Peralta Energy
Oakland, CA
510.459.0827

Report version: 1.0

Author: Ben Thompson

**Report prepared for:**
Berkeley Student Cooperative

**Property name & address:**
Casa Zimbabwe, Central Kitchen & Central Office, 2424 Ridge Rd., Berkeley CA 94709

**Property type:**
Residence hall, office and warehouse with basement garage.

## Executive Summary:

The property presents a significant opportunity to reduce energy use and operating costs. Total annual electric and gas savings is projected to be on the order of $17,000. Total project cost is projected to be $70 - $100,000 not counting new windows, for a simple payback of 4.1 to 5.8 years. Maintenance savings (eg. changing fluorescent tube lights) is not included.

The space heating and solar hot water systems need to be re-commissioned. Neither the space heating nor the solar hot water systems are functioning properly. Solar hot water system is loosing heat to the air at night due to continuously operating circulation pump. The space heating system fails to deliver heat when desired, and delivers heat when it is not desired. Ventilation fans run continuously at high speed. Walk-in cooler and freezer fan operation is inefficient. CZ kitchen exhaust fans run continuously.

Space heating: The boilers, air supply fans and hot water circulator pumps run continuously, even on warm days, rather than responding to demand. The pneumatic control system is obsolete and should be replaced with a digital control system with a web based interface.

Solar hot water: At a minimum, this sytem needs to be re-commissioned with new sensors and controllers and a web based interface to monitor performance. Some of the collectors should to be replaced as well.

Lighting also presents an opportunity for savings. A photocell is recommended to control loading dock lights. Occupant sensor for crafts room. Improved sensor for lounge. Replace all 'T-8' linear fluorescent lamps with LED.

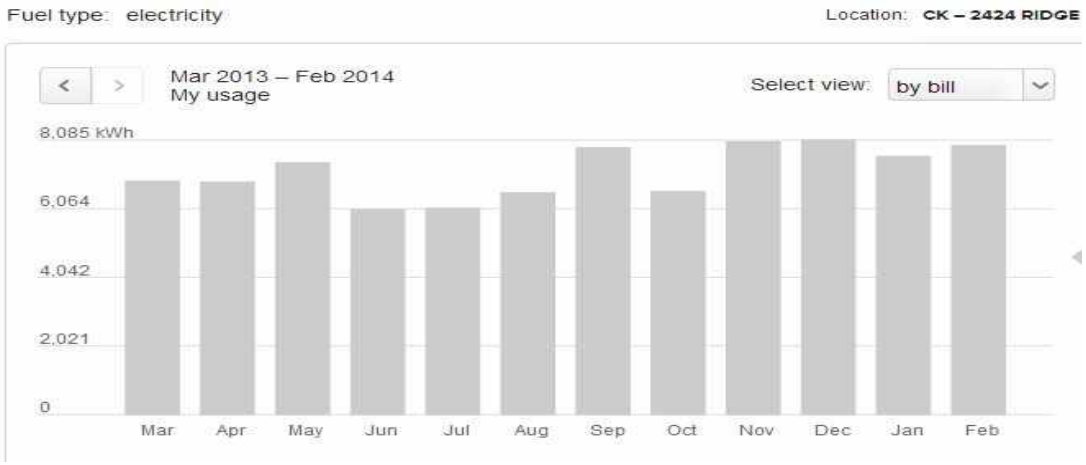
## Existing Conditions

| **Annual Energy Use:** | **Annual Energy Costs:** |
|---|---|
| Facility site energy use intensity: | Electricity: *$32,800*. |
| *111.4 kBTU/sq ft.* | Average cost/kWh: *$0.09/kWh* |
| Electrical use: *347,451 kWh/yr.* | Gas: *$8,274*. |
| Gas use: *33, 314 therms/yr.* | Average cost/therm: *$0.25/therm* |

