RLW ANALYTICS

2004-2005 Los Angeles County-Internal Services Department/Southern California Edison/Southern California Gas Company Energy Efficiency Partnership Impact Evaluation Study

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Appendices

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Impact Evaluation

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1. Appendix A – Retrocommissioning Site Reports

Below are detailed site write-ups of the all ten retrocommissioning (RCx) projects performed for the Los Angeles County-Internal Services Department/Southern California Edison/Southern California Gas Company Energy Efficiency Partnership 2004-2005 Impact Evaluation. Each write-up begins with a table of identified measures taken from the RCx contractor's site reports. Note that the savings and costs are shown incrementally, as opposed to by individual measure. The site savings tables list all recommended measures, but for most sites, a subset of the recommended measures were implemented as part of this element.

For each implemented measure, the description of the measure has been copied from the RCx contractor's final site report. The text quoted from the RCx contractor's report is italicized below; some minor edits were of the quoted sections performed to refer readers to related tables and figures.

Next the baseline and measure simulation input file code that modeled the measure are shown side by side. The specific code changes for the measure are shown bolded. The changes are shown in context to aid understanding of which schedules or equipment the code change references.

Then, a graphical display of pertinent actual building data used to determine if the implemented measure has performed as modeled. The building data were acquired from the County's Enterprise Energy Information Management System (EEMIS). If analysis of the building data indicated that the measure was operating differently from the way it was modeled, the measure was adjusted or eliminated in the "evaluation model". The goal was get the evaluation model as close to actual building performance as possible. All of the changes were shown and discussed in these site reports.

Similarly, the baseline model was compared with building data from before the retrocommissioning activities occurred. If there were any discrepancies found between the data and the model, changes were made to the baseline model and were documented in the site report.

The final evaluation model and modified baseline were run with California Energy Commission's typical year data for the climate zone where the facility was located. Ex post site savings were calculated from the difference between the modified baseline and the evaluation model.

1.1 Bellflower Courthouse

1.1.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several energy efficiency measures (EEMs) were recommended for implementation due to their favorable economic benefit to the County. Table 1 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 1: Bellflower Courthouse Savings

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implemen-tation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 - AHU Clr Blr S/S	(14)	269,203	25,328	$ 40,651	$ 24,098	$ 64,749	$ 64,749	$ -	$ -	-
EEM #2 - OA Econ DB + EEM 1	(9)	320,377	21,762	$ 49,631	$ 20,655	$ 5,537	$ 70,286	$ 25,780	$ 25,780	0.4
EEM #3 - DAT Reset + EEMs 1-2	(6)	325,144	28,201	$ 49,523	$ 26,873	$ 6,110	$ 76,396	$ 17,230	$ 43,010	0.6
EEM #4 - TAB + EEMs 1-3	(5)	372,823	31,619	$ 60,133	$ 30,173	$ 13,910	$ 90,306	$ 15,870	$ 58,880	0.7
EEM #5 - Clr Blr LO + EEMs 1-4	4	369,140	32,538	$ 60,505	$ 31,060	$ 1,259	$ 91,565	$ -	$ 58,880	0.6
EEM #6 - Blr OAT Reset + EEMs 1-5	4	369,808	32,938	$ 60,672	$ 31,446	$ 553	$ 92,118	$ -	$ 58,880	0.6
EEM #7 - Blr Replace + EEMs 1-6	4	369,808	34,915	$ 60,672	$ 33,355	$ 1,909	$ 94,027	$ -	$ 58,880	0.6

*Note 1: Total annual savings and implementation costs are cumulative.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.1.2 EEM 1. HVAC System Start / Stop

The start/stop schedules for the cooling system, heating system, and ventilation fans were adjusted from a continuous operating schedule (HVAC fans only) to 5am to 10pm (fans) and 5am to 7pm (central plant), Monday through Friday. The systems are now commanded off Saturday and Sunday.

Measure Modeling Estimation Changes

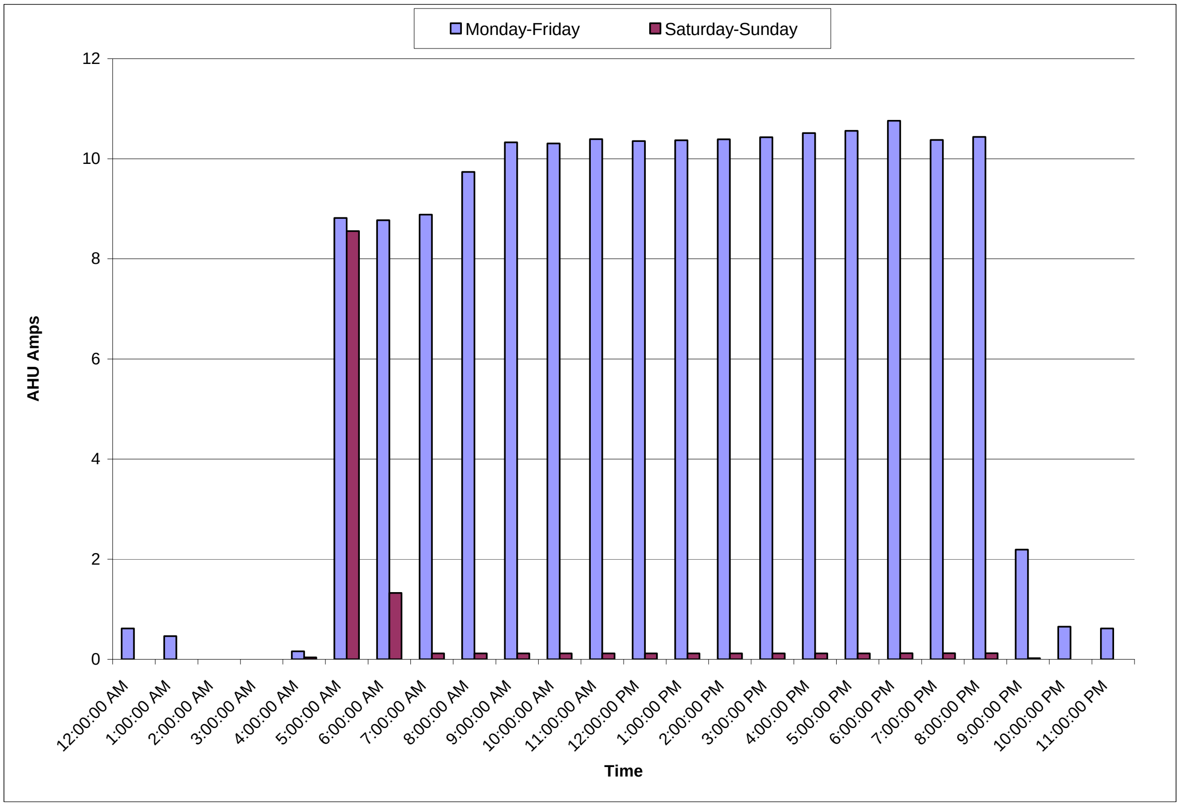
The modeling changes are highlighted in bold. The field marked "values" is the field that represents the schedule of the facility and is explained in the line below the "values." The weekday fan, chiller, boiler and infiltration schedules all had identical schedules for this site.

Baseline	**EEM 1**
Fan Schedule - Day" = DAY-SCHEDULE-PD	5am -10pm, OFF weekends.
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1))	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)**
Always ON	**5am -7pm**
"Fan Schedule - Wknd Day" = DAY-SCHEDULE-PD	"EEM 1 Fan Sch - WEH" = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1)	**VALUES = (0)**
Always ON	Always Off

Verification

Post implementation data show the actual fan schedule as 4am to 8pm Monday through Friday and 4am to 5am Saturday to Sunday. Figure 1 below displays the post-implementation data for average air handler amp draw across all AHUs at the facility. Similar schedules were observed for chiller and boiler operation.

Figure 1: Bellflower Courthouse Fan Operation Hours



Evaluation Model Changes

The chiller, fan and boiler schedules were changed in the evaluation model to reflect operational data, that is, from 4am to 8pm Monday through Friday and 4am to 5am Saturday and Sunday. Note that only the fan schedule code is shown below, but the same hours were applied to the boiler and chiller. The modeling changes are highlighted in bold. The field marked "values" is the field that represents the schedule of the facility and is explained in the line below the "values."

EEM 1 Fan Sch - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, 0, &D, 0) ..
Weekdays 4am to 8pm
EEM 1 Fan Sch - WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, 1, 0)
Weekends 4am-5am

1.1.3 EEM 2. Outside Air Economizer

The minimum outside air damper position was adjusted from a fully closed position to a more open position to provide outside air ventilation. The control sequence was modified to enable economizer control whenever the outside air is less than the return air temperature to allow for *maximum free cooling. This was accomplished pneumatically through a new outside air lockout relay. Previously the economizer was controlled through an enthalpy comparator (though the dampers were stuck closed).*

Measure Modeling Estimation Changes

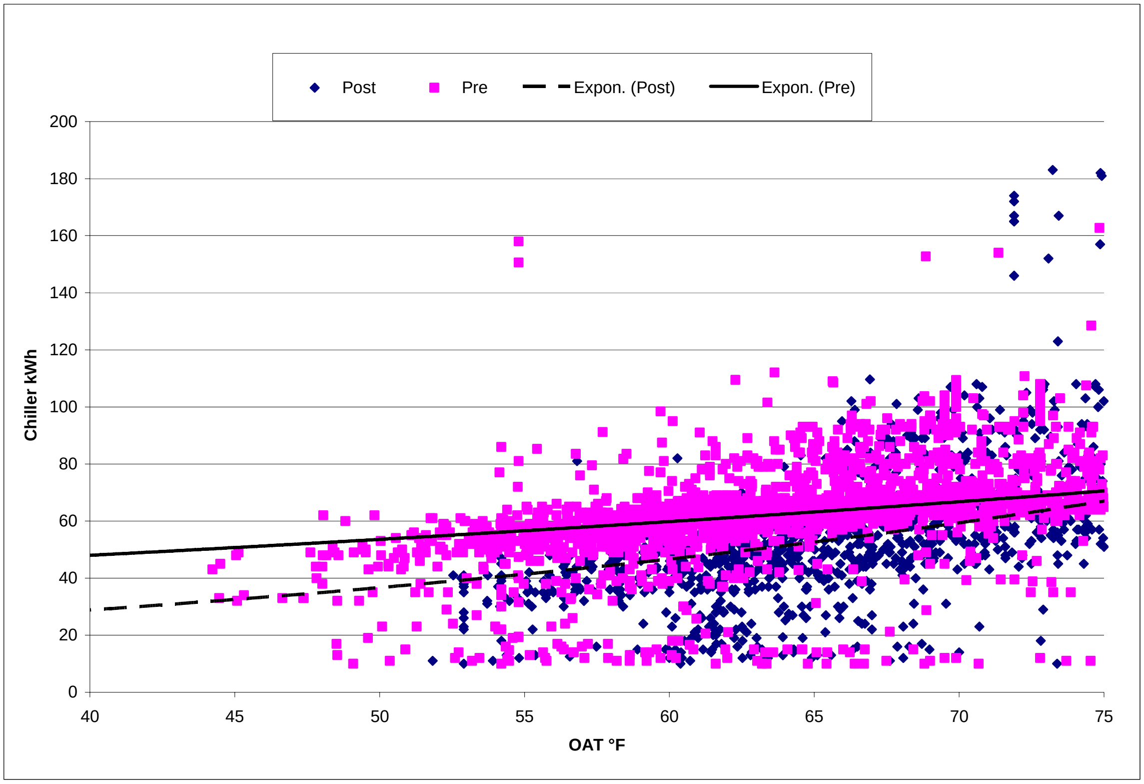
All air handlers were changed from fixed outside air percentage to dry-bulb temperature economizer control. Some minimum flows were increased and some were decreased.

Baseline	**EEM 2**
AHU-1 East 1st Flr = SYSTEM	AHU-1 East 1st Flr = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = PLENUM-ZONES	RETURN-AIR-PATH = PLENUM-ZONES
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
MIN-SUPPLY-T = 60	MIN-SUPPLY-T = 60
ECONO-LIMIT-T = 130	**ECONO-LIMIT-T = 75**
SUPPLY-FLOW = 5310	SUPPLY-FLOW = 5310
RETURN-FLOW = 3850	RETURN-FLOW = 3850
MIN-OUTSIDE-AIR = 0.2	**MIN-OUTSIDE-AIR = 0.386**
OA-CONTROL = FIXED	**OA-CONTROL = OA-TEMP**

Verification

The economizer could not be verified directly since mixed air temperatures were not available via EEMIS. However, Figure 2 suggests that the economizer is functioning as model since pre implementation chiller energy consumption is greater than post implementation consumption for the temperature range where the economizer is functioning, less that 75 F.

Figure 2: Bellflower Courthouse Economizer Verification



1.1.4 EEM 3. Discharge air (DAT)/Mixed air temperature (MAT) reset.

The control sequence was modified to automatically adjust the DAT/MAT set points based on return air temperature. The reset schedule was set with the temperature set points shown in Table 2 and Table 3, adjustable through new dual input pneumatic controllers. The reset schedule is not as aggressive in Table 3 because AH-4, 6, and 8 serve courtrooms. Due to the varying occupancy that occurs in courtrooms (and therefore larger swings in return air temperatures), the reset schedule was reduced from 10°F to 5°F to promote stable room temperatures.

Measure Modeling Estimation Changes

The reset schedules changes from the RCx contractors report are shown in Table 2 and Table 3.

Table 2: Bellflower AH Reset Schedule (AH-1, 2, 3, 5 and 7 only)

Return Air Temp.	Discharge Air Temp.	Mixed Air Temp.
76°F	55°F	52°F
70°F	65°F	62°F

Table 3: Bellflower Courthouse AH Reset Schedule (AH-4, 6 and 8 only)

Return Air Temp.	Discharge Air Temp.	Mixed Air Temp.
76°F	55°F	52°F
70°F	60°F	57°F

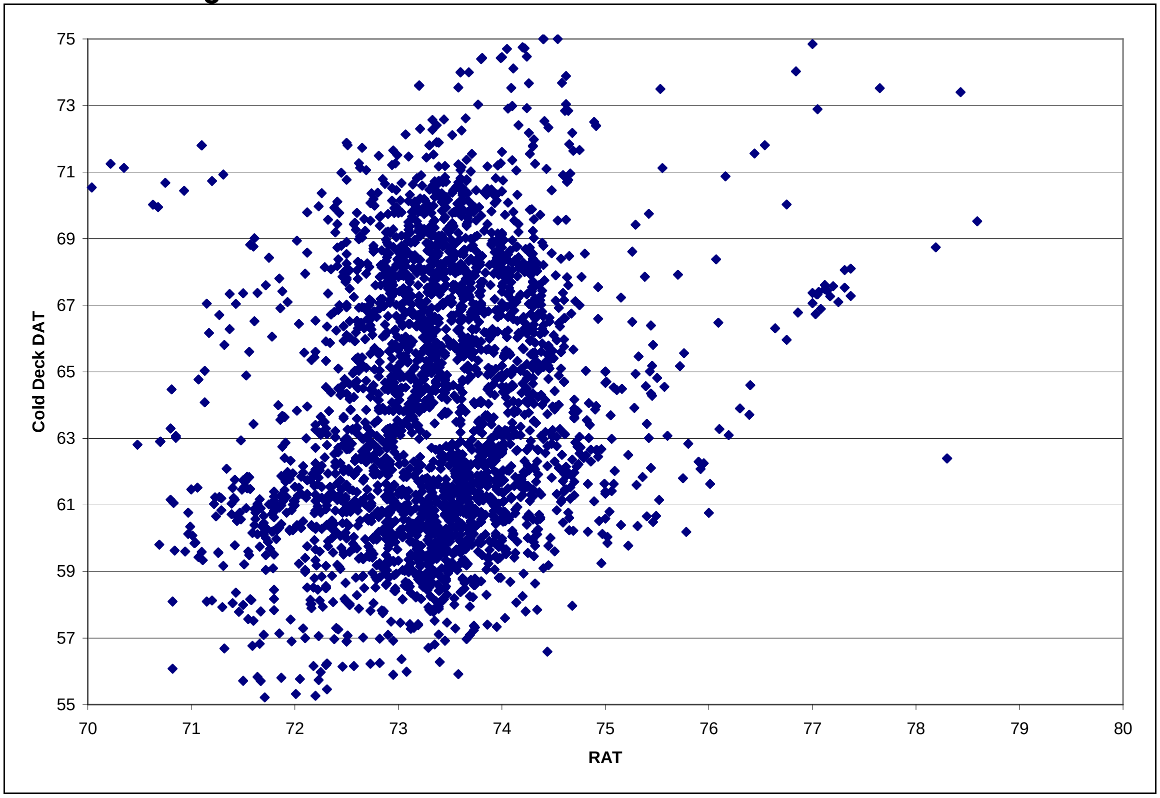
Baseline	**Reset EEM 3**
AHU-1 East 1st Flr = SYSTEM	AHU-1 East 1st Flr = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = PLENUM-ZONES	RETURN-AIR-PATH = PLENUM-ZONES
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
MIN-SUPPLY-T = 60	**MIN-SUPPLY-T = 55**
	COOL-CONTROL = WARMEST
ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
	RESET-PRIORITY = TEMP-FIRST
	COOL-MAX-RESET-T = 60

Baseline	**Reset EEM 3**
AHU-4 West 2nd Flr = SYSTEM	AHU-4 West 2nd Flr = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = PLENUM-ZONES	RETURN-AIR-PATH = PLENUM-ZONES
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
MIN-SUPPLY-T = 60	**MIN-SUPPLY-T = 55**
	COOL-CONTROL = WARMEST
ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
	COOL-MAX-RESET-T = TEMP-FIRST
	COOL-MAX-RESET-T = 58

Verification

Post implementation data show discharge air temperature reset did not appear to be operating on any of the air handlers. As Figure 3 below, the discharge air temperature (while chiller is running) does not trend downward as the return air increases. Data from all of the air handlers at the facility had similar plots.

Figure 3: Bellflower Courthouse DAT Reset Verification



Evaluation Model Changes

The cold deck DAT control was changed back to "fixed" for all air handlers for the evaluation model since the RAT reset was not functioning as modeled.

1.1.5 EEM 4. VAV Repair

Full air balance was originally recommended, but the final approved TAB implementation scope involved the repair/replacement/balance of 40 VAV boxes based on the boxes that showed no change in CFM between full heating and full cooling. Thermostat Issues: 20 VAV boxes were verified operable by stroking the damper the full range of motion. The deficiency for these boxes was determined to be a thermostat issue where the stat would not allow ample pressure to build to stroke the damper. Additionally, the controllers for these boxes were verified for operability. Repair Dampers/Pneumatics: The dampers associated with 1 VAV box were not attached to the shaft. A clip was added to repair this issue. Additionally, 1 VAV box was found to have loose pneumatic connections, which were in turn repaired. Balance Remaining Boxes: 18 VAV boxes were found to be improperly balanced, as the dampers were set to a fixed position. The boxes were individually balanced without adjusting duct static pressure requirements to bring flows as close as possible to design values.

Measure Modeling Estimation Changes

This measure was modeled by changing minimum flow ratio from 70% to 60% for all air handlers. The line of code changes for all air handlers at the facility are shown below.

Measure
< MIN-FLOW-RATIO = 0.6
Baseline
> MIN-FLOW-RATIO = 0.7

Verification

VAV box repairs could not be verified with available building data at this site. The measure is assumed to be functioning as modeled for the evaluation, as the assumptions are reasonable and the modeling methodology appears sound given the procedures implemented for this measure.

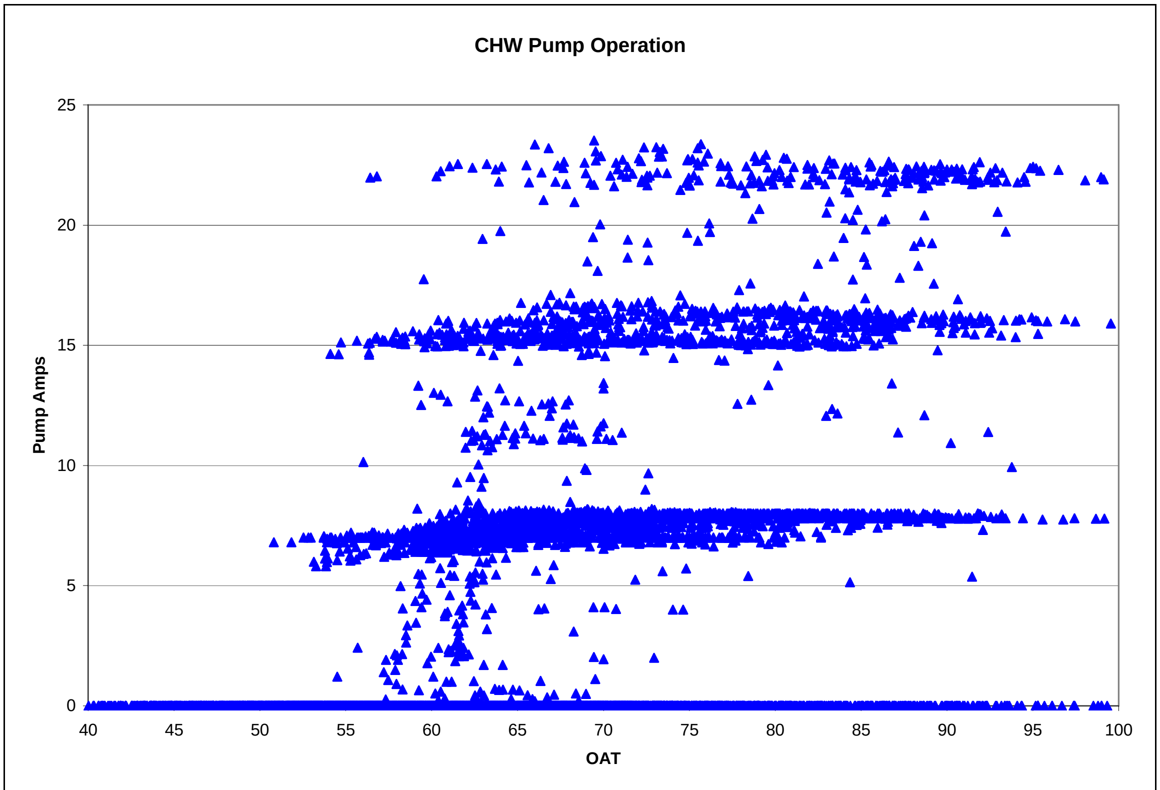
1.1.6 EEM 5. Hot Water Pump/Chilled Water Pump Outside Air Set point

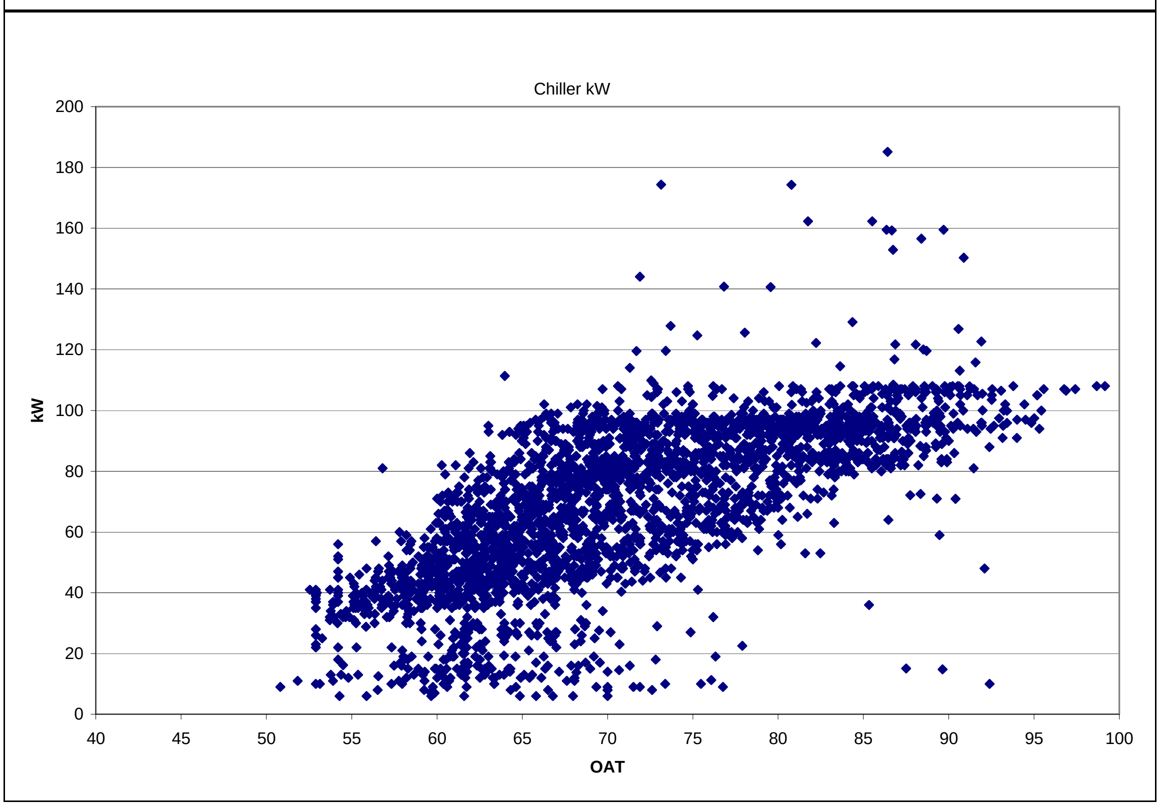
The prefunctional report recommended the reduction of the OAT enable for the heating system from 76°F to 70°F. It was also recommended to raise the OAT enable for the cooling system to 60°F.

Verification

The heating enable set point was not directly verifiable since boiler status and hot water pump operation were not available via EEMIS. The cooling enable temperature is verified with chiller and chilled water pump power draw against outside air set points in Figure 4 below. The plot shows OAT operation enabled at closer to 55F than the modeled 60F.

Figure 4: Bellflower Courthouse Outside Air Set point Verification


CHW Pump Operation
Pump Amps
0
5
10
15
20
25
40
45
50
55
60
65
70
75
80
85
90
95
100
OAT


Chiller kW
kW
0
20
40
60
80
100
120
140
160
180
200
40
45
50
55
60
65
70
75
80
85
90
95
100
OAT

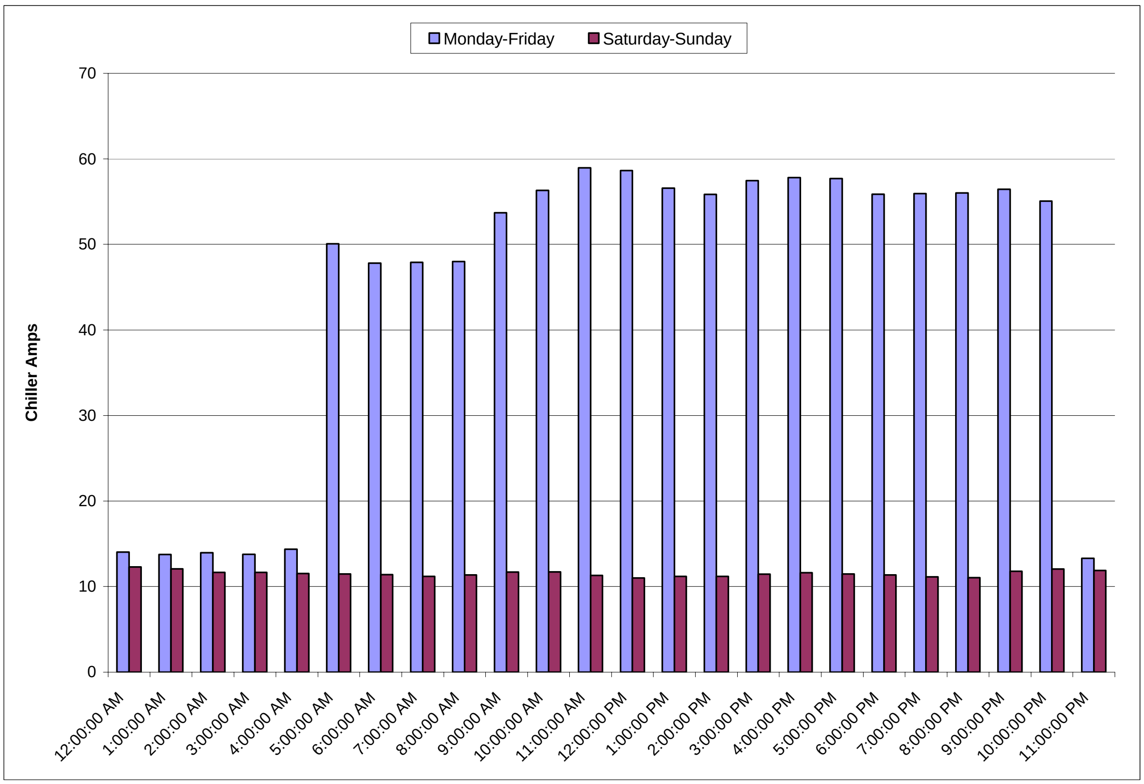
Evaluation Model Changes

No changes were made to heating enable set point. The cooling system enable, or "chiller lock out" (SNAP-T) was changed from 60 to 55°F to reflect actual system operation.

1.1.7 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. No modifications to the baseline model were necessary at this site. Figure 5.shows the average chiller amp draw pre implementation, which matches the baseline model cooling system schedule of 4AM to 10PM weekdays, off weekends.

Figure 5: Bellflower Courthouse Fan Baseline Operation



1.1.8 Bellflower Courthouse Evaluation Summary

The table shows the status of the implemented measure in the evaluation model.

Table 4: Bellflower Courthouse EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
OA Economizer	2	Not adjusted
DAT Reset	3	Removed
TAB	4	Not adjusted
System Enable OA SP	5	Adjusted

Table 5: Bellflower Courthouse Savings Summary

Bellflower Courthouse	kWh	kW	Therms
Modified Baseline Usage	1,463,860	271	47,002
Evaluation Usage	1,116,952	249	19,392
Ex-Post Savings	346,908	22	27,610
Ex-Ante Savings	369,808	4	34,915
Realization Rate	94%	555%	79%

Note that program reported ex-ante include boiler savings were already attributed to the Boiler Retrofit element and a OAT boiler reset that according to the final site report The site report indicates the retrocommissioning savings for the site as the EEM 5 row in Table 1, while the program claimed savings for the EEM 7 row.

1.2 Beverly Hills Courthouse

1.2.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 6 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 6: Beverly Hills Courthouse Recommendations

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implemen-tation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 - AHU VFDs Clr Blr S/S	(23)	320,135	11,516	$ 44,523	$ 11,119	$ 55,642	$ 55,642	$ 20,492	$ 20,492	0.4
EEM #2 - HD Reset + EEM 1	(23)	322,189	12,416	$ 44,965	$ 11,988	$ 1,311	$ 56,953	$ 8,614	$ 29,106	0.5
EEM #3 - OA Econ DB + EEMs 1-2	(25)	327,274	15,768	$ 45,937	$ 15,225	$ 4,209	$ 61,162	$ 8,678	$ 37,784	0.6
EEM #4 - CT Control + EEMs 1-3	(23)	330,285	15,768	$ 46,727	$ 15,225	$ 790	$ 61,952	$ -	$ 37,784	-
EEM #6 - FCU Stp 80F	(23)	331,656	15,943	$ 47,053	$ 15,394	$ 495	$ 62,447	$ -	$ 37,784	-

*Note 1: Total annual savings and implementation costs are cumulative. An additional implementation cost of $12,601 was approved for repair of 12 mixing boxes for EEM 5.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.2.2 EEM 1. HVAC Start/Stop Schedules and VFD Control

This EEM reduced the operating schedule for cooling and heating plant equipment, and air handling unit (AHU) fans. The system schedules were modified from the following baseline operation:

The schedule for the HVAC fans was reduced from continuous operation to operate between 5am to 7 pm. Chilled water system operated from 3am to 9pm with a 55°F OAT lockout during occupied periods. Chiller schedule was modified to 5am to 7 pm, with a 61°F OAT lockout. The heating water system operated from 3am to 9pm with a 72°F OAT lockout during occupied periods. Boiler schedule was modified to 5am to 7 pm, with a 70°F OAT lockout.

Measure Modeling Estimation Changes

Modeled fan schedule changed from continuous fan operation to 5am to 7pm weekdays and off weekends as shown in the code changes highlighted in bold below.

Baseline	EEM 1
"AC-2 Fan M-F" = DAY-SCHEDULE-PD	**"EEM 1 Fan Sch Day" = DAY-SCHEDULE-PD**
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1)	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,**
	&D, &D, &D, &D, &D, 0)
..	..
"AC-1/5 Fan WEH" = DAY-SCHEDULE-PD	**"EEM 1 Fan Sch WEH" = DAY-SCHEDULE-**

	PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1)	**VALUES = (0)**

The weekday chiller schedule was changed from 3am- 9pm to 5am - 7pm.

Baseline	**EEM 1**
Clr Loop - Day = DAY-SCHEDULE-PD	EEM 1 Clr Sch Day = DAY-SCHEDULE-PD
TYPE = ON/OFF	TYPE = ON/OFF
VALUES = (0, &D, &D, 1, &D, &D, &D, &D, &D, &D,	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D,**
&D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)	**&D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)**

Chiller OAT lockout "Snap-T" changed to 61°from 55°.

Baseline	**EEM 1**
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-DESIGN-DT = 10	LOOP-DESIGN-DT = 10
LOOP-OPERATION = SNAP	LOOP-OPERATION = SNAP
COOLING-SCHEDULE = "Clr Loop - Year"	COOLING-SCHEDULE = "Clr Loop - Year"
PUMP-SCHEDULE = "Clr Loop - Year"	**PUMP-SCHEDULE = "EEM 1 Clr Sch"**
SNAP-T = 55	**SNAP-T = 61**
SNAP-LOCN = OUTDOOR	SNAP-LOCN = OUTDOOR
DESIGN-COOL-T = 47	**DESIGN-COOL-T = 46**
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
SUPPLY-UA = 55	SUPPLY-UA = 55
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 Core Zn (G.C7)"	LOOP-LOSS-ZONE = "EL1 Core Zn (G.C7)"

Modeled boiler schedule changed from 3am to 9pm to 5am through 7pm

Baseline	**EEM 1**
HW Loop 3am to 9pm = DAY-SCHEDULE-PD	EEM 1 Blr Sch Day = DAY-SCHEDULE-PD
TYPE = ON/OFF	TYPE = ON/OFF
VALUES = (0, &D, &D, 1, 1, &D, &D, &D, &D, &D, &D, &D,	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D,**
&D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)	**&D, &D, &D, &D, &D, &D, &D, &D, 0)**

HW Loop OAT lockout "FSNAP-T" set to 72°from 70°.

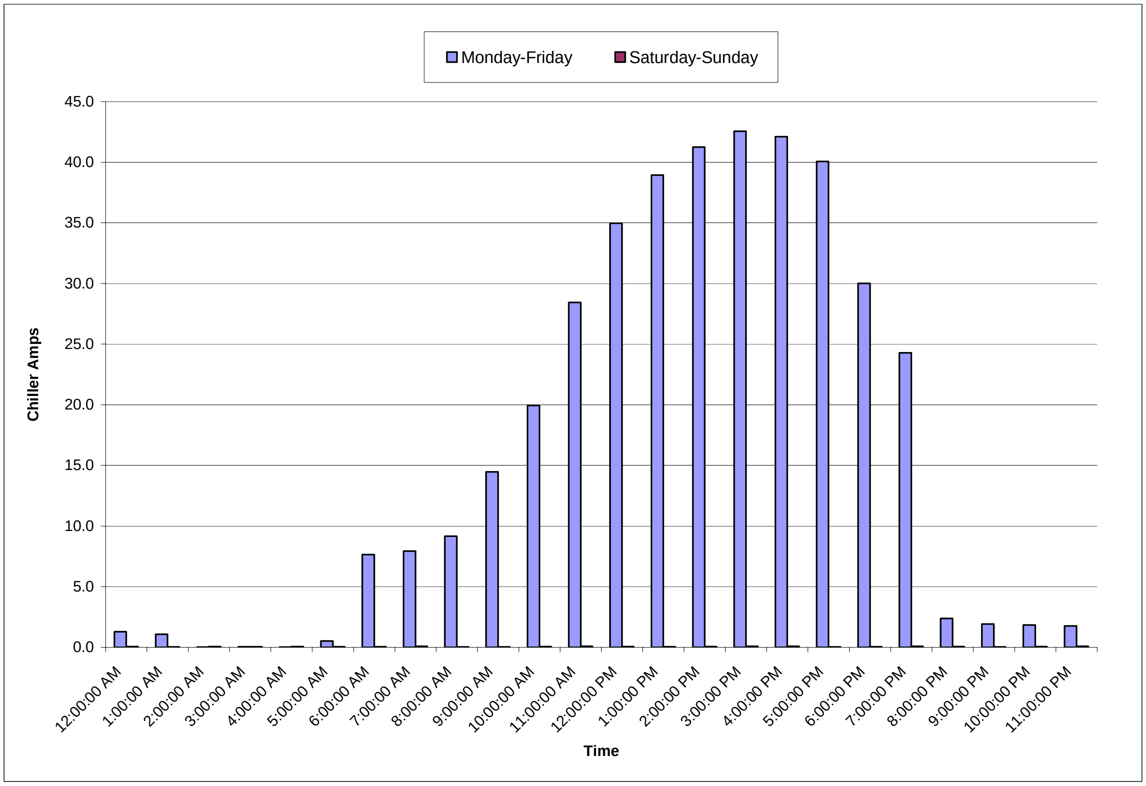
Baseline	**EEM 1**
Hot Water Loop = CIRCULATION-LOOP	Hot Water Loop = CIRCULATION-LOOP
TYPE = HW	TYPE = HW
LOOP-DESIGN-DT = 10	LOOP-DESIGN-DT = 10
LOOP-OPERATION = SNAP	LOOP-OPERATION = SNAP
PUMP-SCHEDULE = "HW Loop- Year"	**PUMP-SCHEDULE = "EEM 1 Blr Sch"**
SNAP-T = 72	**SNAP-T = 70**
SNAP-LOCN = OUTDOOR	SNAP-LOCN = OUTDOOR
DESIGN-HEAT-T = 150	DESIGN-HEAT-T = 150
HEAT-SETPT-CTRL = FIXED	HEAT-SETPT-CTRL = FIXED
LOOP-PUMP = "HW Loop Pump"	LOOP-PUMP = "HW Loop Pump"
SUPPLY-UA = 115	SUPPLY-UA = 115
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 Core Zn (G.C7)"	LOOP-LOSS-ZONE = "EL1 Core Zn (G.C7)"

The AHU fans ran continuously due to a Modbus communication issue with the VFDs. When the VFD for RF-5 was replaced due to maintenance issues, it was discovered that the new VFD model would not communicate with existing VFDs through the Modbus. AHU fans were required to remain in "Hand" to maintain communication. The Modbus was removed and VFD control was tied directly into the Teletrol system. Automatic fan VFD control was restored based on duct static pressure.

Verification

Actual post implementation building data show chillers operating from 5am to 7pm Monday through Friday and off on Saturday and Sunday, as shown in Figure 6. Chiller lock-out temperature of 61F was also verified.

Figure 6: Beverly Hills Post Implementation Courthouse Chiller Hours



Evaluation Model Changes

The fans were modeled to operate from 5am to 7pm Monday through Friday and off on Saturday or Sunday. Note that only the fan schedule code is inserted below, but the same hours were applied to the boiler and chiller. The code changes are highlighted in bold.

EEM 1 Fan Sch Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)
..
EEM 1 Fan Sch WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0)

1.2.3 EEM 2. Hot Deck/Cold Deck Reset

The existing control sequence was modified to automatically adjust the hot deck set point based on outside air temperature and the cold deck set points based on return air temperature. The reset schedule was set with the adjustable temperature set points shown in Table 7.

Table 7: Beverly Hills Courthouse AHU Reset Schedule

RAT	CDT
74°F	55°F
70°F	60°F

OSA	HDT
55°F	105°F
70°F	77°F

Above 70°F OAT, the strategy also closes the hot deck damper. Resetting the hot deck temperatures will produce natural gas savings, and closing the hot deck damper will produce electrical savings from chiller and fan energy.

Measure Modeling Estimation Changes

There were no model changes for cold deck.

AHU reset schedule inserted as described above.

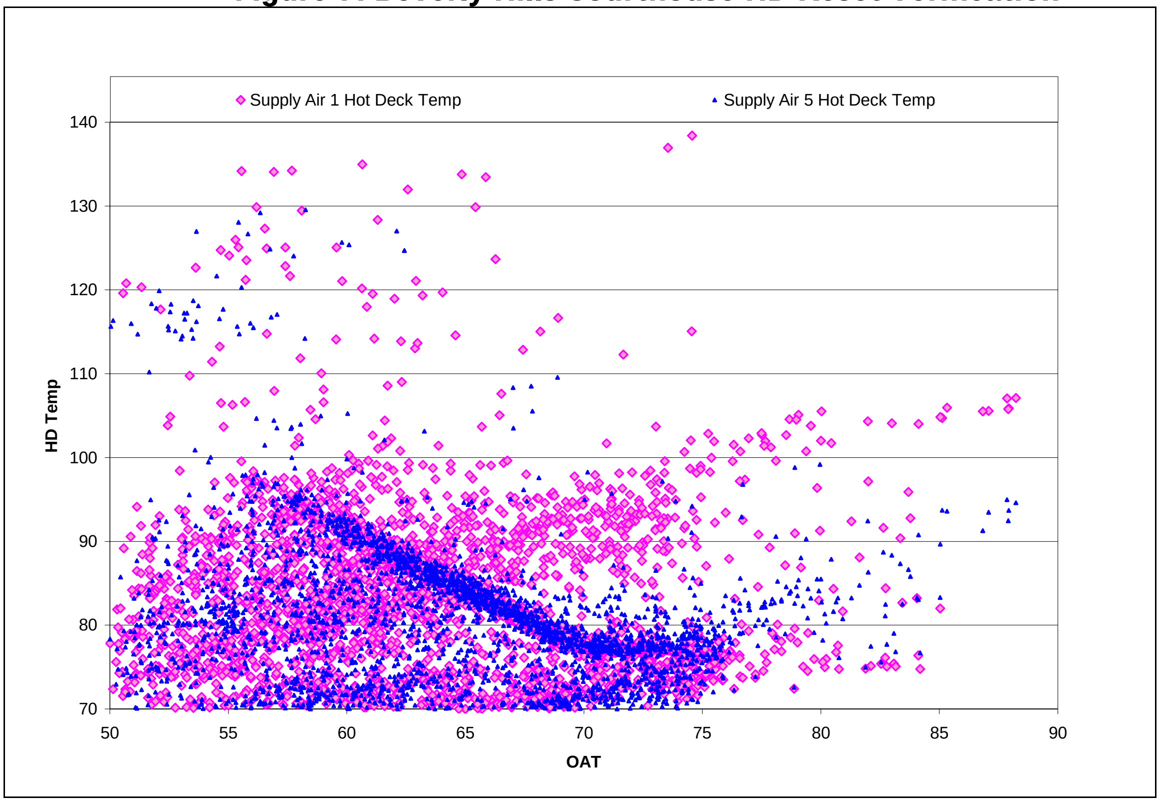
Baseline	**EEM 2**
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
	HEAT-RESET-SCH = "EEM 2 HD Reset"
	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 58	MIN-SUPPLY-T = 58
SUPPLY-FLOW = 29378	SUPPLY-FLOW = 29378
RETURN-FLOW = 12409	RETURN-FLOW = 12409
MIN-OUTSIDE-AIR = 0.2	MIN-OUTSIDE-AIR = 0.2
OA-CONTROL = FIXED	OA-CONTROL = FIXED
FAN-SCHEDULE = "EEM 1 Fan Sch"	FAN-SCHEDULE = "EEM 1 Fan Sch"
FAN-CONTROL = SPEED	FAN-CONTROL = SPEED
SUPPLY-KW/FLOW = 0.000657	SUPPLY-KW/FLOW = 0.000657
RETURN-KW/FLOW = 0.00134	RETURN-KW/FLOW = 0.00134
FAN-EIR-FPLR = "Variable Speed Drive FPLR"	FAN-EIR-FPLR = "Variable Speed Drive FPLR"
RETURN-FAN-CONTR = SPEED	RETURN-FAN-CONTR = SPEED
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"
CHW-LOOP = "Chilled Water Loop"	CHW-LOOP = "Chilled Water Loop"
	EEM 2 HD Reset Day = DAY-

	SCHEDULE-PD
	TYPE = RESET-TEMP
	OUTSIDE-HI = 70
	OUTSIDE-LO = 50
	SUPPLY-HI = 105
	SUPPLY-LO = 77

Verification

The hot deck reset appeared to be functioning as modeled. Hot deck temperature is plotted against outside air temperature while hot water pumps were operational in Figure 7 below. Although there is considerable "noise", which may be a result of transient conditions, the data show evidence of a functioning reset.

Figure 7: Beverly Hills Courthouse HD Reset Verification



1.2.4 EEM 3. Outside Air Economizer

The existing control sequence was modified to implement an outside air economizer strategy that modulates economizer dampers to maintain the mixed air temperature set point whenever the outside air temperature is less than the return air temperature.

Measure Modeling Estimation Changes

AC 1, 3, and 5 were changed from fixed outside air percentage to dry bulb temperature economizer control. AC 2 and 5 merely changed ECONO-LIMIT-T, economizer enable low limit set points.

EEM2	**EEM3**
AC-1 = SYSTEM	AC-1 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
HEAT-RESET-SCH = "EEM 2 HD Reset"	HEAT-RESET-SCH = "EEM 2 HD Reset"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 58	MIN-SUPPLY-T = 58
	ECONO-LIMIT-T = 75
	ECONO-LOW-LIMIT = 60
SUPPLY-FLOW = 29378	SUPPLY-FLOW = 29378
RETURN-FLOW = 12409	RETURN-FLOW = 12409
MIN-OUTSIDE-AIR = 0.2	**MIN-OUTSIDE-AIR = 0.27**
OA-CONTROL = FIXED	**OA-CONTROL = OA-TEMP**
FAN-SCHEDULE = "EEM 1 Fan Sch"	FAN-SCHEDULE = "EEM 1 Fan Sch"
FAN-CONTROL = SPEED	FAN-CONTROL = SPEED
SUPPLY-KW/FLOW = 0.000657	SUPPLY-KW/FLOW = 0.000657
RETURN-KW/FLOW = 0.00134	RETURN-KW/FLOW = 0.00134
FAN-EIR-FPLR = "Variable Speed Drive FPLR"	FAN-EIR-FPLR = "Variable Speed Drive FPLR"
RETURN-FAN-CONTR = SPEED	RETURN-FAN-CONTR = SPEED
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"
CHW-LOOP = "Chilled Water Loop"	CHW-LOOP = "Chilled Water Loop"

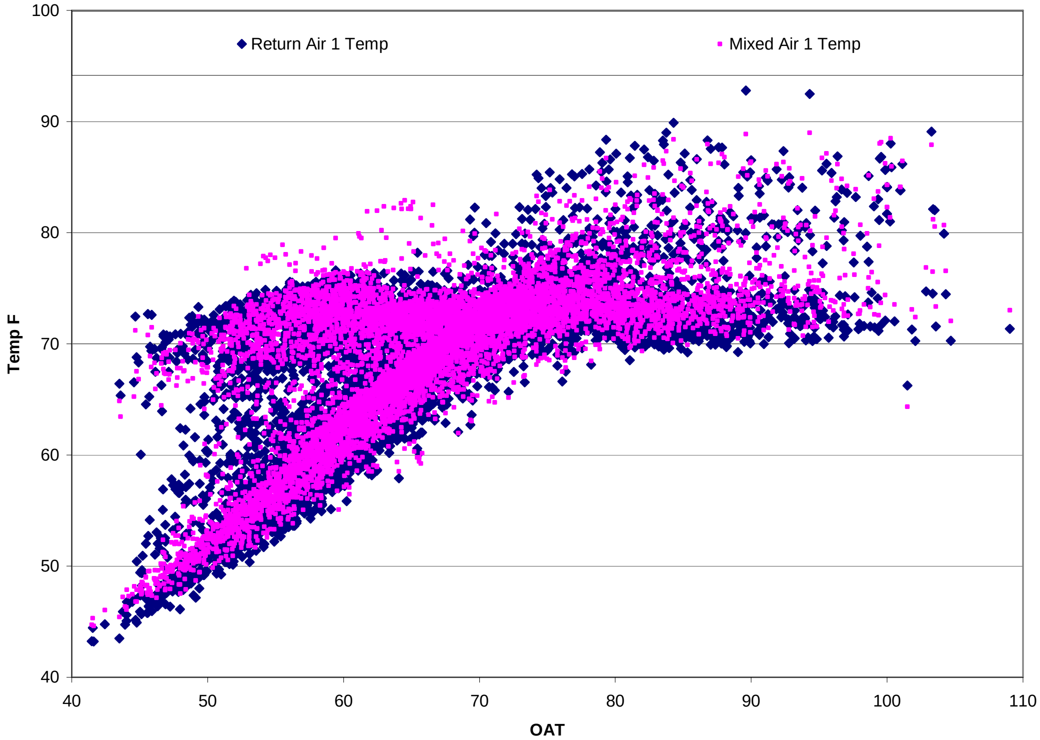
AC-2 = SYSTEM	AC-2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
HEAT-RESET-SCH = "EEM 2 HD Reset"	HEAT-RESET-SCH = "EEM 2 HD Reset"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 58	MIN-SUPPLY-T = 58
ECONO-LIMIT-T = 70	**ECONO-LIMIT-T = 75**
	ECONO-LOW-LIMIT = 60
SUPPLY-FLOW = 22892	SUPPLY-FLOW = 22892

AC-5 = SYSTEM	AC-5 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
HEAT-RESET-SCH = "EEM 2 HD Reset"	HEAT-RESET-SCH = "EEM 2 HD Reset"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 58	MIN-SUPPLY-T = 58
ECONO-LIMIT-T = 65	**ECONO-LIMIT-T = 75**
	ECONO-LOW-LIMIT = 60
SUPPLY-FLOW = 13030	SUPPLY-FLOW = 13030
RETURN-FLOW = 6460	RETURN-FLOW = 6460
MIN-OUTSIDE-AIR = 0.3	**MIN-OUTSIDE-AIR = 0.12**
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP
MAX-OA-FRACTION = 1	MAX-OA-FRACTION = 1

Verification

The economizers appear to be functioning as modeled. The mixed air temperature largely follows outside air temperature up to 75F, and then follows return air at outside temperatures above 75 as shown in Figure 8 below. Other air handlers had similar plots that indicated functioning economizers.

Figure 8: Beverly Hills Courthouse Economizer Verification



1.2.5 EEM 4. Condenser Water Temperature

This measure recommends adjusting the condenser water temperature, which will result in additional chiller energy savings. The temperature is maintained at 82°F for one cooling tower, and 84°F for the other tower. It was recommended to reduce the condenser tower to chiller water temperature to 75°F.

Measure Modeling Estimation Changes

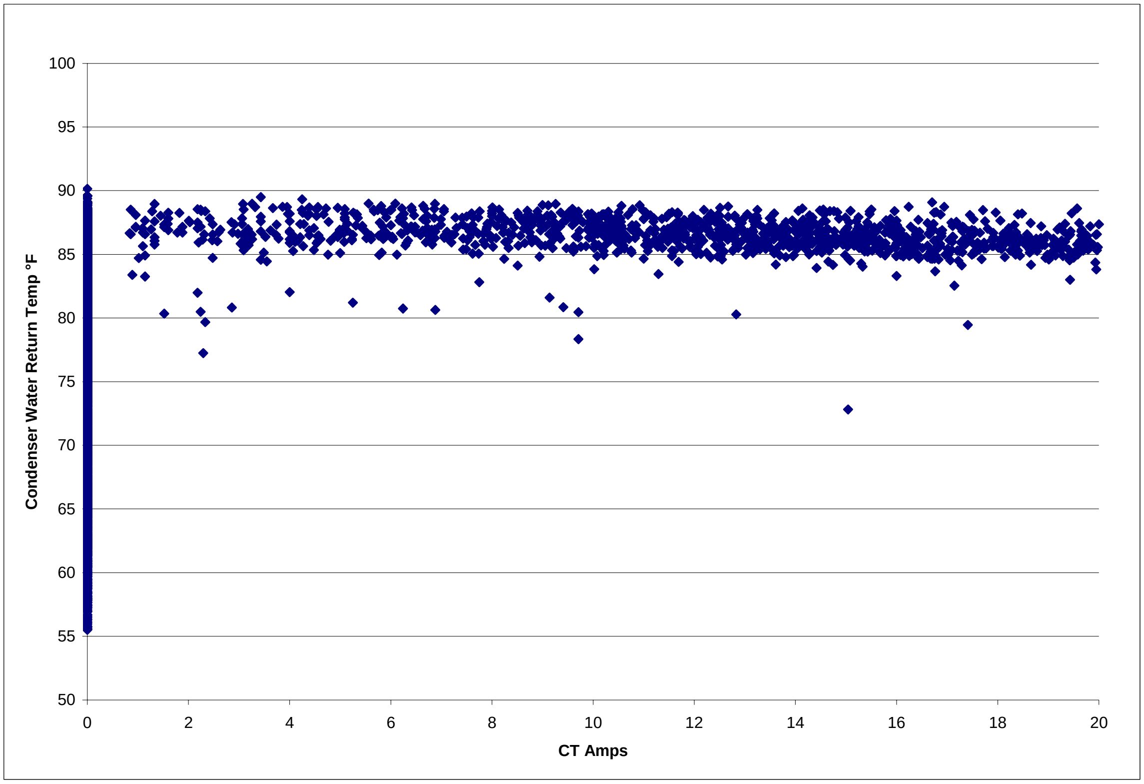
Condenser water temperature set to 84°F, not to 75°F as indicated in the report.

