MEASUREMENT AND VERIFICATION OF ENERGY EFFICIENCY PROGRAM FOR LOS ANGELES DEPARTMENT OF WATER AND POWER

Monthly Report
(PROGRAM YEAR 2006-07)

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Introduction

Los Angeles Department of Water & Power (LADWP) has implemented several energy efficiency programs to motivate customer reduction in energy demand resulting in energy savings. In order to verify the energy savings achieved by their customers, LADWP has contracted with Expedient Energy (ExEn) to conduct independent Measurement and Verification (M&V) for their energy conservation and incentive measures.

LADWP electric customers have implemented energy conservation measures at their buildings and facilities in accordance with the LADWP's Incentive Programs in four project areas:

- HVAC
- Refrigeration
- Chiller Efficiency
- Lighting (CLEO)

LADWP provided copies of participant application forms to ExEn in each of the four targeted areas. Upon receipt and review of these applications, ExEn conducted site visits of selected customers and performed targeted M&V audits.

This document provides the findings of the M&V Audits in each area.

Executive Summary

Purpose of Measurement & Verification (M&V)

M&V* is utilized to quantify facility and utility energy savings using industry standardized, replicable methodologies. These methodologies allow accurate comparison results of a facility's energy usage at various times, e.g. before and after implementation of Energy Efficiency Measures (EEMs). M&V provides real data that indicates the value of the project implementation, as well as confirming that the EEMs were initiated as indicated by the participant application forms.

ExEn's M&V Program for LADWP Energy Efficiency Program serves three specific purposes:

1. Verify proper installation and implementation of the Energy Efficiency Measures associated with the Energy Efficiency Program
2. Note deficiencies, as needed
3. Measure actual energy savings associated with EEM implementation

**Measurement and Verifi cation (M&V) within this report defines project -specific Energy Efficiency Measures (EEMs) as implemented in accordance with the LADWP Energy Efficiency Program (EEP).*

Methodology

The specific methodologies utilized by ExEn for measuring and verifying actual energy savings as a result of implemented efficiency measures vary depending upon the actual technologies being assessed. However, the general methodology utilizes the assumed baseline efficiency of the equipment to be replaced and the actual energy usage of the new equipment under the same times and modes of operation. For example, an assumption of replaced equipment energy usage at peak hours of operation is compared to new equipment energy usage at peak hours of operation. Specific methodologies, and discrepancies as applicable, are noted for each program.

OVERVIEW OF INDIVIDUAL PROGRAMS

HVAC

ExEn visited four (4) identified sites and performed the required M&V to verify the following:

- Proper installation
- Confirming the installed unit for size and efficiency as per submittals
- Check operation of condenser fan, compressors, and supply air fan
- Note any deficiencies

ExEn prepared independent energy saving calculations and conducted verification of electric demand saving (kW) and electric energy savings (kWh) attributed to the EEM's and compared to LADWP established baseline energy consumption for the EEMs.

Analysis Methodology

Efficiency of package units is measured by the *Energy Efficiency Ratio* (EER) or Cooling Btu's per hour divided by electric input in Watts.

The energy savings is based on comparing the efficiency of the new installed unit with the existing unit that was replaced. Savings are estimated by simply applying the ratio of baseline efficiency (see table A) to installed efficiency. This method assumes that the baseline HVAC equipment operates identically to the proposed equipment but in a less efficient manner.

Determining Energy Savings:

The following activities have been completed in order to demonstrate savings:

- Determine baseline, minimum standard, efficiency (EER) by comparing the existing unit efficiency with the required minimum Title-24 efficiency and degrading the efficiency by 1% per year
- Determine new HVAC system efficiency (EER)
- Calculate post-installation HVAC system equipment energy use (kW-h)

Table-A: Title 24 Minimum Efficiency Requirements

	Efficiency			
Title 24 standard	65,000 Btu/h and 135,000 Btu/h	135,000 Btu/h and 240,000 Btu/h	240,000 Btu/h and 760,000 Btu/h	760,000 Btu/h
1995	8.2 EER	8.5 EER	8.5 EER	8.2 EER
1998	8.9 EER	8.5 EER	8.5 EER	8.2 EER
2001	10.3 EER	9.7 EER	9.5 EER	9.2 EER
2005	10.3 EER	9.7 EER	9.5 EER	9.2 EER

For all units over 20 years old, a base efficiency of 6.4 EER is assumed.

Projected HVAC Project Energy Savings

The following table summarizes M&V results for HVAC program.

HVAC Projects Summary

Project	LADWP Projected Savings	ExEn Savings	LADWP Projected Savings	ExEn Savings	% of LADWP Projection
	kW	kW	kWh	kWh	
[redacted]	5.50	6.60	5,726	6,868	120%
	5.50	7.38	5,726	7,686	134%
	1.34	2.04	1,395	2,119	152%
	4.35	4.80	4,528	4,994	110%
Total	**16.69**	**20.81**	**17,374**	**21,668**	**125%**

Conclusion and Recommendations for HVAC Program

As shown in the table above, actual total customer energy savings exceeded LADWP projected energy savings by 25%. Better-than-projected realized energy savings by customers can be directly tied to the conservative baseline energy consumption assumptions used by LADWP to determine the efficiency of the original existing units scheduled for replacement. Assumptions must be recognized as such and are based on factors such as the recognized industry standards of energy usage determined by the age and condition of the unit. Another method of determining a baseline is to measure the actual energy usage of the units in question. The measurement method provides a more accurate baseline of energy usage.

Refrigeration (RP)

ExEn visited four (4) identified sites to perform required M&V to verify proper installation of the new refrigerators and door gasket replacement on refrigerators that was incentivized according to EEP's by LADWP.

ExEn prepared independent energy saving calculations and conducted verification of electric demand saving (kW) and electric energy savings (kWh) attributed to the EEM's.

