Report version: 1.1
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Report prepared for: EMG Corp.

Property address:
1415 Harrison Street, Oakland CA 94612

Property type:
Multifamily, seven story high-rise, 81 SRO apartments. Originally built 1914.
Total conditioned area: 27,690 square feet, excluding ground floor retail.
Central heating, cooling and domestic hot water.

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Executive Summary:

We have calculated a potential savings of 27.8% TDV energy from a combination of measures. The dollar savings is approximately 22%. The property already has undergone significant energy saving upgrades, including a partial lighting retrofit and dual pane windows.

Energy use is dominated by space heating and water heating. Lighting and space *cooling* are also significant.

Space heating for all apartment units is provided by a central gas boiler, with dual single speed pumps delivering hot water to radiators in each unit. The units are not cooled. The lobby area is heated and cooled by a rooftop packaged unit delivering conditioned air via ducts. The elevator mechanical room has cooling provided by a mini-split heat pump. Some of the bathrooms have been retrofit with ventilation fans. Installation of fans in the remaining bathrooms is recommended.

Existing Conditions

Annual Energy Use

(All figures except TDV energy use are based on billing data May 2013 - April 2014. TDV energy use is calculated from energy simulation model.)

Year round baseline electricity cost	$18,588
Annual domestic hot water	$ 7,188
Seasonal use (space heating and cooling)	$ 9,143
Total energy cost	$34,919
Electrical use	211,710 kWh/yr.
Gas use	14,092 therms/yr.
Calculated TDV energy use intensity	194.4 kBTU/sq ft/yr

Billing Data

Start Date	Usage Kwh	Cost ($)	$/kWh
05/23/13	20400	2172	$0.11
06/24/13	20000	2139.2	$0.11
07/25/13	18880	2052.64	$0.11
08/22/13	19360	2097.26	$0.11
09/20/13	20080	2098.43	$0.10
10/23/13	17360	1670.35	$0.10
11/21/13	20000	1912.57	$0.10
12/23/13	18640	1744.2	$0.09
01/23/14	16880	1549.37	$0.09
02/21/14	18880	1786.19	$0.09
03/25/14	17360	1634.59	$0.09
04/24/14	17520	1826.29	$0.10

Annual electricity cost	$22,683.09
Average rate	$0.10
Annual Baseline electricity	$18,588.00
Annual gas heat	$5,048.00
Electricity for heat & cool	$4,095.09
Total annual for heat & cool	$9,143.09

Start Date	Usage – Therms	Cost ($)	$/therm
05/23/13	912	842.93	$0.92
06/24/13	741	661.09	$0.89
07/24/13	728	639.7	$0.88
08/22/13	699	599.33	$0.86
09/23/13	704	600.32	$0.85
10/22/13	1013	903.27	$0.89
11/21/13	1723	1521.7	$0.88
12/23/13	1516	1418.38	$0.94
01/23/14	1559	1566.64	$1.00
02/24/14	1174	1243.95	$1.06
03/25/14	1204	1207.09	$1.00
04/24/14	1018	1031.92	$1.01

Annual gas cost	$12,236.32
Average rate	$0.91
DHW gas cost	$7,188.00
Heating gas cost	$5,048.32
Annual electricity cost	$22,683.00
Total annual energy cost	$34,919.32

Building assemblies:

Floor: Uninsulated concrete basement with slab.
Roof: Flat built-up roof. R-12 foam insulation.
Walls: 6" masonry.
Windows: Windows in all units are dual pane with non-metal frames. Six units also have '8-lite' wood doors to the fire escape. Windows in these doors are single pane. The lobby area has single pane site built windows with metal frames.

Appliances:

Average refrigerator age is 2 years and average usage is 275 kWh/yr.
Units have microwave ovens and no other appliances.

Lighting:

Units and bathrooms have compact fluorescent lighting with on/off switches. Hallways have fluorescent lights that remain on 24/7. Lobby has a combination of T8 and T12 lighting that is on 24/7. laundry room has T12 lighting with occupancy control. Basment has T8 fixtures with on/off switches.

