pictures in the project files were informative but detailed photos of nameplates or a written description would aid in the evaluation process.

v. **Ensure project files contain the final versions of savings calculations and supporting documentation.** It is important to stay up-to-date on the project files and include all documentation. For example, the installation contractor in a shared Google document files provides energy savings but those files were not in the project files. Keeping the project files current provides DC SEU with a clear paper trail that is easily defend. The electronic project files that were reviewed had various levels of documentation. Key documentation includes final versions clearly marked.

C. To manage free-ridership results

Given the small sample sizes for these tracks, the evaluation team does not have any recommendations specific to program design.

4.2 7120PV SOLAR ENERGY SYSTEMS

4.2.1 Track description

The District of Columbia has a strong foundation in supporting sustained development of customer-sited renewable energy systems. During the 2011 Quick-Start Renewable Energy program, the DC SEU implemented activities in two market segments, commercial solar hot water and rooftop PV for small scale (<10 kW) installations. Approximately 20 systems were installed in the quick-start initiative.

Beginning in fiscal year 2012, the DC SEU began supporting customer-sited renewable energy in low-income markets in wards seven and eight in the District of Columbia. Through this initiative, the DC SEU works with competitively selected implementation contractors (IC) to deploy small-scale photovoltaic systems. The funds are not offered as incentives to the open market because of the limited budget and the expected number of projects.

In FY13, the DC SEU expanded renewable offerings to the multifamily low-income sector with the inclusion of the commercial solar hot water technology piloted in FY11.

Table 4-10 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-10. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	192,877	196,735	1.02
kW	31.6	32.3	1.02
MMBtu	0.0	0.0	n/a

4.2.2 Overall sampling methodology

There is generally little variation within the Solar PV track and there is only one type of measure installed. However, there was one project that accounted for 24 percent of the track's electricity savings. This project was sampled with certainty; the remaining projects were randomly sampled.

Table 4-11. FY13 Population and Sample Summary

	Project File Evaluation Sample							
Measure	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Solar PV	56	15	84,534	12.8	0.0	43.8%	40.6%	-
Total	**56**	**15**	**84,534**	**12.8**	**0.0**	**43.8%**	**40.6%**	**-**

4.2.3 Process evaluation

A process evaluation was not done for this track in this evaluation cycle; however, a staff interview was conducted November 25, 2013, to understand how the track is intended to work

Table 4-12. FY13 Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth interviews	1	1	

A. Summary of key findings

Not applicable

4.2.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and spillover batteries were used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-13. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant phone surveys	20	17	Difficulty recruiting due to limited participation data

We removed two records from the net-to-gross analysis as the recordings indicated that the respondent did not fully answer the free-ridership questions.

B. Summary of results

This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results. It is important to note that reason would suggest that it is unlikely limited-income program participants would be able to fund projects with these considerable costs; therefore, a NTG value of 100 percent is more likely.

Table 4-14. Net-to-Gross Results Summary—Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Spillover	90% Margin Error (±)	Net-to-Gross
Solar PV	56	15	192,877	14.9%	12.9%			85.1%
Total	**56**	**15**	**192,877**	**14.9%**	**12.9%**	**0.3%**	**2.0%**	**85.4%**

C. Drivers net-to-gross results

The overall net-to-gross for the 7120PV track is 85.4 percent, with a free-ridership rate of 14.9 percent and 0.3 percent spillover.

4.2.5 Impact evaluation

The initial task for the impact evaluation was to review and verify the variables used to calculate claimed savings for FY13. Using the National Renewable Energy Laboratory's (NREL) PV Watts 2 software, the evaluation team calculated program kWh savings using the measure data from the tracking system. Once this was completed realization rates were calculated by dividing verified savings by reported savings.

The evaluation team was unable to determine how the kW saving was derived based on the project file data and the KITT extracts, so the original kWh was divided by the original kW to determine hours for each project. The verified kWh was then divided by the hours to determine the verified kW for each project. The evaluation team will review this methodology and other available data and information with the DC SEU before finalizing the realization rate for kW.

Physical site inspections were performed to verify installed measures. Also included was a brief customer interview to gather information about the program (process). A standard inspection and interview format was used so information gathered from one project to the next was consistent.

A. Impact sampling methodology for onsite measurement and verification

The onsite sample was drawn from the overall project sample list. A random number generator was applied to the list, which was then sorted from the smallest to largest number, and the first ten projects on the list were selected for site visits.

Table 4-15. FY13 Onsite M&V Sample Summary

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Solar PV	56	2	47,216	8.0	0.0	24.5%	25.4%	-
Total	**56**	**2**	**47,216**	**8.0**	**0.0**	**24.5%**	**25.4%**	**-**

B. Verification of impacts

The evaluation team conducted reviews of the DC SEU savings estimates for reasonableness by inputting individual solar project variables into the National Renewable Energy Laboratory's (NREL) PV Watts 2 software. The evaluation team also reviewed the Mid-

Atlantic TRM to assess potential variations in inputs and methods from those implemented in the District. For this program, the net-to-gross ratio is assumed to be 1.15[19] for FY12.

Table 4-16. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Solar PV	192,877	196,735	1.02	31.6	32.3	1.02	0.0	0.0	n/a
Track Total	**192,877**	**196,735**	**1.02**	**31.6**	**32.3**	**1.02**	**0.0**	**0.0**	**n/a**

C. Impact evaluation deviation from plan

Table 4-17. FY13 Impact Evaluation Plan vs. Actual Sample

Activity	Plan	Actual	Explanation for Variance
Conduct desk audits	15	15	
Conduct onsite Verification	5	2	Unable to setup appointments with sample participant within evaluation timeframe
Conduct phone verification	20	17	Difficulty in recruitment due to limited population

D. Summary of key findings describing adjustments to ex-ante savings

- Project file documentation was not always complete. The data collection process was a bit difficult based on the number of variables required to verify the ex-ante savings and the difficulty in verifying where the data variables were coming from. The Direct Current rating is generally collected from the Photovoltaic panel's data tag, which was not available through on-site verification, photographs or any other specific documentation. Also, the de-rating factor is calculated based on plugging values into an equation worksheet and the actual calculations to determine these values for each component were not available for verification.
- Pieces of data were missing to adequately verify ex-ante savings for a number of the desk audits that were performed. For example Solar PV inspection documents were missing various degrees of data including tilt, azimuth, or number of PV panels. This led the evaluator to make assumptions based on their expert experience.
- The electronic project files that were reviewed had various levels of documentation. Nine of the files included only a the CAT File. Six of the files additional documentation included:
  - Final CAT file
  - Inspection form
  - DC SEU Check Request
  - Photos

[19] Reference VEIC memo to the DDOE, *Screening assumptions for the DC SEU solar renewable energy program portfolio,* August 30, 2012; the evaluation team reviewed this memo and finds the recommendations reasonable at this time.

- Plans and specifications (including PV Watts file)
- IQC Work Orders.

4.2.6 Recommendations

A. To improve design, operations, customer experience, and recruitment

This track was not scheduled for a process evaluation in this evaluation cycle; however, process-related findings and recommendation were identified as a part of the impact evaluation effort.

i. **For improved ease in locating pertinent project files for evaluation, the evaluation team recommends that a "Final Project Documentation" folder contain consistently named files critical for the evaluation effort.** It is important to stay up-to-date on the project files and include all documentation. Keeping the project files current provides DC SEU with a clear paper trail that is easily defend. The electronic project files that were reviewed had various levels of documentation.

   Critical files include:

   - CAT file
   - Inspection form
   - DC SEU check request
   - Photos of equipment and name plates
   - Plans and specifications (including PV Watts file)
   - QC work orders
   - Detailed project invoices.

ii. **To improve the customer experience it is important to routinely follow-up with the program participants.** Fifteen of the program participants participated in the phone surveys, four of them report issues with the installed equipment. Some instances of failure can occur but the remarks conveyed by the participants indicated the equipment has never worked since installed.

   Verbatim comments captured by phone interviewers:

   Because it really has not been hooked up because the problem I had with PEPCO and the name on my bill...there is not a problem with the solar equipment, it is with the name on the bill.

   Hooked it up in August and unit is still not working. I have called several times. I keep calling and keep calling and nothing been completed.

   I do not know how it is going to perform because it is not performing yet at all.

   It is not activated. I was so excited for the program, I have made a lot of time to work with them and I have waited over a year. When they came to install the panel on the roof it caused problems with my TV. I had to purchase another TV.

B. To improve impact evaluation results

i. **Develop a final annual report that provides all variables used to calculate savings in PV Watts 2.** The report should also include all project ID, premise data, participant date and the ex-ante savings from installing the PV system. This report will aid the evaluators in verifying the ex-ante savings.

ii. **Document all variables required to determine savings within project files.**

iii. **Fully document all equipment and locations during the QA/QC onsite audit.** For example some of the inverters are located under the photovoltaic panels which cannot be verified from the ground. There were also instances when the inspections forms were not completed sufficiently missing basic information including the number of PV panels installed. Care should be taken to verify all equipment and pertinent data. Pictures or a written description would aid in the evaluation process.

iv. **Ensure project files contain the final versions of savings calculations and supporting documentation.** It is important to stay up-to-date on the project files and include all documentation. Keeping the project files current provides DC SEU with a clear paper trail that is easily defend. The electronic project files that were reviewed had various levels of documentation. Key documentation includes final versions clearly marked:

- CAT file
- Inspection form
- DC SEU check request
- Photos of equipment and name plates
- Plans and specifications (including PV Watts file)
- QC work orders
- Detailed project invoices.

C. To manage free-ridership results

Given the small sample sizes for these tracks, the evaluation team does not have any recommendations specific to program design.

4.3 7420FHLB FORGIVABLE HOME LOAN BANK

4.3.1 Track description

The DC SEU has partnered with Industrial Bank to offer a special program through the Federal Home Loan Bank of Atlanta, the Energy Efficiency and Weatherization program. This program provides forgivable loan funds of up to $12,000 for home rehabilitation to eligible low-income homeowners to implement energy efficiency and weatherization improvements and select safety improvements. The loan is forgiven at 20 percent each year, over five years. No loan payments are required so long as the homeowner does not break any program regulations during the payback period.

District homeowners earning 80 percent area median income or less, who live in single family homes, duplexes, townhouses, condos, cooperatives or manufactured/mobile housing titled as real estate are eligible to apply. Homeowners must have owned the home for at least one year and plan to remain in their home for five more years.

Eligible improvements include:

- Insulation
- Heating, ventilation and air conditioning systems
- Low-flow plumbing
- Water heaters
- Roofing improvements
- Window replacement
- Exterior door replacement
- Other health and safety improvements.

Homeowner participation requirements include:

- Income qualification for the program
- Must complete a loan application and provide required income/asset documentation
- Must complete a phone session of credit counselling
- Allow pre- and post-inspections of the home to confirm/monitor work completed
- Must complete a post-funding application resulting in the filing of a lien on the homeowner's property for the balance of the forgivable loan.
- Meet the five-year occupancy requirements.

Table 4-18 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-18. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	30,531	30,579	1.00
kW	3.2	3.2	1.00
MMBtu	109.7	119.2	1.09

4.3.2 Overall sampling methodology

Because of the similarities between 7420FHLB and 7420HPES, we treated these tracks as one for the purposes of sampling. While there are various measures installed by this program, choosing a random sample of projects is likely to result in a representative distribution of measures for evaluation. In addition, this track will have a higher number of projects evaluated, so coverage of measures is not expected to be an issue. The evaluation team selected a random sample of projects, and ensured that resulting list of projects have appropriate representation for measure types.

Table 4-19. FY13 Population and Sample Summary

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Lighting	31	2	1,806	0.2	-2.7	6.4%	6.5%	6.5%
Water Heating and Saving	20	2	125	0.0	1.0	8.5%	8.5%	20.2%
Building Shell	13	1	15	0.0	3.0	2.0%	-	2.3%
Heating	9	1	0	0.0	1.9	0.0%	-	12.5%
Total	**40**	**3**	**1,946**	**0.2**	**3.2**	**6.4%**	**6.5%**	**2.9%**

4.3.3 Process evaluation

A process evaluation was not done for this track in this evaluation cycle; however, a staff interview was conducted January 22, 2014, to understand how the track is intended to work A limited process evaluation review is currently schedule for FY15.

Table 4-20. Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth interviews	1	1	

A. Summary of key findings

Not applicable.

4.3.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and spillover batteries were used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-21. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant phone surveys	10	10	

Two records were removed from the net-to-gross analysis due to the respondents indicating that lighting or water savings equipment provided was no longer installed.

B. Summary of results

This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.

Table 4-22. FY13 Net-to-gross Results Summary—Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Spillover	90% Margin Error (±)	Net-to-Gross
Building Shell	13	2	733	0.0%	0.0%			100.0%
Heating	1	0	23	n/a	n/a			n/a
Lighting	31	3	28,294	17.0%	33.9%			83.0%
Other HVAC	1	0	5	n/a	n/a			n/a
Water Heating	17	3	1,477	12.5%	28.5%			87.5%
Total	**63**	**8**	**30,531**	**16.4%**	**20.1%**	**4.0%**	**10.6%**	**87.6%**

Table 4-23. FY13 Net-to-gross Results Summary—Gas

End Use	N	n	Population MMBtu	Free-ridership	90% Margin Error (±)	Spillover	90% Margin Error (±)	Net-to-Gross
Building Shell	13	2	132.0	0.0%	0.0%			100.0%
Heating	5	0	10.0	n/a	n/a			n/a
Other HVAC	7	0	5.0	n/a	n/a			n/a
Water Heating	8	2	5.0	10.9%	31.4%			89.1%
Total	**33**	**4**	**152.0**	**0.4%**	**4.8%**	**0.0%**	**0.0%**	**99.6%**

C. Drivers net-to-gross results

- The kWh free-ridership rate for the 7420FHLB track is 16.4 percent and a spillover rate of 4.0 percent, resulting in a kWh net-to-gross rate of 87.6 percent.
- The lighting end use had the highest kWh free-ridership rate, although only three records were surveyed for this end use and eight for the entire track.
- The natural gas free-ridership rate for the 7420FHLB track is 0.4 percent and with no spillover, the natural gas net-to-gross rate is 99.6 percent.

4.3.5 Impact evaluation

The initial task for impact evaluation was to review the DC SEU TRM, compare it to the Mid-Atlantic TRM, and verify variables used to calculate claimed savings for FY13. Using both the Mid-Atlantic TRM and the DC SEU TRM the evaluation team calculated program kWh, kW, and MMBtu savings using the measure data from the tracking system. Once this was completed, realization rates were calculated by dividing verified savings by reported savings.

A. Impact sampling methodology for onsite measurement and verification

The onsite sample was drawn from the overall project sample list. A random number generator was applied to the list, which was then sorted from the smallest to largest number. The first 5 projects on the list were selected for site visits, and 4 onsite visits were completed. To supplement onsite verification efforts, 10 telephone surveys were conducted to verify the receipt and installation on reported measures.

Table 4-24. FY13 Onsite M&V Sample Summary

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Lighting	31	0	0	0.0	0.0	-	-	-
Water Heating and Saving	20	0	0	0.0	0.0	-	-	-
Building Shell	13	0	0	0.0	0.0	-	-	-
Heating	9	0	0	0.0	0.0	-	-	-
Total	**40**	**0**	**0**	**0.0**	**0.0**	**-**	**-**	**-**

B. Verification of impacts

The evaluation team conducted reviews of the engineering algorithms documented by DC SEU for reasonableness and in accordance with the DC SEU TRM. The evaluation team also reviewed the Mid-Atlantic TRM to assess potential variations in inputs and methods from those implemented in the District. For this program, the net-to-gross ratio is assumed to be 1.00 for FY13.

Table 4-25. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Lighting	28,294	28,294	1.00	3.1	3.1	1.00	-42.2	-42.2	1.00
Water Heating and Saving	1,477	1,565	1.06	0.1	0.1	1.06	5.0	10.2	2.06
Building Shell	733	660	0.90	0.0	0.0	0.00	131.7	118.5	0.90
Heating	28	60	2.15	0.0	0.0	0.00	15.2	32.7	2.15
Track Total	**30,531**	**30,579**	**1.00**	**3.2**	**3.2**	**1.00**	**109.7**	**119.2**	**1.09**

C. Impact evaluation planned activities and completed activities comparison

Table 4-26. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct desk audits	10	3	3 project files available
Conduct onsite Verification	5	0	Were unable to schedule any on-sites
Conduct phone verification	10	10	

D. Summary of key findings describing adjustments to ex-ante savings

- The common theme throughout this iteration of evaluations is project documentation—specifically, key variables that directly affect the outcome of the reported savings were unavailable. The realization rates for most the measures are in range, but those that include building shell (air sealing and insulation) or heating equipment are either higher or lower than expected.
- Water Heating and Savings MMBtu Temperature: Using the DC SEU TRM, HERO variables and the MMBtu savings returned higher number than reported.
- Heating: one project included in the sample had the following two measures: a heating system replacement with a realization rate of 97 percent; and, a programmable thermostat with a realization rate of 280 percent. The thermostat was evaluated using the Mid-Atlantic TRM reported deemed savings of 3.41 MMBtu. This caused the combined realization rate to increase dramatically.

4.3.6 Recommendations

A. To improve design, operations, customer experience, and recruitment

Not applicable.

B. To improve impact evaluation results

i. **Follow DC SEU TRM savings algorithms. DC SEU for the most part followed the DC SEU TRM.** There were a few examples in the TRM that was unclear on the

procedure for calculating kW savings. Providing clear examples in the TRM lays out a clear path to verifying that algorithms were followed.

ii. **Fully document variable inputs used to determine savings.** For programs that feature the installation of multiple measures it is important to fully document what was actually installed; either the number of measures (aerators, showerheads, etc.); the number of feet (pipe insulation, caulking, weather-stripping, etc.); the test in and test out blower door CFM_50, or the home and water heating source. In each situation it is imperative to the integrity of the reported savings of each program to know what was installed.

iii. **Improve onsite QA/QC to ensure all contractors are installing measures as claimed.** Inspection of all projects for new contractors is recommended until the DC SEU staff have concluded that reporting is accurate. Once contractors pass the initial QA/QC review, inspection of 10 percent of projects is recommended to ensure reporting remains accurate. When issues arise, increased QA/QC may be needed.

C. To manage free-ridership results

i. **Consider shifting away from CFLs and installing LEDs.** Customers are less likely to install LED lights on their own or without assistance. This recommendation is made in conjunction with the 7420HPES track.

4.4 7420HPES HOME PERFORMANCE WITH ENERGY STAR®

4.4.1 Track description

The Home Performance with ENERGY STAR® (HPwES) track is modeled after a national program sponsored by the US Department of Energy (US DOE) and partnered locally by the DC SEU. Typical HPwES home improvement projects begin with a comprehensive energy audit of a home conducted by a certified DC HPwES participating contractor. Using a number of diagnostic tests, the contractor provides the homeowner with a home energy audit report. The comprehensive report includes recommendations for energy efficient improvements specific to the home, along with each improvement's associated annual energy savings. The homeowner then works with the contractor to decide on which improvements make the best sense for the home and the homeowner's budget. The certified contractor completes the agreed upon home efficiency improvements.

The HPwES track targets DC residents living in single-family homes, row homes (each unit is ground to sky), or converted (one to four unit) apartments and row homes. Both owner-occupied homes and rental properties, with the property owner's authorization, are eligible to participate.

The DC SEU is responsible for establishing a network of contractors who are qualified to perform a comprehensive energy audit and complete the recommended improvements or work closely with other contractors who can. The HPwES track is currently working with five participating contractors from whom customers can choose to conduct the home energy audit.

All audit data is entered into the Home Energy Reporting Online (HERO) web based savings tool by the contractor. DC SEU staff reviews the HERO application for completeness, accuracy, and health and safety requirements for recommended measures. The contractors then install the recommended equipment, perform a test-out, and enter the test-out data into HERO. The DC SEU reviews the test-out data and, if approved, forwards a document to the customer for signature.