Analysis Methodology

The energy savings is based on the post-installation electrical consumption of the new refrigeration equipment. Savings are estimated by simply applying the ratio of baseline efficiency to proposed efficiency. This method assumes that the baseline refrigeration equipment operates identically to the proposed equipment but in a less efficient manner.

Determination of Energy Savings:

The following activities were completed in order to demonstrate savings:

- Determine baseline, minimum standard, efficiency
- Determine new refrigeration system efficiency
- Calculated post-installation refrigeration system equipment energy use (kW-h)

Projected Refrigeration Project Energy Savings

The following table summarizes M&V result for Refrigeration program:

Refrigeration Projects Summary

Project	LADWP Projected Savings	ExEn Savings	% of LADWP Projection
	kWh	kWh	
[redacted]	4,927	5,256	107%
	1,661	1,664	100%
	110,300	107,222	97%
	107,582	104,506	97%
Total	**224,470**	**218,648**	**97%**

Conclusion and Recommendations for Refrigeration Program (RP)

M&V determined that the total targeted energy savings for the refrigeration incentive program was met within the acceptable margin of 3% below the LADWP established baseline.

Chiller Efficiency (CEP)

ExEn's subcontractor Alliance Consulting Engineers (ACE) visited the four (4) designated sites to perform required M&V to verify proper installation of the chillers that were incentivized according to EEP's by the department.

ExEn prepared independent energy saving calculations and conducted verification of electric demand saving (kW) and electric energy savings (kWh) attributed to the EEM's.

Analysis Methodology

The energy saving calculations are based on the new chiller IPLV (Integrated Part Load Value) compared to measured IPLV based on kW/ton chiller efficiency under different load conditions as is shown below. The key assumption that allows this type of calculation is that the proposed and baseline chillers have identical operating characteristics. That is, the only difference between the proposed and baseline chillers is the rated efficiency.

Site Measurement:

- A = kW/ton @ 100% Load
- B = kW/ton @ 75% Load
- C = kW/ton @ 50% Load
- D = kW/ton @ 25% Load
- Calculating the measured IPLV

IPLV = 1/((0.01/A)+(0.42/B)+(0.45/C)+(0.12/D))

After analyzing all gathered data, chiller's kW/ton performance was extrapolated and calculated for various load condition. Then, the calculated kW/ton was used to determine chiller's IPLV.

Projected Chiller Project Energy Savings

The following table summarizes M&V results for Chiller Efficiency program.

Chiller Projects Summary

Project	LADWP Projected Savings	ExEn Savings	LADWP Projected Savings	ExEn Savings	% of LADWP Projection
	kW	kW	kWh	kWh	
[redacted]	56.51	58.91	108,388	112,995	104%
	72.40	76.68	138,863	147,076	106%
	214.80	203.65	411,986	390,598	95%
	292.50	281.98	561,015	540,837	96%
Total	**851.01**	**824.87**	**1,220,253**	**1,191,506**	**97%**

Conclusion and Recommendations for Chiller Efficiency Program (CEP)

M&V determined that the total targeted energy savings for the chiller efficiency incentive program was met within the acceptable margin of 3% below the LADWP established baseline.

Lighting (CLEO)

ExEn's subcontractor Global Energy Services (GES) visited the ten (10) designated sites to perform required M&V to verify proper installation of the lighting system that was incentivized according to EEP's by LADWP.

ExEn prepared independent energy saving calculations and conducted verification of electric demand saving (kW) and electric energy savings (kWh) attributed to the EEM's.

Analysis Methodology

The pre-retrofit parameters were compared to post-retrofit parameters to derive electric demand (kW) and electric energy (kWh) savings.

Projected Lighting Project Energy Savings

The following table summarizes M&V results for lighting program.

CLEO Projects Summary

Project	LADWP Projected Savings	ExEn Savings	LADWP Projected Savings	ExEn Savings	% of LADWP Projection
	kW	kW	kWh	kWh	
[redacted]	3.281	1.737	12,678	6,712	53%
	3.978	3.886	14,894	14,701	98%
	2.214	2.205	8,289	8,256	100%
	1.350	1.312	5,054	4,912	97%
	19.58	18.192	73,308	68,111	93%
	8.541	7.42	31,978	28,691	87%
	4.323	3.873	16,185	15,259	90%
	8.49	7.945	24,484	23,020	94%
Total	**51.757**	**46.57**	**186,869**	**169,662**	**90%**

Conclusion and Recommendations for Lighting Program (CLEO)

In some cases customer installed lighting fixtures were not the same as the fixtures proposed in the incentive applications. Therefore, the verified total energy savings for the lighting incentive program for the selected customers in this report are 10% less than the LADWP projected energy savings. We recommend that all lighting energy savings measures applications for rebate be verified for installation *before* the rebate amounts are paid to the customers.

Summary Conclusion and Recommendations for All Programs

Measurement & Verification of energy savings for most LADWP incentive programs showed that the baseline energy savings were achieved as projected by LADWP. In rare cases, the installed equipment were not the same as the units proposed in the incentive applications. In these situations energy savings calculations were not in line with established LADWP baselines. In order to avoid a recurrence of this issue, Expedient Energy recommends verification of all installed equipment before the incentive amount is paid to the customers. These discrepancies highlight the need for continuing measurement and verification efforts in any successful energy efficiency program to ensure both the accuracy and efficacy of the process.

HVAC Detail of Measurement and Verification Activities

To perform Measurement & Verification for task HVAC-3, ExEn visited these four selected sites:

[redacted] A new 10-ton Lennox package Gas/Electric roof top air conditioning unit was installed at this facility.

[redacted] A new 10-ton Carrier package Gas/Electric roof top air conditioning unit was installed.

[redacted]. A new 2-ton RUUD package roof top Heat Pump unit was installed for one of the units in this building.