Mechanical equipment:

Harrison Hotel Equipment			
RTU	Trane	YHC102A3RLA1L	
	Cooling tons		10
	SEER		11
	AFUE		0.8
	Manufactured	Mar 2005	
Heating Boiler	Laars	PNCH0750NACK2CXN	
	input		750000
	output		630000
	AFUE		0.84
Heating Pumps			
Motors	Baldor	VJMM3218T	
	HP		5
Pumps	Bell & Gossett	2X9.5	
	HP		5
	GPM		15
	RPM		1750
	count		2
DHW	AO Smith	HW 399 592	
DHW circ pump	Gosset	102213 HV-BNFI	
	HP		2
Exhaust fan	Penn	RT200	
	CFM		2875
Mini-split	Indoor	MW30C3G	
Friedrich	Cooling capacity	30700 Btu/hr	
	SEER		16.5
	EER		9.5
	Outdoor	MR30C3G	
Water pressure pumps			
Motor	Franklin		1303007104
	HP		3
	PH		3
	RPM		3500
Pump	Goulds	2ST1H2A3	
	size		1.25
	Count		2

Modeled pre and post retrofit energy use intensity (EUI):

Pre-retrofit TDV EUI: 194.4 kBTU/sq ft/yr (average weather year).
After retrofit TDV EIU: 152.1 kBTU/sq ft/yr (average weather year)
This represents a total TDV energy savings of approx 27.8%.

Operating cost in average weather year before retrofit: $37,593
Operating cost in average weather year after retrofit: $29,034
Total dollar savings: $,8,559 (22.8%)

Recommended energy efficiency measures (EEMs):

Energy savings percentages in the table below are given for each individual energy efficiency measure modeled separately.
The figure for combined EEMs is for all measures modeled together. The combined measures are not a simple sum of individual measures.

Energy efficiency measure	TDV energy use kBTU/ ft^2/yr	% energy savings	Total kWh/Yr	Annual kWh savings	Peak demand (kW)	Total Therms/yr	Annual Therm savings	Annual operating cost	Annual Dollar savings
No EEMs	194.4		219424		43.5	14922		$37,593	
Window shading	192.6	-0.9%	214485	4939	42.3	15198	-276	$37,287	$306
Condensing DHW	182.6	-6.5%	219424	0	43.5	12717	2205	$35,715	$1,878
Var speed pumps	176.4	-10.2%	179827	39597	37.7	14922	0	$33,286	$4,307
Exhaust fan EC motor	192.3	-1.1%	215607	3817	43.1	14922	0	$37,182	$411
Outdoor air reset	187.5	-3.7%	213858	5566	43.5	14212	710	$36,405	$1,188
Lobby lighting	189.9	-2.4%	209393	10031	42.6	15074	-152	$36,360	$1,233
Combined EEMs	**152.1**	**-27.8%**	**159362**	**60062**	**35.2**	**12490**	**2432**	**$29,034**	**$8,559**

Window shading:

Install two rows of shading devices over both upper and lower rows of lobby windows to reduce cooling load. Shading devices are assumed to project out 4 feet from building and be level with tops of windows. The reduced load on the air conditioning system more than offsets the increased load on the heating system.

Domestic hot water boiler:

Replace exising domestic hot water boiler with high efficiency condensing boiler. Existing boiler is 21 years old (manufactured 1993). Replacement will provide significant savings. Savings are based on new model: Hamilton Engineering - EVO Duo HWDN00299ASME

Outdoor air reset:

Install outdoor air temperature reset control to shut down boiler when outdoor air temperature rises above set point. During inspection, the boiler was found to be delivering heat to apartments when the outdoor air temperature was 72 degrees and the coolest apartment (second floor shady side of building) was measured at 75 degrees with the window open. For modeling purposes, the savings has been calculated by reducing the heating hour schedule.

Variable speed pumps:

Replace fixed speed pump motors that provide heat to apartment radiators with variable speeds pump motors. This will provide the single biggest source of energy savings in the project.

Also replace water supply pressure booster pumps with variable speed pumps for additional marginal savings.

NOTE: Existing parallel booster pumps are not operating due to poor condition of pumps. No water pressure problems are reported, but there is currently no way to boost pressure in the event of a reduction in street water pressure. Savings estimate is based on four hours per day of normal operation for a single pump.