Baseline	**EEM4**
Condenser Water Loop = CIRCULATION-LOOP	Condenser Water Loop = CIRCULATION-LOOP
TYPE = CW	TYPE = CW
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
COOL-SETPT-T = 85	**COOL-SETPT-T = 84**
LOOP-PUMP = "CW Loop Pump"	LOOP-PUMP = "CW Loop Pump"

Verification

Figure 9 shows that the condenser water temperature change is functioning as indicated in estimation model, not as stated in the report. In almost all instances where the return temperature is above 84°F when the cooling tower fan is running.

Figure 9: Beverly Hills Courthouse Condenser Water Temperature



1.2.6 EEM 6. Temperature Setback for Chiller Room Fan Coil

This measure included check report setting back the temperature on the chiller room fan coil unit from 70°F to 78°F.

Measure Modeling Estimation Changes

Chiller room fan coil temperature set point modeled at 80°F, not 78°F as indicated in the report.

Baseline	EEM6
FCU Clg M-F = DAY-SCHEDULE-PD	EEM 6 - FCU Clg Sch Day = DAY-SCHEDULE-PD
TYPE = TEMPERATURE	TYPE = TEMPERATURE
VALUES = (70)	**VALUES = (80)** **"EEM 6 - FCU Clg Sch Day" = DAY-SCHEDULE-PD** **TYPE = TEMPERATURE** **VALUES = (80)** **"FCU Clg M-F" = DAY-SCHEDULE-PD** **TYPE = TEMPERATURE** **VALUES = (70)**

Verification

This measure cannot be verified since no chiller room temperature data were available via EEMIS. Measure is assumed to be functioning as modeled for the evaluation.

1.2.7 =Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. Discrepancies were noted between actual building pre implementation data collected between 1/1/2005 and 5/31/2005. Therefore, a modified baseline model was created using operational schedules from the pre implementation data. The changes to the schedules are shown in Table 8.

Table 8: Beverly Hills Courthouse Baseline Hour Comparison

	Baseline WD	Baseline WE	Modified BL WD	Modified BL WE
Fans	Continuous	Continuous	4AM-9PM	Off
Chiller	3AM-9PM	Off	4AM-9PM	Off

The results of the actual fan and chiller hours are shown in Figure 10 and Figure 11. Although there was some sporadic overnight and weekend fan usage, the fans were not did not operating continuously during the period considered.

Figure 10: Beverly Hills Courthouse Fan Baseline Operation

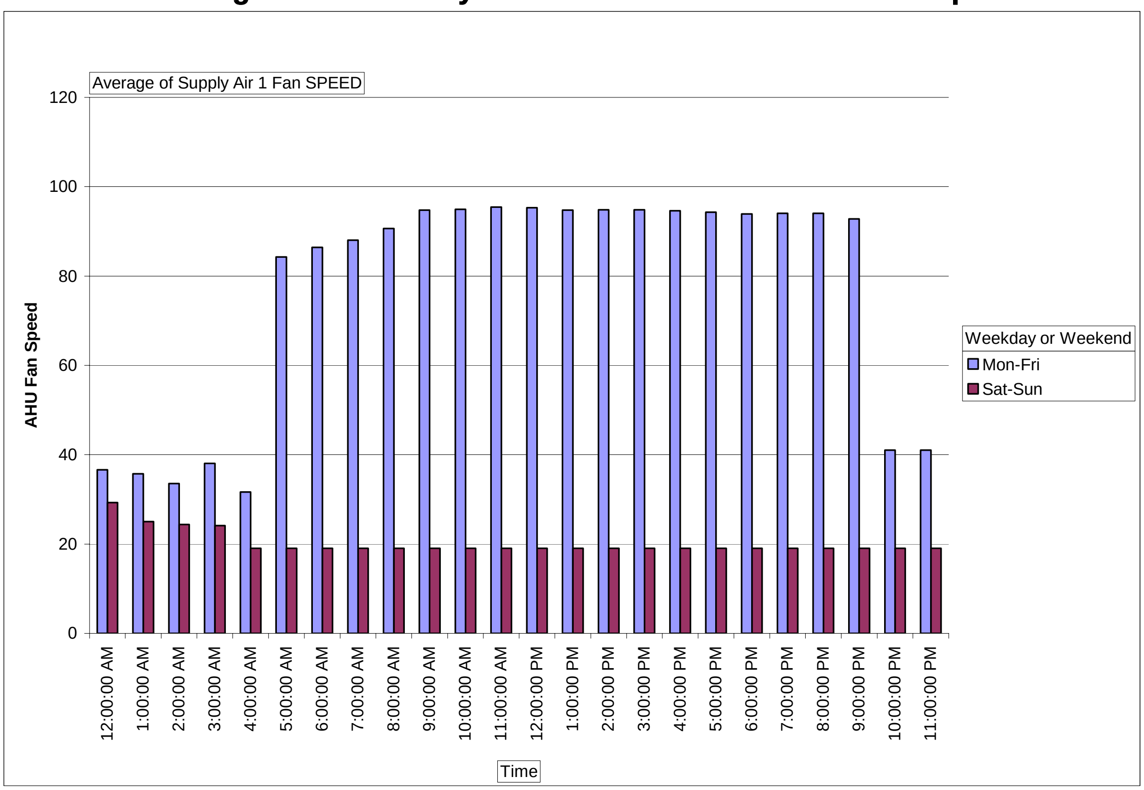
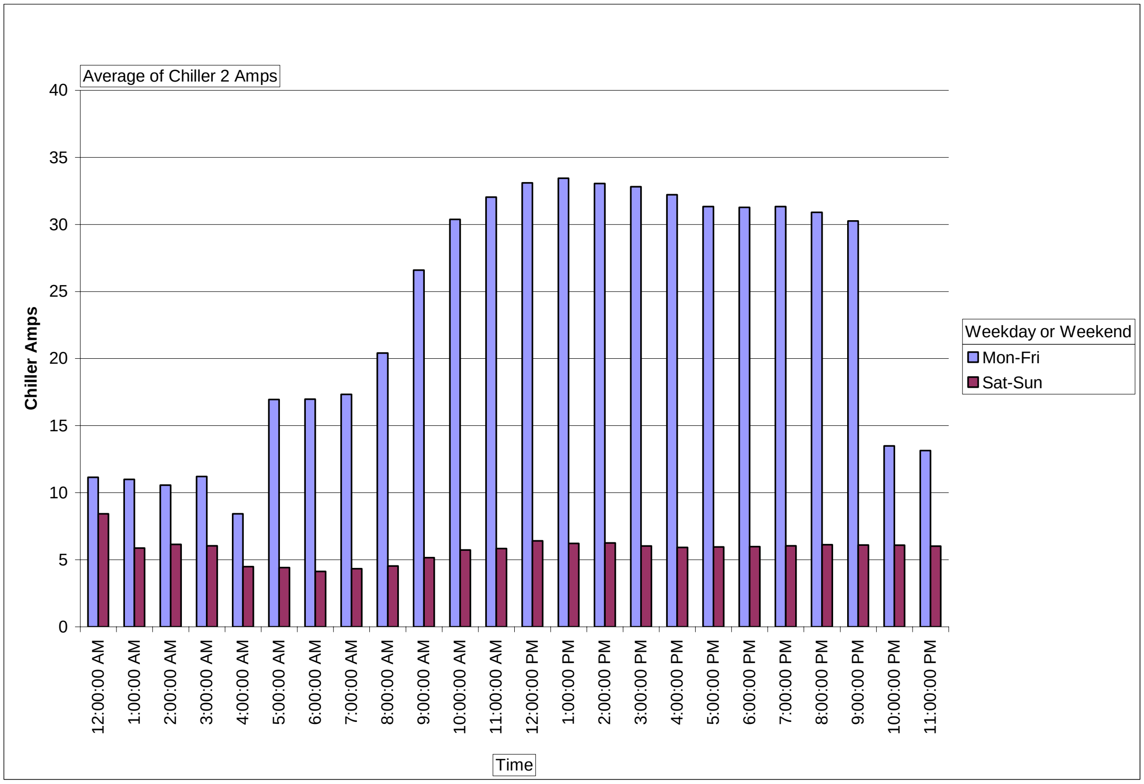


Figure 11: Beverly Hills Courthouse Chiller Baseline Schedule



1.2.8 Beverly Hills Courthouse Evaluation Summary

The table shows the status of the implemented measures in the evaluation model.

Table 9: Beverly Hills Courthouse EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
HD Reset	2	Not adjusted
OA Economizer	3	Not adjusted
CT Control	4	Not adjusted
FCU SP	6	Not adjusted

The table summarizes the evaluated savings. The greatest change in savings was due to modifications in the baseline fan schedule.

Table 10: Beverly Hills Courthouse Savings Summary

Bev. Hills Courthouse	kWh	kW	Therms
Modified Baseline Usage	1,254,396	317	23,694
Evaluation Usage	1,169,012	336	11,640
Ex-Post Savings	85,384	-19	12,054
Ex-Ante Savings	331,656	-23	15,943
Realization Rate	26%	-	76%

1.3 Compton Courthouse

1.3.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 11 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 11: Compton Courthouse Savings

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implementation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 - AHU/EF Clr Blr S/S	(95)	86,795	19,086	$ (2,672)	$ 15,542	$ 12,870	$ 12,870	$ -	$ -	-
EEM #2 - OA Econ Enth + EEM 1	(110)	145,744	22,471	$ 13,874	$ 18,371	$ 19,375	$ 32,245	$ 22,436	$ 22,436	0.7
EEM #3 - HD/CD Reset + EEMs 1-2	(109)	235,530	44,683	$ 30,851	$ 37,186	$ 35,792	$ 68,037	$ 15,708	$ 38,144	0.6
EEM #5 - Garage Fan S/S + EEMs 1-4	(109)	341,617	44,683	$ 52,027	$ 37,186	$ 21,176	$ 89,213	$ 34,680	$ 72,824	0.8
EEM #6 - AHUs 13-15 Temp SB + EEMs 1-6	(108)	376,139	46,873	$ 58,834	$ 39,010	$ 8,631	$ 97,844	$ 6,218	$ 79,042	0.8

*Note 1: Total annual savings and implementation costs are cumulative.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.3.2 EEM 1. HVAC System Start/Stop

This EEM recommends reducing the operating schedule for cooling and heating plant equipment (including DHW pumps), air handling unit (AHU) fans, and exhaust fans to operate between 5:00am to 7:00 pm. Baseline operation, based on trend data, assumes that the heating system runs continuously, and the AHU fans and cooling system run between 4:00am and 8:00 pm.

Measure Modeling Estimation Changes

Runtimes changed from 4am to 8pm to 5am to 7pm Monday through Friday.

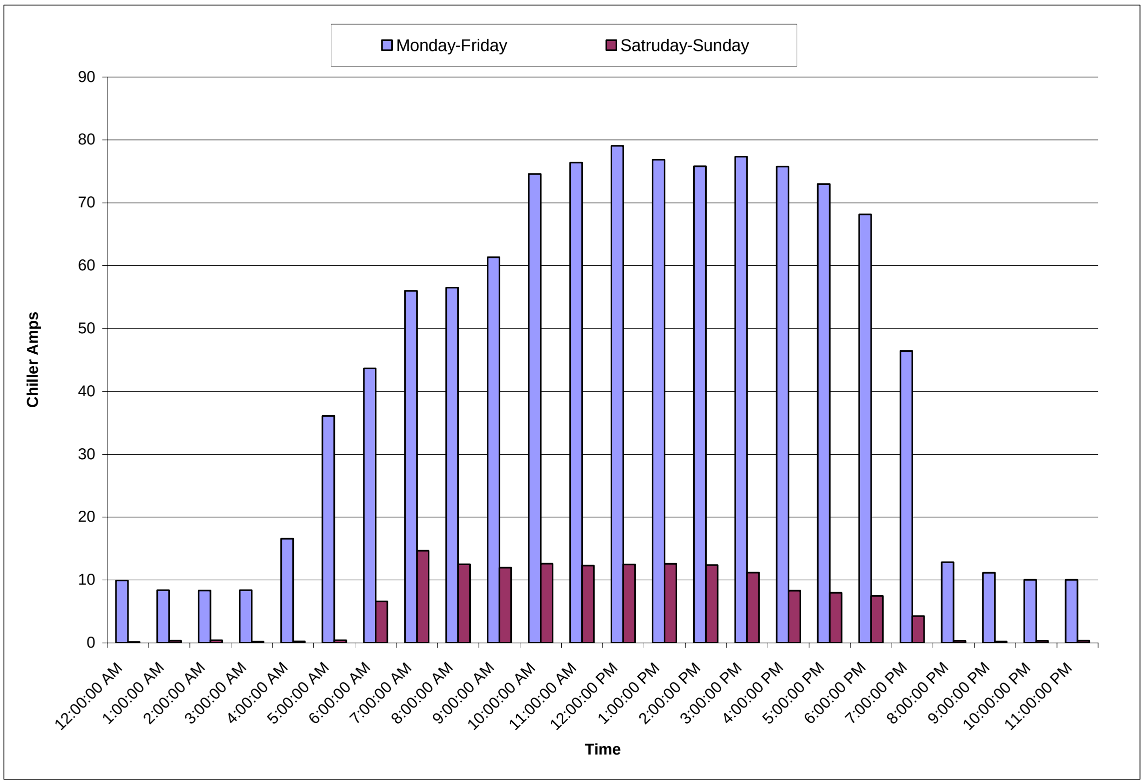
Baseline	EEM 1
"Fan Schedule - Day" = DAY-SCHEDULE-PD	"EEM 1 Fan Sch - Day" = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 1, 0)	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)**
"Boiler Schedule - Day On" = DAY-SCHEDULE-PD	"EEM 1 Blr Sch - DAY" = DAY-SCHEDULE-PD
TYPE = ON/OFF	TYPE = ON/OFF
VALUES = (1)	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)**
"Chiller - Day" = DAY-SCHEDULE-PD	"EEM 1 - Chiller Sch Day" = DAY-SCHEDULE-PD

TYPE = ON/OFF	TYPE = ON/OFF
VALUES = (0, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 1, 0.5, 0)	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)**

Verification

The chiller was verified as operating from 4am to 7pm and not operating on the weekend, as shown in Figure 12.

Figure 12: Compton Courthouse Chiller Operation Hours



Evaluation Model Changes

The evaluation model set fans, chillers and boilers schedules operating 4am to 7pm Monday through Friday and off the weekends.

EEM 1 Fan Sch - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 0)
..
EEM 1 Fan Sch - WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG

VALUES = (0)	

1.3.3 EEM 2. Outside Air Economizer

The outside air economizer sequence was adjusted and tested to confirm the code in the DDC software was controlling the economizers correctly, based on return and outside air enthalpies. It was the responsibility of ISD to confirm that the hardware on the outside air dampers was operable, per the deficiency log submitted after point to point testing.

Measure Modeling Estimation Changes

OA control changed from temp to enthalpy.

Baseline	**EEM2**
AHU-1 = SYSTEM	AHU-1 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
HEAT-CONTROL = CONSTANT	HEAT-CONTROL = CONSTANT
MIN-SUPPLY-T = 57	MIN-SUPPLY-T = 57
COOL-CONTROL = CONSTANT	COOL-CONTROL = CONSTANT
ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
	ENTHALPY-LIMIT = 30
SUPPLY-FLOW = 41040	SUPPLY-FLOW = 41040
RETURN-FLOW = 17823	RETURN-FLOW = 17823
MIN-OUTSIDE-AIR = 0.5	**MIN-OUTSIDE-AIR = 0.51**
OA-CONTROL = OA-TEMP	**OA-CONTROL = OA-ENTHALPY**
MAX-OA-FRACTION = 0.8	MAX-OA-FRACTION = 0.8

Baseline	**EEM1**
AHU-2 = SYSTEM	AHU-2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
HEAT-CONTROL = CONSTANT	HEAT-CONTROL = CONSTANT
MIN-SUPPLY-T = 57	MIN-SUPPLY-T = 57
COOL-CONTROL = CONSTANT	COOL-CONTROL = CONSTANT
ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
	ENTHALPY-LIMIT = 30
SUPPLY-FLOW = 34160	SUPPLY-FLOW = 34160
RETURN-FLOW = 6990	RETURN-FLOW = 6990
MIN-OUTSIDE-AIR = 0.5	**MIN-OUTSIDE-AIR = 0.36**

OA-CONTROL = OA-TEMP	**OA-CONTROL = OA-ENTHALPY**
MAX-OA-FRACTION = 0.8	MAX-OA-FRACTION = 0.8

Baseline	**EEM1**
AHU-3 = SYSTEM	AHU-3 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
HEAT-CONTROL = CONSTANT	HEAT-CONTROL = CONSTANT
MIN-SUPPLY-T = 57	MIN-SUPPLY-T = 57
COOL-CONTROL = CONSTANT	COOL-CONTROL = CONSTANT
ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
	ENTHALPY-LIMIT = 30
SUPPLY-FLOW = 39870	SUPPLY-FLOW = 39870
RETURN-FLOW = 25170	RETURN-FLOW = 25170
MIN-OUTSIDE-AIR = 0.3	**MIN-OUTSIDE-AIR = 0.07**
OA-CONTROL = OA-TEMP	**OA-CONTROL = OA-ENTHALPY**
MAX-OA-FRACTION = 0.6	MAX-OA-FRACTION = 0.6

Verification

The operation is enthalpy economizer compared to a dry-bulb economizer is hard to discern without a humidity sensor. Therefore, the measure is assumed to be working as modeled.

1.3.4 EEM 3. AHU Cold Deck/Hot Deck Reset Control Strategy

This EEM restores the hot deck discharge air temperature control to the design intent, which is a reset strategy based on outside air temperature. Above 70°F OAT, the strategy also closes the hot deck damper, as shown in Table 12.

Table 12: Compton Courthouse AHU Hot Deck Reset Schedule

Outside Air Temp. (°F)	Design Hot Deck (°F)
50	105
55	96
65	77
>70	Closed to Min. Position

Table 13 summarizes the cold deck reset strategy that was implemented.

Table 13: Compton Courthouse AHU Cold Deck Reset Schedule

Return Air Temperature (°F)	Cold Duct Setpoint (°F)
74°F	55°F
70°F	60°F

Measure Modeling Estimation Changes

Hot deck changed from fixed to reset hot deck DAT on OA and cold deck DAT on .

Baseline	**EEM3**
Hot Water Loop = CIRCULATION-LOOP	Hot Water Loop = CIRCULATION-LOOP
TYPE = HW	TYPE = HW
LOOP-DESIGN-DT = 40	LOOP-DESIGN-DT = 40
LOOP-OPERATION = SCHEDULED	**LOOP-OPERATION = SNAP**
HEATING-SCHEDULE = "EEM 1 Blr Sch"	HEATING-SCHEDULE = "EEM 1 Blr Sch"
PUMP-SCHEDULE = "EEM 1 Blr Sch"	PUMP-SCHEDULE = "EEM 1 Blr Sch"
	SNAP-T = 72
	SNAP-LOCN = OUTDOOR
DESIGN-HEAT-T = 170	**DESIGN-HEAT-T = 160**
HEAT-SETPT-CTRL = FIXED	HEAT-SETPT-CTRL = FIXED
LOOP-PUMP = "HW Loop Pump"	LOOP-PUMP = "HW Loop Pump"
SUPPLY-UA = 230	SUPPLY-UA = 230
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 South Perim Zn (M.S15)"	LOOP-LOSS-ZONE = "EL1 South Perim Zn (M.S15)"

AHU-1 = SYSTEM	AHU-1 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
	HEAT-RESET-SCH = "EEM 3 - DAT Reset Sch"
HEAT-CONTROL = CONSTANT	**HEAT-CONTROL = RESET**
MIN-SUPPLY-T = 57	MIN-SUPPLY-T = 57
COOL-CONTROL = CONSTANT	**COOL-CONTROL = WARMEST**
ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
	ENTHALPY-LIMIT = 30
	RESET-PRIORITY = TEMP-FIRST
	COOL-MAX-RESET-T = 58
SUPPLY-FLOW = 41040	SUPPLY-FLOW = 41040
RETURN-FLOW = 17823	RETURN-FLOW = 17823
MIN-OUTSIDE-AIR = 0.5	**MIN-OUTSIDE-AIR = 0.51**
OA-CONTROL = OA-TEMP	**OA-CONTROL = OA-ENTHALPY**
MAX-OA-FRACTION = 0.8	MAX-OA-FRACTION = 0.8
FAN-SCHEDULE = "EEM 1 Fan Sch"	FAN-SCHEDULE = "EEM 1 Fan Sch"

Verification

The cold deck is resetting on RAT as modeled and is shown in Figure 13. Figure 14 shows evidence of the hot deck functioning since there is a visible trend sloping downward despite considerable noise. Other air handlers had similar plots of properly functioning resets.

Figure 13: Compton Courthouse Cold Deck Verification

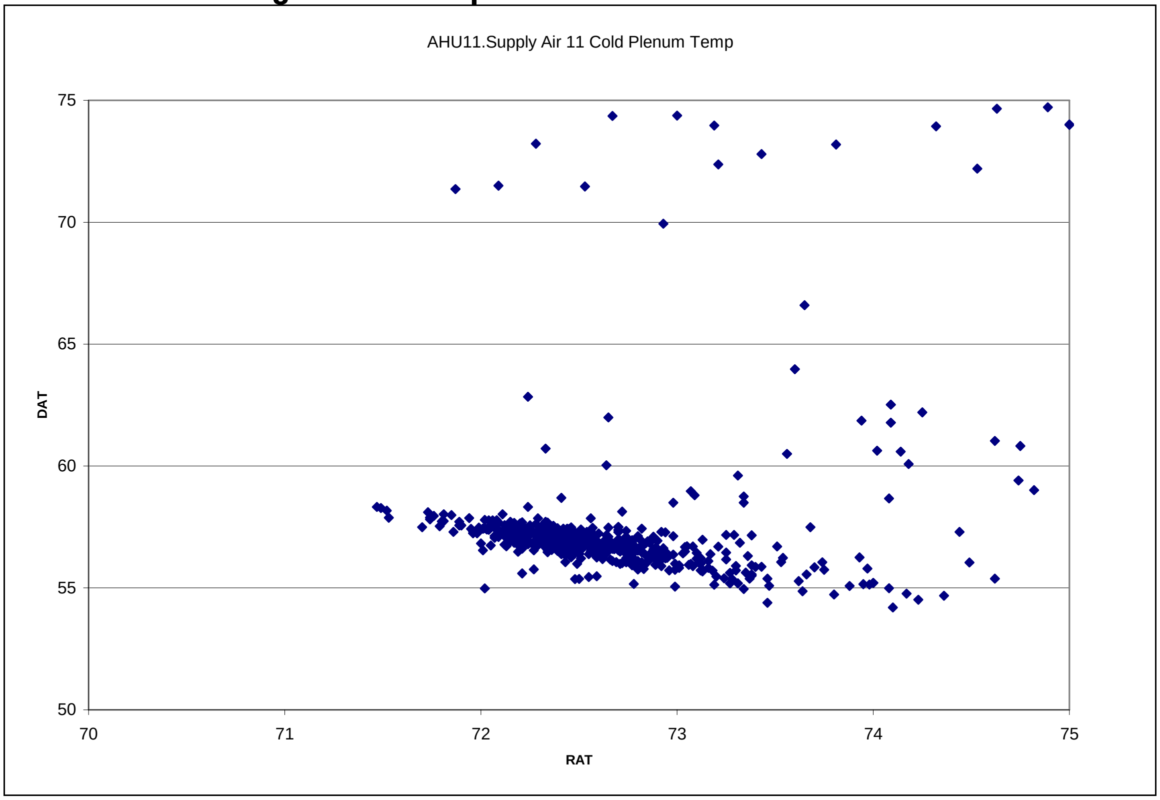
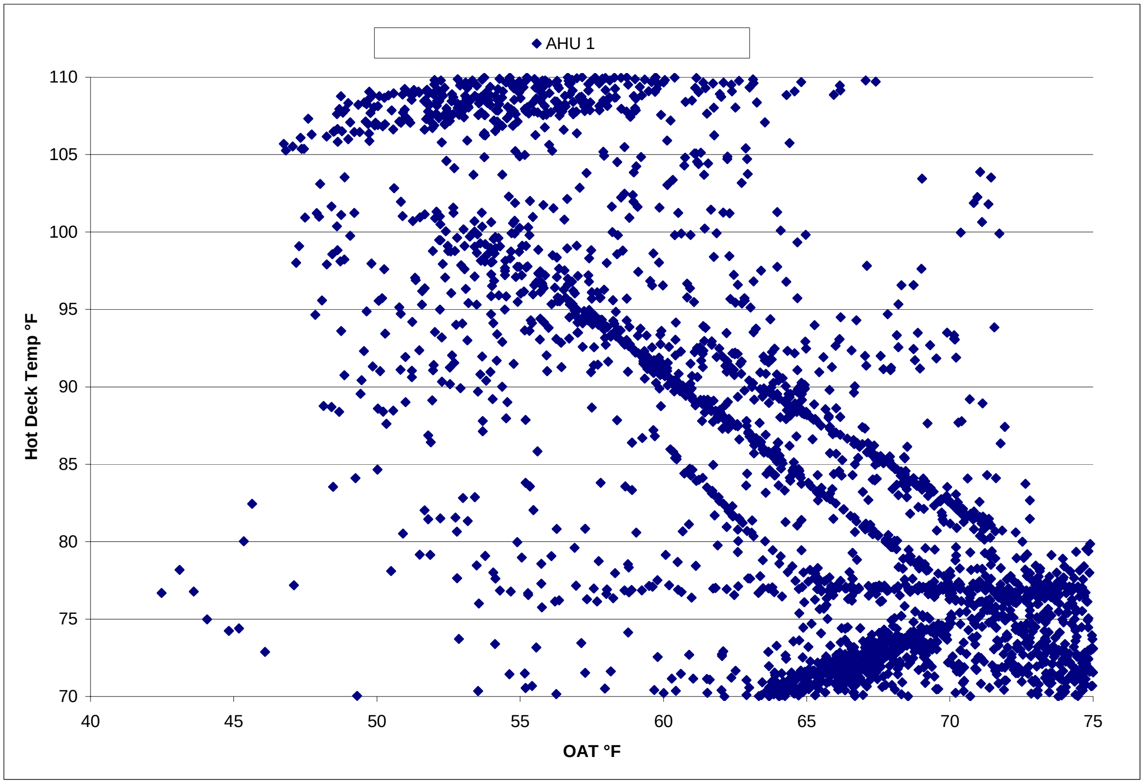


Figure 14: Compton Courthouse Hot Deck Verification



1.3.5 EEM 5. Garage Exhaust Fan CO Control.

This EEM included installing 18 carbon monoxide (CO) sensors and 4 diesel sensors throughout the parking garage to control the start/stop operation of the parking garage supply and exhaust fans based on a CO setpoint of 35 ppm.

Measure Modeling Estimation Changes

The code changes are inserted and highlighted in bold below. The schedule was the only update and it was changed from being on 24 hours a day to operating from 4am to 9am and 3pm to 6pm.

Baseline	**EEM5**
EM1 = ELEC-METER	EM1 = ELEC-METER
TYPE = UTILITY	TYPE = UTILITY
INTERIOR-POWER = (6.98, 1)	INTERIOR-POWER = (6.98, 1)
INTERIOR-SCH = ("Kit EFs", "EF 11 & 13")	INTERIOR-SCH = ("Kit EFs", "EF 11 & 13")
INTERIOR-EU = (VENT-FANS, VENT-FANS)	INTERIOR-EU = (VENT-FANS, VENT-FANS)
EXTERIOR-POWER = (53.4)	EXTERIOR-POWER = (53.4)
EXTERIOR-SCH = ("Garage EF")	EXTERIOR-SCH = ("Garage EF")
EXTERIOR-EU = (VENT-FANS)	EXTERIOR-EU = (VENT-FANS)INPUT ..
Garage EF Wk = WEEK-SCHEDULE-PD	EEM 5 - Garage EF - Day = DAY-SCHEDULE-PD

TYPE = FRACTION	TYPE = FRACTION
DAY-SCHEDULES = ("Garage EF M-F", &D, &D, &D, &D, "Garage EF WEH")	**VALUES = (0, &D, &D, &D, 1, &D, &D, &D, &D, 0, &D, &D, &D, &D,**
	&D, 1, &D, &D, 0)

Verification

There were no available building data to verify this measure and it was assumed to be functioning for the evaluation model.

1.3.6 EEM 6. AHUs 13-15 Temperature Setback Control

This EEM adds strategy to reduce the operating time of the penthouse and mechanical room air handlers (AHU-13 to 15). Currently these units run based on a schedule. This EEM recommends operating the fans based on the zone temperature as well, so that they will only operate when an area becomes too warm or too cool.

Measure Modeling Estimation Changes

Cooling set points for these areas were changed from 74 to 80 and heating set points from 74 to 65.

Baseline	EEM6
13 Flr Core Zone = ZONE	13 Flr Core Zone = ZONE
TYPE = CONDITIONED	TYPE = CONDITIONED
DESIGN-HEAT-T = 74	**DESIGN-HEAT-T = 65**
HEAT-TEMP-SCH = "Htg 13-15"	**HEAT-TEMP-SCH = "EEM 6 - AHU 13-15 Heating"**
DESIGN-COOL-T = 74	**DESIGN-COOL-T = 80**
COOL-TEMP-SCH = "Clg 13-15"	**COOL-TEMP-SCH = "EEM 6 AHU 13-15 Cooling"**
THERMOSTAT-TYPE = PROPORTIONAL	THERMOSTAT-TYPE = PROPORTIONAL
THROTTLING-RANGE = 4	THROTTLING-RANGE = 4
SIZING-OPTION = ADJUST-LOADS	SIZING-OPTION = ADJUST-LOADS
SPACE = "13th Flr Core"	SPACE = "13th Flr Core"
14Flr Core Zone = ZONE	14Flr Core Zone = ZONE
TYPE = CONDITIONED	TYPE = CONDITIONED
DESIGN-HEAT-T = 74	**DESIGN-HEAT-T = 65**
HEAT-TEMP-SCH = "Htg 13-15"	**HEAT-TEMP-SCH = "EEM 6 - AHU 13-15 Heating"**
DESIGN-COOL-T = 74	**DESIGN-COOL-T = 80**
COOL-TEMP-SCH = "Clg 13-15"	**COOL-TEMP-SCH = "EEM 6 AHU 13-15 Cooling"**
THERMOSTAT-TYPE = PROPORTIONAL	THERMOSTAT-TYPE = PROPORTIONAL
THROTTLING-RANGE = 4	THROTTLING-RANGE = 4
SIZING-OPTION = ADJUST-LOADS	SIZING-OPTION = ADJUST-LOADS
SPACE = "14 Flr Core"	SPACE = "14 Flr Core"

"Cooling Schedule - Day" = DAY-SCHEDULE-PD	"EEM 6 AHU 13-15 Cool Day" = DAY-SCHEDULE-PD
TYPE = TEMPERATURE	TYPE = TEMPERATURE
VALUES = (74)	**VALUES = (80)**
"Htg 13-15 M-F" = DAY-SCHEDULE-PD	"EEM 6 - AHU 13-15 Heat Day" = DAY-SCHEDULE-PD
TYPE = TEMPERATURE	TYPE = TEMPERATURE
VALUES = (72)	**VALUES = (65)**

Verification

The evaluation team was unable to verify this measure since the room temperature data were not available via EEMIS. This is simple measure and is assumed to be functioning as modeled for the evaluation.

1.3.7 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. Discrepancies were noted between actual building pre implementation data collected between 3/9/2005 and 5/31/2005. Therefore, a modified baseline model was created using operational schedules from the pre implementation data. The changes to the schedules are shown in Table 14.

Table 14 Compton Courthouse Baseline Schedule Changes

	Baseline WD	Baseline WE	Modified WD	Modified BL WE
Fans	4AM-8PM	Off	3AM-7PM	Off
Boiler	Continuous	Off	Continuous	Continuous

The results of the actual fan and chiller hours are shown in Figure 15, Figure 16, and Figure 17.

Figure 15: Compton Courthouse Fan Baseline Schedule

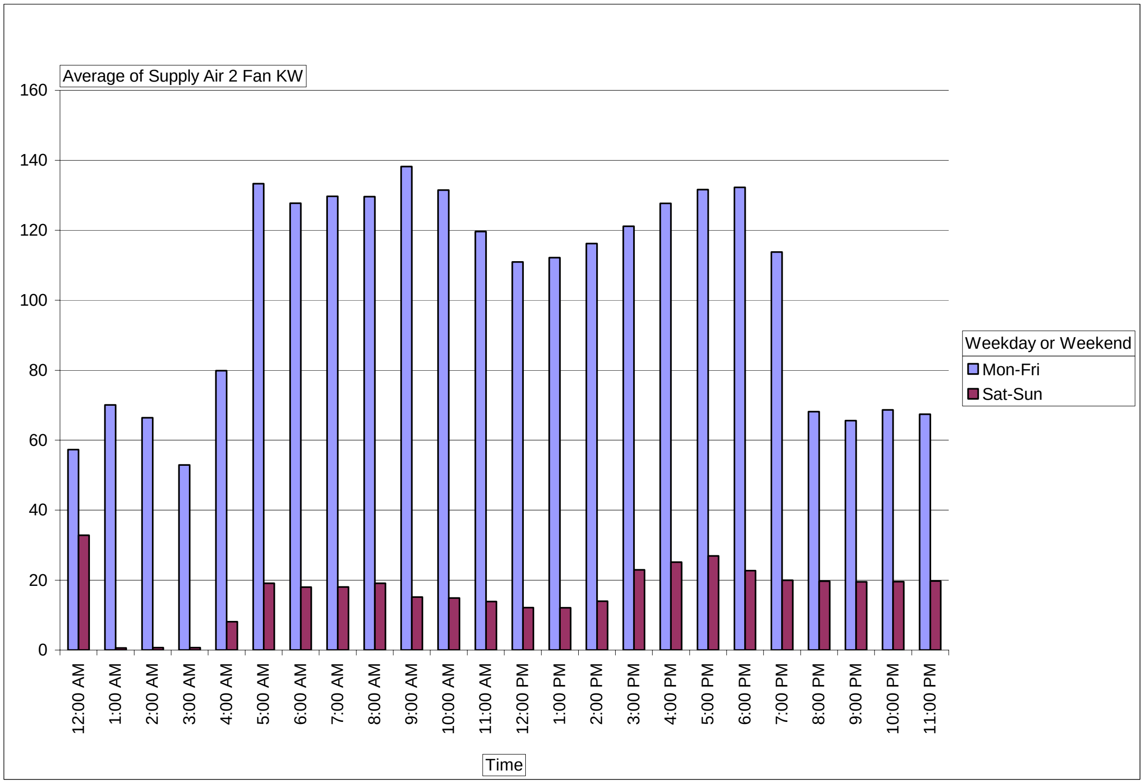


Figure 16: Compton Courthouse Hot Water Baseline Schedule

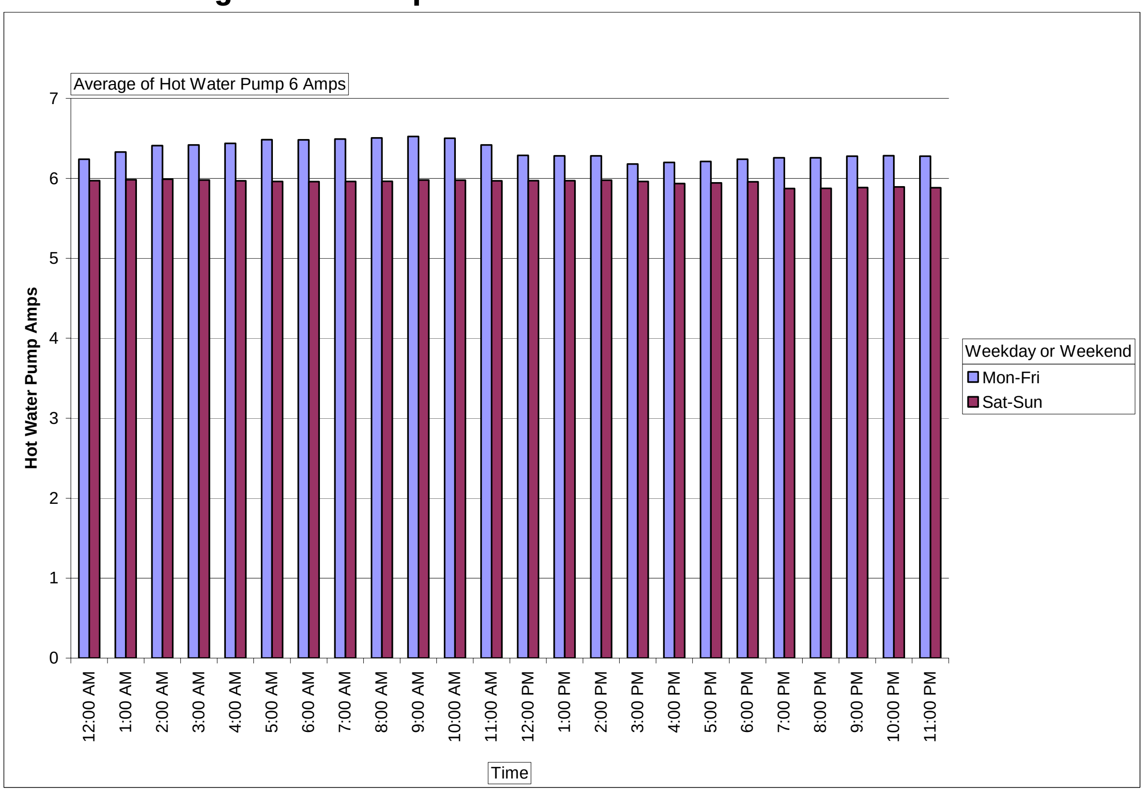
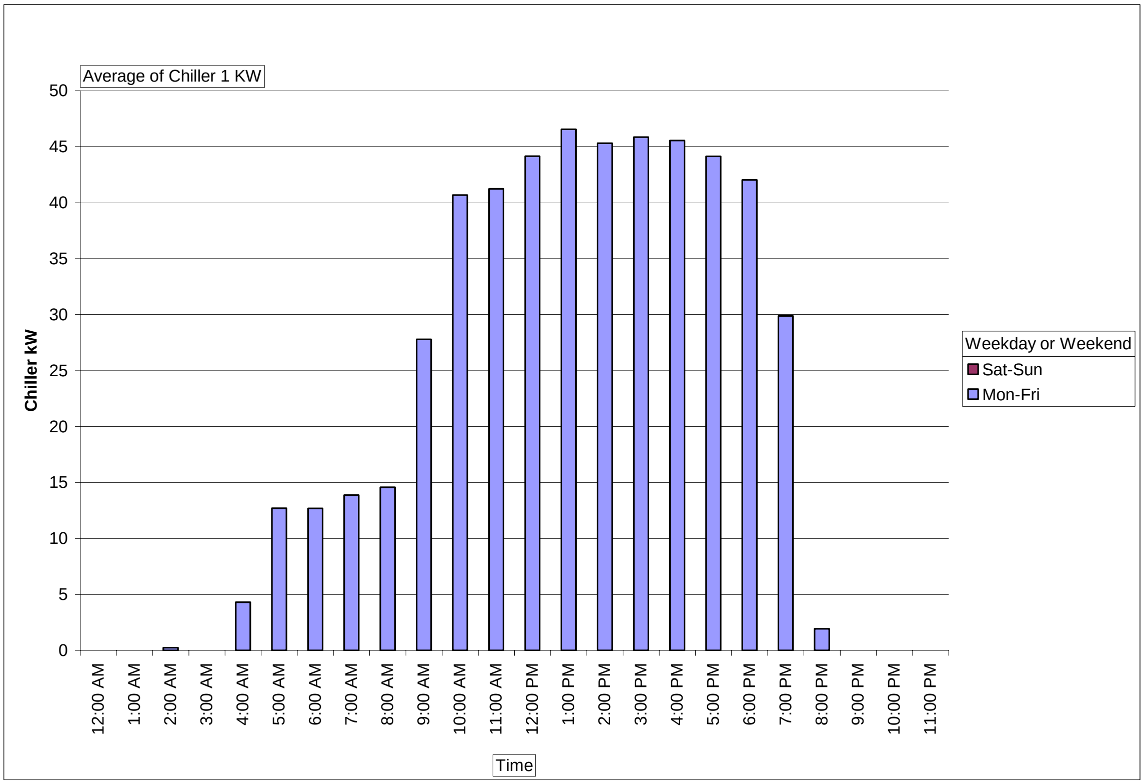


Figure 17: Compton Courthouse Chiller Baseline Schedule



1.3.8 Compton Courthouse Summary

The table shows the status of the implemented measures in the evaluation model.

Table 15: Compton Courthouse EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
OA Economizer	2	Not adjusted
DAT Reset	3	Not adjusted
Garage Fan Control	5	Not adjusted
Temperature SB	6	Not adjusted

The high therm realization rate is due to changes in baseline boiler schedule.

Table 16: Compton Courthouse Savings Summary

Compton Courthouse	kWh	kW	Therms
Modified Baseline Usage	5,494,267	1,450	136,206
Evaluation Usage	5,128,814	1,270	72,925
Ex-Post Savings	365,453	180	63,281
Ex-Ante Savings	376,139	-108	46,873
Realization Rate	97%	-	135%

1.4 Downey Courthouse

1.4.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 17 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 17: Downey Courthouse Savings

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implemen-tation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 AHU VFDs Blr Clr S/S	11	550,338	19,099	$ 88,497	$ 18,433	$ 106,930	$ 106,930	$ 35,045	$ 35,045	0.3
EEM #2 DAT Resets + EEM 1	19	604,403	28,590	$ 98,510	$ 27,598	$ 19,178	$ 126,108	$ 8,224	$ 43,269	0.3
EEM #4 OA Econ DB + EEMs 1-3	14	696,401	29,378	$ 112,690	$ 28,358	$ 14,940	$ 141,048	$ 8,624	$ 51,893	0.4
EEM #5 Blr Tuneup + EEMs 1-4a	14	696,401	29,893	$ 112,690	$ 28,856	$ 498	$ 141,546	$ -	$ 51,893	0.4

*Note 1: Total annual savings and implementation costs are cumulative.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.4.2 EEM 1. HVAC System Start/Stop

The start/stop schedule for the cooling system, heating system, and ventilation fans were adjusted from a continuous operating schedule to 5am to 7 pm, Monday through Friday. The systems are commanded off during Saturday and Sunday. AHU-1 fans were running continuously because the variable frequency drives (VFDs) serving the SF-1 and SF-2 had failed and were running in "Hand". VFD failure was attributed to the cold room environment in which they were originally mounted and partly to failed backdraft dampers which required the VFD to start fans that were spinning backwards. Chiller outside air lockout temperature was adjusted to 60°F and the boiler outside air temperature lockout temperature was lowered to 70°F. These set point modifications will result in fewer run time hours for the central plant equipment.

Measure Modeling Estimation Changes

The chiller, boiler and fans in the baseline model run 24/7. The chiller, boiler and fans in the EEM 1 model run on weekdays from 3am to 10pm and on weekends from 5am to 7pm. The schedules are not consistent with the EEM 1 report description of 5am to 7 pm, Monday through Friday and commanded off during Saturday and Sunday.

Chiller outside air lockout temperature was adjusted to 60°F in the EEM 4 model, not the EEM 1 model. The boiler outside air temperature lockout temperature was lowered to 70°F in the EEM 2 model, not the EEM 1 model.

The zones in the baseline model have a minimum flow ratio of 1. The zones in the EEM 1 model have a minimum flow ratio of 0.67.

Chiller and Boiler schedules are identical to the fan schedules below

Baseline	EEM 1
Fan Schedule - Day = DAY-SCHEDULE-PD	EEM 1 Fan Schedule - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1,)	**VALUES = (0, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D,**
	&D, &D, &D, &D, &D, 1, &D, &D, 0)
..	..
Fan Schedule - WEH = DAY-SCHEDULE-PD	EEM 1 Fan Schedule - WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1)	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,**
	&D, &D, &D, &D, &D, 0)

Fans

Baseline	EEM 1
AHU-1,2 = SYSTEM	AHU-1,2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
DDS-TYPE = DUAL-FAN	DDS-TYPE = DUAL-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
MIN-SUPPLY-T = 53	MIN-SUPPLY-T = 53
SUPPLY-FLOW = 44710	**SUPPLY-FLOW = 56500**
RETURN-FLOW = 51340	RETURN-FLOW = 51340
MIN-OUTSIDE-AIR = 0.1	MIN-OUTSIDE-AIR = 0.1
OA-CONTROL = FIXED	OA-CONTROL = FIXED
HSUPPLY-FLOW = 20640	HSUPPLY-FLOW = 20640
FAN-SCHEDULE = "Fan Schedule - Year"	**FAN-SCHEDULE = "EEM 1 Fan Schedule"**
FAN-CONTROL = SPEED	FAN-CONTROL = SPEED
SUPPLY-KW/FLOW = 0.000786	SUPPLY-KW/FLOW = 0.000786
RETURN-KW/FLOW = 0.000244	RETURN-KW/FLOW = 0.000244
MIN-FAN-RATIO = 1	**MIN-FAN-RATIO = 0.3**
HSUPPLY-KW/FLOW = 0.000756	HSUPPLY-KW/FLOW = 0.000756
RETURN-FAN-LOC = COMMON	RETURN-FAN-LOC = COMMON
RETURN-FAN-CONTR = SPEED	RETURN-FAN-CONTR = SPEED
MIN-FLOW-SOURCE = COLD-DUCT	MIN-FLOW-SOURCE = COLD-DUCT
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"
CHW-LOOP = "Chilled Water Loop"	CHW-LOOP = "Chilled Water Loop"

Baseline	EEM 1

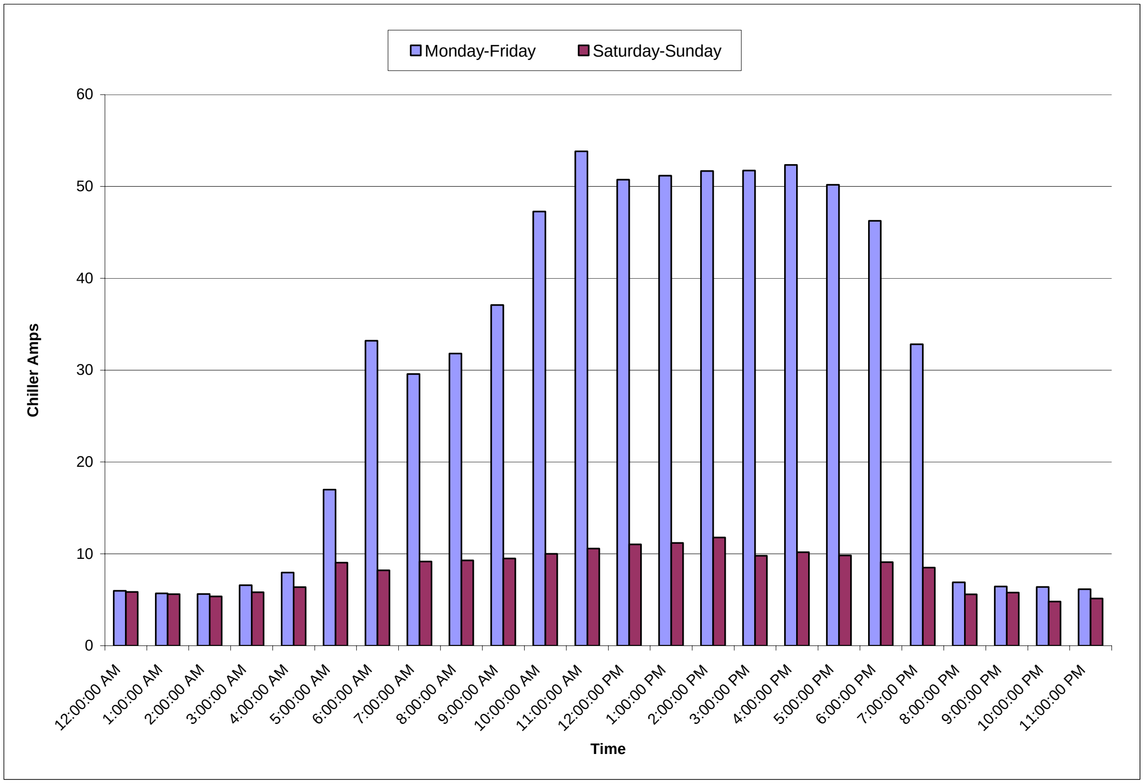
AHU-3 Elevator = SYSTEM	AHU-3 Elevator = SYSTEM
TYPE = MZS	TYPE = MZS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
MIN-SUPPLY-T = 55	MIN-SUPPLY-T = 55
SUPPLY-FLOW = 6150	SUPPLY-FLOW = 6150
MIN-OUTSIDE-AIR = 1	MIN-OUTSIDE-AIR = 1
OA-CONTROL = FIXED	OA-CONTROL = FIXED
FAN-SCHEDULE = "Fan Schedule - Year"	**FAN-SCHEDULE = "EEM 1 Fan Schedule"**
FAN-CONTROL = SPEED	FAN-CONTROL = SPEED
SUPPLY-KW/FLOW = 0.000773	SUPPLY-KW/FLOW = 0.000773
NIGHT-CYCLE-CTRL = CYCLE-ON-ANY	**NIGHT-CYCLE-CTRL = STAY-OFF**
CHW-LOOP = "Chilled Water Loop"	CHW-LOOP = "Chilled Water Loop"

Baseline	**EEM 1**
All Zones	All Zones
TYPE = CONDITIONED	TYPE = CONDITIONED
MIN-FLOW-RATIO = 1	**MIN-FLOW-RATIO = 0.67**
EXHAUST-FLOW = 2430	EXHAUST-FLOW = 2430
EXHAUST-KW/FLOW = 0.000632	EXHAUST-KW/FLOW = 0.000632
HASSIGNED-FLOW = 1e-005	HASSIGNED-FLOW = 1e-005
DESIGN-HEAT-T = 72	DESIGN-HEAT-T = 72
DESIGN-COOL-T = 72	DESIGN-COOL-T = 72
COOL-TEMP-SCH = "Cooling Schedule - Year"	COOL-TEMP-SCH = "Cooling Schedule - Year"
THERMOSTAT-TYPE = PROPORTIONAL	THERMOSTAT-TYPE = PROPORTIONAL
THROTTLING-RANGE = 4	THROTTLING-RANGE = 4
SIZING-OPTION = ADJUST-LOADS	SIZING-OPTION = ADJUST-LOADS
SPACE = "Basement Space"	SPACE = "Basement Space"

Verification

Post implementation data show chiller operating schedule as 4am to 7pm Monday through Friday and not operating on the weekends, as shown in Figure 18. Boiler and chiller schedule were shown to be identical to this schedule.

Figure 18: Downey Courthouse Chiller Operation Hours



Evaluation Model Changes

The fans, boilers, and chillers were modeled to operate from 4am to 7pm. Note that only the fan schedule code is shown below, but the same hours were applied to the boiler and chiller.

EEM 1 Fan Schedule - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, 1, 1, &D, &D,
&D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)
EEM 1 Fan Schedule - WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0)

1.4.3 EEM 2. Hot deck/cold deck reset

The control sequence was modified to automatically adjust the hot deck set point based on outside air temperature and the cold deck set points based on return air temperature. The reset schedule was set with the adjustable temperature set points shown in Table 18.

Table 18: Downey Courthouse AHU Reset Schedule

RAT	CDT
74°F	55°F
70°F	60°F

OSA	HDT
55°F	105°F
70°F	77°F

Implementation involved installing E/P transducers and connecting the existing hot water and chilled water valves to the Teletrol system. This approach was recommended over pneumatic controls repair for better long term sustainability of savings and for remote monitoring purposes.

Measure Modeling Estimation Changes

The boiler in the baseline model has no lockout. The boiler in the EEM 2 model has an outdoor air temperature lockout of 75 F.

The design cooling temperature differential in the baseline model is 8 F and the design cooling temperature is 42F. The design cooling temperature differential in the EEM 2 model is 12 F and the design cooling temperature is 45F

The air handlers in the baseline model have a minimum supply temperature of 53 F. The air handlers in the EEM 2 model have a minimum supply temperature of 55 F.