[redacted] A new 7.5-ton Trane package Gas/Electric roof top air conditioning unit was installed at this facility.

The following describes the site locations and HVAC systems that were verified per EEP incentive for these locations:

[redacted] This store is located in a strip mall and is a single-story structure. A new 10-ton Lennox package Gas/Electric roof top air conditioning unit was installed at this facility. Table below shows summary of the energy savings for this unit.

Account Name: [redacted]
Service Address:

Size of replaced unit	10 Tons
Age of replaced unit	15 Years
Minimum T-24 efficiency (1995 Std)	8.2 EER
Efficiency degradation	1% Per Year
Existing Unit Efficiency	**6.97** EER

	DESCRIPTION: Replaced (1) 10.0 Tons AC units with new LENNOX, LGA120H2B				
A	New AC Units Tons Replaced			10	Tons
B	Annual Cooling Hours			1,041	Hours
C	EER of Existing AC unit		7.0	1.72	kW/Ton
D	EER of New AC unit		11.3	1.06	kW/Ton
E	Existing AC Demand	= A x C		17.22	kW
F	New AC Demand	= A x E		10.62	kW
G	**Demand kW Saved**	= E - F		**6.6**	kW
H	**Annual kWh Saved**	= G x B		**6,868**	kWh

[redacted]. This building is a relatively old stand alone single story building. A new 10-ton Carrier package Gas/Electric roof top air conditioning unit was installed. Table below shows summary of the energy savings for this unit.

Account Name:
Service Address: [redacted]

Size of replaced unit	10 Tons
Age of replaced unit	20 Years
Minimum T-24 efficiency (1995 Std)	8.2 EER
Efficiency degradation	1% Per Year
Existing Unit Efficiency	**6.56** EER

	DESCRIPTION: Replaced (1) 10.0 Tons AC units with new CARRIER, 48HJD012				
A	New AC Units Tons Replaced			10	Tons
B	Annual Cooling Hours			1,041	Hours
C	EER of Existing AC unit		6.6	1.83	kW/Ton
D	EER of New AC unit		11.0	1.09	kW/Ton
E	Existing AC Demand	= A x C		18.29	kW
F	New AC Demand	= A x E		10.91	kW
G	**Demand kW Saved**	= E - F		**7.4**	kW
H	**Annual kWh Saved**	= G x B		**7,686**	kWh

[redacted]. The complex is a relatively old 3-story building. A new 2-ton RUUD package roof top Heat Pump unit was installed for one of the units in this building. Table below shows summary of the energy savings for this unit.

Account Name:
Service Address: [redacted]

Size of replaced unit	2 Tons
Age of replaced unit	30 Years
Existing Unit Efficiency	**6.4** EER

	DESCRIPTION: Replaced (1) 2.0 Tons AC units with new RUUD, RQPLB-024JK000				
A	New AC Units Tons Replaced			2	Tons
B	Annual Cooling Hours			1,041	Hours
C	EER of Existing AC unit		6.4	1.88	kW/Ton
D	EER of New AC unit		14.0	0.86	kW/Ton
E	Existing AC Demand	= A x C		3.75	kW
F	New AC Demand	= A x E		1.71	kW
G	**Demand kW Saved**	= E - F		**2.0**	kW
H	**Annual kWh Saved**	= G x B		**2,119**	kWh

[redacted] This store is located in a strip mall and is a single-story structure. A new 7.5-ton Trane package Gas/Electric roof top air conditioning unit was installed at this facility. Table below shows summary of the energy savings for this unit.

Account Name:
Service Address: [redacted]

Size of replaced unit	7.5 Tons
Age of replaced unit	14 Years
Minimum T-24 efficiency (1995 Std)	8.2 EER
Efficiency degradation	1% Per Year
Existing Unit Efficiency	**7.05** EER

	DESCRIPTION: Replaced (1) 7.5 Tons AC units with new TRANE, YHC092A3RLA				
A	New AC Units Tons Replaced			7.5	Tons
B	Annual Cooling Hours			1,041	Hours
C	EER of Existing AC unit		7.1	1.70	kW/Ton
D	EER of New AC unit		11.3	1.06	kW/Ton
E	Existing AC Demand	= A x C		12.76	kW
F	New AC Demand	= A x E		7.96	kW
G	**Demand kW Saved**	= E - F		**4.8**	kW
H	**Annual kWh Saved**	= G x B		**4,994**	kWh

HVAC Summary of LADWP Projected Savings

The following table provides LADWP projected savings and ExEn M&V Data Results.

TABLE-1

Energy Efficiency Report Summary

Account Name	Service Address	# of Unit	Manufaturer	Model Number	Serial Number	Capacity Tons	Unit Effeciency New EER	Unit Effeciency Old EER	New Unit kW	Old Unit kW	Savings kW	Annual Savings kWh	% of LADWP Projection
[redacted]	[redacted]	1	LENNOX	LGA120H2B	_____	10.0	11.3	7.0	LADWP Projected Savings				
									-	-	5.50	5,726	120%
									ExEn Calculated Savings				
									10.62	17.22	6.60	6,868	
[redacted]	[redacted]	1	CARRIER	48HJD012	_____	10.0	11.0	7.3	LADWP Projected Savings				
									-	-	5.50	5,726	134%
									ExEn Calculated Savings				
									10.91	18.29	7.38	7,686	
[redacted]	[redacted]	1	RUUD	RQPLB-024JK000	7464F260615585	2.0	14.0	7.3	LADWP Projected Savings				
									-	-	1.34	1,395	152%
									ExEn Calculated Savings				
									1.71	3.75	2.04	2119	
[redacted]	[redacted]	1	TRANE	YHC092A3RLA	6281101422L	7.5	11.3	7.3	LADWP Projected Savings				
									-	-	4.35	4,528	110%
									ExEn Calculated Savings				
									7.96	12.76	4.80	4,994	

Conclusion and Recommendations for HVAC Program

As shown in the table above, actual customer energy savings exceeded LADWP projected energy savings by 25%. Better-than-projected realized energy savings by customers can be directly tied to the conservative baseline energy consumption assumptions used by LADWP to determine the efficiency of the original existing units scheduled for replacement. Assumptions are based on factors such as the recognized industry standards of energy usage determined by the age and condition of the unit. Another method of determining a baseline is to measure the actual energy usage of the units in question. This method provides a more accurate baseline of energy usage.