The DC SEU offers financial incentives of up to $1,800 to those who successfully complete a qualifying home energy upgrade, such as air sealing and insulating your home. Participating households receive upon project completion:

- $200 cash back on your BPI energy audit
- 50 percent cash back on air sealing work, up to $800
- 50 percent cash back on insulation work, up to $800.

Table 4-27 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-27. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	171,098	158,549	0.93
kW	16.9	15.3	0.91
MMBtu	606.2	616.9	1.02

4.4.2 Overall sampling methodology

Because of the similarities between 7420FHLB and 7420HPES, we treated these tracks as one for the purposes of sampling. While there are various measures installed by this program, choosing a random sample of projects is likely to result in a representative distribution of measures for evaluation. In addition, this track will have a higher number of projects evaluated, so coverage of measures is not expected to be an issue. The evaluation team selected a random sample of projects and ensured that the resulting list of projects has appropriate representation for measure types.

Table 4-28. FY13 Population and Sample Summary

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Lighting	223	43	27,949	3.1	-42.1	21.5%	21.5%	21.5%
Water Heating and Saving	192	35	5,960	0.4	1.4	18.5%	18.0%	22.1%
Heating	10	1	176	0.0	35.0	3.9%	-	42.0%
Building Shell	27	6	361	0.0	36.2	8.0%	-	5.1%
Total	**271**	**53**	**34,445**	**3.5**	**30.4**	**20.1%**	**21.0%**	**5.0%**

4.4.3 Process evaluation

A process evaluation was not done for this track in this evaluation cycle; however, a staff interview was conducted January 22, 2014, to understand how the track is intended to work. A limited process evaluation review is currently schedule for FY15.

Table 4-29. Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth interviews	1	1	

A. Summary of key findings

Not applicable.

4.4.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and spillover batteries were used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-30. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant phone surveys	50	55	Over-recruited in the event some data dropped from analysis due to data quality

Fourteen records were removed from the net-to-gross analysis—for 12 records, respondent claimed that the equipment was no longer installed (2 lighting and 10 water savings measures); and, in two cases, we conducted the interview with the contractor rather than the property manager.

B. Summary of results

Table 4-31. FY13 Net-to-gross Results Summary—Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Spillover	90% Margin Error (±)	Net-to-Gross
Building Shell	27	4	4,525	0.9%	7.3%			99.1%
Lighting	223	27	129,795	26.4%	13.1%			73.6%
Other HVAC	8	1	4,564	50.0%	76.9%			50.0%
Water Heating	185	9	32,214	18.0%	20.5%			82.0%
Total	**443**	**41**	**171,098**	**24.8%**	**10.6%**	**1.8%**	**3.3%**	**77.0%**

Table 4-32. FY13 Net-to-gross Results Summary—Gas

End Use	N	n	Population MMBtu	Free-ridership	90% Margin Error (±)	Spillover	90% Margin Error (±)	Net-to-Gross
Building Shell	22	4	712.0	0.9%	6.9%			99.1%
Heating	1	0	14.0	n/a	n/a			n/a
Other HVAC	7	1	69.0	50.0%	76.1%			50.0%
Water Heating	47	4	6.0	21.9%	32.5%			78.1%
Total	**77**	**9**	**802.0**	**5.3%**	**11.6%**	**5.5%**	**11.7%**	**100.2%**

C. Drivers ret-to-gross results

- The overall kWh net-to-gross rate is 77.0 percent with a free-ridership rate of 24.8 percent and a spillover rate of 1.8 percent.

- The overall natural gas net-to-gross rate is 100.2 percent with a free-ridership rate of 5.3 percent and a spillover rate of 5.5 percent.
- The building shell end use had the lowest free-ridership rate for both kWh and natural gas and contributed the most natural gas savings. The building shell results are based only on four survey responses; therefore, caution should be used when interpreting these results at the end use level.
- The lighting end use had the greatest participation in the 7420HPES track and contributed the highest kWh savings.

4.4.5 Impact evaluation

The initial task for impact evaluation was to review the DC SEU TRM, compare it to the Mid-Atlantic TRM, and verify variables used to calculate claimed savings for FY13. Using both the Mid-Atlantic TRM and the DC SEU TRM, the evaluation team calculated program kWh, kW, and MMBtu savings using the measure data from the tracking system. Once this was completed, realization rates were calculated by dividing verified savings by reported savings.

Physical site inspections were performed to verify installed measures and included a customer interview to gather information about the initiative. A standard inspection and interview format was used so information gathered from one project to the next was consistent.

A. Impact sampling methodology for onsite measurement and verification

The onsite sample was drawn from the overall project sample list. A random number generator was applied to the list, which was then sorted from the smallest to largest number. The first 15 projects on the list were selected for site visits, and four onsite visits were completed. To supplement onsite verification efforts, 35 telephone surveys were conducted to verify the receipt and installation on reported measures.

Table 4-33. FY13 Onsite M&V Sample Summary

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Lighting	223	7	2,899	0.3	0.0	2.2%	2.2%	0.0%
Water Heating and Saving	192	5	1,454	0.1	0.3	4.5%	4.6%	4.5%
Heating	10	1	827	0.0	15.1	18.1%	-	18.1%
Building Shell	27	1	25	0.0	1.6	0.6%	-	0.2%
Total	**271**	**8**	**5,206**	**0.4**	**17.0**	**3.0%**	**2.6%**	**2.8%**

B. *Verification of impacts*

The evaluation team conducted reviews of the engineering algorithms documented by DC SEU for reasonableness and in accordance with the DC SEU TRM. The evaluation team also reviewed the Mid-Atlantic TRM to assess potential variations in inputs and methods from those implemented in the District. For this program, the net-to-gross ratio is assumed to be 1.00 for FY13.

Table 4-34. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Lighting	129,795	114,219	0.88	14.5	12.7	0.88	-195.7	-172.2	0.88
Water Heating	32,214	34,147	1.06	2.4	2.5	1.06	6.2	6.6	1.06
Heating	4,564	5,386	1.18	0.0	0.0	0.00	83.4	27.5	0.33
Building Shell	4,525	4,797	1.06	0.0	0.0	0.00	712.2	754.9	1.06
Track Total	**171,098**	**158,549**	**0.93**	**16.9**	**15.3**	**0.91**	**606.2**	**616.9**	**1.02**

C. *Impact evaluation planned activities and completed activities comparison*

Table 4-35. FY13 Impact Evaluation Plan vs. Actual Sample

Activity	Plan	Actual	Explanation for Variance
Conduct desk audits	46	53	Additional project files were available for review
Conduct onsite Verification	15	8	Difficulty in recruitment within evaluation timeframe
Conduct phone verification	50	55	Over-recruitment in the event some surveys would be dropped for quality

D. *Summary of key findings describing adjustments to ex-ante savings*

- The common theme throughout this iteration of evaluations is project documentation, specifically, key variables that directly affect the outcome of the reported savings were unavailable. The realization rates for most of the measures are in range, but those that include building shell (air sealing and insulation) or heating equipment are either higher or lower than expected.
- Compact Fluorescent Lamp: For the most part, the evaluator was abIe to verify product specifications with the exception of three types of bulbs installed through the program. One type of bulb (GE 3-way) was listed on the GE website, but is not in the ENERGY STAR product list that was downloaded on January 23, 2014 so it is not eligible for program savings. The evaluator was unable to identify the other two products conclusively, but based on the measure name and the ability to match them to KITT bulb types, we are confident with our identification of the bulb. This does not impact the realization rate but is a documentation issue.

- Heating: One duct sealing and duct insulation project was included in the sample. There appears to be a calculation error in the report MMBtu realization resulting in the low realization rate.
- Onsite inspections and phone surveys: Based on the onsite inspections there appears to be some discrepancy in the number of measures reported versus the measures that were physically identified in the onsite inspections. Granted, the onsite inspection sample was very small, but only one of the sites inspected had the exact number of measures installed as reported in the tracking database. There was no indication by the participant that additional measure beyond what was inspected was installed. The results of phone surveys brought similar results. Of the 35 participants contacted, 4 participants indicated no aerators were installed and more participants indicated other measures were not installed. Programs like this with multiple measures installed are tough on QA/QC protocols. Increasing QA/QC activity would uncover inconsistencies in contractor reporting.

4.4.6 Recommendations

A. To improve design, operations, customer experience, and recruitment

i. **Improve onsite QA/QC to ensure all contractors are installing measures as claimed.** Inspection of all projects for new contractors is recommended until the DC SEU staff have concluded that reporting is accurate. Once contractors pass the initial QA/QC review, inspection of 10 percent of projects is recommended to ensure reporting remains accurate. When issues arise, increased QA/QC may be needed.

B. To improve impact evaluation results

i. **Follow DC SEU TRM savings algorithms.** DC SEU for the most part followed the DC SEU TRM. There were a few examples in the TRM that was unclear on the procedure for calculating kW savings. Providing clear examples in the TRM lays out a clear path to verifying that algorithms were followed.

ii. **Fully document variable inputs used to determine savings.** For programs that feature the installation of multiple measures it is important to fully document what was actually installed; either the number of measures (aerators, showerheads, etc.); the number of feet (pipe insulation, caulking, weather-stripping, etc.); the test in and test out blower door CFM_50, or the home and water heating source. In each situation it is imperative to the integrity of the reported savings of each program to know what was installed.

C. To manage free-ridership results

i. **Consider shifting away from CFLs and installing LEDs.** Customers are less likely to install LED lights on their own or without assistance. This recommendation is made in conjunction with the 7420FHLB track.

ii. **Follow-up with customers who have not installed equipment beyond that provided through the direct install component to encourage participation in the**

components of the program that require customer contribution. Customers may be less likely to install larger or more costly equipment on their own.

4.5 7510BLTZ T12 LIGHTING REPLACEMENT AND 7510MTV T12 MARKET TRANSFORMATION VALUE

4.5.1 Track description

The T12 lighting replacement tracks target small- to medium-sized business (less than 10,000 square feet or less than 5,000 kWh per month). The 7510BLTZ track provides upgrades from older, inefficient T12 fluorescent tube lighting to high efficiency T8 products in qualifying businesses, institutions, and multifamily residential buildings in DC at no cost through DC SEU implementation contractors, while the 7510MTV track negotiates participant contribution to the cost of the project. The 7510BLTZ track transitioned to the 7510MTV track in FY13 to support the movement toward market-based initiatives.

The existing T12 lighting must be replaced by HPT8 28W lamps with low ballast factors (except in cases where specific conditions warrant higher ballast factors). The program also provides incentives for replacing incandescent bulbs with compact fluorescent light bulbs or fluorescent exit signs with higher efficiency LED models. In order for a business to qualify, the fixtures must be operated for a minimum of 2,000 hours annually (defined as 40 hours per week, 50 weeks per year).

Eligible measures include:

- T8 lighting upgrades
- LED exit signs
- CFLs.

DC SEU staff and Certified Business Enterprise (CBE) contractors are responsible for outreach to potential participants. The CBE contractors install eligible equipment, and DC SEU staff inspect 100 percent of the projects prior to release of the financial incentive.

Table 4-36 and Table 4-37 provide a summaries of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-36. FY13 Reported and Verified Results—7510BLTZ

Metric	Reported	Verified	Realization Rate
kWh	3,644,922	4,212,011	1.16
kW	826.9	1,029.7	1.25
MMBtu	-2,379.4	-2,039.4	0.86

Table 4-37. FY13 Reported and Verified Results—7510MTV

Metric	Reported	Verified	Realization Rate
kWh	1,079,285	1,460,503	1.35
kW	237.9	353.6	1.49
MMBtu	-717.9	-949.7	1.32

4.5.2 Overall sampling methodology

The 7510BLTZ and 7510MTV tracks were combined for the purposes of sampling projects, given similarities between the two tracks. Both tracks target nonresidential lighting projects, so there are very few different types of measures installed. However, for these tracks there is wide variation in the size of projects. The evaluation team sampled the top 10 percent of projects by total electricity savings from these combined tracks and supplemented with randomly selected smaller projects to fill out the sample. This resulted in 9 projects sampled with certainty from the highest savings stratum and 31 selected randomly from the second stratum of all other electricity savings for impact evaluation activities.

Table 4-38. FY13 Population and Sample Summary—7510BLTZ

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Fluorescent Lighting	57	23	2,807,053	652.8	-1,833.2	81.9%	83.4%	81.9%
CFLs	18	3	57,841	13.8	-37.3	29.2%	33.0%	29.7%
LED Exit Sign	16	3	754	0.1	-0.5	3.6%	3.6%	3.5%
Total	**57**	**23**	**2,865,648**	**666.6**	**-1,871.0**	**78.6%**	**80.6%**	**78.6%**

Table 4-39. FY13 Population and Sample Summary—7510MTV

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Fluorescent Lighting	38	16	435,964	90.5	-288.9	44.4%	41.2%	44.1%
CFLs	12	4	16,366	3.9	-10.4	30.5%	30.5%	30.6%
LED Exit Signs	17	5	17,691	2.2	-11.9	41.4%	41.4%	41.4%
Total	**38**	**16**	**470,021**	**96.6**	**-311.2**	**43.5%**	**40.6%**	**43.3%**

4.5.3 Process evaluation

A staff interview was conducted November 22, 2013, to understand how the track is intended to work and to identify key researchable questions. In particular, The DC SEU staff was interested in understanding how the move toward the market-based initiative is understood and perceived.

In January 2014, in-depth interviews were conducted with ten market actors and 32 participating customer to elicit feedback on their experiences with the programs, including program satisfaction, how they learned of the program, how the decision was made to install program-qualifying equipment, installation verification, and company characteristics.

Table 4-40. FY13 Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct DC SEU staff in-depth Interview	1	1	
Conduct participant surveys: 7510BLTZ	30	19	Difficulty in recruitment due to small population
Conduct participant surveys: 7510MTV	15	13	Difficulty in recruitment due to small population
Conduct Market Actor Interviews	10	10	

A. Summary of key findings

- Both contractors and customers were highly satisfied with the 7510BLTZ and 7510MTV tracks and 16 of 22 participants surveyed have recommended the DC SEU initiative to others. The table below shows the number of highly satisfied ratings with each aspect (rating of 8, 9, or 10) on a 0 to 10 scale where 0 is very dissatisfied and 10 is very satisfied.

Table 4-41. Number of Highly Satisfied Ratings by Program Aspect

Program Aspect	BLTZ		MTV	
	N	n	N	n
Rebate amount or financial incentive	12	12	6	4
Performance of new equipment	15	14	7	6
Application process	14	12	7	7
Interactions with DC SEU staff	14	12	4	4
Type of eligible equipment	14	12	7	6
Technical assistance received from DC SEU	11	9	7	7
Preapproval process	10	7	5	5
Amount of time to receive rebate or financial incentive	12	9	3	3
Experience overall	15	12	7	6
Assistance from contractor who installed equipment	15	11	7	6
Information about DC SEU energy efficiency offerings	15	8	7	5

- Eleven of the 24 responding participants said they face no barriers when deciding whether or not to purchase energy efficient equipment. The primary barrier companies do face is the lack of funds available for investment (4 of 24). Other barriers mentioned by individual respondents included lack of financing, return on investment, the time required to install, timing of the rebate, building age, and lack of knowledge regarding lighting options.

- Contractors reported struggling with the compliance guidelines for eligibility for the program, feeling they were still unclear on everything required.
- The most common sources of information about the 7510BLTZ and 7510MTV tracks were from DC SEU staff (10 of 28) and contractors (9 of 28). Another four learned of the track offerings from colleagues or other businesses. About half (3 of 8) of the customers who heard about the program from a contractor were aware of it prior to the contact with the contractor. Seventeen would like to receive emails regarding DC SEU initiatives, while 11 were interested in DC SEU mailings and 3 would like to hear about initiatives from DC SEU staff. Two more would like some type of in-person visit to discuss the initiatives available. Contractors reported wanting more leads to come from DC SEU and support in the form of marketing budgets ($500–$1,000) for outreach materials, including handouts.
- With the exception of one contractor who is no longer CBE certified, all indicated they expect their participation levels to either stay the same or increase for 2014. Two said the program helped them bring in additional work and allowed them to make more money in 2013. One said, "*It essentially assists us because we're trying to push people to higher efficiency equipment that typically has a 20–30% price increase. [The program] is essentially closing the gap between normal market replacements versus hopefully getting people to take that next step up in terms of efficiency*."
- Most (26 of 32) of the participants had some interaction with DC SEU staff during the run of their project. At least 15 of the companies were able to complete the necessary paperwork internally. DC SEU staff completed the application for nine participants. Only three had the contractor complete the paperwork, although all but one of the contractors said they complete application forms on behalf of their customers.
- While participants in the 7510BLTZ track were all very satisfied with the rebate amount or financial incentives, two of the 7510MTV participants were not very satisfied. One respondent said "*I heard that if I'd done it about a month earlier it would have been 100%, but I paid 30%.*" A couple of contractors also mentioned the rebate amounts (or proportions) being lower than what they have experienced in other territories. One 7510BLTZ participant was dissatisfied with the amount of time it took to receive the funding for their project, saying it had been "*months of waiting.*"
- Overall, the program communications were highly rated by both contractors and customers. The preapproval and application processes worked well. Two 7510 BLTZ participants had issues with the amount of time it took to get the funding through the preapproval process, leading to dissatisfied ratings. Most participants were very satisfied with their interaction with DC SEU staff, although one 7510BLTZ participant had "*lots of call backs and back and forth playing phone tag."*
- Lack of information was the cause for dissatisfaction among several participants. It was the reason for two participants providing dissatisfied ratings for the type of equipment eligible for the rebates or financial incentives. Not that they did not like what was eligible or thought something was missing, but that they were not aware of what was eligible. There was also some general dissatisfaction regarding lack of information. Participants mentioned not understanding the amount of the incentive, lack of awareness prior to a contractor visiting, and getting information from sources other than DC SEU which was less than reliable.

- The reasons why customers choose whether or not to participate in the program varied according to contractors. One thinks the customers are more aware of their energy use now, with customers seeing high energy bills and wanting to make changes to reduce their energy burden. *"They are more interested in conservation,"* said one contractor. One concern is that after an audit customers see the overall cost and just take the low-hanging fruit. Another issue can be that the customer sees the assessment and is not prepared for what all the costs would be. Larger businesses are more likely to have budgets in place, but smaller businesses do not have the upfront funds to cover those costs. Thirty percent can still be a high amount depending on the size of the project. All of the respondents did say they do not have any problems selling energy efficient equipment though. One said it gets easier every year.
- Participants did not request additional technologies be added to the program, but a few contractors had thoughts on how the program could expand. One would like to see an increase in rebates for LEDs, citing that in Maryland they cover 80 percent of LEDs' cost. Another would like the lighting to extend beyond T12 and T8, stating T5 lamps are the next step in efficiency, and those are not included. Their reasoning behind this is the prices have come down on those dramatically in the last year and they have had a lot of clients wonder why the subsidies stop at T8.
- Participant concerns with contractors were not serious and resulted mostly from delays or timeline issues. Two of the three participants with dissatisfied ratings for contractor assistance worked with NDS Fix-It though they did not mention them by name.
- Ten of 22 participants are aware that they have realized energy savings as a result of installing the new lighting.

4.5.4 Net-to-gross methodology and results

A. Methodology

The full free-ridership and spillover batteries were used for these tracks. See Section 1.2 for detailed descriptions of these batteries.

Table 4-42. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant surveys: 7510BLTZ	30	19	Difficulty in recruitment due to small population
Participant surveys: 7510MTV	15	13	Difficulty in recruitment due to small population

We removed two records from the free-ridership analysis for 7510BLTZ because respondent claimed that the equipment was not installed. For one of these cases, verification confirmed installation; however, because the respondent claimed equipment was not installed, the response data for the net-to-gross questions was not considered valid. It is not unusual for phone verification data to contradict onsite verification; when this situation occurs, the onsite

verification data is used in the evaluation. For 7510MTV, six respondents could not answer the free-ridership and spillover questions.

