LOCAL LAW 87 ANNUAL REPORT

FISCAL YEAR 2016

Prepared December 2016

energy NYC

Local Law 87 Annual Report

Fiscal Year 2016

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DCAS Energy Management – Local Law 87 Annual Report

Local Law 87 of 2009 (LL 87) calls for energy auditing and retro-commissioning of public and private sector buildings over 50,000 gross square feet to aid the City in meeting its greenhouse gas emissions reduction goals as reflected in *OneNYC and One City: Built to Last*.

DCAS Energy Management (DEM) commissions qualified energy consultants to prepare Energy Efficiency Reports (EERs) for City buildings, as part of the City's compliance with LL 87. As of June 30, 2016, DEM has filed a total of 178 EERs with the Department of Buildings (DOB). Thirteen (13) EERs were filed in FY 2016, the period covered by this report; six (6) EERs were filed in Fiscal Year (FY) 2015; the remaining 159 EERs were filed in FY 2014 in an early compliance period. This report reviews the FY 2015 and 2016 EERs together, and summarizes the following: 1) the most common EER improvements recommended by the energy audits for these buildings; 2) the analysis of the accuracy of such energy audits in predicting costs of the recommended capital improvements; 3) the post-installation analysis of the accuracy with which such audits predicted the actual savings achieved by the capital improvements; and recommendations as to appropriate legislative or administrative actions.

This Annual Report is submitted to the speaker of the city council and the mayor pursuant to LL 87's requirement for reporting on capital improvements to base building systems for the period July 1, 2015 through June 30, 2016 (FY 2016).

Reasonable Energy Conservation Measures (ECMs)

LL 87 calls for an energy audit to identify, "at a minimum, all reasonable measures including capital improvements that would, if implemented, reduce energy use and/or the cost of operating the building." Furthermore the law stipulates that "reasonable capital improvements to the building's base building systems that are recommended in the building's energy audit shall be completed including, at a minimum, all those improvements of the base building systems having a simple payback of not more than seven years…"

In compliance with LL 87, the City has implemented all reasonable measures with a simple seven (7) year payback or less. These reasonable measures are termed Energy Conservation Measures (ECMs) in the EER, as opposed to Retro-Commissioning Measures or Operations and Maintenance Measures (RCMs), as set forth in the definition of "simple payback" contained in LL 87. The City has done so through its energy efficiency capital improvement programs, where measures meet the capital eligibility requirements set forth in the New York City Comptroller's Directive 10 and are confirmed by the Office of Management and Budget. Where reasonable measures do not meet capital eligibility requirements, the City seeks to fund those measures through its expense-funded program in coordination with retro-commissioning measure implementation. Henceforth, for the purpose of this report, these reasonable measures will be referred to as ECMs.

Energy Efficiency Reports Submitted Pursuant to LL 87

The 178 EERs submitted to the Department of Buildings (DOB) to date represent buildings managed by 14 City agencies in all five boroughs.

EERs Submitted by Boro	# of EERs	% of Total
Bronx	33	19%
Manhattan	46	26%
Brooklyn	55	31%
Queens	35	20%
Staten Island	9	5%
Total	178	

EERs submitted by Fiscal Year and Agency	# of EERs	Sq. Feet.
FY14 Total	159	30,300,098
Brooklyn Public Library	2	412,917
Department of Citywide Administrative Services	25	8,352,722
Department of Homeless Services	9	1,006,165
Department of Correction	7	2,935,530
Department of Education	80	12,323,383
Department of Health and Mental Hygiene	1	260,308
Department of Transportation	2	211,200
Department of Parks and Recreation	7	457,729
Department of Sanitation	9	1,318,707
New York Fire Department	2	663,196
Human Resources Administration	2	145,441
New York Police Department	11	1,560,821
New York Public Library	1	600,000
Taxi and Limousine Commission	1	51,979
FY15	6	500,053
Department of Education	6	500,053
FY16	13	2,838,137
Department of Citywide Administrative Services	4	1,801,300
Department of Homeless Services	2	272,380
Department of Education	7	764,457
Total EERs Submitted to DOB as of 06/30/2016	**178**	**33,638,288**

A list of these reports is included in Appendix A. Actual reports are provided by DCAS to DOB upon DOB's request.

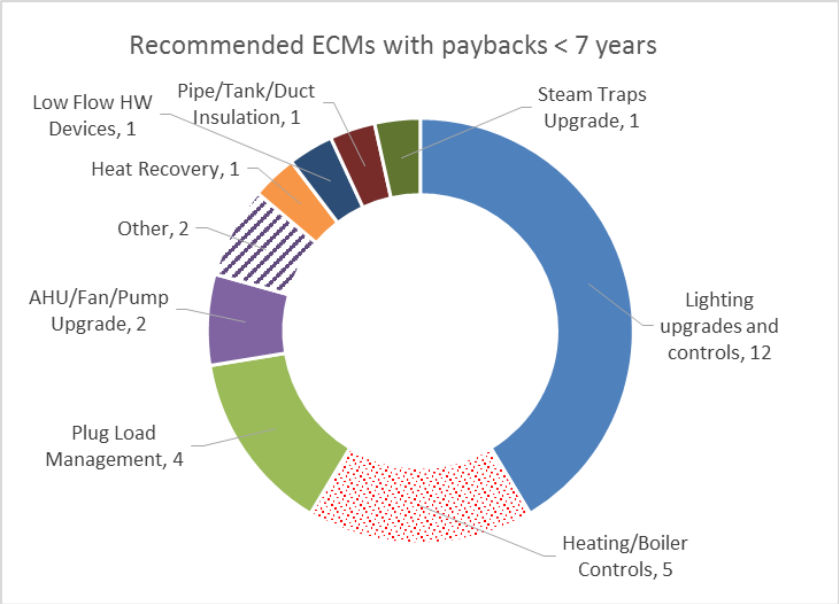
Most Common EER Improvement Recommendations

There were 107 recommended ECMs in the 19 EERs filed with the DOB in FY 2015 and 2016. Over a quarter of the ECMs – 27% -- met the seven (7) year simple payback criteria for mandatory implementation for City buildings. The same proportion had paybacks of 20 years or more.

ECMS by payback period	# of ECMs	% of ECMs
Paybacks of 7 years or less	29	27%
Paybacks from 7 to 10 years	19	18%
Paybacks from 10 to 20 years	30	28%
Paybacks of 20 years or more	29	27%
Total	107	100%

The most common improvements to base building systems recommended in these EERs irrespective of payback are for lighting upgrades and controls, and heating/boiler controls. Other measures recommended with less frequency cover other aspects of heating systems upgrades, electrical equipment upgrades, building controls, and building envelop improvements.