Refrigeration Detail of Measurement and Verification Activities

ExEn visited four selected sites to perform M&V on Refrigeration TASK-4. The following describes the sites and number of refrigerators that were verified per EEP incentive.

[redacted]. This restaurant is out of business and no access to the store was available.

[redacted]. Establishment is a restaurant. A new refrigerator unit with Glass Door Rich-In style was installed in this resturant. Table-1 shows summary of the energy savings for this unit.

[redacted]. New gaskets were installed on glass door refrigerators for total of 65 refrigerators. Table-2 shows summary of the energy savings for these units.

[redacted]. New gaskets were installed on glass door refrigerators for total of 71 refrigerators. Table-2 shows summary of the energy savings for these units.

Refrigeration Summary of LADWP Projected Savings

The following tables show verified data and energy savings projections for each location.

Project: M&V
Task: RP - 4
Date: 7/8/2008
EXEN Job #: 08-135

TABLE-1

Energy Efficiency Report Summary											
							Savings	Annual Savings LADWP	Annual Savings ExEn	Delta Annual Savings	% of LADWP Projection
Account Name	Service Address	Description	Manufacturer	Model #	Type	# of Units	kW	kWh	kWh	kWh	
[redacted]		Commercial Ice Machine Air Cooled 1,001-1,500 lbs	Hoshizaki	KM-1300 SRH	RCU-A	1	0.60	4,927	Out of Business	N/A	N/A
[redacted]		New Refrigerantor (Glass door reach-in)	True Food service Equipment	GDM-33	Reach-In	1	0.19	1,661	1,664	3	100%

TABLE-2

Energy Efficiency Report Summary											
				Refrigerator	Total Gasket	Gasket	Savings	Annual Savings LADWP	Annual Savings ExEn	Delta Annual Savings	% of LADWP Projection
Account Name	Service Address	Description	# of Refrigerator	Glass Door	Linear Foot	Modle #	kW	kWh	kWh	kWh	
[redacted]		Rerigerator Door Gasket replaced	52	28" x 59"	768.5	EES 2263	12.24	110,300	107,222	-3,078	97%
			15	29.88" x 60.75"	226.6	EES 2263					
			4	31" x 59"	60.0	EES 2263					
[redacted]		Refrigerator Door Gasket replaced	65	29.88" x 65.06"	1,029	EES 2263	11.93	107,582	104,506	-3,076	97%

Conclusion and Recommendations for Refrigeration Program (RP)

M&V determined that the total targeted energy savings for the refrigeration efficiency incentive program was met within the acceptable margin of 3% below the LADWP established baseline.

Chiller Efficiency Detail of Measurement and Verification Activities

ExEn's subcontractor Alliance Consulting Engineers (ACE) visited the selected sites to perform required M&V to verify proper installation of the chiller system that was incentivized according to EEP's by the department.

ExEn prepared independent energy saving calculations and conducted verification of electric demand saving (kW) and electric energy savings (kWh) attributed to the EEM's.

Analysis Methodology

The energy saving calculations are based on the new chiller IPLV (Integrated Part Load Value) compared to measured IPLV based on kW/ton chiller efficiency under different load conditions as is shown below.

Site Measurement:

- A = kW/ton @ 100% Load
- B = kW/ton @ 75% Load
- C = kW/ton @ 50% Load
- D = kW/ton @ 25% Load
- Calculating the measured IPLV

IPLV = 1/((0.01/A)+(0.42/B)+(0.45/C)+(0.12/D))

To measure kW/ton of the new installed chiller the following tasks are performed:

1. Utilizing a Electric Meter (B-clamp Meter 6000) measured the electric input to the chiller
2. Utilizing the chiller's control board to register electric input and performance load
3. Record performance data throughout the day at various chiller loading condition
4. Process and analyze data and project chiller efficiency

After analyzing all gathered data, chiller's kW/ton performance was extrapolated and calculated for various load condition. Then, the calculated kW/ton was used to determine chiller's IPLV (see table B).

The key assumption that allows this type of calculation is that the proposed and baseline chillers have identical operating characteristics. That is, the only difference between the proposed and baseline chillers is the rated efficiency.

Chiller Efficiency Detail of M&V Site Visits

ExEn visited four selected sites to perform M&V on task CEP-1. The following describes the site and number of Chiller systems that were verified per EEP incentive.

[redacted]. The building is equipped with two chillers, located in the basement. Only chiller CH-2 is included in this program. The chiller capacity is 299 tons. Table-1 shows summary comparison of the energy savings for this unit based on the LADWP and M&V calculation methodology. Based on this comparison the new installed chiller performs approximately 4.0% (see table-1) better than the original projections.

[redacted] The building is equipped with three chillers, located in a chiller plant. Only the smaller pony chiller CH-3 is included in this program. The chiller capacity is 362 tons. Table-1 shows summary comparison of the energy savings for this unit based on the LADWP and M&V calculation methodology. Based on this comparison the new installed chiller performs approximately 6.0% (see table-1) better than the original projections.

[redacted] The building is equipped with two chillers, located in a chiller plant. Both chillers CH-1 and CH-2 are included in this program. The chillers are 600 tons each for a total capacity of 1200 tons. Table-1 shows summary comparison of the energy savings for these units based on the LADWP and M&V calculation methodology. Based on this comparison the new installed chillers perform approximately 5.0% (see table-1) less than the original projections.