B. Summary of results

This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.

Table 4-43. FY13 Net-to-gross Results Summary—7510BLTZ Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Lighting	57	17	3,644,922	13.3%	11.4%	0.0%	0.0%	86.7%
Total	**57**	**17**	**3,644,922**	**13.3%**	**11.4%**	**0.0%**	**0.0%**	**86.7%**

Table 4-44. FY13 Net-to-gross Results Summary—7510MTV Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Lighting	38	7	1,079,285	25.9%	24.6%	14.7%	19.9%	88.8%
Total	**38**	**7**	**1,079,285**	**25.9%**	**24.6%**	**14.7%**	**19.9%**	**88.8%**

C. Drivers net-to-gross results

- Net-to-gross results were very similar between 7510BLTZ and 7510MTV (86.7 percent and 88.8 percent, respectively). The number of survey completes are low for 7510MTV, however, so caution is warranted when comparing and interpreting results.
- Free-ridership rate was higher for 7510MTV (25.9 percent compared to 13.4 percent for 7510BLTZ). This may be different due to the timing of the projects as 7510BLTZ customers participated in late 2012/early 2013 compared to customers in 7510MTV who participated in the second half of 2013 where there's been less time between implementation and the survey.
- 7510BLTZ had no like spillover while 7510MTV had a like spillover rate of 14.7 percent although the like spillover was driven by one respondent.
- One 7510MTV case indicated having unlike spillover of HVAC equipment in which they indicated they updated energy efficient parts.

4.5.5 Impact evaluation

The impact evaluation for the T12 lighting replacement tracks consisted of conducting file reviews, desk audits and on-site inspections to verify key energy savings characteristics.

A. Impact sampling methodology for onsite measurement and verification

A weighted sampling methodology was applied to the savings values in each project type to develop the onsite sample. Out of a total of 95 projects completed in the two tracks, 6 of the

originally sampled projects were successfully recruited for on-sites and another 10 projects not originally in the samples were added as on-sites. The remaining projects from the initial sample received desk audits and engineering analysis.

Table 4-45. FY13 Onsite M&V Sample Summary—7510BLTZ

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Fluorescent Lighting	57	12	552,778	105.7	-356.5	16.1%	13.5%	15.9%
CFLs	18	4	6,449	1.5	-4.1	3.3%	3.7%	3.3%
LED Exit Sign	16	2	516	0.1	-0.3	2.4%	2.4%	2.4%
Total	**57**	**13**	**559,743**	**107.3**	**-360.9**	**15.4%**	**13.0%**	**15.2%**

Table 4-46. FY13 Onsite M&V Sample Summary—7510MTV

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Fluorescent Lighting	38	3	32,126	7.3	-21.4	3.3%	3.3%	3.3%
CFLs	12	0	0	0.0	0.0	-	-	-
LED Exit Signs	17	1	1,072	0.1	-0.7	2.5%	2.5%	2.5%
Total	**38**	**3**	**33,198**	**7.4**	**-22.1**	**3.1%**	**3.1%**	**3.1%**

B. Verification of impacts

The evaluation team conducted reviews of the claimed savings for reasonableness and in accordance with the DC SEU TRM. The evaluation team also reviewed the Mid-Atlantic TRM to assess potential variations in inputs and methods from those implemented in the District. For these tracks, the net-to-gross ratio is assumed to be 1.00 for FY13.

Table 4-47. FY13 Summary of Impact Evaluation Results—7510BLTZ

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Fluorescent Lighting	3,425,967	4,031,960	1.18	782.5	974.7	1.25	-2,239.6	-1,924.3	0.86
CFLs	197,789	169,247	0.86	41.8	53.9	1.29	-125.6	-107.9	0.86
LED Exit Sign	21,166	10,804	0.51	2.7	1.0	0.39	-14.2	-7.2	0.51
Track Total	**3,644,922**	**4,212,011**	**1.16**	**826.9**	**1,029.7**	**1.25**	**-2,379.4**	**-2,039.4**	**0.86**

Table 4-48. FY13 Summary of Impact Evaluation Results—7510MTV

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Fluorescent Lighting	983,003	1,379,422	1.40	219.7	334.3	1.52	-655.3	-897.3	1.37
CFLs	53,573	39,777	0.74	12.8	15.4	1.21	-34.0	-25.7	0.76
LED Exit Signs	42,709	41,303	0.97	5.4	4.0	0.74	-28.7	-26.7	0.93
Track total	**1,079,285**	**1,460,503**	**1.35**	**237.9**	**353.6**	**1.49**	**-717.9**	**-949.7**	**1.32**

C. Impact evaluation planned activities and completed activities comparison

Table 4-49. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct desk audits-7510BLTZ	30	23	Shift to additional 7510MTV project file reviews
Conduct desk audits -7510 MTV	10	16	Additional focus on 7510MTV as moving toward more market transformation projects
Conduct onsite verification-7510BLTZ	10	13	Increased for deficiency in 7610BLTZ
Conduct onsite verification-7510 MTV	5	3	Difficulty recruiting due to small participant population and evaluation timeframe
Conduct onsite metering	15	0	Metering not required for evaluation effort based on project types for FY13

D. Summary of key findings describing adjustments to ex-ante savings

- Overall, it was unclear how the claimed savings were calculated. The “as built” audit spreadsheets contained data on the existing fixture description, and some description on the proposed fixture, but not assumed fixture input power. The evaluation methodology followed the TRM along with the fixture descriptions, and in most cases the results did not match up precisely with the claimed savings.
- The claimed savings did not include delamping measures, whereas the verified savings did. For example, if a fixture had four T12 lamps and a magnetic ballast, and was retrofit with two T8 lamps and an electronic ballast, the claimed savings would consider the retrofit as a two lamp T12 fixture retrofit with two T8 lamps. The verified

savings considered the difference in energy between a four-lamp T12 fixture and a two-lamp T8 fixture.

- In many instances, the proposed fixture input power was adjusted in the verified savings calculations due to different nominal lamp wattage, ballast factor, or the number of lamps per fixture.
- In projects that replaced T12 U-shaped lamps with T8 U-shaped lamps, the claimed savings appeared to assume a 4' linear fixture in the existing and proposed fixtures. The verified savings assumed the input power for U-shaped lamps, which differs slightly from 4' linear lamps.

4.5.6 Recommendations

A. To improve program design, operations, customer experience, and recruitment

i. **Improve tracking of projects in process so contractors and customers understand what stage they are at and how and when they are likely to move through the process.** This could address some of the dissatisfaction with project delays, rebate delays, and a few of the communication issues that were raised by participants and contractors. One contractor mentioned a useful tracking tool used by Potomac Edison.

ii. **Continue to market through direct, in-person meetings by DC SEU staff and contractors.** Arrange for in-person meetings to discuss participation details, answer any questions, and provide training for the application process.

iii. **Provide more marketing materials to the market actors for distribution to their customers.** If possible, personalize the materials so the contractor is also listed. Another option is to provide a marketing budget to the contractors so they can print their own materials. Anywhere from $200 to $1,000 per year was suggested.

iv. **Make DC SEU more visible to the public either through events, advertisements, and/or sponsorships.** Visibility will increase awareness, interest, and legitimacy of the programs offered.

v. **Continue to provide ways to alleviate the upfront costs for customers that cannot cover the expense, either by reducing the cost or through financing options.**

B. To improve impact evaluation results

i. **During QA/QC, document the differences between what is found during the onsite inspection and/or other project documentation.** The "as built" audit spreadsheets and invoices were utilized for the desk reviews. In Leidos' experience, invoices do not always accurately reflect the project that was undertaken. Where discrepancies are found, such as lamp counts that do not line up with expectations based on fixture quantities in the application or ballasts on the invoice, more follow up should be conducted with the customer. For many of the projects, the lamp and

ballast model numbers shown on the audit spreadsheet, invoice, and post-installation inspection form did not match up.

ii. **For large projects, conduct onsite pre-inspections to more accurately determine installed fixture quantities and baseline conditions for rebate.** In the sample, the four largest projects represented nearly 70 percent of the claimed energy savings and discrepancies in these projects accounted for the majority of the 1.17 overall program realization rate for kWh.

iii. **To facilitate evaluation efforts, the proposed fixture description of the nominal lamp wattage should be more descriptive so that the fixture can be matched to an input power in the TRM.** Also, the fixture description should match up with the lamp and ballast model numbers listed in the audit spreadsheet. The existing fixture descriptions in the "as built" audit spreadsheets are descriptive and the input power could be found easily in the TRM. However, the proposed fixture description is lacking and confusing. For example, a proposed fixture could be described as "2L HPT8 w/ Low Ballast Factor." It is unclear if the intended lamp is a reduced wattage 28W T8 lamp, or a 32W T8 lamp. Furthermore, the proposed fixture description seldom matched the listed lamp and ballast model numbers. In many instances, a normal or high output ballast model number would be listed, but the fixture description would state a low ballast factor.

C. To manage free-ridership results

Given the small sample sizes for these tracks, the evaluation team does not have any recommendations specific to program design. However, continued research is recommended to keep a pulse on the 7510MTV track given its importance to the DC SEU portfolio both in contribution to savings and in the effort to move to market-based programming.

4.6 7510CIRX BUSINESS ENERGY REBATES

4.6.1 Track description

The Business Energy Rebates (BER) track provides a comprehensive set of services and financial incentives to serve the varied needs of small- to medium-sized business and institutions located within the district. The program covers prescriptive rebates for lighting, HVAC, compressed air, refrigeration, VFD motors, food service equipment, and vending machines. The program, which was based on other implemented VEIC tracks, was launched in the second quarter of FY12. In order to manage subscription rates in 2013, the application form states that the project funding is available from October to March with an intended "re-launch" for the second half of the year.

The BER track targets small- to medium-sized business (less than 10,000 square feet or less than 5,000 kWh per month). While larger customers can participate, they are encouraged to participate in an appropriate Custom program. The program is implemented through individual contractors with oversight by DC SEU staff.

To participate in the program, customers download application forms from the DC SEU website. All downloaded forms are tracked in KITT, along with the contact information of the person downloading the form. After the application is submitted, the preapproval process consists of screening projects that contain over 100 measures, or 65,000 kWh per year annual energy use[20] for inclusion in the Custom program. As part of the preapproval process, the customer submits spec sheets. After being preapproved, the customer then installs the products and provides a proof of purchase. A submittal checklist is filled out by the customer and verified by DC SEU Staff (the submittal checklist interactively calculates rebates). DC SEU Staff conduct follow-up quality assurance and quality control inspections on 100 percent of the BER projects.

The list of measures includes:

- Lighting (e.g., LED, occupancy sensors, day-lighting and high efficiency T5/T8)
- HVAC
- Compressed air
- Refrigeration
- Food service and vending
- Spray rinse valves
- Chiller performance
- Demand-controlled ventilation/economizer and energy recovery ventilation

[20] The 65,000 kWh per year is very difficult to adhere to as usage data is not available unless a specific request and approval from the customer is obtained.

- Variable frequency drive.

Table 4-50 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-50. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	2,194,303	2,119,264	0.97
kW	372.9	397.3	1.07
MMBtu	-435.9	-433.7	0.99

4.6.2 Overall sampling methodology

The BER track includes a wider variety of equipment types than most other C&I programs. There is also wide variety in the savings of prescriptive projects. The priority for this initiative is to account for larger projects first, and then to randomly select additional projects. Selecting the top 10 percent of electric and gas projects results in seven projects sampled with certainty, and covers all but one measure type. This last measure was only installed at one project. If this project is not included in the eight projects sampled randomly, the evaluation team will substitute this project for the lowest-priority randomly sampled case.

Table 4-51. FY13 Population and Sample Summary

	Project File Evaluation Sample							
Measure	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Lighting	42	11	431,025	90.5	-237.5	34.4%	36.9%	37.9%
Motors & Drives	2	2	672,737	115.2	0.0	100.0%	100.0%	-
Cooling	7	1	131,508	2.6	0.0	57.6%	29.2%	-
Refrigeration	7	2	10,892	0.8	0.0	40.5%	41.5%	-
Other	1	0	0	0.0	0.0	-	-	-
Water Heating and Saving	1	1	0	0.0	190.9	-	-	100.0%
Total	**54**	**14**	**1,246,163**	**209.2**	**-46.6**	**56.8%**	**56.1%**	**10.7%**

4.6.3 Process evaluation

A process evaluation was not done for this track in this evaluation cycle. A staff interview was conducted November 25, 2013, to gain a better understanding of the initiative similarities and differences, as well as any opportunities or challenges faced by the initiative and what information from the evaluation would be useful.

Table 4-52. FY13 Process Evaluation Plan vs. Actual Sample

Activity	Plan	Actual	Explanation for Variance
Conduct DC SEU staff in-depth Interview	1	1	

A. Summary of key findings

Not applicable.

4.6.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and full spillover battery was used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-53. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant surveys	35	19	Difficulty in recruitment due to small population

One respondent claimed that the equipment was no longer installed and was removed from the net-to-gross analysis. Four other respondents were not able to answer the free-ridership and spillover questions.

B. Summary of results

This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.

Table 4-54. FY13 Net-to-gross Results Summary-Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Cooling	7	2	228,150	71.2%	44.5%	0.0%	0.0%	28.8%
Lighting	42	11	1,252,139	12.7%	14.2%	7.0%	10.9%	94.3%
Motors and Drives	2	0	672,737	n/a	n/a	n/a	n/a	n/a
Other	1	1	14,392	25.0%	0.0%	0.0%	0.0%	75.0%
Refrigeration	7	0	26,885	n/a	n/a	n/a	n/a	n/a
Total	**59**	**14**	**2,194,303**	**21.8%**	**15.8%**	**5.9%**	**9.0%**	**84.1%**

C. Drivers net-to-gross results

- The overall kWh free-ridership rate is 21.8 percent with 5.9 percent like spillover, resulting in a kWh net-to-gross rate of 84.1 percent.

- The lighting end use had the lowest kWh free-ridership rate and the highest like spillover rate.
- One customer who installed cooling equipment indicated unlike spillover of one 20-ton chiller.
- Two customers who installed lighting equipment through the program indicated having unlike spillover. One customer mentioned installing at least 100 9-watt LED light bulbs while the other said they installed two motional detectors for their offices.
- The evaluation team was not able to complete the one water heating end use record who received natural gas savings to be able to calculate rates for natural gas.

4.6.5 Impact evaluation

The impact evaluation for Business Energy Rebates consisted of conducting file reviews, desk audits, and on-site inspections to verify key energy savings characteristics.

A. Impact sampling methodology for onsite measurement and verification

Due to the limited timeframe for evaluation, efforts were initially made to schedule projects within the desk review sample. Once willing participants were exhausted within the desk review sample, scheduling was attempted for the remaining population with the intention of achieving the number of on-sites specified in the EM&V plan.

Table 4-55. FY13 Onsite M&V Sample Summary

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Lighting	42	5	193,811	62.3	-114.8	15.5%	25.4%	18.3%
Motors & Drives	2	1	236,788	90.0	0.0	35.2%	78.1%	-
Cooling	7	1	131,508	2.6	0.0	57.6%	29.2%	-
Refrigeration	7	2	11,525	0.8	0.0	42.9%	38.6%	-
Other	1	0	0	0.0	0.0	-	-	-
Water Heating and Saving	1	0	0	0.0	0.0	-	-	-
Total	**54**	**10**	**573,633**	**155.7**	**-114.8**	**26.1%**	**41.8%**	**26.3%**

B. Verification of impacts

The evaluation team conducted reviews of the engineering algorithms documented by DC SEU for reasonableness and in accordance with the DC SEU TRM. The evaluation team also reviewed the Mid-Atlantic TRM to assess potential variations in inputs and methods from those implemented in the District. For this track, the net-to-gross ratio is assumed to be 1.00 for FY13.

Table 4-56. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Lighting	1,252,139	1,242,553	0.99	245.3	257.0	1.05	-626.8	-627.8	1.00
Motors & Drives	672,737	672,737	1.00	115.2	127.0	1.10	0.0	0.0	0.00
Cooling	228,150	162,697	0.71	9.0	9.0	0.99	0.0	0.0	0.00
Refrigeration	26,885	26,884	1.00	2.0	3.0	1.51	0.0	0.0	0.00
Other	14,392	14,392	1.00	1.3	1.3	1.00	0.0	0.0	1.00
Water Heating and Saving	0	0	1.00	0.0	0.0	1.00	190.9	194.1	1.02
Track total	**2,194,303**	**2,119,264**	**0.97**	**372.9**	**397.3**	**1.07**	**-435.9**	**-433.7**	**0.99**

C. Impact evaluation planned activities and completed activities comparison

Table 4-57. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct desk audits	15	14	
Conduct onsite verification	15	10	Difficulty in recruitment due to small population and

D. Summary of key findings describing adjustments to ex-ante savings

During the desk audits and on-site inspections, several factors were found that led to adjustments in the ex-ante savings as well as a few calculation outliers:

- There appeared to be inconsistent use of the TRM calculation procedures in some projects. For instance, a fast food restaurant with exterior lighting had a claimed savings consistent with 2,000 EFLH instead of 4,380 for exterior fixtures. In another project, it appeared the connected load per occupancy sensor did not follow the TRM stipulations based on the sensor type.
- During the on-site inspections, fixture quantities were found to differ from the claimed savings, application, and invoices. Overall, quantity adjustments were minor.
- Variable frequency drive projects are using a custom calculation procedure for kWh savings based on a bin analysis, while the summer demand reduction is using the connected load adjusted by a coincident factor. In the adjustments, a bin analysis is also used to calculate the summer demand reduction for these projects.
- For the refrigeration projects, the savings calculations assume 8,760 EFLH for freezer/refrigerator runtime, but used a coincident factor that was less than 1.0. For measures with a flat load profile, the coincident factor should be 1.0.
- There are concerns with the use of "Commercial Indoor Lighting - Blended" loadshape for all interior lighting. Site-specific hours of use and coincident factors that were determined from the on-site verifications and project documentation were compared to the use of the blended factor and resulted in much lower realization rates. The largest

variance in this approach was on a hotel lighting project with the replaced lighting found in the hotel guest rooms; using the "Lodging - Guest Room Lighting" loadshape resulted in RRs for this project from 0.13 on kW to 0.43 for fossil fuel. Overall, the RRs were 0.66 for kWh, 0.55 for kW, and 0.62 for fossil fuel through this approach.

4.6.6 Recommendations

A. To improve program design, operations, customer experience, and recruitment

Not applicable.

B. To improve impact evaluation results

i. **For large projects, conduct onsite inspections to more accurately determine installed fixture quantities, baseline conditions for rebate, connected load per occupancy sensor, lamp wattages, and ballast factors for savings calculations.** In the sample, two projects represented more than 50 percent of the claimed energy savings, and one had fixture quantities that differed as a result of the on-site inspection. Another had differences in the connected load per occupancy sensor.

ii. **Provide references to the source of all key values for projects that are using documents outside of CAT for saving calculations.** We recommend using “Comments” listing the source of those values in the final Excel savings calculation file so they can be succinctly tracked.

iii. **Revise the TRM and tracking system to accommodate additional loadshapes more reflective of the projects completed.** Alternatively, collect needed data each year for all projects completed to conduct analysis to update the "Commercial Indoor Lighting - Blended" loadshape annually. The results of comparing the "Commercial Indoor Lighting - Blended" to site-specific loadshapes based on the evaluation effort indicated the population for the initiative is not representative of the Blended loadshape.

C. To manage free-ridership results

Given the small sample sizes for these tracks, the evaluation team does not have any recommendations specific to program design.