For recommended improvements with paybacks of seven years or less, the ECMs, and their frequencies, are as follows:



Cost Predictions

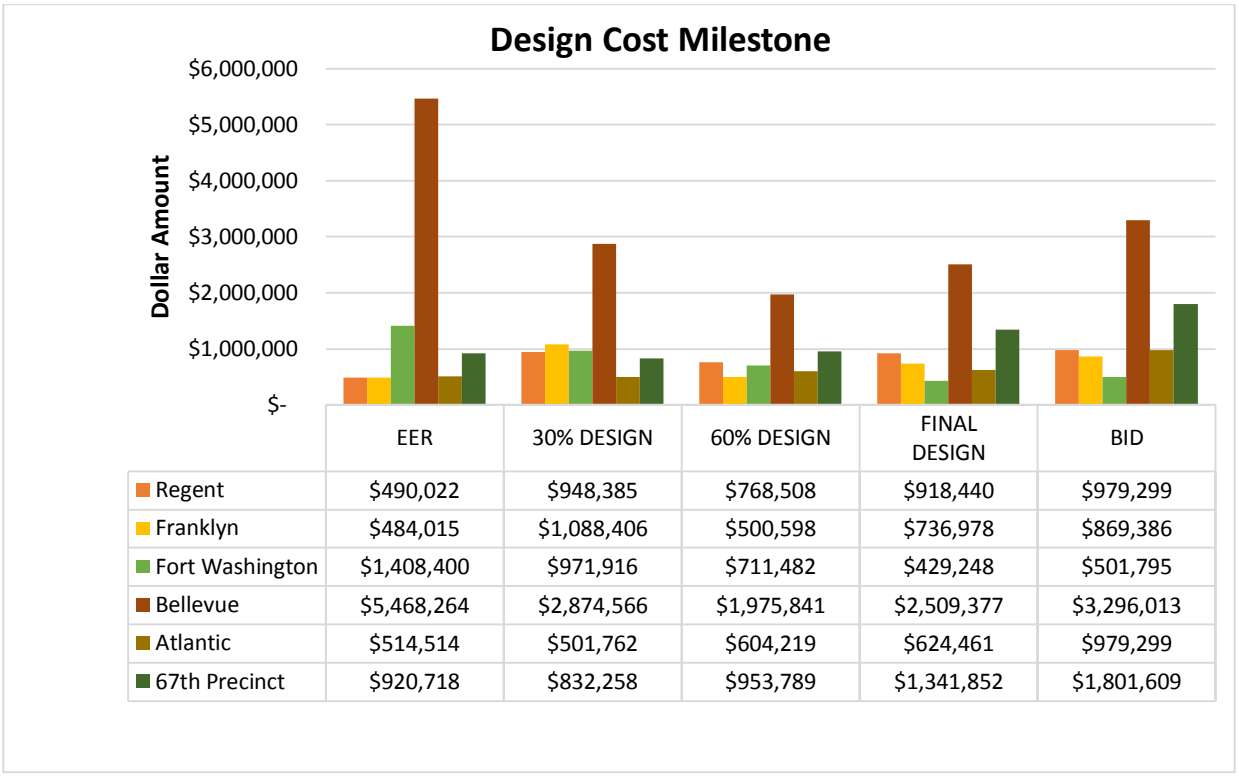
Local Law 87 requires DCAS to include in the annual report an analysis of the accuracy of energy audits in predicting costs of the recommended capital improvements. Substantial lead time is required for capital planning, funding, and project implementation following an energy audit. It is expected that over the next two years there will be a sufficient post-implementation period for a broad range of projects growing out of EERs, with enough capital improvements to more accurately assess the accuracy of the reports in predicting costs and savings.

Until then, DEM has analyzed predictive cost and savings information for two sets of information that it has. First, there were nine ECMs that were feasible and reasonable to implement along with the implementation of RCMs, in seven buildings. For these measures, projected costs were underestimated by almost 20% on an aggregate basis for selected ECMs. As shown in the table that follows, cost estimates varied widely for particular measures and for the same measure at different locations, but were within a reasonable range in total in the construction environment. Variations in cost estimates have been due to such factors as changes in quantities of a recommended ECM, unexpected field conditions, differences in material and labor cost estimates, and small variations in scope. For example, the $1,265 cost recommendation of first ECM below was for upgrading a total of eight exit lights identified in the audit; the actual quantity of fixtures that needed replacement was forty-one. The large cost increase was a result of both the larger number of units installed and a higher cost per unit (per-unit went from $158 to $306). The variation in particular ECM cost projections supports DCAS's recommendations (see Recommendation section) for flexibility in identifying EMCs for implementation.

Recommended ECM	Projected Implementation Cost	Actual Implementation Cost	% Actual Implementation Cost is Over (Under) Projected
Upgrade Remaining non-LED Exit Lighting to LED	$ 1,265	$ 12,536	891%
Insulate Feed Water Tank	$ 2,062	$ 5,090	147%
Install Boiler Fuel Economizers	$ 17,109	$ 1,804	-89%
Occupancy sensors in classrooms	$ 55,136	$ 64,620	17%
Occupancy sensors in classrooms	$ 30,258	$ 30,773	2%
Replace or repair Steam Traps	$ 21,011	$ 27,127	29%
Install LED Exit Signs	$ 13,358	$ 17,547	31%
Install LED Exit Signs	$ 20,873	$ 15,580	-25%
Install LED Exit Signs	$ 12,903	$ 27,701	115%
Total	*$ 173,975*	*$ 202,778*	*17%*

Second, DEM has tracked design-stage cost estimates and bid costs for capital projects now under construction for projects that resulted from EERs, as shown in the bar chart and table below. While the total final bid costs for these particular six construction projects were close to – in fact, 9% below – the total costs projected in the EERs, that is not the case on a project-by-project basis. For individual projects, EER cost projections vary widely from actual bid costs (consistent with the experience reported above for individual ECM cost projections). Four of the projects had bid costs ranging from 80% to double the initial projection. These ranges are not out of line with industry norms but also point to the

need for some flexibility in implementation, if changes in savings estimates do not keep pace with changes in cost estimates.