Exhaust fan:

Replace existing shaded pole motor on centrtal exhaust fan with high efficiency EC motor.

Lobby lighting:

Install daylight sensors to reduce lighting hours in the lobby. Replace T12 lamps with T8 lamps. For modeling the savings is calculated by changing lighting schedule from 24 hours to 'Hotel' hours, and by reducing lighting power density from 0.7 watts/ft^2 to 0.5 watts/ft^2 in the lobby.

Vending machine:

Install 'energy miser' on vending machine. This is a simple 'plug & play' type measure. Savings of approx $100/yr is not included in energy model because the machine is not a building component.

Measures evaluated and not recommended:

Replacement of central heating boiler with new high efficiency condensing unit would provide an additional TDV energy savings of 2.1%. The existing boiler is less than ten years old (manufactured 2005) and has a remaining service life of at least ten years. Boiler replacement is not recommended at this time.

Solar:

The roof area is 4000 sq ft, but the available roof area is about half that (2,000 sq ft).

Solar PV panels are approximately 15 sq ft each, so the available roof area can accomodate about 133 PV panels (possibly a bit more depending on mounting configuration). At 200 watts/panel, that provides approximately 27 kW DC, or about 25 kW AC. The potential electrical generation is 35,000 kWh/yr. The electric rate for the hotel is $0.10/kWh, so the savings would be around $3,500/year.

The current cost to heat domestic hot water is approximately $7200/year. A solar thermal system could save about $5,000/year assuming a 'solar fraction' of 70%. savings is in reference to existing hot water heater, not the recommended high efficiency replacement.

Installation of a solar thermal hot water system would reduce the amount of space available for a solar PV system.

Energy Modeling Methodology

Peralta Energy uses computer simulation energy models of buildings to predict savings potential. The building characteristics are re-created using software that accounts for the building location, size, usage, construction type, equipment efficiencies, thermostat settings, etc. Current utility rates are also entered into the model, as well as the most recent 12 months of actual energy usage data. The model uses both 30 year average weather data for the building location, as well as the 12 months of actual 'normalized' weather data that matches the time period for utility usage data. The use of 30 year average weather data allows the software to predict how much energy the building will use in future average years. The use of normalized weather data that matches the time period of actual utility usage data allows for 'calibration' of the building simulation model. This calibration process allows for a more accurate representation of the building energy usage than an uncalibrated model. Once a baseline model of an existing building has been developed and calibrated, an energy efficiency engineer can make a series of changes to the model to simulate the energy and economic impact of those changes. This process significantly improves the accuracy of the recommended Energy Efficiency Measures (EEMs) generated by a Level 2 energy audit.

Peralta Energy's calibrated energy usage charts show three lines:
Actual energy use corresponds to the utility billing data for the period under study.
Modeled energy use is the predicted energy usage of the building in future years, using 30 year average weather.
Normalized energy use is what the model predicts the building would use in a weather year that matches the actual weather for the period under study.

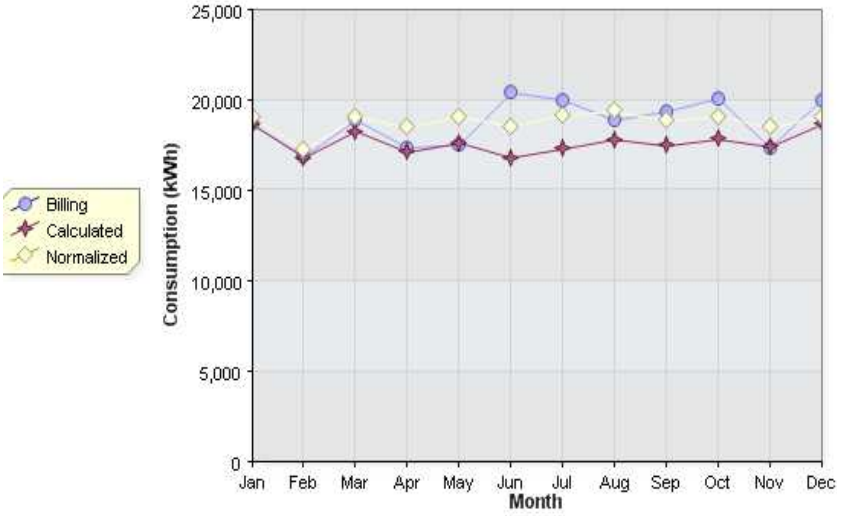
The closer the 'normalized' line is to the 'actual' line, the more accurate the overall model.