4.7 7520CUST, 7520MARO, AND 7520NEWC CUSTOM SERVICES FOR C&I CUSTOMERS

4.7.1 Track description

The Large Commercial and Institutional (C&I) Customers Custom initiative was launched in Q2 of FY12. The initiative provides a comprehensive set of energy services to owners of large buildings who are replacing old equipment, renovating an existing building, or beginning a new construction project. The initiative targets the largest energy consumers within the district (those with over 600 GWh of electricity consumption and 150 kW in energy demand). The DC SEU staff are targeting 20 entities (primarily institutional entities) on the “largest users” list that represent about 90 percent of the total target market.

The initiative targets building envelope, lighting, and HVAC system selection and sizing. The key features of the incentive structure are to offset the incremental costs of adding energy efficiency (offset up to 75 percent of incremental project costs), provide comprehensive services (equipment, design, modeling, and commissioning), and share the economic effects with the customer.

Energy consultants work with large targeted accounts, and a project intake coordinator supports the smaller customers by helping them navigate offerings and answering questions. Projects may also come in from sources such as business and trade associations, the General Services Administration, city government, and through trade allies. Energy consultants provide technical assistance to customers, determine energy savings, and provide incentive calculations for measures.

The energy consultants conduct a technical assistance study to determine energy savings metrics (kWh, kW and therms) and calculate incentives based on the savings. There are no incentive caps and contractors are not required to be CBE certified. Contractors and site personnel are responsible for the installation of measures. A follow-up QA/QC inspection is conducted by the DC SEU energy consultants on 100 percent of the projects. Based on the results of the follow-up inspection, the final incentive is calculated and paid to the customer.

Description and list of measures included:

- Lighting
- HVAC
- Compressed Air
- Chiller Performance
- Demand-Controlled Ventilation/Economizer
- Energy Recovery Ventilation
- VFD
- Refrigeration Analysis

- New construction
- Other.

The following tables provide a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-58. FY13 Reported and Verified Results—7520CUST

Metric	Reported	Verified	Realization Rate
kWh	19,751,948	20,793,168	1.05
kW	2,858.8	3,031.2	1.06
MMBtu	63,209.1	62,149.4	0.98

Table 4-59. FY13 Reported and Verified Results—7520MARO

Metric	Reported	Verified	Realization Rate
kWh	636,671	566,420	0.89
kW	55.1	56.7	1.03
MMBtu	-	-	-

Table 4-60. FY13 Reported and Verified Results—7520NEWC

Metric	Reported	Verified	Realization Rate
kWh	88,749	88,749	1.00
kW	8.8	8.8	1.00
MMBtu	-	-	-

4.7.2 Overall sampling methodology

The 7520CUST and 7520MARO tracks are similar in the methodology for estimating energy savings, so they will be sampled together. The Market Opportunity track only contributes four projects, so much of the evaluation will rely on C&I Custom projects. There is very wide variability in the energy savings resulting from these programs' projects, so the highest-saving projects stratum will again be sampled with certainty (18 projects). The remainder of projects—the second stratum—will be randomly sampled. The high-savings projects cover all types of measures that were installed through this program, and the evaluation team will review the randomly sampled projects to ensure that they represent all measure types, as appropriate.

For 7520NEWC, only one project was completed, so that project will be evaluated.

Table 4-61. FY13 Population and Sample Summary—7520CUST

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Lighting	59	23	6,794,504	1,154.9	-1,404.9	59.5%	63.7%	53.4%
Motors & Drives	22	12	3,896,424	311.8	0.0	74.6%	53.7%	-
Cooling	12	3	609,777	149.3	6,968.5	26.2%	55.8%	100.0%
Whole-building Improvements	1	1	666,307	184.0	19,601.3	100.0%	100.0%	100.0%
Process	1	0	0	0.0	0.0	-	-	-
Other	2	2	40,349	11.9	1,737.2	100.0%	100.0%	100.0%
Heating	8	8	14,639	0.0	34,421.4	100.0%	-	100.0%
Water Heating and Saving	3	3	4,762	0.0	3,049.3	100.0%	-	100.0%
Refrigeration	1	0	0	0.0	0.0	-	-	-
Food Service	1	0	0	0.0	0.0	-	-	-
Total	**103**	**46**	**12,393,058**	**1,848.7**	**64,372.8**	**62.7%**	**64.7%**	**~100.0%**

Table 4-62. FY13 Population and Sample Summary—7520MARO

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Cooling	2	1	491,484	26.7	0.0	84.0%	100.0%	-
Motors & Drives	2	0	0	0.0	0.0	-	-	-
Total	**4**	**1**	**491,484**	**26.7**	**0.0**	**77.2%**	**48.5%**	**-**

Table 4-63. FY13 Population and Sample Summary—7520NEWC

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Whole-building Savings	1	1	88,749	8.8	0.0	100.0%	100.0%	-
Total	**1**	**1**	**88,749**	**8.8**	**0.0**	**100.0%**	**100.0%**	**-**

4.7.3 Process evaluation

Tetra Tech staff conducted an in-depth interview with the DC SEU program leads in late November 25, 2013, to gain a better understanding of the initiative similarities and differences, as well as any opportunities or challenges faced by the initiative and what information from the evaluation would be useful.

In January 2014, in-depth interviews were conducted with six market actors and 42 participating customers to elicit feedback on their experiences with the programs, including program satisfaction, how they learned of the program, how the decision was made to install program-qualifying equipment, installation verification, and company characteristics.

Table 4-64. FY13 Process Evaluation Plan versus Actual

Activity	Plan	Actual	Explanation for Variance
Conduct DC SEU staff in-depth Interview	3	2	Two staff interviewed on one call and energy consultant interview deferred
Conduct contractor interviews	8	6	Unable to reach another contractor working with MARO and unable to reach either NEWC trade ally.
Conduct participant surveys: 7520CUST	40	41	
Conduct participant surveys: 7520MARO	5	2	Difficulty in recruitment due to small population
Conduct participant surveys: 7520NEWC	1	0	Difficulty in recruitment due to small population

A. Summary of key findings

i. Satisfaction

- Both contractors and customers were highly satisfied with the 7520CUST and 7520MARO tracks. The table below shows the number of "Very Satisfied" ratings with each aspect (rating of 8–10) on a 0 to 10 scale where 0 is very dissatisfied and 10 is very satisfied.

Table 4-65. Number of "Very Satisfied" Ratings (8, 9, or 10) by Program Aspect

Program Aspect	7520CUST		7520MARO	
	N	n	N	n
Experience overall	29	24	2	2
Performance of new equipment	30	26	2	2
Type of eligible equipment	30	26	2	1
Interactions with DC SEU staff	28	25	2	2
Technical assistance received from DC SEU	29	25	2	2
Assistance from contractor who installed equipment	24	18	1	1
Application process	28	20	2	2
Preapproval process	27	19	1	1
Amount of time to receive rebate or financial incentive	29	20	2	2
Information about DC SEU energy efficiency offerings	28	18	2	2
Rebate amount or financial incentive	30	20	2	1

- Twenty-six of 32 participants have recommended the DC SEU initiative to others and feel they have realized energy savings as a result of participating in the initiatives.

- Participants in the 7520CUST and 7520MARO tracks are very satisfied with the performance of new equipment that has been installed through the initiatives. In two cases, dissatisfaction stems from issues with bulb quality. When questioned on what other types of equipment they would like to see eligible for the program, two participants would like broader eligibility on lighting. One participant thinks "there are many more legitimate energy conserving pieces out there that do not qualify. They should expand that list of eligible equipment." Contractors have also heard from customers that they wonder why the financial incentives stop with T8's and do not extend to T5's. In addition, contractors feel that even the large customers would benefit from prescriptive incentives for lighting, lighting controls, VFDs, and transformers.

- Overall, the program communications were highly rated by both contractors and customers. Most participants were very satisfied with their interaction with DC SEU staff and contractors found them to be very responsive. One contractor said "*[Program Manager] is a really nice person and has kept us up to speed on program changes.*"

- The preapproval and application processes work well. Three participants had issues with the amount of time it took to get the funding through the preapproval process, leading to dissatisfied ratings. Two participants who were dissatisfied with the application process felt the application could better outline the equipment eligible for the program.

- Two aspects receiving the most dissatisfied ratings included the amount of time it took to receive the rebate or financial assistance and the actual rebate amount. Four of the dissatisfied participants thought they were going to receive more financial assistance than they did. For one of them, the misunderstanding about the amount they would receive changed their payback timeline. Another participant feels there should be more clarity in how the incentives were calculated so they would better understand what they could receive. In one case the proportion of the cost the incentive covered "*wasn't even enough to cover the administrative fees.*" Contractors also had concerns regarding the calculations of incentive payments. A couple felt it was not clear how they were determined. One said, "*In Maryland they show the exact calculation on their website. It would be good to know what we're going to get ahead of time because it would impact what we would prioritize.*" Another said, "*Submitting project through the custom program seems like a black hole.*"

- Four participants dissatisfied with the amount of time it took to receive their rebates mentioned that it took months longer than they expected, up to six months for two participants, even after multiple inquiries by one of them and another required a second set of paperwork.

ii. Awareness

- In contrast to other tracks, where awareness of the track came from just a few sources, participants in 7520CUST heard about the DC SEU funding from a wide variety of sources. While the most common sources of information about the 7520CUST and 7520MARO tracks were from contractors (18 of 42) and DC SEU staff (8 of 42), participants also used the DC SEU website (5), found out at conferences or trade shows (5), were told by colleagues (3), or received a DC SEU email (2).

- Half (9 of 18) of the customers who heard about the program from a contractor were aware of it prior to the contact with the contractor.
- Twenty-seven would like to receive emails regarding DC SEU initiatives, while 5 were interested in DC SEU mailings and another 5 would like to hear about initiatives from DC SEU staff. While contractors are happy with the program, a few mentioned additional support opportunities from DC SEU, such as more leads, provision for marketing budgets, and more assistance understanding the initiatives.
- Contractors felt there could be more marketing and outreach to customers for the custom tracks. This feeling is supported by some of the comments from participants who were dissatisfied with the information about DC SEU energy efficiency offerings, "*If a third party hadn't told me about it I would not have known about. Certainly DC SEU didn't reach me.*" Participants also felt they did not fully understand what was available through the custom tracks, three noting they did not really understand what equipment was eligible, two were unclear on the amount of financial incentive available, and one was confused about whether or not an energy analysis visit was included.

iii. DC SEU staff interaction and participation

- Almost all (39 of 42) participants had some interaction with DC SEU regarding their project. A large portion (18 of 40) received assistance from DC SEU with their applications. About one-quarter (12 of 40) of the companies were able to complete the necessary paperwork internally. Only six participants reported assistance from a contractor to complete the paperwork, which corresponds with the level of assistance contractors reported providing.
- Unlike direct install programs, where the project is full-service and customers may not realize they are receiving what the initiative deems "technical assistance", the technical assistance on custom projects is often more visible. Participants were very satisfied with the level of technical assistance they received through the custom tracks, although a few participants admitted that they already knew what they were looking for or had another source for that type of advice. When asked specifically about the value of the technical assistance provided through the program, participants provided comments such as
  - "They're experts at what they do and they do all of the researching for you and what I liked about it is they're not biased to one product or another. They bring you a wealth of knowledge and through working with them you determine what product is best for the environment you work in. They're just great to work with."
  - "They had some good materials that walked us through things to start looking at. They were very helpful in determining the quality and level of the equipment because there is a lot of things out there."
  - "They did a nice job telling me what bulbs would be accepted and how much money they had and why to do it now."
  - "For example, some technical assistance made clear how much energy we would save so it made it more of a priority. Without their tech assistance we wouldn't have known how much that was." (7520MARO)

  - "They were great they did almost the entire calculation for use so it was easy to show savings. They were very efficient and helpful. There was equipment down and they were very helpful with that." (7520MARO)

- Regarding estimated 2014 participation, all contractors indicated they expect their participation levels to either stay the same or increase. One said the anticipated increase is a reflection of increased comfort with the program.
- Nine of 38 participants said they face no barriers when deciding whether or not to purchase energy efficient equipment. The primary barriers companies do face are the lack of funds available for investment (8 of 38) and the need to show a short return on investment (7 of 38). Three of the companies also mentioned upper management resistance to energy efficiency. Other barriers mentioned by individual respondents included other spending priorities, lack of financing, management time to oversee projects, incremental cost for higher efficiency, aesthetics, and maintaining historic value of a building.
- The reasons why customers choose whether or not to participate in the program varied according to contractors. One feels that customers participate because they are concerned with ENERGY STAR rankings so they look at this as an opportunity to improve their score. One thinks the incremental costs are too high for smaller users that are looking for a shorter return on investment, whereas the larger businesses are more comfortable with a two to three year payback.

4.7.4 Net-to-gross methodology and results

A. Methodology

The full free-ridership and spillover batteries were used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-66. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant surveys: 7520CUST	40	41	
Participant surveys: 7520MARO	5	2	Difficulty in recruitment due to small population
Participant surveys: 7520NEWC	1	0	Difficulty in recruitment due to small population

We dropped two records from the free-ridership analysis for 7520CUST because the free-ridership questions skipped.

B. Summary of results

These end-use measures had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.

Table 4-67. FY13 Net-to-gross Results Summary—7520CUST Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Cooling	13	3	2,333,571	35.2%	39.8%	0.0%	0.0%	64.8%
Heating	1	0	14,639	n/a	n/a	n/a	n/a	n/a
Lighting	59	25	11,415,740	48.3%	12.5%	7.3%	6.5%	59.0%
Motors and Drives	21	3	4,996,634	35.5%	42.1%	0.0%	0.0%	64.5%
Other*	3	2	714,244	28.0%	30.1%	46.6%	33.5%	118.7%
Other HVAC**	2	1	275,275	100.0%	0.0%	175.0%	n/a	175.0%
Refrigeration	1	0	2,437	n/a	n/a	n/a	n/a	n/a
Water Heating	1	0	4,762	n/a	n/a	n/a	n/a	n/a
Total	**101**	**34**	**19,757,302**	**44.2%**	**11.4%**	**7.6%**	**6.1%**	**63.4%**

* ENERGY STAR steam cookers and food holding cabinets, building-wide HVAC project

** Demand controlled ventilation

Table 4-68. FY13 Net-to-gross Results Summary—7520CUST Gas

End Use	N	n	Population MMBtu	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Cooling	2	0	6,969.0	n/a	n/a	n/a	n/a	n/a
Heating	7	3	34,421.0	42.0%	35.4%	0.0%	0.0%	58.0%
Other	3	2	19,897.0	29.6%	30.6%	49.3%	33.6%	119.7%
Other HVAC	1	0	1,502.0	n/a	n/a	n/a	n/a	n/a
Water Heating	2	2	3,049.0	13.5%	0.0%	0.0%	0.0%	86.5%
Total	**15**	**7**	**65,839.0**	**36.3%**	**21.8%**	**17.2%**	**17.1%**	**80.9%**

Table 4-69. FY13 Net-to-gross Results Summary—7520MARO Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Cooling	2	2	585,423	16.7%	0.0%	0.0%	0.0%	83.3%
Motors and Drives	2	0	51,248	n/a	n/a	n/a	n/a	n/a
Total	**4**	**2**	**636,671**	**16.7%**	**30.7%**	**0.0%**	**0.0%**	**83.3%**

C. Drivers net-to-gross results

- The 7520CUST track has an overall kWh net-to-gross rate of 63.4 percent. This is driven by the 44.2 percent free-ridership rate and the 7.6 percent like spillover rate. The natural gas net-to-gross rate for the 7520CUST track is higher, at 80.9 percent.

- The overall kWh net-to-gross rate for the 7520MARO track is 83.3 percent, although results are based on only two customers being surveyed.
- One 7520CUST customer categorized as installing “Other” end use equipment (building-wide HVAC project) indicated unlike spillover of 20 control panels, part of an energy management system.
- Another 7520CUST customer indicated making several unlike spillover upgrades but was unable to provide detailed information about them.

4.7.5 Impact evaluation

The impact evaluation consisted of a combination of desk audits and onsite verification results in order to cover all of the projects in the sample given the short time frame. Nineteen sites received onsite verifications and an additional 27 projects received desk audits for calculation of the realization rates. Engineering analysis was conducted from the onsite inspection and project file review findings based on the project complexity.

A. Impact sampling methodology for onsite measurement and verification

A weight sampling methodology was applied to the savings values in each project type to develop the onsite sample. Out of a total of 103 projects in the program, 17 were selected for onsite verifications, and they were evenly split across the measure types. Nine projects were successfully recruited and received onsite inspections from the original sample, and an additional ten projects were recruited from the remaining population. The additional 27 projects without onsite inspections received desk audits and engineering analysis.

Table 4-70. FY13 Onsite M&V Sample Summary—7520CUST

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Lighting	59	8	4,197,927	862.1	-1266.4	36.8%	47.6%	48.2%
Motors & Drives	22	3	152,789	3.5	0.0	2.9%	0.6%	-
Cooling	12	5	492,109	36.8	0.0	21.1%	13.7%	-
Whole-building Improvements	1	0	0	0.0	0.0	-	-	-
Process	1	0	0	0.0	0.0	-	-	-
Other	2	0	0	0.0	0.0	-	-	-
Heating	8	3	14,639	0.0	1644.2	100.0%	-	4.8%
Water Heating	3	0	0	0.0	0.0	-	-	-
Refrigeration	1	0	0	0.0	0.0	-	-	-
Food Service	1	0	0	0.0	0.0	-	-	-
Total	**103**	**19**	**4,857,463**	**902.3**	**377.8**	**24.6%**	**31.6%**	**0.6%**

Table 4-71. FY13 Onsite M&V Sample Summary—7520MARO

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Cooling	2	0	0	0.0	0.0	-	-	-
Motors & Drives	2	0	0	0.0	0.0	-	-	-
Total	**4**	**0**	**0**	**0.0**	**0.0**	**-**	**-**	**-**

Table 4-72. FY13 Onsite M&V Sample Summary—7520NEWC

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Whole-building Savings	1	0	0	0.0	0.0	-	-	-
Total	**1**	**0**	**0**	**0.0**	**0.0**	-	-	-

B. Verification of impacts

The evaluation team conducted reviews of the engineering algorithms documented by DC SEU for reasonableness and in accordance with the DC SEU TRM for those measures with valid TRM calculation protocols or assumptions. For measures without valid TRM protocols, a review of the custom calculations was conducted. For this program, the net-to-gross ratio is assumed to be 1.00 for FY13.