	EER	30% DESIGN	60% DESIGN	FINAL DESIGN	BID
Regent	$490,022	$948,385	$768,508	$918,440	$979,299
Franklyn	$484,015	$1,088,406	$500,598	$736,978	$869,386
Fort Washington	$1,408,400	$971,916	$711,482	$429,248	$501,795
Bellevue	$5,468,264	$2,874,566	$1,975,841	$2,509,377	$3,296,013
Atlantic	$514,514	$501,762	$604,219	$624,461	$979,299
67th Precinct	$920,718	$832,258	$953,789	$1,341,852	$1,801,609

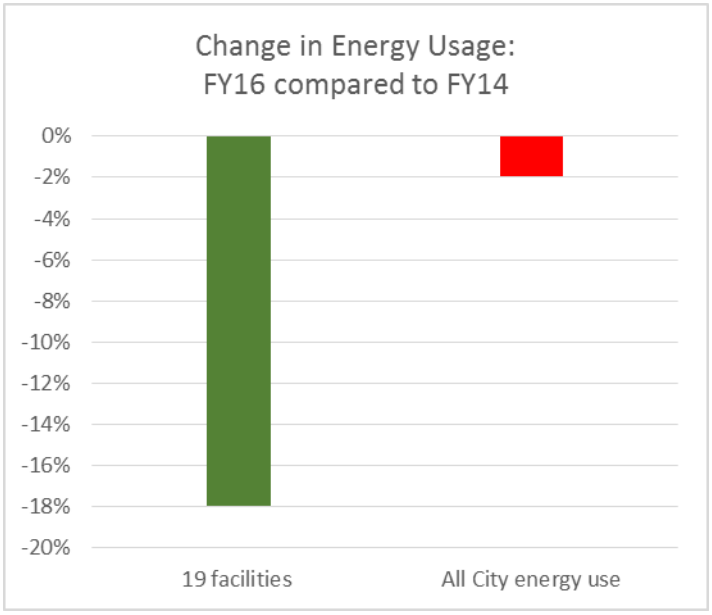
COST ESTIMATES COMPARISON

Project	EER / Class 5	BID	% BID over or Under EER Projection
Regent	$490,022	$979,299	100%
Franklyn	$484,015	$869,386	80%
Fort Washington	$1,408,400	$501,795	-64%
Bellevue	$5,468,264	$3,296,013	-40%
Atlantic	$514,514	$979,299	90%
67th Precinct	$920,718	$1,801,609	96%
TOTAL	**$9,285,933**	**$8,427,401**	**-9.2%**

Savings Predictions

Local Law 87 also requires an analysis of the accuracy of audits in predicting savings. With respect to assessing savings estimates, more time will be needed to complete either whole-facility upgrades or selected single-ECM verifications. This is because, as stated above, the long lead time for planning, budgeting for, and implementing capital work has resulted in projects based on completed EERs that are still under construction. After implementation, a year of operation is necessary in order to assess the accuracy with which the audit predicts the actual savings achieved.

However, DEM has reviewed the actual energy used in the 19 facilities for which EERs were filed in FY15 and FY16. Retro-commissioning (RCM) work as done at those facilities, along with the implementation of a few low-cost ECMs. The chart below shows that as a whole, those facilities used 18% less energy in FY16 compared to FY14; the citywide drop over that same period was 2%. This is a dramatic difference, and likely points to the impact of savings from all of the work done, including the recommended RCMs, which are operational or maintenance measures implemented in the short term.



Further, DEM engaged the City University of New York (CUNY)'s Building Performance Lab to assess savings at the whole building level for select retrofit projects that are similar to some of the capital work recommended in LL87 EERs that will be the subject of future years' reports. That analysis can be found in Appendix B.

General Findings -- Accuracy of EERs in predicting costs:

Estimated costs by ECM reflected in EERs are not congruent with construction industry standard practices used for bids and therefore do not accurately predict the actual cost of ECM implementation. In the early years of LL87 compliance, it was common to find ECM cost estimates based on material and labor costs alone. Another factor that contributes to EERs understating the actual costs associated with capital measures is the omission from EERs of costs associated with:

- Design and/or construction management fees
- Overhead and profit
- Environmental remediation costs (e.g., asbestos/PCBs)
- Field conditions
- Scope changes

To resolve this issue, DEM has worked with its consultants to ensure that all relevant estimated costs are incorporated into the simple payback calculation in EERs. As a result, the accuracy of cost estimates in recent reports has improved. However, costs reported in the EER are still likely to vary compared to actual installed cost because cost estimates for ASHRAE Level II Energy Audit are not required to be bid-level construction cost estimates.

General Findings -- Accuracy of EERs in predicting savings:

The M&V analyses provided by CUNY's Building Performance Lab demonstrate reduced energy usage where energy retrofit projects were completed, indicating that retrofits do yield reduced energy consumption and lower energy costs. And DEM's own analyses show energy savings after implementation of operational measures recommended in energy audits. Thus, the energy audit is an adequate tool for identifying measures that will yield energy savings. However, the report's accuracy in predicting the amount of savings is difficult to determine. A precise comparison of audit estimates for energy reductions and actual energy reductions is not possible as energy usage is measured at the building level and not by individual ECMs. There are other variables that impact energy use at a building level including but not limited to its hours of occupancy, type of use, existing building equipment, and changes to plug loads, which makes it difficult to isolate the precise impact of an ECM. Despite these uncertainties, it is clear that building energy use decreased through the EER process.

Recommended LL 87 of 2009 Legislative or Administrative Actions

The drafters of this legislation had the foresight to anticipate that recommendations for legislative or administrative changes to LL 87 might be necessary, as real-world execution is not always consistent with the well-intentioned requirements of the law. Since the passage of LL 87, DCAS has gained significant practical experience with the benefits and challenges of compliance with the law. Based on this experience, DCAS will be proposing changes that provide the ability to implement more ECMs, including those with longer paybacks than this law requires, and to not pursue ECMs where building conditions have changed. In order to do this efficiently, within a given building ECMs with longer paybacks would be bundled together with ECMs with shorter paybacks. Time limits for implementation of ECMS relative to the filing of the related EER may also need to be extended. These changes will help meet the City's 80 x 50 carbon reduction goals sooner and more efficiently.