Our computer simulations are developed using EnergyPro software. Weather data comes from NOAA. (Predictions of energy usage or energy savings are not a guarantee of actual savings that may result from facility improvements.)

Calibrated energy usage:

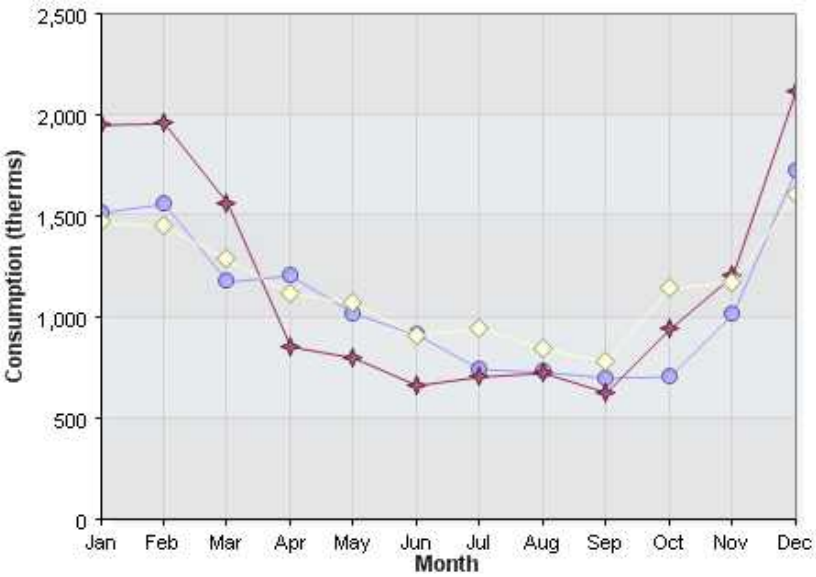
Pre-retrofit electricity:

- Blue line is actual billing data.
- Red line shows modeled usage using 30 year average weather.
- Yellow line shows modeled usage with weather data for the same period as the actual billing data.



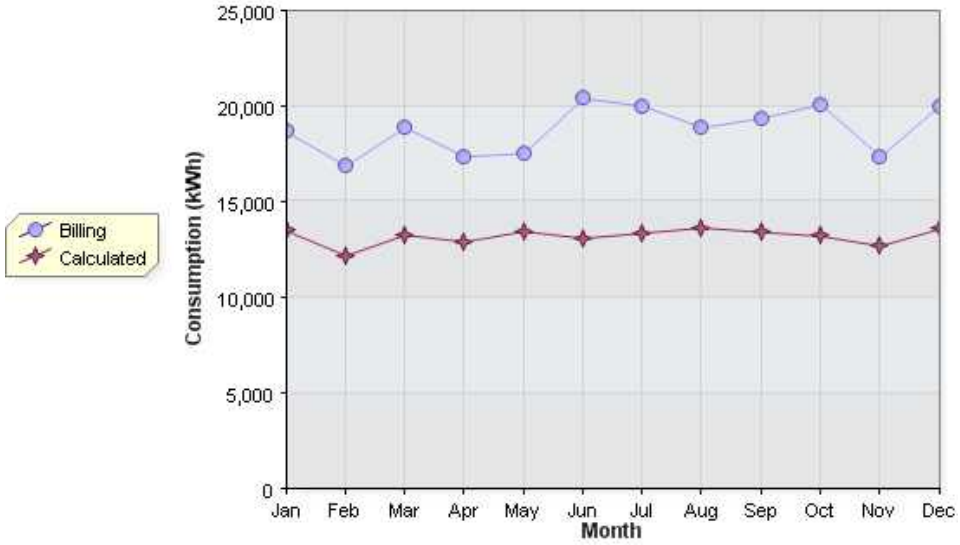
Pre-retrofit gas:

The period was mild compared to average years (mild winter).