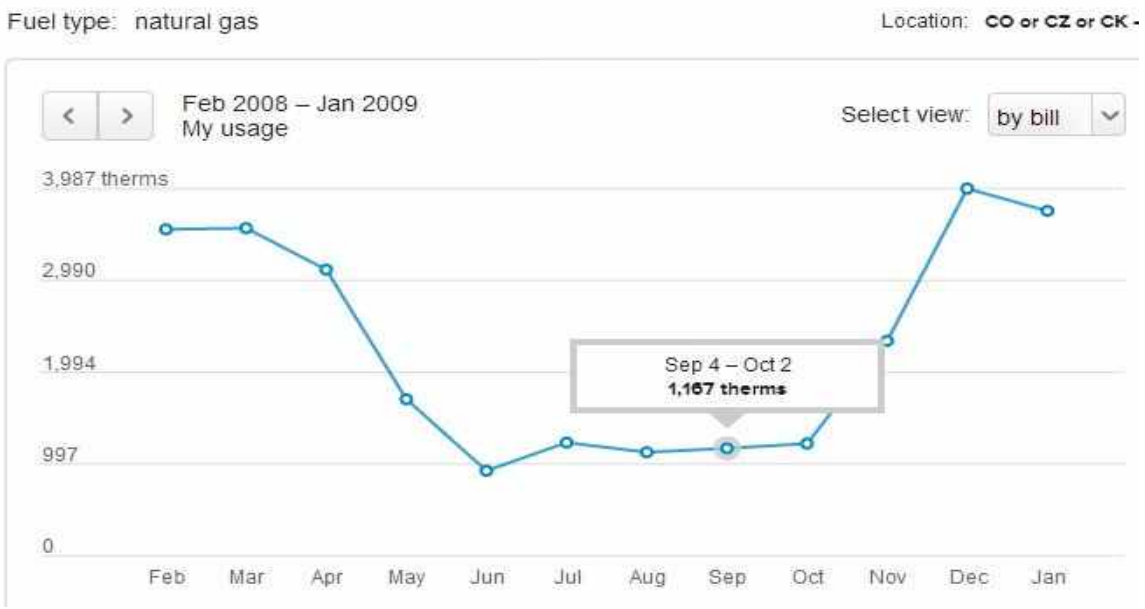
*$CO_2$ emissions: 630,000 pounds $CO_2$/year*

Greenhouse gas emissions are calculated at CPUC ClimateSmart rates of 0.524 lbs. $CO_2$/kilowatt-hour and 13.446 lbs. $CO_2$/therm of gas.

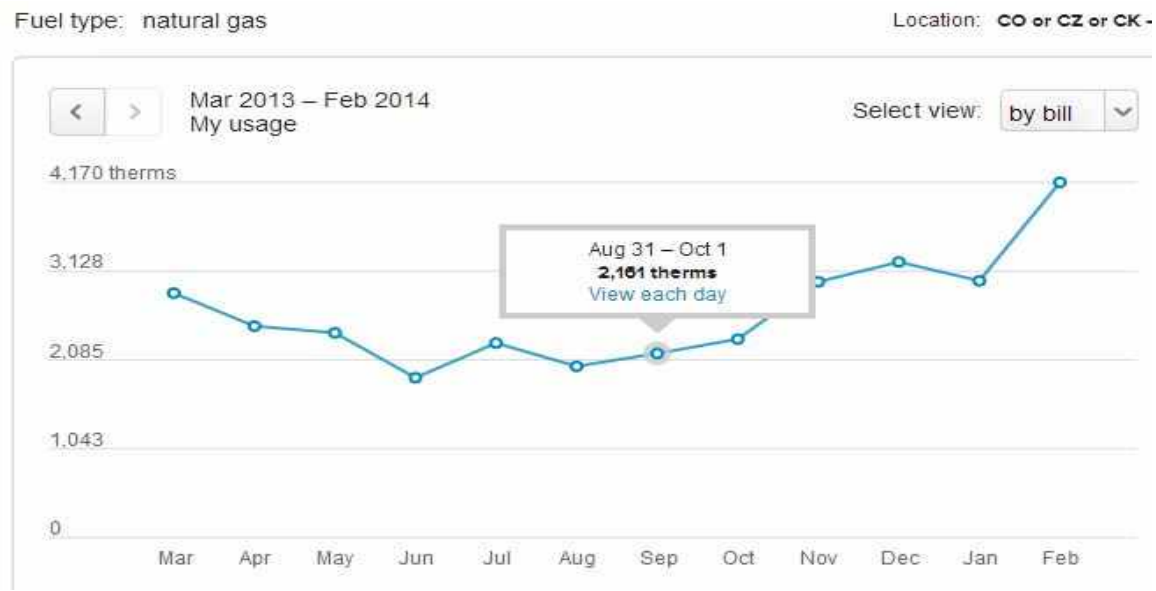
Electricy usage for CZ, CK and CO are shown in the tables below (2 electric meters).




Summer time gas use was significantly lower six years ago, as shown below.




Summer time gas use since 2008 has been much higher.