EEM 2
EEM 2 HD Reset Sch - Day = DAY-SCHEDULE-PD
TYPE = RESET-TEMP
OUTSIDE-HI = 70
OUTSIDE-LO = 55
SUPPLY-HI = 105
SUPPLY-LO = 77

Baseline	**EEM 2**
AHU-1,2 = SYSTEM	AHU-1,2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
DDS-TYPE = DUAL-FAN	DDS-TYPE = DUAL-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
	HEAT-RESET-SCH = "EEM 2 - HD DAT Reset Sch"
	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 53	**MIN-SUPPLY-T = 55**
	COOL-CONTROL = WARMEST
	COOL-MAX-RESET-T = 58

SUPPLY-FLOW = 56500	SUPPLY-FLOW = 56500
RETURN-FLOW = 51340	RETURN-FLOW = 51340
MIN-OUTSIDE-AIR = 0.1	MIN-OUTSIDE-AIR = 0.1
OA-CONTROL = FIXED	OA-CONTROL = FIXED
HSUPPLY-FLOW = 20640	HSUPPLY-FLOW = 20640
FAN-SCHEDULE = "EEM 1 Fan Schedule"	FAN-SCHEDULE = "EEM 1 Fan Schedule"
FAN-CONTROL = SPEED	FAN-CONTROL = SPEED
SUPPLY-KW/FLOW = 0.000786	SUPPLY-KW/FLOW = 0.000786
RETURN-KW/FLOW = 0.000244	RETURN-KW/FLOW = 0.000244
MIN-FAN-RATIO = 0.3	MIN-FAN-RATIO = 0.3
HSUPPLY-KW/FLOW = 0.000756	HSUPPLY-KW/FLOW = 0.000756
	HFAN-SCHEDULE = "EEM 2 HD Fan Sch"
RETURN-FAN-LOC = COMMON	RETURN-FAN-LOC = COMMON
RETURN-FAN-CONTR = SPEED	RETURN-FAN-CONTR = SPEED
MIN-FLOW-SOURCE = COLD-DUCT	MIN-FLOW-SOURCE = COLD-DUCT
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"
CHW-LOOP = "Chilled Water Loop"	CHW-LOOP = "Chilled Water Loop"

Baseline	**EEM 2**
Hot Water Loop = CIRCULATION-LOOP	Hot Water Loop = CIRCULATION-LOOP
TYPE = HW	TYPE = HW
LOOP-DESIGN-DT = 40	LOOP-DESIGN-DT = 40
LOOP-OPERATION = SCHEDULED	**LOOP-OPERATION = SNAP**
HEATING-SCHEDULE = "EEM 1 Boiler Sch"	HEATING-SCHEDULE = "EEM 1 Boiler Sch"
	PUMP-SCHEDULE = "EEM 1 Boiler Sch"
	SNAP-T = 75
	SNAP-LOCN = OUTDOOR
DESIGN-HEAT-T = 170	DESIGN-HEAT-T = 170
HEAT-SETPT-CTRL = FIXED	HEAT-SETPT-CTRL = FIXED
LOOP-PUMP = "HW Loop Pump"	LOOP-PUMP = "HW Loop Pump"
SUPPLY-UA = 50	SUPPLY-UA = 50
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 Core Zn (B.C5)"	LOOP-LOSS-ZONE = "EL1 Core Zn (B.C5)"

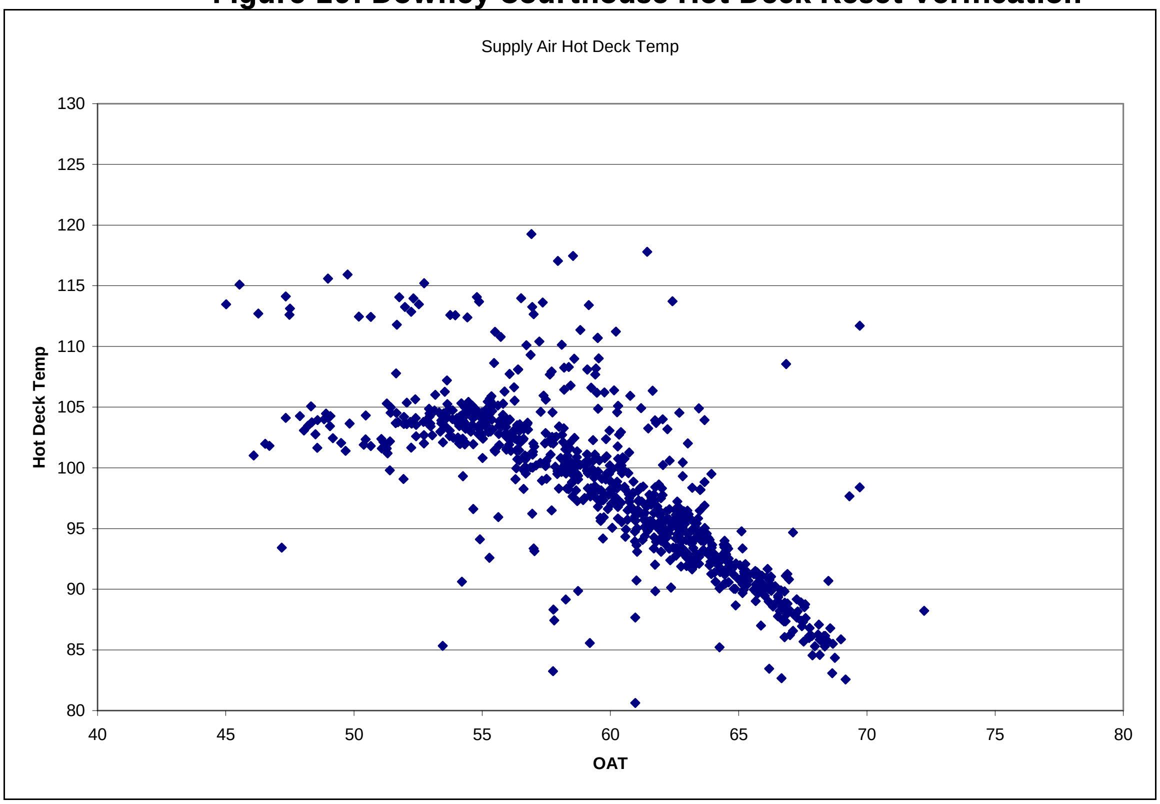
Baseline	**EEM 2**
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-DESIGN-DT = 8	**LOOP-DESIGN-DT = 12**

LOOP-OPERATION = SCHEDULED	LOOP-OPERATION = SCHEDULED
COOLING-SCHEDULE = "EEM 1 Chiller Sch"	COOLING-SCHEDULE = "EEM 1 Chiller Sch"
DESIGN-COOL-T = 42	**DESIGN-COOL-T = 45**
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
SUPPLY-UA = 20	SUPPLY-UA = 20
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 Core Zn (B.C5)"	LOOP-LOSS-ZONE = "EL1 Core Zn (B.C5)"

Verification

Figure 19 show the hot deck temperature resetting as modeled.

Figure 19: Downey Courthouse Hot Deck Reset Verification



1.4.4 EEM 4. Outside Air Economizer

The main economizer damper was shut and would not modulate during the prefunctional phase. This EEM recommended installing E/P transducers in order to interface the pneumatic economizer damper actuators to the Teletrol system. A new mixed air temperature sensor was also installed directly upstream of the chilled water coil to control the economizer dampers through Teletrol. The economizer control sequence was modified to maintain the mixed air temperature set point whenever the outside air was less than the return air temperature.

Measure Modeling Estimation Changes

The chiller in the baseline model has no outdoor temperature lockout. The chiller in the EEM 4a model has a lockout temperature of 60 F OAT.

The air handler in the baseline model has a fixed 10% outdoor air. The air handler in the EEM 4a model has a temperature-controlled economizer with limits of 75 F to 55 F OAT.

Baseline	**EEM 4a**
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-DESIGN-DT = 12	LOOP-DESIGN-DT = 12
LOOP-OPERATION = SCHEDULED	**LOOP-OPERATION = SNAP**
COOLING-SCHEDULE = "EEM 1 Chiller Sch"	COOLING-SCHEDULE = "EEM 1 Chiller Sch"
	PUMP-SCHEDULE = "EEM 1 Chiller Sch"
	SNAP-T = 60
	SNAP-LOCN = OUTDOOR
DESIGN-COOL-T = 45	DESIGN-COOL-T = 45
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
SUPPLY-UA = 20	SUPPLY-UA = 20
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 Core Zn (B.C5)"	LOOP-LOSS-ZONE = "EL1 Core Zn (B.C5)"

Baseline	**EEM 4a**
AHU-1,2 = SYSTEM	AHU-1,2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
DDS-TYPE = DUAL-FAN	DDS-TYPE = DUAL-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
HEAT-RESET-SCH = "EEM 2 - HD DAT Reset Sch"	HEAT-RESET-SCH = "EEM 2 - HD DAT Reset Sch"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 55	MIN-SUPPLY-T = 55
COOL-CONTROL = WARMEST	COOL-CONTROL = WARMEST
	ECONO-LIMIT-T = 75
	ECONO-LOW-LIMIT = 55
COOL-MAX-RESET-T = 58	COOL-MAX-RESET-T = 58
SUPPLY-FLOW = 56500	SUPPLY-FLOW = 56500
RETURN-FLOW = 51340	RETURN-FLOW = 51340
MIN-OUTSIDE-AIR = 0.1	**MIN-OUTSIDE-AIR = 0.15**
OA-CONTROL = FIXED	**OA-CONTROL = OA-TEMP**

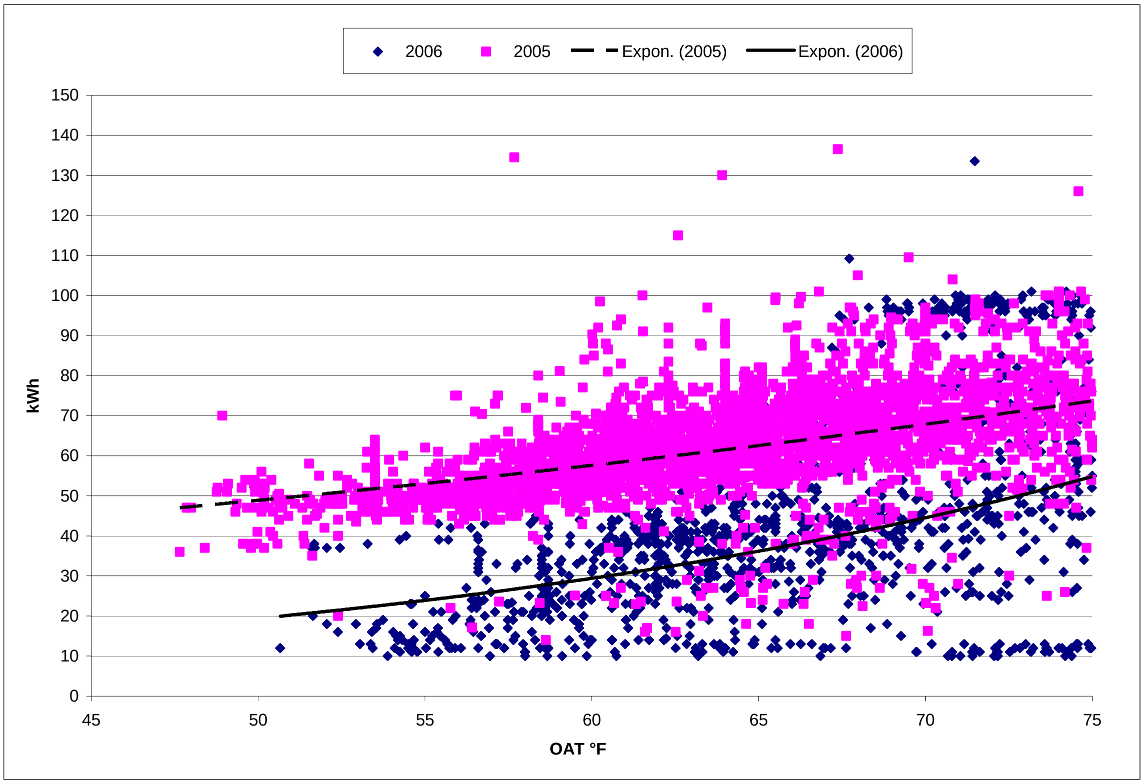
Verification

Since there are no mixed air temperature sensors at the facility, the economizer operation can't be directly verified. However, the economizer does seem to be functioning as intended since the average chiller power draw is less when the outside air is in the economizer enable range, less that 75F, as seen in Figure 20. However, the chiller lock-out temperature appears to be closer to 55F than 60F as there is significant chiller usage during periods where the outside air temperature is between 55 and 60°F.

Evaluation Model Changes

The evaluation model chiller lock-out temperature was changed from 60 to 55F.

Figure 20: Downey Courthouse Economizer Verification



1.4.5 EEM 5. Boiler Tune-up

ACCO adjusted the boiler controls and performed a new flue gas analysis. The excess air quantity was reduced and the boiler efficiency was increased from 74 to 77%. Results of the flue gas analysis performed during the prefunctional phase are listed in Table 19*, and the results of the flue gas analysis after the adjustment is noted in Table 20 and Table 21.*

Table 19: Downey Courthouse Baseline Flue Gas Analysis Results

Boiler B-2			
Stack Temperature:	**545°F**	CO (0% O2):	3 ppm
Ambient Temperature:	71.5°F	Nx:	76 ppm
O_2:	**8.4%**	Nx (0% O2):	127 ppm
CO_2:	7.1%	**Efficiency:**	**74.7%**
CO:	2 ppm	Ex. Air:	59.81

Boiler 1 was not operational and available for service during initial testing, and a flue gas analysis was not completed for this boiler during the prefunctional phase. Mechanical contractors returned to perform a boiler tune up. It was determined during the tune-up that the building natural gas pressure was lower than the desired manufacturer rating. Low gas pressure was affecting both Downey Courthouse and Public Library Headquarters. The gas pressure was increased and a new flue gas analysis was taken. Table 20 and Table 21 summarize the readings taken after the tune-up.

Table 20: Downey Courthouse Post Boiler Tune-Up Flue Gas Analysis Results- Boiler 1

Boiler B-1			
Stack Temperature:	**492°F**	CO (3% O2):	81 ppm
Ambient Temperature:	61.5°F	Nx:	52 ppm
O_2:	**7.2%**	Nx (3% O2):	68 ppm
CO_2:	7.7%	**Efficiency:**	**77.2%**
CO:	62 ppm	Ex. Air:	46.76

Table 21: Downey Courthouse Post Boiler Tune-Up Flue Gas Analysis Results- Boiler 2

Boiler B-2			
Stack Temperature:	**482°F**	CO (3% O2):	18 ppm
Ambient Temperature:	64.5°F	Nx:	45 ppm
O_2:	**7.3%**	Nx (0% O2):	59 ppm
CO_2:	7.7%	**Efficiency:**	**77.5%**
CO:	13 ppm	Ex. Air:	47.7

Measure Modeling Estimation Changes

The boiler in the baseline model is 74.7% thermal efficiency and the boiler in the EEM 5 model is 78.0% efficiency

Baseline	**EEM5**
Boiler1 (HWFrcdDrft) = BOILER	Boiler1 (HWFrcdDrft) = BOILER
TYPE = HW-BOILER-W/DRAFT	TYPE = HW-BOILER-W/DRAFT
CAPACITY = -1.2	CAPACITY = -1.2
ELEC-INPUT-RATIO = 0.0024	ELEC-INPUT-RATIO = 0.0024
HEAT-INPUT-RATIO = 1.33869	**HEAT-INPUT-RATIO = 1.2821**
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"

Verification

The boiler tune up could not be verified with available building data. The tune-up documentation appears reasonable and the boilers were assumed to be operating as modeled for the evaluation model.

1.4.6 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. No modifications to the baseline model were necessary at this site. Building data and the baseline model indicated continuous operation of all systems, as shown in Figure 21, Figure 22 and Figure 23.

Figure 21: Downey Courthouse Chiller Baseline Operating Hours

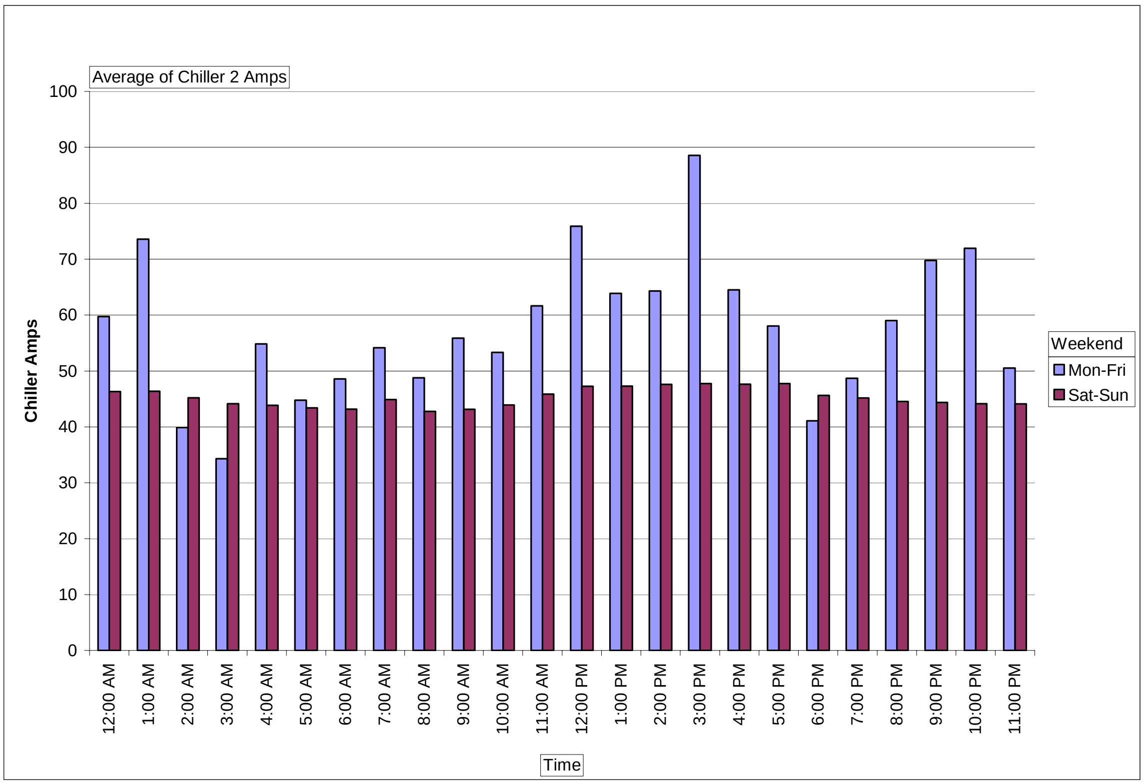


Figure 22: Downey Courthouse Fan Baseline Operating Hours

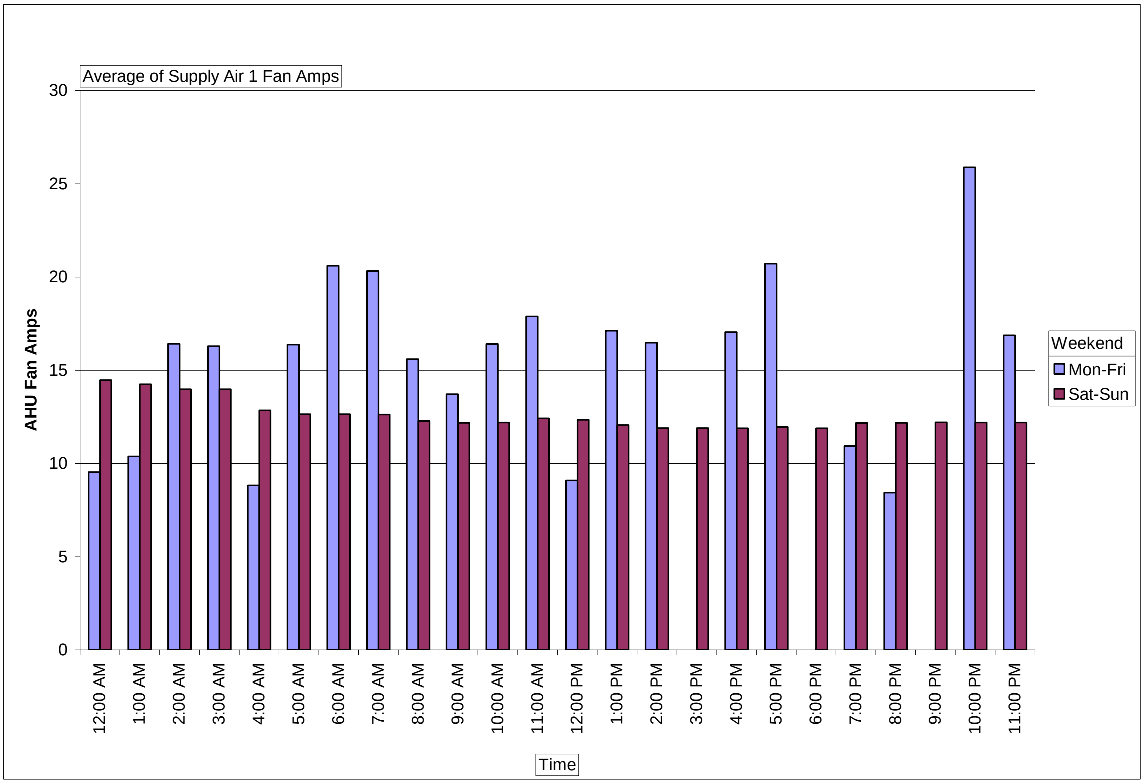
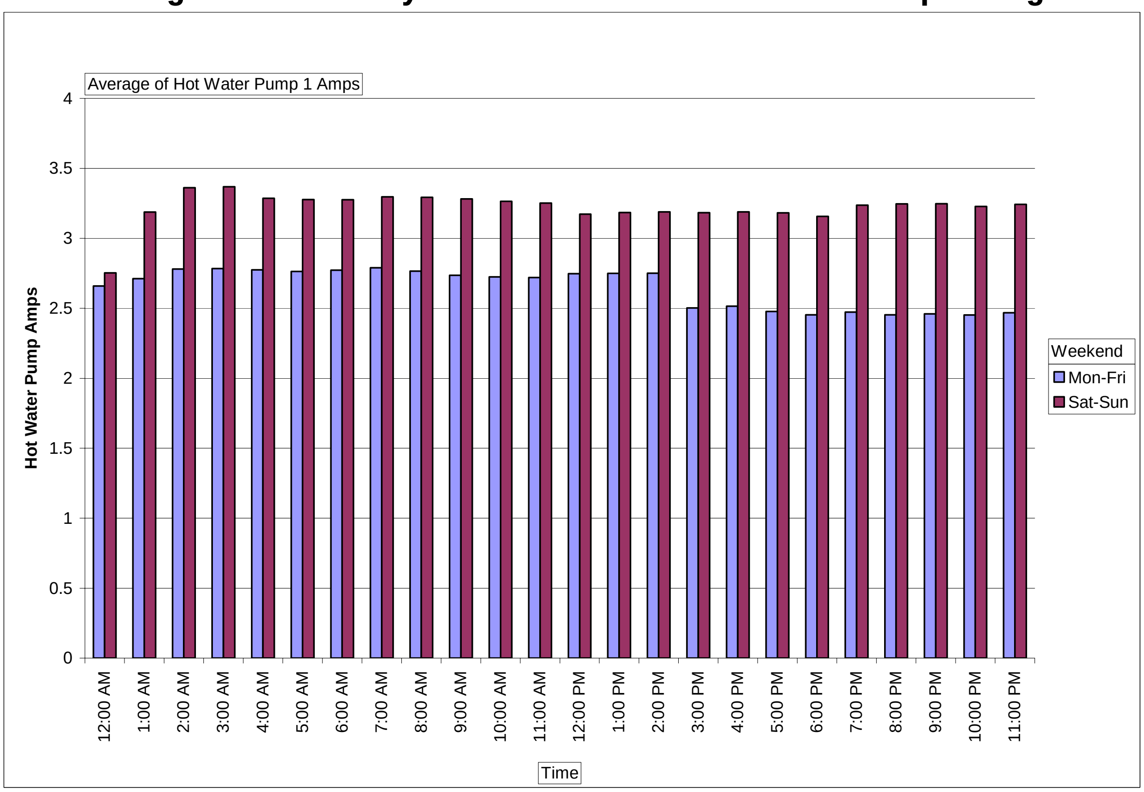


Figure 23: Downey Courthouse Hot Water Baseline Operating Hours



1.4.7 Downey Courthouse Summary

Table 22: Downey Courthouse EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
DAT Reset	2	Not adjusted
OA Economizer	4	Not adjusted
Boiler Tune-up	5	Not adjusted

Table 23: Downey Courthouse Savings Summary

Downey Courthouse	kWh	kW	Therms
Modified Baseline Usage	2,094,553	331	41,270
Evaluation Usage	1,253,458	321	5,092
Ex-Post Savings	841,095	11	36,178
Ex-Ante Savings	696,401	14	29,893
Realization Rate	121%	76%	121%

1.5 Public Library Headquarters

1.5.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 24 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 24: Public Library Headquarters Savings

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implemen-tation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 - AHU Clr Blr SS	(86)	140,348	24,797	$ 10,242	$ 23,808	$ 34,050	$ 34,050	$ 5,665	$ 5,665	0.2
*EEM #2a - Night Purge 100% + EEM 1	(48)	128,895	23,147	$ 13,009	$ 22,215	$ 1,174	$ 35,224	$ 10,690	$ 16,355	0.5
*EEM #3a - OA Econ DB + EEMs 1-2a	8	152,041	23,332	$ 22,988	$ 22,393	$ 10,157	$ 45,381	$ -	$ 16,355	0.4
EEM #4 - DAT Reset + EEMs 1-3a	(1)	198,625	29,250	$ 29,557	$ 28,108	$ 12,284	$ 57,665	$ 3,762	$ 20,117	0.3
EEM #5 - TAB + EEMs 1-4	6	243,241	31,621	$ 38,659	$ 30,397	$ 11,391	$ 69,056	$ 27,040	$ 47,157	0.7
EEM #6 - Blr OAT Lockout 70 + EEMs 1-5	10	246,182	33,253	$ 39,745	$ 31,972	$ 2,661	$ 71,717	$ -	$ 47,157	0.7
EEM #7 - Boiler Efficiency + EEMs 1-6	10	246,182	33,696	$ 39,745	$ 32,400	$ 428	$ 72,145	$ -	$ 47,157	0.7

*Note 1: Total annual savings and implementation costs are cumulative.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.5.2 EEM 1. HVAC System Start/Stop

The start/stop schedule for the cooling system, heating system, and ventilation fans were adjusted from a continuous operating schedule to 6am to 10 pm, Monday through Saturday. The systems are commanded off Sunday.

Measure Modeling Estimation Changes

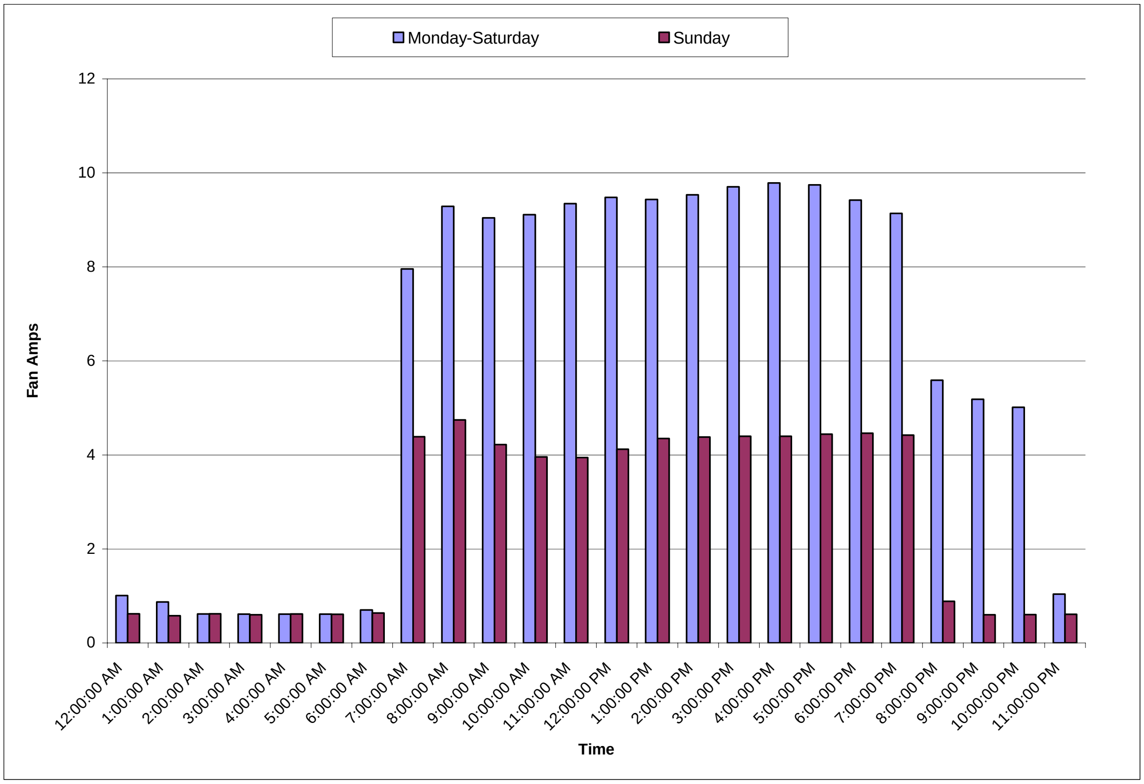
Only the fan schedule is shown below but this applies to the cooling and heating system as well. The fans in the baseline schedule run 24/7. The fans in the EEM1 model run 6am-10pm Monday through Saturday and are off on Sunday.

Baseline	**EEM1**
Fans M-F = DAY-SCHEDULE-PD	EEM 1 Fan Sch - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1, &D, &D, &D, &D, &D, 1, 1)	**VALUES = (0, &D, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D,**
..	**&D, &D, &D, &D, &D, &D, &D, &D, 0)**
	..
Fan WEH = DAY-SCHEDULE-PD	EEM 1 Fan Sch - WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1, &D, &D, &D, &D, &D, 1, 1)	**VALUES = (0)**

Verification

Air handler operation was verified from 6am to 10pm Monday through Saturday and 6am to 7pm on Sunday. See Figure 24 below.

Figure 24: Public Library Headquarters Post Implementation Fan Operation Hours



Evaluation Model Changes

The fans, chillers and boilers were modeled to operate from 6am to 10pm Monday through Saturday and 6am to 7pm on Sunday. Note that only the fan schedule code is inserted below, but the same schedule was applied to the hot water and chilled water loops.

EEM 1 Fan Sch - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, &D, &D, 0)
EEM 1 Fan Sch - WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D,

&D, &D, &D, &D, &D, 0)

1.5.3 EEM 2. Night Purge Control

A night purge control sequence was added to allow the ventilation fans (AHU-1 and 2) to cycle during unoccupied hours to purge the building of excess heat when outside air temperatures are cool. The purpose of the control sequence is to reduce electrical demand of the cooling system during the morning startup period. Eight zone temperature sensors were added in the following zones.

- *1st Floor, Room 102. Technical Services.*
- *1st Floor, Room 115. Administrative Collection.*
- *1st Floor, Room 108. Computer Room.*
- *2nd Floor, Room 201. Executive Offices.*
- *2nd Floor, Room 204. Staff Services.*
- *2nd Floor, Room 206. Facilities Management.*
- *2nd Floor, Room 208. Public Services.*
- *2nd Floor, Room 220. Marketing.*

The control sequence enables an individual AHU only if the highest zone temperature located on that floor increases beyond a night purge set point (82°F). The AHU is disabled when the highest zone temperature falls below the night purge disable set point (77°F).

Measure Modeling Estimation Changes

The night vent schedule in the EEM 2 model operates on weekdays from 10pm to 6am and on weekends from 7pm to 7am.

Baseline	EEM2
	VENT-TEMP-SCH = "EEM 2 - Night Vent Temp Sch"
FAN-SCHEDULE = "EEM 1 Fan Sch"	FAN-SCHEDULE = "EEM 1 Fan Sch"
FAN-CONTROL = SPEED	FAN-CONTROL = SPEED
SUPPLY-KW/FLOW = 0.001039	SUPPLY-KW/FLOW = 0.001039
RETURN-KW/FLOW = 0.000394	RETURN-KW/FLOW = 0.000394
FAN-EIR-FPLR = "Variable Speed Drive FPLR"	FAN-EIR-FPLR = "Variable Speed Drive FPLR"
	NIGHT-VENT-CTRL = SCHEDULED+DEMAND
	NIGHT-VENT-SCH = "EEM 2 - Night Vent SS"
	NIGHT-VENT-RATIO = (0.8)
EXHAUST-FAN-SCH = "Exhaust Fan Annual"	EXHAUST-FAN-SCH = "Exhaust Fan Annual"
RETURN-FAN-CONTR = SPEED	RETURN-FAN-CONTR = SPEED
RETURN-EIR-FPLR = "Variable Speed Drive FPLR"	RETURN-EIR-FPLR = "Variable Speed Drive FPLR"
REHEAT-DELTA-T = 30	REHEAT-DELTA-T = 30
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"
CHW-LOOP = "Chilled Water Loop"	CHW-LOOP = "Chilled Water Loop"
COOL-CTRL-RANGE = 1	COOL-CTRL-RANGE = 1

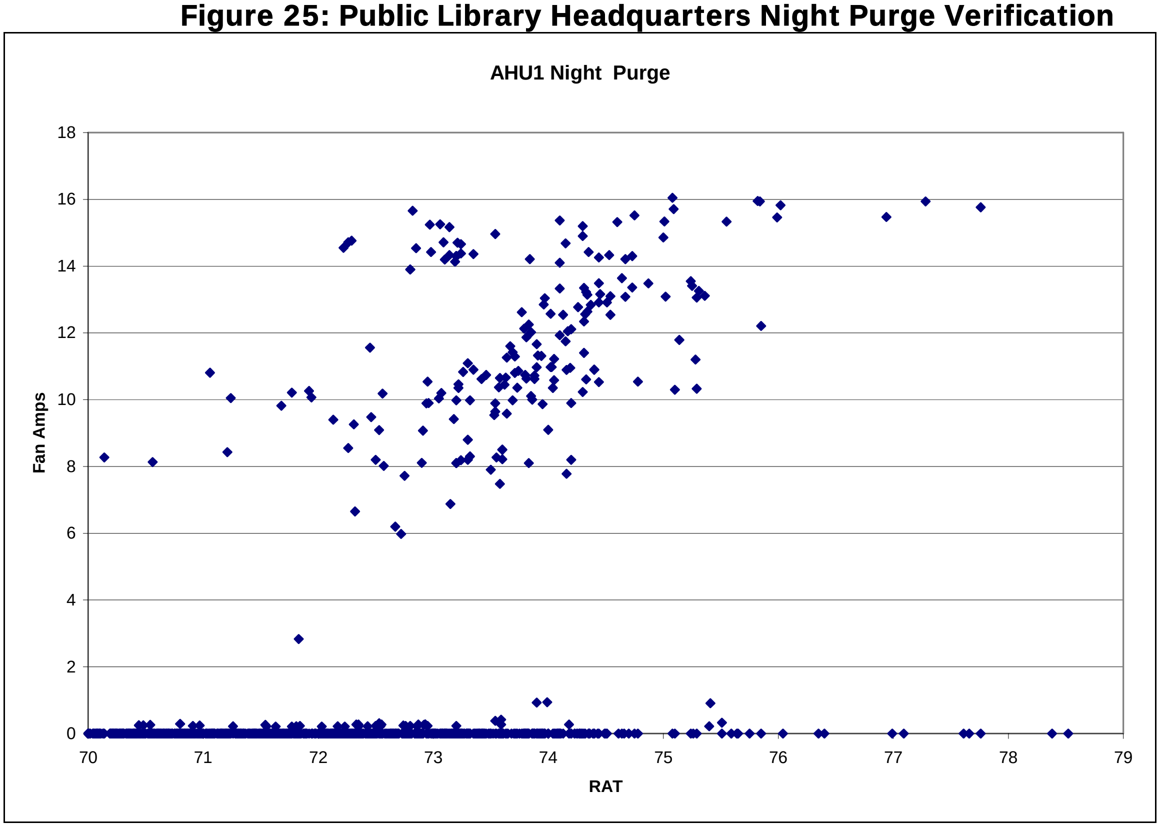
EEM2
Night Vent M-F = DAY-SCHEDULE-PD

TYPE = ON/OFF
VALUES = (1, &D, &D, &D, &D, &D, 0, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, &D, &D, 1)
..
Night Vent WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (1, &D, &D, &D, &D, &D, &D, 0, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 1)
EEM 2 - NV Temp Sch - Day = DAY-SCHEDULE-PD
TYPE = TEMPERATURE
VALUES = (82)

Verification

The night purge appeared appears to be working. The data shown has been filtered to show only night hours. However, the purge set point appears to be 72 F rather than 82 as modeled and this is shown in Figure 25. This 72 F set point was seen for all air handlers at the facility.

Figure 25: Public Library Headquarters Night Purge Verification



Evaluation Model Changes

The evaluation model changed the night purge set point to 72°F to reflect actual operation.

1.5.4 EEM 3. Outside Air Economizer

The outside air economizers were originally set to a fully open position because of concerns with ventilation during the construction period. The minimum outside air damper position was adjusted from a fully open position to the position which produced the minimum design outside air flow. The control sequence was modified to enable economizer control whenever the outside air is less than the return air temperature. The sequence was also adjusted to link the outside air, return air and exhaust air dampers together. Previously, the return air damper was controlled by a separate signal.

Measure Modeling Estimation Changes

The minimum outside air ratio in the baseline model is 0.9 for AHU-1 and 0.4 for AHU-2. The minimum outside air ratio in the EEM 3 model is 0.239 for AHU-1 and 0.169 for AHU-2.

Baseline	**EEM3**
AHU-1 1st Flr = SYSTEM	AHU-1 1st Flr = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
MIN-SUPPLY-T = 56	MIN-SUPPLY-T = 56
ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
SUPPLY-FLOW = 27962	SUPPLY-FLOW = 27962
RETURN-FLOW = 25495	RETURN-FLOW = 25495
MIN-OUTSIDE-AIR = 0.9	**MIN-OUTSIDE-AIR = 0.239**
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP
AHU-2 2nd Flr = SYSTEM	AHU-2 2nd Flr = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
MIN-SUPPLY-T = 56	MIN-SUPPLY-T = 56
ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
SUPPLY-FLOW = 29921	SUPPLY-FLOW = 29921
RETURN-FLOW = 28739	RETURN-FLOW = 28739
MIN-OUTSIDE-AIR = 0.4	**MIN-OUTSIDE-AIR = 0.169**
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP

Verification

The economizer could not be verified directly since there are no mixed air temperature data available via EEMIS. The measure is assumed to be working as modeled for the evaluation.

1.5.5 EEM 4. Discharge air (DAT) / Mixed air temperature (MAT) reset

The control sequence was modified to automatically adjust the DAT/MAT set points based on return air temperature. The reset schedule was set with the adjustable temperature set points shown in Table 25.

Table 25: Public Library Headquarters AHU Reset Schedule

Return Air Temp.	Discharge Air Temp.	Mixed Air Temp.
76°F	55°F	52°F
71°F	65°F	62°F

Note that the mixed air temperature reset schedule was set identical to the discharge air temperature schedule, minus an offset of 3°F. This adjustable offset is intended to address supply fan heat, so that the mixed air temperature set point and discharge air temperature set point would control to the same condition.

Measure Modeling Estimation Changes

The chiller lockout temperature in the baseline model is 58° F OAT. The cooling system enable temperature in the EEM 4 model is 65° F OAT.

The chiller design temperature in the baseline model is 46° F. The chiller design temperature in the EEM 4 model is 45° F.

The AHU minimum supply temperature in the baseline model is 56 F. The AHU minimum supply temperature in the EEM 4 model is 55 F OAT.

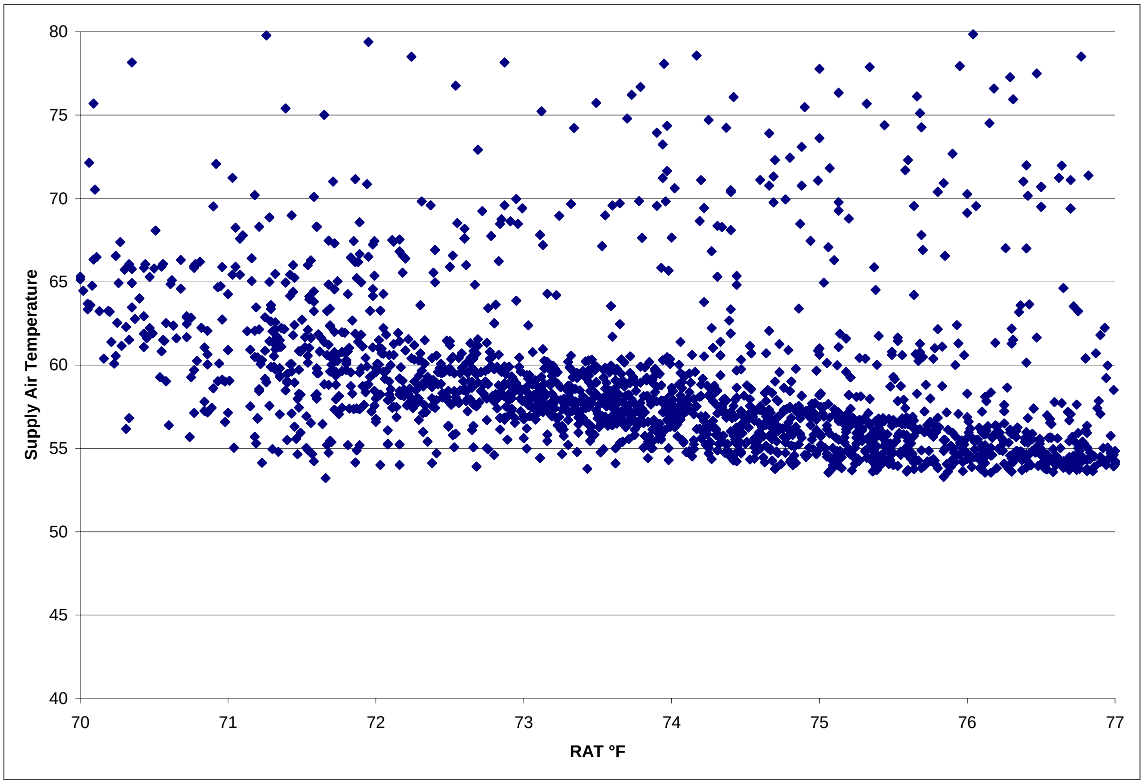
Baseline	**EEM4**
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-DESIGN-DT = 15	LOOP-DESIGN-DT = 15
LOOP-OPERATION = SNAP	LOOP-OPERATION = SNAP
PUMP-SCHEDULE = "EEM 1 CHWP Sch"	PUMP-SCHEDULE = "EEM 1 CHWP Sch"
SNAP-T = 58	**SNAP-T = 65**
SNAP-LOCN = OUTDOOR	SNAP-LOCN = OUTDOOR
DESIGN-COOL-T = 46	**DESIGN-COOL-T = 45**
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
Baseline	**EEM4**
AHU-1 1st Flr = SYSTEM	AHU-1 1st Flr = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
MIN-SUPPLY-T = 56	**MIN-SUPPLY-T = 55**
	COOL-CONTROL = WARMEST

ECONO-LIMIT-T = 75	ECONO-LIMIT-T = 75
	RESET-PRIORITY = TEMP-FIRST
	COOL-MAX-RESET-T = 60
SUPPLY-FLOW = 27962	SUPPLY-FLOW = 27962
RETURN-FLOW = 25495	RETURN-FLOW = 25495
MIN-OUTSIDE-AIR = 0.239	MIN-OUTSIDE-AIR = 0.239
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP

Verification

Figure 26 shows the DAT reset appears to be working as modeled. The down sloped trend of the DAT reset is visible, although there is considerable noise.

Figure 26: Public Library Headquarters DAT Reset Verification



1.5.6 EEM 5. Test and Balance / Mixing Box Repair

Test and balance (TAB) and VAV box troubleshooting was performed, which included the following tasks:

- ***Perform air balance.*** *Total measured air flow to AHU-1 was measured 22% lower than design during the prefunctional phase. Manual volume and fire damper positions were reviewed and re-adjusted for the supply and return distribution serving AHU-1 and AHU-2. Air flow quantities for these ventilation fans were re-verified and re-balanced to design quantities. Minimum outside air quantities were adjusted to match design quantities. Water flow measurements were found to be within acceptable deviation from design and were not adjusted.*

- ***Repair inoperative VAV boxes.*** *The initial air flow measurement indicated that the mixing damper did not modulate in 16 VAV boxes. ACCO investigated the operation of these VAV boxes.*
- ***Repair/replace inoperative reheat valves.*** *Terminal unit testing during the prefunctional phase indicated that 9 reheat valves did not modulate when changed from heating to cooling modes. It was also suspected, based on testing, that approximately 26 reheat valves may not fully close and allow hot water to leak by into the coil even when heating is not called for. ISD was responsible for repair of deficient reheat valves.*
- ***Re-calibrate thermostats.*** *Terminal unit testing reported that 11 thermostats were set outside of an expected range between 68 and 76°F, which could have been indicative of a thermostat or terminal unit issue. ISD was responsible for calibration of pneumatic thermostats.*
- *The following issues were noted during TAB activities (refer to TAB report for specific locations).*
  - ☐ *Reheat coils not piped (2)*
  - ☐ *Hot water isolation valve closed (2)*
  - ☐ *Hot water valve stuck open (1)*
  - ☐ *HW piping leaks at reheat coils (1)*
  - ☐ *Reheat coil control valve not connected to pneumatics (1).*
  - ☐ *Replaced controllers (3)*
  - ☐ *Crushed flex duct (1)*
  - ☐ *Branch duct disconnected (1)*
  - ☐ *Replace/repaired volume damper (3)*
  - ☐ *Removed blockage in ductwork (1)*
  - ☐ *Replace thermostat/cover (5)*

Measure Modeling Estimation Changes

The minimum flow ratio in the baseline model is 0.54 for all zones. The minimum flow ratio in the EEM 5 model is 0.4 for all zones.

Baseline	**EEM 5**
All Zones	All Zones
TYPE = CONDITIONED	TYPE = CONDITIONED
MIN-FLOW-RATIO = 0.54	**MIN-FLOW-RATIO = 0.4**
EXHAUST-FLOW = 700	EXHAUST-FLOW = 700
DESIGN-HEAT-T = 73	DESIGN-HEAT-T = 73
HEAT-TEMP-SCH = "Heat Sch"	HEAT-TEMP-SCH = "Heat Sch"
DESIGN-COOL-T = 77	DESIGN-COOL-T = 77
COOL-TEMP-SCH = "Cool Sch"	COOL-TEMP-SCH = "Cool Sch"
THERMOSTAT-TYPE = PROPORTIONAL	THERMOSTAT-TYPE = PROPORTIONAL
SIZING-OPTION = ADJUST-LOADS	SIZING-OPTION = ADJUST-LOADS
TERMINAL-TYPE = SVAV	TERMINAL-TYPE = SVAV
SPACE = "Lower Core Space"	SPACE = "Lower Core Space"

Verification

The mixing box repairs could not be verified with available building data. The modeled post implementation 40% minimum flow percentage is a reasonable estimate given the implemented procedures. The measure is assumed to be functioning as modeled for the evaluation.

1.5.7 EEM 6. Hot water pump outside air temperature (OAT) enable

The prefunctional report recommended the reduction of the OAT enable for the heating system from 88°F to 70°F.

Measure Modeling Estimation Changes

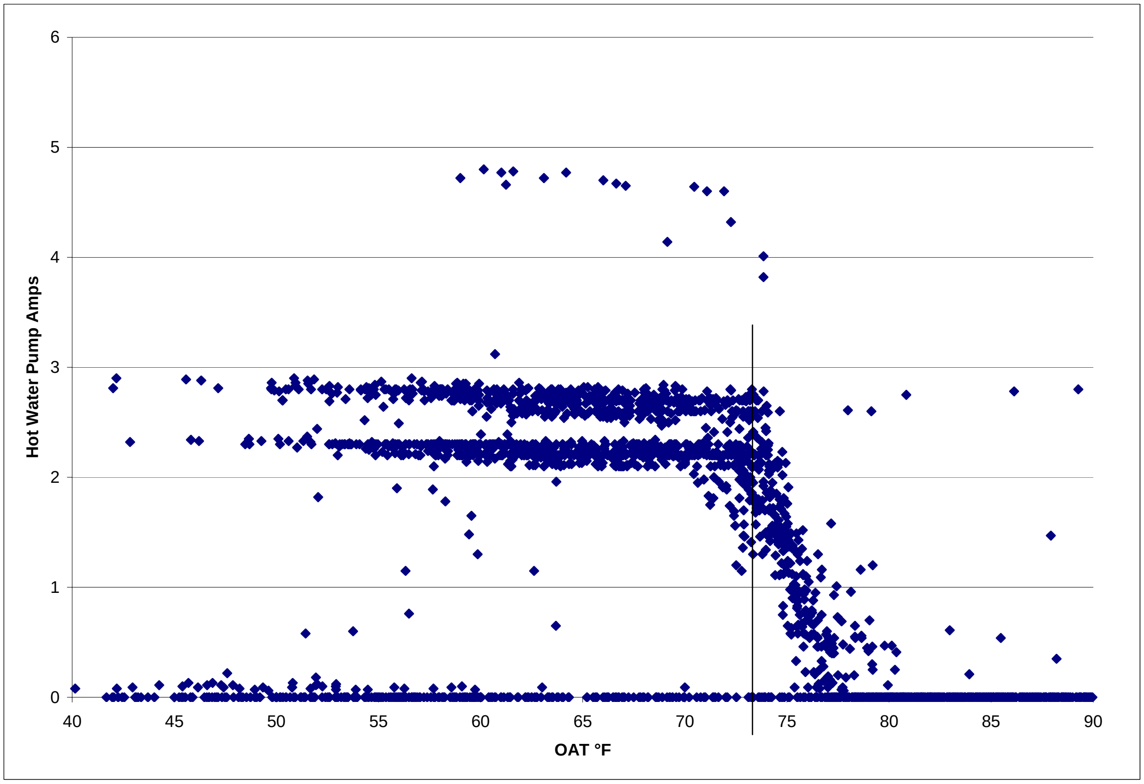
The design temperature in the baseline model is 75°F. The heat loop temperature in the EEM 6 model is 160°F.

Baseline	**EEM 6**
Hot Water Loop = CIRCULATION-LOOP	Hot Water Loop = CIRCULATION-LOOP
TYPE = HW	TYPE = HW
LOOP-OPERATION = SCHEDULED	**LOOP-OPERATION = SNAP**
HEATING-SCHEDULE = "EEM 1 HWP Sch"	HEATING-SCHEDULE = "EEM 1 HWP Sch"
PUMP-SCHEDULE = "EEM 1 HWP Sch"	PUMP-SCHEDULE = "EEM 1 HWP Sch"
	SNAP-T = 75
	SNAP-LOCN = OUTDOOR
DESIGN-HEAT-T = 170	**DESIGN-HEAT-T = 160**
LOOP-PUMP = "HW Loop Pump"	LOOP-PUMP = "HW Loop Pump"
SUPPLY-UA = 140	SUPPLY-UA = 140
RETURN-UA = 140	RETURN-UA = 140
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "Plnm BW Zn"	LOOP-LOSS-ZONE = "Plnm BW Zn"

Verification

This measure appears to be working as modeled. The outside air temperature reduction was verified as approximately 75 °F and is shown in Figure 27 below.

Figure 27: Public Library Headquarters Air Temperature Enable Verification



1.5.8 EEM 7. Boiler Tune-up

ACCO adjusted the boiler controls and performed a new flue gas analysis. The excess air quantity was reduced and the boiler efficiency was increased from 73 to 77%. Results of the flue gas analysis performed during the prefunctional phase are listed in Table 26, and the results of the flue gas analysis after the adjustment is noted in Table 27.

Table 26: Public Library Headquarters Baseline Flue Gas Analysis Results

Stack Temperature:	**553°F**	CO (0% O2):	17 ppm
Ambient Temperature:	56.5°F	Nx:	9 ppm
O_2:	**9.0%**	Nx (0% O2):	15 ppm
CO_2:	6.7%	**Efficiency:**	**73.2%**
CO:	10 ppm	Ex. Air:	67.31

Table 27: Public Library Headquarters Baseline Flue Gas Analysis Results

Stack Temperature:	**481°F**	CO (3% O2):	36 ppm
Ambient Temperature:	71.5°F	Nx:	5 ppm
O_2:	**8.0%**	Nx (3% O2):	6 ppm
CO_2:	7.3%	**Efficiency:**	**77.2%**
CO:	26 ppm	Ex. Air:	55.19

Measure Modeling Estimation Changes

Baseline	EEM 7
Boiler1 (HWNatDrft) = BOILER	Boiler1 (HWNatDrft) = BOILER
TYPE = HW-BOILER	TYPE = HW-BOILER
CAPACITY = -1.5	CAPACITY = -1.5
HEAT-INPUT-RATIO = 1.366	**HEAT-INPUT-RATIO = 1.2987**
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"

Verification

The boiler tune-up cannot be verified with available building data. The boiler tune-up documentation is reasonable and the boiler is assumed to be operating as modeled for the evaluation model.