Table 4-73. FY13 Summary of Impact Evaluation Results—7520CUST

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Lighting	11,415,740	11,324,904	0.99	1,812.6	1,764.3	0.97	-2,629.7	-3,077.8	1.17
Motors & Drives	5,226,206	5,732,567	1.10	580.1	985.2	1.70	0.0	0.0	1.00
Cooling	2,331,768	2,104,159	0.90	267.8	175.4	0.66	6,968.5	6,968.5	1.00
Whole-building Improvements	666,307	666,307	1.00	184.0	92.0	0.50	19,601.3	19,601.3	1.00
Process	44,179	44,179	1.00	1.9	1.9	1.00	0.0	0.0	1.00
Other	40,349	40,349	1.00	11.9	11.9	1.00	1,737.2	1,737.2	1.00
Heating	14,639	867,942	59.29	0.0	0.0	1.00	34,421.4	33,785.0	0.98
Water Heating and Saving	4,762	4,762	1.00	0.0	0.0	1.00	3,049.3	3,074.0	1.01
Refrigeration	4,240	4,240	1.00	0.5	0.5	1.00	0.0	0.0	1.00
Food Service	3,758	3,758	1.00	0.0	0.0	1.00	61.2	61.2	1.00
Track total	**19,751,948**	**20,793,168**	**1.05**	**2,858.8**	**3,031.2**	**1.06**	**63,209.1**	**62,149.4**	**0.98**

Table 4-74. FY13 Summary of Impact Evaluation Results—7520MARO

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Cooling	585,423	515,172	0.88	26.7	28.4	1.06	0.0	0.0	n/a
Motors & Drives	51,248	51,248	1.00	28.4	28.4	1.00	0.0	0.0	n/a
Track Total	**636,671**	**566,420**	**0.89**	**55.1**	**56.7**	**1.03**	**0.0**	**0.0**	**n/a**

Table 4-75. FY13 Summary of Impact Evaluation Results—7520MARO

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Whole-building Savings	88,749	88,749	1.00	8.8	8.8	1.00	0.0	0.0	n/a
Track Total	**88,749**	**88,749**	**1.00**	**8.8**	**8.8**	**1.00**	**0.0**	**0.0**	**n/a**

C. Impact evaluation planned activities and completed activities comparison

Table 4-76. Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct project file reviews—7520CUST	42	46	Adjusted for additional on-sites.
Conduct project file reviews—7520MARO	1	1	
Conduct project file reviews—7520NEWC	1	1	
Conduct engineering analysis—7520CUST	15	18	Increased based on project complexities
Conduct onsite verification—7520CUST	17	19	Increased based on customer participation
Conduct phone verification—7520CUST	45	41	Difficulty recruiting due to small population
Conduct participant surveys: 7520MARO	5	2	Difficulty recruiting due to small population
Conduct participant surveys: 7520NEWC	1	0	Difficulty recruiting due to small population

D. Summary of key findings describing adjustments to ex-ante savings

- Two projects were found to have calculation errors that lead to very large realization rates. For one project, the spreadsheet calculator was incorrectly linking to the number of motors from a different table. For another project, the number of hours was not being used in the bin analysis calculation.
- For projects with bin analysis, a summer demand period bin analysis was conducted for the ex-post savings, which increased savings in most cases.
- For a few projects, a bin analysis was used for the ex-ante savings based on the Sterling, VA weather station instead of Washington, DC; Washington, DC has a much higher number of hours over 90 degrees, so using Sterling was understating the energy use in the summer peak period.
- In many instances, the proposed fixture input power was adjusted in the verified savings calculations due to different nominal lamp wattage, ballast factor, or the number of lamps per fixture.
- For one project, the savings determined by the energy model was split into two claims; however, the summer demand reduction was repeated across both claims, which effectively doubled the claimed from what it should have been.
- For one project, data was retrieved from the customer's building management system during a peak temperature week in the summer. This data was used to adjust the savings analysis for the project, leading to reduced unoccupied period cooling and heating savings but increased fan savings.

4.7.6 Recommendations

A. To improve program design, operations, customer experience, and recruitment

i. **Improve communication and tracking of projects in process so contractors and customers understand what the project stage is and when they are likely to**

move through the process. This could address some of the dissatisfaction with project delays, rebate delays, and a few of the communication issues that were raised by participants and contractors.

ii. **Increase outreach efforts to customers and contractors in order to increase awareness and understanding of DC SEU offerings.** There are multiple parties involved with the custom tracks, and some participants and contractors feel that they do not fully understand what the custom tracks offer. Therefore, more outreach and communication is necessary for these particular tracks. That may include further education of key contractors and eliciting their assistance to provide outreach, providing additional information on the DC SEU website that more clearly describes the initiatives, or clarifying the eligible project types and financial assistance levels available. Also, with customers learning about the initiatives from so many different sources, it is important to provide clear and detailed information for all of the venues used as outreach channels.

iii. **Consider options for addressing customer and contractor suggestions for large commercial prescriptive rebates.** With the 7510BLTZ and 7510MTV tracks recommending larger commercial customers to the custom tracks, some contractors and participants feel that there is a missed opportunity for larger customers that are only interested in an expedited lighting upgrade.

iv. **Continue to utilize the customer satisfaction surveys following installation as a way to identify and remedy unsatisfied participants.** The DC SEU staff conduct a customer satisfaction survey to identify and address issues early on and the evaluation team recommends this continue as a more timely tool for issue identification and resolution for participating business.

B. To improve impact evaluation results

i. **During QA/QC, document the differences between what is found during the onsite inspection and/or other project documentation.** The “as built” audit spreadsheets and invoices were utilized for the desk reviews. In Leidos’ experience, invoices do not always accurately reflect the project that was undertaken. Where discrepancies are found, such as lamp counts that do not line up with expectations based on fixture quantities in the application or ballasts on the invoice, more follow up should be conducted with the customer. For many of the projects, the lamp and ballast model numbers shown on the audit spreadsheet, invoice, and post-installation inspection form did not match up.

ii. **During the on-site inspections, attempt to verify more of the criteria for lighting.** Oftentimes, the lamp and ballast model numbers shown on the audit spreadsheet, invoice, and post-installation inspection documents did not match up. The best chance at obtaining the actual lamp and ballasts installed is to inspect during the post-installation inspection. Most of the time, the lamp model numbers can be read directly from the installed lamps. Ballast model numbers can be found in extra stock, if available. In some instances, the ballast model number can be easily found by removing the ballast cover if it is in an easily accessible location and safe to do so.

iii. **For non-lighting projects, attempt to collect data on site from customer building-management systems to verify key criteria for energy savings.** For the one project where onsite data was utilized in the ex-post savings, we found a reduced unoccupied period and reduced load factors from the ex-ante analysis. This data can be used from the pre-inspection to refine the savings analysis for the incentive offer and verify the savings being realized in the post-inspection.

iv. **Provide references to the source of all key values for projects that are using documents outside of CAT for saving calculations.** We recommend using "Comments" listing the source of those values in the final Excel savings calculation file so they can be succinctly tracked.

v. **Conduct more rigorous QA/QC of custom energy savings calculations.** Two projects were found to have large errors in their savings analysis in supplemental Excel files. In both cases, these happen to understate savings, but they could have just as easily overstated savings and led to very large incentive offers.

vi. **Use a consistent approach for demand and energy savings.** For projects using a bin analysis approach for energy savings, conducting a summer demand period bin analysis for the demand reduction would be more accurate than using loadshape factors based on connected load reduction.

C. To manage free-ridership results

i. **Continue to work closely with prospective customers to identify DC SEU opportunities to influence project scope for greater energy savings beyond what customers are already planning.** Ensure that project incentives align with the DC SEU-influenced project scope. And, ensure documentation and tracking identifies the components of the project attributable to the DC SEU, along with the scope of work not attributable.

ii. **Investigate the cost effectiveness of providing rebates for T5 fixtures, which may help reduce free ridership in this custom group.** Both contractors and customers expressed interest in T5 rebates; however, caution is warranted as the evaluation team also identified issues with customer and contractor understanding of product eligibility and available rebate amounts for the 7520CUST, which may have affected the number of participants who said they would have installed anyway and thus increased the free-ridership rate inappropriately.

4.8 7610BLTZ LI MF T12 FOR LOW-INCOME MULTIFAMILY

4.8.1 Track description

The low-income multifamily T12 lighting replacement track allows for the replacement of fixtures inside rental units of qualifying low-income multifamily residential buildings. Multifamily residential buildings that do not qualify as low-income can still have their common space fixtures incented or installed under the 7510BTZ or 7510MTV tracks if projects meet requirements. This initiative was phased out in FY13 and absorbed into the 7620LICP track.

Description and list of measures included:

- T8 lighting upgrades
- LED exit signs
- CFLs.

DC SEU staff and Certified Business Enterprise (CBE) contractors are responsible for outreach to potential participants. The CBE contractors install eligible equipment and DC SEU staff inspect 100 percent of the projects prior to release of the financial incentive.

Table 4-77 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-77. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	471,730	388,781	0.82
kW	151.4	143.5	0.95
MMBtu	-322.5	-247.2	0.77

4.8.2 Overall sampling methodology

This track focuses on lighting, so there is little variety in the types of measures installed. There is some variability in project size and therefore savings, so the top 10 percent of projects (high savings stratum) will be sampled with certainty. There are only ten completed projects, so this results in one project sampled with certainty and an additional four selected randomly from the stratum that includes all other savings.

Table 4-78. FY13 Population and Sample Summary

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Fluorescent Lighting	10	5	187,859	67.4	-134.1	52.0%	53.7%	53.2%
CFLs	1	1	106,807	25.5	-67.9	100.0%	100.0%	100.0%
LED Exit Signs	1	1	3,891	0.5	-2.5	100.0%	100.0%	100.0%
Total	**10**	**5**	**298,556**	**93.3**	**-204.4**	**63.3%**	**61.7%**	**63.4%**

4.8.3 Process evaluation

A process evaluation was not done for this track in this evaluation cycle. A staff interview was conducted November 25, 2013, to gain a better understanding of the initiative similarities and differences, as well as any opportunities or challenges faced by the initiative and what information from the evaluation would be useful.

Table 4-79. FY13 Process Evaluation Plan versus Actual

Activity	Plan	Actual	Explanation for Variance
Conduct DC SEU staff in-depth Interview	1	1	

A. Summary of key findings

No process findings were identified as a part of the FY13 evaluation effort.

4.8.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and full spillover battery was used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-80. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant surveys	10	1	Difficulty in recruitment due to small population

B. Summary of results

These tracks had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.

Table 4-81. FY13 Net-to-gross Results Summary-Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Lighting	10	1	471,730	37.5%	75.6%	0.0%	0.0%	62.5%
Total	**10**	**1**	**471,730**	**37.5%**	**75.6%**	**0.0%**	**0.0%**	**62.5%**

C. Drivers net-to-gross results

- 7610BLTZ saw a free-ridership rate of 37.5 percent with no like spillover, which resulted in a net-to-gross rate of 62.5 percent. These results are based on only one respondent being interviewed.
- This customer mentioned installing additional light bulbs for unlike spillover, but was unable to provide specifics as to the quantity or type.

4.8.5 Impact evaluation

Due to the limited population size for this track, a census was selected for file reviews and desk audits. Engineering calculations were performed based on the results of the desk audits.

A. Impact sampling methodology for onsite measurement and verification

Table 4-82. FY13 Onsite M&V Sample Summary

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Fluorescent Lighting	10	2	58,322	16.0	-39.2	16.2%	12.8%	15.6%
CFLs	1	0	0	0.0	0.0	-	-	-
LED Exit Signs	1	0	0	0.0	0.0	-	-	-
Total	**10**	**2**	**58,322**	**16.0**	**-39.2**	**12.4%**	**10.6%**	**12.2%**

B. Verification of impacts

The evaluation team conducted reviews of the claimed savings for reasonableness and in accordance with the DC SEU TRM. The evaluation team also reviewed the Mid-Atlantic TRM to assess potential variations in inputs and methods from those implemented in the District. For these tracks, the net-to-gross ratio is assumed to be 1.00 for FY13.

Table 4-83. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Fluorescent Lighting	361,033	303,075	0.84	125.4	111.2	0.89	-252.2	-191.8	0.76
CFLs	106,807	81,932	0.77	25.5	31.9	1.25	-67.9	-53.0	0.78
LED Exit Signs	3,891	3,774	0.97	0.5	0.4	0.74	-2.5	-2.4	1.00
Track Total	**471,730**	**388,781**	**0.82**	**151.4**	**143.5**	**0.95**	**-322.5**	**-247.2**	**0.77**

C. Impact evaluation planned activities and completed activities comparison

Table 4-84. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct project file reviews	5	5	
Conduct onsite verification	5	2	Difficulty recruiting due to small participant population and evaluation timeframe
Conduct participant surveys	10	1	Difficulty recruiting due to small participant population and evaluation timeframe

D. Summary of key findings describing adjustments to ex-ante savings

- Overall, it was unclear how the claimed savings were calculated. The "as built" audit spreadsheets contained data on the existing fixture description, and some description on the proposed fixture, but not assumed fixture input power. The evaluation methodology followed the TRM along with the fixture descriptions, and in most cases the results did not match up precisely with the claimed savings. In many instances the proposed fixture input power was adjusted in the verified savings calculations due to different nominal lamp wattage, ballast factor, or the number of lamps per fixture.

4.8.6 Recommendations

A. To improve design, operations, customer experience, and recruitment

No process recommendations identified in this evaluation cycle.

B. To improve impact evaluation results

i. **During QA/QC, document the differences between what is found during the onsite inspection and other project documentation.** The "as built" audit spreadsheets and invoices were utilized for the desk reviews. In Leidos' experience, invoices do not always accurately reflect the project that was undertaken. Where discrepancies are found, such as lamp counts that do not line up with expectations based on fixture quantities in the application or ballasts on the invoice, more follow-up should be conducted with the customer. For many of the projects, the lamp and

ballast model numbers shown on the audit spreadsheet, invoice, and post-installation inspection form did not match up.

ii. **For large projects, conduct onsite pre-inspections to more accurately determine installed fixture quantities and baseline conditions for rebate.**

iii. **To facilitate evaluation efforts, the proposed fixture description of the nominal lamp wattage should be more descriptive so that the fixture can be matched to an input power in the TRM.** Also, the fixture description should match up with the lamp and ballast model numbers listed in the audit spreadsheet. The existing fixture descriptions in the "as built" audit spreadsheets are descriptive and the input power could be found easily in the TRM. However, the proposed fixture description is lacking and confusing. For example, a proposed fixture could be described as "2L HPT8 w/ Low Ballast Factor." It is unclear if the intended lamp is a reduced wattage 28W T8 lamp or a 32W T8 lamp. Furthermore, the proposed fixture description seldom matched the listed lamp and ballast model numbers. In many instances, a normal or high output ballast model number would be listed, but the fixture description would state a low ballast factor.

C. To manage free-ridership results

Given the small sample sizes for these tracks, the evaluation team does not have any recommendations specific to program design.

4.9 7610ICDI LI MF IMPLEMENTATION CONTRACTOR DIRECT INSTALL

4.9.1 Track description

The Low-income Multi Family (LIMF) Implementation Contractor Direct Install (ICDI) track provides specific services and products to LIMF community residents of the District of Columbia. The initiative is promoted to property owners, property managers, developers, architects, and engineers and is designed to serve a wide variety of energy efficiency needs. The ICDI track covers 100 percent of the costs (products and direct installation) and hires implementation contractors to perform the direct installation.

Once there is an interested party and eligibility for the initiative has been confirmed, the DC SEU evaluation team assesses the site and provides recommendations. After three-party agreements (between DC SEU, Contractor, and Owner) have been signed, the implementation contractors install the products. Through the LIMF ICDI track, all spaces in a building can be served, including common areas and individual residential units. The track's products include in-unit direct install of CFLs, low-flow faucet aerators in bathrooms and kitchens, low-flow showerheads, hot water tank and pipe wrap (customized), and other measures depending on the needs of each property. After implementation, the DC SEU performs QA/QC on each project, visiting a representative sample of the total number of units in a project (30 units maximum per property or 20 percent of the total, whichever is lower).

Table 4-85 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-85. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	1,187,537	1,231,956	1.04
kW	124.0	122.9	0.99
MMBtu	417.6	298.8	0.72

4.9.2 Overall sampling methodology

This track includes only two types of measures (lighting and water-saving devices), both of which were installed at 23 of 26 projects. Therefore, we sampled the top 10 percent of electricity- and gas-saving projects to ensure that we account for a sufficient proportion of track savings. This results in 4 projects sampled with certainty from the high-energy savings stratum and 16 sampled randomly from the all other savings stratum.

Table 4-86. FY13 Population and Sample Summary

End-use	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Lighting	24	21	797,086	88.7	-1,200.3	81.0%	81.0%	81.0%
Water Heating Measures	23	21	203,677	14.4	1,495.6	100.0%	100.0%	78.7%
Total	**25**	**22**	**1,000,763**	**103.1**	**295.3**	**84.3%**	**83.2%**	**70.7%**

4.9.3 Process evaluation

This track was not scheduled for a process evaluation in this evaluation cycle. An in-depth interview was conducted with the DC SEU track manager in December 2013 to understand how the initiative operated in FY12, to develop the draft logic model, and to identify key researchable issues specific to the initiative. As a part of the impact evaluation effort, several process-related recommendations were identified.

Table 4-87. FY13 Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct DC SEU staff in-depth Interview	1	1	

A. Summary of key findings

- The project folders included multiple copies of project files. Locating the final documents used to support the reported savings proved difficult for many projects.
- The assumptions made to generate savings values for the projects implemented through this track often underestimated or overestimated savings. This was due to all lighting measures assumed to be in-unit installations with “unknown” heating type, while all faucet aerators were assumed to be bathroom installations.
- Necessary documentation of key savings inputs, such as fuel type (heating and water heating) and number of common area lighting installations was absent from most project files. As a result, the on-site verification process was relied upon to determine significant savings impacts.

4.9.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and full spillover battery was used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-88. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant surveys	20	5	Difficulty in recruitment due to small population

B. Summary of results

This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.

Table 4-89. FY13 Net-to-gross Results Summary—Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Lighting	24	1	983,860	0.0%	0.0%	0.0%	0.0%	100.0%
Water Heating	9	2	203,677	39.4%	50.1%	0.0%	0.0%	60.6%
Total	**33**	**3**	**1,187,537**	**6.9%**	**23.0%**	**0.0%**	**0.0%**	**93.1%**

Table 4-90. FY13 Net-to-gross Results Summary—Gas

End Use	N	n	Population MMBtu	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Water Heating	15	2	1,900.0	10.8%	33.6%	43.2%	53.6%	132.4%
Total	**15**	**2**	**1,900.0**	**10.8%**	**33.6%**	**43.2%**	**53.6%**	**132.4%**

C. Drivers net-to-gross results

- Overall kWh net-to-gross rate for the 7610ICDI track was 93.1 percent and 132.4 percent for natural gas.
- The Lighting end use had no kWh free-riders and was the highest contributor to kWh savings.
- One 7610ICDI customer who installed water heating equipment indicated having unlike spillover of 100 toilet tank modifiers.
- The number of survey completes are low; therefore, caution should be used when interpreting these results at the end use level.

4.9.5 Impact evaluation

The impact evaluation effort for this track included onsite measure installation, verification, and desk audits to verify KITT reports for measures and calculations and to confirm these were supported by onsite efforts and project file information such as QA/QC reports, external calculators/calculation methods, and applications or incentive agreements. Desk reviews also check the veracity of the deemed values and user inputs for measures, to inform the onsite data collection plans, and to identify any issues to be addressed.

A. Impact sampling methodology for onsite measurement and verification

The selection of onsite visits was based upon availability of property facility managers during onsite measurement timeframe. Fewer onsite verification efforts were conducted than originally planned due to the availability of participants.

Table 4-91. FY13 Onsite M&V Sample Summary

Measure	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Lighting	24	12	501,538	56.0	-758.1	51.0%	51.1%	51.1%
Water Heating Measures	23	12	6,1673	2.9	938.5	30.3%	20.2%	49.4%
Total	**25**	**12**	**563,211**	**58.9**	**180.4**	**47.4%**	**47.5%**	**43.2%**

B. Verification of impacts

For the desk review, the evaluation team reviewed the project file documents uploaded to the SharePoint project site by the VEIC Evaluation. In particular, the project files were mostly located in the “Measures for Upload” (also called “Materials for Upload” in some project files) folder within the project folders. Data was most commonly found on the “Total Building Tally” or “Review” (if provided) worksheet and was compared to the KITT reported quantities by measure type. The evaluation team also spot-checked QA/QC forms and other various project data and information such as the application and direct install worksheets. The folder titled “Applications and Selection Docs,” which contained subfolders for applications and income verification, only contained files for some projects. Therefore, the evaluation team was able to verify major measure inputs for some projects (e.g., building heating fuel type and DHW heating fuel type were only stipulated among the project files in a few instances) and determine whether or not the track savings were fully attributable to low-income housing. Most projects included multiple end uses (lighting and hot water heating) and multiple deemed calculation methodologies for each end use. The desk reviews included a review of all reported measures, savings calculations, user input data and/or TRM assumptions.