[redacted] The building is equipped with three chillers, located in a chiller plant. All three chillers CH-1, CH-2 and CH-3 are included in this program. Each chiller is 500 tons. Combined, the three chillers provide 1500 tons of cooling. Table-1 shows summary comparison of the energy savings for these units based on the LADWP and M&V calculation methodology. Based on this comparison the new installed chillers perform approximately 4.0% (see table-1) less than the original projections.

Table B

CALCULATED IPLV FIGURES BASED ON FIELD MEASUREMENT VERIFICATION				
Building #	**3350**	**3450**	**3530**	**5905**
	kW/ton	**kW/ton**	**kW/ton**	**kW/ton**
At 100% load	0.61	0.56	0.58	0.55
At 75% load	0.47	0.41	0.45	0.43
At 50% load	0.34	0.28	0.32	0.31
At 25% load	0.45	0.39	0.44	0.38
IPLV	**0.40**	**0.34**	**0.38**	**0.36**

PROVIDED IPLV BY LADWP FOR REBATE AMOUNT PAID TO THE CUSTOMER				
IPLV	**0.41**	**0.35**	**0.37**	**0.36**

Chiller Efficiency Summary of LADWP Projected Savings

The following table shows verified data and energy savings projections for each location.

Project: M&V
Task: CEP-1
DATE: 9/9/2008
ExEn Job#: 08-135

TABLE -1

Energy Efficiency Report Summary

		New Installed Chiller				Existing Chiller		New Chiller				Baseline T-24	Annual Operation	Energy savings New Vs. T-24 Published IPLV		Energy savings New Vs. T-24 Estimated IPLV (2)		% of LADW Projection
Account Name	Service Address	# of Unit	Manufacturer	Model #	Serial #	Total Ton	kW/Ton (1)	Total Ton	Published IPLV	M & V IPLV (2)	kW	IPLV	Hours	Annual kW	Annual kWh	Annual kW	Annual kWh	
[redacted]	[redacted]	1	Carrier Evergreen	19XRV3030327KBH64	72821	299	0.9	299	0.408	0.40	119.59	0.597	1918	56.51	108,388	58.91	112,995	104%
[redacted]	[redacted]	1	Carrier Evergreen	19XRV4142343KBH64	72818	362	0.9	362	0.350	0.34	122.42	0.55	1918	72.40	138,863	76.68	147,076	106%
[redacted]	[redacted]	2	Carrier Evergreen	19XRV5051446LCH64	72819 72820	1,200	0.9	1,200	0.371	0.38	456.35	0.55	1918	214.80	411,986	203.65	390,598	95%
[redacted]	[redacted]	3	York	YKDFDFQ7-CPF	SERM-185440 SERM-185550 SERM-185660	1,200	0.9	1,500	0.355	0.36	543.02	0.55	1918	292.50	561,015	281.98	540,837	96%

Notes:
(1) Existing unit efficiency assumed by LADWP
(2) Established based on the average data measured.

Conclusion and Recommendations for Chiller Efficiency Program (CEP)

M&V determined that the total targeted energy savings for the chiller efficiency incentive program was met within the acceptable margin of 3% below the LADWP established baseline.

Lighting Efficiency Detail of M&V Activities

ExEn's subcontractor Global Energy Services (GES) visited ten (10) sites to perform the required M&V to verify proper installation of the lighting system that was incentivized according to EEP's by the department.

ExEn prepared independent energy saving calculations and conducted verification of electric demand saving (kW) and electric energy savings (kWh) attributed to the EEM's.

Analysis Methodology

The pre-retrofit parameters were compared to post-retrofit parameters to derive electric demand (kW) and electric energy (kWh) savings

System Performance Factors - Illumination levels were verified to the lighting levels stated or desired by the LADWP and provided in the site data package, unless otherwise noted. Generally, these levels include: 50 foot-candles (fc) at work station surfaces, 30 fc in work areas and 10 fc in non-work areas, measured at a height of 30 inches above floor level. Total harmonic distortion of electronic ballasts used in fluorescent retrofits does not exceed 15 percent.

Savings Calculation:

The average kW and peak kW are the same for all measures. Unless otherwise specified, GES determines the hours of operation per year for all measures during the pre- and post-inspection and enters that number in their final post-inspection report spreadsheet. The resulting number of hours are used to determine the annual energy savings (kWh). **LADWP baseline of 72W for 2T12 and ES Ballast and 55W for a 2T8 and Electronic Ballast is used. Also, the LADWP kW and kWh savings take the de-lamping from T12 to T8 into consideration which could not be field-verified. As such, the energy (kW and kWh) savings are for retrofits only.**

Lighting Efficiency Detail of M&V Site Visits

ExEn's subcontractor Global Energy Services (GES) visited the following ten (10) sites to perform the required M&V to verify proper installation of the lighting system that was incentivized according to EEP's by LADWP. Detail of each site visit follows in the next section.

1. [redacted]
2. [redacted]
3. [redacted]
4. [redacted]
5. [redacted]
6. [redacted]
7. [redacted]
8. [redacted]
9. [redacted]
10. [redacted]

1. Customer Name: [redacted] – Commercial Office

Date of EM&V: 07-09-2008

This is a multi-tenant 2-story commercial office. Customer received a proposal for retrofit of 300 two (2) T-12 lamps and one electro-magnetic ballast with two (2) T-8 lamps and one electronic ballast. A lighting retrofit was performed on 193 2-lamp fixtures. The fixtures in the WIC - Pediatric area are four lamps with two electronic ballasts. However, the installed ballasts are High Light Output ballasts (REL-2P32-HL-SC) with an input power of 79W for two (2) T-8 lamps. The field verified energy savings are compared to a baseline of two (2) F-40 with energy saver magnetic ballast as the existing condition. The new system uses 0.007KW more per two (2) T-8 with one electronic ballast.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	KW Saving Per Item	Hours	Total kW Savings	Total kWh Savings
LID0102	CLEO-4	2X4, 2L- FI. Fixture	193	0.017	3864	3.281	12678
Total			193	0.017	3864	3.281	12678