Comparison of gas use at Cloyne and CZ-CK-CO, which are similar sized facilities.

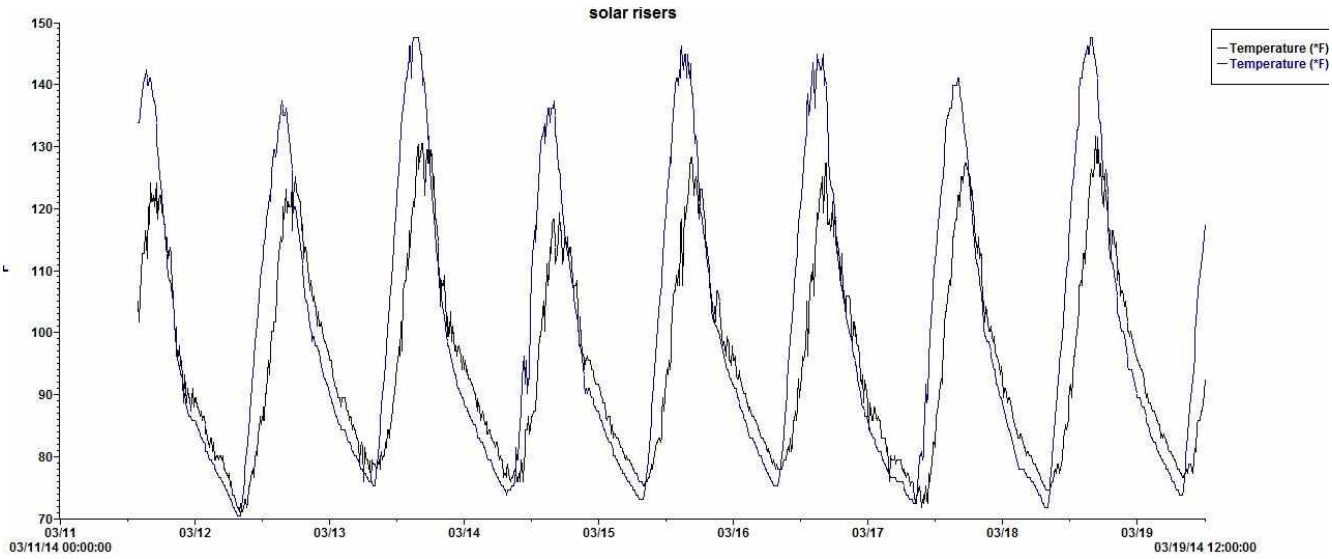
| | | | |
|---|---|---|---|
| Cloyne annual therms/sq ft | 0.30 | Therms/yr | 11706 |
| CZ annual therms/sq ft | 0.82 | Therms/yr | 33314 |

## Mechanical equipment:

- Heating: Two Weil-McLean boilers provide heat for space and domestic hot water. Office, central kitchen and common areas of dormitory have central forced air with three pre-heat coils and fifteen zone level re-heat coils. Controls are pneumatic. Dorm bedrooms have baseboard convectors (radiators) controlled by room thermostats.
- Water heating is provided by a solar thermal system with back-up provided by a heat exchanger loop from the boilers.
- Mechanical ventilation is provided by several supply and exhaust fans. Three of the original exhaust fans that were part of the central kitchen have been removed.

## Solar hot water system:

Measured temperatures on the risers (pipes) leading to and from the solar collectors remains over 70 degrees at night. The circulator pump runs continuously. The hot water system is loosing heat at night to the outdoors. The temperature split (difference) between the inlet pipe(lower peaks) and the collector outlet (higher peaks) is about 20 degrees during the day. This is an expected (design) value.




## Lighting:

Almost all of the lighting in the facility is T-8 fluorescent tubes. Occupancy sensors control lighting in bathrooms and several other locations.