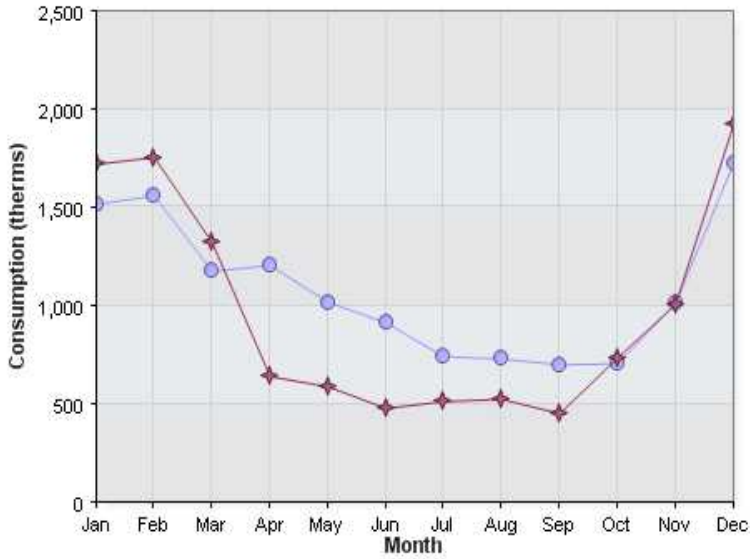


Post-retrofit predicted energy use:

After retrofit predicted electricity (red line) compared to recent billing data (blue):



After retrofit predicted gas (red line) compared to recent billing data (blue):



Energy model data inputs:

The actual PG&E rates at the property:
Electric rate: EML TB Multifamily CARE. Gas rate: GM T Multifamily CARE.

Energy model data inputs	
Weather station	Oakland Museum
Utility Rate Electric	PG&E Multifamily CARE electric
Utility Rate Gas	PG&E Multifamily CARE gas
Virtual electric rate	$0.10/kWh
Virtual gas rate	$0.91/therm
Year built	1914
Conditioned floor area	27,690
Wall assemblies	6” concrete
Roof assemblies	4” concrete w/R-12 foam
Floor assemblies	slab
Windows, apartments	dual pane non-metal
Windows, lobby	single pane metal frame
Occupancy type	Multi-family high rise
Occupant density	100 sq ft/person
Lighting power density, apartments	0.25 watts/sq ft
Lighting power density, lobby	0.7 watts/sq ft
Lighting power density, basement	0.36 watts/sq ft
Lighting schedule, appartments	Multifamily
Lighting schedule, lobby	24 hour
Lighting schedule, basement	Office
Ventilation rate	0.15 cfm/sq ft
Water heater efficiency	0.82
Plug load	0.5 watts/sq ft
Fan HP/unit	5
Fan speed	fixed
Heating Pump HP	5
Heating Pump speed	fixed
Heating pump gpm	15
Heating pump count	2
Economizer	fixed temp 75
HVAC schedule, apartments	Multifamily heating
HVAC schedule, lobby	Retail heating and cooling
Thermostat winter	70
Thermostat summer	75
Heating boiler set point	180
Heating boiler recovery efficiency	0.81
Outside air preheat coil setpoint	NA
Cooling supply air setpoint	55
Bath exhaust fans total cfm	1650
Bath exhaust fans total HP	1.5
Central exhaust fan cfm	1200
Central exhaust fan HP	1

CalGreen Compliance:

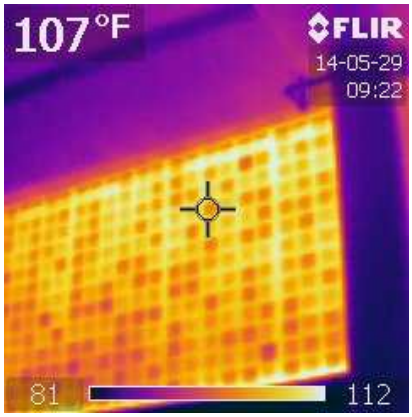
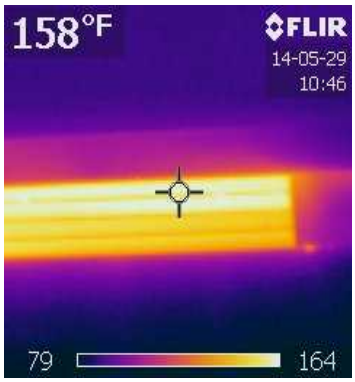
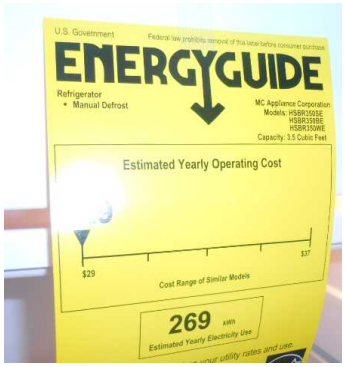
CalGreen verification will be facilitated by collecting invoices showing specific product names and product numbers or models.

- EnergyStar bath fans with humidistat controls are required for compliance.
  Example models: Delta Electronics # VFB25ACH. Air King Model # ESB80DH
- New toilets must be 1.28 gal. Shower heads must be under 2.0 gpm.
- Caulks, adhesives, paint: Invoices from contractors and sub-contractors must show product names and numbers in order to verify *low VOC* compliance.
- Carpet, pads, resilient flooring: Invoices from contractors and sub-contractors must show product names and numbers in order to verify *green certification*.
- Irrigation controllers must include soil moisture or weather sensors.
- Operations & maintenance manual must be provided to facility operator. A sample O&M template is available here:
  http://www.hcd.ca.gov/codes/calgreen/WS-2.docx
- The O&M manual must meet the following specifications:

At the time of final inspection, a manual, compact disc, web-based reference or other media acceptable to the enforcing agency which covers 10 specific subject areas shall be placed in the building.

1. Directions to homeowner or occupant that the manual shall remain with the building throughout the lifecycle of the structure.
2. Operation and maintenance instructions for:
   a. Equipment and appliances, including energy and water-saving devices and systems, HVAC systems, water-heating systems, lighting and other major appliances and electronic equipment.
   b. Roof and yard drainage, including gutters and downspouts.
   c. Space conditioning systems, including condensers, condensate drains and air filters
   d. Landscape irrigation systems
   e. Water reuse systems
3. Information on ways to optimize water and energy use including household recycling opportunities and water/ energy reduction opportunities through utilities or recycling programs
4. Information on routine maintenance to maintain integrity of building interior and exterior including painting and caulking, grading etc.
5. Instructions for keeping gutters clean and directing downspouts to divert water away (at least 5 feet) from the home and importance of roof and yard drainage
6. Instructions on the positive impacts of an interior relative humidity between 30–60 percent and what methods an occupant may use to maintain the relative humidity level in that range.
7. Information on public transportation/ carpooling in the area
8. Information on statewide solar incentive programs available
9. Instructions on water-conserving landscape and irrigation design and controllers for conserving water.
10. Copy of all special inspection verifications required by the Authority Having Jurisdiction.

Photos of Existing Conditions:

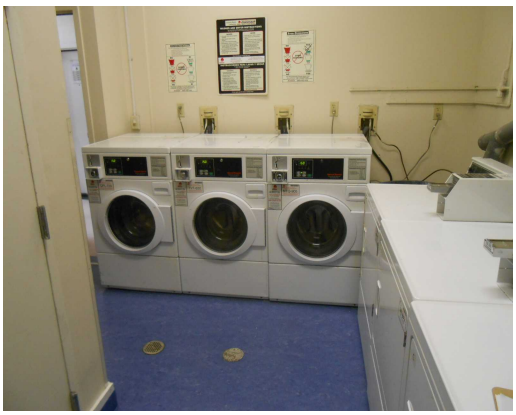
Windows in lobby are single pane, metal frame. 	Lobby windows make a big load on the cooling system. (Thermal image.) Install shade devices on exterior. 
Hot water pump motors are fixed speed. Install variable speed motors for significant savings. 	Thermal image. Radiator is delivering heat while apartment window is open and outdoor air is 72 degrees. Install outdoor air reset on boiler. 
All apartment windows are high efficiency dual pane with non-metal frames. 	Refrigerators in all units are high efficiency. 