APPENDIX A: EERs Submitted to DOB Pursuant to Local Law 87

ITEM	Facility Name	Address	Agency	BIN	BBL	Sq Ft	EER DOB Filing Date
1	St. Mary's Recreational Ctr	450 St Anns Ave	DPR	2003692	2025570001	56,125	12/24/13
2	Murray Bergtraum HS	411 Pearl St	DOE	1001388	1001130100	305,000	12/24/13
3	PS 8	100 Lindenwood Rd	DOE	5066295	5052210001	60,000	12/20/13
4	26th Repair Shop	640 West 26th St	DSNY	1012267	1006700050	205,000	12/27/13
5	122nd Police Precinct	2320 Hylan Blvd	NYPD	5107580	5039060001	51,439	12/27/13
6	Brooklyn Central Court	120 Schermerhorn St	DCAS	3000534	3001690017	264,000	12/27/13
7	Queens Borough Hall	120-55 Queens Blvd	DCAS	4052812	4022740002	261,000	12/27/13
8	Manhattan Criminal Court	100 Centre St	DCAS	1079000	1001670001	795,700	12/27/13
9	Police Headquarters	1 Police Plz	NYPD	1079143	1001190001	751,908	12/27/13
10	Public Health Lab	455 1st Ave	DOHMH	1020610	1009320017	260,308	12/27/13
11	Humanities & Social Sc Lib	476 5th Ave	NYPL	1034194	1012570001	600,000	12/27/13
12	158th St. Fleet Svc's Shop	675 West 158th St	DOT	1087614	1021340218	94,200	12/30/13
13	100 Gold St.	100 Gold St	DCAS	1001289	1000940025	594,000	12/27/13
14	Woodside Insp. Facility	24-55 Brooklyn-Queens Expwy	TLC	4022499	4010160045	51,979	12/27/13
15	Brooklyn Heights Branch	280 Cadman Plz West	BPL	3001939	3002390016	62,917	12/27/13
16	Mario Merola /County Court	851 Grand Concourse	DCAS	2002869	2024680001	555,859	12/27/13
17	Co-op City (PS 153, 178, 180, 181 & 455)	650-850 Baychester Ave	DOE	2097470	2051410150	1,190,650	12/31/13
18	X174	456 White Plains Rd	DOE	2020580	2034780018	202,880	12/30/13
19	X129	2055 Mapes Ave	DOE	2012957	2031090001	148,475	12/31/13
20	Brooklyn Supreme Court	292-360 Adams St	DCAS	3000257	3001390020	823,584	12/30/13
21	Queens Criminal Court	125-01 Queens Blvd	DCAS	4206522	4096530001	648,000	12/30/13
22	K009	80 Underhill Ave	DOE	3028204	3011450026	139,375	12/26/13
23	Q020	142-30 Barclay Ave	DOE	4114657	4050470001	156,175	12/30/13
24	Q120	58-01 136th St	DOE	4139491	4063730001	111,725	12/30/13
25	Q125	46-02 47th Ave	DOE	4052874	4022840006	164,683	12/20/14
26	K302	350 Linwood St	DOE	3088357	3039690001	209,275	12/31/13
27	M199	270 West 70th St	DOE	1030351	1011580040	105,700	12/31/13
28	K126	424 Leonard St	DOE	3067788	3027120001	160,925	12/31/13
29	X054	2703 Webster Ave	DOE	2113630	2032780014	98,980	12/30/13
30	Q092	99-01 34 Ave	DOE	4042496	4017140018	98,130	12/24/13
31	K135	686 Linden Blvd	DOE	3102005	3046730001	72,280	12/24/13

ITEM	Facility Name	Address	Agency	BIN	BBL	Sq Ft	EER DOB Filing Date
32	K067	51 Saint Edwards St	DOE	3332507	3020390002	138,125	12/30/13
33	M721	250 West Houston St	DOE	1009757	1005810054	133,325	12/30/13
34	R080	715 Ocean Terrace	DOE	5113169	5006830001	299,200	12/30/13
35	K013	557 Pennsylvania Ave	DOE	3085070	3038230001	64,925	12/30/13
36	M217	645 Main St	DOE	1084848	1013730001	115,085	12/24/13
37	Bushwick Multi Service Ctr	1420 Bushwick Ave	HRA	3080067	3034440022	52,000	12/26/13
38	5-Boro Complex	1 Randalls Island	DPR	1085920	1018190203	59,664	12/30/13
39	M075	735 West End Avenue	DOE	1034190	1012530065	110,575	12/24/13
40	X068	4011 Monticello Avenue	DOE	2067852	2049860081	94,860	12/30/13
41	X078	1400 Needham Avenue	DOE	2060191	2047190001	109,280	12/30/13
42	X111	3740 Baychester Avenue	DOE	2065992	2049160001	105,775	12/30/13
43	X112	1925 Schieffelin Ave	DOE	2065991	2049050500	85,325	12/24/13
44	X125	1111 Pugsley Avenue	DOE	2025717	2037900040	175,325	12/31/13
45	X127	1560 Purdy Avenue	DOE	2041247	2039480055	153,725	12/24/13
46	X131	885 Bolton Avenue	DOE	2103869	2036440001	184,975	12/27/13
47	X142	3750 Baychester Avenue	DOE	2066190	2049350001	164,751	12/31/13
48	K131	4305 Fort Hamilton Parkway	DOE	3136085	3056030001	103,354	12/30/13
49	K307	209 York Street	DOE	3000158	3000560007	111,744	12/24/13
50	K318	101 Walton Street	DOE	3061328	3022460001	181,375	12/30/13
51	Q021	147-36 26th Avenue	DOE	4108665	4048030001	125,260	12/24/13
52	Q219	144-39 Gravett Road	DOE	4448708	4065070001	115,450	12/30/13
53	Q238	88-15 182nd Street	DOE	4212425	4099190006	240,055	12/20/13
54	K801	65 Court Street	DOE	3002557	3002660020	342,200	12/20/13
55	M115	586 West 117th Street	DOE	1063228	1021330040	124,900	12/30/13
56	K218	370 Fountain Avenue	DOE	3095977	3042780001	181,325	12/23/13
57	K115	1500 East 92 Street	DOE	3232559	3082560001	123,000	12/24/13
58	K181	1023 New York Avenue	DOE	3327776	3049040010	153,725	12/30/13
59	M043	509 West 129th Street	DOE	1059723	1019840033	135,000	12/24/13
60	M540 A Philip Randolph HS	443 West 135 Street	DOE	1059409	1019570078	163,000	12/30/13
61	K010	511 7th Avenue	DOE	3016509	3008690001	77,000	12/24/13
62	K033	70 Thompkins Avenue	DOE	3048517	3017430018	175,300	12/31/13
63	K081	990 Dekalb Avenue	DOE	3043248	3016020019	130,925	12/26/13
64	K220	4812 9th Avenue	DOE	3012824	3007780023	109,000	12/24/13