## Energy Retrofit Recommendations:

### Low cost measures:

| | Existing annual kWh | New annual kWh | Annual kWh savings | Cost | Annual $ savings | ROI yrs |
|---|---|---|---|---|---|---|
| Exhaust fan contoller (MeLink) – CZ kitchen | 5088 | 509 | 4579 | $4,000.00 | $457.90 | 8.74 |
| | | | | | | |
| Loading dock photocell | 3504 | 2000 | 1504 | $500.00 | $150.40 | 3.32 |
| | | | | | | |
| Crafts room occ sensor | 1728 | 576 | 1152 | $200.00 | $115.20 | 1.74 |
| | | | | | | |
| CK and CZ coolers | 49112 | 28238 | 20874 | $5,189.00 | $2,087.40 | 2.49 |
| | | | | | | |
| Rooftop condensing unit CZ cooler | 6665 | 3500 | 3165 | $2,000.00 | $316.50 | 6.32 |
| | | | | | | |
| Totals | 66097 | 34823 | 31274 | $11,889.00 | $3,127.40 | 4.52 |

| **Lighting** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | fixtures | watts/fix | watts | annual hours | annual kWh | lamps | new LED watts | annual kWh savings | Cost @ $25ea | Annual $ savings | ROI yrs |
| CO lights | 25 | 64 | 1600 | 2000 | 3200 | 50 | 1000 | 1200 | $1,250 | $120 | 10.42 |
| CK lights | 40 | 64 | 2560 | 2000 | 5120 | 80 | 1600 | 1920 | $2,000 | $192 | 10.42 |
| CK dock lights | 10 | 64 | 640 | 5000 | 3200 | 20 | 400 | 1200 | $500 | $120 | 4.17 |
| | | | | | | | | | | | |
| CZ lights | | | | | | | | | | | |
| Arts & Crafts | 6 | 64 | 384 | 1500 | 576 | 12 | 240 | 216 | $300 | $22 | 13.89 |
| Entryway | 6 | 64 | 384 | 6000 | 2304 | 12 | 240 | 864 | $300 | $86 | 3.47 |
| Garage | 26 | 64 | 1664 | 8760 | 14577 | 52 | 1040 | 5466 | $1,300 | $547 | 2.38 |
| Corridors | 120 | 32 | 3840 | 8760 | 33638 | 80 | 1600 | 19622 | $2,000 | $1,962 | 1.02 |
| Kitchen | 8 | 64 | 512 | 6600 | 3379 | 16 | 320 | 1267 | $400 | $127 | 3.16 |
| | | | | | | | | | | | |
| **Lighting Totals** | **241** | **480** | **11584** | **40620** | **65994** | **322** | **6440** | **31756** | **$8,050** | **$3,176** | **6.1** |

## Capitol intensive measures:

The central heating system should be re-commissioned with digital controls and actuators, demand responsive variable frequency drives on the central supply and exhaust fans, outdoor reset sensors and new zone level thermostats. Cost will be $50,000 to $80,000. Electrical usage and savings is shown in the table below. Post-refrofit duty cycle (on %) of fans and pumps is estimated.

| **Pumps and fans** | Serves | On % | HP | Amps | Volts | Watts | PF | kWh/yr | Assumed New on % | New kWh/yr | Savings |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| **HVAC system** | | | | | | | | | | | |
| Air compressor | | 33% | | 2 | 220 | 440 | 0.66 | 839 | 0% | 0 | $84 |
| Supply fan 1 – boiler room | general | 100% | 5 | 16 | 220 | 3520 | 0.66 | 20351 | 50% | 10176 | $1,018 |
| Supply fan 2 - over cooler | dorm | 100% | 2 | 6 | 220 | 1320 | 0.66 | 7632 | 50% | 3816 | $382 |
| Supply fan 3 - over cooler | kitchen | 100% | 7.5 | 6 | 220 | 5550 | 1 | 48618 | 50% | 24309 | $2,431 |
| Exhaust fan 1 – parts room | general | 100% | 2 | 6 | 220 | 1320 | 0.66 | 7632 | 50% | 3816 | $382 |
| Exhaust fan 4 | women's dorm | 100% | 0.33 | 1.5 | 110 | 244.2 | 1 | 2139 | 100% | 2139 | $0 |
| Exhaust fan 5 | men's dorm | 100% | 0.33 | 1.5 | 110 | 244.2 | 1 | 2139 | 100% | 2139 | $0 |
| Exhaust fan 8 | garage exhaust | 0% | 2 | 10 | 220 | 1480 | 0.66 | | 0% | 0 | $0 |
| Exhaust fan 9 | unit ventilation | 100% | 0.75 | 3 | 110 | 555 | 1 | 4862 | 50% | 2431 | $243 |
| main hot water circ pump | building | 100% | | | | 950 | 0.66 | 5493 | 20% | 1099 | $439 |
| main hot water circ pump | building | 100% | | | | 950 | 0.66 | 5493 | 20% | 1099 | $439 |
| | | | | | | | | | | 0 | |
| **DHW** | | | | | | | | | | 0 | |
| circ pump near tank | | 94% | | | | 410 | 0.66 | 2228 | 70% | 1659 | $57 |
| small DHW circ pump | | 100% | | | | 215 | 0.66 | 1243 | 70% | 870 | $37 |
| solar circ pump | | 100% | | | | 215 | 0.66 | 1243 | 30% | 373 | $87 |
| | | | | | | | | | | | |
| **Totals** | | | | | | | | **109912** | | **53925** | **$5,599** |
| | | | | | | | | | | | |
| Note: | | | | | | | | | | | |
| Exhaust fans 2, 6 & 7 were removed when CK was decommissioned. Garage exhaust is currently turned off | | | | | | | | | | | |