GES FIELD VERIFICATION

Location	Pix	F.C.	# Verified	New	Baseline Watts per fixture	Retrofit Ballast REL-2P32-HL-SC	KW Savings per Item	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Corridor	Y	35	193	w/2 T8 & 1 El. Ball.	88	79	0.009	3864	1.737	6712	53%
Total			193		88	79	0.009	3864	1.737	6712	53%

Conclusion and Recommendations

As shown and described above, the customer installed a higher energy use lighting fixture than submitted in the rebate application. Therefore, the amount of energy savings are 47% less than originally projected. It is recommended that the actual installation of all lighting energy savings measures applications be verified before the rebate amounts are paid to the customer.

2. [redacted]

Date of EM&V: 7-10-2008

This is a single-story Post Office. Eight (8) foot fixtures have been retrofitted with three (3) T-8 or one (1) T-8 on a 4-foot section and two (2) T-8 in the other 4-foot section with one 3-Lamp electronic ballast.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	KW Saving Per Item	Hours	Total kW Savings	Total kWh Savings
LIC0101	CLEO-3	40W T12 & Mag. Ball.	32	0.017	3744	0.544	2037
LIC0102	CLEO-3	1 40W T12 & Mag. Ball.	16	0.013	3744	0.208	779
LIE0101	CLEO-5	2 40W T12 & Mag. Ball.	22	0.027	3744	0.594	2224
LIE0102	CLEO-5	2 40W T12 & Mag. Ball.	10	0.022	3744	0.22	824
LIE0103	CLEO-5	3 40W T12 & Mag. Ball.	6	0.047	3744	0.282	1056
LIE0104	CLEO-5	4 40W T12 & Mag. Ball.	48	0.038	3744	1.824	6829
LIE0105	CLEO-5	4 40W T12 & Mag. Ball.	5	0.055	3744	0.275	1030
LIJ0102	CLEO-10	Incandescent	1	0.031	3744	0.03	116
Total			140			3.978	14894

GES FIELD VERIFICATION

Location	Plx	F.C.	# Verified	New	Baseline Watts per fixture	Retrofit Ballast REL-2P32-HL-SC	KW Savings per item	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Lobby	Y	40	32	1 T8 & 1 El. Ball.	43	26	0.017	3744	0.544	2037	100%
Side & Breakroom	Y	50	16	1 T8 & 1 El. Ball.	43	30	0.013	3744	0.208	779	100%
Lobby	Y	40	22	2 T8 & 1 El. Ball.rlo	72	45	0.027	3744	0.594	2224	100%
Main Floor	Y	50	10	2 T8 & 1 El. Ball.nlo	72	50	0.022	3744	0.22	824	100%
Main Floor	Y	55	6	3T8 & 1 El. Ball.	115	72	0.043	3744	0.258	966	91%
Mail Room (5' Ceiling)	Y	75	48	3 T8 & 1 El. Ball.	115	78	0.037	3744	1.776	6649	97%
Lobby	Y	55	5	4 T8 & 1 El. Ball.	144	93	0.051	3744	0.255	955	93%
	Y		1	LED	36	5	0.031	8640	0.031	268	100%
Total			140						3.886	14701	98%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.

3. [redacted]

Date of EM&V 07-09-2008

This is a single-story Post Office. Eight (8) foot fixtures have been retrofitted with three (3) T-8 or one (1) T-8 on a 4-foot section and two (2) T-8 in the other 4-foot section with one 3-Lamp electronic ballast.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	KW Savings per Item	Hours	Total kW Savings	Total kWh Savings
LIC0101	CLEO-3	60W Inc.	1	0.033	3744	0.033	124
LIC0102	CLEO-3	75 W Inc.	2	0.05	3744	0.1	374
LIE0101	CLEO-5	60W incand.	1	0.048	3744	0.048	180
LIE0102	CLEO-5	1 40W T12 & Mag. Ball.	2	0.017	3744	0.034	127
LIE0103	CLEO-5	1 40W T12 & Mag. Ball.	7	0.013	3744	0.091	341
LIE0104	CLEO-5	40W T12 & Mag. Ball.	4	0.027	3744	0.108	404
LIE0105	CLEO-5	40W T12 & Mag. Ball.	10	0.047	3744	0.47	1760
LIE0105	CLEO-5	40W T12 & Mag. Ball.	35	0.038	3744	1.33	4980
Total			62			2.214	8289

GES FIELD VERIFICATION

Location	Picture	F.C.	# Verified	New	Baseline Watts per Fixture	Installed Watts per Fixture	KW Savings per item	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Janitor			1	<14 Watts	60	13	0.047	3744	0.047	176	142%
Front			2	14-26 Watts	75	23	0.052	3744	0.104	389	104%
Side Door			1	< 14 Watts	60	13	0.047	3744	0.047	176	98%
Restroom			2	1 T8 & 1 El. Ball.	72	26	0.046	3744	0.092	344	271%
Main Floor	Y	60	7	1 T8 & 1 El. Ball.	43	26	0.017	3744	0.119	446	131%
Main Floor	Y	100	4	2 T8 &1El. Ball.	72	55	0.017	3744	0.068	255	63%
Main Floor (Lobby)	Y	45	10	3 T8 & 1 El. Ball.	115	68	0.047	3744	0.47	1760	100%
Main Floor (Lobby Counter)	Y	100	34	3 T8 & 1 El. Ball.	115	78	0.037	3744	1.258	4710	95%
Total			61						2.205	8256	100%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.