1.5.9 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. No modifications to the baseline model were necessary at this site. Building data and the baseline model indicated continuous operation of all systems, as shown in Figure 28, Figure 29 and Figure 30**.**

Figure 28: Public Library Headquarters Fan Baseline Schedule

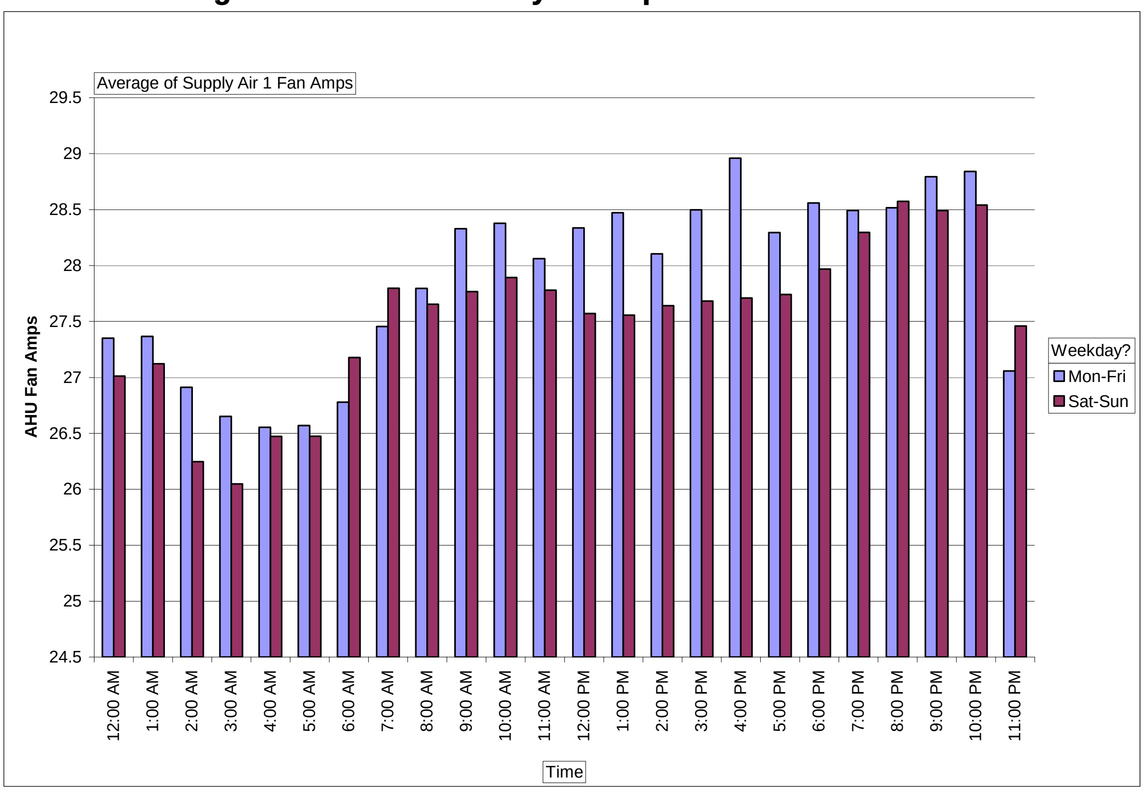


Figure 29: Public Library Headquarters Hot Water Baseline Schedule

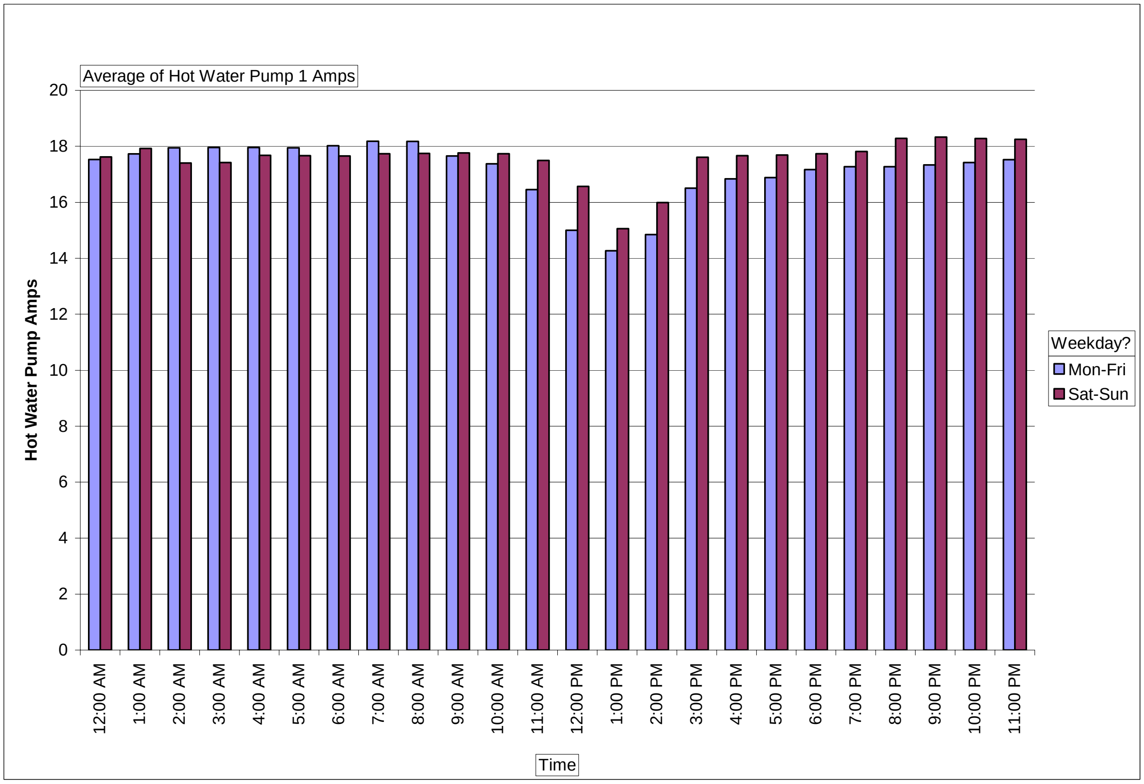
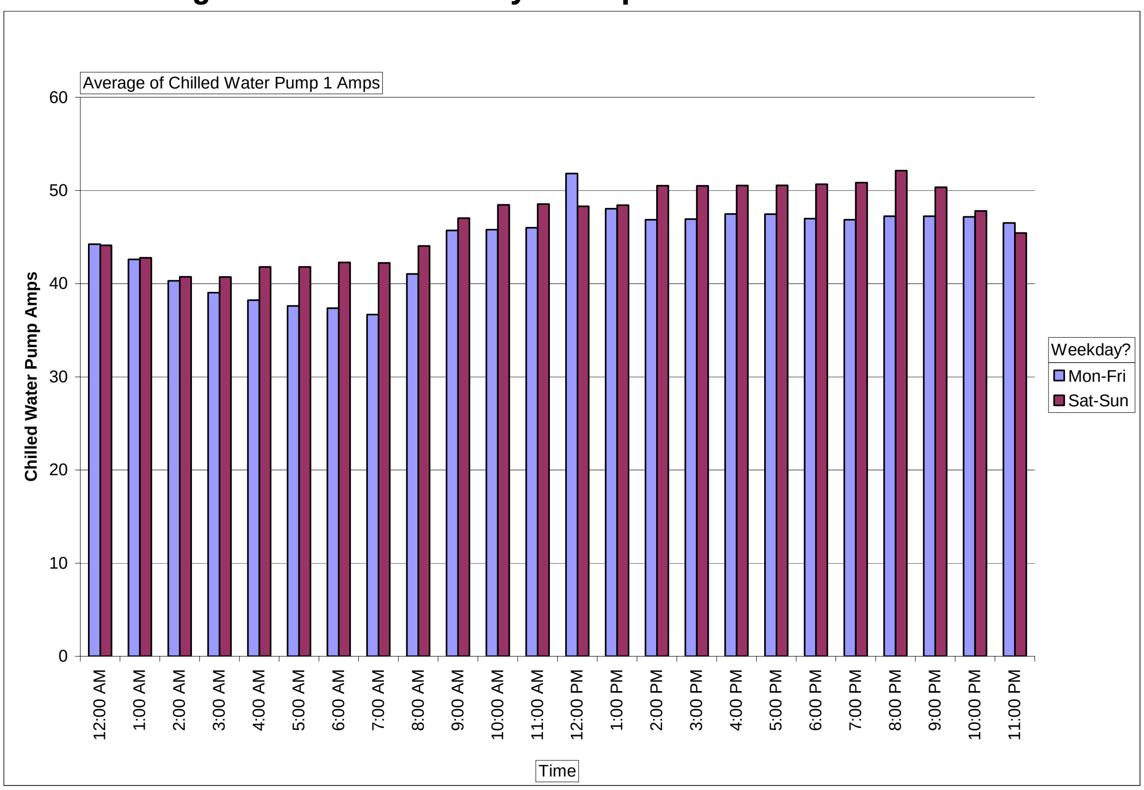


Figure 30: Public Library Headquarters Chiller Baseline Schedule



Also, the baseline model had multiple naming conventions for the chiller. The regular chiller was titled "Chiller Day M-F" and operated 24 hours a day, 7 days a week. A "Chiller Day July-Nov Off" also appeared and it operated from 4am-7pm Monday through Friday. It was used as the daily chiller schedule from July 21 to November 20 and is shown below.

```
Chiller Sch = SCHEDULE-PD
   TYPE            = ON/OFF
   MONTH           = ( 7, 11, 12 )
   DAY             = ( 21, 20, 31 )
   WEEK-SCHEDULES  = ( "Chiller Wk On", "Chiller Wk Jun-Nov
Off", Chiller Wk On" )
         "
```

These mid year changes in the schedule did not agree with actual building, thus they were changed back to the modified baseline schedule. This model change is inserted below.

```
Baseline
Chiller Day July-Nov Off = DAY-SCHEDULE-PD
   TYPE            = ON/OFF
   VALUES          = ( 0, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D,
&D, &D,
         &D, &D, &D, &D, &D, 0 )

Modified Baseline
Chiller Day July-Nov Off = DAY-
SCHEDULE-PD
   TYPE            = ON/OFF
   VALUES          = ( 1 )
```

1.5.10 Public Library Headquarters Evaluation Summary

Table 28: Public Library Headquarters EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
Night Purge	2	Adjusted
OA Economizer	3	Not adjusted
DAT Reset	4	Not adjusted
TAB	5	Not adjusted
Boiler Lock-out SP	6	Not adjusted
Boiler Tune-up	7	Not adjusted

Table 29: Downey Library Headquarters Savings Summary

Library Headquarters	kWh	kW	Therms
Modified Baseline Usage	1,612,514	314	49,466
Evaluation Usage	1,327,120	279	15,869
Ex-Post Savings	285,394	36	33,597
Ex-Ante Savings	246,182	10	33,696
Realization Rate	116%	355%	100%

1.6 East Los Angeles Courthouse

1.6.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 30 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 30: East LA Courthouse Savings

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implemen-tation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 AHU Chlr Blr S/S**	1	562,027	41,181	$ 78,474	$ 37,660	$ 116,134	$116,134	$ -	$ -	-
EEM #2 OA Econ DB + EEM 1	14	580,886	41,121	$ 83,966	$ 37,603	$ 5,435	$121,569	$ 8,728	$ 8,728	0.1
EEM #3 Misc AHU Setpt + EEM 1-2**	20	613,447	41,121	$ 90,745	$ 37,603	$ 6,779	$128,348	$ -	$ 8,728	0.1
EEM #4 TAB + EEM 1-3	30	695,963	42,496	$108,494	$ 38,930	$ 19,076	$147,424	$ 61,153	$ 69,880	0.5
EEM #5 DAT Resets + EEM 1-4	31	706,093	44,018	$109,829	$ 40,400	$ 2,805	$150,229	$ 8,728	$ 78,608	0.5
EEM #6 Boiler Replacement + EEM 1-5	29	697,839	45,555	$108,464	$ 41,884	$ 119	$150,348		$ 78,608	0.5

*Note 1: Total annual savings and implementation costs are cumulative. Implementation cost is made up of two change orders, in the amount of **$71,178** and **$7,430**.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.6.2 EEM 1. HVAC System Start/Stop

This EEM modified the operating schedule for cooling and heating plant equipment, air handling unit (AHU) fans, and exhaust fans to operate between 5:00am to 7:00 pm. The system schedules should be modified from the following baseline operation:

- *Chilled water system operated between 4am and 7 pm, 5 days per week, from October through May. Between June and September the chilled water system operated 24 hours/day, 5 days per week, and was off on the weekends. There is no chiller lockout that is evident in the trend data. A lockout of 60°F was implemented as part of the RCx program.*
- *The heating water system varied between 24 hour/day operation and operating 4am to 8 pm, Monday through Friday. There is no boiler lockout that is evident in the trend data. A boiler outside air lockout temperature of 70°F was recommended as part of this EEM.*
- *Based on trend data, the AHU supply and return fans ran continuously.*

Measure Modeling Estimation Changes

The chiller lockout temperature in the EEM 1 model was set to 55 F OAT, not 60 F as described by EEM 1. The chiller cooling set point control is fixed for both models.

The chiller in the EEM 1 model is scheduled to run on the baseline chiller schedule, not the "EEM1 CHW Oper Sch". The cooling tower and the chilled water pumps in the EEM 1 model are scheduled to run on the "EEM 1 HW Loop Sch", not the "EEM1 CHW Oper Sch." Also of note, the EEM1 chiller schedule, "EEM1 CHW Oper Sch", is not implemented in any of the EEM models.

The boiler lockout temperature in the EEM 1 model was set to 75 F OAT, not 70 F OAT as described by EEM 1. The boiler heating set point control is fixed in the baseline mode and is set to OA-RESET in the EEM1 model. The outside high temperature of the reset schedule is 70 F.

The electric reheat set point in the baseline model is 74 F. The electric reheat set point in the EEM 1 model is 70 F.

The AHU fans in the baseline model run 24/7. The AHU fans in the EEM 1 model operate from 4am to 8pm, not 5am to 7pm as described by EEM 1.

Chiller and Cooling Tower

Baseline	**EEM 1**
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-DESIGN-DT = 8	LOOP-DESIGN-DT = 8
LOOP-OPERATION = SCHEDULED	**LOOP-OPERATION = SNAP**
COOLING-SCHEDULE = "CHW Loop Oper Sch"	**_COOLING-SCHEDULE = "CHW Loop Oper Sch"**
	PUMP-SCHEDULE = "EEM 1 HW Loop Sch"
	SNAP-T = 55
	SNAP-LOCN = OUTDOOR
DESIGN-COOL-T = 45	DESIGN-COOL-T = 45
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
SUPPLY-UA = 50	SUPPLY-UA = 50
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "G Flr Core CV"	LOOP-LOSS-ZONE = "G Flr Core CV"

Baseline	**EEM 1**
Condenser Water Loop = CIRCULATION-LOOP	Condenser Water Loop = CIRCULATION-LOOP
TYPE = CW	TYPE = CW
LOOP-OPERATION = SCHEDULED	LOOP-OPERATION = SCHEDULED
COOLING-SCHEDULE = "CHW Loop Oper Sch"	**COOLING-SCHEDULE = "EEM 1 HW Loop Sch"**
	DESIGN-COOL-T = 80
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
COOL-SETPT-T = 85	COOL-SETPT-T = 85
LOOP-PUMP = "CW Loop Pump"	LOOP-PUMP = "CW Loop Pump"

Boiler

Baseline	**EEM 1**
CH Hot Water Loop = CIRCULATION-LOOP	CH Hot Water Loop = CIRCULATION-LOOP
TYPE = HW	TYPE = HW
LOOP-OPERATION = SCHEDULED	**LOOP-OPERATION = SNAP**
HEATING-SCHEDULE = "HW Loop Oper	HEATING-SCHEDULE = "HW Loop Oper Sch"

Sch"	
PUMP-SCHEDULE = "HW Loop Oper Sch"	**PUMP-SCHEDULE = "EEM 1 HW Loop Sch"**
	SNAP-T = 75
	SNAP-LOCN = OUTDOOR
DESIGN-HEAT-T = 190	DESIGN-HEAT-T = 190
HEAT-SETPT-CTRL = FIXED	**HEAT-SETPT-CTRL = OA-RESET**
	HEAT-RESET-SCH = "EEM 1 - HWST Reset Sch"
LOOP-PUMP = "CH HW Loop Pump"	LOOP-PUMP = "CH HW Loop Pump"
SUPPLY-UA = 800	SUPPLY-UA = 800
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "G Flr Core CV"	LOOP-LOSS-ZONE = "G Flr Core CV"

EEM 1
EEM 1 - HWST Reset day = DAY-SCHEDULE-PD
TYPE = RESET-TEMP
OUTSIDE-HI = 70
OUTSIDE-LO = 40
SUPPLY-HI = 180
SUPPLY-LO = 120

Baseline	**EEM 1**
Heating Schedule - Day = DAY-SCHEDULE-PD	Electric RH Day = DAY-SCHEDULE-PD
TYPE = TEMPERATURE	TYPE = TEMPERATURE
VALUES = (74)	**VALUES = (70)**
	..
Heating Schedule - Day = DAY-SCHEDULE-PD	Electric RH WEH = DAY-SCHEDULE-PD
TYPE = TEMPERATURE	TYPE = TEMPERATURE
VALUES = (74)	**VALUES = (70)**

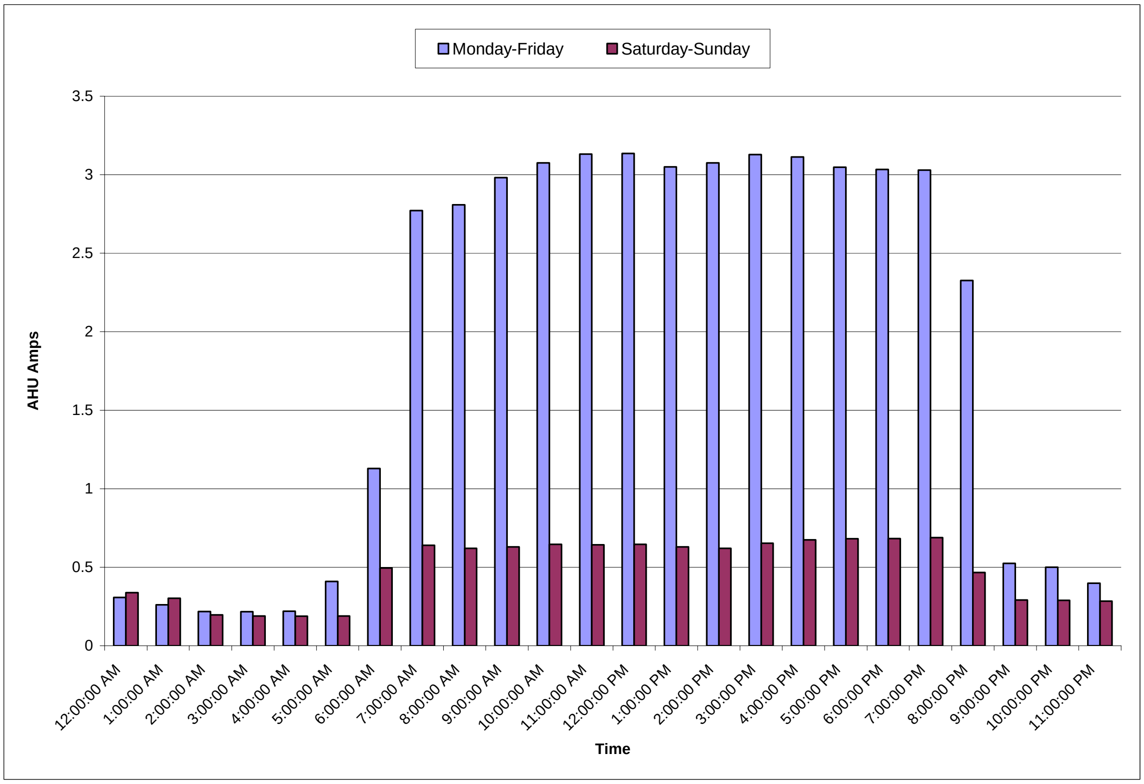
Fans

Baseline	**EEM 1**
Fan Schedule - Day = DAY-SCHEDULE-PD	EEM 1 Fan Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,	**VALUES = (0, &D, &D, 0, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,**
&D, &D, &D, &D, &D, 1)	**&D, &D, &D, &D, &D, &D, 0, 0)**
..	..
Fan Schedule - WEH = DAY-SCHEDULE-PD	EEM 1 Fan WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1)	**VALUES = (0)**

Verification

The schedule was verified as operating 5am to 8pm Monday through Friday and off on Saturday or Sunday as shown in Figure 31 below.

Figure 31: East LA Courthouse Fan Operation Hours



Evaluation Model Changes

The fans, chillers, and boilers were modeled to operate between 5am and 8pm Monday through Friday and off on Saturday and Sunday. Note that only the fan schedule code is inserted below, but the same hours were applied to the hot water loop.

EEM 1 Fan Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, 0, 0, 0.5, 1, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, 0)
..
EEM 1 Fan WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0)

1.6.3 EEM 2. Outside Air Economizer

This EEM repaired the pneumatic controls serving the economizer dampers in order to improve the outside air economizer control sequence. The outside air switchover set point was modified to 72°F (previously 68°F) in order to extend the period when free cooling can occur. The Add/Subtract Repeaters on AH-1, 2, and 3 were found to be faulty and were replaced. The Economizer Logic Networks were replaced on AH-2 and AH-3.

Measure Modeling Estimation Changes

In the baseline model, there are no economizers modeled for AHU 2 through AHU 5, the outside air control is fixed, not set at 68 F OAT as described by EEM 2. The minimum outside air fraction was reduced for each AHU in the EEM 1 model.

Baseline	**EEM 2**
AH-1 = SYSTEM	AH-1 = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
PREHEAT-SOURCE = HOT-WATER	PREHEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = ELECTRIC	BASEBOARD-SOURCE = ELECTRIC
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
MIN-SUPPLY-T = 56	MIN-SUPPLY-T = 56
ECONO-LIMIT-T = 68	**ECONO-LIMIT-T = 72**
PREHEAT-T = 55	PREHEAT-T = 55
ECONO-LOW-LIMIT = 50	**ECONO-LOW-LIMIT = 55**
SUPPLY-FLOW = 10100	SUPPLY-FLOW = 10100
RETURN-FLOW = 7156	RETURN-FLOW = 7156
	MIN-OUTSIDE-AIR = 0.17
	OA-CONTROL = OA-TEMP
Baseline	**EEM 2**
AH-2 = SYSTEM	AH-2 = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
PREHEAT-SOURCE = HOT-WATER	PREHEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = ELECTRIC	BASEBOARD-SOURCE = ELECTRIC
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
MIN-SUPPLY-T = 56	MIN-SUPPLY-T = 56
	ECONO-LIMIT-T = 72
PREHEAT-T = 55	PREHEAT-T = 55
	ECONO-LOW-LIMIT = 55
SUPPLY-FLOW = 22000	SUPPLY-FLOW = 22000
RETURN-FLOW = 14662	RETURN-FLOW = 14662
MIN-OUTSIDE-AIR = 0.55	**MIN-OUTSIDE-AIR = 0.08**
OA-CONTROL = FIXED	**OA-CONTROL = OA-TEMP**

Baseline	**EEM 2**
AH-3 = SYSTEM	AH-3 = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
PREHEAT-SOURCE = HOT-WATER	PREHEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = ELECTRIC	BASEBOARD-SOURCE = ELECTRIC
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
MIN-SUPPLY-T = 56	MIN-SUPPLY-T = 56
	ECONO-LIMIT-T = 72
PREHEAT-T = 55	PREHEAT-T = 55
	ECONO-LOW-LIMIT = 55
SUPPLY-FLOW = 12000	SUPPLY-FLOW = 12000
RETURN-FLOW = 8088	RETURN-FLOW = 8088
MIN-OUTSIDE-AIR = 0.4	**MIN-OUTSIDE-AIR = 0.1**
OA-CONTROL = FIXED	**OA-CONTROL = OA-TEMP**
Baseline	**EEM 2**
AH-4 = SYSTEM	AH-4 = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
PREHEAT-SOURCE = HOT-WATER	PREHEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = ELECTRIC	BASEBOARD-SOURCE = ELECTRIC
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
MIN-SUPPLY-T = 56	MIN-SUPPLY-T = 56
	ECONO-LIMIT-T = 72
PREHEAT-T = 55	PREHEAT-T = 55
	ECONO-LOW-LIMIT = 55
SUPPLY-FLOW = 14000	SUPPLY-FLOW = 14000
RETURN-FLOW = 8528	RETURN-FLOW = 8528
MIN-OUTSIDE-AIR = 0.4	**MIN-OUTSIDE-AIR = 0.1**
OA-CONTROL = FIXED	**OA-CONTROL = OA-TEMP**
Baseline	**EEM 2**
AH-5 = SYSTEM	AH-5 = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
PREHEAT-SOURCE = HOT-WATER	PREHEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = ELECTRIC	BASEBOARD-SOURCE = ELECTRIC
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
MIN-SUPPLY-T = 56	MIN-SUPPLY-T = 56
	ECONO-LIMIT-T = 72
PREHEAT-T = 55	PREHEAT-T = 55
	ECONO-LOW-LIMIT = 55

SUPPLY-FLOW = 14000	SUPPLY-FLOW = 14000
RETURN-FLOW = 8568	RETURN-FLOW = 8568
MIN-OUTSIDE-AIR = 0.4	**MIN-OUTSIDE-AIR = 0.07**
OA-CONTROL = FIXED	**OA-CONTROL = OA-TEMP**

Verification

Since no mixed air temperature data were available for this facility, this measure is difficult to verify directly. Additionally, there are considerable gaps in post implementation data archived in the system. Since this measure saves energy when outside temperatures are between 68 and 72, there are insufficient data to verify the measure has been implemented. Consequently, the measure is assumed to be functioning as modeled for the evaluation.

1.6.4 EEM 3. Chilled Water Fan Coil Units

This EEM modified the chilled water control valves and thermostat control for the fan coil units (AH-6, 7, and 9). Formerly, these AHUs operated continuously, indicating that either they were not properly cycling on and off with demand or the set point is too low. Energy savings will result from setting back temperatures and cycling fans during periods when the equipment is not used.

Measure Modeling Estimation Changes

The design cooling temperature in the baseline model is 72 F. The design cooling temperature in the EEM 3 model is 80 F. The fan-coil unit fans in the baseline model run 24/7. The fan-coil unit fans in the EEM 3 model only run weekends from 5am to 9pm.

Baseline	**EEM 3**
AH-6 = SYSTEM	AH-6 = SYSTEM
TYPE = FC	TYPE = FC
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
MIN-OUTSIDE-AIR = 1	MIN-OUTSIDE-AIR = 1
OA-CONTROL = FIXED	OA-CONTROL = FIXED
FAN-SCHEDULE = "AH 7-9 Fan Schedule"	**FAN-SCHEDULE = "EEM 5 AH 7-9 Fan Sch"**
SUPPLY-KW/FLOW = 0.000908	SUPPLY-KW/FLOW = 0.000908
CHW-LOOP = "Chilled Water Loop"	CHW-LOOP = "Chilled Water Loop"
..	..
AH-6 Zone = ZONE	AH-6 Zone = ZONE
TYPE = CONDITIONED	TYPE = CONDITIONED
ASSIGNED-FLOW = 1256	ASSIGNED-FLOW = 1256
DESIGN-COOL-T = 72	**DESIGN-COOL-T = 80**
COOL-TEMP-SCH = "AH 7-9 Cooling Sch"	**COOL-TEMP-SCH = "EEM 5 - AH 6-9 Cooling Sch"**
SIZING-OPTION = ADJUST-LOADS	SIZING-OPTION = ADJUST-LOADS
SPACE = "AH-6 Space"	SPACE = "AH-6 Space"

Baseline

AH 7-9 Fan Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (1, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 1)
..
AH 7-9 Fan WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (1)

EEM 3
EEM 5 AH 7-9 Fan Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 0)
..
EEM 5 AH 7-9 Fan WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, &D, 0)

Verification

Fan coil unit modifications cannot be verified due to lack of building data.

1.6.5 EEM 4. Repairs, Re-balance, Re-calibrate, Adjustments

This EEM recommended repairing the deficient issues discovered from air flow measurements taken in the facility and during point to point testing. Test and balance (TAB) recommendations included:

- ***Repair inoperative mixing boxes.*** *The initial air flow measurement indicated that VAV dampers do not modulate correctly in 5 boxes. All these boxes were repaired. Additionally, 9 reheat valves did not work at all, 1 reheat valve was leaking, and 18 electric reheats (in constant volume boxes only) did not work. Reheat issues were not addressed under this EEM. Nearly every box (141) was out of design by more than 10%.*
- ***Re-calibrate thermostats.*** *Initial terminal unit testing reported that 45 thermostats were set outside of an expected range between 68 and 78°F or failed the pneumatic thermostat pressure test. Thermostats were calibrated as part of balancing effort.*
- ***Re-balance condenser water flows.*** *Water flow at chilled water and condenser water pumps were found to be 33% (CHWP-1 and P-2) and 90% (CWP-3 only), respectively, above the design requirements. The hot water pumps were within an acceptable range. It was discovered that the chilled water system also serves the Probation Building next to the courthouse. In addition, the chilled water flow at the individual cooling coils was within the acceptable range. The pressure drop across the condenser water loop was measured at 99' TDH, compared to the design pressure drop is 155' TDH, which resulted in excessive water flow through the loop. The pressure drop measured across the condenser water bundle of the chiller was within its design tolerance.*

- ***Re-balance air flow.*** *Initial surveys indicated that the supply and return air flows were significantly lower than design, especially on the Ground Floor (served by AHU-1), 2nd Floor (AHU-3), and the 4th floor (AHU-5). The supply and return air distribution system was balanced to design requirements.*
- ***Duct Leakage.*** *There were numerous locations in the ductwork throughout the building where excessive leakage was evident. Most leaks were repaired as part of the balancing effort.*
- ***Economizer Adjustments.*** *All of the economizers required some mechanical linkage and controls adjustments in order to operate according to the sequence of operations. These adjustments were made wherever possible.*

Measure Modeling Estimation Changes

The minimum flow ratio was reduced for each VAV zone.

Baseline	**EEM 4**
G Flr West Perim HWR = ZONE	G Flr West Perim HWR = ZONE
TYPE = CONDITIONED	TYPE = CONDITIONED
MIN-FLOW-RATIO = 0.5	**MIN-FLOW-RATIO = 0.45**
..	..
EL1 West Perim Zn (M.W13) = ZONE	EL1 West Perim Zn (M.W13) = ZONE
TYPE = CONDITIONED	TYPE = CONDITIONED
MIN-FLOW-RATIO = 0.3	**MIN-FLOW-RATIO = 0.25**
..	..
EL1 West Perim Zn (T.W19) = ZONE	EL1 West Perim Zn (T.W19) = ZONE
TYPE = CONDITIONED	TYPE = CONDITIONED
MIN-FLOW-RATIO = 0.52	**MIN-FLOW-RATIO = 0.47**
EL2 East Perim Zn (G.E3) = ZONE	EL2 East Perim Zn (G.E3) = ZONE
TYPE = CONDITIONED	TYPE = CONDITIONED
MIN-FLOW-RATIO = 0.9	**MIN-FLOW-RATIO = 0.8**

Verification

Repairs, rebalance, recalibrations, and adjustments cannot be verified since there is not building data specific to these measures available via EEMIS. The measure is assumed to be functioning as modeled for the evaluation, as the deficiencies are well documented and the modeling methodology appears sound given the procedures implemented for this measure.

1.6.6 EEM 5. Supply Air Temperature Reset

This EEM modified temperature control to a supply air reset control strategy. This EEM allows the supply air discharge temperature to float as a function of the return air temperature as shown in Table 31.

Table 31: East LA Courthouse AHU Reset Schedule

Supply Air Temperature	Return Air Temperature
55°F	76°F
60°F	71°F

Measure Modeling Estimation Changes

The temperature reset schedule is misnamed EEM 3 in the code and is not called EEM 5.

This measure is applied to AH 1 through AH 5.

The outside air temperature limits for the CD reset are 75 F and 35 F, these values are not mentioned in the EEM 5 description.

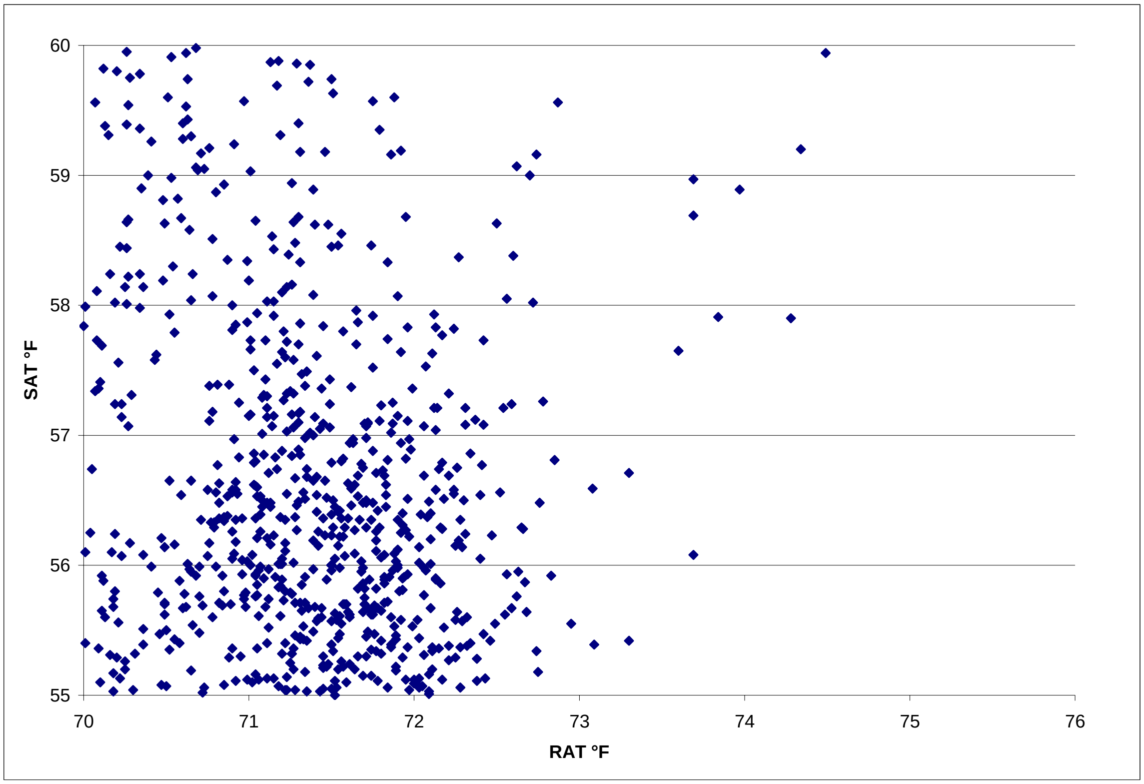
Baseline	**EEM 5**
AH-1" = SYSTEM	AH-1 = SYSTEM
TYPE = VAVS	TYPE = VAVS
HEAT-SOURCE = NONE	HEAT-SOURCE = NONE
ZONE-HEAT-SOURCE = HOT-WATER	ZONE-HEAT-SOURCE = HOT-WATER
PREHEAT-SOURCE = HOT-WATER	PREHEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = ELECTRIC	BASEBOARD-SOURCE = ELECTRIC
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
MIN-SUPPLY-T = 56	MIN-SUPPLY-T = 56
	COOL-RESET-SCH = "EEM 3 DAT Reset Sch"
	COOL-CONTROL = RESET
ECONO-LIMIT-T = 72	ECONO-LIMIT-T = 72
PREHEAT-T = 55	PREHEAT-T = 55
ECONO-LOW-LIMIT = 55	ECONO-LOW-LIMIT = 55
SUPPLY-FLOW = 10100	SUPPLY-FLOW = 10100
RETURN-FLOW = 7156	RETURN-FLOW = 7156
MIN-OUTSIDE-AIR = 0.17	MIN-OUTSIDE-AIR = 0.17
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP

EEM 3 CD DAT Reset DAY = DAY-SCHEDULE-PD
TYPE = RESET-TEMP
OUTSIDE-HI = 75
OUTSIDE-LO = 35
SUPPLY-HI = 60
SUPPLY-LO = 55

Verification

Figure 32 shows there is no trend to the supply air reset data. The data below was filtered to show the points when the system was operating. However, this graph was unclear as to whether or not the measure was working and the evaluation model assumed it was working.

Figure 32: East LA Courthouse Supply Air Temperature Reset Verification



1.6.7 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. Discrepancies were noted between actual building pre implementation data collected between 1/1/2005 and 5/31/2005. Therefore, a modified baseline model was created using operational schedules from the pre implementation data. The changes to the schedules are shown in Table 32.

Table 32: ELA Courthouse Baseline Hour Comparison

	Baseline WD	Baseline WE	Modified WD	Modified BL WE
Fans	Continuous	Continuous	Continuous	Continuous
Chiller	4AM-7PM	Off	2AM-9PM	Off
Boiler	4AM-10PM	Off	Continuous	Continuous

Actual baseline data for the schedules are shown in Figure 33, Figure 34 and Figure 35.

Figure 33: East LA Courthouse Fan Baseline Schedule

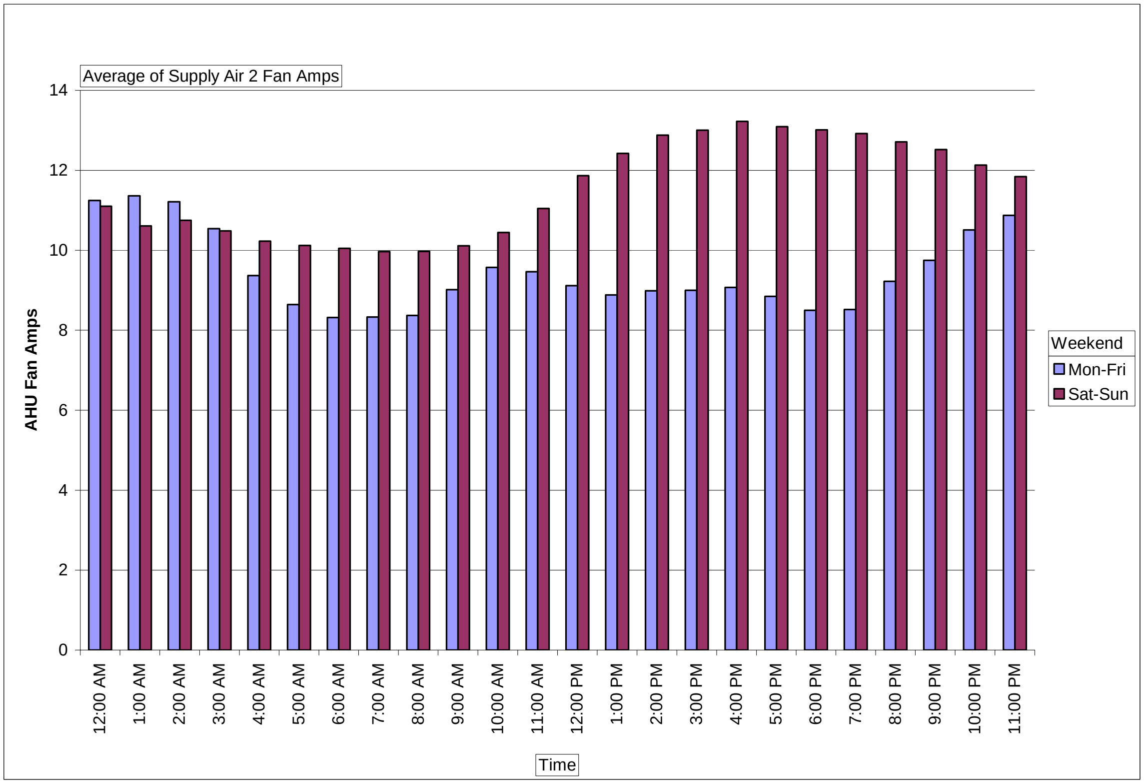


Figure 34: East LA Courthouse Hot Water Baseline Schedule

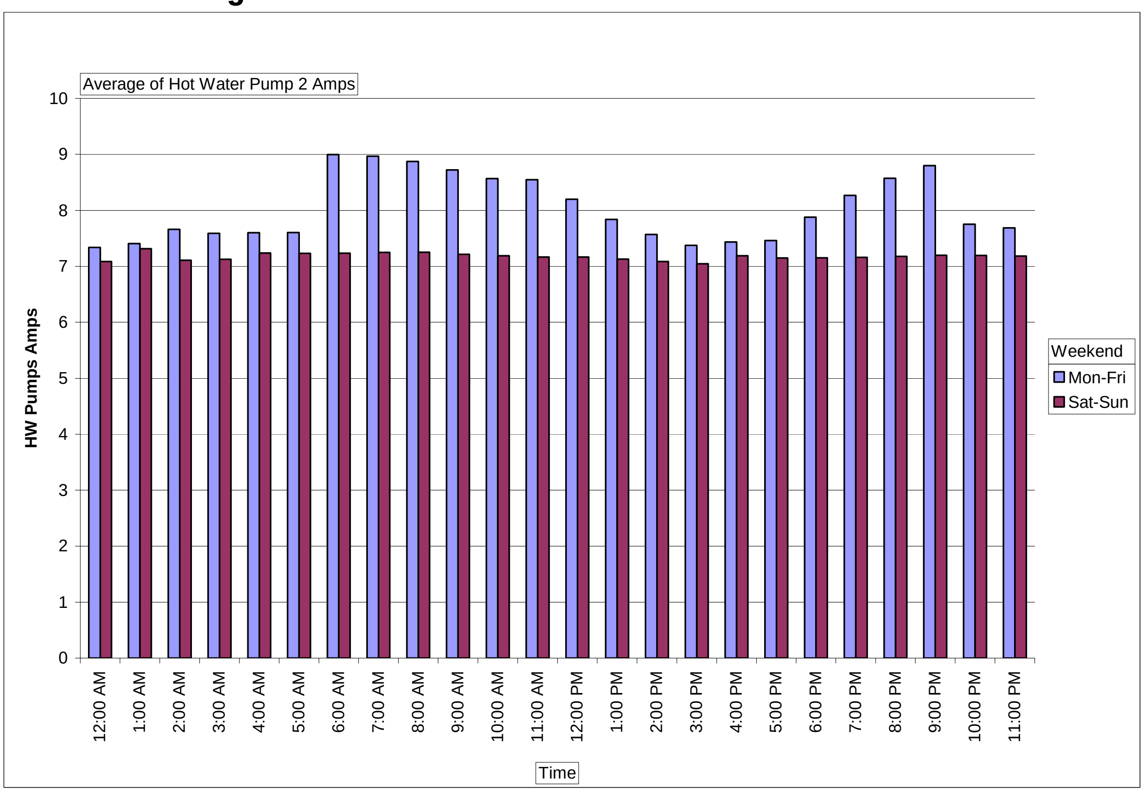
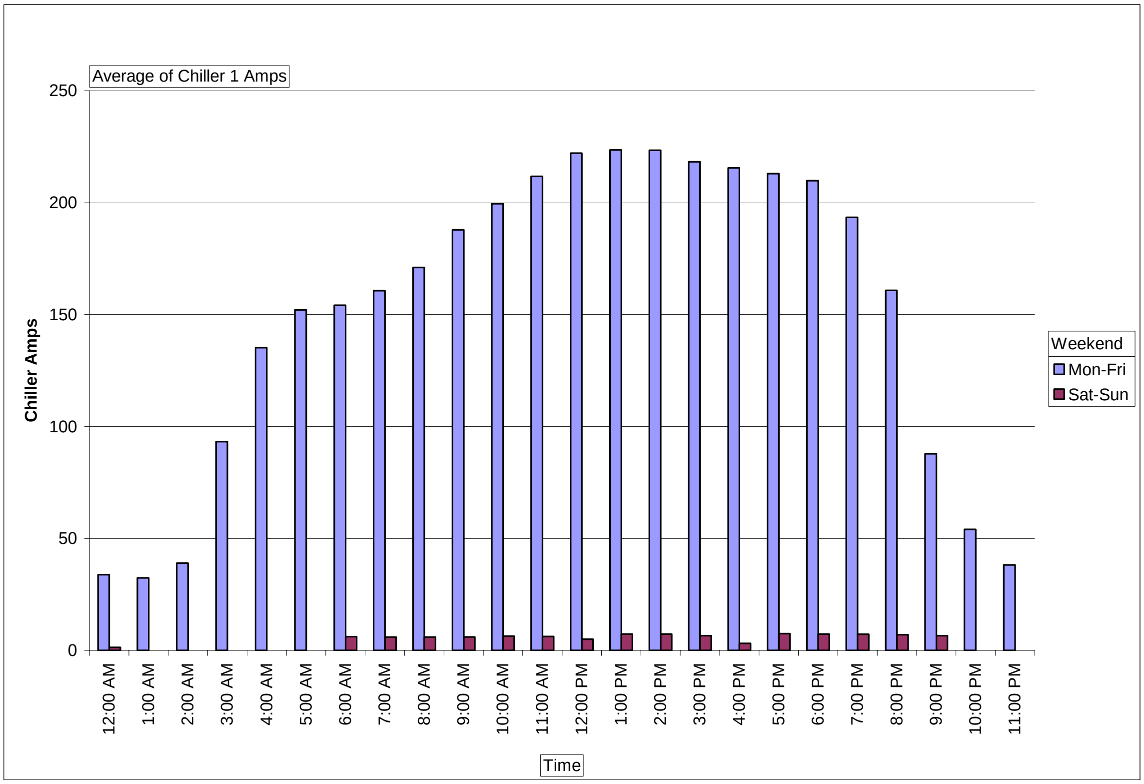


Figure 35: East LA Courthouse Chiller Baseline Schedule



Also, the baseline model had multiple naming conventions for the fans, chilled water loop and hot water loop.

The regular fan was titled "Fan Schedule - Day"" and operated 24 hours a day, 7 days a week. An "AH 7-9 Fan Day" also appeared and it operated 24/7, as shown below. Since these are the hours set by the modified baseline, the schedule was left as 24/7.

AH 7-9 Fan Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (1, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 1)

The regular chiller was titled "CHW Loop Oper," while there was also a "CHW Loop Oper Winter" and "CHW Loop Oper - Summer". The winter loop was supposed to run from September 30 through May 31. The model code is shown below.

CHW Loop Oper Sch = SCHEDULE-PD
TYPE = ON/OFF/TEMP
MONTH = (5, 9, 12)
DAY = (31, 30, 31)
WEEK-SCHEDULES = ("CHW Loop Oper Winter", "CHW Loop Oper - Summer",

"CHW Loop Oper Winter")

These discrepancies in the schedule did not match actual pre implementation building data. Building schedules should be uniform across the year, except for seasonal business fluctuation. For the evaluation model, operating schedule to the modified baseline schedule obtained directly from pre-implementation data. This model change is shown below.

Baseline
CHW Loop Oper Sum Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/TEMP
VALUES = (1)

Modified Baseline
CHW Loop Oper Sum Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/TEMP
VALUES = (0, &D, 1, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 1, &D, 0)

1.6.8 ELA Courthouse Evaluation Summary

Table 33: East LA Courthouse EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
OA Economizer	2	Not adjusted
Setpoint Setback	3	Not adjusted
TAB	4	Not adjusted
DAT Reset	5	Not adjusted

Table 34: East LA Courthouse Savings Summary

East LA Courthouse	kWh	kW	Therms
Modified Baseline Usage	2,247,309	535	68,674
Evaluation Usage	1,557,059	509	21,365
Ex-Post Savings	690,250	26	47,309
Ex-Ante Savings	697,839	29	45,555
Realization Rate	99%	89%	104%

The ex-ante estimates claimed savings from the boiler replacement. The site report clearly indicated that the boiler upgrades were implemented as part of boiler retrofit and saving were attributed to that element. The evaluation team used the EEM#5 model as the foundation for the evaluation model, but the ex ante savings are reported from EEM #6 as shown in Table 30, which included boiler replacement savings.

1.7 El Monte Courthouse

1.7.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 35 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs. ISD took responsibility for implementing the EEMs noted in Table 35 in this facility. The results of EEMs 1, 3, and 4 were verified by EMC during functional testing.

Table 35: El Monte Courthouse Measure Summary

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implementation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 AHU Blr Clr SS	(10)	406,132	7,991	$ 60,861	$ 7,328	$ 68,189	$ 68,189	$ -	$ -	-
EEM #3 DAT Resets + EEMs 1-2	(12)	422,667	11,450	$ 64,104	$10,668	$ 6,583	$ 74,772	$ -	$ -	-
EEM #4 OA Econ DBE + EEMs 1-3	12	502,229	11,547	$ 82,836	$10,762	$ 18,826	$ 93,598	$ -	$ -	-
EEM #5 CT Controls + EEMs 1-4	12	504,872	11,547	$ 83,637	$10,762	$ 801	$ 94,399	$ -	$ -	-
EEM #6 Garage Exh Fan SS + EEMs 1-5	12	539,516	11,547	$ 88,964	$10,762	$ 5,327	$ 99,726	$ -	$ -	-
EEM #7 FCU Setpoint + EEMs 1-6	12	549,007	11,546	$ 90,430	$10,761	$ 1,465	$101,191	$ -	$ -	-
EEM #8 Blr Tuneup + EEMs 1-7	12	549,007	12,570	$ 90,430	$11,749	$ 988	$102,179	$ -	$ -	-

*Note 1: Total annual are cumulative. Implementation costs are not listed because ISD chose to complete the EEMs with internal resources. An implementation cost of $15,846 was approved for repair of 15 mixing boxes for EEM 2.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.7.2 EEM 1. HVAC System Start/Stop.

The operating schedule for the air handling unit (AHU) fans was reduced to match the schedule of the central plant equipment: Monday through Friday, 5:00am to 6:00 pm, and off on the weekends and holidays. This EEM also included an outside air lockout for the boiler and chillers of 72°F and 58°F, respectively.

Measure Modeling Estimation Changes

Fans in the baseline case are modeled to operate 24/7.

The chiller lockout temperature in the base case model is 55 F OAT.

The boiler lockout temperature is modeled as 72 F OAT for both the baseline and EEM1.

The boiler schedule changed significantly for weekdays. The boiler is always off on weekends for the baseline and EEM1. The baseline boiler operates for 18 hours in January March and December, 14 hours in February, April, May, and November, and 12 hours in October. The baseline boiler goes to 2 hour operation from June 1 to September 1. EEM1 boiler operates from 5am to 6pm on all weekdays.

Baseline	EEM1
Fan Schedule - Day = DAY-SCHEDULE-PD	EEM 1 Fan Day = DAY-SCHEDULE-PD

TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1, &D, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, &D, 1)	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,**
	&D, &D, &D, &D, 0, 0)
..	..
Fan Schedule - WEH = DAY-SCHEDULE-PD	EEM 1 Fan WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (1)	**VALUES = (0)**

Baseline	**EEM1**
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-OPERATION = SNAP	LOOP-OPERATION = SNAP
COOLING-SCHEDULE = "Chiller Schedule - year"	COOLING-SCHEDULE = "Chiller Schedule - year"
PUMP-SCHEDULE = "Chiller Schedule - year"	PUMP-SCHEDULE = "Chiller Schedule - year"
SNAP-T = 55	**SNAP-T = 58**
SNAP-LOCN = OUTDOOR	SNAP-LOCN = OUTDOOR
DESIGN-COOL-T = 47	DESIGN-COOL-T = 47
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
SUPPLY-UA = 50	SUPPLY-UA = 50
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL3 North Perim Zn (B.N1)"	LOOP-LOSS-ZONE = "EL3 North Perim Zn (B.N1)"

Verification

It appears the schedule changes did not occur for the AHUs as the units are still operating 24/7. See Figure 36 below. The chillers are operating from 4am-5pm Monday through Friday and not operating on the weekends, as shown in Figure 37.

Figure 36: El Monte Courthouse AHU Operation Hours

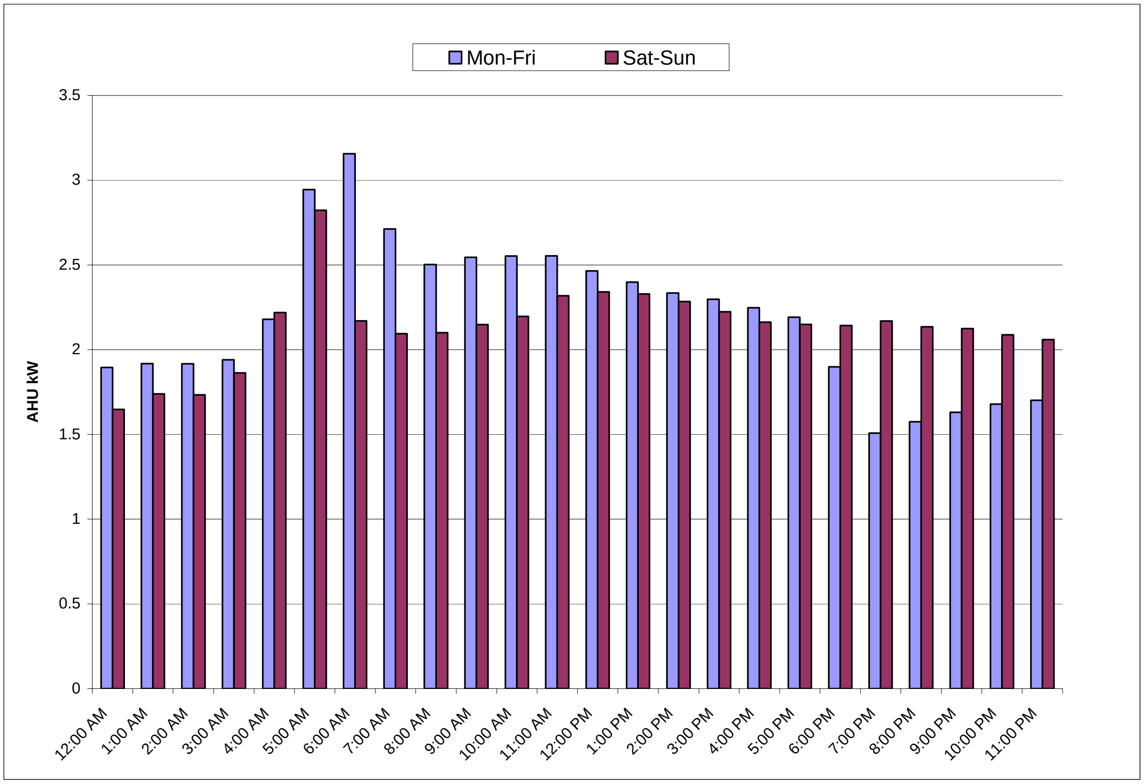
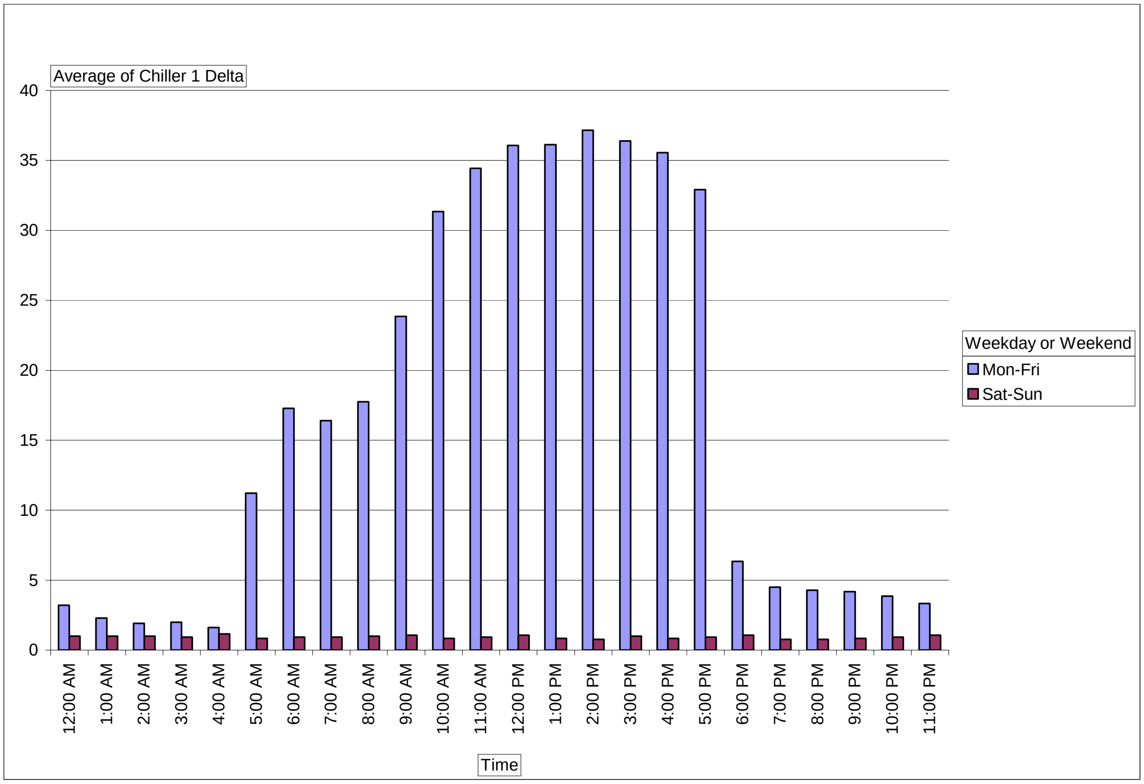


Figure 37: El Monte Courthouse Chiller Operation Hours



Evaluation Model Changes

The fans were modeled to operate 24/7. Note that only the fan schedule code is inserted below, but the same hours were applied to the hot water schedule. The chillers were modeled to fit the schedule verified above.