Lobby lights are on while daylight is bright. Install daylight sensors to reduce lighting.

Install an 'energy miser' on the soda vending machine. Payback one year.

Replacement of dometic hot water boiler with high efficiency condensing unit is recommended for significant savings.

Replacement of washers and dryers is not recommended at this time.



These water pressure booster pumps are not currently in service.

Pumps are switched off due to poor condition of pumps.

EnergyPro Reports: Pre and Post Retrofit

Pre-retrofit

Annual Results	Energy Cost			Electricity (kWh)			Fossil Fuel (therms)		
End Use	Existing	Improved	Savings	Existing	Improved	Savings	Existing	Improved	Savings
Space Heating	$6,503			1			7,315		
Space Cooling	$1,163			10,489			0		
Fans	$4,412			39,793			0		
Pumps	$8,332			75,151			0		
Domestic Hot Water	$6,762			0			7,607		
Indoor Lighting	$4,138			37,326			0		
Outdoor Lighting	$0			0			0		
Appliances/Plug Loads	$5,306			47,856			0		
Ancillary	$977			8,808			0		
Renewables	$0			0			0		
TOTAL	**$37,593**			**219,424**			**14,922**		

CO_2 (lbs/year)	Existing	Improved	Savings
Electricity	151,403		
Fossil Fuel	173,837		
TOTAL	**325,240**		
Average Demand (kW)	20.46		
TDV Energy (kBtu/ft^2-yr)	194.38		

Climate Zone:	3
Electric Rate:	PG&E Multifamily CARE
Gas Rate:	PG&E Multifamily CARE Gas
Floor Area:	27,690
Type:	Highrise Res

The estimated operating costs shown in this report are dependent upon many factors. The construction and conservation features of the project clearly are important. Equally important is the thermostat setting. How the thermostat is used, appliance use, and occupant interaction all influence the annual operating cost. The estimates provided in this report are based on typical conditions; your actual usage will vary.

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Post-retrofit

Annual Results	Energy Cost			Electricity (kWh)			Fossil Fuel (therms)		
End Use	Existing	Improved	Savings	Existing	Improved	Savings	Existing	Improved	Savings
Space Heating	$6,351	$6,351	$0	0	0	0	7,089	7,089	0
Space Cooling	$674	$674	$0	6,022	6,022	0	0	0	0
Fans	$3,846	$3,846	$0	34,354	34,354	0	0	0	0
Pumps	$3,746	$3,746	$0	33,461	33,461	0	0	0	0
Domestic Hot Water	$4,840	$4,840	$0	0	0	0	5,402	5,402	0
Indoor Lighting	$3,231	$3,231	$0	28,861	28,861	0	0	0	0
Outdoor Lighting	$0	$0	$0	0	0	0	0	0	0
Appliances/Plug Loads	$5,358	$5,358	$0	47,856	47,856	0	0	0	0
Ancillary	$986	$986	$0	8,808	8,808	0	0	0	0
Renewables	$0	$0	$0	0	0	0	0	0	0
TOTAL	**$29,034**	**$29,034**	**$0**	**159,362**	**159,362**	**0**	**12,490**	**12,490**	**0**

CO_2 (lbs/year)	Existing	Improved	Savings
Electricity	109,960	109,960	0
Fossil Fuel	145,512	145,512	0
TOTAL	**255,472**	**255,472**	**0**
Average Demand (kW)	16.82	16.82	0.00
TDV Energy (kBtu/ft^2-yr)	152.08	152.08	0.00

Climate Zone:	3
Electric Rate:	PG&E Multi-family CARE
Gas Rate:	PG&E Gas Multi-family CARE
Floor Area:	27,690
Type:	Highrise Res

Improvements above shown with cumulative savings benefit for combined measures

The estimated operating costs shown in this report are dependent upon many factors. The construction and conservation features of the project clearly are important. Equally important is the thermostat setting. How the thermostat is used, appliance use, and occupant interaction all influence the annual operating cost. The estimates provided in this report are based on typical conditions; your actual usage will vary.

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