4. [redacted]

Date of EM&V: 07-09-2008

This is a single-story Post Office. Eight (8) foot fixtures have been retrofitted with three (3) T-8 or one (1) T-8 on a 4-foot section and two (2) T-8 in the other 4-foot section with one 3-Lamp electronic ballast.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	KW Savings per item	Hours	Total kW Savings	Total kWh Savings
LIA0102	CLEO-1	75W Incand.	2	0.05	3744	0.100	374
LIC0101	CLEO-3	1 40W T12 & Mag. Ball.	14	0.017	3744	0.238	891
LIE0101	CLEO-5	1 40W T12 & Mag. Ball.	2	0.027	3744	0.054	202
LIE0102	CLEO-5	2 40W T12 & Mag. Ball.	14	0.022	3744	0.308	1153
LIE0104	CLEO-5	3 40W T12 & 2 Mag. Ball.	16	0.038	3744	0.608	2276
LIE0106	CLEO-5	4 40W T12 & Mag. Ball.	1	0.042	3744	0.042	157
Total			49			1.35	5054

GES FIELD VERIFICATION

Location	Picture	F.C.	# Verified	New	Baseline Watts per Fixture	Installed Watts per Fixture	KW Savings per item	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Restroom	Y	20	2	23W screw-in CFL	75	23	0.052	3744	0.104	389	104%
Mail Room	Y	63	14	1 T8 & 1 El. Ball.	45	26	0.019	3744	0.266	996	112%
Locker Room	Y	52	2	2 T8 &1 El. Ball.	72	45	0.027	3744	0.054	202	100%
Main Floor	Y	54	14	2 T8 & 1 El. Ball.	72	55	0.017	3744	0.238	891	77%
Main Floor	Y	73	16	3 T8 & 3 El. Ball.	116	78	0.038	3744	0.608	2276	100%
PO Box Area	Y	50	1	4 T8 & 1 El. Ball.	144	102	0.042	3744	0.042	157	100%
Total			49						1.312	4912	97%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.

5. [redacted]

Date of EM&V: 08-15-2008

This is a [redacted] grocery store similar to Albertsons and Ralphs. Majority of the retrofits in this store are of old 8-foot T-8 lamps to new energy efficient 4-feet T-8 lamps and electronic ballasts.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Location	# Incentive	KW Saving Per Item	Hours	Total kW Savings	Total kWh Savings
LID0107	CLEO-4	Sales Area	224	0.05	3744	11.2	41933
LIE0113	CLEO-5	Main Floor	156	0.033	3744	5.148	19274
LIA0102	CLEO-1	Display	16	0.049	3744	0.784	2935
LIE0117	CLEO-5	Meat	36	0.068	3744	2.448	9165
Total			432			19.58	73308

GES FIELD VERIFICATION

Location	Picture	F.C.	# Verified	New	Baseline Watts per Fixture	Installed Watts per Fixture	KW Savings per item	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Sales Area	Y	64	224	4T8 & 1 El. Ball.rlo	144	94	0.05	3744	11.2	41933	100%
Main Floor	Y	62	156	2 T8 & 1 El. Ball.rlo	72	45	0.027	3744	4.212	15770	82%
Display	Y	65	16	25W CFL	75	25	0.05	3744	0.8	2995	102%
Meat	Y	45	36	4 T8 & 1 El. Ball.rlo	144	89	0.055	3744	1.98	7413	81%
Total			432						18.192	68111	93%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.

6. [redacted]

Date of EM&V: 08-15-2008

This is a single-story Post Office. Eight (8) foot fixtures have been retrofitted with three (3) T-8 or one (1) T-8 on a 4-foot section and two (2) T-8 in the other 4-foot section with one 3-Lamp electronic ballast.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	KW Saving Per Item	Hours	Total kW Savings	Total kWh Savings
LIC0102	CLEO-3	2 40W T12 & Mag. Ball.	5	0.013	3744	0.065	243
LIC0201	CLEO-3	1'X8' 96W T12 & Mag. Ball.	1	0.02	3744	0.02	75
LIE0101	CLEO-5	4 40W T12 & Mag. Ball.	71	0.027	3744	1.917	7177
LIE0102	CLEO-5	2 40W T12 & Ma	10	0.022	3744	0.22	824
LIE0103	CLEO-5	3 40W T12 & Mag. Ball.	14	0.047	3744	0.658	2464
LIE0104	CLEO-5	3 40W T12 & Mag. Ball.	108	0.038	3744	4.104	15365
LIE0105	CLEO-5	4 40W T12 & Mag. Ball.	15	0.055	3744	0.825	3089
LIE0106	CLEO-5	4 40W T12 & Mag. Ball.	13	0.042	3744	0.546	2044
LIJ0102	CLEO-10	Replace Incand.	6	0.031	3744	0.186	696
Total			243			8.541	31978

GES FIELD VERIFICATION

Location	Picture	F.C.	# Verified	New	Baseline Watts per Fixture	Installed Watts per Fixture	KW Savings per item	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Lobby/Office	Y	40	5	2 T8 & 1 El. Ball.	43	30	0.013	3744	0.065	243	100%
Post area	Y	50	1	2 T8 & 1 El. Ball.	72	52	0.02	3744	0.02	75	100%
Main Floor		50	71	2 T8 & 1 El. Ball.	72	45	0.027	3744	1.917	7177	100%
Office	Y	40	10	2 T8 & 1 El. Ball.NO	72	53	0.019	3744	0.19	711	86%
3 40W T12 & Mag. Ball.	Y	60	14	3 T8 & 1 El. Ball.RL	115	72	0.043	3744	0.602	2254	91%
Work Area	Y	60	108	3 T8 & 1 El. Ball.	115	78	0.037	3744	3.996	14961	97%
Office	Y	55	15	4 T8 & 1 El. Ball.	144	93	0.051	3744	0.765	2864	93%
Office	Y	65	13	4 T8 & 1 El. Ball.	144	103	0.041	3744	0.533	1996	98%
Exits	Y	5	6	LED	36	5	0.031	8640	0.186	1607	100%
Total			243						8.274	31889	97%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.