EEM 1 Fan Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (1)
..
EEM 1 Fan WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (1)

1.7.3 EEM 2. Mixing Box Repair

The original EEM recommended investigating 31 inoperative mixing boxes, re-calibrating 7 suspect thermostats, repairing failed static dampers and transducers, and investigating the cause of high cold deck static pressures. EMC performed an additional investigation and identified 7 critical mixing boxes that required repair. Note that there were no savings listed in Table 35 since the scope of this EEM was significantly reduced from the TAB EEM discussed in the prefunctional report.

1.7.4 EEM 3. AHU Hot Deck Reset Control Strategy

This EEM restored the hot deck discharge air temperature control to the design intent, which is a reset strategy based on outside air temperature. The reset schedule is summarized in Table 36.

Table 36: Current El Monte Courthouse AHU Hot Deck Reset Schedule

Table 1-2. Current AHU Hot Deck Reset Schedule

AHU 1		AHU 2		AHU 3	
Outside Air Temp.	Discharge Air Temp	Outside Air Temp.	Discharge Air Temp	Outside Air Temp.	Discharge Air Temp
40°F	77°F	40°F	80°F	40°F	77°F
70°F	105°F	80°F	105°F	65°F	105°F

Measure Modeling Estimation Changes

The minimum supply temperature in the baseline model is 54 F for AHU-1 and 53 for AHU-2 and AHU-3. The minimum supply temperature was set to 55 F for all air handlers in EEM 3.

The hot deck reset maximum outside air temperature for AHU-1 is modeled as 77 F, not 70F as described by EEM 3.

AH-1	
Baseline	**EEM3**
AH-1 = SYSTEM	AH-1 = SYSTEM

TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
SIZING-RATIO = 1.15	SIZING-RATIO = 1.15
RETURN-AIR-PATH = PLENUM-ZONES	RETURN-AIR-PATH = PLENUM-ZONES
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
	HEAT-RESET-SCH = "EEM 3 DAT Reset Schedule 1"
	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 54	**MIN-SUPPLY-T = 55**
SUPPLY-FLOW = 51515	SUPPLY-FLOW = 51515
RETURN-FLOW = 50900	RETURN-FLOW = 50900
MIN-OUTSIDE-AIR = 0.5	MIN-OUTSIDE-AIR = 0.5
OA-CONTROL = FIXED	OA-CONTROL = FIXED

AH-2 & AH-3	
Baseline	**EEM3**
AH-2 = SYSTEM	AH-2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
SIZING-RATIO = 1.15	SIZING-RATIO = 1.15
RETURN-AIR-PATH = PLENUM-ZONES	RETURN-AIR-PATH = PLENUM-ZONES
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
	HEAT-RESET-SCH = "EEM 3 DAT Reset Sch 2"
	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 53	**MIN-SUPPLY-T = 55**
SUPPLY-FLOW = 27185	SUPPLY-FLOW = 27185
RETURN-FLOW = 20850	RETURN-FLOW = 20850
MIN-OUTSIDE-AIR = 1	MIN-OUTSIDE-AIR = 1
OA-CONTROL = FIXED	OA-CONTROL = FIXED

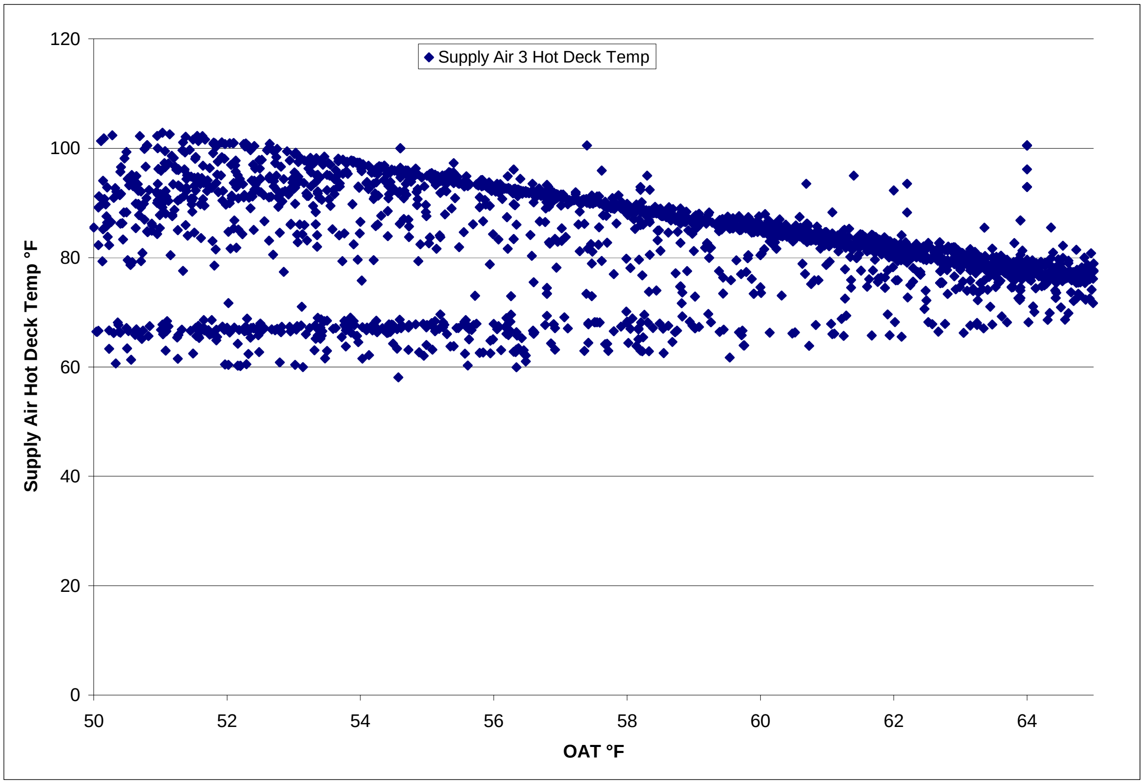
AH -1
EEM 3 DAT Reset Sch = DAY-SCHEDULE-PD
TYPE = RESET-TEMP
OUTSIDE-HI = 77
OUTSIDE-LO = 40
SUPPLY-HI = 105
SUPPLY-LO = 77
AH -2
EEM 3 DAT Reset day 2 = DAY-SCHEDULE-

PD
TYPE = RESET-TEMP
OUTSIDE-HI = 80
OUTSIDE-LO = 40
SUPPLY-HI = 105
SUPPLY-LO = 80
AH -3 Weekday
EEM 3 DAT Reset day 3 = DAY-SCHEDULE-PD
TYPE = RESET-TEMP
OUTSIDE-HI = 65
OUTSIDE-LO = 40
SUPPLY-HI = 105
SUPPLY-LO = 77

Verification

The temperature reset appears to be working, as seen in Figure 38.

Figure 38: El Monte Courthouse Hot Deck Reset Verification



1.7.5 EEM 4. Outside Air Economizer.

This EEM recommended repairing the economizer dampers in order to implement an optimized outside air economizer control sequence. Many sets of economizer dampers would not modulate during point-to-point testing. Repairs would likely involve the replacement of certain transducers, dampers, and actuators. The existing enthalpy economizer control sequence was kept in place and all three return air humidity sensors were recommended for replacement. During functional testing it was confirmed and tested that the programming for the enthalpy based economizer controls is in place and working. However, the hardware deficiencies still need to be addressed by ISD before the economizer operation is considered optimized.

Measure Modeling Estimation Changes

The minimum outside air ratio for the baseline model was 0.5 for AHU-1, 1 for AHU-2, and 0.1 for AHU-3 and all had fixed economizers. The minimum outside air ratio for the EEM 4 model was 0.27 for AHU-1, 0.17 for AHU-2, and 0.22 for AHU-3 and all had enthalpy economizers.

AH-1	
Baseline	**EEM4**
AH-1 = SYSTEM	AH-1 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
SIZING-RATIO = 1.15	SIZING-RATIO = 1.15
RETURN-AIR-PATH = PLENUM-ZONES	RETURN-AIR-PATH = PLENUM-ZONES
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
HEAT-RESET-SCH = "EEM 3 DAT Reset Schedule 1"	HEAT-RESET-SCH = "EEM 3 DAT Reset Schedule 1"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 55	MIN-SUPPLY-T = 55
	ECONO-LIMIT-T = 75
	ENTHALPY-LIMIT = 25
SUPPLY-FLOW = 51515	SUPPLY-FLOW = 51515
RETURN-FLOW = 50900	RETURN-FLOW = 50900
MIN-OUTSIDE-AIR = 0.5	**MIN-OUTSIDE-AIR = 0.27**
OA-CONTROL = FIXED	**OA-CONTROL = OA-ENTHALPY**

AH-2	
Baseline	**EEM4**
AH-2 = SYSTEM	AH-2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
SIZING-RATIO = 1.15	SIZING-RATIO = 1.15
RETURN-AIR-PATH = PLENUM-ZONES	RETURN-AIR-PATH = PLENUM-ZONES
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
HEAT-RESET-SCH = "EEM 3 DAT Reset Sch 2"	HEAT-RESET-SCH = "EEM 3 DAT Reset Sch 2"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 55	MIN-SUPPLY-T = 55

	ECONO-LIMIT-T = 75
	ENTHALPY-LIMIT = 25
SUPPLY-FLOW = 27185	SUPPLY-FLOW = 27185
RETURN-FLOW = 20850	RETURN-FLOW = 20850
MIN-OUTSIDE-AIR = 1	**MIN-OUTSIDE-AIR = 0.17**
OA-CONTROL = FIXED	**OA-CONTROL = OA-ENTHALPY**

AH-3	
Baseline	**EEM4**
AH-3 = SYSTEM	AH-3 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
SIZING-RATIO = 1.15	SIZING-RATIO = 1.15
RETURN-AIR-PATH = PLENUM-ZONES	RETURN-AIR-PATH = PLENUM-ZONES
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
HEAT-RESET-SCH = "EEM 3 DAT Reset Sch 3"	HEAT-RESET-SCH = "EEM 3 DAT Reset Sch 3"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 55	MIN-SUPPLY-T = 55
	ECONO-LIMIT-T = 75
	ENTHALPY-LIMIT = 25
SUPPLY-FLOW = 24940	SUPPLY-FLOW = 24940
RETURN-FLOW = 23670	RETURN-FLOW = 23670
MIN-OUTSIDE-AIR = 0.1	**MIN-OUTSIDE-AIR = 0.22**
OA-CONTROL = FIXED	**OA-CONTROL = OA-ENTHALPY**

Verification

The economizer operation can't be directly verified since mixed air temperature data are not available for this site. The measure is assumed to be functioning as modeled for the evaluation model.

1.7.6 EEM 5. Cooling Tower Fan VFD Replacement

This EEM recommended replacing the Cooling Tower Fan CT-2 VFD and raising the condenser water supply temperature to 70°F. Currently, there is a mechanical/controls problem with the VFDs, and they operate continuously at full speed. There is no steady condenser water temperature control, and under certain ambient conditions, the condenser water temperature drops below 65°F, which is below the recommendation of the chiller manufacturer.

Measure Modeling Estimation Changes

The modeling change was changing the cooling tower fan to variable speed control. No set point or other control changes were modeled.

Baseline	**EEM5**
Open Tower = HEAT-REJECTION	Open Tower = HEAT-REJECTION
TYPE = OPEN-TWR	TYPE = OPEN-TWR

CAPACITY = 6	CAPACITY = 6
NUMBER-OF-CELLS = 1	NUMBER-OF-CELLS = 1
FAN-KW/CELL = 6.4	FAN-KW/CELL = 6.4
CAPACITY-CTRL = ONE-SPEED-FAN	**CAPACITY-CTRL = VARIABLE-SPEED-FAN**
DESIGN-WETBULB = 74	DESIGN-WETBULB = 74
CW-LOOP = "Condenser Water Loop"	CW-LOOP = "Condenser Water Loop"

Verification

The cooling tower fan VFD replacement could not be verified with available building data. The measure was assumed to be functioning as in the estimation models.

1.7.7 EEM 6. Timer Control for Exhaust Fan

This EEM recommended repairing the timer control for the Garage Exhaust Fan (EF-1). The exhaust fan currently runs continuously according to trend data. The recommendation is to operate the fan only from 5:00am to 6:00pm to match the building occupancy schedule.

Measure Modeling Estimation Changes

The baseline model has the fans running continuously. The EEM6 model operates the fans 5am-6pm on weekdays and off on the weekends.

Baseline	**EEM6**
EM1 = ELEC-METER	EM1 = ELEC-METER
TYPE = UTILITY	TYPE = UTILITY
EXTERIOR-POWER = (6.3)	EXTERIOR-POWER = (6.3)
EXTERIOR-SCH = ("Garage EF Sch")	**EXTERIOR-SCH = ("EEM 6 GF Schedule")**
EXTERIOR-EU = (VENT-FANS)	EXTERIOR-EU = (VENT-FANS)
Garage EF Day = DAY-SCHEDULE-PD	EEM 6 GF Day = DAY-SCHEDULE-PD
TYPE = FRACTION	TYPE = FRACTION
VALUES = (1, &D, &D, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D,	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,**
&D, &D, &D, 1)	**&D, &D, &D, &D, 0)**
..	..
Garage EF WEH = DAY-SCHEDULE-PD	EEM 6 GF WEH = DAY-SCHEDULE-PD
TYPE = FRACTION	TYPE = FRACTION
VALUES = (1)	**VALUES = (0)**

Verification

The timer controls could not be verified with available building data. They were assumed to be operating as modeled.

1.7.8 EEM 7. Chilled Water Control Valves

This EEM recommended repairing the chilled water control valves and thermostat control for the fan coil units. Currently, they run continuously, indicating that either they are not properly cycling on or off with demand or the space thermostat set point is too low. Thermostat repair is critical to reducing the operating time of these units.

Measure Modeling Estimation Changes

The FCU cooling set points were raised from 70 F in the baseline model to 80 F in the EEM 7 model.

FCU fans in the baseline model run 24/7 and FCU fans in the EEM 7 model run from 5am to 9pm.

Baseline	**EEM7**
FCU Cooling Day = DAY-SCHEDULE-PD	EEM 7 FCU Cool Day = DAY-SCHEDULE-PD
TYPE = TEMPERATURE	TYPE = TEMPERATURE
VALUES = (70)	**VALUES = (80)**
..	..
FCU Cooling WEH = DAY-SCHEDULE-PD	EEM 7 FCU Cool WEH = DAY-SCHEDULE-PD
TYPE = TEMPERATURE	TYPE = TEMPERATURE
VALUES = (70)	**VALUES = (80)**
Baseline	**EEM7**
FCU Fan Day = DAY-SCHEDULE-PD	EEM 7 FCU Fan Day = DAY-SCHEDULE-PD
TYPE = ON/OFF	TYPE = ON/OFF
VALUES = (1)	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,**
	&D, &D, &D, &D, &D, &D, &D, 0)

Verification

The chilled water control valves could not be verified. This measure was assumed to be working as modeled.

1.7.9 EEM 8. Boiler Tune-up

ACCO adjusted the boiler controls and performed a new flue gas analysis. The excess air quantity was reduced and the boiler efficiency was increased from 72.1% to 73.4% on Boiler 1 and 72.7% to 73.5% on Boiler 2. Results of the flue gas analysis performed during the prefunctional phase are listed in Table 37, and the results of the flue gas analysis after the adjustment is noted in Table 38.

Table 37: El Monte Courthouse Baseline Flue Gas Analysis

Boiler B-1			
Stack Temperature:	525°F	CO (0% O2):	10 ppm
Ambient Temperature:	61.5°F	Nx:	65 ppm
O_2:	10.7%	Nx (0% O2):	133 ppm
CO_2:	5.8%	Efficiency:	72.1%
CO:	5 ppm	Ex. Air:	93.36

Boiler B-2			
Stack Temperature:	378°F	CO (0% O2):	8 ppm
Ambient Temperature:	69.0°F	Nx:	24 ppm
O_2:	14.2%	Nx (0% O2):	75 ppm
CO_2:	3.8%	Efficiency:	72.7%
CO:	3 ppm	Ex. Air:	188.62

Table 38: El Monte Courthouse Post-Tune-up Baseline Flue Gas Analysis

Boiler B-1			
Stack Temperature:	534°F	CO (3% O2):	11 ppm
Ambient Temperature:	79.5°F	Nx:	39 ppm
O_2:	10.0%	Nx (0% O2):	64 ppm
CO_2:	6.2%	Efficiency:	73.4%
CO:	7 ppm	Ex. Air:	81.65

Boiler B-2			
Stack Temperature:	558°F	CO (0% O2):	- ppm
Ambient Temperature:	73.5°F	Nx:	74 ppm
O_2:	9.1%	Nx (0% O2):	112 ppm
CO_2:	6.7%	Efficiency:	73.5%
CO:	- ppm	Ex. Air:	68.64

Measure Modeling Estimation Changes

The boiler tune-up was modeled by increasing the efficiency of the boiler shown below.

Baseline	EEM8
Boiler1 (HWNatDrft) = BOILER	Boiler1 (HWNatDrft) = BOILER
TYPE = HW-BOILER	TYPE = HW-BOILER
CAPACITY = -1.2	CAPACITY = -1.2
HEAT-INPUT-RATIO = 1.381	**HEAT-INPUT-RATIO = 1.3158**
AQUASTAT-SETPT-T = 190	AQUASTAT-SETPT-T = 190
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"

Verification

The boiler tune-up could not be verified with available building data. It was assumed to be functioning as modeled for the evaluation.

1.7.10 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. Discrepancies were noted between actual building pre implementation data collected between 1/1/2005 and 5/31/2005. Therefore, a modified baseline model was created using operational schedules from the pre implementation data. The changes to the schedules are shown in Table 39.

Table 39: El Monte Courthouse Baseline Hour Comparison

	Baseline WD	Baseline WE	Modified BL WD	Modified BL WE
Fans	Continuous	Continuous	Continuous	Continuous

Chiller	6AM-5PM	Off	4AM-7PM	Off
Boiler	Multiple	Off	4AM-7PM	Off

The results of the actual fan and chiller usage data modified baseline hours are shown in Figure 39 and Figure 40.

Figure 39: El Monte Courthouse Fan Modified Baseline Hours

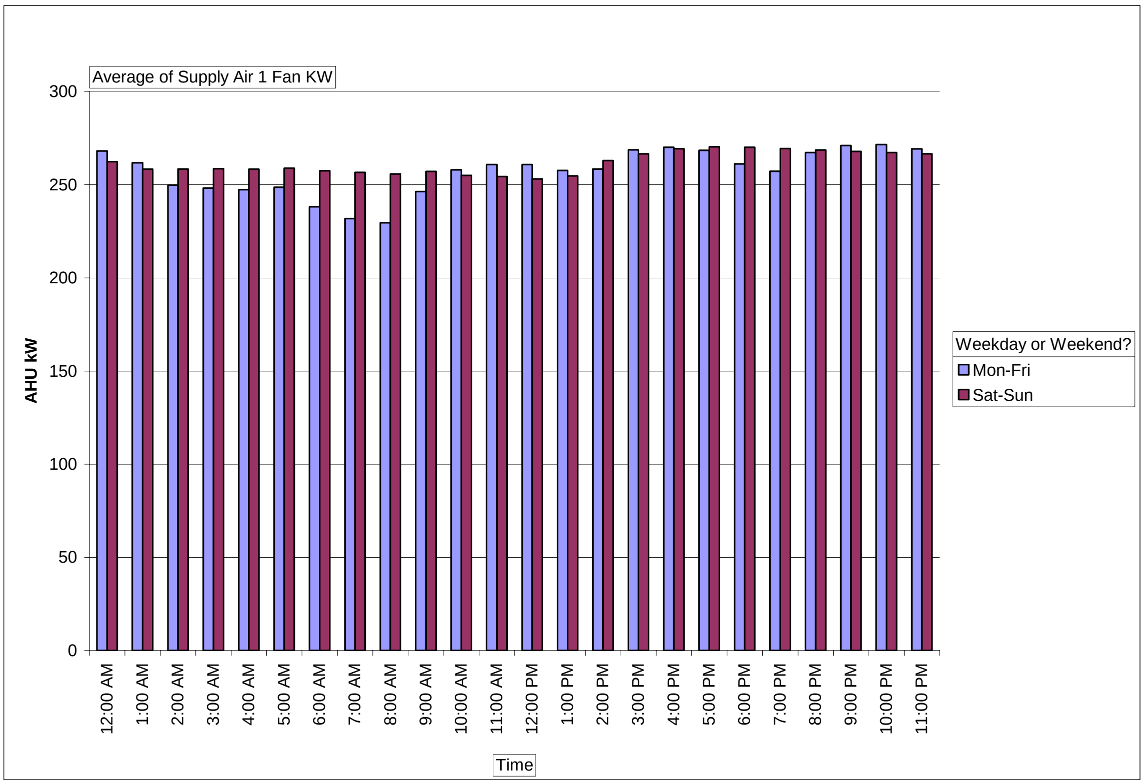
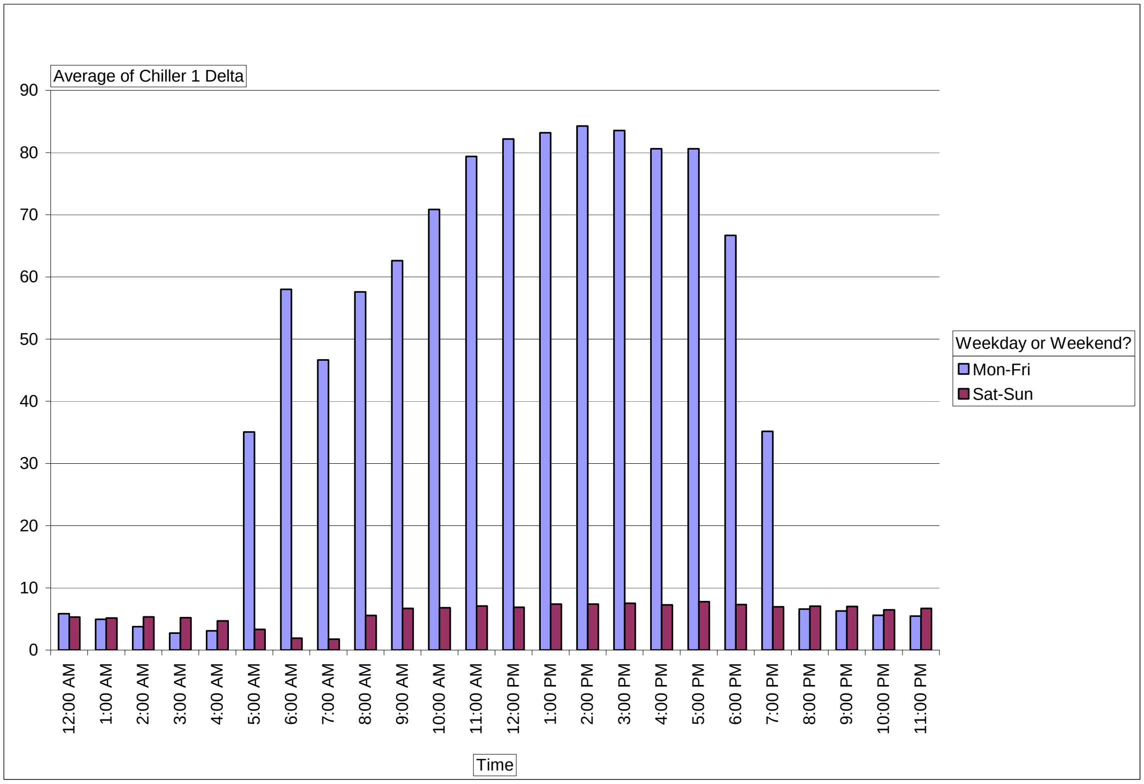


Figure 40: El Monte Courthouse Chiller Modified Baseline Hours



The heating system had many weekday schedules shown below. This effort may have been used to calibrate the model to monthly billing therm usage.

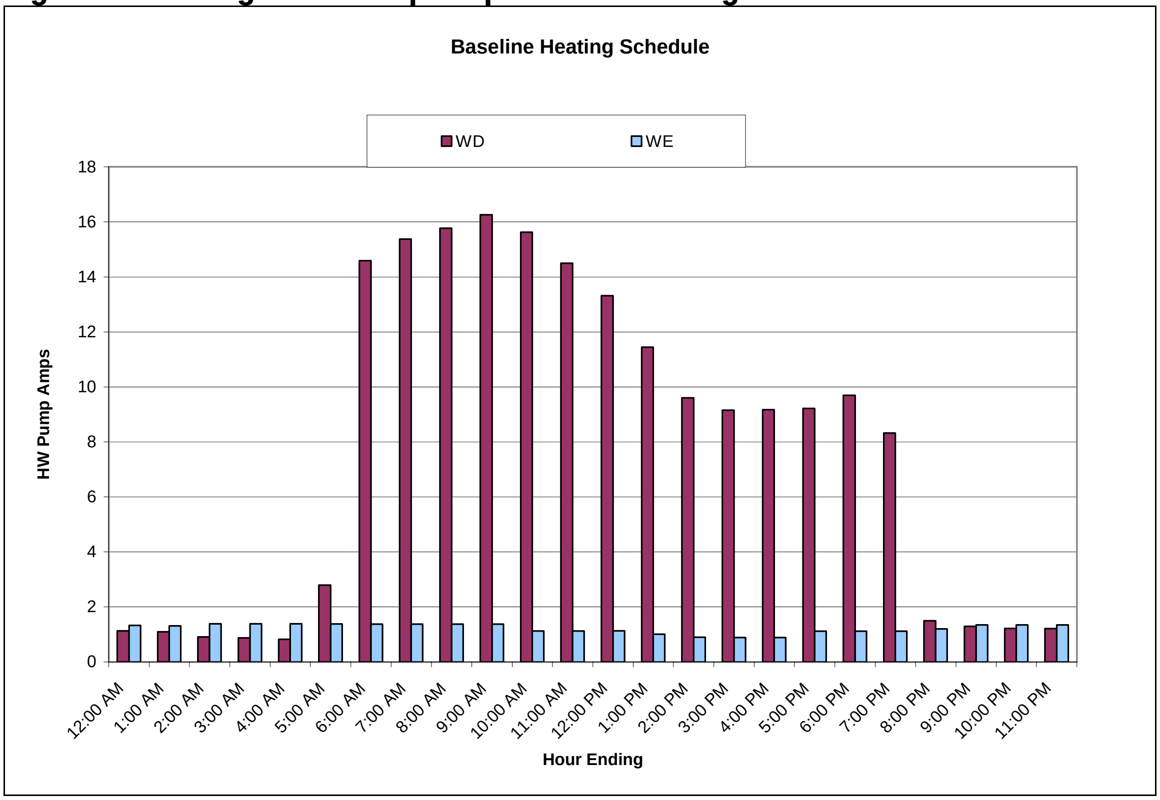
HW 14hrs = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 0)
..
HW 0hrs = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0)
..
HW 24hrs = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (1, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 1)
..
HW 12hrs = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, 0, &D, 1, &D, &D, &D, &D, &D, &D,

&D,
&D, &D, &D, &D, 0)
..
HW 18hrs = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, 1, 1, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 1, 0)
..
HW 2hrs = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, 0, &D, 1, &D, 0, &D, 0, &D, 0, &D, &D,
&D, 0, &D, 0)

HW Schedule- Year = SCHEDULE-PD
TYPE = ON/OFF
MONTH = (1, 2, 3, 5, 9, 10, 11, 12)
DAY = (31, 28, 31, 31, 30, 31, 30, 31)
WEEK-SCHEDULES = ("HW 18hrs M-F", "HW 14hrs M-F", "HW 18hrs M-F",
"HW 14hrs M-F", "HW 2hrs M-F", "HW 12hrs M-F", "HW 14hrs M-F",
"HW 18hrs M-F")

The pre implementation data show a fairly consistent schedule for the entire that is exactly the same as what was observed for chiller schedule.

Figure 41 Average HW Pump Amps 6-2004 through 5-2005



Thus the multiple boiler schedules were changed to match the chiller schedule year round for the modified baseline schedule. The model changes for the chiller are shown below.

Baseline
Chiller Schedule - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, 0, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, 0.5, 0)
Modified Baseline
Chiller Schedule - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 0)

1.7.11 El Monte Courthouse Evaluation Summary

The table below shows the status of the implemented measures in the evaluation model.

Table 40: El Monte Courthouse EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
DAT Reset	3	Not adjusted
OA Economizer	4	Not adjusted
CT Controls	5	Not adjusted
Garage Fan Control	6	Not adjusted
FCU SP	7	Not adjusted
Boiler Tune-up	8	Not adjusted

The low realization rate is mostly due to post implementation fans running continuously.

Table 41: El Monte Courthouse Savings Summary

El Monte Courthouse	kWh	kW	Therms
Modified Baseline Usage	2,026,714	393	40,236
Evaluation Usage	1,740,455	387	30,567
Ex-Post Savings	286,259	5	9,669
Ex-Ante Savings	549,007	12	12,570
Realization Rate	52%	43%	77%

1.8 Malibu Administration Center and Courthouse

1.8.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 42 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 42: Malibu Administration Center and Courthouse Savings

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implemen-tation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 AHU/EF SS (DD-3, MZ-1 Only)	(1)	20,236	3,583	$ 2,916	$ 3,459	$ 6,375	$ 6,375	$ -	$ -	-
EEM #3 DAT Resets + EEM 1-2	11	60,733	7,559	$ 11,533	$ 7,299	$ 12,457	$ 18,832	$ 13,488	$ 13,488	0.7
EEM #4b OA Econ DBE + EEM 1-3	11	87,575	3,277	$ 16,404	$ 3,163	$ 735	$ 19,567	$ 16,928	$ 30,416	1.6
EEM #5 CT Controls + EEM 1-4	16	121,306	3,277	$ 24,197	$ 3,163	$ 7,793	$ 27,360	$ -	$ 30,416	1.1
Boiler Replacement + EEMs 1-5	16	121,306	7,409	$ 24,197	$ 7,154	$ 3,991	$ 31,351	$ -	$ 30,416	1.0
Sheriff's Building Off + EEMs 1-6	53	198,753	9,354	$ 44,966	$ 9,032	$ 22,647	$ 53,998	$ -	$ 30,416	0.6

*Note 1: Total annual savings and implementation costs are cumulative.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.8.2 EEM 1. HVAC System Start/Stop

This measure modified the operating schedule for DD-3 and the Multi-Zone Unit to a Monday through Friday operation (5:00am to 7:00 pm). DD-2 and the central plant would remain operating between 5:00am and 8:00pm Monday through Saturday, to match the Library schedule (listed as 8:00am to 8:00 pm). The HVAC system maintained the following schedule prior to implementation:

- Chilled water system operated 5:00am to 8:00 pm, Monday through Saturday with a 60°F OAT lockout.
- Hot water system operated 5:00am to 8:00 pm, Monday through Saturday with a 70°F OAT lockout.
- Based on trend data, MZ-1, DD-2, and DD-3 operated 5:00am to 8:00pm Monday through Saturday.

Measure Modeling Estimation Changes

The design heating temperature for the boiler was decreased from 175 F to 155 F, but this is not described in EEM1.

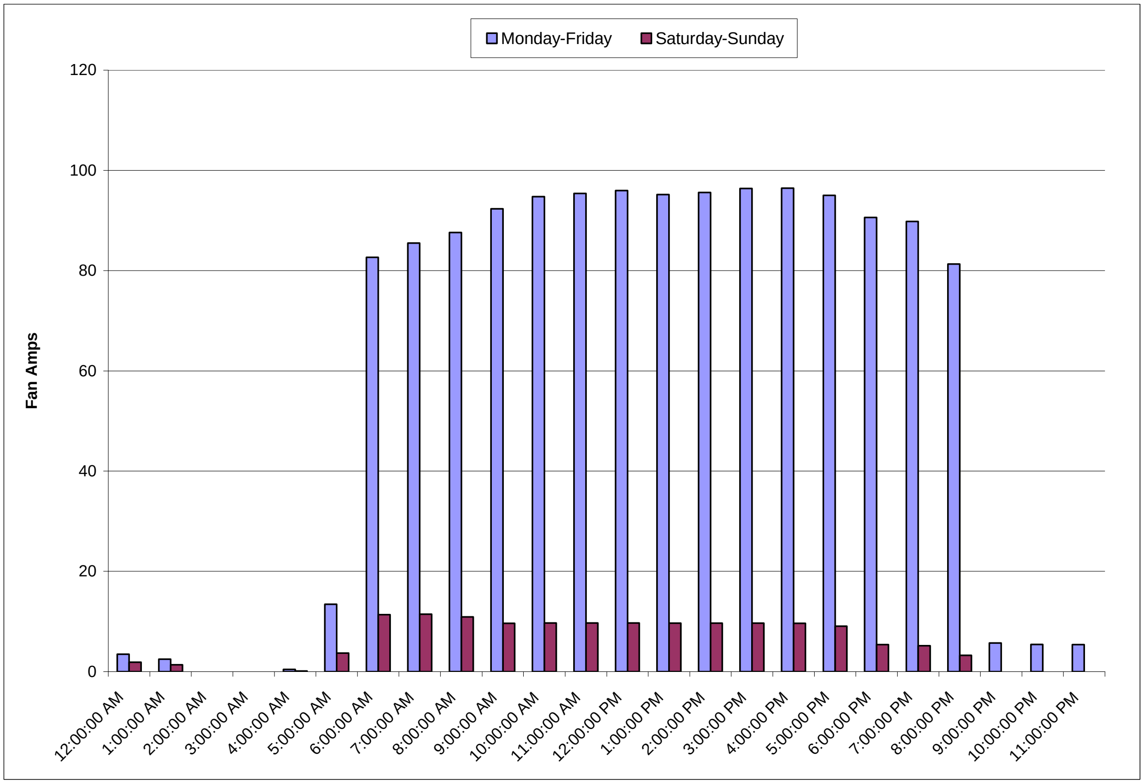
Baseline	**EEM1**
HW/DHW Loop = CIRCULATION-LOOP	HW/DHW Loop = CIRCULATION-LOOP
TYPE = DHW	TYPE = DHW
LOOP-DESIGN-DT = 40	LOOP-DESIGN-DT = 40
LOOP-RECIRC-FLOW = 160	LOOP-RECIRC-FLOW = 160
DESIGN-HEAT-T = 175	**DESIGN-HEAT-T = 155**
LOOP-PUMP = "HW Loop Pump"	LOOP-PUMP = "HW Loop Pump"
SUPPLY-UA = 260	SUPPLY-UA = 260
LOOP-LOCN = UNDERGROUND	LOOP-LOCN = UNDERGROUND

ASSIGN-LOSSES-TO = SPACE-HEAT/COOL	ASSIGN-LOSSES-TO = SPACE-HEAT/COOL
PROCESS-FLOW = (0.06)	PROCESS-FLOW = (0.06)
PROCESS-SCH = ("DHW Schedule - Year")	PROCESS-SCH = ("DHW Schedule - Year")
Baseline	**EEM1**
Fan DD-3 MZ-1 Wk = WEEK-SCHEDULE-PD	EEM 1 Fan DD-3 MZ-1 Wk = WEEK-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
DAY-SCHEDULES = ("Fan 5am to 8pm", &D, &D, &D, &D, "Fan 5am to 8pm",	**DAY-SCHEDULES = ("EEM 1 Fan DD-3 MZ-1 Day", &D, &D, &D, &D,**
"Fan Off Day")	**"EEM 1 Fan DD-3 MZ-1 WEH")**
Weekday and Saturday	**Weekday**
Fan 5am to 8pm = DAY-SCHEDULE-PD	EEM 1 Fan DD-3 MZ-1 Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,**
&D, &D, &D, &D, &D, &D, 0)	**&D, &D, &D, &D, &D, 1, 0)**
Sunday	**Weekend**
Fan Off Day = DAY-SCHEDULE-PD	EEM 1 Fan DD-3 MZ-1 WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG	TYPE = ON/OFF/FLAG
VALUES = (0)	VALUES = (0)

Verification

Fan operating hours were verified as Monday through Friday 5am to 8pm and no operating hours on the weekend, as shown in Figure 42.

Figure 42: Malibu Courthouse Fan Operating Hours



1.8.3 EEM 3. Hot Deck Temperature Reset

This measure implemented an AHU hot deck/cold deck reset control strategy. The energy savings benefits for this particular EEM significantly reduces the waste energy contributed to simultaneous heating and cooling, which can equate to more energy usage on constant volume systems (versus VAV systems). Also, resetting hot deck and cold decks together, reduces artificial loads on the building, which otherwise results in the heating and cooling systems "fighting each other." The implemented reset schedules are shown in Table 43.

Table 43: Malibu Courthouse AHU Reset Schedule

Cold Deck Temperature	Return Air Temperature
55°F	76°F
60°F	71°F
Hot Deck Temperature	**Outside Air Temperature**
100°F	50°F
75°F	75°F

Measure Modeling Estimation Changes

The baseline conditions are not described by EEM 3. Maximum supply temperature is 100 F and heat control is constant for all AHUs

The minimum supply temperature in the baseline case is 51 F for DD-2, 62 F for DD-3, and 60 F for MZ-1.

Minimum supply temperature is set to 58 F and reset temperature is set to 61 in EEM 3.

The HD Reset schedule should be named EEM 3, not EEM-4.

The HD Reset high limit temperature is modeled as 105 F, not 100 F as described by EEM 3.

DD-2 East CH/L	
Baseline	**EEM3**
DD-2 East CH/L = SYSTEM	DD-2 East CH/L = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = DHW-LOOP	HEAT-SOURCE = DHW-LOOP
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 100	MAX-SUPPLY-T = 100
HEATING-SCHEDULE = "AHU Heating Sch - Year"	**HEATING-SCHEDULE = "EEM 3 - Blr LO Sch"**
	HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"
HEAT-CONTROL = CONSTANT	**HEAT-CONTROL = RESET**
MIN-SUPPLY-T = 51	**MIN-SUPPLY-T = 58**
	COOL-CONTROL = WARMEST
	COOL-MAX-RESET-T = 61
SUPPLY-FLOW = 25350	SUPPLY-FLOW = 25350
RETURN-FLOW = 13000	RETURN-FLOW = 13000
MIN-OUTSIDE-AIR = 0.46	MIN-OUTSIDE-AIR = 0.46
OA-CONTROL = FIXED	OA-CONTROL = FIXED
FAN-SCHEDULE = "Fan DD-2"	FAN-SCHEDULE = "Fan DD-2"
FAN-CONTROL = FAN-EIR-FPLR	FAN-CONTROL = FAN-EIR-FPLR
DD-3 West CH	
Baseline	**EEM3**
DD-3 West CH = SYSTEM	DD-3 West CH = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = DHW-LOOP	HEAT-SOURCE = DHW-LOOP
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 100	MAX-SUPPLY-T = 100
HEATING-SCHEDULE = "AHU Heating	**HEATING-SCHEDULE = "EEM 3 - Blr**

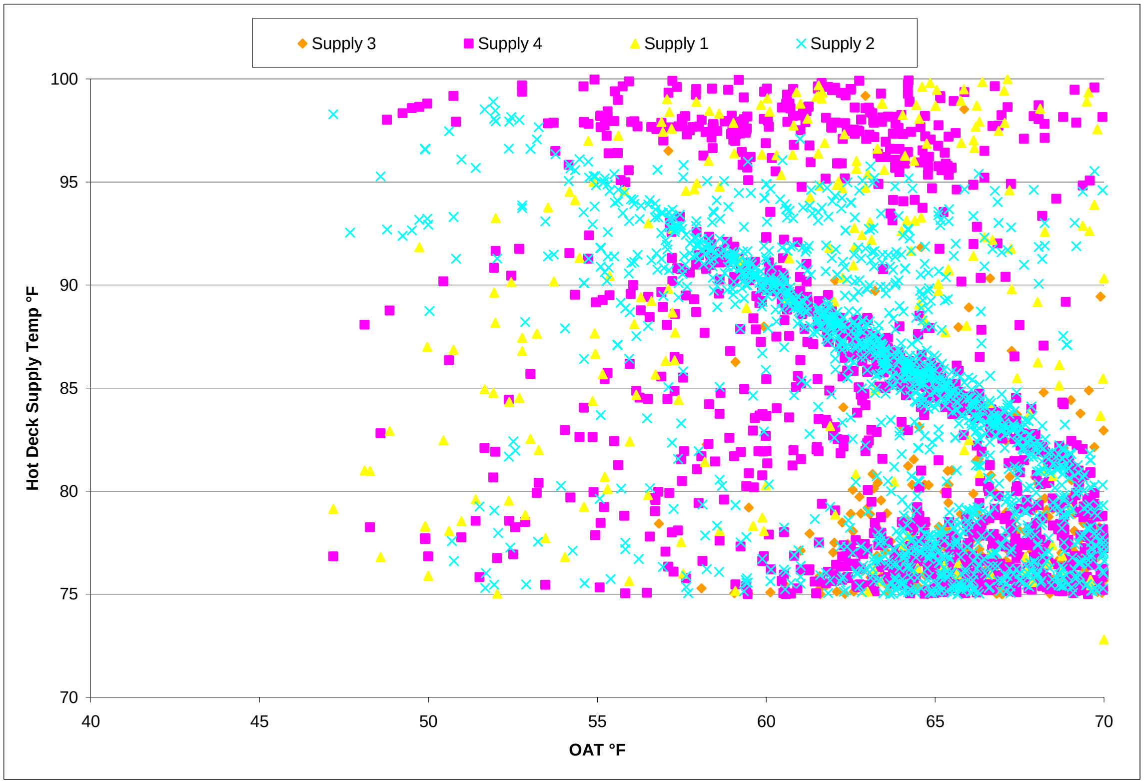
Sch - Year"	**LO Sch"**
	HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"
	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 62	**MIN-SUPPLY-T = 58**
	COOL-CONTROL = WARMEST
	COOL-MAX-RESET-T = 61
SUPPLY-FLOW = 25350	SUPPLY-FLOW = 25350
RETURN-FLOW = 9570	RETURN-FLOW = 9570
MIN-OUTSIDE-AIR = 0.41	MIN-OUTSIDE-AIR = 0.41
OA-CONTROL = FIXED	OA-CONTROL = FIXED
FAN-SCHEDULE = "EEM 1 Fan DD-3 MZ-1"	FAN-SCHEDULE = "EEM 1 Fan DD-3 MZ-1"
FAN-CONTROL = FAN-EIR-FPLR	FAN-CONTROL = FAN-EIR-FPLR
MZ-1	
Baseline	**EEM3**
MZ-1 = SYSTEM	MZ-1 = SYSTEM
TYPE = MZS	TYPE = MZS
HEAT-SOURCE = DHW-LOOP	HEAT-SOURCE = DHW-LOOP
MAX-SUPPLY-T = 100	MAX-SUPPLY-T = 100
HEATING-SCHEDULE = "AHU Heating Sch - Year"	**HEATING-SCHEDULE = "EEM 3 - Blr LO Sch"**
	HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"
	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 60	**MIN-SUPPLY-T = 58**
	COOL-CONTROL = WARMEST
	COOL-MAX-RESET-T = 61
SUPPLY-FLOW = 4850	SUPPLY-FLOW = 4850
RETURN-FLOW = 3250	RETURN-FLOW = 3250
MIN-OUTSIDE-AIR = 0	MIN-OUTSIDE-AIR = 0
OA-CONTROL = FIXED	OA-CONTROL = FIXED
FAN-SCHEDULE = "EEM 1 Fan DD-3 MZ-1"	FAN-SCHEDULE = "EEM 1 Fan DD-3 MZ-1"

HD Reset Sch - Day = DAY-SCHEDULE-PD
TYPE = RESET-TEMP
OUTSIDE-HI = 75
OUTSIDE-LO = 50
SUPPLY-HI = 105
SUPPLY-LO = 75

Verification

Hot Deck (HD) Reset appears to be working as HD temperature trends inversely with OAT. Figure 43 shows the data. Although the noise has not been filtered out, the general trend is visible.

Figure 43: Malibu Courthouse HD Temperature Reset Verification



1.8.4 EEM 4. Outside Air Economizer

This measure upgraded the economizer dampers on DD-2 and DD-3 in order to implement an optimized outside air economizer control sequence based on DDC control. The measure also added a mixed air sensor for DD-2 and DD-3. The economizer control sequence was modified to maintain the mixed air temperature set point whenever the outside air is less than the return air temperature.

This strategy also included outside air enthalpy lockout control. The economizer is controlled based on outside air temperature until an enthalpy set point is reached, at which time the economizer dampers are set to minimum position. The mixed air temperature set point is also adjusted based on a 2°F differential from the cold deck (accounting for supply fan motor heat gain).

Measure Modeling Estimation Changes

The baseline conditions are not described in EEM 4.

The minimum outside air ratios in the base case are modeled as 0.46 for DD-2, 0.4 for DD-3 and 0 for MZ-1. The minimum outside air ratio for EEM 4 is modeled as 0.2 for all systems.

DD-2 East CH/L	
Baseline	**EEM4**
DD-2 East CH/L = SYSTEM	DD-2 East CH/L = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = DHW-LOOP	HEAT-SOURCE = DHW-LOOP

BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 100	MAX-SUPPLY-T = 100
HEATING-SCHEDULE = "EEM 3 - Blr LO Sch"	HEATING-SCHEDULE = "EEM 3 - Blr LO Sch"
HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"	HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 58	MIN-SUPPLY-T = 58
COOL-CONTROL = WARMEST	COOL-CONTROL = WARMEST
	ECONO-LIMIT-T = 72
	ENTHALPY-LIMIT = 30
	ECONO-LOW-LIMIT = 57
COOL-MAX-RESET-T = 61	COOL-MAX-RESET-T = 61
SUPPLY-FLOW = 25350	SUPPLY-FLOW = 25350
RETURN-FLOW = 13000	RETURN-FLOW = 13000
MIN-OUTSIDE-AIR = 0.46	**MIN-OUTSIDE-AIR = 0.2**
OA-CONTROL = FIXED	**OA-CONTROL = OA-ENTHALPY**

DD-3 West CH	
Baseline	**EEM4**
DD-3 West CH = SYSTEM	DD-3 West CH = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = DHW-LOOP	HEAT-SOURCE = DHW-LOOP
BASEBOARD-SOURCE = NONE	BASEBOARD-SOURCE = NONE
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 100	MAX-SUPPLY-T = 100
HEATING-SCHEDULE = "EEM 3 - Blr LO Sch"	HEATING-SCHEDULE = "EEM 3 - Blr LO Sch"
HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"	HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 58	MIN-SUPPLY-T = 58
COOL-CONTROL = WARMEST	COOL-CONTROL = WARMEST
	ECONO-LIMIT-T = 72
	ENTHALPY-LIMIT = 30
	ECONO-LOW-LIMIT = 57
COOL-MAX-RESET-T = 61	COOL-MAX-RESET-T = 61
SUPPLY-FLOW = 25350	SUPPLY-FLOW = 25350
RETURN-FLOW = 9570	RETURN-FLOW = 9570
MIN-OUTSIDE-AIR = 0.41	**MIN-OUTSIDE-AIR = 0.2**
OA-CONTROL = FIXED	**OA-CONTROL = OA-ENTHALPY**

MZ-1	
Baseline	**EEM4**

MZ-1 = SYSTEM	MZ-1 = SYSTEM
TYPE = MZS	TYPE = MZS
HEAT-SOURCE = DHW-LOOP	HEAT-SOURCE = DHW-LOOP
MAX-SUPPLY-T = 100	MAX-SUPPLY-T = 100
HEATING-SCHEDULE = "EEM 3 - Blr LO Sch"	HEATING-SCHEDULE = "EEM 3 - Blr LO Sch"
HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"	HEAT-RESET-SCH = "EEM-4 HD Reset Sch - Year"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 58	MIN-SUPPLY-T = 58
COOL-CONTROL = WARMEST	COOL-CONTROL = WARMEST
	ECONO-LIMIT-T = 72
	ENTHALPY-LIMIT = 30
	ECONO-LOW-LIMIT = 57
COOL-MAX-RESET-T = 61	COOL-MAX-RESET-T = 61
SUPPLY-FLOW = 4850	SUPPLY-FLOW = 4850
RETURN-FLOW = 3250	RETURN-FLOW = 3250
MIN-OUTSIDE-AIR = 0	**MIN-OUTSIDE-AIR = 0.2**
OA-CONTROL = FIXED	**OA-CONTROL = OA-ENTHALPY**

Verification

The economizer could not be verified directly since mixed air temperature data are not available for this site. The measure is assumed to function as modeled for the evaluation model.

1.8.5 EEM 5. Condenser Water Supply Temperature

This measure reduced the condenser water supply temperature set point to 70°F. Based on a review of trend data and point to point testing results, the VFD was modulating to maintain a set point of 82°F. Energy savings will result from a lower condenser water temperature, which will result in improved chiller efficiency.

Measure Modeling Estimation Changes

Baseline	**EEM5**
Condenser Water Loop = CIRCULATION-LOOP	Condenser Water Loop = CIRCULATION-LOOP
TYPE = CW	TYPE = CW
LOOP-OPERATION = STANDBY	LOOP-OPERATION = STANDBY
DESIGN-COOL-T = 82	DESIGN-COOL-T = 82
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
COOL-SETPT-T = 82	**COOL-SETPT-T = 70**
LOOP-PUMP = "CW Loop Pump"	LOOP-PUMP = "CW Loop Pump"

Verification

The condenser water supply temperature could not be verified with available building data. It was assumed operational for evaluation model.

1.8.6 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. Discrepancies were noted between actual building pre implementation data collected between 1/1/2005 and 5/31/2005. Therefore, a modified baseline model was created using operational schedules from the pre implementation data. The changes to the schedules are shown in Table 44.

Table 44: Malibu Courthouse Baseline Hour Comparison

	Baseline WD	Baseline WE	Modified BL WD	Modified BL WE
Fans	5AM-8PM	Off	5AM-8PM	5AM-8PM
Chiller	5AM-8PM	Off	5AM-8PM	5AM-8PM
Boiler	Continuous*	Continuous	5AM-8PM	5AM-8PM

* Had multiple schedules

The analysis of the actual fan, chiller, and boiler data are shown in Figure 44, Figure 45 and Figure 46.