ITEM	Facility Name	Address	Agency	BIN	BBL	Sq Ft	EER DOB Filing Date
65	East Harlem Multi Srvce Ctr	413 East 120th St	HRA	1054888	1018080008	93,441	12/24/13
66	Roy Wilkins Recreation Ctr	Baisley Blvd & Merrick Blvd	DPR	4268835	4124060180	60,000	12/24/13
67	M099	410 East 100th Street	DOE	1052998	1016930001	115,000	12/30/13
68	M022	111 Columbia Street	DOE	1004070	1003350001	151,000	12/31/13
69	X057	2111 Crotona Ave	DOE	2012359	2030810026	91,280	12/24/13
70	X104	1449 Shakespeare Ave	DOE	2088263	2028730027	124,900	12/30/13
71	K138	760 Prospect Place	DOE	3330794	3012330026	164,525	12/31/13
72	K383	1300 Greene Avenue	DOE	3075413	3032980001	211,375	12/31/13
73	K225	1075 Ocean View Avenue	DOE	3245498	3087120056	102,000	12/24/13
74	R044	80 Maple Parkway	DOE	5027641	5012180001	116,500	12/30/13
75	M025	145 Stanton Street	DOE	1004323	1003540080	160,000	12/24/13
76	M084	32 West 92 Street	DOE	1081042	1012050006	104,525	12/31/13
77	X039	965 Longwood Avenue	DOE	2005616	2027100001	102,100	12/24/13
78	Q600	37-02 47th Avenue	DOE	4003259	4002280020	195,785	12/31/13
79	M600	225 West 24th Street	DOE	1014174	1007740019	363,130	12/31/13
80	Brooklyn Public Library	10 Grand Army Plz	BPL	3029665	301183002	350,000	2/10/14
81	Bronx Housing Court	1118 Grand Concourse	DCAS	2101266	2024620039	99,000	12/23/13
82	Bronx Concourse Plaza	198 East 161 Street	DCAS	2099027	2024430094	231,190	12/27/13
83	Bronx Bergen Building	1932 Arthur Ave	DCAS	2009911	2029470018	90,000	12/23/13
84	Mark A. Constantino Judicial Ctr	130 Stuyvesant	DCAS	5000085	5000080070	150,300	12/23/13
85	Manhattan Supreme Court	60 Centre St	DCAS	1085748	1001600021	322,300	12/27/13
86	Sun Building	280 Broadway	DCAS	1079215	1001531002	242,062	12/27/13
87	Long Island City Courthouse	25-10 Court Sq	DCAS	4000698	4000830001	59,300	12/23/13
88	Queens Civil Court	89-17 Sutphin Blvd	DCAS	4448759	4096800001	320,535	12/24/13
89	Louis J. Lefkowitz Building	80 Centre St	DCAS	1001830	1001660027	472,500	12/27/13
90	Manhattan Civil Court	111 Centre St	DCAS	1001833	1001690010	467,000	12/24/13
91	Excelsior Building	137 Centre St	DCAS	1002358	1001970017	59,000	12/24/13
92	Health Building	125 Worth St	DCAS	1001831	1001680032	406,109	12/24/13
93	Bronx Family & Criminal Court	215 East 161st St	DCAS	2002704	2024540001	490,000	12/24/13
94	Staten Island Borough Hall	10 Richmond Ter	DCAS	5000063	5000070001	81,538	12/24/13
95	Queens Supreme Court	88-11 Sutphin Blvd	DCAS	4207071	4096910001	308,200	12/24/13
96	Manhattan Family Court	60 Lafayette St	DCAS	1001842	1001710031	491,000	12/24/13

ITEM	Facility Name	Address	Agency	BIN	BBL	Sq Ft	EER DOB Filing Date
97	Off. of Emergency Mgmt. HQ	165 Cadman Plz East	DCAS	3000172	4000850006	66,245	12/27/13
98	Manhattan Appellate Court	27 Madison Ave	DCAS	1016743	1008550001	54,300	12/24/13
99	Bellevue Men's Shelter	400 East 30th Street	DHS	1087298	1009620097	277,076	12/27/13
100	Regent Hotel Shelter	2720 Broadway	DHS	1056586	1018760020	102,275	12/27/13
101	Franklin Women's Shelter	1122 Franklin Ave	DHS	2004260	2026130001	97,000	12/27/13
102	Atlantic Ave Men's Shelter	1322 Bedford Ave	DHS	3029748	3011990015	164,320	12/27/13
103	PATH Office	346 Powers Ave	DHS	2091301	2025720006	72,000	12/30/13
104	Ft Washington Arm.-Shelter	216 Ft Washington Ave	DHS	1063381	1021380079	88,519	12/24/13
105	Borden Avenue Shelter	21-10 Borden Ave	DHS	4000526	4000680002	55,000	12/24/13
106	Briarwood Residence	80-20 134th St	DHS	4314908	4096620020	50,000	12/24/13
107	Manhattan House of Detention	125 White St	DOC	1079000	1001670001	1,079,000	12/24/13
108	George R. Vierno Ctr (GRVC)	9-9 Hazen St	DOC	2096863	4026050040	458,000	12/23/13
109	Otis Bantun Correctional Ctr (OBCC)	Riker's Island	DOC	9999999	2999999999	344,632	12/23/13
110	Rose M. Singer (RMSC)	19-19 Hazen St	DOC	9999999	2999999999	291,000	12/24/13
111	George Motchan Det Ctr (GMDC)	15-15 Hazen St	DOC	2097042	4026050040	533,491	12/24/13
112	Eric M. Taylor Center (EMTC)	10-10Hazen St	DOC	9999999	4026050040	484,407	12/24/13
113	Vernon C. Bain Center (VCBC)	1 Halleck St	DOC	2101256	2027800073	310,000	12/27/13
114	Maspeth Central Shops	58-50 57th Rd	DOT	4805470	4026750015	117,000	12/27/13
115	Chelsea Recreational Center	430 West 25th Street	DPR	1012811	1007220057	83,940	12/24/13
116	Brownsville Rec. Ctr	598 Christopher Ave	DPR	3085992	3038680002	72,000	12/23/13
117	Asphalt Green Rec. Ctr	1750 AquaCenter York Ave	DPR	1085696	1015870001	56,000	12/23/13
118	Ranaqua Shops and Garage	1900 Birchall Ave	DPR	2101004	2043330001	70,000	12/23/13
119	Queens West 2,3,4,6 DG; CRS	52-35 58th Street	DSNY	4462505	4023610268	550,000	12/27/13
120	Cioffe Borough Repair Shop	106-01 Ave D	DSNY	3252759	3038710001	75,000	12/23/13
121	SI 3 District Garage; RBS	Muldoon Ave, entrance to Fresh Kills	DSNY	5000000	5026850100	59,798	12/23/13
122	Brooklyn W11G	1824 Shore Parkway	DSNY	3378180	3069430002	75,000	12/23/13
123	Brooklyn North 1, 4 DG	157-175 Varick St	DSNY	3070545	3029620005	79,305	12/27/13
124	Manhattan 3 DG	South St Pier 36	DSNY	1805208	1002410013	55,330	12/27/13
125	Queens 7/11 DG Annex	120-15 31st Ave	DSNY	4802407	4043460075	101,930	12/23/13
126	Bronx 12 DG	1643 East 233rd St	DSNY	2090261	2049740028	117,344	12/23/13
127	Fort Totten	Various - See FDNY sheet	FDNY	9999999	4059170001	421,996	12/24/13
128	Fire Academy - Randalls	Various - See FDNY sheet	FDNY	1085640	1018190015	241,200	12/27/13