7. [redacted]

Date of EM&V 08-15-2008

This is a single-story Post Office. Eight (8) foot fixtures have been retrofitted with three (3) T-8 or one (1) T-8 on a 4-foot section and two (2) T-8 in the other 4-foot section with one 3-Lamp electronic ballast.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	KW Saving Per Item	Hours	Total kW Savings	Total kWh Savings
LIC0102	CLEO-3	2 40W T12 & Mag. Ball.	2	0.017	3744	0.034	127
LIC0201	CLEO-3	1'X8' 96W T12 & Mag. Ball.	18	0.013	3744	0.234	876
LIE0101	CLEO-5	4 40W T12 & Mag. Ball.	18	0.027	3744	0.486	1820
LIE0102	CLEO-5	2 40W T12 & Ma	4	0.022	3744	0.088	329
LIE0103	CLEO-5	3 40W T12 & Mag. Ball.	12	0.047	3744	0.564	2112
LIE0104	CLEO-5	3 40W T12 & Mag. Ball.	48	0.038	3744	1.824	6829
LIE0105	CLEO-5	4 40W T12 & Mag. Ball.	14	0.055	3744	0.77	2883
LIE0106	CLEO-5	4 40W T12 & Mag. Ball.	4	0.042	3744	0.168	629
LIJ0102	CLEO-10	Replace Incand.	5	0.031	3744	0.155	580
Total			125			4.323	16185

GES FIELD VERIFICATION

Location	Picture	F.C.	# Verified	New	Baseline Watts per Fixture	Installed Watts per Fixture	KW Savings per Item	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Lobby/Office	Y	40	2	2 T8 & 1 El. Ball.	43	26	0.017	3744	0.034	127	100%
Post area	Y	50	18	2 T8 & 1 El. Ball.	72	52	0.02	3744	0.36	1348	154%
Main Floor		50	18	2 T8 & 1 El. Ball.	72	45	0.027	3744	0.486	1820	100%
Office	Y	40	4	2 T8 & 1 El. Ball.NO	72	50	0.022	3744	0.088	329	100%
3 40W T12 & Mag. Ball.	Y	60	12	3 T8 & 1 El. Ball.RL	115	72	0.043	3744	0.516	1932	91%
Work Area	Y	60	48	3 T8 & 1 El. Ball.	115	78	0.037	3744	1.776	6649	97%
Office	Y	55	14	4 T8 & 1 El. Ball.	144	93	0.051	3744	0.714	2673	93%
Office	Y	65	4	4 T8 & 1 El. Ball.	144	103	0.041	3744	0.164	614	98%
Exits	Y	5	5	LED	36	5	0.031	8640	0.155	1339	100%
Total			125						4.293	16832	99%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.

8. [redacted]

Date of EM&V: 08-15-2008

This is a Gymnasium where the 400W High Bay Metal Halide Lighting has been retrofitted with six (6) T-5 lamps and electronic ballasts and reflector. Per LADWP record, 24 fixtures have received incentives. The incentive amount is for 24 fixtures but we verified that 36 fixtures were retrofitted.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	KW Saving Per Item	Hours	Total kW Savings	Total kWh Savings
LIF0200	CLEO-6	400W MET. Hal.	24	0.15	2400	3.6	8640
Total			24			3.6	8640

GES FIELD VERIFICATION

Location	Picture	F.C.	# Verified	New	Baseline Watts per Fixture	Installed Watts per Fixture	KW Sav per unit	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
South	Y	40 Horizon.	36	6T5- HO El. Bal.	440	3X117 W	0.09	2400	3.24	7776	90%
Gymnasium		20Vertical	36			or 350W			3.24	7776	90%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.

9. [redacted]

Date of EM&V: 08-15-2008

This is an Art room where students make different art objects. The projects in [redacted] were installed directly by the facilities department installers. The hardware was procured from electrical vendors.

As per the installation F32T8 (25Watt Philips) lamps were installed with low watt electronic ballasts.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	KW Saving Per Item	Hours	Total kW Savings	Total kWh Savings
LIE0113	CLEO-5	2-T12 &2 Ball.	30	0.033	3240	0.99	3208

GES FIELD VERIFICATION

Location	Picture	F.C.	# Verified	New	Baseline Watts per Fixture	Installed Watts per Fixture	KW Sav per unit	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Art Room	Y	50 FC	30	2-T8, 1 - El. Ballast	72	40	0.032	3240	0.96	3110	97%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.

10. [redacted]

Date of EM&V: 08-15-2008

These are two adjacent music rooms (3400 and 3401) with 25-foot high ceilings. The projects in [redacted] were installed directly by the facilities department installers. The hardware was procured from electrical vendors. Sixty (60) fluorescent light fixtures were removed and replaced with T-8 and electronic ballasts in these two music rooms.

Energy Saving Table:

LADWP EXISTING DATA

Measure Code	Invoice Task No.	Existing	# Incentive	Kw/Unit	Hours	Total kW Savings	Total kWh Savings
LIE118	CLEO-5	4T12 + 2 Ballasts	60	0.065	3240	3.9	12636

GES FIELD VERIFICATION

Location	Picture	F.C.	# Verified	New	Baseline Watts per Fixture	Installed Watts per Fixture	KW Sav per unit	Hours	Total kW Savings	Total kWh Savings	% of LADWP Projection
Music Room 3400, 3401	Y	47 FC	65	4-T8, 1 - El. Ballast	144	85	0.059	3240	3.835	12425	98%

Conclusion and Recommendations

All lighting energy savings measures at this site were installed according to the submitted application and the projected energy savings are being achieved.