Figure 44: Malibu Courthouse Fan Baseline Schedule

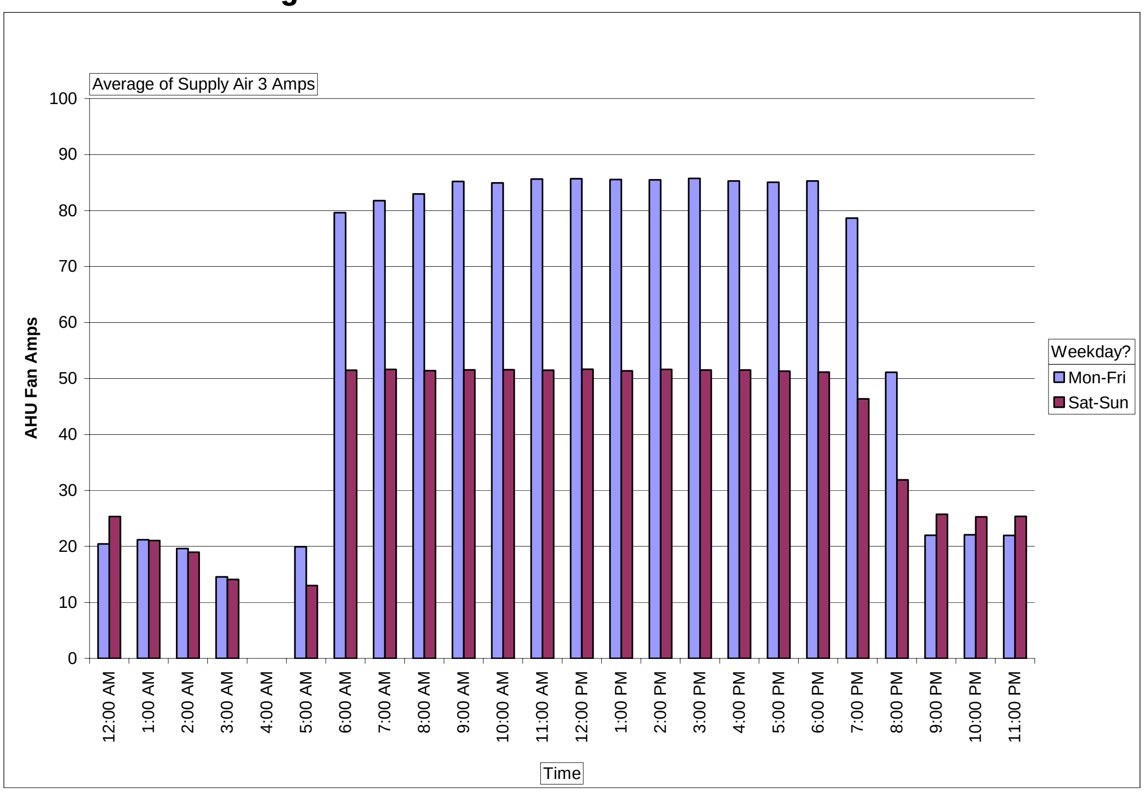


Figure 45: Malibu Courthouse Hot Water Baseline Schedule

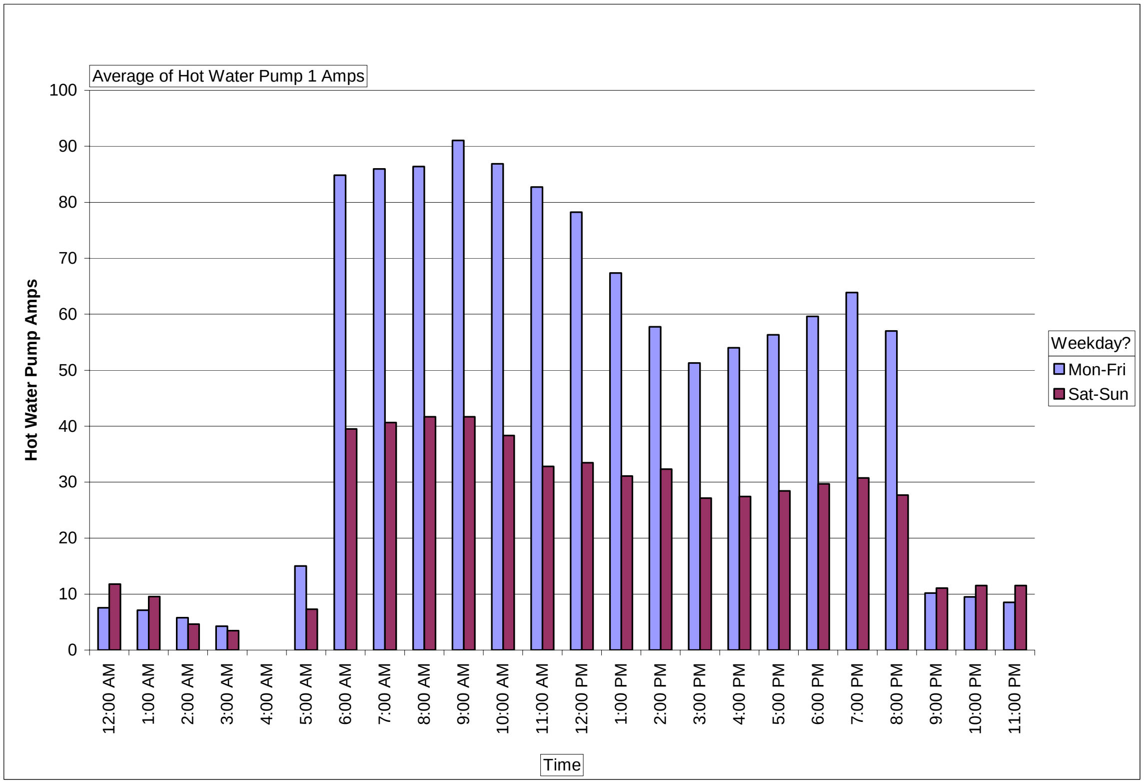
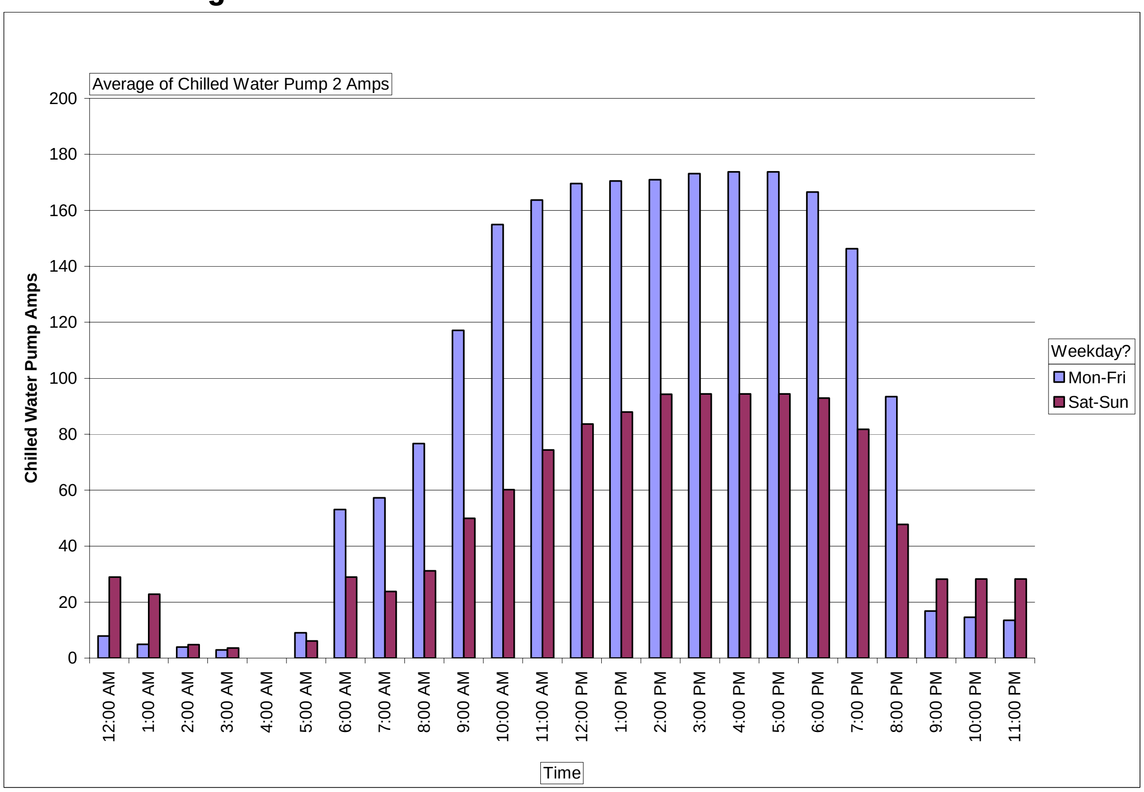


Figure 46: Malibu Courthouse Chilled Water Baseline Schedule



Baseline Chiller Schedule - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, &D, 61, &D, &D, 61, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, 0)
Modified Baseline Chiller Schedule - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, &D, **1**, &D, &D, **1**, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, 0)

1.8.7 Malibu Courthouse Evaluation Summary

The table shows the status of the implemented measures in the evaluation model.

Table 45: Malibu Courthouse EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
DAT Reset	3	Not adjusted
OA Economizer	4	Not adjusted
CT Controls	5	Not adjusted

The high realization rates seen below are mostly due to increased baseline hours of operation.

Table 46: Malibu Courthouse Savings Summary

Malibu Courthouse	kWh	kW	Therms
Modified Baseline Usage	997,017	270	44,008
Evaluation Usage	822,193	264	33,837
Ex-Post Savings	174,824	6	10,171
Ex-Ante Savings	198,753	53	9,354
Realization Rate	88%	10%	109%

The program ex-ante estimates were overestimated due to two sources. According to the RCx site report, the boiler retrofit savings were attributed to another program and should have been excluded from the ex ante estimate. Additionally, a building served by Malibu Courthouse central plant, the Sheriff's building, was condemned. The load for this building was included in the baseline model, but building was removed from the model for the run call Sheriff's Building Off +EEM 1-6 in Table 42. Effectively, the Program ex ante savings claimed the reduced load from shutting down the building as program savings. The realization rate for this site would have been over 100% if these savings had not been claimed.

1.9 Santa Monica Courthouse

1.9.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 47 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 47: Santa Monica Courthouse Savings

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implemen-tation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 - Chlr Blr AHU S/S	(14)	218,851	19,808	$ 31,995	$ 18,250	$ 50,245	$ 50,245	$ 5,402	$ 5,402	0.1
EEM #2 - AHU Hot Deck Reset Sequence	(14)	222,264	20,613	$ 32,668	$ 19,027	$ 1,450	$ 51,695	$ 9,580	$ 14,982	0.3
EEM #3b - OA Econ DB/Enth + EEM 2	(14)	224,895	22,351	$ 33,562	$ 20,705	$ 2,572	$ 54,267	$ 13,266	$ 28,248	0.5
EEM #4 - Clg Twr Cntrls Mod. + EEMs 1-3b	(14)	267,108	22,397	$ 43,544	$ 20,749	$ 10,026	$ 64,293	$ -	$ 28,248	0.4

*Note 1: Total annual savings and implementation costs are cumulative. An additional implementation cost of **$17,756** was approved for repair of 17 mixing boxes for EEM 5.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.9.2 EEM 1. HVAC Start/Stop Schedules and VFD Control

This EEM reduced the operating schedule for cooling and heating plant equipment, and air handling unit (AHU) fans. The system schedules were modified from the following baseline operation:

- *Chilled water system operated continuously with a 55°F OAT lockout during occupied periods, and a 65°F OAT lockout during unoccupied hours. The schedule was modified to operate the chiller plant on a schedule from 5am to 7 pm, with a chiller outside air lockout temperature of 60°F.*
- *The heating water system operated continuously. The schedule was modified during implementation to operate the heating water plant from 5am to 7 pm.*
- *Based on trend data, the AHU fans and cooling system ran continuously. The original control sequence also controlled AHU duct static pressure based on an active/inactive deck control strategy. The sequence was simplified to control fan speeds and static dampers to a dedicated duct static pressure set point. The fans were set to run from 5am to 7 pm.*

There were also 2 VFDs that were not operating in automatic mode. VFD operation for SF-3 and RF-4 was addressed in Teletrol software and the VFDs were restored to automatic mode.

Measure Modeling Estimation Changes

The EEM1 model turns off the chiller, boiler, and fans on weekends.

The baseline chiller lockout temperature was modeled at 62 OAT, not 55 OAT occupied and 65 OAT unoccupied. 62 OAT is the measured lockout temperature after implementing EEM1.

The chiller design cooling temperature was increased 1 F in the model but not mentioned by the EEM.

Continuous chiller operation in the baseline case is modeled as a schedule of 4am to 10pm.

The boiler heat set point was set to 180 in EEM1 but not modeled in the baseline.

Continuous boiler operation in the baseline case is modeled as a schedule of 5am to 11pm.

All fans in the baseline case operate 24/7 except for system MZ. The baseline fan schedule for MZ is from 5am to 10pm.

Chiller

Baseline	**EEM 1**
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-OPERATION = SNAP	LOOP-OPERATION = SNAP
PUMP-SCHEDULE = "Chiller Schedule"	**PUMP-SCHEDULE = "EEM 1 - Chiller Sch"**
SNAP-T = 62	**SNAP-T = 60**
SNAP-LOCN = OUTDOOR	SNAP-LOCN = OUTDOOR
DESIGN-COOL-T = 45	**DESIGN-COOL-T = 46**
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
SUPPLY-UA = 50	SUPPLY-UA = 50
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 Core Zn (G.C42)"	LOOP-LOSS-ZONE = "EL1 Core Zn (G.C42)"

Weekday
Baseline Chiller on 4am to 10pm. EEM1 Chiller on 5am to 7pm
Weekend
Baseline Chiller on 4am to 10pm. EEM1 Chiller off 24 hours.

Baseline	**EEM 1**
Chiller Schedule - Day = DAY-SCHEDULE-PD	EEM 1 - Chiller Sch Day = DAY-SCHEDULE-PD
TYPE = ON/OFF	TYPE = ON/OFF
VALUES = (0, &D, &D, 0, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,	**VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,**
&D, &D, &D, &D, 1, 1, &D, &D, 0, 0)	**&D, &D, &D, &D, &D, 0)**
..	..
Chiller Schedule - Wknd Day = DAY-SCHEDULE-PD	EEM 1 - Chiller Sch WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF	TYPE = ON/OFF
VALUES = (0, &D, &D, 0, 1,	**VALUES = (0)**

&D, &D, &D, &D, &D, &D, &D, &D, &D,	
&D, &D, &D, &D, &D, &D, &D, &D, 0, 0)	

Boiler

Baseline	**EEM 1**
DHW/HW Loop = CIRCULATION-LOOP	DHW/HW Loop = CIRCULATION-LOOP
TYPE = DHW	TYPE = DHW
LOOP-DESIGN-DT = 30	LOOP-DESIGN-DT = 30
LOOP-RECIRC-FLOW = 110	LOOP-RECIRC-FLOW = 110
LOOP-OPERATION = SCHEDULED	LOOP-OPERATION = SCHEDULED
PUMP-SCHEDULE = "Boiler Heating Schedule"	PUMP-SCHEDULE = "Boiler Heating Schedule"
DESIGN-HEAT-T = 160	DESIGN-HEAT-T = 160
	HEAT-SETPT-T = 180
LOOP-PUMP = "HW Loop Pump"	LOOP-PUMP = "HW Loop Pump"
PROCESS-FLOW = (0.1)	PROCESS-FLOW = (0.1)
PROCESS-SCH = ("DHW Annual")	PROCESS-SCH = ("DHW Annual")

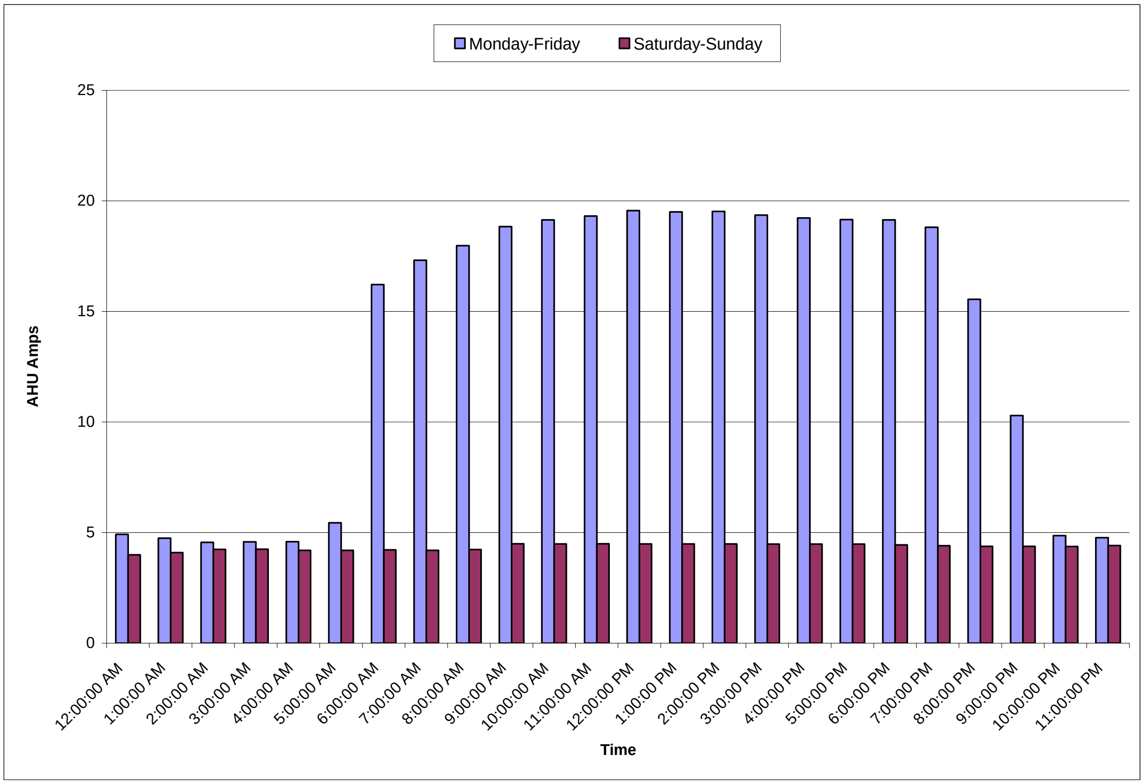
Weekday
Baseline Boiler on 5am to 11pm. EEM1 Boiler on 5am to 7pm
Weekend
Baseline Boiler on 5am to 11pm. EEM 1 Boiler off 24 hours
Note: baseline heating temp 72. EEM 1 has 75 instead of 1 in boiler on/off schedule
Fans

AHUs	
Weekday	
Baseline Fans on 24 hours.	EEM1 Fans on 5am to 7pm
Weekend	
Baseline Fans on 24 hours.	EEM 1 Fans off 24 hours
MZ (RTU)	
Weekday	
Baseline Fans on 5am to 10pm. EEM1 Fans on 5am to 7pm	
Weekend	
Baseline Fans off 24 hours. EEM1 Fans off 24 hours.	

Verification

The units were verified operating from 5am to 9pm Monday through Friday and not operating on the weekend. See Figure 47.

Figure 47: Santa Monica Courthouse Fan Operation Hours



Evaluation Model Changes

The fans, boilers, and chillers were modeled to operate from 5am to 9pm Monday through Friday and not operate on the weekends. Note that only the fan schedule code is inserted below, but the same schedule were applied to the boiler and chiller.

EEM 1 - Fan Sch Day = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, &D, 0)
EEM 1 - Fan Sch WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0)

1.9.3 EEM 2. Hot Deck / Cold Deck Reset

The existing control sequence was modified to automatically adjust the hot deck set point based on outside air temperature and the cold deck set points based on return air temperature. The reset schedule was set with the adjustable temperature set points shown in Table 48.

Table 48: Santa Monica Courthouse AHU Reset Schedule

RAT	CDT
74°F	55°F
70°F	60°F

OSA	HDT
55°F	105°F
70°F	77°F

Above 80°F OAT, the strategy also closes the hot deck damper. Resetting the hot deck temperatures will produce natural gas savings, and closing the hot deck damper will produce electrical savings from chiller and fan energy.

Measure Modeling Estimation Changes

EEM 2 does not describe the base conditions.

Outside air lower limit is modeled as 50 F, not 55 F as described by EEM 2.
Outside air upper limit is modeled as 65 F, not 70 F as described by EEM 2.

Baseline	**EEM 2**
HD Reset Day = DAY-SCHEDULE-PD	EEM 2 HD Reset Day = DAY-SCHEDULE-PD
TYPE = RESET-TEMP	TYPE = RESET-TEMP
OUTSIDE-HI = 72	**OUTSIDE-HI = 65**
OUTSIDE-LO = 50	OUTSIDE-LO = 50
SUPPLY-HI = 105	SUPPLY-HI = 105
SUPPLY-LO = 72	**SUPPLY-LO = 77**

Verification

The hot and cold deck temperatures appear to be resetting correctly as seen in Figure 48 and Figure 49.

Figure 48: Santa Monica Courthouse CD Reset Verification

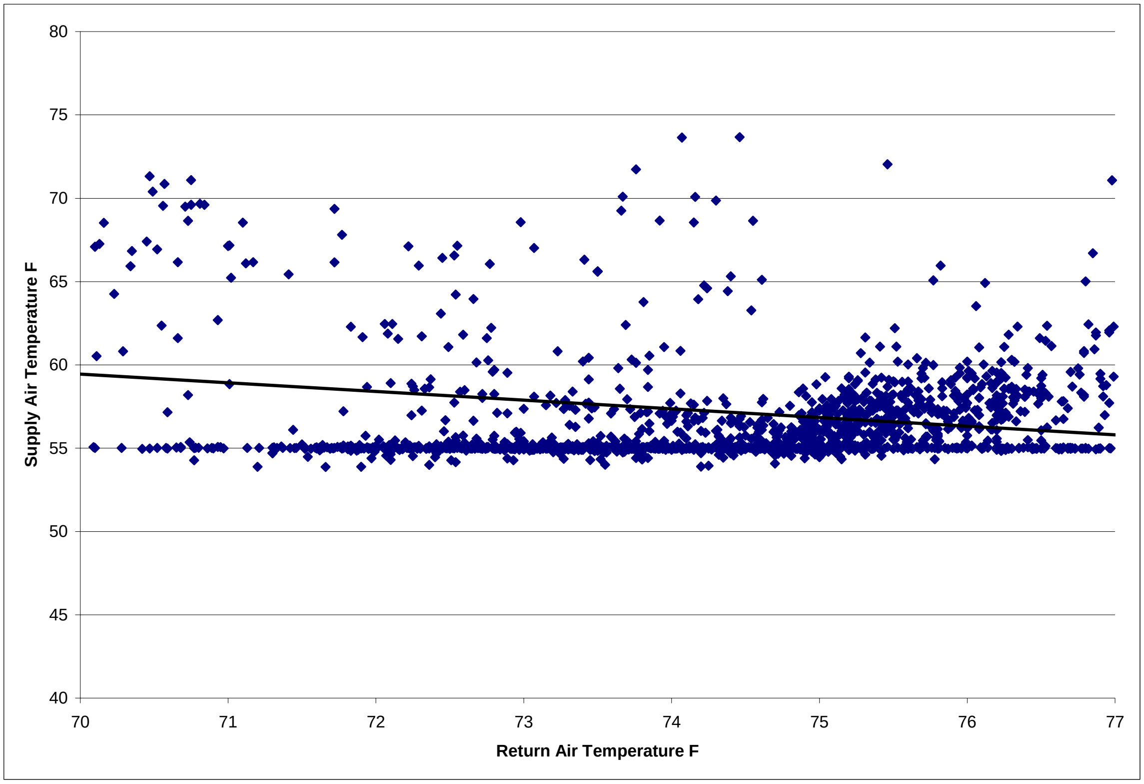
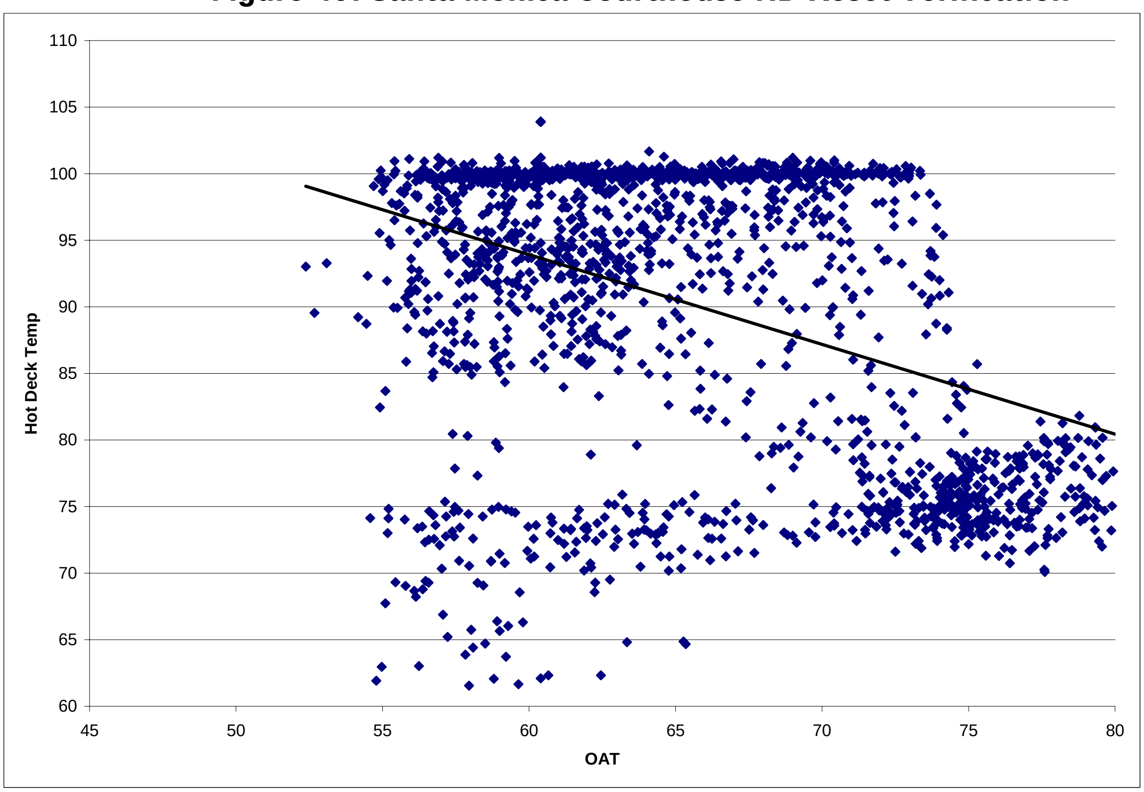


Figure 49: Santa Monica Courthouse HD Reset Verification



1.9.4 EEM 3. Outside Air Economizer

This measure modified the economizer damper control sequence for AHU-1, 2 and 3 in order to implement an optimized outside air economizer control sequence. The economizer control sequence was modified to maintain the mixed air temperature set point whenever the outside air is less than the return air temperature. This strategy also included outside air enthalpy lockout control. The economizer is controlled based on outside air temperature until an enthalpy set point is reached, at which time the economizer dampers are set to minimum position. The mixed air temperature set point is also adjusted based on a 3°F differential from the cold deck (accounting for supply fan motor heat gain).

Measure Modeling Estimation Changes

The baseline case is not described for each air handler

AHU1 is modeled as having no economizer in the base case. The base case is described as an inoperable outside air damper.

The supply and return flow for AHU 2 increased but is not described by EEM 2..

The minimum outside air ratio was adjusted from 0.6 to 0.23 for AHU-1 and from 0.1 to 0.16 for AHU 2 and AHU 3.

AHU 1	
Baseline	**EEM 3**
ECONO-LIMIT-T = 130	**ECONO-LIMIT-T = 75**
	ENTHALPY-LIMIT = 25
	ECONO-LOW-LIMIT = 55
SUPPLY-FLOW = 36572	SUPPLY-FLOW = 36572
RETURN-FLOW = 23724	RETURN-FLOW = 23724
MIN-OUTSIDE-AIR = 0.6	**MIN-OUTSIDE-AIR = 0.23**
OA-CONTROL = FIXED	**OA-CONTROL = OA-ENTHALPY**

AHU 2	
Baseline	**EEM 3**
ECONO-LIMIT-T = 65	**ECONO-LIMIT-T = 75**
	ENTHALPY-LIMIT = 25
	ECONO-LOW-LIMIT = 55
SUPPLY-FLOW = 20168	**SUPPLY-FLOW = 22699**
RETURN-FLOW = 18985	**RETURN-FLOW = 20600**
MIN-OUTSIDE-AIR = 0.1	**MIN-OUTSIDE-AIR = 0.16**
OA-CONTROL = OA-TEMP	**OA-CONTROL = OA-ENTHALPY**

AHU 3	
Baseline	**EEM 3**
ECONO-LIMIT-T = 65	**ECONO-LIMIT-T = 75**
	ENTHALPY-LIMIT = 25

	ECONO-LOW-LIMIT = 55
SUPPLY-FLOW = 22699	SUPPLY-FLOW = 22699
RETURN-FLOW = 20600	RETURN-FLOW = 20600
MIN-OUTSIDE-AIR = 0.2	**MIN-OUTSIDE-AIR = 0.16**
OA-CONTROL = OA-TEMP	**OA-CONTROL = OA-ENTHALPY**

Verification

The economizer operation can't be directly verified since mixed air temperature data is not available for this site. The economizer is assumed to function as modeled for the evaluation.

1.9.5 EEM 4. Condenser Water Temperature Adjustment

This measure recommends adjusting the condenser water temperature, which will result in additional chiller energy savings. The temperature is maintained at 85°F from the cooling towers. It was recommended to reduce the condenser tower to chiller water temperature to 75°F.

Measure Modeling Estimation Changes

The lockout temperature is set to 60°F OAT not 62°F OAT as described by the EEM.
The cooling set point was set to 70°F in EEM4 but not modeled in the baseline

The number of cells for the cooling tower was adjusted from 1 in the base case to 2 in EEM 4.

The fan was changed from one-speed in the base case to two-speed in EEM 4.

Baseline	EEM 4
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-OPERATION = SNAP	LOOP-OPERATION = SNAP
PUMP-SCHEDULE = "EEM 1 - Chiller Sch"	PUMP-SCHEDULE = "EEM 1 - Chiller Sch"
SNAP-T = 60	SNAP-T = 60
SNAP-LOCN = OUTDOOR	SNAP-LOCN = OUTDOOR
DESIGN-COOL-T = 46	DESIGN-COOL-T = 46
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
	COOL-SETPT-T = 70
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
SUPPLY-UA = 50	SUPPLY-UA = 50
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 Core Zn (G.C42)"	LOOP-LOSS-ZONE = "EL1 Core Zn (G.C42)"

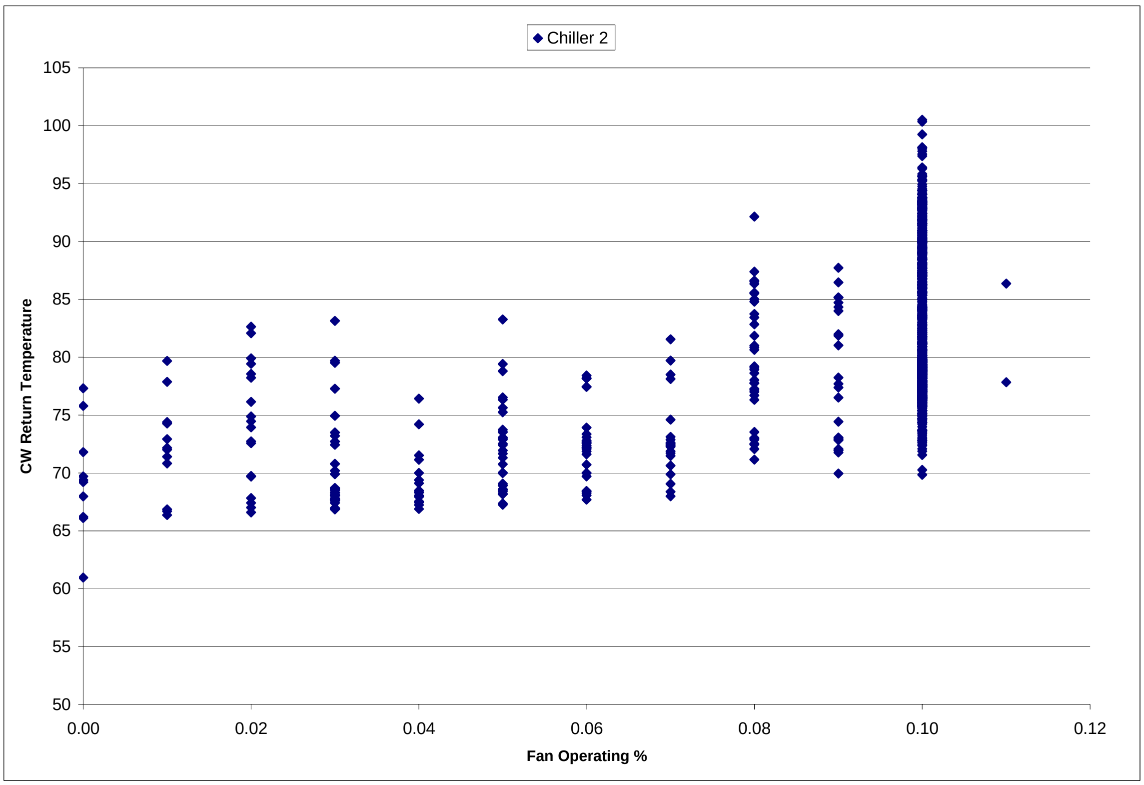
Baseline	EEM 4
Open Tower = HEAT-REJECTION	Open Tower = HEAT-REJECTION
TYPE = OPEN-TWR	TYPE = OPEN-TWR

CAPACITY = 2	CAPACITY = 2
CAPACITY-RATIO = 0.5	CAPACITY-RATIO = 0.5
NUMBER-OF-CELLS = 1	**NUMBER-OF-CELLS = 2**
FAN-KW/CELL = 3.26	FAN-KW/CELL = 3.26
CAPACITY-CTRL = ONE-SPEED-FAN	**CAPACITY-CTRL = TWO-SPEED-FAN**
DESIGN-WETBULB = 68	DESIGN-WETBULB = 68
CW-LOOP = "Condenser Water Loop"	CW-LOOP = "Condenser Water Loop"

Verification

The condenser water temperature has been verified in Figure 50. In general, when the condenser temperature is above the set point the fan is on.

Figure 50: Santa Monica Courthouse Condenser Water Verification



1.9.6 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. Discrepancies were noted between actual building pre implementation data collected between 1/1/2005 and 5/31/2005. Therefore, a modified baseline model was created using operational schedules from the pre implementation data. The changes to the schedules are shown in Table 49.

Table 49: Santa Monica Courthouse Baseline Hour Comparison

	Baseline WD	Baseline WE	Modified BL WD	Modified BL WE
Fans	Continuous	Continuous	5AM-7PM	Off
Chiller	4AM-10PM	4AM-10PM	4AM-10PM	Off
Boiler	5AM-11PM	5AM-11PM	Continuous	Continuous

The results of the actual fan, chiller, and boiler hours are shown in Figure 51, Figure 52 and Figure 53.

Figure 51: Santa Monica Courthouse Fan Baseline Schedule

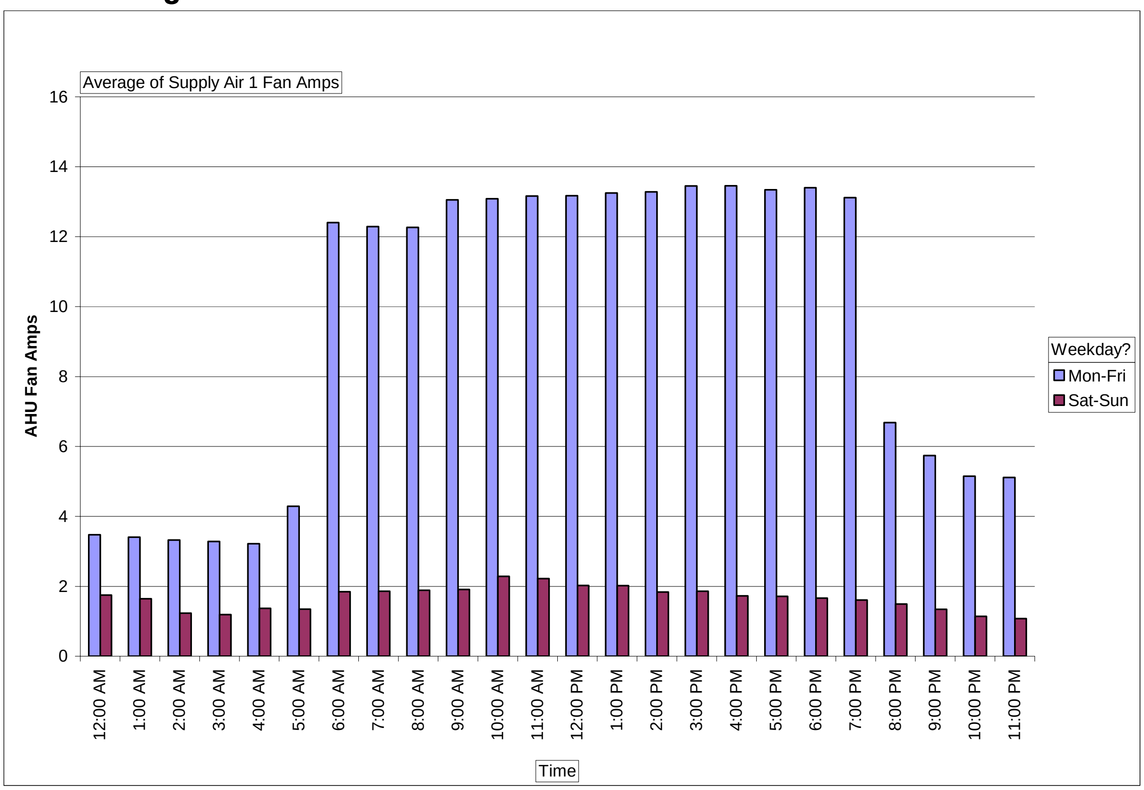


Figure 52: Santa Monica Courthouse Chiller Baseline Schedule

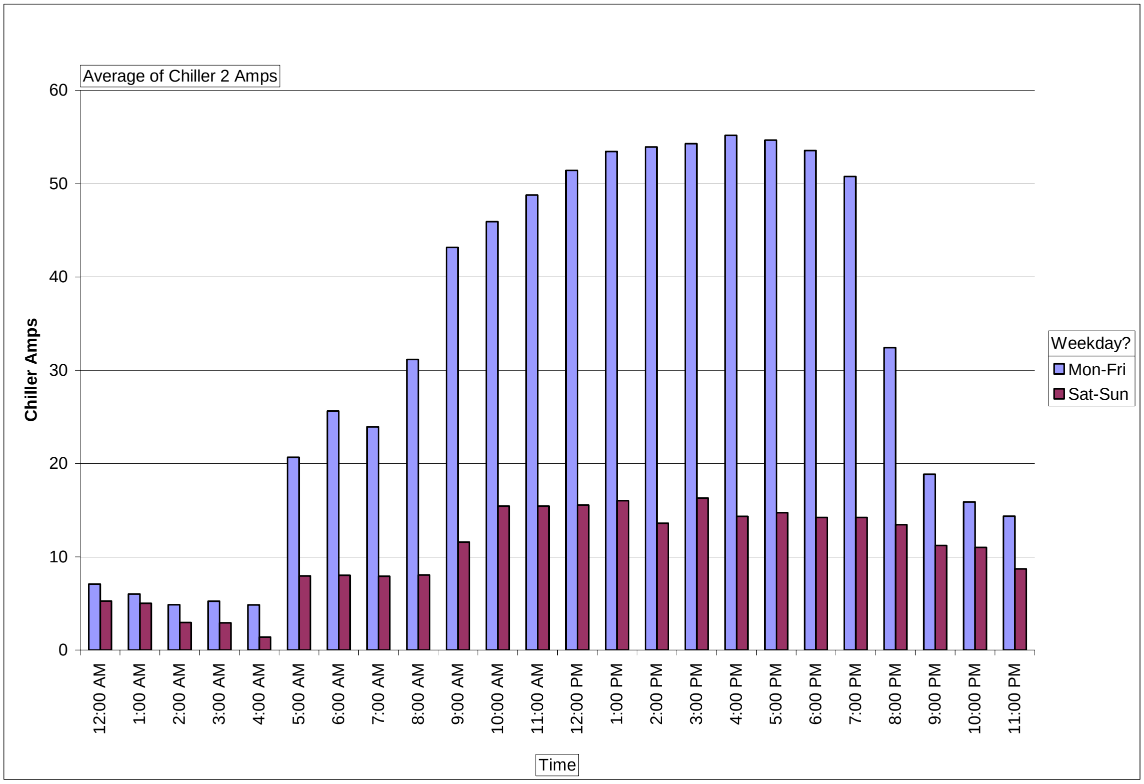
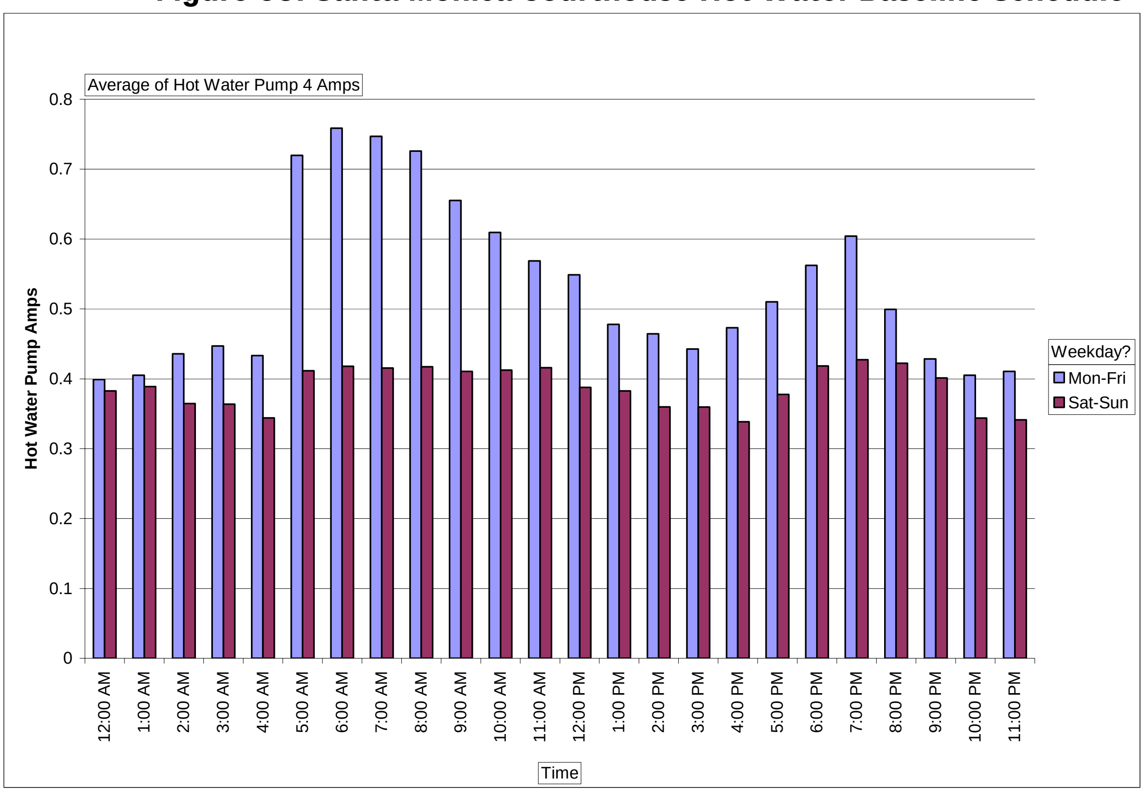


Figure 53: Santa Monica Courthouse Hot Water Baseline Schedule



In apparent attempt to calibrate the baseline model to monthly billing data, fan schedules were extensively manipulated throughout the year.

AHUs Fan - Year = SCHEDULE-PD
TYPE = ON/OFF
MONTH = (4, 6, 8, 9, 10, 12)
DAY = (30, 30, 31, 30, 31, 31)
WEEK-SCHEDULES = ("AHUs Fan - Week", "AHUs Fan May-Jun Wk",
"AHUs Fan - Week", "AHUs Fan Sep Wk", "AHUs Fan Oct Wk",
"AHUs Fan Nov-Dec Wk")

Seasonal and monthly changes are not typically seen in fan schedules, especially at a public building. The baseline schedules were modified to a consistent and reasonable schedule as indicated by the pre implementation data.

Baseline
AHUs Fan Oct M-F = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, 1, 1, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, 1, 1, 1, 1, 0, 0)
Modified Baseline
AHUs Fan Oct M-F = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, 0, 0, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, 1, 0)

Baseline
AHUs Fan Nov-Dec M-F = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, 1, 1, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, 1, 1, 1, 1, 0, 0)
Modified Baseline
AHUs Fan Nov-Dec M-F = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, 0, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, 1, 0)

Baseline
AHUs Fan Sep Sat = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0, &D, &D, &D, 0, 0, 0, 1, 1, &D, &D, &D, &D, &D, &D,
&D, 1, 0, 0, 0, &D, &D, 0, 0)
Modified Baseline
AHUs Fan Sep Sat = DAY-SCHEDULE-PD
TYPE = ON/OFF
VALUES = (0)

1.9.7 Santa Monica Courthouse Evaluation Summary

The table shows the status of the implemented measures in the evaluation model.

Table 50: Santa Monica Courthouse EEM Status

EEM	#	Evaluation Status
Scheduling	1	Adjusted
DAT Reset	2	Not adjusted
OA Economizer	3	Not adjusted
CT Controls	4	Not adjusted

The low realization rates are due to increased fan, heating, and cooling usage post implementation on weekends.

Table 51: Santa Monica Courthouse Savings Summary

Santa Monica Courthouse	kWh	kW	Therms
Modified Baseline Usage	1,184,544	338	31,155
Evaluation Usage	1,172,117	322	31,465
Ex-Post Savings	12,427	16	-310
Ex-Ante Savings	267,108	-14	22,397
Realization Rate	5%	-	-1%

1.10 Whittier Courthouse

1.10.1 Overview of Implemented Measures

During the RCx process, the baseline building operation was analyzed in detail and many recommendations were made to optimize HVAC system performance. During the prefunctional testing phase, several EEMs were recommended for implementation due to their favorable economic benefit to the County.

Table 52 below summarizes the actual cost and the expected energy savings based on the implementation of the approved EEMs.

Table 52: Whittier Courthouse Savings

EEMs	Peak Monthly Demand Savings	Electricity Savings	Natural Gas Savings	Total Electrical Savings	Total Natural Gas Savings	Indiv. EEM Annual Savings	Total Annual Savings*	Individual EEM Implementation Cost	Implemen-tation Costs*	SPB**
	kW	kWh	Therms	$	$	$/year	$/year	$	$	yrs
EEM #1 Chiller 2 Repair	13	7,050	-	$ 2,472	$ -	$ 2,472	$ 2,472	$ -	$ -	-
EEM #2 AHU/EF Blr Clr SS + EEM 1	10	407,317	5,854	$ 61,642	$ 5,385	$ 64,555	$ 67,027	$ -	$ -	-
EEM #3 CT Controls + EEMs 1-2	38	481,121	5,854	$ 81,041	$ 5,385	$ 19,399	$ 86,426	$ -	$ -	-
EEM #4 FCU Setpoint + EEMs 1-3	38	482,562	5,875	$ 81,371	$ 5,405	$ 350	$ 86,776	$ -	$ -	-
EEM #5 Boiler Tuneup + EEMs 1-4	38	482,562	7,739	$ 81,371	$ 7,205	$ 1,800	$ 88,576	$ -	$ -	-
EEM #6 DAT Resets + EEMs 1-5	68	543,947	16,146	$ 96,489	$ 15,323	$ 23,236	$ 111,812	$ 8,416	$ 8,416	0.1
EEM #7 OA Econ DB + EEMs 1-6	69	535,390	20,281	$ 94,416	$ 19,315	$ 1,919	$ 113,731	$ 7,764	$ 16,180	0.1

*Note 1: Total annual savings and implementation costs are cumulative. An implementation cost of **$5,916** was approved for repair of 5 mixing boxes for EEM 8.
**Note 2: Simple payback is calculated using the cumulative costs and savings.

1.10.2 EEM 2. HVAC System Start/Stop

This EEM recommended reducing the operating schedule for cooling and heating plant equipment to Monday through Friday, 5:00am to 7:00 pm, and the air handling unit (AHU) fans, and exhaust fans to operate between 5:00am to 8:00 pm.

Measure Estimation Modeling Changes

The fan, chilled water loop and hot water loop were scheduled to operate from 5am to 7pm Monday through Friday and not operate on the weekends.

Baseline	EEM 2
Chilled Water Loop = CIRCULATION-LOOP	Chilled Water Loop" = CIRCULATION-LOOP
TYPE = CHW	TYPE = CHW
LOOP-DESIGN-DT = 10	LOOP-DESIGN-DT = 10
LOOP-OPERATION = SNAP	LOOP-OPERATION = SNAP
COOLING-SCHEDULE = "CHW Loop Operation Sch"	**COOLING-SCHEDULE = "EEM 1 CHW Loop Sch"**
	PUMP-SCHEDULE = "EEM 1 CHW Loop Sch"
SNAP-T = 60	SNAP-T = 60
SNAP-LOCN = OUTDOOR	SNAP-LOCN = OUTDOOR
DESIGN-COOL-T = 45	DESIGN-COOL-T = 45
COOL-SETPT-CTRL = FIXED	COOL-SETPT-CTRL = FIXED
LOOP-PUMP = "CHW Loop Pump"	LOOP-PUMP = "CHW Loop Pump"
SUPPLY-UA = 100	SUPPLY-UA = 100

LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 South Perim Zn (B.S4)"	LOOP-LOSS-ZONE = "EL1 South Perim Zn (B.S4)"
Hot Water Loop = CIRCULATION-LOOP	Hot Water Loop = CIRCULATION-LOOP
TYPE = HW	TYPE = HW
LOOP-DESIGN-DT = 10	LOOP-DESIGN-DT = 10
LOOP-OPERATION = SCHEDULED	LOOP-OPERATION = SNAP
HEATING-SCHEDULE = "HW Loop Operation Sch"	HEATING-SCHEDULE = "HW Loop Operation Sch"
	PUMP-SCHEDULE = "EEM 1 HW Loop Sch"
	SNAP-T = 72
	SNAP-LOCN = OUTDOOR
DESIGN-HEAT-T = 160	DESIGN-HEAT-T = 160
HEAT-SETPT-CTRL = FIXED	HEAT-SETPT-CTRL = FIXED
LOOP-PUMP = "HW Loop Pump"	LOOP-PUMP = "HW Loop Pump"
SUPPLY-UA = 500	SUPPLY-UA = 500
LOOP-LOCN = ZONE	LOOP-LOCN = ZONE
LOOP-LOSS-ZONE = "EL1 South Perim Zn (B.S4)"	LOOP-LOSS-ZONE = "EL1 South Perim Zn (B.S4)"

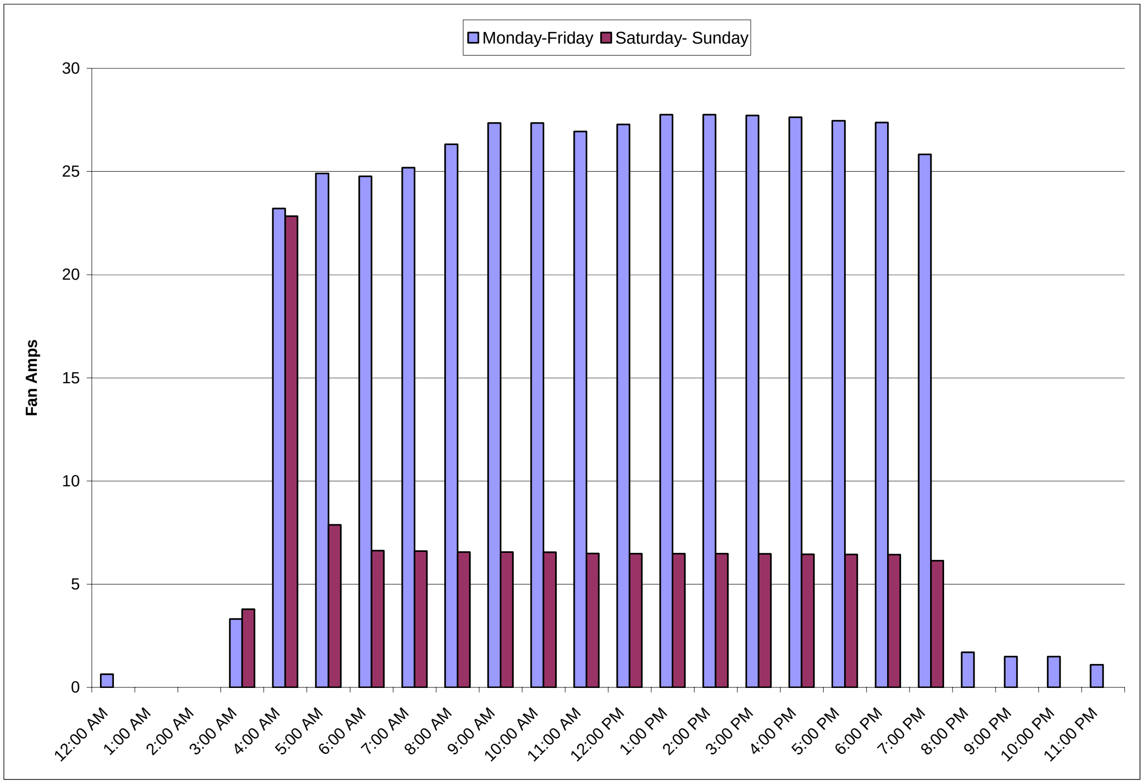
Schedule Changes applied to fans, HW loop and CHW loop:

EEM 1 Fan Sch - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 0)
..
EEM 1 Fan Sch - WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0)

Verification

The verified fan, CHW loop and HW loop hours were 3am to 7pm Monday through Friday and 3am-4am on Saturday and Sunday, as shown in Figure 54.

Figure 54: Whittier Courthouse Fan Operation Hours



Evaluation Model Changes

The fan, chilled water loop and hot water loop were modeled to operate from 3am to 7pm Monday through Friday and 3am-4am Saturday and Sunday, as proved in the verification section.

EEM 1 Fan Sch - Day = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, 1, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, 0)
..
EEM 1 Fan Sch - WEH = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = **(0, 0, 0, 1, 0)**

1.10.3 EEM 5. Boiler Tune-up

ACCO adjusted the boiler controls and performed a new flue gas analysis. The excess air quantity was reduced and the boiler efficiency was increased from 68.3% to 68.7% on Boiler 1 and 66.3% to 68.6% on Boiler 2.

Measure Modeling Estimation Changes

The boiler efficiencies were increased for the measure model.

Baseline	EEM5
Boiler1 (HWNatDrft) = BOILER	Boiler1 (HWNatDrft) = BOILER
TYPE = HW-BOILER	TYPE = HW-BOILER
CAPACITY = -2	CAPACITY = -2
HEAT-INPUT-RATIO = 1.41844	**HEAT-INPUT-RATIO = 1.3263**
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"
..	..
Boiler 2 = BOILER	Boiler 2 = BOILER
TYPE = HW-BOILER	TYPE = HW-BOILER
CAPACITY = -2	CAPACITY = -2
HEAT-INPUT-RATIO = 1.41844	**HEAT-INPUT-RATIO = 1.3736**
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"

Verification

The boiler tune-up could not be verified with available building data. It was assumed to be working as modeled above.