ITEM	Facility Name	Address	Agency	BIN	BBL	Sq Ft	EER DOB Filing Date
129	NYPD Command (BNN Div)	245 Glenmore Ave	NYPD	3083636	3036980032	60,000	12/23/13
130	Central Repair Shop (CRS)	53-15 58th St	NYPD	4054276	4023610150	75,400	12/27/13
131	84th Precinct & Eng Co 207	301 Gold St	NYPD	3000252	3001340006	50,000	12/23/13
132	NYPD Precinct 67th	2820 Snyder Ave	NYPD	3117400	3051110024	53,976	12/23/13
133	NYPD Precinct 72nd	830 4th Ave	NYPD	3009843	3006680029	53,600	12/24/13
134	NYPD Precinct 81st	30 Ralph Ave	NYPD	3044596	3016330039	58,745	12/27/13
135	Police Acad/13th Precinct	230 East 21st St	NYPD	1019613	1009010006	296,405	12/27/13
136	NYPD Precinct 48th	450 Cross Bronx Expwy	NYPD	2009509	2029070010	59,328	12/27/13
137	NYPD Precinct 73rd	1470 East New York Ave	NYPD	3080735	3034970002	50,020	12/24/13
138	K191	1600 Park Place	DOE	3036635	3013750012	92,480	12/31/13
139	K251	1037 E 54 St	DOE	3214729	3077580001	91,280	12/31/13
140	K276	1070 East 83rd	DOE	3225637	3080340001	282,180	12/31/13
141	K279	1070 East 104 St	DOE	3326733	3082300001	124,925	12/31/13
142	K287	50 Navy St	DOE	3000203	3001110001	98,725	12/24/13
143	K321	180 7th Ave	DOE	3337516	3009710028	109,444	12/31/13
144	K329	2929 West 30th St	DOE	3189517	3070510001	122,225	12/31/13
145	K650	257 N 6th St	DOE	3062135	3023300011	224,525	12/24/13
146	M019	185 1st Ave	DOE	1006478	1004530034	84,125	12/31/13
147	M028	475 West 155th St	DOE	1076739	1021070026	122,525	12/24/13
148	M054	103 W 107th St	DOE	1055990	1018620011	137,000	12/31/13
149	Q011	54-25 Skillman Ave	DOE	4028447	4012390001	101,260	12/31/13
150	Q191	85-15 258 St	DOE	4180083	4088010014	82,620	12/31/13
151	Q205	75-25 Bell Blvd	DOE	4164007	4077530001	120,648	12/31/13
152	Q225	190 Beach 110th St	DOE	4303853	4161810001	84,100	12/31/13
153	R031	55 Layton Ave	DOE	5001150	5000490182	92,600	12/31/13
154	R052	450 Buel Ave	DOE	5053746	5037050001	85,699	12/31/13
155	X101	2750 Lafayette Ave	DOE	2080231	2055470001	182,525	12/31/13
156	X121	2750 Throop Ave	DOE	2054253	2045260001	111,700	12/24/13
157	X135	2441 Wallace Ave	DOE	2051313	2044320001	163,300	12/31/13
158	M661	240 2nd Ave	DOE	1020416	1009210064	55,260	12/24/13
159	University Ave Res	1041 University Ave	DHS	2003496	2025270014	99,975	12/27/13
160	K022	442 St. Marks Avenue	DOE	3028281	3011480050	105,925	12/30/14

ITEM	Facility Name	Address	Agency	BIN	BBL	Sq Ft	EER DOB Filing Date
161	K185	8601 Ridge Blvd	DOE	3153416	3060430001	64,880	12/23/14
162	K269	1957 Nostrand Avenue	DOE	3113780	3049940023	97,300	12/30/14
163	K849 and K839	4001 18th Avenue	DOE	3127692	3054160048	57,180	06/30/15
164	K902	62 Park Place	DOE	3259250	3009410050	92,480	12/30/14
165	Q089	85-28 Britton Avenue	DOE	4037370	4015140001	82,288	12/30/14
166	K152	725 East 23rd Street	DOE	3205780	3075510026	197,100	12/11/15
167	Webster Avenue SRO	1075 Webster Ave	DHS	2102353	2024250020	174,600	12/11/15
168	K309	794 Monroe Street	DOE	3045047	3016430036	106,860	12/23/15
169	Manhattan Municipal Building	1 Centre St	DCAS	1001394	1001210001	1,070,800	12/23/15
170	Manhattan Surrogate's Court	31 Chambers St	DCAS	1001670	1001530024	212,500	12/23/15
171	Q081	559 Cypress Ave	DOE	4082076	4034370001	69,000	12/23/15
172	Q154	75-02 162nd St	DOE	4148003	4068340001	91,260	12/23/15
173	Q131 within (Q131,Q911)	170-45 84th Ave	DOE	4211112	4098750001	73,232	12/23/15
174	X015	2195 Andrews Avenue	DOE	2096013	2032240009	162,125	12/23/15
175	Brooklyn Borough Hall	209 Joralemon St	DCAS	3000256	3001390001	50,000	04/18/16
176	Brooklyn Municipal Building	210 Joralemon St	DCAS	3002558	3002660030	468,000	04/20/16
177	M841	466 West End Avenue	DOE	1032754	1012300001	64,880	06/08/16
178	Barbara Kleinman Residence	269 Skillman Ave	DHS	3338306	3028850001	97,780	01/06/16

APPENDIX B: Measurement and Verification of Energy Reductions

The Energy Data Lab (EDL) at the CUNY Building Performance Lab (BPL) was tasked by NYC DCAS Energy Management (DEM) with analyzing a number of energy retrofit projects completed during FY16. EDL analyzed energy consumption data at the whole facility level for these projects, and found that the data demonstrate reduced energy usage where energy retrofit projects were completed and operational for at least one year.

Methodology

Energy consumption data was provided to CUNY Building Performance Lab (BPL) in the form of a .csv file that contained billing data by meter for electric, gas and steam; as well as a limited amount of data from fuel oil delivery logs. The data were reviewed for gaps and outliers, and prepared for analysis: a raw data file was created for each facility that included electricity and fuel energy consumption data for 12 months prior to the retrofit start data and 12 months post-retrofit completion. Where a facility used multiple fuel energy types (i.e., natural gas and steam), consumption data for those meters was converted to BTUs and combined for analysis purposes; electricity data was left in kilowatt-hour (kWh) units. A standard daily average outside air temperature data file was used for analysis, with LaGuardia airport as the selected weather station.

The energy usage reduction analysis follows the Efficiency Valuation Organization's International Performance Measurement and Verification Protocol (IPMVP) Option C Whole Facility[1] measurement and verification (M&V) approach based on the monthly energy use data from the utility bills, and is also consistent with the methodology put forth in ASHRAE Guideline 14-2014, Measurement of Energy, Demand and Water Savings. This M&V approach requires that an empirical energy model between energy use and its main influencing parameter, which in this case is weather (outdoor air temperature), be developed to model baseline period energy use.

The baseline period is defined as the 12 months immediately preceding implementation of the energy conservation measures in the building. This model is then adjusted to post-installation conditions, using weather data (outdoor air temperature) from the post-installation period. The result is an estimate of what the baseline energy use would have been, had no measures been installed in the building. Energy usage reduction, essentially avoided energy usage, are the difference between the adjusted baseline use and the measured energy use for the post-install period.

It should be noted, that there may be some overlap between retrofit start/end dates and monthly energy consumption billing period start/end dates, due to the way in which utility meters are read and energy consumption is billed.