For the onsite verification, the evaluation team attempted to verify the installation of the measures listed in this file. However, it was not possible to visit every occupied unit within the facilities, so a sample of units were reviewed. The onsite verification information was primarily used to inform the evaluation process in general and to confirm major algorithm inputs such

as building heating fuel type and DHW heating fuel type, as well as common area installations of lighting measures, which were used to establish realization rates.

Table 4-92. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Lighting	983,860	1,052,719	1.07	109.6	109.6	1.00	-1,482.7	-1,431.8	0.97
Water heating measures	203,677	179,237	0.88	14.4	13.3	0.92	1,900.4	1,730.6	0.91
Track Total	**1,187,537**	**1,231,956**	**1.04**	**124.0**	**122.9**	**0.99**	**417.6**	**298.8**	**0.72**

C. Impact evaluation planned activities and completed activities comparison

Table 4-93. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct project file reviews	20	22	Due to lower than anticipated recruiting rates for onsite surveys, 2 additional sites from the population were used to obtain more onsite results and the additional desk reviews were conducted.
Conduct onsite verification	20	12	Difficulties in recruitment with limited population
Conduct phone verification	20	5	Difficulties in recruitment with limited population

D. Summary of key findings describing adjustments to ex-ante savings

- Lighting measures:
  - The increase in kWh and decrease in MMBtu for lighting measures were mostly driven from corrections to the location of the fixtures (e.g. from “In-Unit” to “Common” areas) and correcting for the buildings heating system fuel type (e.g., from “Unknown” to “Electric” or “Gas”). The kW for lighting measures overall did not change with any significance from the previously mentioned corrections as kW savings per fixture are the same no matter the heating fuel type if the location was not changed in conjunction with the updates. The majority of the evaluation’s lighting fuel type change did not include a location change.
  - As discussed above, an observation made during the evaluation included what appears to be the use of a default savings value of “In-Unit” building location and “Unknown” heat type for all lighting measures. The “In-Unit” location type is a conservative approach; however, the “Unknown” heat type is not. Even though the building heat type was provided within a good portion of the sites’ project documentation (the application in particular), all projects assumed the “Unknown” heat type. For 17 of 22 sites, corrections were made to the site heating fuel type during the evaluation. There were multiple projects, though, that did not have an application, the heating fuel type was not selected, or there was not enough detail within the application to determine the heating fuel type. For these five sites, the evaluation team did not adjust fuel type to calculate verified savings.

- For some projects, the review of project files and/or the onsite verification process determined that some lighting measures were installed in common areas. This necessitated a change in savings algorithms for these measures as those measures assumed to be “In-unit” installations were confirmed as “Common Area” installations. The evaluation team, in some cases, was able to confirm whether these measures were installed in areas with high usage (hallways, stairwells, etc.) or low usage (maintenance rooms, kitchens, etc.). Where this was not possible, the conservative “low” usage was assumed.

- Water Heating Measures:
  - The decreases in kWh, kW and MMBtu for water heating measures were mostly driven by correcting the location for 49 percent of the aerators (i.e., from “bath” to “kitchen” areas).
  - As discussed above, an observation made during the evaluation included the use of a default savings value of the “bath” apartment location for all faucet aerator measures. The “bath” location selection is not the most conservative approach. In addition, the “Review” and “Total Building Tally” tabs of the CAT spreadsheets accounted for differences between location of installation. Most project files provided this “bath” versus “kitchen” location breakdown on the QA “Reviewed” worksheet as well. For sites with this documentation detail, corrections were made during the evaluation.
  - Three project sites were corrected for DHW fuel type from the details within the application provided. There were three projects though, that did not have an application, the DHW fuel type was not selected, there was not sufficient detail within the application to determine water heating fuel type and did not receive an onsite survey. For these sites, the evaluation team did not adjust fuel type to calculate verified savings.

4.9.6 Recommendations

A. To improve design, operations, customer experience, and recruitment

This track was not scheduled for a process evaluation in this evaluation cycle; however, process-related findings and recommendation were identified as a part of the impact evaluation effort.

i. **For improved ease in locating pertinent project files for evaluation, the evaluation team recommends that a “Final Project Documentation” folder contain consistently named files critical for the evaluation effort.**

Critical files include:

- Project application and/or incentive agreement (ensure inclusion of building heat and domestic hot water fuel types)
- Work Order/Reviewed/Materials for Upload file
- QAQC documents
- Material invoices/procurement documents

- Direct installation worksheets.

B. To improve impact evaluation results

i. **Use the key algorithm inputs found within many project files for savings estimations rather than default values.** Examples of this include using the building heating system and water heating fuel types found in program documentation (application verified though onsite QA) and the location of faucet aerators (installation contractor should provide itemized invoices or installation worksheets with this detail that is verified during onsite QA). For those without, capturing and/or verifying such information is necessary. It is also important to ensure this information is included correctly on the application.

ii. **Improve the level of detail captured for the heating systems within project documentation (e.g., application), which can use either gas or electricity to operate (e.g., apartment furnace and roof top unit).** As all of the measures installed through this track require the input of fuel type (gas vs. electric) in order to calculate savings through their prescribed algorithms, this information is crucial for accurate estimation of savings. As a result, this information should be part of the application process, with the heating and water heating fuel clearly stipulated thereupon.

iii. **Improve mechanism by which common area and in-unit installations are tracked.** Currently, the CAT spreadsheet contains a tab called “Common Area Installations,” the purpose of which is to track the different lighting installations by location type. However, very few projects took advantage of this tab. As a result, despite the fact that QA/QC and other documents showed that there were common area lighting installations at most facilities, we were only able to account for those few that either utilized the “Common Area Installations” tab or where the common area installations were informed by onsite visits. For those projects where numbers of common area installations could not be determined, we assumed in-unit installation, which had the consequence of limiting the savings that could be claimed by the project, and by the track in general. Therefore, we recommend that this tab be consistently utilized across all projects so that common area installations can be taken into account on a consistent basis.

iv. **Provide an explanation for why measures described within project documentation but were not passed during the QA process may allow for the potential of more eligible savings.** An example includes the “Insulate Hot Water Pipes” also described as “Foil Tape, Pipe Wrap Seal installed” measures which were identified within the “Total Building Tally” worksheet but not within the “Review” worksheet. These measures were also found within other project documentation; however, no notes were provided to explain their omission within the final project KITT savings. Therefore, it was unclear whether this omission was purposeful or erroneous.

C. To manage free-ridership results

Given the small sample sizes for these tracks, the evaluation team does not have any recommendations specific to program design.

4.10 7620LICP LI MF COMPREHENSIVE EFFICIENCY IMPROVEMENTS

4.10.1 Track description

The Low-income Multifamily Comprehensive track, which launched near the end of February 2012, is designed to serve low-income multifamily housing, specifically new construction, substantial renovation, and redevelopment housing. Each project is independently evaluated and specific energy conservation measures (ECMs) are chosen depending on the project's needs. Some of these ECMs include measures affecting the thermal envelope (air and thermal barriers, doors, and windows), high efficiency heating and cooling systems, domestic hot water systems, in-unit and common area lighting, low flow water fixtures, appliances, and controls. Financial incentives for projects are determined on a project-by-project basis through a strategic assessment of the costs and savings associated with the ECMs installed.

Description and list of measures included:

- Thermal shell improvements: insulation and air sealing
- Hot water efficiency: comprehensive hot water conservation and high efficiency hot water heaters
- Air conditioning efficiency: energy efficiency heat pumps and air conditioners
- Efficient appliances: ENERGY STAR refrigerator, dishwashers and commercial clothes washers
- Efficient ventilation: bath exhaust fans, heat recovery ventilator, makeup heat natural gas and kitchen exhaust hoods
- Heating efficiency: high efficiency furnace fan motors and boilers
- Lighting hardware fixtures: compact fluorescent, LED, etc.
- Lighting efficiency and controls: fixture-mounted occupancy sensors.

The initiative works with developers and owners of low-income multifamily projects who are constructing, redeveloping, or rehabilitating affordable housing projects. To be eligible for participation, multifamily projects must meet the following criteria:

- Be located in the District of Columbia
- Be in the design or planning stage of a new construction or substantial rehabilitation development
- Be able to document that at least 66 percent of the residential units per building are designated for or inhabited by households with incomes at or below 60 percent Area Median Income.

In FY13, ten projects were completed through the Low-income Multifamily Comprehensive track. Table 4-94 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-94. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	1,959,041	1,921,321	0.98
kW	184.3	181.8	0.99
MMBtu	5,864.7	5,880.0	1.00

4.10.2 Overall sampling methodology

The Low Income Multifamily Comprehensive track includes a wide variety of measures with the ten projects in PY2013 each installing more than 20 major end-use types. The sample size for this track is the same as the number of projects completed, so there is no sampling conducted for this track. The entire population of projects was evaluated.

Table 4-95. FY13 Population and Sample Summary

	Project File Evaluation Sample							
End-use	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Lighting	9	9	657,465	80.0	-101.1	100.0%	100.0%	100.0%
Cooling	7	7	458,348	29.6	0.0	100.0%	100.0%	-
Water Heating Measures	9	9	231,967	18.6	2,893.7	100.0%	100.0%	100.0%
Building Shell	7	7	213,427	6.3	40.7	100.0%	100.0%	100.0%
Heating	5	5	154,744	27.5	2,985.5	100.0%	100.0%	100.0%
Other	7	7	121,615	10.8	0.0	100.0%	100.0%	-
Appliances	9	9	110,507	10.4	45.9	100.0%	100.0%	100.0%
Motors & Drives	1	1	10,967	1.1	0.0	100.0%	100.0%	-
Total	**10**	**10**	**1,959,041**	**184.3**	**5,864.7**	**100.0%**	**100.0%**	**100.0%**

4.10.3 Process evaluation

This track was not scheduled for a process evaluation in this evaluation cycle. An in-depth interview was conducted with the DC SEU track manager in December 2013 to understand how the initiative operated in FY12, to develop the draft logic model, and to identify key researchable issues specific to the initiative. As a part of the impact evaluation effort, several process-related recommendations were identified.

Table 4-96. FY13 Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct DC SEU staff in-depth Interview	1	1	

A. Summary of key findings

- The project folders often contained inconsistencies with regard to file names, locations and contents. Files with similar names often contained disparate information while seemingly identical files contained dissimilar information.
- Unlike all other tabs, the “MFGeneral” tab of the CAT spreadsheets ubiquitously contained hard-coded savings information, which required the use of external spreadsheets and other such records in order to determine savings algorithms. This resulted in our assuming the KITT values, as we could not obtain information to confirm or disconfirm these values.
- In some tabs of the CAT spreadsheets, important columns were hidden from view, making it difficult to discern the source of savings calculations.
- The project folders included multiple copies of project files. Locating the final documents used to support the reported savings proved difficult for many projects.
- The DC SEU team is in the process of including the full file name and not just a hyperlink within the CAT file for indicating/referencing auxiliary calculators and/or calculation methodologies. Since many ECMs use external sources for calculated savings, this effort is necessary to allow the evaluation team to identify the correct methods used for calculating savings.
- Per the CAT manual, whenever a default value is changed, an explanation should be provided to substantiate that change in the “Notes” field in the “Custom” tab.” In multiple cases, these notes did not match key inputs in the external calculator and/or final savings did not match between the two files. Therefore, the final version of this external calculator must be included, and final savings must match those within the CAT file. If an online calculator is used, all inputs to the methodology for the ECM also must be clear and provided.

4.10.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and full spillover battery was used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-97. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant surveys	10	4	Difficulty in recruitment due to small population

B. Summary of results

This track had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.

Table 4-98. FY13 Net-to-gross Results Summary-Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Like Spillover	90% Margin Error (±)	Net-to-Gross
Clothes Washers	3	0	31,429	n/a	n/a	n/a	n/a	n/a
Building Shell	7	0	212,937	n/a	n/a	n/a	n/a	n/a
Cooling	7	1	449,090	25.0%	65.9%	0.0%	0.0%	75.0%
Heating	3	0	136,244	n/a	n/a	n/a	n/a	n/a
Lighting	9	2	657,465	15.2%	36.8%	0.0%	0.0%	84.8%
Motors and Drives	1	0	10,967	n/a	n/a	n/a	n/a	n/a
Other HVAC	7	0	149,914	n/a	n/a	n/a	n/a	n/a
Other	6	0	21,808	n/a	n/a	n/a	n/a	n/a
Refrigeration	8	0	57,761	n/a	n/a	n/a	n/a	n/a
Water Heating	5	1	231,967	12.5%	48.7%	0.0%	0.0%	87.5%
Total	**10**	**4**	**1,959,041**	**17.5%**	**30.1%**	**0.0%**	**0.0%**	**82.5%**

C. Drivers net-to-gross results

- The free-rider rate for the 7620LICP track is 17.5 percent and with no like spillover, the resulting overall kWh net-to-gross rate is 82.5 percent.
- Four unique premises were surveyed, although two premises had the same decision maker; therefore, three interviews were conducted. Thus, caution should be used when interpreting these results at the end use level.
- No customers indicated having like or unlike spillover.

4.10.5 Impact evaluation

The impact evaluation effort for this track included onsite measure installation verification and desk audits to verify KITT reports for measures and calculations and to confirm these were supported by onsite efforts and project file information such as QA/QC reports, external calculators/calculation methods, and applications or incentive agreements. Desk reviews also check the veracity of the deemed values and user inputs for measures, to inform the on-site data collection plans, and to identify any issues to be addressed.

A. Impact sampling methodology for onsite measurement and verification

The selection of onsite visits was based upon availability of property facility managers during onsite measurement timeframe. Fewer onsite verification efforts were conducted than originally planned due to the availability of participants.

Table 4-99. FY13 Onsite M&V Sample Summary

End-use	Onsite M&V Sample Subset							
	N	n_{onsite}	kWh_{onsite}	kW_{onsite}	$MMBtu_{onsite}$	% kWh	% kW	% MMBtu
Lighting	9	4	408,289	55.0	-7.2	62.1%	68.8%	7.1%
Cooling	7	4	232,194	20.6	0.0	50.7%	69.6%	-
Water Heating	9	4	71,592	4.7	419.8	30.9%	25.1%	14.5%
Building Shell	7	4	35,735	2.2	35.1	16.7%	35.2%	86.2%
Heating	5	3	136,244	25.9	-193.5	88.0%	94.2%	-6.5%
Other	7	4	64,316	4.3	0.0	52.9%	39.6%	-
Appliances	9	4	67,862	5.6	45.1	61.4%	53.9%	98.2%
Motors & Drives	1	1	10,967	1.1	0.0	100.0%	100.0%	-
Total	**10**	**4**	**1,027,198**	**119.4**	**299.3**	**52.4%**	**64.8%**	**5.1%**

B. Verification of Impacts

For the desk review, the evaluation team reviewed the project file documents uploaded to the SharePoint project site by the VEIC Evaluation group. In particular, the CAT project files located in the "CAT Analysis" (also called "EC Docs" or "Analysis" in some project files) folder within the "Database" worksheet was compared to the KITT reported quantities by measure type. The evaluation team also reviewed all external calculators and calculation methodologies referenced in the "Notes" field in the "Custom" tab or within the "Overview" tab of the CAT file. Other critical files reviewed included the project application, spot-checks of QA/QC forms, and other various project data and information available. The folder titled "Applications and Selection Docs" which contained subfolders for applications and income verification only contained files for some projects to review. Therefore, the evaluation team was able to verify major measure inputs (e.g., building and DHW heating fuel types) and if the track savings were fully attributable to low-income housing for a portion projects. Most projects included multiple end uses (e.g., lighting, heating, cooling, and appliances) and multiple deemed and/or custom calculation methodologies for each end-use. The desk reviews included a review, when possible, of all reported measures, savings calculations, user input data, and/or TRM assumptions. A few unique measures were unable to be fully assessed due to their complexity; these measures are addressed in the individual project memos and represent a small proportion of overall project and track-level savings.

For the onsite verification, the evaluation team attempted to verify the installation of the measures listed in this file. However, it was not possible to visit every occupied unit within the facilities, so a sample of units were reviewed. The onsite verification information was primarily used to inform the evaluation process in general and to confirm major algorithm inputs such as equipment efficiency and count of bedrooms, which were used to establish realization rates.

Table 4-100. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Lighting	657,465	656,909	1.00	80.0	84.1	1.05	-101.1	-101.1	1.00
Cooling	458,348	456,795	1.00	29.6	29.8	1.01	0.0	-	-
Water Heating	231,967	207,379	0.89	18.6	16.3	0.88	2,893.7	2,895.3	1.00
Building Shell	213,427	213,163	1.00	6.3	6.2	0.99	40.7	40.5	1.00
Heating	154,744	156,356	1.01	27.5	24.6	0.89	2,985.5	2,985.3	1.00
Other	121,615	121,692	1.00	10.8	10.8	1.00	0.0	-	-
Appliances	110,507	98,060	0.89	10.4	9.0	0.86	45.9	60.1	1.31
Motors & Drives	10,967	10,967	1.00	1.1	1.1	1.00	0.0	-	-
Track Total	**1,959,041**	**1,921,321**	**0.98**	**184.3**	**181.8**	**0.99**	**5,864.7**	**5,880.0**	**1.00**

C. Impact Evaluation Planned Activities and Completed Activities Comparison

Table 4-101. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct project file reviews	10	10	
Conduct onsite verification	5	4	Difficulties in recruitment with limited population
Conduct phone verification	10	4	Difficulties in recruitment with limited population

D. Summary of Key Findings Describing Adjustments to Ex-ante Savings

- Cross-cutting
  - Key inputs for measures were compared across similar projects and it was differences found that tended to lead to updates made.
  - Key inputs for various measures used different values with no explanation provided. Examples include the hours of use for appliances, the cycles per week of dishwashers, the minutes per person per day for showerheads, the water temperature rise of low flow fixtures, and baseline conditions (for example, the baseline efficiency of domestic hot water heaters).
- Lighting Measures:
  - Realization rates for kWh, kW, and MMBtu are near 100 percent.
- Cooling Measures:
  - The slight increase in kW for cooling measures was driven by an update to the loadshape multiplier used for three projects. The evaluation used the loadshape identified in the TRM and what similar projects in the track used for this measure. There was no indication within the project documentation that an alternative was used.

- Water Heating Measures:
  - The decrease in kWh and kW for the water heating measures was driven by findings for two projects. One project was found to have installed higher showerhead and bath/kitchen aerator rated fixture flows than what was estimated as an input for the measures savings calculations. The onsite also found only 93 percent efficiency hot water tanks installed versus 95 percent. The second project was found to have a lower bedroom count than what was estimated as an input for the measures savings calculations. The onsite also found the project to have installed higher kitchen aerator rated fixture flows than what was estimated as an input for the measures savings calculations.
- Building Shell Measures:
  - Realization rates for kWh, kW, and MMBtu are near 100 percent.
  - For kW review, the evaluation applied the loadshape used for other similar projects in the track. There was no indication within the project documentation for what was assumed.
- Heating Measures:
  - The slight increase in kWh and decrease in kW for the heating measures was driven by findings for one project that implemented furnace fan motors. The methodology used could not be confirmed and therefore the EVT TRM method was used which is what similar to what other projects in this track used. There was no indication within the project documentation that an alternative was used.
- Appliance Measures:
  - The decrease in kWh and kW for appliance measures were due to the findings for one project. This project was found to have refrigerators installed whose model number is not on the CEE qualifying refrigerators list.
  - The increase in MMBtu for appliance measures were due to the findings for a separate project. This project did not include the gas savings for the energy star dishwasher. There was no indication within the project documentation that this was excluded for a particular reason.
- Motors & Drives
  - Realization rates for kWh and kW are near 100 percent.