1.10.4 EEM 6. AHU Discharge Air Temperature (DAT) Reset Control Strategy

This EEM was implemented on AHU-3 only and recommends the cold deck reset be based on return air temperature and hot deck reset be based on outside air temperature. Currently, the discharge air temperature of both decks is maintained at a constant temperature. The hot deck control sequence would be modified according to the adjustable reset control strategy shown in Table 53.

Table 53: Whittier Courthouse AHU Hot Deck Reset Strategy

Outside Air Temp. (°F)	Design Hot Deck (°F)
50	100
75	75

Table 54 summarizes the cold deck reset strategy that was implemented.

Table 54: Whittier Courthouse AHU Cold Deck Reset Strategy

Return Air Temperature (°F)	Cold Duct Setpoint (°F)
76	55
71	60

Implementation involved installing E/P transducers and connecting the existing hot water and chilled water valves to the Teletrol system. This approach was recommended over pneumatic controls repair for better long term sustainability of savings and for remote monitoring purposes.

Measure Modeling Estimation Changes

The DAT reset models were changed as shown below.

Baseline	**EEM 6**
AHU-4" = SYSTEM	AHU-4 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 80	MAX-SUPPLY-T = 80
HEATING-SCHEDULE = "EEM 1 HW Loop Sch"	HEATING-SCHEDULE = "EEM 1 HW Loop Sch"
HEAT-CONTROL = CONSTANT	HEAT-CONTROL = CONSTANT
MIN-SUPPLY-T = 51	**MIN-SUPPLY-T = 59**
SUPPLY-FLOW = 15000	SUPPLY-FLOW = 15000
RETURN-FLOW = 11000	RETURN-FLOW = 11000
MIN-OUTSIDE-AIR = 0.4	MIN-OUTSIDE-AIR = 0.4
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP
MAX-OA-FRACTION = 0.8	MAX-OA-FRACTION = 0.8
AHU-3 = SYSTEM	AHU-3 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
HEATING-SCHEDULE = "EEM 1 HW Loop Sch"	HEATING-SCHEDULE = "EEM 1 HW Loop Sch"
	HEAT-RESET-SCH = "EEM 2 HD Reset Sch"
	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 51	**MIN-SUPPLY-T = 59**
COOL-CONTROL = CONSTANT	**COOL-CONTROL = WARMEST**
	COOL-MAX-RESET-T = 61
SUPPLY-FLOW = 64856	SUPPLY-FLOW = 64856
RETURN-FLOW = 51353	RETURN-FLOW = 51353
MIN-OUTSIDE-AIR = 0.05	MIN-OUTSIDE-AIR = 0.05
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP
MAX-OA-FRACTION = 0.4	MAX-OA-FRACTION = 0.4
AHU-2 = SYSTEM	AHU-2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
MIN-SUPPLY-T = 51	**MIN-SUPPLY-T = 59**
SUPPLY-FLOW = 5003	SUPPLY-FLOW = 5003
RETURN-FLOW = 3960	RETURN-FLOW = 3960

MIN-OUTSIDE-AIR = 0.2	MIN-OUTSIDE-AIR = 0.2
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP
MAX-OA-FRACTION = 0.4	MAX-OA-FRACTION = 0.4
AHU-1 = SYSTEM	AHU-1 = SYSTEM
TYPE = MZS	TYPE = MZS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
MAX-SUPPLY-T = 100	MAX-SUPPLY-T = 100
MIN-SUPPLY-T = 51	**MIN-SUPPLY-T = 59**
SUPPLY-FLOW = 5941	SUPPLY-FLOW = 5941
RETURN-FLOW = 4194	RETURN-FLOW = 4194
MIN-OUTSIDE-AIR = 0	MIN-OUTSIDE-AIR = 0
OA-CONTROL = FIXED	OA-CONTROL = FIXED
FAN-SCHEDULE = "EEM 1 Fan Schedule"	FAN-SCHEDULE = "EEM 1 Fan Schedule"
SUPPLY-KW/FLOW = 0.000663	SUPPLY-KW/FLOW = 0.000663
RETURN-KW/FLOW = 0.000388	RETURN-KW/FLOW = 0.000388
HW-LOOP = "Hot Water Loop"	HW-LOOP = "Hot Water Loop"
CHW-LOOP = "Chilled Water Loop"	CHW-LOOP = "Chilled Water Loop"

Verification

The hot and cold deck resets appear to be functioning properly as seen in Figure 55 and Figure 56. There is some noise in the graphs, but the downward trend can be seen which indicates the resets are working.

Figure 55: Whittier Courthouse Hot Deck Reset Verification

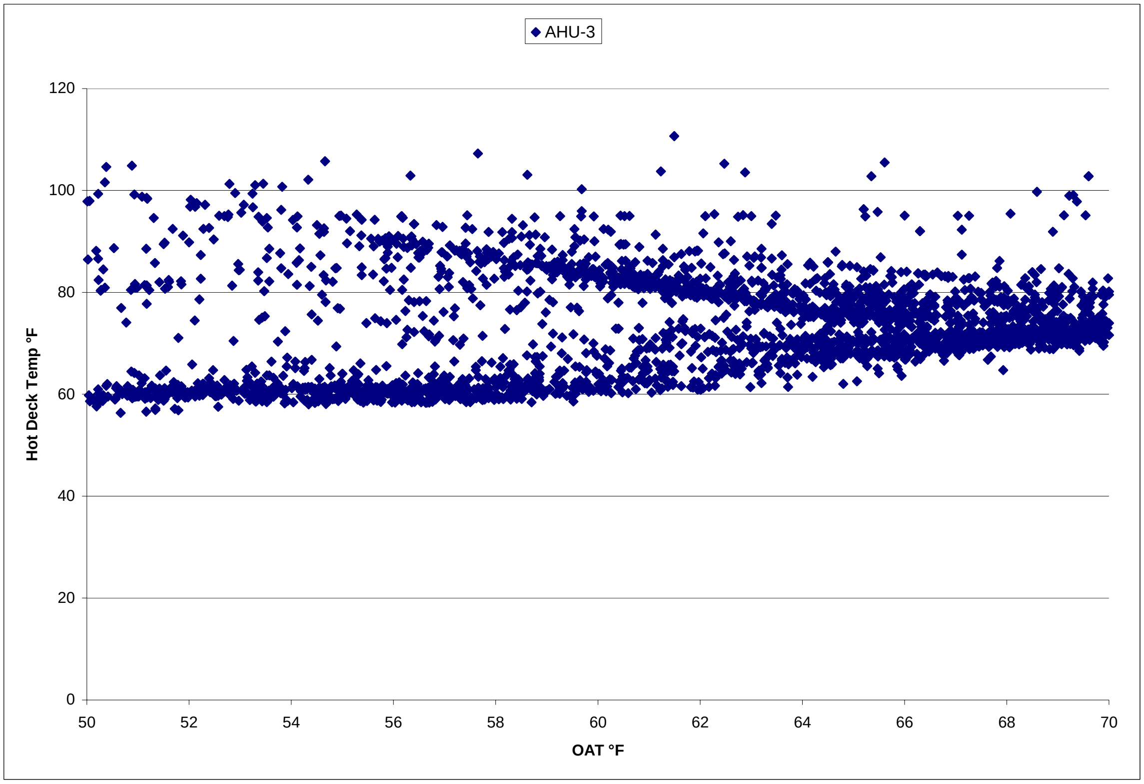
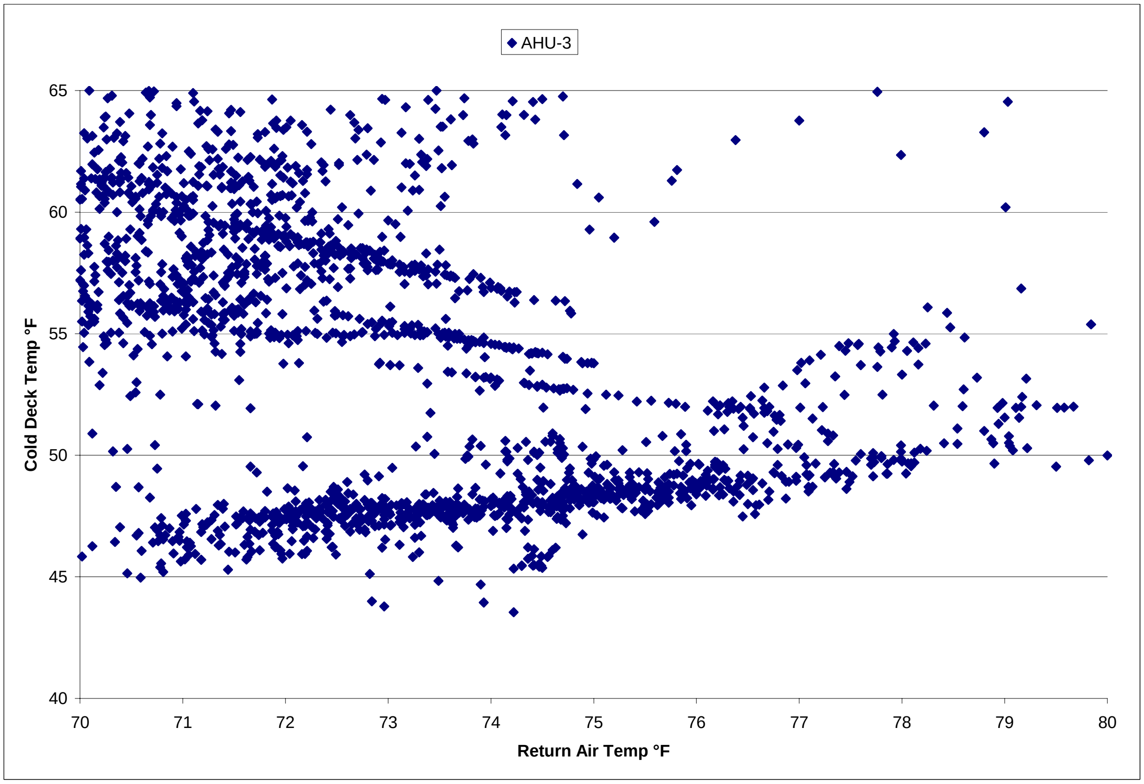


Figure 56: Whittier Courthouse Cold Deck Reset Verification



1.10.5 EEM 7. Outside Air Economizer Control (AHU-3 only)

This EEM recommended installing E/P transducers in order to interface the pneumatic economizer damper actuators to the Teletrol system. A new mixed air temperature sensor was also installed directly upstream of the chilled water coil to control the economizer dampers through Teletrol. The economizer control sequence was modified to maintain the mixed air temperature set point whenever the outside air was less than the return air temperature.

Measure Modeling Estimation Changes

The following modifications were made to account for the economizer.

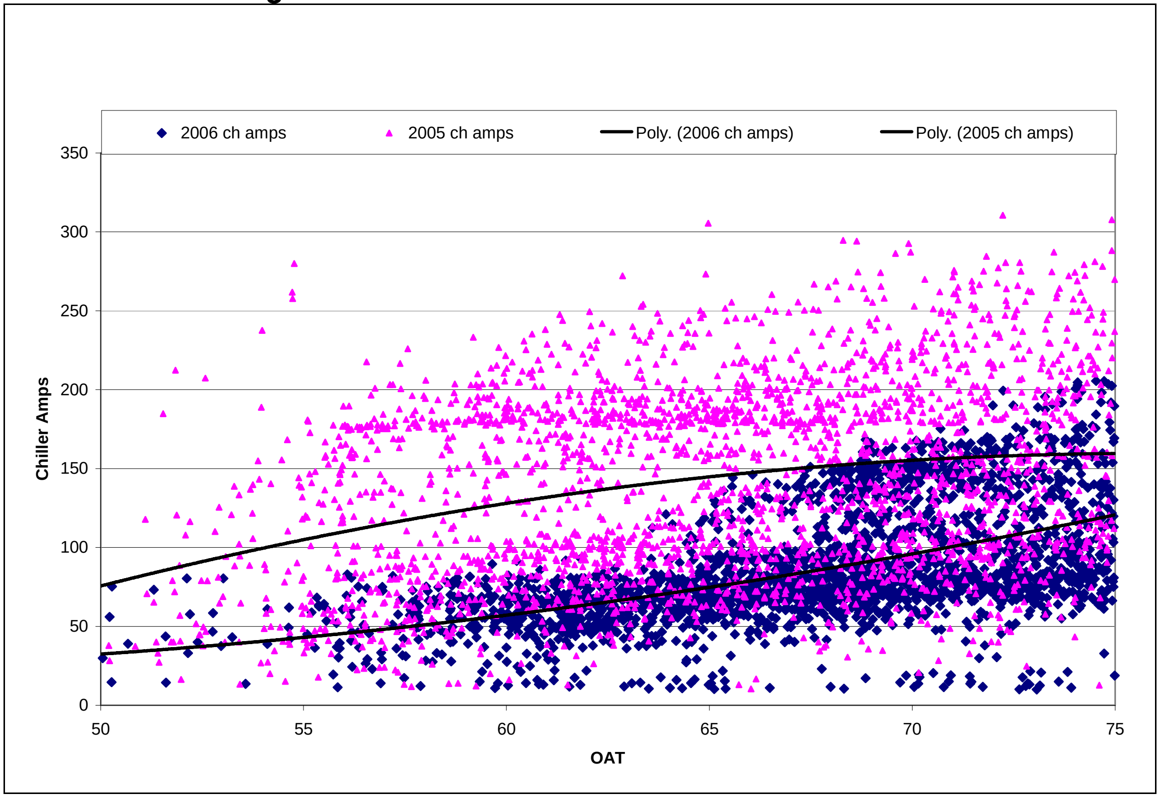
Baseline	EEM 7
AHU-4 = SYSTEM	AHU-4 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 80	MAX-SUPPLY-T = 80
HEATING-SCHEDULE = "EEM 1 HW Loop Sch"	HEATING-SCHEDULE = "EEM 1 HW Loop Sch"
HEAT-CONTROL = CONSTANT	HEAT-CONTROL = CONSTANT
MIN-SUPPLY-T = 59	MIN-SUPPLY-T = 59
	ECONO-LIMIT-T = 65
	ECONO-LOW-LIMIT = 57
SUPPLY-FLOW = 15000	SUPPLY-FLOW = 15000
RETURN-FLOW = 11000	RETURN-FLOW = 11000
MIN-OUTSIDE-AIR = 0.4	**MIN-OUTSIDE-AIR = 0**
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP
MAX-OA-FRACTION = 0.8	MAX-OA-FRACTION = 0.8
FAN-SCHEDULE = "EEM 1 Fan Schedule"	FAN-SCHEDULE = "EEM 1 Fan Schedule"
FAN-CONTROL = CONSTANT-VOLUME	FAN-CONTROL = CONSTANT-VOLUME
SUPPLY-KW/FLOW = 0.000877	SUPPLY-KW/FLOW = 0.000877
RETURN-KW/FLOW = 0.000309	RETURN-KW/FLOW = 0.000309
AHU-3 = SYSTEM	AHU-3 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 95	MAX-SUPPLY-T = 95
HEATING-SCHEDULE = "EEM 1 HW Loop Sch"	HEATING-SCHEDULE = "EEM 1 HW Loop Sch"
HEAT-RESET-SCH = "EEM 2 HD Reset Sch"	HEAT-RESET-SCH = "EEM 2 HD Reset Sch"
HEAT-CONTROL = RESET	HEAT-CONTROL = RESET
MIN-SUPPLY-T = 59	MIN-SUPPLY-T = 59

COOL-CONTROL = WARMEST	COOL-CONTROL = WARMEST
	ECONO-LIMIT-T = 72
	ECONO-LOW-LIMIT = 56
COOL-MAX-RESET-T = 61	COOL-MAX-RESET-T = 61
SUPPLY-FLOW = 64856	SUPPLY-FLOW = 64856
RETURN-FLOW = 51353	RETURN-FLOW = 51353
MIN-OUTSIDE-AIR = 0.05	MIN-OUTSIDE-AIR = 0.05
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP
MAX-OA-FRACTION = 0.4	**MAX-OA-FRACTION = 0**
FAN-SCHEDULE = "EEM 1 Fan Schedule"	FAN-SCHEDULE = "EEM 1 Fan Schedule"
FAN-CONTROL = CONSTANT-VOLUME	FAN-CONTROL = CONSTANT-VOLUME
SUPPLY-KW/FLOW = 0.000371	SUPPLY-KW/FLOW = 0.000371
RETURN-KW/FLOW = 0.000248	RETURN-KW/FLOW = 0.000248
AHU-2 = SYSTEM	AHU-2 = SYSTEM
TYPE = DDS	TYPE = DDS
HEAT-SOURCE = HOT-WATER	HEAT-SOURCE = HOT-WATER
RETURN-AIR-PATH = DUCT	RETURN-AIR-PATH = DUCT
DDS-TYPE = SINGLE-FAN	DDS-TYPE = SINGLE-FAN
MAX-SUPPLY-T = 90	MAX-SUPPLY-T = 90
MIN-SUPPLY-T = 59	MIN-SUPPLY-T = 59
	ECONO-LIMIT-T = 65
	ECONO-LOW-LIMIT = 57
SUPPLY-FLOW = 5003	SUPPLY-FLOW = 5003
RETURN-FLOW = 3960	RETURN-FLOW = 3960
MIN-OUTSIDE-AIR = 0.2	**MIN-OUTSIDE-AIR = 0.25**
OA-CONTROL = OA-TEMP	OA-CONTROL = OA-TEMP
MAX-OA-FRACTION = 0.4	**MAX-OA-FRACTION = 0**
FAN-SCHEDULE = "EEM 1 Fan Schedule"	FAN-SCHEDULE = "EEM 1 Fan Schedule"
FAN-CONTROL = CONSTANT-VOLUME	FAN-CONTROL = CONSTANT-VOLUME
SUPPLY-KW/FLOW = 0.000872	SUPPLY-KW/FLOW = 0.000872
RETURN-KW/FLOW = 0.000661	RETURN-KW/FLOW = 0.000661

Verification

This measure could not be verified directly since the mixed air temperature was not available via EEMIS. Nevertheless, it appears the economizers are working correctly according to Figure 57. The general trend is that the chiller is only operating while above the economizer set point temperature. There are some points where the chiller was operating below the set point temperature; however they were less than 1% of the total data points and will be neglected.

Figure 57: Whittier Courthouse Economizer Verification



1.10.6 EEM 8. Repair of Boxes, Controllers, Thermostats

This EEM adds the repair or replacement of deficient issues discovered from air flow measurements taken in the facility. The recommendations included repairing 46 inoperative mixing boxes, replacing 13 inoperative mixing box controllers, and recalibrating 28 thermostats. EMC was directed to repair 5 mixing boxes during the implementation phase.

Measure Modeling Estimation Changes

No changes.

Verification

The repair of boxes, controllers, and thermostats cannot be verified. There were no savings claimed for this measure.

1.10.7 Baseline Modifications

Pre implementation building data was compared to the baseline model to determine if the operational conditions match baseline model inputs. Discrepancies were noted between actual building pre implementation data collected between 1/1/2005 and 5/31/2005. Therefore, a modified baseline model was created using operational schedules from the pre implementation data. The changes to the schedules are shown in Table 55.

Table 55: Whittier Courthouse Baseline Hour Comparison

	Baseline WD	Baseline WE	Modified BL WD	Modified BL WE

Fans	Continuous	Continuous	Continuous	Continuous
Chiller	5AM-8PM	Off	4AM-9PM	Off
Boiler	4AM-9PM	Off	5AM-9PM	Off

The results of the actual fan, chilled water loop and hot water loop hours are shown in Figure 58, Figure 59 and Figure 60.

Figure 58: Whittier Courthouse Fan Baseline Schedule

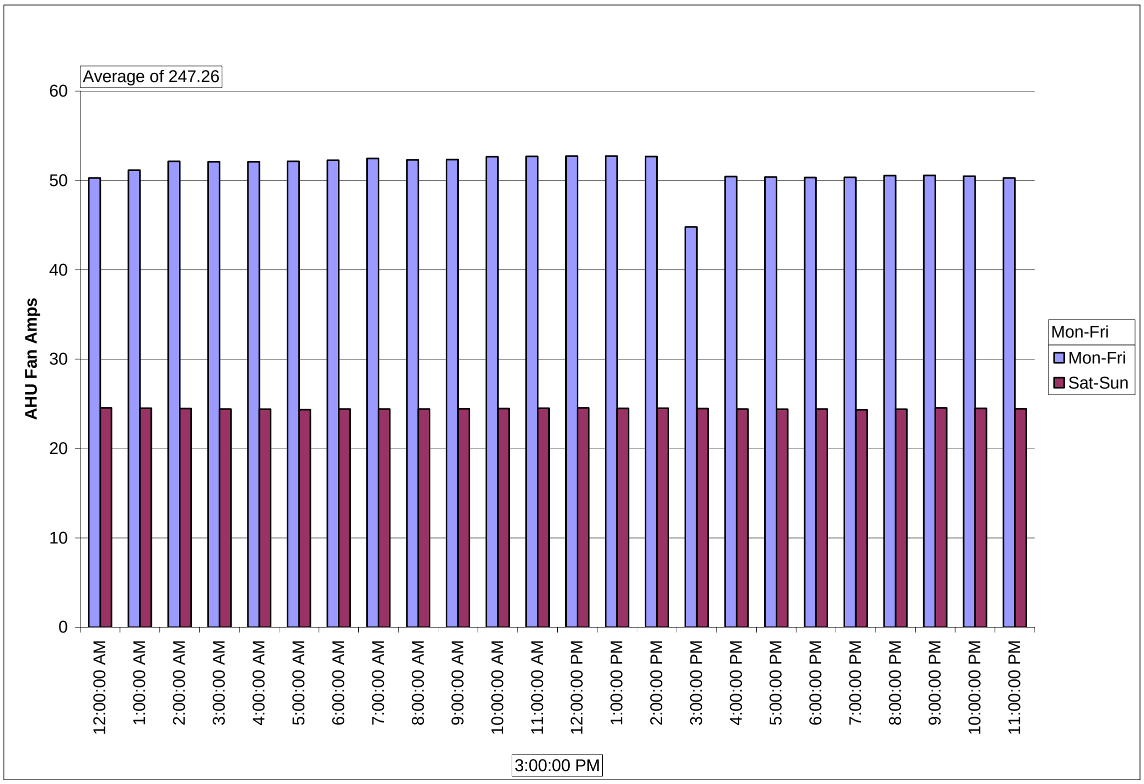


Figure 59: Whittier Courthouse Heating Baseline Schedule

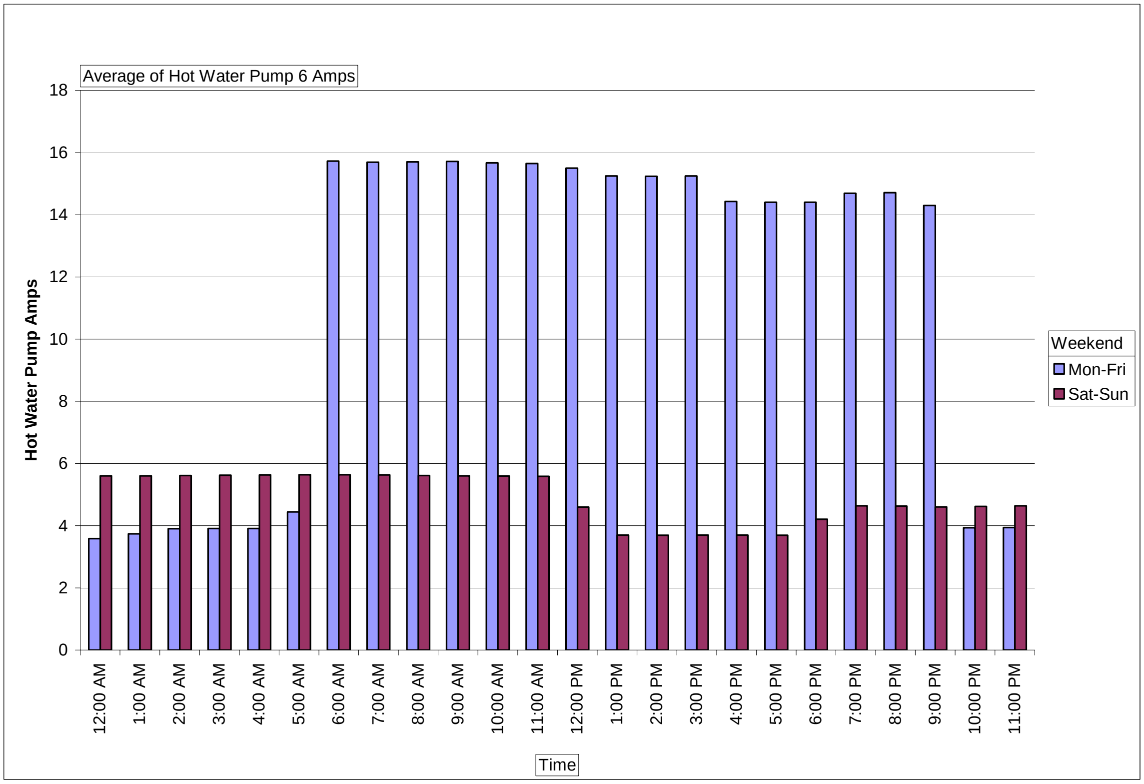
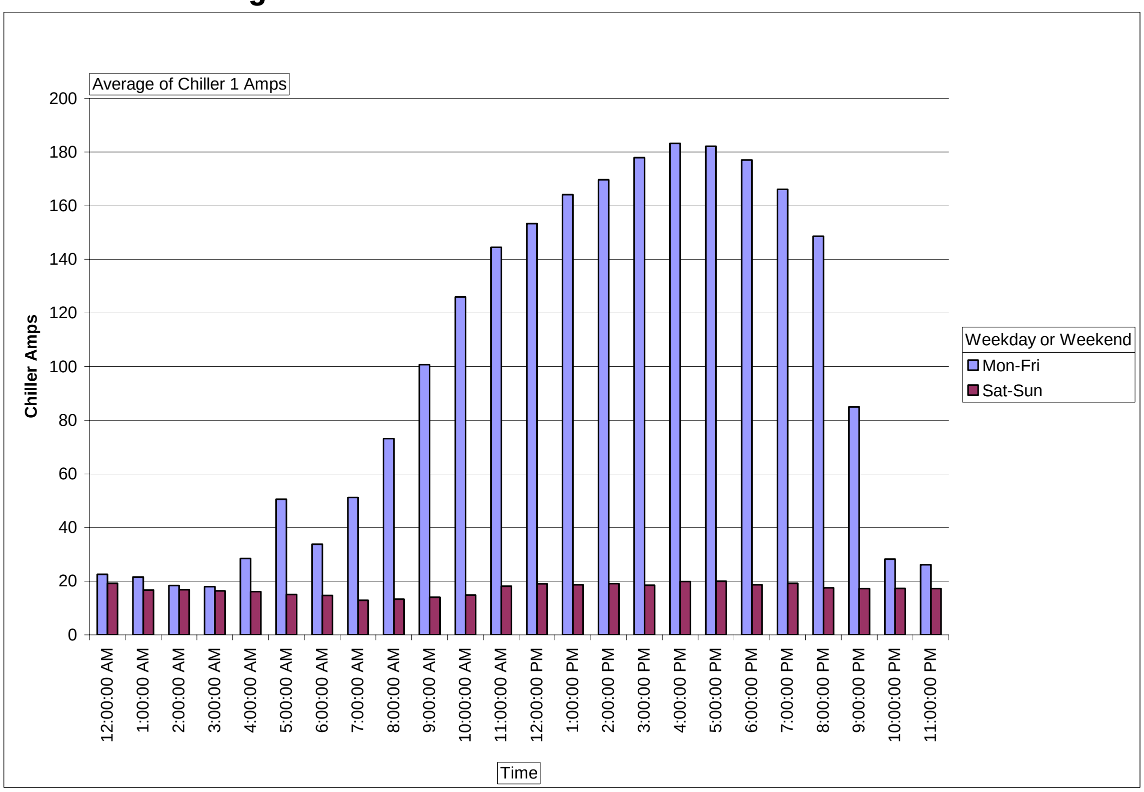


Figure 60: Whittier Courthouse Chiller Baseline Schedule



There several fan schedules used throughout the year in an apparent attempt to calibrate the baseline model to monthly billing data.

The regular fan was titled "Fan Sch - 24 hrs" and operated 24/7. A "Fan 4am to 8 pm" also appeared and operated from 4am-8pm in the months of June and October. A "Fan Jul Aug Wk" also appeared in the code and operated 24 hours a day Monday through Friday and did not operate on the weekends for the months of July and August.

Fan Schedule = SCHEDULE-PD
TYPE = ON/OFF/FLAG
MONTH = (1, 5, 6, 9, 10, 12)
DAY = (31, 31, 30, 30, 31, 31)
WEEK-SCHEDULES = ("Fan Jul Aug Wk", "Fan Schedule 24/7",
"Fan June & Oct Wk", "Fan Jul Aug Wk", "Fan June & Oct Wk",
"Fan Schedule 24/7")

The baseline was modified to always on the fans were running continuously for the five months preceding retrocommissioning activities.

Baseline
Fan 4am to 8pm = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (0, &D, &D, &D, 1, &D, &D, &D, &D, &D, &D, &D, &D, &D,
&D, &D, &D, &D, &D, &D, 0)
Modified Baseline
Fan 4am to 8pm = DAY-SCHEDULE-PD
TYPE = ON/OFF/FLAG
VALUES = (1)

1.10.8 Whittier Courthouse Evaluation Summary

The table shows the status of the implemented measures in the evaluation model.

Table 56: Whittier Courthouse EEM Status

EEM	#	Evaluation Status
Chiller Repair	1	Adjusted
Scheduling	2	Not adjusted
CT Controls	3	Not adjusted
FCU SP	4	Not adjusted
Boiler Tune-up	5	Not adjusted
DAT Reset	6	Not adjusted
OA Economizer	7	Not adjusted

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The high kWh realization rate is mostly a result of increased baseline fan usage

Table 57: Whittier Courthouse Savings Summary

Whittier Courthouse	kWh	kW	Therms
Modified Baseline Usage	1,964,197	402	42,612
Evaluation Usage	1,237,146	347	22,323
Ex-Post Savings	727,051	55	20,289
Ex-Ante Savings	535,390	69	20,281
Realization Rate	136%	79%	100%

1.11 RCx Element - Savings Summary

Table 58: Savings Summary – All Sites

	kWh	kW	Therms
Revised Program Goals	2,713,319	1,401	219,630
Ex Ante Savings	4,694,138	50	284,047
Ex Post Savings	4,205,533	366	271,880
Realization Rate	90%	732%	96%
% of Revised Goal	155%	26%	124%
Error Bound (Ex Post)	289,666	29	12,032
Relative Precision	7%	8%	4%

Table 59: Retrocommissioning Site Results Summary

Site	kWh Savings Tracking	kWh Savings Evaluated	kWh RR	Coincident Peak kW Tracking	Coincident Peak kW Evaluated	kW RR	Therm Savings Tracking	Therm Savings Evaluated	Therm RR
Bellflower CH	369,808	346,908	94%	4	22	555%	34,915	27,610	79%
Beverly Hills CH	331,656	85,384	26%	-23	-19		15,943	12,054	76%
Compton CH	376,139	365,453	97%	-108	180		46,873	63,281	135%
Downey CH	696,401	841,095	121%	14	11	76%	29,893	36,178	121%
Public Library HQ	246,182	285,394	116%	10	36	355%	33,696	33,597	100%
East LA CH	687,839	690,250	100%	29	26	89%	45,555	47,309	104%
El Monte CH	549,007	286,259	52%	12	5	43%	12,570	9,669	77%
Malibu Center & CH	198,753	174,824	88%	53	6	10%	9,354	10,171	109%
Santa Monica CH	267,108	12,427	5%	-14	16		22,397	-310	
Whittier	535,390	727,051	136%	69	55	79%	20,281	20,289	100%
San Fernando CH (est)	435,855	390,488	90%	4	29	732%	12,570	12,032	96%
Total	**4,694,138**	**4,205,533**	**90%**	**50**	**366**	**732%**	**284,047**	**271,880**	**96%**

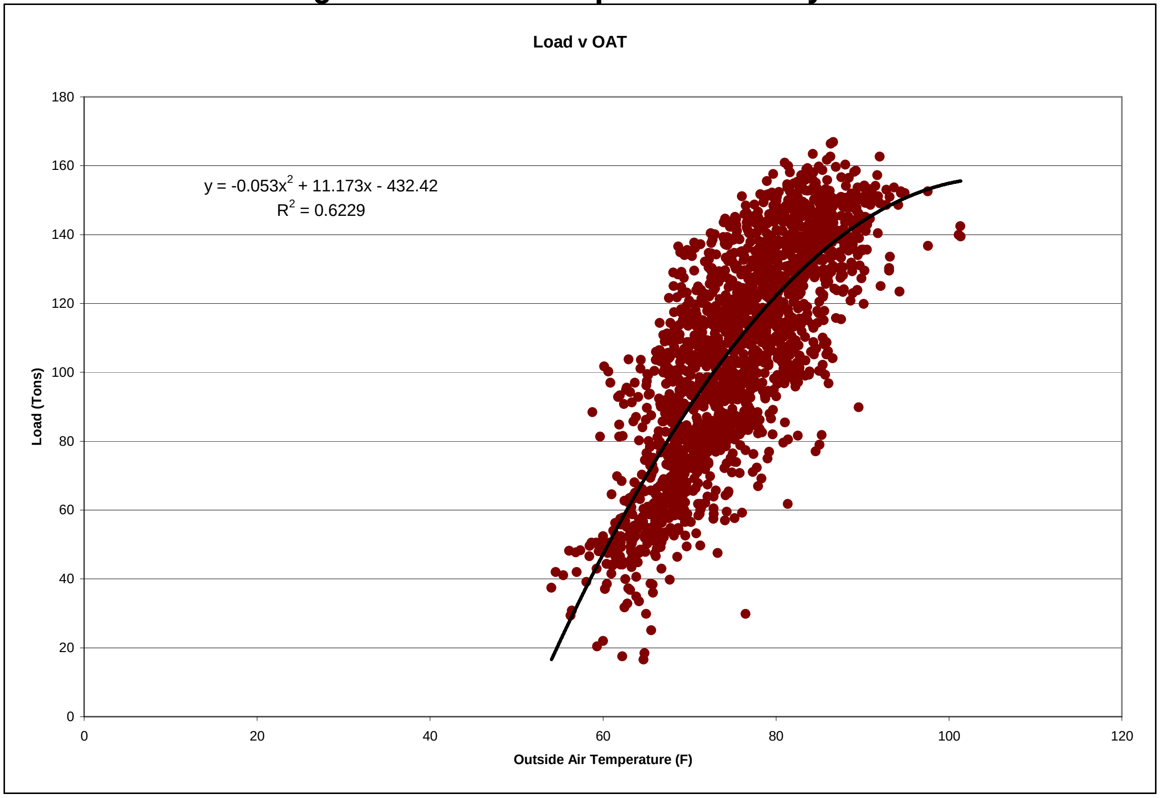
2. Appendix B - Chiller Retrofits

2.1 ISD Headquarters

The ISD Headquarters on Eastern Avenue had the preexisting 160 ton chiller, a Carrier 30HR160 replaced with a higher efficiency Trane RTHB150, a nominal 150 ton chiller as part of the Partnership's Retrofit Element.

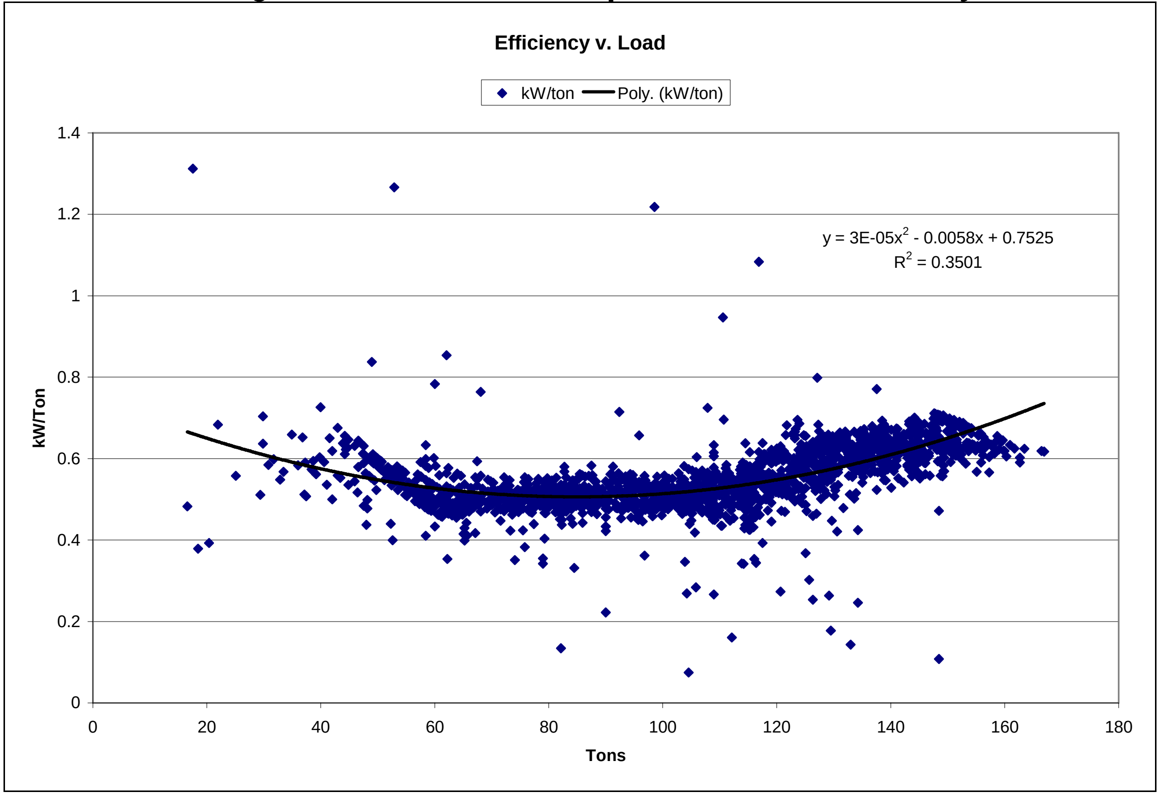
The project was evaluated with data acquired from the County's Enterprise Energy Information Management System (EEMIS). First facility load as a function of outside air temperature was calculated from the temperature drop across the chiller, ΔT when chiller was running. The equation used was, Load (tons) = ΔT*24*GPM.

Figure 61: ISD Headquarters Facility Chiller Load



A part load efficiency curve was created from new chiller data from EEMIS. The data produced a curve remarkably close to manufacturer's performance data. The 2nd order polynomial curve fit was used to estimate load for the savings calculation.

Figure 62: New ISD Headquarters Chiller Efficiency Curve

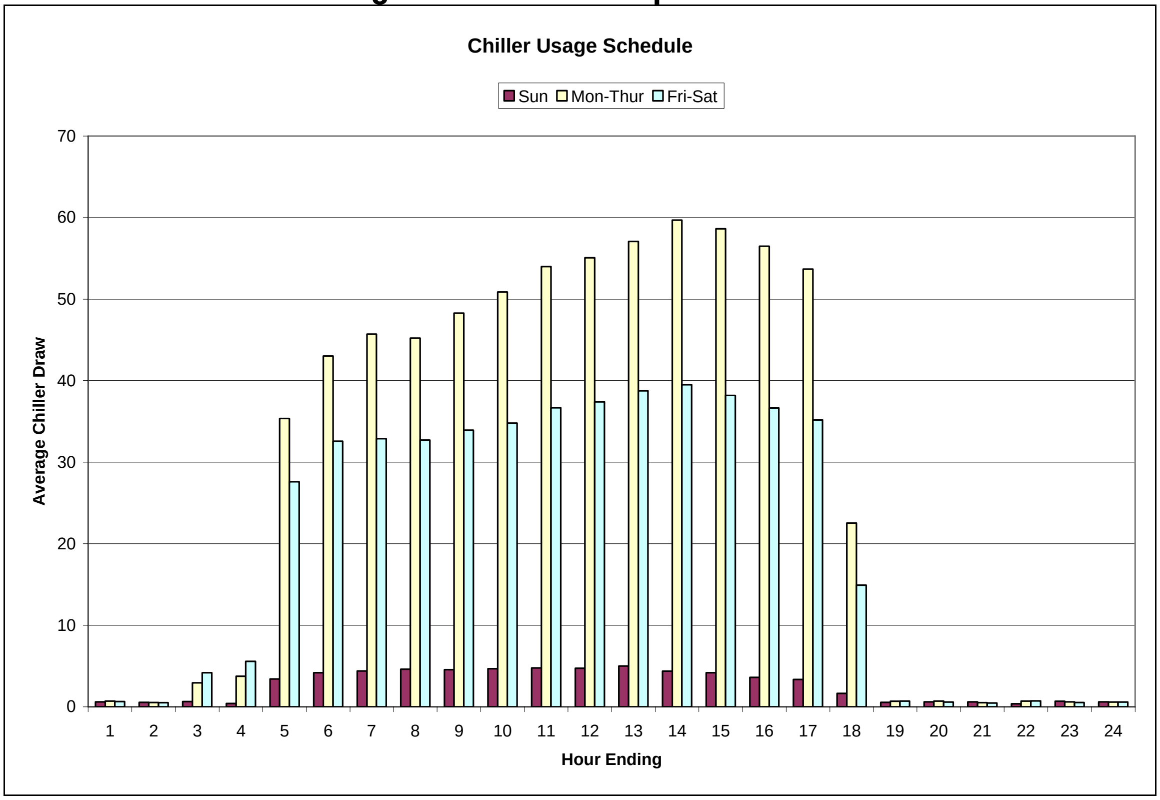


The installation contractor's performance data was used to estimate usage of the preexisting chiller.

Tons	kW
155	153.2
142	140.3
116.3	114.9
103.4	102.2
77.5	76.6
63.6	62.8
51.6	51
25.7	25.4

Many employees at the facility work a four day work week, and take Fridays off, and as a result, chiller usage for Fridays is about 70% of the Monday through Thursday average. However, there is considerable usage on Saturday, which is similar to Friday. Sunday shows chiller usage at 9% of the Monday through Thursday average.

Figure 63: ISD Headquarters Chiller Data



The savings were calculated with CEC weather data for climate zone 8. The hourly facility load was estimated via the load regression model as a function of ambient temperature. The contractor's performance data were used to model usage of the preexisting chiller. The efficiency regression equation from actual data was used to simulate new chiller usage. The chiller schedule was modeled as 4am through 6pm. The savings were simply the difference in simulated usage between the new and the preexisting chillers. The Friday-Saturday and Sunday savings were proportioned 70% and 9% of the full occupancy savings respectively. The coincident peal kW savings were difference in simulated kW during the hottest hour found in the weather data.

Table 60: ISD Headquarters Savings Summary

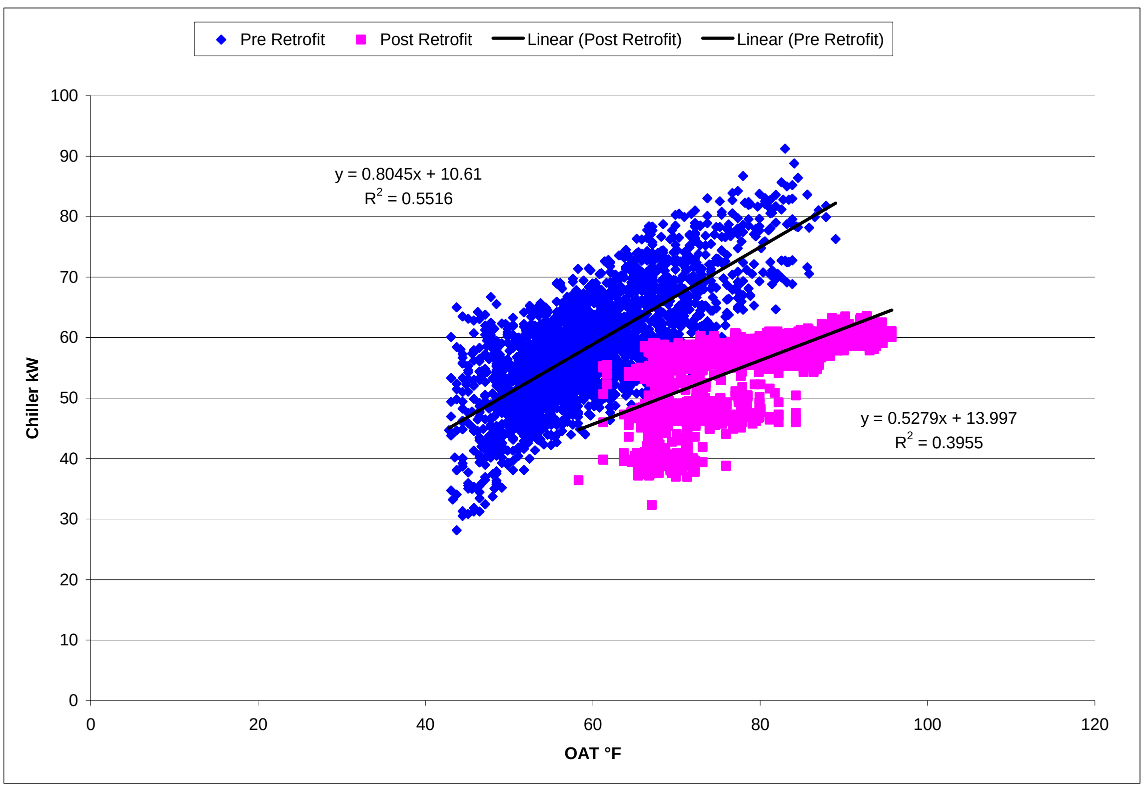
Site	kWh Savings Tracking	kWh Savings Evaluated	kWh RR	Coincident Peak kW Tracking	Coincident Peak kW Evaluated	kW RR
ISD Headquarters	89,544	112,990	126%	61.5	64.7	105%

2.2 Dorothy Kirby Center

The Dorothy Kirby Center (DKC) in Los Angeles had the preexisting 130 ton air cooled chiller, a York YCAM12 replaced with a higher efficiency Carrier 30HXC076, a nominal 76 ton water cooled chiller as part of the Partnership's Retrofit Element.

A data logger was installed on the preexisting chiller from November 2005 to January 2006. The data logger was installed on the new chiller was installed on the new chiller from May to July 2006. The power draw of the chillers against outdoor air temperature is shown below. The regression equations from these datasets were used to calculate the savings of the measure.

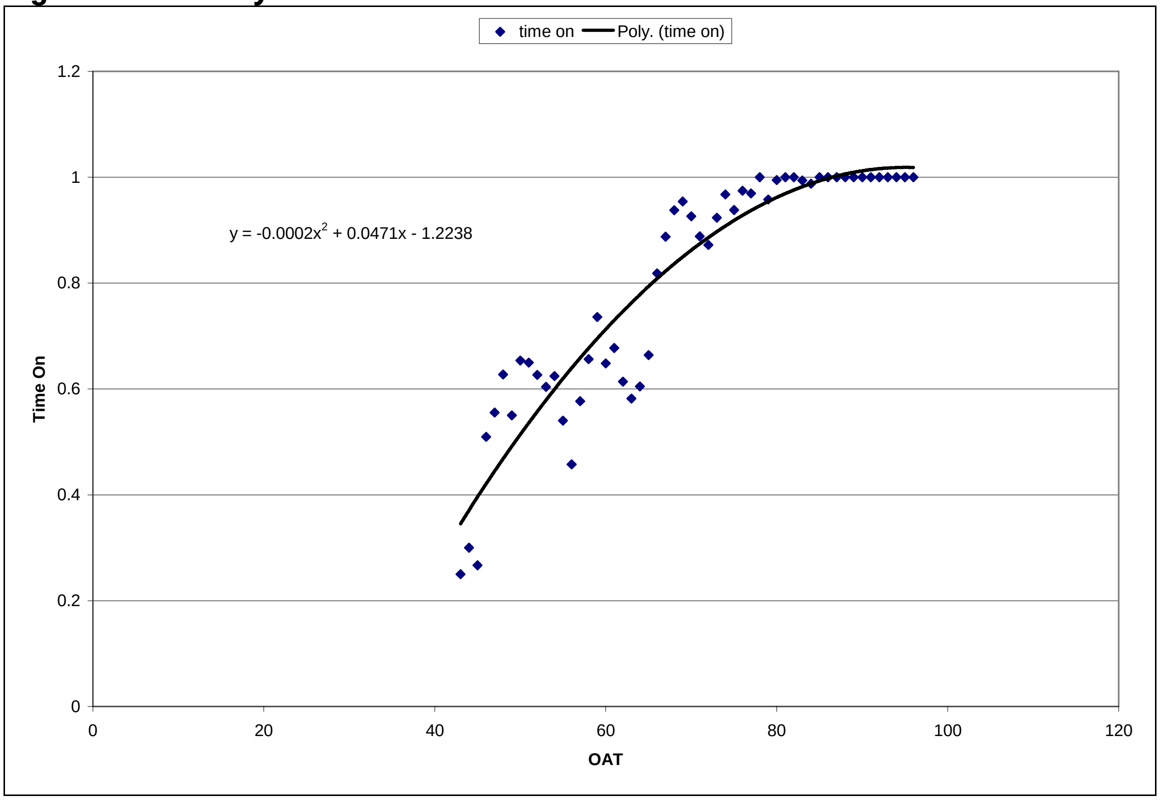
Figure 64: DKC Power Draw v. OAT



Since the chiller was cycling on and off during the monitoring periods, the savings calculations need to account for this diversity as the above regressions do not. Therefore a diversity curve as a function of OAT was created shown in

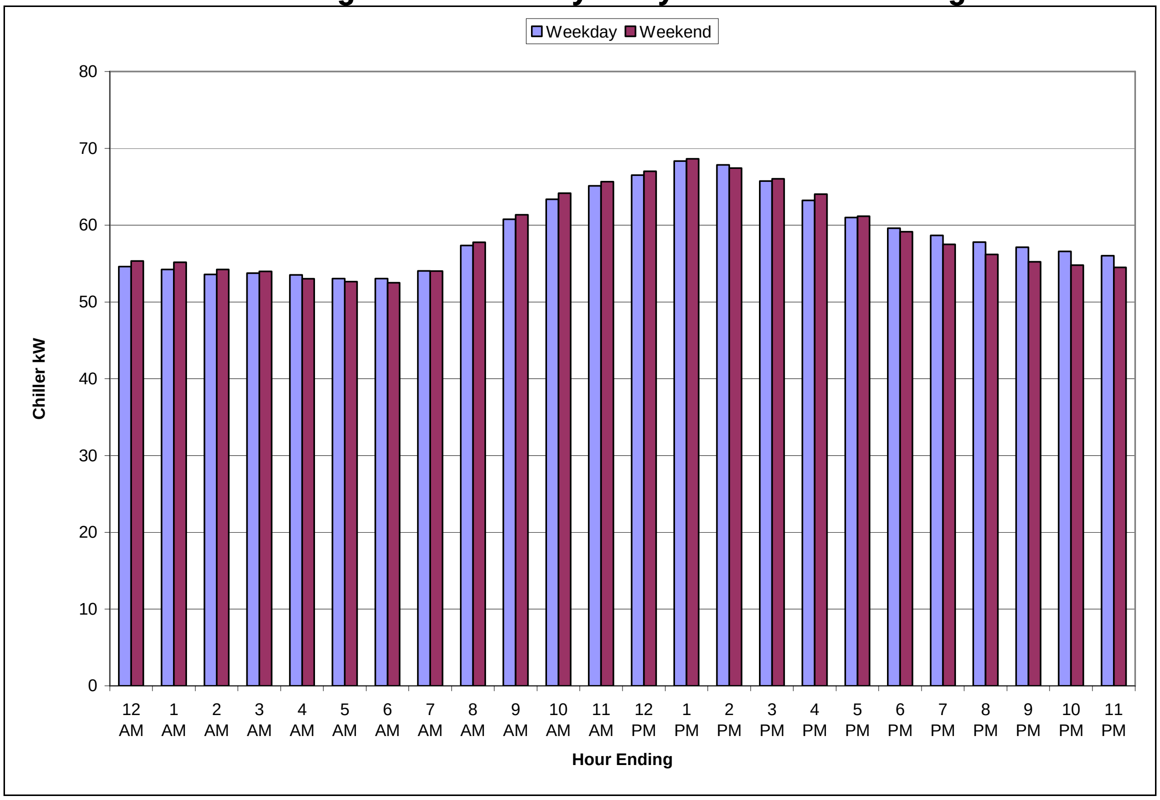
Figure 65.

Figure 65: DKC Cycle Time v. OAT



The Dorothy Kirby Center is a residential facility and temperature is maintained continuously as can be seen in Figure 66.

Figure 66: Dorothy Kirby Center Chiller Usage



The savings were calculated with CEC weather data for climate zone 9. The pre and post facility load were estimated via the load regression models as a function of hourly ambient temperature. The coincident peal kW savings were difference in simulated kW during the hottest hour found in the weather data.