Case Studies

Case Study #1: Central Harlem Health Center
Project: Lighting Upgrade
Retrofit Dates: 5/1/2014-9/1/2014

[1] International Performance Measurement & Verification Protocol (IPMVP) – Core Concepts April 2016 EVO 10000 – 1:2016

The electric model in Figure 1a shows pre-installation baseline usage (blue line), actual post-installation usage (red line) and adjusted baseline usage (dotted pink line); the retrofit construction period is the gap in between the pre- and post-retrofit periods. According to this model, adjusted baseline usage during this period was estimated at 319,640 kWh, and actual usage was 268,800 kWh. As such, the electric reduction over the 12-month post-installation period (through August 2015) was: 50,840 kWh ± 34.6%, or 15.9% of adjusted baseline usage.

The project at this facility was a lighting retrofit. The lighting upgrade would be estimated to affect electric usage, with little effect (if any) on natural gas usage. The energy usage reduction models confirm the reduced electricity usage, and seem to indicate that this reduction primarily affected the electric baseload; this can be seen in the way the entire adjusted baseline usage is lower, yet the actual summer electric peak is still about the same relative magnitude as they would have been had no retrofit occurred, according to the adjusted baseline model.

As such, the data support the evidence of an overall decrease in electricity consumption from the baseline to the post-installation period, although the statistical metrics associated with the model convey a moderately high degree of uncertainty around the fit of the model to the data provided. It should be noted that actual electricity consumption is higher than the adjusted baseline around March 2015; the cause of this change in typical usage pattern is unknown.

The natural gas model in Figure 1b shows no significant difference in usage from the pre-retrofit to post-retrofit periods, confirming that the lighting upgrade had no perceptible effect on the fuel energy consumption.

Figure 1a. Central Harlem Health Center – Electricity Reduction Model

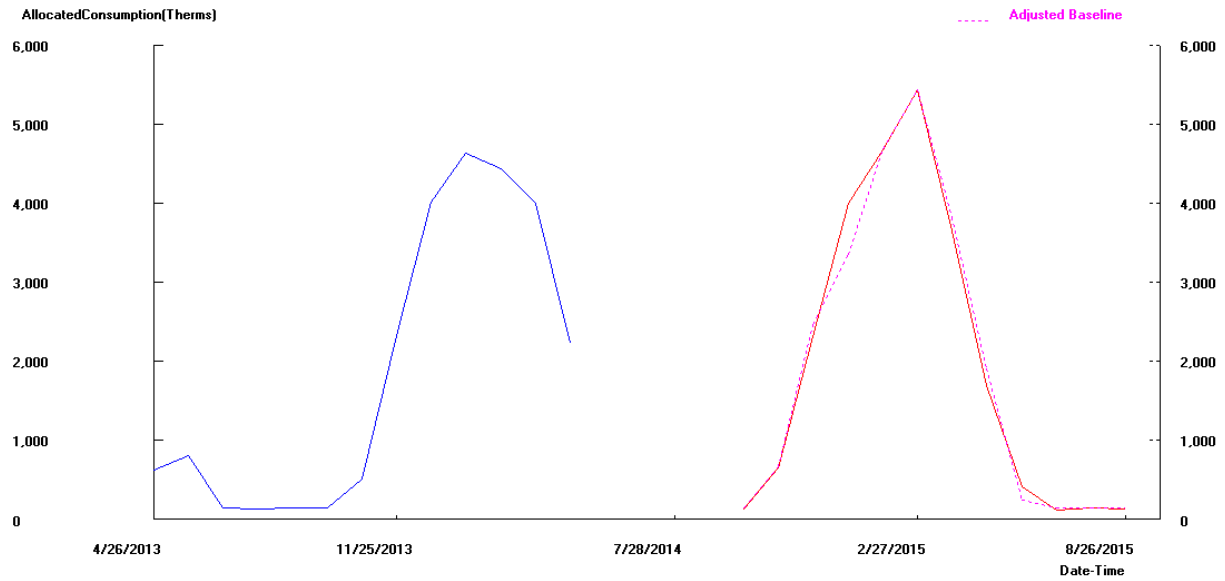


Figure 1b. Central Harlem Health Center – Natural Gas Reduction Model

Case Study #2: Randall's Island (Buildings 6 & 7)
Project: High-Efficiency RTU Replacments
Retrofit Dates: 4/7/2015-7/1/2015

The electric model in Figure 2 shows pre-installation baseline usage (blue line), actual post-installation usage (red line) and adjusted baseline usage (dotted pink line); the retrofit construction period is the gap in between the pre- and post-retrofit periods. According to this model, adjusted baseline usage during this period was estimated at 449,220 kWh, and actual usage was 343,513 kWh. As such, the electric reduction over the 12-month post-installation period (through June 2016) was: 105,707 kWh ± 16.6%, or 23.5% of adjusted baseline usage. Note that the fuel energy was not modeled, as fuel oil is used at the facility and only delivery log data is available, which is not sufficient for a reliable model.

The project at this facility was replacement of current rooftop packaged units (RTUs) used for cooling with high-efficiency RTUs. This upgrade would be estimated to affect electric usage. The energy usage reduction models confirm the reduced electricity usage, and seem to indicate that this reduction yielded a slight overall reduction in electricity consumption, with a significant drop in summer peaks. It should be noted that there were a number of estimated electricity meter readings during the pre- and post-retrofit periods: March 2014, December 2015 and June 2016. Often, when readings are estimated for one month, we find actual readings for the following month that are higher than expected, to compensate for under-reporting during the estimated month. This would likely explain the unusual spikes in usage that are seen in the post-retrofit actual usage, which are higher than the adjusted baseline.

Overall, the data support the evidence of a decrease in electricity consumption from the baseline to the post-installation period, and the statistical metrics associated with the model convey a moderately low degree of uncertainty around the fit of the model to the data provided.

Figure 2. Randall's Island – Electricity Reduction Model

Case Study #3: Asser Levy Pool
Project: Lighting Retrofit
Retrofit Dates: 5/4/2015-6/19/2015

The electric model in Figure 3 shows pre-installation baseline usage (blue line), actual post-installation usage (red line) and adjusted baseline usage (dotted pink line); the retrofit construction period is the gap in between the pre- and post-retrofit periods. According to this model, adjusted baseline usage during this period was estimated at 374,595 kWh, and actual usage was 322,320 kWh. As such, the electric reduction over the 12-month post-installation period (through June 2016) was: 52,175 kWh ± 37.1%, or 13.9% of adjusted baseline usage.

The project at this facility was a lighting retrofit. The lighting upgrade would be estimated to affect electric usage, with little effect on fuel energy usage. The electricity usage reduction model confirms overall reduced electricity usage; however, the model shows some reduction in peak usage during summer 2015 and an uptick in usage again a year post-retrofit (summer 2016). There was an estimated electricity meter reading in October 2015 which might account for the drop in usage for that month; however, the overall usage pattern does not appear to be consistent with this type of retrofit. This could point to other physical or operational changes to at the facility (e.g., a change in operating hours for the pool) which might merit further investigation. The fuel energy was not modeled, as fuel oil is used at the facility and only delivery log data is available, which is not sufficient for a reliable model.