4.10.6 Recommendations

A. To Improve Design, Operations, Customer Experience, and Recruitment

This track was not scheduled for a process evaluation in this evaluation cycle; however, process-related findings and recommendation were identified as a part of the impact evaluation effort.

i. **For improved ease in locating pertinent project files for evaluation, the evaluation team recommends that a "Final Project Documentation" folder contain consistently named files critical for the evaluation effort.**

Critical files include:

- Project application and/or incentive agreement (ensure inclusion of building heat and domestic hot water fuel types)
- CAT file
- All CAT referenced calculators and calculation methodologies including documentation supporting the key inputs used to estimated savings
- QAQC documents
- Detailed material invoices/procurement documents.

B. To Improve Impact Evaluation Results

i. **Use consistent calculation methodologies, algorithms, and key input assumptions across similar projects and like measures.** Provide an explanation when calculations or key inputs deviate from standards. Per the CAT manual, whenever a default value is changed, an explanation should be provided to substantiate that change in the "Notes" field in the "Custom" tab."

ii. **Ensure that the "final" calculator is included in all project files and that these savings match what the CAT file.** Multiple external calculators were used outside of the CAT file and discrepancies were found between the CAT 'Custom' tab 'Notes' column and what was found within the auxiliary calculators - adding to the uncertainty of key input assumptions.

iii. **If an online calculator is used to estimate savings, all inputs to the methodology for this ECM must be clear and provided.**

iv. **When creating project documentation, such as the CAT spreadsheets, make all information accessible to the evaluation team.** This includes specifically the 'un-hiding' of columns containing crucial information.

v. **Avoid hard coding of savings values so that algorithms can be easily determined.** As discussed above, the "MFGeneral" tab of the CAT spreadsheet contained hard-coded savings values, whereas the rest of the tabs retained the formulas used to generate savings. This resulted in our inability to verify some of the savings claimed in KITT through re-creation of savings algorithms.

C. To manage free-ridership results

Given the small sample sizes for these tracks, the evaluation team does not have any recommendations specific to program design.

4.11 7710FBNK EFFICIENT PRODUCTS AT FOOD BANKS PROGRAM

4.11.1 Track description

The DC SEU Food Bank CFL Distribution program supplies free compact fluorescent light bulbs (CFLs) to low-income households in the District who receive goods from participating food banks. DC SEU contracted with a CFL supplier to deliver the bulbs to Bread for the City, SOME (So Others Might Eat), Covenant Baptist Church's Food Pantry, and DC Housing Authority. Bread for the City distributed the bulbs to their food bank clients along with their other services. Due to lower than anticipated bulb distribution at Bread for the City, the Covenant Baptist Church and DC Housing Authority were brought on as distribution event destinations led by DC SEU staff.

About the organizations:

SOME (So Others Might Eat) is a nonprofit organization founded in 1970 that seeks to help alleviate poverty and homelessness in the District of Columbia. The organization provides food, clothing, and healthcare services to the poor and homeless. In addition, SOME provides job training, substance-abuse rehabilitation, counseling, low-cost housing, and other services to break the cycle of poverty and dependence.

Bread for the City was started in 1974 by a coalition of downtown churches; Bread for the City is a front line agency serving Washington's poor. The mission of Bread for the City is to provide vulnerable residents in the District of Columbia with comprehensive services, including food, clothing, medical care, and legal and social services. Bread for the City promotes the mutual collaboration of clients, volunteers, donors, staff and other community partners to alleviate the suffering caused by poverty.

Energy Federation, Inc. (EFI) is the payment processor for CFL orders. They verify the accuracy of the invoices submitted by the certified business enterprise (CBE) CFL suppliers. They QC model numbers, number of packages delivered, incentive amounts per package, CBE handling fees and expected amounts owed and submit the invoice for payment.

In FY13, EFI partnered with a lighting manufacturer, TCP, to supply standard and specialty CFLs for the Food Bank Program. In addition to being an Incentive Fulfillment Contractor, EFI is a wholesale distributor for energy conservation products. Products supplied included 13-watt, 20-watt, and 23-watt standard CFLs and covered A-style, 14-watt R30, 23-watt PAR38, and 3-way spiral specialty bulbs.

Covenant Baptist Church's Food Pantry was brought as an additional location for hosting CFL distribution events. These events were managed by DC SEU staff.

DC Housing Authority's Langston Terrace. The District of Columbia Housing Authority provides quality affordable housing to extremely low- through moderate-income households, fosters sustainable communities, and cultivates opportunities for residents to improve their lives. The DC SEU was referred to the Langston Terrace Resident Manager as the residents had almost exclusively incandescent bulbs in their townhouses and apartments. The DC SEU distributed bulbs on site in September 2013.

The program implementation began in FY12, in August of 2012, with Bread for the City and the Greater Washington Urban League. SOME joined mid-August 2012 and distributed the majority of CFLs later that year. Participating food banks were allowed to give out up to 12 CFLs per household after verifying that the household is located in the District and falls within the program's income requirements. If the household is eligible, the food bank asks a series of questions to determine how many CFLs should be distributed based on their household needs.

In FY13, the program launched in April 2013 at Bread for the City. The plan was for Bread for the City to be the sole distributor of the program, but they encountered issues where they were not able to distribute as many bulbs as anticipated. Therefore, the Covenant Baptist Church and the DC Housing Authority were added as new organizations to the program to help reach program goals. DC SEU staff were always in attendance for events at these locations. This allowed for better communication with customers and gave an opportunity to share materials and educate the recipients.

Bread for the City had issues with residents not coming in monthly to receive services, so they were not picking up the bulbs. This was thought to be because of the summer months but also because people tended to come only in the beginning of the month, so the supply was not in line with the demand. Also, some residents had already received bulbs, so Bread for the City limited the number of bulbs to six per household in an effort to distribute to more people, which slowed down the amount of distribution. DC SEU changed their approach in July through September by staffing six events held at Bread for the City's NW Center to assist with the distribution of the bulbs.

A change made between program years involved the CFL supplier. In FY12 the program required that CFL suppliers be CBE certified, but that criteria was removed for FY13 to have the ability to purchase bulbs for half the price of what the CBE supplier charged. DC SEU also added specialty bulbs in FY13 for those who requested them but quickly learned that people were having a hard time articulating what kind of bulb they needed, so the program will not be offering specialty bulbs in FY14.

For FY14, the program plans to decrease the number of bulbs distributed and is looking for new partnerships with additional churches since that was successful. Bread for the City is still interested, but DC SEU is worried their market is already saturated with bulbs from the program, so they are looking for organizations where the residents have not been involved with such a program. The program model still is not where they want it to be after changes from FY12 to FY13 but the DC SEU are continuing to work on that.

Table 4-102 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-102. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	2,416,513	2,418,361	1.00
kW	269.6	269.6	1.00
MMBtu	-3,989.5	-3,842.9	0.96

4.11.2 Overall sampling methodology

The entire population was reviewed as a part of this evaluation effort.

4.11.3 Process evaluation

A process evaluation was not conducted in this evaluation cycle.

Table 4-103. FY13 Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Conduct DC SEU staff in-depth Interview	1	1	

A. Summary of key findings

Not applicable.

B. Net-to-gross indicators

A net-to-gross assessment was not conducted in this evaluation cycle.

4.11.4 Impact evaluation

The impact evaluation involved review of tracking data and invoices from EFI. Overall, the impacts claimed by the initiative were evaluated to be quite accurate. Minimal issues were identified that did not significantly affect claimed savings.

The only issue in comparing tracked savings to the TRM is that savings values in the tracking system are rounded to one decimal place for kWh savings, while the TRM has two decimal places. This has a significant effect for natural gas penalties, which were overstated in tracking data by approximately 3 percent. Heating penalties are only a fraction of a therm per unit, so a loss of precision has a larger effect.

A. Impact sampling methodology for onsite measurement and verification

Not applicable.

B. Verification of impacts

The evaluation team verified impacts for the retail lighting initiative by comparing tracked savings to deemed savings established in the DC SEU TRM. In addition, we reviewed tracked quantities in conjunction with reported quantities directly from EFI.

Table 4-104. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Standard CFLs	2,238,306	2,240,156	1.00	249.7	249.8	1.00	-3,699.7	-3,560.9	0.96

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Specialty CFLs	178,206	178,205	1.00	19.8	19.8	1.00	-289.8	-282.0	0.97
Track Total	**2,416,513**	**2,418,361**	**1.00**	**269.6**	**269.6**	**1.00**	**-3,989.5**	**-3,842.9**	**0.96**

C. Impact evaluation planned activities and completed activities comparison

Table 4-105. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Report file reviews	12	6	Received 6 invoices from EFI

D. Summary of key findings describing adjustments to ex-ante savings

- The tracking data rounds some savings amount to fewer decimals than represented in the TRM. This loss of precision affects, in particular, the heating penalties reported through the initiative.

4.11.5 Recommendations

A. To improve program design, operations, customer experience, and recruitment

Not applicable.

B. To improve impact evaluation results

i. **Ensure that the tracking system accurately applies the values from the TRM to a consistent level of decimal places.**

4.12 7710APPL RETAIL EFFICIENT APPLIANCES

4.12.1 Track description

In January 2013, the DC SEU began offering mail-in rebates for qualifying energy-efficient ENERGY STAR refrigerators and clothes washers. These rebates continued through FY13, and starting July 1, 2013, additional rebates were offered for natural gas water heaters, furnaces, and boilers. DC SEU has partnered with local retailers and contractors to promote these rebates, including providing rebate forms in retail stores where possible. These stores include five within Washington, DC, and 19 in Maryland. Stores outside of DC are included because of the relatively small number of stores that sell appliances within DC and the proximity of the surrounding stores. The rebates are processed by EFI.

In FY13, $50 rebates were offered for ENERGY STAR clothes washers and refrigerators. In FY13 the DC SEU realized that the majority of appliances sold at DC appliance retailers were ENERGY STAR qualified. In an effort to encourage customers to purchase the most energy efficient appliances, in FY14 the DC SEU changed the appliance rebates to tiered rebate amounts based on efficiency level of the equipment.

In FY13, Energy Star gas boilers qualified for a flat $500 rebate, but water heater and furnace rebates were tiered. Boilers must be ENERGY STAR-rated with a minimum AFUE of 85 percent. Furnace rebates were tiered, with AFUE 90 to 91.9 percent qualifying for a $600 rebate, AFUE 92 to 93.9 percent qualifying for a $650 rebate, and AFUE 94 percent + qualifying for a $850 rebate. Water heater rebates depend on the type of equipment installed as well as the efficiency level. All water heaters must be ENERGY STAR rated, with a minimum efficiency factor (EF) of 0.67 qualifying for a $150 rebate; storage water heaters with an EF of 0.80 or higher qualify for a $700 rebate. Tankless water heaters with an EF of 0.82 or higher qualified for a $500 rebate.

Table 4-106. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	99,569	99,569	1.00
kW	14.3	13.8	0.96
MMBtu	162.0	251.2	1.55

4.12.2 Overall sampling methodology

The evaluation team randomly sampled measure rebates for clothes washers and refrigerators for project file review and phone surveys. Tracking system reviews were completed for all heating and water heating rebates, but because of the small number of rebates processed we did not review project files.

Table 4-107. FY13 Population and Sample Summary

Measure	Project File Evaluation Sample							
	N	$n_{project}$	kWh_n	kW_n	$MMBtu_n$	% kWh	% kW	% MMBtu
Refrigerators	459	32	3,970	0.6	0.0	7.0%	7.0%	-
Clothes Washers	455	32	2,957	0.4	7.3	7.0%	7.0%	6.9%
Heating Equipment	5	0	0	0.0	0.0	-	-	-
Water Heaters	2	0	0	0.0	0.0	-	-	-
Total	**875**	**64**	**6,926**	**1.0**	**7.3**	**7.0%**	**7.0%**	**4.5%**

4.12.3 Process evaluation

A process evaluation was not done for this track in this evaluation cycle; however, a staff interview was conducted January 22, 2014, to understand how the track is intended to work. A limited process evaluation review is currently schedule for FY15.

Table 4-108. Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth interviews	1	1	

A. Summary of key findings

- Appliance track is successfully rolled out to all major appliance stores in DC.
- Heating and water heating equipment started later in the year and will be promoted more heavily in FY14.

4.12.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and spillover batteries were used for this track. See Section 1.2 for detailed descriptions of these batteries.

Table 4-109. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant surveys	70	74	Over-recruited in the event some data would be dropped due to quality

We removed two records from the free-ridership analysis—one claimed that equipment was no longer installed and one survey was completed with the contractor rather than the participant.

B. Summary of results

Table 4-110. FY13 Net-to-gross Results Summary—Electric

End Use	N	n	Population kWh	Free-ridership	90% Margin Error (±)	Spillover	90% Margin Error (±)	Net-to-Gross
Clothes Washer	388	31	42,456	59.8%	13.9%			40.2%
Refrigerator	378	41	57,113	55.1%	12.1%			44.9%
Total	**766**	**72**	**99,569**	**57.1%**	**9.1%**	**5.4%**	**4.2%**	**48.3%**

Table 4-111. FY13 Net-to-gross Results Summary—Gas

End Use	N	n	Population MMBtu	Free-ridership	90% Margin Error (±)	Spillover	90% Margin Error (±)	Net-to-Gross
Clothes Washer	388	31	107.0	59.7%	13.9%			40.3%
Heating	5	0	50.0	n/a	n/a			n/a
Water Heating	2	0	5.0	n/a	n/a			n/a
Total	**395**	**31**	**162.0**	**59.7%**	**13.9%**	**16.7%**	**10.6%**	**57.0%**

C. Drivers net-to-gross results

- The 7710APPL track had a kWh net-to-gross rate of 48.3 percent and a natural gas net-to-gross rate of 57.0 percent .These findings are consistent with appliance rebate programs in other jurisdictions.
- The track had high free-ridership rates in both the kWh and natural gas for both clothes washers and refrigerators. Higher free-ridership rates are common for this type of program.
- Spillover was 16.7 percent for natural gas compared to 5.4 percent for kWh.

4.12.5 Impact evaluation

The evaluation team reviewed the algorithms for these new prescriptive measures added to the TRM in FY13. In practice, DC SEU applies a blended average of fuel savings for clothes washers since the savings are dependent on what water heater and clothes dryer fuel the participant uses. The DC SEU used the data collected on rebate forms about these fuels to arrive at proportions of rebate customers who use gas, electric, or other fuels for water heating and clothes drying. These averages were applied in the savings algorithm to produce a single savings estimate for each efficiency level of appliance.

The evaluation team conducted a tracking system review of all measures rebated by the appliance track, as well as a review of a sample of rebate applications to verify tracked

quantities and efficiency levels. We also conducted a telephone survey with a sample of participants.

A. Impact sampling methodology for onsite measurement and verification

Not applicable.

B. Verification of impacts

Two primary issues arose through the tracking system review. First, the clothes washer coincidence factor (CF) was rounded in the TRM differently than it was rounded in the tracking data. This resulted in a discrepancy in the actual summer peak kW claimed for these measures.

Second, the natural gas savings applied in the tracking data differed significantly from the deemed values in the TRM. This affected clothes washers only, but these measures are a major portion of the gas savings claimed by the appliance track. This resulted in an overall realization rate of 155 percent.

Table 4-112. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Refrigerators	57,113	57,113	1.00	9.3	9.3	1.00	0.0	0.0	1.00
Clothes Washers	42,456	42,456	1.00	5.0	4.5	0.90	106.6	195.8	1.84
Heating Equipment	0	0	1.00	0.0	0.0	1.00	50.1	50.1	1.00
Water Heaters	0	0	1.00	0.0	0.0	1.00	5.3	5.3	1.00
Track Total	**99,569**	**99,569**	**1.00**	**14.3**	**13.8**	**0.96**	**162.0**	**251.2**	**1.55**

C. Impact evaluation planned activities and completed activities comparison

Table 4-113. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Desk reviews	63	64	
Phone verification	70	74	Additional respondents recruited in the event some data would be dropped due to quality

D. Summary of key findings describing adjustments to ex-ante savings

- Differences in rounding between tracking data and the TRM resulted in a non-100 percent realization rate for summer peak kW.
- Major differences in natural gas savings from the TRM to the tracking system resulted in a significant increase in verified gas savings.

4.12.6 Recommendations

A. To improve program design, operations, customer experience, and recruitment

i. **Continue to engage retailers and contractors with marketing and events.**

ii. **As the appliance track gains traction, be sure to communicate updates to the initiative to retailers and trade allies, such as changes to qualifying equipment, rebate levels, or funding status.**

B. To improve impact evaluation results

i. **Ensure that the tracking system accurately applies the values from the TRM.** This applies both to the deemed savings values as well as load shape coincidence factors. In the case of the coincidence factors, if the value in the tracking system is more accurate, this value should be reflected in the TRM to encourage accuracy and transparency.

C. To manage free-ridership results

i. **Continue to encourage higher levels of efficiency by providing higher rebate levels for Top Ten and Most Efficient products.**

ii. **Apply the net-to-gross values during cost screening exercises.** Although a limited battery was used for this assessment, the findings are consistent with those from other jurisdictions.

4.13 7710LITE ENERGY EFFICIENT PRODUCTS

This section presents the evaluation findings for the Energy Efficient Products Retail Lighting track. The section will provide a brief description of the initiative, followed by process and impact evaluation results and recommendations for future initiative operation.

4.13.1 Track description

The Retail CFL initiative works with retailers and manufacturers to lower prices on CFLs in the DC area. CFL bulbs, in particular specialty bulbs, are not as familiar to residents and are less commonly used than incandescent equivalents. The DC SEU initiative provides educational material to increase awareness of different types of CFLs and works with participating retailers and manufacturers to increase availability of the bulbs. RFPs for the initiative were released in early 2012, and the first retailers began promotions in FY12 on July 19, 2012. Pricing for FY13 was negotiated with manufacturers in August and September 2012 and new MOUs were created to reflect additional products and new pricing beginning October 1, 2013.

The Retail CFL initiative targets lighting manufacturers and retailers for participation to reach residents and small businesses as end-use customers. The manufacturers and retailers are provided incentives on a per-bulb basis. The initiative is implemented by DC SEU with Energy Federation Incorporated (EFI) providing support for incentive payment and data tracking. EFI is responsible for compiling and verifying manufacturer invoices and processing payments. Manufacturers submit invoices to EFI for payment, and work with stores to gather sales reports that they submit along with the invoice requests.

Table 4-114 provides a summary of the reported and verified kWh, kW, and MMBtu along with the resulting realization rates.

Table 4-114. FY13 Reported and Verified Results

Metric	Reported	Verified	Realization Rate
kWh	12,699,881	12,713,227	1.00
kW	1,895.3	1,897.8	1.00
MMBtu	-17,317.3	-16,806.4	0.97

4.13.2 Overall sampling methodology

Generally there was no sampling for the retail efficient products lighting initiative. For in-store surveys and postcard distribution, the evaluation team selected stores with sufficient sales volume to support conducting activities. For in-store surveys, the evaluation team targeted stores with average sales of at least 500 bulbs per month. We requested stores to distribute postcards that had sales between 100 and 500 bulbs per month. Some stores declined to participate in the postcard initiative, but with the assistance of DC SEU, all of the stores selected to have in-store surveys participated. Telephone interviews were limited to customers who provided their contact information on either the in-store or postcard surveys, so there was no further sampling for this survey.

Impact evaluation was conducted on a census of tracking data and reports from EFI.

4.13.3 Process evaluation

The evaluation team conducted several activities to support the process evaluation of the retail lighting initiative. These activities included interviewing the DC SEU staff at the beginning and end of the fiscal year, participant in-person and telephone surveys, retailer interviews, and store visits.

Several process changes occurred during FY13 to address concerns from retailers raised during either FY12 or early in FY13. The most significant change was the timing of the incentive payments. Previously, the 20 Turnkey retailers received 75 percent of the incentive when purchasing bulbs, and were required to provide documentation that they had sold through 75 percent of the incentivized products in order to receive the remaining 25 percent. These stores found this to be a barrier to continued participation, so DC SEU adjusted to providing the entire incentive when stores purchase the bulbs. Also, in addition to the initiative manager and Retail Account Manager, DC SEU added a Project Assistant to assist with administrative tasks such as managing memoranda of understanding (MOUs) and processing information from EFI.