Table 61: Dorothy Kirby Savings Summary

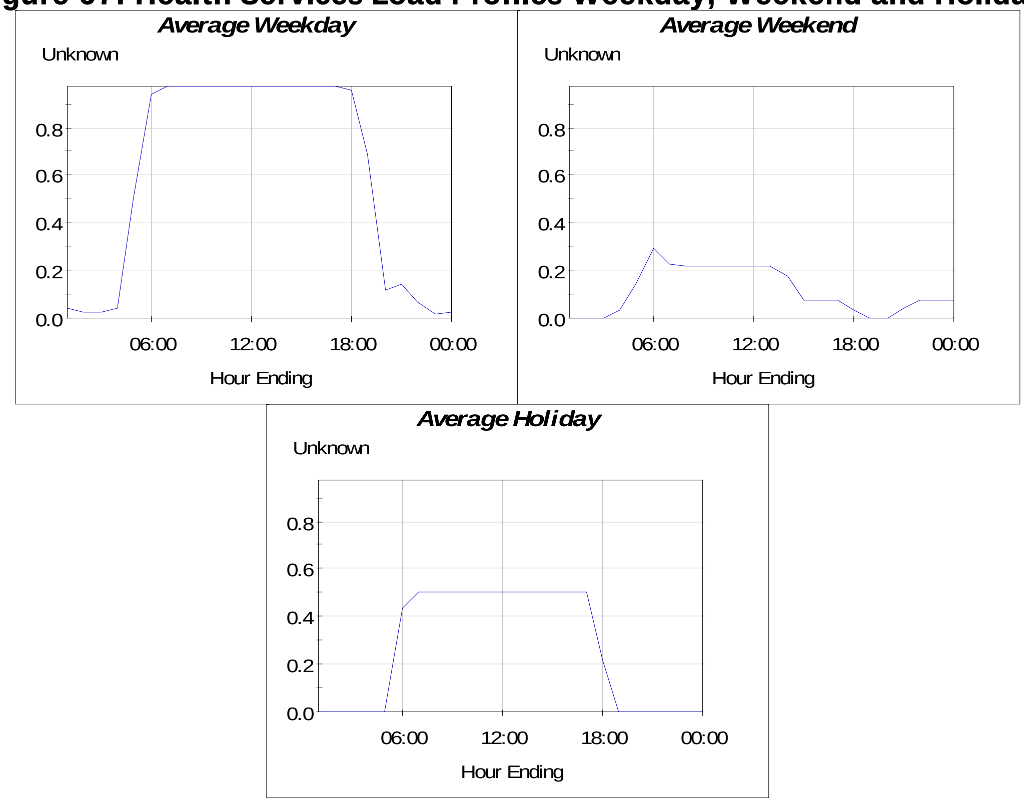
Site	kWh Savings Tracking	kWh Savings Evaluated	kWh RR	Coincident Peak kW Tracking	Coincident Peak kW Evaluated	kW RR
Dorothy Kirby Center	47,757	112,857	236%	32.8	25.1	76%

3. Appendix C - Building Wide Lighting Controls

3.1 Los Angeles County Department of Health Services-

This facility had lighting controls implemented on a 268 kW lighting load that had been previously running "always on". The evaluation team placed lighting loggers run time loggers on a sample of controlled fixtures before the implementation of the control system. The loggers were then left in place for eight weeks after control system was implemented before retrieval. The "always on" status was confirmed during the initial site visit and was corroborated by the logger data. The post implementation data showed the immediate effectiveness of the control system.

Figure 67: Health Services Load Profiles Weekday, Weekend and Holidays



Evaluated Results

Post implementation load profiles were created from the logger data for weekdays, weekends and holidays as seen in Figure 67. The post implementation data encompassed Memorial Day and Independence Day. The load profiles were extrapolated to estimate annual lighting usage, and associated measure savings as seen in Table 62. The evaluation team measured post implementation usage was greater than the program had forecasted, resulting in a project kWh saving realization rate of 83%.

Table 62: Department of Health Services Lighting Run Time

Hour Ending	Weekday % ON	Weekend % ON	Holiday% ON
1:00AM	6%	0%	0%
2:00AM	3%	0%	0%
3:00AM	3%	0%	0%
4:00AM	4%	3%	0%
5:00AM	51%	14%	0%
6:00AM	97%	29%	43%
7:00AM	100%	23%	50%
8:00AM	100%	21%	50%
9:00AM	100%	21%	50%
10:00AM	100%	21%	50%
11:00AM	100%	21%	50%
12:00PM	100%	21%	50%
1:00PM	100%	21%	50%
2:00PM	100%	18%	50%
3:00PM	100%	7%	50%
4:00PM	100%	7%	50%
5:00PM	100%	7%	50%
6:00PM	100%	3%	22%
7:00PM	73%	0%	0%
8:00PM	12%	0%	0%
9:00PM	14%	4%	0%
10:00PM	7%	7%	0%
11:00PM	2%	7%	0%
12:00AM	3%	7%	0%
Average	61%	11%	26%
Days/Year	249	104	12
Hours ON/Year	3673	304	75
Total Hours/Year	4052		

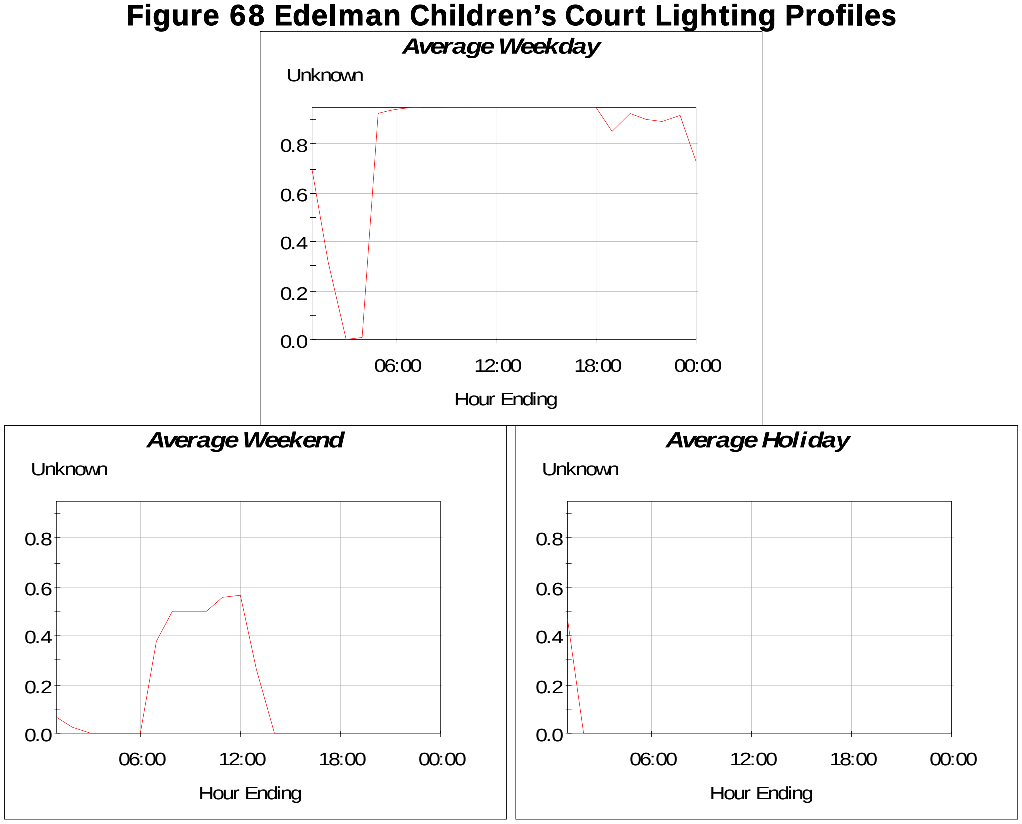
Table 63: Department of Health Services BWLC Project Summary

	Annual Lighting Hours	kWh Usage	kWh Savings	Realization Rate kWh
Baseline	8,760	470,237	-	-
Tracking	3,120	167,482	302,755	-
Evaluated	4,052	217,487	252,750	83%

3.2 Edmund D. Edelman Children's Court -

This facility had lighting controls implemented on a 132 kW lighting load that had been previously running "always on". The evaluation team visited the site and placed lighting loggers run time loggers on a sample of controlled fixtures before the implementation of the control system. The loggers were then left in place for eight weeks after control system was implemented before retrieval. The always on status was confirmed during the initial site visit and was corroborated by the logger data. The post implementation data load profiles are shown in Figure 68

Figure 68 Edelman Children's Court Lighting Profiles



Evaluated Results

Post implementation load profiles were created from the logger data for weekdays, weekends and holidays as seen in Figure 67. The load profiles were extrapolated to estimate annual lighting usage, and associated measure savings as seen in Table 64. The evaluation team measured post implementation usage was greater than the program had forecasted, resulting in a project kWh saving realization rate of 72%. Post-implementation data show evening occupancy regularly overriding control attempts.

Table 64: Edelman Children's Court Lighting Run Time

Hour Ending	Weekday % ON	Weekend % ON	Holiday % ON
1:00AM	68%	7%	47%
2:00AM	32%	2%	0%
3:00AM	0%	0%	0%
4:00AM	1%	0%	0%
5:00AM	97%	0%	0%
6:00AM	99%	0%	0%
7:00AM	100%	38%	0%
8:00AM	100%	50%	0%
9:00AM	100%	50%	0%
10:00AM	100%	50%	0%
11:00AM	100%	56%	0%
12:00PM	100%	57%	0%
1:00PM	100%	27%	0%
2:00PM	100%	0%	0%
3:00PM	100%	0%	0%
4:00PM	100%	0%	0%
5:00PM	100%	0%	0%
6:00PM	100%	0%	0%
7:00PM	89%	0%	0%
8:00PM	97%	0%	0%
9:00PM	95%	0%	0%
10:00PM	94%	0%	0%
11:00PM	97%	0%	0%
12:00AM	77%	0%	0%
Average	81%	14%	2%
Days/Year	249	104	12
Hours ON/Year	4863	389	6
Total Hours/Year	5257		

Table 65 Edelman Children's Court BWLC Project Summary

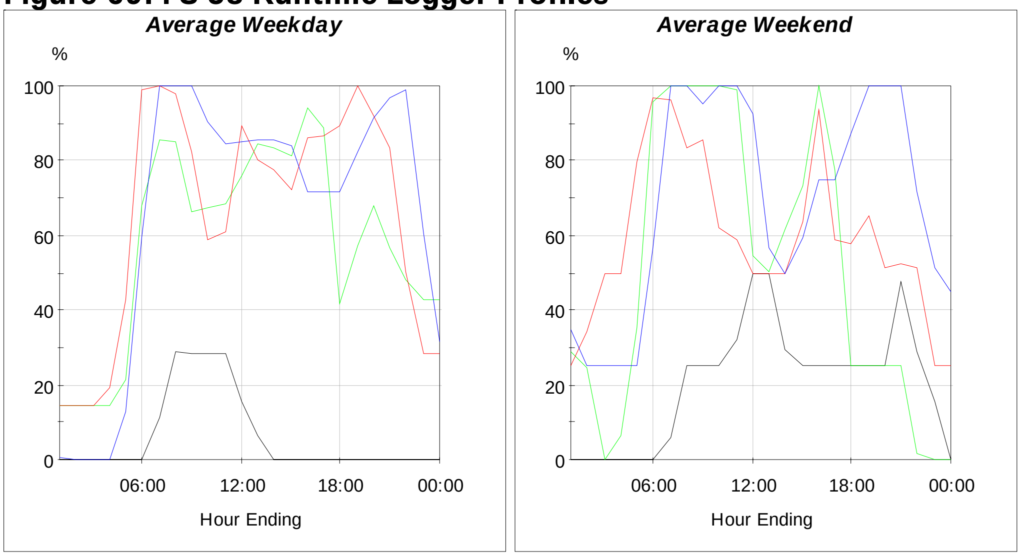
	Annual Lighting Hours	Annual kWh Usage	Annual kWh Savings	Realization Rate kWh
Baseline	8,760	1,154,414		
Tracking	3,900	513,952	640,463	
Evaluated	5,257	692,824	461,590	72%

4. Appendix D - Lighting Retrofits Site Reports

Three lighting retrofit sites were evaluated with pre and post implementation site visits and three week monitoring of lighting system runtime with a time of use event loggers on a sample of fixtures.

4.1 Fire Station 58

Figure 69: FS 58 Runtime Logger Profiles



Fire station 58 had four logger installations, the runtime profiles of the loggers are shown above in Figure 69. The numerical logger extrapolation results and are shown in Table 66.

Table 66: Fire Station 58 Runtime Monitoring Results

	FS58 1	FS58 1	FS58 2	FS58 2	FS58 3	FS58 3	FS58 4	FS58 4
Hour Ending	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1:00AM	0.0	0.0	14.3	29.1	14.3	25.0	0.4	34.7
2:00AM	0.0	0.0	14.3	24.5	14.3	34.2	0.0	25.0
3:00AM	0.0	0.0	14.3	0.0	14.3	50.0	0.0	25.0
4:00AM	0.0	0.0	14.3	6.5	19.2	50.0	0.0	25.0
5:00AM	0.0	0.0	21.1	35.3	42.5	79.5	12.7	25.0
6:00AM	0.0	0.0	68.2	95.5	98.8	96.6	59.3	56.5
7:00AM	11.3	6.0	85.7	100.0	100.0	96.5	100.0	100.0
8:00AM	28.7	25.0	85.1	100.0	97.7	83.7	100.0	100.0
9:00AM	28.6	25.0	66.3	100.0	82.3	85.5	100.0	95.0
10:00AM	28.6	25.0	67.3	100.0	58.6	61.8	90.4	100.0
11:00AM	28.6	31.9	68.3	99.2	61.1	59.1	84.6	100.0
12:00PM	15.4	50.0	76.1	54.4	89.4	50.0	84.8	92.6
1:00PM	6.2	50.0	84.6	50.2	80.5	50.0	85.7	56.9
2:00PM	0.0	29.3	83.4	61.6	77.5	50.0	85.7	50.0
3:00PM	0.0	25.0	81.4	73.2	72.4	63.9	84.1	59.3
4:00PM	0.0	25.0	94.2	100.0	85.9	93.8	71.4	75.0
5:00PM	0.0	25.0	88.6	77.4	86.6	58.9	71.4	75.0
6:00PM	0.0	25.0	41.7	25.3	89.3	58.0	71.4	87.0
7:00PM	0.0	25.0	57.1	25.0	100.0	65.3	82.4	100.0
8:00PM	0.0	25.0	67.8	25.0	91.9	51.2	91.6	100.0
9:00PM	0.0	47.6	56.7	25.0	83.2	52.2	96.9	99.9
10:00PM	0.0	28.9	48.0	1.4	50.3	51.2	98.8	71.6
11:00PM	0.0	15.5	42.9	0.0	28.6	25.1	60.5	51.6
12:00AM	0.0	0.0	42.9	0.0	28.2	25.0	31.6	44.8
Total	147.4	484.2	1384.6	1208.6	1566.7	1416.3	1563.8	1649.9
Days/year	261	104	261	104	261	104	261	104
Hours	384.6	503.5	3613.9	1256.9	4089.0	1473.0	4081.5	1715.9
Annual Run Time	**888**		**4871**		**5562**		**5797**	
Coincident Factor	**1%**		**83%**		**87%**		**85%**	

The contractor's amended fixture counts matched the evaluation team's fixture counts and wattage reductions were verified as correct. Therefore, ex-post energy savings were calculated by applying the monitored hours to the fixture wattage reduction, shown in Table 67. The coincident peak kW reduction was calculated as the fixture wattage reduction times the coincident factor, which is the percentage of time that the fixtures are operated during the Monday through Friday peak period.

Table 67: Fire Station 58 Fixture Summary

		EXISTING LIGHTING SYSTEM									AS/BUILT				
Logger File	Area	Code	Existing Fixture Type	DESCRIPTION	FIX. QTY.	Peak % On	TOTAL FIX. KW	Contractor Annual Hours	Metered ANNUAL HOURS	ANNUAL KWH	New Fixture type	FIX. QTY Instlled	TOTAL FIX.(S) KW	ANNUAL KWH	CoincidentPeak kW Savings
2	DORM HALL	F44EE	WRAP	Fluorescent, (4) 48", ES lamp	5	83	0.72	8,760	4,871	3,507.0	4 Ft. T8 Lamp & Electronic Ballast	5	0.50	2,435	0.22
2	RESTROOMS	F42EE	WRAP	Fluorescent, (2) 48", ES lamp	2	83	0.14	8,760	4,871	701.4	4 Ft. 2 Lamp T8 & Electronic Ballast	2	0.09	458	0.05
2	TOOL ROOM	F42EE	WRAP	Fluorescent, (2) 48", ES lamp	2	83	0.14	8,760	4,871	701.4	4 Ft. 2 Lamp T8 & Electronic Ballast	2	0.09	458	0.04
2	ENGINE ROOM	F41EE	WRAP	Fluorescent, (1) 48", ES lamp	4	83	0.17	8,760	4,871	837.8	4 Ft. 1 Lamp T8 & Electronic Ballast	4	0.11	546	0.05
2	TURNOUT ROOM	I75/ 1	76 W INCAND	Incandescent, (1) 75W lamp	1	83	0.15	8,760	4,871	730.6	20 Watt Screw-in	2	0.05	224	0.09
3	PHONE ROOM	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	1	87	0.08	8,760	5,562	417.2	20 Watt Screw-in	1	0.02	128	0.05
3	CAPT TOILET	F41EE	WRAP	Fluorescent, (1) 48", ES lamp	1	87	0.04	8,760	5,562	239.2	4 Ft. 1 Lamp T8 & Electronic Ballast	1	0.03	156	0.01
1	RESTROOMS	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	7	1	0.53	8,760	888	466.3	20 Watt Screw-in	7	0.16	143	0.01
1	THE CAVE	F42EE	WRAP	Fluorescent, (2) 48", ES lamp	3	1	0.22	8,760	888	191.8	4 Ft. 2 Lamp T8 & Electronic Ballast	3	0.14	125	0.00
1	CLOSET	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	2	1	0.15	8,760	888	133.2	20 Watt Screw-in	2	0.05	41	0.00
1	LAUNDRY	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	1	1	0.08	8,760	888	66.6	20 Watt Screw-in	1	0.02	20	0.00
4	SLOPSINK	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	1	85	0.08	8,760	5,797	434.8	20 Watt Screw-in	1	0.02	133	0.04
4	STORAGE KITCHEN	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	1	85	0.08	8,760	5,797	434.8	20 Watt Screw-in	1	0.02	133	0.04
104 Hours	ATTICS (2)	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	2	10	0.15	8,760	104	15.6	20 Watt Screw-in	2	0.05	5	0.02
4380 Hours	ENG RM NITE LITE	I100/ 1	100 W INCAND	Incandescent, (1) 100W lamp	1	-	0.10	8,760	4,360	436.0	26 Watt Screw-in	1	0.03	144	0.00
4380 Hours	OUT BLDG (4)	F42EE	WRAP	Fluorescent, (2) 48", ES lamp	4	-	0.29	8,760	4,360	1,255.7	4 Ft. 2 Lamp T8 & Electronic Ballast	4	0.19	820	0.00
4380 Hours	OUT BLDG (4)	MV250/ 1	WALL PACK	Mercury Vapor, (1) 250W lamp	2	-	0.58	8,760	4,360	2,528.8	(1) 175 WATT METAL HALIDE	2	0.43	1,875	0.00
				Total			3.682			13,098.1			2.01	7,844	0.62

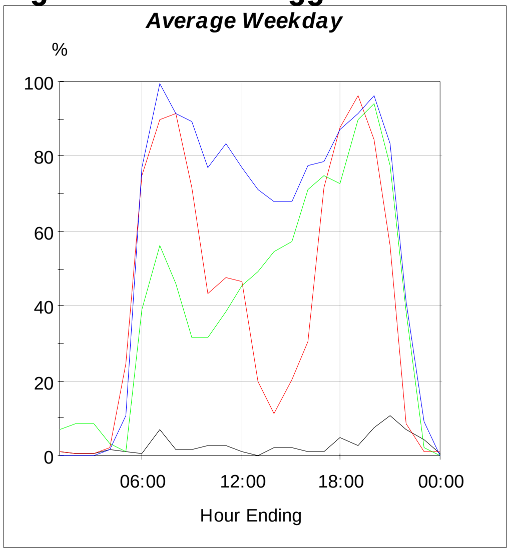
Site energy and coincident peak kW savings realization rates, 36% and 21%, are low due to over predicted runtime for all fixtures.

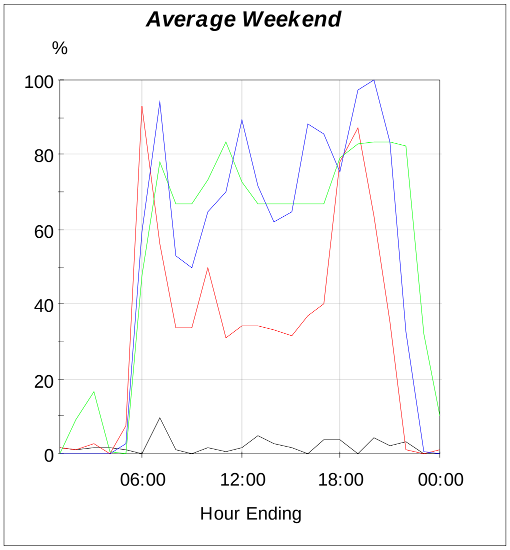
Table 68: Fire Station 58 Savings Summary

Site	Tracking		Evaluated		Realization Rate	
	kWh	kW	kWh	kW	kWh	kW
Fire Station 58	14,638	1.67	5,254	0.35	36%	21%

4.2 Fire Station 25

Figure 70: FS 25 Logger Runtime Profiles





Fire station 25 had four successful logger installations, the runtime profiles of the loggers are shown above. The numerical results are shown in Table 69.
Table 69: Fire Station 25 Runtime Monitoring Results

	FS25 1	FS25 1	FS25 2	FS25 2	FS25 3	FS25 3	FS25 4	FS25 4
Hour Ending	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1:00AM	0.9	1.8	0.9	1.8	6.9	0.0	0.0	0.0
2:00AM	0.5	1.2	0.6	1.0	8.3	9.1	0.0	0.1
3:00AM	0.5	1.5	0.7	2.7	8.3	16.7	0.0	0.0
4:00AM	1.3	1.8	2.1	0.0	3.3	0.5	1.4	0.0
5:00AM	0.9	0.9	24.5	7.3	0.9	0.0	10.5	2.9
6:00AM	0.3	0.0	74.7	93.3	38.9	47.8	77.1	59.5
7:00AM	6.8	9.6	89.8	56.1	56.3	77.9	99.3	94.1
8:00AM	1.3	0.9	91.7	33.9	46.2	66.7	91.7	53.1
9:00AM	1.3	0.0	71.6	33.5	31.6	66.7	89.6	50.0
10:00AM	2.6	1.4	43.2	50.0	31.7	73.1	76.8	64.7
11:00AM	2.9	0.4	47.4	31.2	38.6	83.3	83.3	69.9
12:00PM	0.8	1.8	46.5	34.2	45.6	72.8	77.0	89.3
1:00PM	0.1	4.7	19.9	34.2	49.3	66.7	71.2	71.5
2:00PM	2.2	2.7	11.4	33.4	54.6	66.7	68.2	61.8
3:00PM	2.2	1.8	20.1	31.5	57.5	66.7	68.0	64.6
4:00PM	0.9	0.0	30.5	36.8	71.2	66.7	77.5	88.2
5:00PM	0.9	3.6	71.4	40.3	75.0	66.7	78.8	85.4
6:00PM	4.9	3.6	87.9	78.1	72.9	79.4	87.3	75.7
7:00PM	2.9	0.0	96.4	87.1	90.1	82.7	91.3	97.2
8:00PM	7.6	4.1	84.6	63.8	93.9	83.3	96.2	100.0
9:00PM	10.6	2.2	56.3	35.1	77.7	83.3	83.5	83.7
10:00PM	6.8	3.3	8.8	1.3	38.4	82.1	41.2	32.4
11:00PM	4.0	0.2	0.9	0.0	2.2	32.2	9.0	0.3
12:00AM	0.5	0.0	1.0	0.9	0.0	10.2	0.0	0.0
Total	63.78	47.32	982.67	787.33	999.17	1,301.24	1,378.80	1,244.16
Days/year	261	104	261	104	261	104	261	104
Hours	166.5	49.2	2564.8	818.8	2607.8	1353.3	3598.7	1293.9
Annual Run Time	**216**		**3384**		**3961**		**4893**	
Coincident Factor	**2%**		**38%**		**65%**		**74%**	

Although the contractor's original fixture count had a significant discrepancy, the contractor's amended fixture counts matched the evaluation team's fixture counts. Therefore, ex-post energy savings were calculated by applying the monitored hours to the fixture wattage reduction, shown in Table 67. The coincident peak kW reduction was calculated as the fixture wattage reduction times the coincident factor.

Table 70: Fire Station 25 Fixture Summary

		EXISTING LIGHTING SYSTEM									AS/BUILT				
Logger File	Area	Code	Existing Fixture Type	DESCRIPTION	FIX. QTY.	Peak % On	TOTAL FIX. KW	Contractor Annual Hours	Metered ANNUAL HOURS	ANNUAL KWH	New Fixture type	FIX. QTY Instlled	TOTAL FIX.(S) KW	ANNUAL KWH	CoincidentPeak kW Savings
1	ENGINE ROOM	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	1	2	0.08	8,760	216	16.2	20 Watt Screw-in	1	0.02	5	0.00
1	ENGINE ROOM	F44EE	WRAP HIGH REACH	Fluorescent, (4) 48", ES lamp	8	2	1.15	8,760	216	248.5	4 Ft. T8 Lamp & Electronic Ballast	8	0.80	173	0.01
1	ENGINE ROOM	F82ES	STRIP	Fluorescent, (2) 96", ES lamp	2	2	0.26	8,760	216	55.2	4 Ft. 4 Lamp T8 & Electronic Ballast	2	0.20	43	0.00
1	TOOL ROOM	F42EE	WRAP	Fluorescent, (2) 48", ES lamp	1	2	0.07	8,760	216	15.5	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	10	0.00
2	DORM	F42EE	WRAP (2 T8 LAMPS)	Fluorescent, (2) 48", ES lamp	4	38	0.29	8,760	3,384	974.5	4 Ft. 2 Lamp T8 & Electronic Ballast	4	0.19	636	0.04
2	HALLWAY	F42EE	WRAP	Fluorescent, (2) 48", ES lamp	1	38	0.07	8,760	3,384	243.6	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	159	0.01
3	KITCHEN	F44EE	WRAP	Fluorescent, (4) 48", ES lamp	4	65	0.58	8,760	3,961	2,281.6	4 Ft. T8 Lamp & Electronic Ballast	4	0.40	1,584	0.11
3	KITCHEN	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	2	65	0.15	8,760	3,961	594.2	20 Watt Screw-in	2	0.05	182	0.07
4	LOCKER ROOM	F42EE	WRAP	Fluorescent, (2) 48", ES lamp	2	74	0.14	8,760	4,893	704.5	4 Ft. 2 Lamp T8 & Electronic Ballast	2	0.09	460	0.04
4	LOCKER ROOM	F42EE	STRIP	Fluorescent, (2) 48", ES lamp	3	74	0.22	8,760	4,893	1,056.8	4 Ft. 2 Lamp T8 & Electronic Ballast	3	0.14	690	0.06
4	RESTROOM	I60/ 1	60 W INCAND	Incandescent, (1) 60W lamp	4	74	0.24	8,760	4,893	1,174.2	11 Watt Screw-in	4	0.06	313	0.13
104 Hours	ATTIC	F42EE	STRIP	Fluorescent, (2) 48", ES lamp	3	10	0.22	8,760	104	22.5	4 Ft. 2 Lamp T8 & Electronic Ballast	3	0.14	15	0.02
104 Hours	EXT CLOSET	I100/ 1	100 W INCAD	Incandescent, (1) 100W lamp	1	10	0.10	8,760	104	10.4	26 Watt Screw-in	1	0.03	3	0.01
4380 Hours	FRONT OFFICE	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	30	-	0.22	8,760	4,380	946.1	4 Ft. T8 Lamp & Electronic Ballast	3	0.30	1,314	0.00
4380 Hours	EXTERIOR	MV400/ 1	WALL PACK	Mercury Vapor, (1) 400W lamp	5	-	2.28	8,760	4,380	9,964.5	(1) 100 WATT METAL HALIDE	5	0.64	2,803	0.00
4380 Hours	EXT EAVES	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	3	-	0.00	8,760	4,380	-	4 Ft. 2 Lamp T8 & Electronic Ballast	0	0.00	-	0.00
4380 Hours	EXTERIOR	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	2	-	0.15	8,760	4,380	657.0	20 Watt Screw-in	2	0.05	201	0.00
				Total			6.198			18,965.2			3.21	8,592	0.49

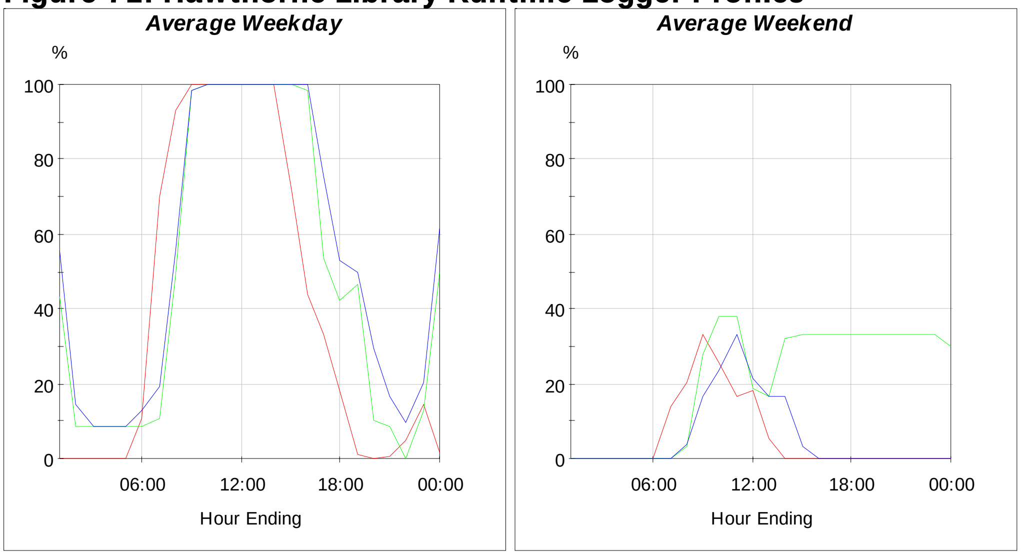
Site energy and coincident peak kW savings realization rates, 40% and 17%, is low due to over predicted runtime for all fixtures.

Table 71: Fire Station 25 Savings Summary

Site	Tracking		Evaluated		Realization Rate	
	kWh	kW	kWh	kW	kWh	kW
Fire Station 25	26,175	2.99	10,373	0.49	40%	17%

4.3 Hawthorne Library

Figure 71: Hawthorne Library Runtime Logger Profiles



Hawthorne Library had three successful logger installations, the runtime profiles of the loggers are shown above. The numerical results are shown in the table. The weekends in this case are actually Sunday-Monday, the days that the library is closed. Consequent the "weekdays" shown in the profiles are Tuesday-Saturday.

Table 72: Hawthorne Library Runtime Logger Results

	HAW 1	HAW 1	HAW 2	HAW 2	HAW 3	HAW 3
Hour Ending	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1:00AM	0.0	0.0	45.2	0.0	13.8	0.0
2:00AM	0.0	0.0	10.0	0.0	6.7	0.0
3:00AM	0.0	0.0	10.0	0.0	6.7	0.0
4:00AM	0.0	0.0	10.0	0.0	6.7	0.0
5:00AM	0.0	0.0	10.0	0.0	12.0	0.0
6:00AM	12.4	0.0	10.0	0.0	19.6	0.0
7:00AM	67.9	14.2	12.7	0.0	55.0	3.9
8:00AM	92.7	20.5	49.2	3.3	98.2	16.7
9:00AM	100.0	33.3	97.8	27.6	100.0	23.7
10:00AM	100.0	25.4	100.0	37.9	100.0	33.3
11:00AM	100.0	16.7	100.0	38.1	100.0	21.3
12:00PM	100.0	18.3	100.0	18.8	100.0	16.7
1:00PM	100.0	5.2	100.0	16.7	100.0	16.7
2:00PM	100.0	0.0	100.0	32.0	100.0	3.3
3:00PM	77.1	0.0	100.0	33.3	100.0	0.0
4:00PM	49.4	0.0	98.6	33.3	80.2	0.0
5:00PM	40.1	0.0	61.4	33.3	56.7	0.0
6:00PM	20.9	0.0	47.5	33.3	53.3	0.0
7:00PM	0.7	0.0	50.4	33.3	27.7	0.0
8:00PM	0.0	0.0	10.6	33.3	13.3	0.0
9:00PM	0.8	0.0	6.7	33.3	7.6	0.0
10:00PM	6.0	0.0	0.2	33.3	20.8	0.0
11:00PM	17.4	0.0	15.2	33.3	68.6	0.0
12:00AM	2.2	0.0	58.2	31.3	58.2	31.3
Total	987.556	133.62	1203.67	505.655	1304.928	166.79
Days/year	251	114	251	114	251	114
Total Hours/Year	2478.8	152.3	3021.2	576.4	3267.1	154.5
Annual Run Time	**2631**		**3598**		**3422**	
Coincident Factor	**55%**		**82%**		**74%**	

The contractor's original fixture counts matched the evaluation team's fixture counts. Therefore, ex-post energy savings were calculated by applying the monitored hours to the fixture wattage reduction, shown in Table 67. The coincident peak kW reduction was calculated as the fixture wattage reduction times the coincident factor.

Table 73: Hawthorne Library Fixture Summary – Part 1

		EXISTING LIGHTING SYSTEM									***AS/BUILT***				
Logger File	**Area**	**Code**	**Existing Fixture Type**	**DESCRIPTION**	**FIX. QTY.**	**Peak % On**	**TOTAL FIX. KW**	**Contractor Annual Hours**	**Metered ANNUAL HOURS**	**ANNUAL KWH**	**New Fixture type**	**FIX. QTY Instlled**	**TOTAL FIX.(S) KW**	**ANNUAL KWH**	**CoincidentPeak kW Savings**
1	HALLWAY	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	55	0.07		2,631	189.4	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	124	0.01
1	HALLWAY	F42EE	U LAMP TROFFER	Fluorescent, (2) 48", ES lamp	1	55	0.07		2,631	189.4	4 ft. 2 Lamp T8 & Elec Ballast U Lamp	1	0.04	100	0.02
1	KITCHEN	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	1	55	0.14		2,631	378.9	4 Ft. T8 Lamp & Electronic Ballast	1	0.10	263	0.02
1	BACK HALLWAY	F41EE	STRIP	Fluorescent, (1) 48", ES lamp	9	55	0.39		2,631	1,018.2	4 Ft. 1 Lamp T8 & Electronic Ballast	9	0.25	663	0.07
1	UPSTAIRS HALL	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	8	55	0.58		2,631	1,515.5	4 Ft. 2 Lamp T8 & Electronic Ballast	8	0.38	989	0.11
2	BACK OFFICE	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	24	82	3.46		3,598	12,433.5	4Ft 4 Lamp T8 &elec ballast hi Reach	24	2.40	8,634	0.87
2	BACK OFFICE	F42EE	WRAP	Fluorescent, (2) 48", ES lamp	3	82	0.22		3,598	777.1	4 Ft. 2 Lamp T8 & Electronic Ballast	3	0.14	507	0.06
2	LIBRARIAN OFFICE	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	2	82	0.29		3,598	1,036.1	4 Ft. T8 Lamp & Electronic Ballast	2	0.20	720	0.07
2	FRONT OFFICE	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	4	82	0.58		3,598	2,072.3	4 Ft. T8 Lamp & Electronic Ballast	4	0.40	1,439	0.14
2	FRONT OFFICE 2	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	3	82	0.43		3,598	1,554.2	4 Ft. T8 Lamp & Electronic Ballast	3	0.30	1,079	0.11
2	MEETING ROOM	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	18	82	2.59		3,598	9,325.1	4 Ft. T8 Lamp & Electronic Ballast	18	1.80	6,476	0.65
2	MEETING ROOM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	7	82	0.50		3,598	1,813.2	4 Ft. 2 Lamp T8 & Electronic Ballast	7	0.33	1,184	0.14
2	MAINTENANCE RM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	2	82	0.14		3,598	518.1	4 Ft. 2 Lamp T8 & Electronic Ballast	2	0.09	338	0.04
2	MAINTENANCE RM	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	2	82	0.15		3,598	539.6	20 Watt Screw-in	2	0.05	165	0.09
2	UPSTAIR STACKS	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	29	82	2.09		3,598	7,511.9	4 Ft. 2 Lamp T8 & Electronic Ballast	29	1.36	4,904	0.59
2	LUNCH ROOM	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	8	82.07	1.15		3,598	4,144.5	4 Ft. T8 Lamp & Electronic Ballast	8	0.80	2,878	0.29
3	BOOK DEPOSIT	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	74.46	0.07		3,422	246.4	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	161	0.02
3	INFO DESK AREA	F46EE	TROFFER	Fluorescent, (6) 48", ES lamp	16	74.46	3.46		3,422	11,825.2	4 Ft. 6 Lamp T8 & Electronic Ballast	16	2.42	8,267	0.77
3	DROP CEILING	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	9	74	1.30		3,422	4,434.4	4 Ft. T8 Lamp & Electronic Ballast	9	0.90	3,079	0.29
3	PERIMETER	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	21	74	1.51		3,422	5,173.5	4 Ft. 2 Lamp T8 & Electronic Ballast	21	0.99	3,377	0.39
3	SLANTED CEILING	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	48	74	6.91		3,422	23,650.3	4Ft 4 Lamp T8 &elec ballast hi Reach	48	4.80	16,424	1.57
3	FLAT CEILING	F44EE	TROFFER	Fluorescent, (4) 48", ES lamp	80	74	11.52		3,422	39,417.2	4 Ft. T8 Lamp & Electronic Ballast	80	8.00	27,373	2.62
3	TYPING BAYS	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	3	74	0.22		3,422	739.1	4 Ft. 2 Lamp T8 & Electronic Ballast	3	0.14	482	0.06
3	LOWER STACK	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	138	74	9.94		3,422	33,997.3	4 Ft. 2 Lamp T8 & Electronic Ballast	138	6.49	22,193	2.57
3	DISPLAY CASE	F41EE	STRIP	Fluorescent, (1) 48", ES lamp	1	74	0.04		3,422	147.1	4 Ft. 1 Lamp T8 & Electronic Ballast	1	0.03	96	0.01
2	KIDS RESTROOM	F42EE	STRIP	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	169	0.06
2	KIDS RESTROOM 2	F42EE	STRIP	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	169	0.06

Table continued on next page.

Table 74: Hawthorne Library Fixture Summary – Part 2

		EXISTING LIGHTING SYSTEM									*AS/BUILT*				
Logger File	**Area**	**Code**	**Existing Fixture Type**	**DESCRIPTION**	**FIX. QTY.**	**Peak % On**	**TOTAL FIX. KW**	**Contractor Annual Hours**	**Metered ANNUAL HOURS**	**ANNUAL KWH**	**New Fixture type**	**FIX. QTY Instlled**	**TOTAL FIX.(S) KW**	**ANNUAL KWH**	**CoincidentPeak kW Savings**
2	MEN RESTROOM	F42EE	U LAMP TROFFER	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 ft. 2 Lamp T8 & Elec Ballast U Lamp	1	0.04	137	0.06
2	MEN RESTROOM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	169	0.06
2	WOMEN RESTROOM	F42EE	U LAMP TROFFER	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 ft. 2 Lamp T8 & Elec Ballast U Lamp	1	0.04	137	0.06
2	WOMEN RESTROOM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	169	0.06
2	MEN RESTROOM	F42EE	U LAMP TROFFER	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 ft. 2 Lamp T8 & Elec Ballast U Lamp	1	0.04	137	0.06
2	MEN RESTROOM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	169	0.06
2	WOMEN RESTROOM	F42EE	U LAMP TROFFER	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 ft. 2 Lamp T8 & Elec Ballast U Lamp	1	0.04	137	0.06
2	WOMEN RESTROOM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	82	0.07		3,598	259.0	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	169	0.06
2	MEN RESTROOM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	82.07	0.07		3,598	259.0	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	169	0.06
2	WOMEN RESTROOM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	82.07	0.07		3,598	259.0	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	169	0.06
260 Hours	CLOSET	F44EE	WRAP	Fluorescent, (4) 48", ES lamp	1	10.00	0.14		260	37.4	4 Ft. T8 Lamp & Electronic Ballast	1	0.10	26	0.01
260 Hours	CUSTODIAL CLOSET	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	10	0.07		260	18.7	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	12	0.01
260 Hours	WASH CLOSET	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	1	10	0.08		260	19.5	20 Watt Screw-in	1	0.02	6	0.01
260 Hours	CLOSET	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	2	10	0.14		260	37.4	4 Ft. 2 Lamp T8 & Electronic Ballast	2	0.09	24	0.01
260 Hours	BOILER ROOM	F42EE	TROFFER	Fluorescent, (2) 48", ES lamp	1	10	0.07		260	18.7	4 Ft. 2 Lamp T8 & Electronic Ballast	1	0.05	12	0.01
260 Hours	CUSTODIAL CLOSET	I75/ 1	75 W INCAND	Incandescent, (1) 75W lamp	1	10	0.08		260	19.5	20 Watt Screw-in	1	0.02	6	0.01
4380 Hours	EXTERIOR	MV250/ 1	WALL PACK	Mercury Vapor, (1) 250W lamp	1	-	0.00		4,380	-	WALL PACK	0	0.00	-	0.00
4380 Hours	EXTERIOR	MV250/ 1	FLOODS	Mercury Vapor, (1) 250W lamp	1	-	0.00		4,380	-	FLOOD	0	0.00	-	0.00
8760 Hours	ALL	I40/ 2	EXIT SIGN	Incandescent, (2) 40W lamp	5	100	0.40		8,760	3,504.0	2 Watt LED Exit Sign	5	0.05	394	0.36
				Total			**49.66**			**171,411.4**			**0.73**	**1,737**	**0.89**

The energy saving realization rate is high due to longer than estimated runtimes. The coincident peak kW realization rate is low because only fixture savings were provided for kW savings, no consideration of peak period runtime was assessed.

Table 75: Hawthorne Library Savings Summary

Site	**Tracking**		**Evaluated**		**Realization Rate**	
	kWh	kW	kWh	kW	kWh	kW
Hawthorne	36,192	16.26	57,115	12.73	158%	78%

5. Appendix E - Boiler Retrofit Sites

There were 31 site that had space heating boilers replaced with higher efficiency units as part of the Partnership Program. The documentation provided was a spreadsheet of participant sites and the model numbers of the equipment to be installed and removed. The evaluation team did not receive the documentation until these activities had been performed so no pre-installation visits were able to be conducted at any of these sites. Efficiency looks up on the preexisting boiler showed all that could be found had thermal efficiencies of .80. The evaluation assumed those without efficiency data were similar.

Post implementation visits were conducted at the six sites highlighted in Table 76. The equipment observed at the sites matched program documentation. The natural gas loads were assessed at the same time. All facilities had only space heating from the boilers and water heating from a separate system as the sole source of natural gas loads. Moreover, it was found that hand washing was the primary hot water usage at these facilities.

Table 76: Selected Program Documentation

No.	Facility	Units	Manufacturer	Model	BTU-output	Manufacturer	Model	BTU-output	EFF	Therm Saving
1	Bellflower Court	2	Ajax	WG-1375	1,100,000	RBI Dominator	DB 1350	1,147,500	85%	5,874
2	Glendale Court	2	Ajax	WG-1250	960,000	RBI Dominator	DB 1050	892,500	85%	5,874
17	East LA Court	2	Rite	200 WG		Rite Engineering	200WGE		83%	5,874
5	San Fernando Court	2	Ajax	VGFD-105(	960,000	RBI Dominator	DB 1350	892,500	85%	5,874
4	Pomona Courthouse	2	Rite	76X	608,000	RBI Dominator	DB 750	checking	85%	5,874
3	ISD Headquarters	2	Ajax	WGB1125	880,000	RBI Dominator	DB 1050	892,500	85%	5,874
6	West L. A. Court.	2	Ajax	WG750	600,000	RBI Dominator	DB 750	checking	85%	5,874
9	Iacoboni Lib	1	Ajax	WGB900		Rite Engineering	90WGE		83%	2,937
6	Hawthorne Lib	1	Tpak	GW900		Rite Engineering	63WGE		83%	2,937
3	Culver City Lib	1	Ajax	WGB-600		Rite Engineering	63WGE		83%	2,937
7	Hollypark Lib	1	Ajax	WG300		RBI	DB300		85%	2,937
20	El Monte Lib	1	Tpak	GW430		Rite Engineering	48WGE		83%	2,937
23	Pico Rivera Lib	1	Tpak	GW602		RBI	DB300		85%	2,937
19	Claremont Lib	1	Ajax	WGB850		Rite Engineering	76WGE		83%	2,937
10	La Puente Lib	1	Tpak	GW473		RBI	DB400		85%	2,937
16	West Covina Lib	1	Ajax	WGB1050		Rite Engineering	85WGE		83%	2,937
18	Baldwin Park Lib	1	Ajax	WG525		RBI	DB600		85%	2,937
5	Hacienda Hgts Lib	1	Tpak	WG525		RBI	DB400		85%	2,937
15	West Covina Lib	1	Ajax	WG1125		Rite Engineering	85WGE		83%	2,937
1	AC Bilbrew Lib	1	Ajax	WGB1050		Rite Engineering	90WGE		83%	2,937
22	La Mirada Lib	1	Ajax	WG525		Rite Engineering	48WGE		83%	2,937
24	Rowland Heights Lib	1	Ajax	WGB600		Rite Engineering	48WGE		83%	2,937
8	Hunt Park Lib	1	Ajax	WGB1500		Rite Engineering	105WGE		83%	2,937
26	Temple City Lib	1	Tpak	GW430		RBI	DB400		85%	2,937
13	Montebello Lib	1	Tpak	GW1350		Rite Engineering	105WGE		83%	2,937
11	Lawndale Lib	1	Rite	90WG		Rite Engineering	48WGE		83%	2,937
2	Compton Lib	1	Tpak	GWA1500		Rite Engineering	90WGE		83%	2,937
25	So El Monte Lib	1	Tpak	GW310		RBI	DB300		85%	2,937
14	Norwalk Lib	1	Ajax	WG1500		Rite Engineering	105WGE		83%	2,937
12	Manhattan Bh Lib	1	Tpak	WG350		Rite Engineering	48WGE		83%	2,937
21	La Canda Lib	1	Ajax	GW525		Rite Engineering	55WGE		83%	2,937
4	Gardena Lib	1	Tpak	GW559		RBI	DB400		85%	2,937

Although the revised provisional sampling plan called for six sites, a census was attempted since an economically efficient billing data analysis was utilized. Billing data were acquired for 29 of the 31 sites. The ISD Headquarters has only a master meter that serves multiple buildings, so usage from that building is indistinguishable. No billing data were provided for the Pasadena Courthouse.

The billing analysis began by calculating an weather normalized annual consumption for each site based upon post implementation billing data. The consumption equations were calculated with a linear regression of billed usage to heating degree days base 65, HDD_{65}. Then typical year HHD_{65} from the appropriate CEC climate zone were applied to the regression equations to obtain normalized annual consumption.

The normalized annualized consumption was disaggregated into heating load and base load with the assumption that water heating is more or less constant year round and there little or no space heating usage in the months of July and August.

Table 77: Boiler Site Summaries

Site	Boilers	Tracking Savings (Therms)	Normalized Annual Consumption (Therms)	Base Load (Therms)	Heating Load (Therns)	New Boiler Eff.	Annual Savings (Therms)	Realization Rate
Bellflower Courthouse	2	5,874	25,537	1,696	23,841	0.85	2,073	35%
Norwalk Library	1	2,937	10,624	763	9,861	0.83	605	21%
Hawthorne Library	1	2,937	11,117	851	10,266	0.85	893	30%
Manhattan Bh Library	1	2,937	2,349	77	2,273	0.83	140	5%
La Mirada Library	1	2,937	2,120	136	1,984	0.83	122	4%
AC Bilbrew Library	1	2,937	5,661	254	5,407	0.83	332	11%
Montebello Library	1	2,937	13,045	855	12,190	0.83	748	25%
West Covina Library	1	2,937	14,715	804	13,911	0.83	854	29%
West LA Courthouse	2	5,874	12,559	787	11,772	0.85	1,024	17%
Gardena Library	1	2,937	4,344	233	4,111	0.85	357	12%
Rowland Heights Library	1	2,937	2,237	125	2,111	0.83	130	4%
East LA Courthouse	2	5,874	38,092	2,924	35,167	0.83	2,159	37%
Hollypark Library	1	2,937	4,497	210	4,287	0.85	373	13%
Compton Library	1	2,937	5,897	545	5,352	0.83	328	11%
El Monte Library	1	2,937	2,375	197	2,177	0.83	134	5%
Pomona Courthouse	2	5,874	74,017	5,713	68,304	0.85	5,939	101%
Baldwin Park Library	1	2,937	3,701	291	3,409	0.85	296	10%
La Canda Library	1	2,937	8,517	490	8,028	0.83	493	17%
Culver City Library	1	2,937	8,240	380	7,860	0.83	482	16%
Iacoboni Library	1	2,937	8,624	242	8,383	0.83	515	18%
Temple City Lib.	1	2,937	5,992	349	5,643	0.85	491	17%
Glendale Courthouse	2	5,874	23,123	1,196	21,927	0.85	1,907	32%
Hunt Park Library	1	2,937	3,095	163	2,932	0.85	255	9%
San Fernando Courthouse	2	5,874	34,270	2,277	31,992	0.85	2,782	47%
Pico Rivera Library	1	2,937	2,069	168	1,901	0.85	165	6%
South El Monte Lib.	1	2,937	3,890	232	3,658	0.85	318	11%
Hacienda Heights Library	1	2,937	2,068	200	1,868	0.85	162	6%
La Puente Library	1	2,937	3,695	259	3,436	0.85	299	10%
Lawndale Library	1	2,937	7,256	357	6,899	0.83	423	14%
ISD Headquarters (est)	2	5,874	34,600	2,432	32,167	0.85	2,797	48%
Pasadena Courthouse (est)	2	5,874	34,600	2,432	32,167	0.85	2,797	48%
Total	**39**	**114,543**	**412,925**	**27,638**	**385,287**		**30,393**	**27%**

The savings were calculated as a result of the difference in thermal efficiencies between the newly installed boiler and the assumed operating efficiency of the previous boiler. Flue gas analysis reports submitted by the county showed an average operating efficiency of 78.2% for similar size and age boilers. The usage for ISD headquarters and the Pasadena Courthouse were estimated as the average of the other six sites where two boilers were installed.

Low realization rates were largely the result of low heating loads found at many of these facilities.

Additionally another distinct billing analysis estimation was conducted with the boiler retrofits site to estimate savings via pre and post implementation weather normalized usage from billing data The results of the analysis are shown in Table 78. The pre/post

billing analysis was shown to be an inaccurate means of estimating savings. Given the increase in boiler efficiencies in the program element realistic savings of 3 -20% pre-retrofit usage
, possibly as much as 25% in the case of a very poorly performing preexisting boiler. However, very few of the savings estimates calculated using this methods are within the reasonable range.

The Bellflower and San Fernando Courthouses underwent retrocommissioning activities during this period, which make the boiler efficiency savings indecipherable from other gas saving measures using this technique. Likewise many of the libraries show increases in normalized annual consumption, and other show savings that are not attainable through boiler efficiency increase alone. In order to have a successful pre/post billing analysis, the measure itself needs to be the only change to the gas consumption of the facility and occupant behavior needs to remain constant. Evidently, there have been considerable operational changes at these facilities, and/or meter misreads. Any effect of the boiler efficiency improvement is dwarfed by changes in operation schedule, and user behavioral changes that affected the post implementation gas consumption such that this technique is not reliable without further investigation of change at the site.

Since site level investigation is beyond the scope of this evaluation, the above engineering estimate of a reasonable fraction of post implementation normalized is provided as the evaluated savings.

Table 78: Boiler Billing Analysis Results

	Tracking Savings (therms)	Boiler Retrofit Billing Analysis			
		Pre-Usage NAC (therms)	Billing Analysis Ex-Post Savings (therms)	Billing Realization Rate	Savings as % of Pre-Usage NAC
Bellflower Courthouse	5,874	49,990	24,453	416%	49%
Norwalk Library	2,937	15,219	4,595	156%	30%
Hawthorne Library	2,937	10,866	-252	-9%	-2%
Manhattan Bh Library	2,937	2,508	159	5%	6%
La Mirada Library	2,937	4,245	2,125	72%	50%
AC Bilbrew Library	2,937	9,286	3,625	123%	39%
Montebello Library	2,937	22,014	8,969	305%	41%
West Covina Library	2,937	19,107	4,392	150%	23%
West LA Courthouse	5,874	13,896	1,336	23%	10%
Gardena Library	2,937	4,246	-97	-3%	-2%
Rowland Heights Library	2,937	2,922	685	23%	23%
Hollypark Library	2,937	1,751	-2,746	-93%	-157%
Compton Library	2,937	15,725	9,828	335%	62%
El Monte Library	2,937	987	-213	-7%	-22%
Baldwin Park Library	2,937	3,701	427	15%	12%
La Canda Library	2,937	8,517	649	22%	8%
Culver City Library	2,937	8,240	3,581	122%	43%
Iacoboni Library	2,937	8,624	5,095	173%	59%
Temple City Lib.	2,937	5,992	1,465	50%	24%
Glendale Courthouse	5,874	23,123	11,741	200%	51%
Hunt Park Library	2,937	3,095	10,307	351%	333%
San Fernando Courthouse	5,874	34,270	16,233	276%	47%
Pico Rivera Library	2,937	2,069	442	15%	21%
South El Monte Lib.	2,937	3,890	1,516	52%	39%
Hacienda Heights Library	2,937	2,068	-2,681	-91%	-130%
La Puente Library	2,937	3,695	-1,366	-47%	-37%
Lawndale Library	2,937	7,256	1,540	52%	21%
Total	108,669	287,302	95,500	88%	33%