As such, the data support the evidence of an overall decrease in electricity consumption from the baseline to the post-installation period, although the statistical metrics associated with the model convey a moderately high degree of uncertainty around the fit of the model to the data provided. The higher degree of uncertainty might be caused by the unusual pattern in post-retrofit actual consumption.

Figure 3. Asser Levy Recreation Center – Electricity Reduction Model

Case Study #4: Morrisania Health Center
Project: Lighting upgrade
Retrofit Dates: 9/1/2014-3/1/2015

The electricity model in Figure 4a shows pre-installation baseline usage (blue line), actual post-installation usage (red line) and adjusted baseline usage (dotted pink line); the retrofit construction period is the gap in between to pre- and post-retrofit periods. According to this model, adjusted baseline usage during this period was estimated at 925,078 kWh, and actual usage was 824,400 kWh. As such, the electric reduction over the 12-month post-installation period (through February 2016) was: 100,678 kWh ± 30.2%, or 10.9% of adjusted baseline savings.

The project at this facility was a lighting retrofit. The energy usage reduction models confirm the reduced electricity usage, and seem to indicate that this reduction primarily affected the electric baseload; this can be seen in the way the entire adjusted baseline usage is lower, yet the actual summer electric peak is still about the same relative magnitude as it would have been had no retrofit occurred, according to the adjusted baseline model.

As such, the data support the evidence of an overall decrease in electricity consumption from the baseline to the post-installation period, although the statistical metrics associated with the model convey a moderately high degree of uncertainty around the fit of the model to the data provided. It

should be noted that there were estimated electricity utility meter readings for the month of January 2016, which might account for the uncharacteristic usage pattern seen around that time.

The natural gas model in Figure 4b shows no significant difference in usage from the pre-retrofit to post-retrofit periods, confirming that the lighting upgrade had no perceptible effect on the fuel energy consumption.

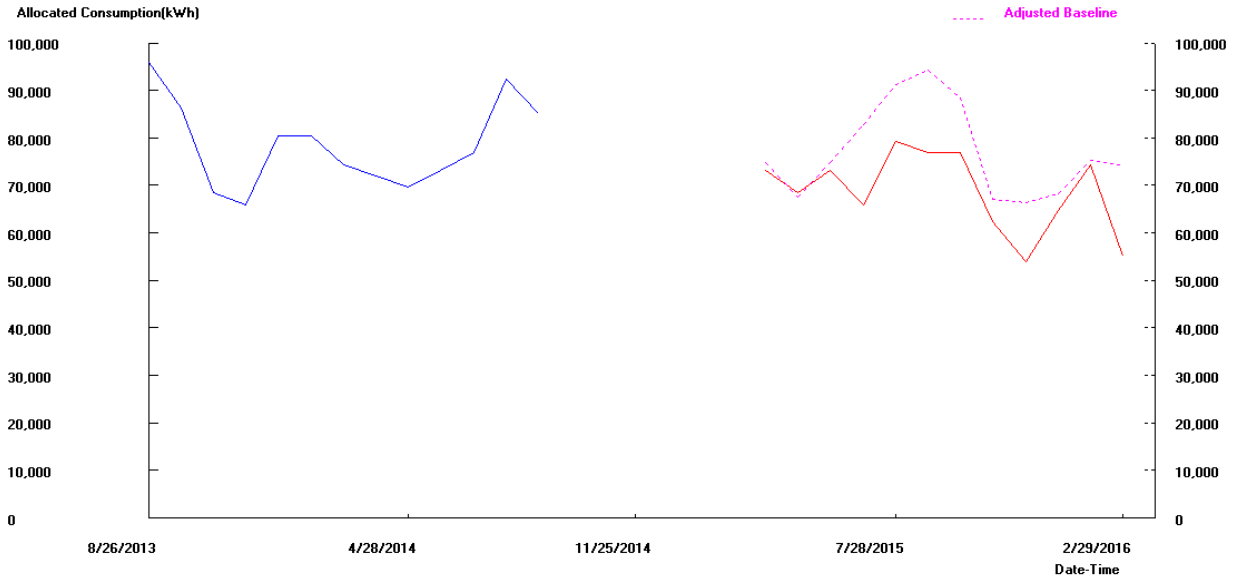


Figure 4a. Morrisania Health Center – Electricity Reduction Model

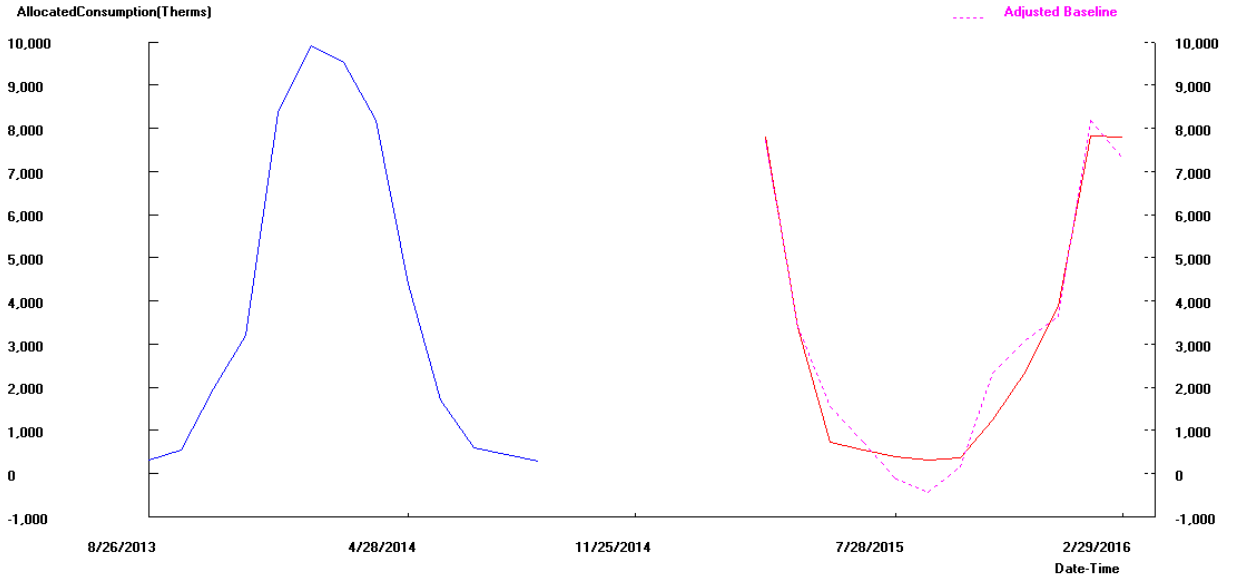


Figure 3b. Morrisania Health Center – Natural Gas Reduction Model