During FY13, the DC SEU changed the initiative's brand and corresponding marketing materials. In FY12 and into the beginning of FY13, the initiative was marketed under the slogan "Cool Bulbs, Hot Price." Along with the shift in overall DC SEU branding, the retail lighting initiative changed to the slogan "Enlighten DC." This included providing signage for stores with the new messaging. In addition, DC SEU encouraged stores to implement some sort of indication on individual products that the price had been discounted. Some stores, such as Home Depot, simply tagged the products with price tags showing the original and discounted prices, while other stores such as Safeway also indicated that the discount was sponsored by DC SEU. Some stores that did not previously carry CFLs had signage showing that the product was subsidized by DC SEU, but did not have a previous price since the product was not available prior to participation in the DC SEU initiative. This transition in marketing occurred throughout the fiscal year, and involved staff visits to the stores to provide materials in person and to review the presence and placement of signage.

The last major design change during the FY13 fiscal year was to include LED bulb discounts. This product began as a mail-in rebate in December 2012; however, response to this offer was extremely low—only 266 rebates were submitted by about 75 customers. DC SEU adjusted the initiative in July 2013 to provide upstream incentives for qualifying LED bulbs using the same model as CFLs. In the final three months of the fiscal year, the initiative provided incentives for approximately 6,300 LED bulbs.

In May 2013, the evaluation team visited 16 participating stores throughout the District. During these visits, the evaluation team looked for signage indicating that the stores participated in the DC SEU initiative. This may have included storefront signs, aisle signs, or specific price tag stickers. In eight of the stores, the evaluation team was easily able to locate at least one type of DC SEU sign. Seven of these eight stores had more than one type of sign posted, such as storefront window signs, larger aisle interrupters, or price tag stickers with the DC SEU brand. As previously mentioned, DC SEU worked continuously throughout the year to get more signage in place, so the evaluation team visits only documented progress as of

early May 2013. DC SEU staff provided documentation that some of the remaining stores have since introduced signage into their store.

In addition, the evaluation team assessed whether stores offered alternate products, in particular noting the presence of incandescent bulbs. Nine of the stores still had either 75- or 100-watt incandescent bulbs for sale at the time of the evaluation team visits. Eight stores had 75-watt incandescent bulbs on their shelves, and six stores had 100-watt incandescent bulbs.

Table 4-115. Process Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth interviews	1	1	
Participant phone surveys	70	32	Insufficient customer contact information
Retailer interviews	12	0	Contact information not available within evaluation timeframe
Store visits	16	16	

The intercept surveys conducted during the evaluation asked respondents if they knew the products they purchased were discounted, and if so, by whom. Only 12 percent of those surveyed knew that the lighting had been discounted by DC SEU, while another 12 percent thought that the products were not discounted. A significant portion (43 percent) were unsure if the product was discounted, or if so, why there was a the discount. Another 20 percent of respondents recognized DC SEU when prompted, for a total of 32 percent of respondents who were aware of the brand overall. Some of these respondents were more knowledgeable than others about the DC SEU, with explanations ranging from “I just heard the name” to “Trying to encourage people in the District to be more energy efficient by using energy efficient products.”

A. Summary of key findings

- The initiative increased participation both in terms of number of stores and number of products sold. FY12 ended with 39 retailers that sold a total of 43,454 bulbs; in FY13, the initiative increased retailer participation by approximately 40 percent up to 55 and sales by over 400 percent to 224,957 bulbs.
- DC SEU responded to turnkey retailer concerns about up-front costs by providing the entire buy-down at the time of purchasing bulbs from the manufacturer.
- The initiative re-branded during the year, which included new marketing materials provided to stores.
- Ensuring that initiative marketing materials are in place continues to be a challenge, at some stores more than others. DC SEU conducts regular store visits review the presence and placement of signage.
- Awareness remains an issue that is expected to improve as marketing reaches more customers and retailers.

4.13.4 Net-to-gross methodology and results

A. Methodology

The limited free-ridership and spillover batteries were used for this track. See Section 1.2 for the detailed descriptions.

The data for this track is not weighted because the population is unknown.

Table 4-116. FY13 Net-to-gross Assessment Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
DC SEU staff in-depth	1	1	
Participant surveys	70	32	Difficulty in recruitment due to small population

We removed two records from the free-ridership analysis because we spoke with a property manager or contractor rather than the household.

B. Summary of results

These tracks had limited participation and therefore there are limited data points for the net-to-gross assessment warranting caution for the interpretation of results.

Table 4-117. FY13 Net-to-gross Results Summary—Electric

End Use	n	Free-ridership	90% Margin Error (±)	Spillover	90% Margin Error (±)	Net-to-Gross
Lighting	30	49.2%	15.0%	Not assessed	n/a	50.8%

C. Drivers net-to-gross results

- The un-weighted free-ridership for the 7710LITE track is 49.2 percent. These results are based on end-use customer responses, who may be unaware of the initiative's influence on product availability and pricing due to the upstream initiative design and free-ridership in this range is common.
- CFLs, which constitute the majority of the 7710LITE savings, are becoming more prevalent outside of energy efficiency programs. For this reason, some level of free-ridership is expected, as customers increasingly more likely to purchase these bulbs without an incentive.

4.13.5 Impact evaluation

The impact evaluation involved review of tracking data, sales reports from EFI, and invoices from manufacturers. Overall, the impacts claimed by the initiative were evaluated to be quite accurate. Minimal issues were identified that did not significantly affect claimed savings. While the evaluation team collected data during in-store and telephone interviews to inform impact evaluation, we do not recommend adjusting current savings based on this data. The in-store data collection was entirely prospective, asking customers reported where they

intended to install the light bulbs. The follow-up telephone survey asked respondents to confirm these locations, but a small number of customers (31) responded to the follow-up survey. These surveys did not identify significant differences from assumptions used by DC SEU for installation rate. See Section 4.13.8 for a discussion of the survey results with respect to installation by sector.

Currently the DC SEU TRM assumes average wattages based on sales data from Efficiency Vermont from 2009–2011. Because EFI tracks bulb wattage and model number for a significant portion of the incentivized lighting products, the evaluation team recommends that average wattages be calculated based on DC SEU sales data now that sufficient sales data is available.

A. Impact sampling methodology for onsite measurement and verification

Not applicable.

B. Verification of impacts

The evaluation team verified impacts for the retail lighting initiative by comparing tracked savings to deemed savings established in the DC SEU TRM. In addition, we reviewed tracked quantities in conjunction with reported quantities directly from EFI.

In FY12, the evaluation team found that some measures had incorrectly applied savings. Specifically, some types of measures are tracked in high- and low-wattage categories, such as LEDs of 15 watts or higher and LEDs of less than 15 watts. In FY13, tracking data incorrectly applied the low-wattage bulb savings to the high-wattage measure category, and vice-versa for LED bulbs; CFLs were correctly tracked in FY13. Since the problem results in some measures with increased and others with decreased savings, the overall impact is an increase of approximately 2 percent in kWh savings for LEDs. In addition, since LEDs account for less than 3 percent of total savings, the overall realization rate is very minimally affected by this error.

One other issue in comparing tracked savings to the TRM is that savings values in the tracking system are rounded to one decimal place for kWh savings, while the TRM has two decimal places. This has a significant effect for natural gas penalties, which were over-stated in tracking data by approximately 3 percent. Heating penalties are only a fraction of a therm per unit; therefore, the loss of precision has a larger effect.

Table 4-118. FY13 Summary of Impact Evaluation Results

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
Standard CFLs	9,853,794	9,860,518	1.00	1,493.3	1,493.5	1.00	-13,499.7	-13,034.3	0.97
Specialty CFLs	2,504,838	2,505,046	1.00	355.3	355.3	1.00	-3,360.0	-3,310.6	0.99
Screw-	341,249	347,663	1.02	46.6	49.0	1.05	-457.5	-461.6	1.01

Measure	kWh			kW			MMBtu		
	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR	Ex-ante Gross	Ex-post Gross	RR
base LEDs									
Track Total	**12,699,881**	**12,713,227**	**1.00**	**1,895.3**	**1,897.8**	**1.00**	**-17,317.3**	**-16,806.4**	**0.97**

Another important subject to consider is the impact of the Energy Independence and Security Act of 2007, or EISA, on the baseline for energy savings. This legislation prohibits the manufacture of standard incandescent bulbs, phasing out certain wattages year by year. This act has already taken effect for 100- and 75-watt bulbs, and 60- and 40-watt bulbs took effect in January 2014. EISA does not, however, prohibit the sale of any existing stock of these bulbs. During the evaluation team's visit to stores in 2013, there was some evidence of this stock still being significant, as some stores had equal numbers of incandescent bulbs as they did energy-efficient options.

C. Impact evaluation planned activities and completed activities comparison

Table 4-119. FY13 Impact Evaluation Plan vs. Actual

Activity	Plan	Actual	Explanation for Variance
Report reviews	12	12	
Phone verification	70	32	Insufficient customer contact information

D. Summary of key findings describing adjustments to ex-ante savings

- Some LEDs that were split into high-wattage and low-wattage categories had the incorrect deemed savings values applied.
- The tracking data rounds some savings amount to fewer decimals than represented in the TRM. This loss of precision affects, in particular, the heating penalties reported through the program.

4.13.6 Recommendations

A. To improve program design, operations, customer experience, and recruitment

i. **Continue to monitor retailer marketing and satisfaction.** DC SEU staff have implemented procedures to maintain regular contact with retailer staff. Use these relationships to enhance both the DC SEU brand and the stores' images through showcasing their participation.

ii. **Continue to conduct in-store events to promote the lighting initiative as well as the overall DC SEU brand.** The extensive presence of the lighting initiative offers a way to reach a significant number of customers and encourage them to participate in other initiatives within the DC SEU portfolio.

iii. **Document the presence of inefficient alternatives, especially the sell-through of incandescent bulbs phased out by EISA.** This supports impact savings claims and the overall effect of the lighting initiative.

iv. **Encourage more retailers to buy into LED bulbs.** The DC SEU initiative began this transition during this program year and should continue to work with participating retailers to increase availability and awareness about these products.

B. To improve impact evaluation results

i. **Review deemed savings by measure type to ensure that the correct savings values are being applied.**

ii. **Increase precision of tracked savings to include additional decimal places so that applied savings match TRM level of precision.**

iii. **Use EFI-reported wattages from incentivized products to update the average wattages used in TRM algorithms for FY14.**

C. To manage free-ridership results

i. **As with gross impacts, promoting LEDs may lead to lower free-ridership and therefore higher net savings.** Customers are less likely to purchase these bulbs without an incentive, as these products are still relatively early in adoption. The same is true of specialty CFLs, though to a lesser extent.

4.13.7 Sector attribution and leakage assessment

In addition to the impact verification activities described above, the evaluation team researched where customers install the products purchased through the initiative; that is, are bulbs purchased through the initiative installed in the District, and are bulbs installed within the District installed in homes or businesses? The evaluation team researched these questions through four primary methods—intercept interviews with purchasers, postcards distributed in stores to purchasers, sales data provided by Costco, and participant telephone surveys of all residential programs.

First, we will briefly discuss the methods used to collect the data informing this evaluation. The data came from three primary sources. First, the evaluation team conducted intercept interviews in four of the participating retail locations with higher sales volume, since these interviews are able to provide more reliable data but are cost prohibitive in stores with lower sales.

Second, the evaluation team provided postcards with the most critical questions included to stores with lower sales volume. These postcards were given to six stores who initially agreed to distribute the postcards to participants. The evaluation team received responses from only three stores, one of which only produced one respondent

Table 4-120. Participating Retailers, Data Collection Method, and Number of Respondents

Store	Method	Respondents
Ace Hardware	Postcard	17
Home Depot	Intercept	70
King Discount	Postcard	40
Rodman's	Intercept	21
Safeway - Georgetown	Intercept	30
Safeway - Piney Branch	Intercept	18
Yes! Organic Market	Postcard	1
Total		**197**[21]

Finally, the evaluation team also conducted 31 telephone interviews with participants from all residential tracks (retail lighting, appliances, and Home Performance with ENERGY STAR®). These interviews served to identify customers who purchased energy-efficient light bulbs outside of the program participation for which we contacted them. We used these interviews in lieu of conducting a large, expensive nonparticipant survey to investigate where DC

[21] Not all respondents are represented throughout this section as some surveys contained invalid data and were excluded from analysis.

customers purchase bulbs: do they favor stores in DC or outside, and are the stores visited in DC participating in the lighting initiative?

A. Cross-sector sales

The DC SEU estimates cross-sector sales as 10 percent of bulbs installed in nonresidential applications.[22] The evaluation results show this estimate to be within reason, although the evaluation suggests 14 percent of bulbs go to nonresidential installations. The data from the in-store surveys is sufficient for a confidence interval of 90% ± 4.2%. In the follow-up telephone survey, all of the respondents said that their initial intent was the same as where they ended up installing the bulbs. Table 4-121 therefore shows the planned installation locations that are based on the intercept and postcard surveys.

Table 4-121. Planned Installation Locations by Store (Cross-sector Sales)

Store	Residence	Business	Home Business
Ace Hardware	100%	0%	0%
Home Depot	76%	22%	2%
King Discount	90%	10%	0%
Rodman's	91%	0%	9%
Safeway - Georgetown	97%	3%	0%
Safeway - Piney Branch	96%	4%	0%
Yes! Organic Market	100%	0%	0%
Total	**85%**	**14%**	**2%**

The evaluation team conducted a brief benchmarking study of cross-sector results from other evaluations completed in 2010 to 2013. These other studies varied widely in their results, ranging from 4 to 17 percent of bulbs being attributed to the nonresidential sector. Based on these studies, the evaluation team believes our survey results are consistent and recommends an adjustment to the value currently used by DC SEU.

[22] See memorandum titled, *Splitting Retail CFL savings in to Residential and Commercial Assumptions*, VEIC EM&V Services, September 17, 2012.

Table 4-122. Benchmarking of Cross-sector Sales

Utility	Year	Nonresidential Installations
PECO	2013	7.7%
PPL	2013	17%
PGE	2010	6%
SCE	2010	6%
SDGE	2010	5%
Duke Energy Progress	2013	10%
Illinois Public Utility Commission	2013	4%
Commonwealth Edison Company	2013	5%
Duquesne Light	2013	12.55%

B. Leakage

The issue of leakage is a challenge for a small service territory like the District of Columbia. DC SEU-sponsored bulbs are easily accessible to non-DC residents because of the small, close geographic area. The DC SEU initiative's design has attempted to limit the extent of leakage by targeting neighborhood stores and grocery stores that are less likely to draw customers from a large area. Some of these stores are close to the edge of the District, though, and so even smaller stores present some risk of leakage.

The results for leakage indicate that up to 15 percent of bulbs may end up installed outside of the District. Two-thirds of these were intended to be installed in Maryland, while the other third were reported to be installed in Virginia and Connecticut.

Table 4-123. Leakage by Destination

Category	Respondents	Packages	Percent of Packages
DC	165	421	85%
MD	*15*	*51*	*10%*
Other	*3*	*22*	*4%*
Total Leakage	18	73	15%
Total Surveyed	**183**	**494**	**100%**

Customers who plan to install bulbs outside DC shopped at many of the stores, including those that are not directly near the edge of the District. The two Safeway grocery stores attracted the fewest non-DC customers, and Home Depot was the only store to attract customers from places other than DC and Maryland. The store with the highest leakage of those surveyed, Rodman's, was already identified by DC SEU as a potential risk, and they have decreased marketing efforts through that store. The results in Table 4-124 are weighted by the number of bulbs purchased by surveyed customers. We also display the total number of bulbs sold through these stores in FY13 to provide a reference for the impact of the leakage.

Table 4-124. Leakage by Retail Location

Store	DC	MD	Other	Total Leakage	Total FY13 Sales
Ace Hardware – Annie's Ace	84%	16%	0%	16%	1,326
Home Depot	84%	8%	8%	16%	114,306
King Discount	79%	21%	0%	21%	180
Rodman's	74%	26%	0%	26%	5,712
Safeway – Georgetown	98%	2%	0%	2%	5,548
Safeway – Piney Branch	100%	0%	0%	0%	5,228
Yes! Organic Market – Brookland*	100%	0%	0%	0%	804
Total	**85%**	**10%**	**4%**	**15%**	**133,104**

* This represents only one respondent, so is included here only as a contribution to the overall results.

To identify leakage into the District, we included lighting questions in the participant surveys regardless of which track the respondent was being surveyed about. First, we asked if customers purchased efficient lighting products such as CFLs or LEDs. Just over half of the respondents indicated that they had purchased efficient lighting products. Participants in the HPwES and efficient appliances tracks were most likely to purchase additional lighting. We caution that these results potentially are biased by the fact that all respondents had already participated in some sort of energy-efficiency program.

Table 4-125. Follow-up Lighting Purchases by Participation Track

	Did not purchase	Purchased	Total
7120PV	9	8	17
7420FHLB	8	2	10
7420HPES	21	34	55
7710APPL	33	41	74
7710LITE	18	14	32
Total	**89**	**99**	**188**

Customers reported purchasing CFLs more frequently than LEDs, however not by as large a margin as might be expected. Nearly half of respondents who purchased additional efficient lighting purchased LEDs, while two-thirds purchased CFLs. There is some overlap, as 12 respondents reported purchasing both CFLs and LEDs.

Table 4-126. Additional Bulb Types Purchased

	CFLs	LEDs	Both	Total
7120PV	4	3	1	8
7420FHLB	2	0	0	2
7420HPES	16	15	3	34
7710APPL	22	13	6	41
7710LITE	8	4	2	14
Total	**52**	**35**	**12**	**99**

Just as many respondents who purchased bulbs through DC SEU-partnering retailers purchased bulbs outside of the District. Thirteen respondents purchased bulbs at more than one type of retailer. In relation to the study of leakage, these responses suggest that District customers are just as likely to purchase bulbs outside of the District as they are to buy them from participating stores. This counteracts the leakage out of the District, as some of these bulbs were purchased at stores such as Lowe's and Home Depot participating in Maryland energy efficient lighting programs.

Table 4-127. Location of Additional Lighting Purchases

	Track					
	7120PV	7420FHLB	7420HPES	7710APPL	7710LITE	Total
Participating Store	3	0	16	17	12	48
Nonparticipant store within DC	0	0	1	7	1	9
Nonparticipating store outside DC	5	2	16	23	3	49
Total	**8**	**2**	**31**	**39**	**13**	**93**

Based on this information, the evaluation team does not recommend adjusting claimed savings for leakage. While some bulbs incentivized by DC SEU certainly end up installed outside of DC, the opposite also occurs and results in energy savings in DC without use of the DC SEU budget.

C. Recommendations

The evaluation team makes the following recommendations regarding cross-sector sales and leakage.

i. **The evaluation team recommends that the nonresidential sector sales estimate be increased from 10 to 14 percent.** This will increase the savings produced by the retail lighting initiative as nonresidential installations result in higher savings.

ii. **Do not adjust savings based on leakage results.** It is not common practice to adjust savings for leakage, and it is not recommended in the Department of Energy's Uniform Methods Project.[23] There is also evidence of leakage into the District.

iii. **Monitor neighboring programs' presence and design to avoid an imbalance in leakage.** If customers see significantly better product availability or pricing through the DC SEU initiative, this could lead to leakage out of the District without similar levels of leakage in. This may be most important for LED products, as CFLs are more well-established.

[23] Department of Energy Uniform Methods Project, Chapter 6: Residential Lighting Evaluation Protocol. http://www1.eere.energy.gov/wip/pdfs/53827-6.pdf.