Potential gas savings of $5,000 is estimated by comparing the current usage at Cloyne Ct. and Casa Zimbabwe. Existing Cloyne gas usage is reasonably efficient.

| **Natural gas** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CZ annual therms/sq ft | | 0.82 | | Therms/yr | 33314 | | $/yr | $8,274 |
| Cloyne annual therms/sq ft | | 0.30 | | Therms/yr | 11706 | | $/yr | $2,892 |
| Difference | | 0.52 | | | 21608 | | | $5,382 |

## Other recommended measures:

- Replace bedroom windows as budget allows.

## Maintenance recommendations:

Supply air screens: Screens are located in the condenser 'room' over the walk-in coolers, on the wall next to the driveway just off the street, and at the patio in front of the central office.

Check all dorm room heating control valves and air vents annually.

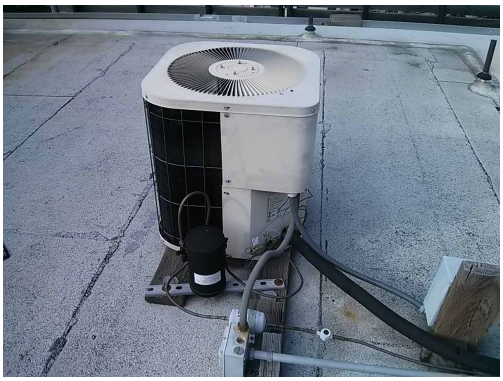
Create an operations and maintenance manual for the boilers and central heating system.

Walk in cooler evaporator fans present a significant opportunity for savings by installing high efficiency motors and fan controllers.

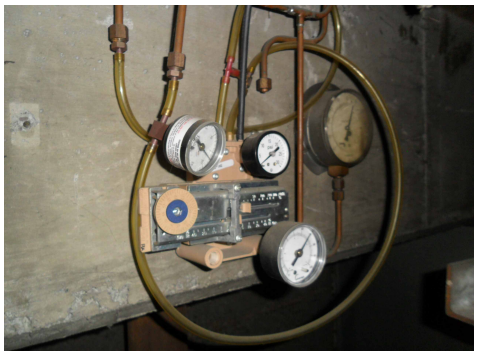
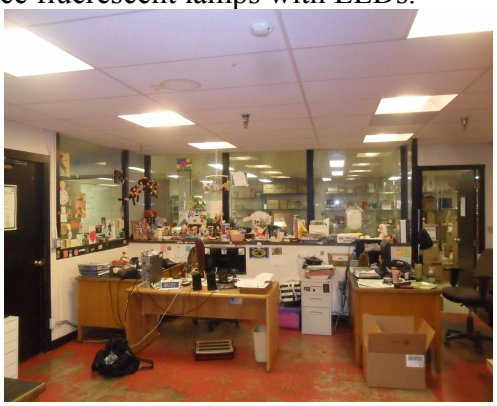
Condenser fan motors should also be replaced.

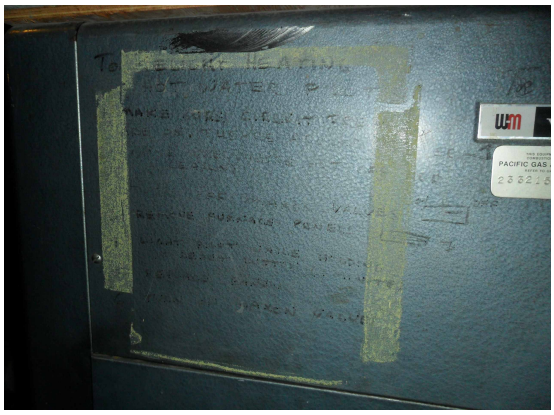
This large exhaust fan removes air from the condenser room over the coolers. Install a thermostatically controlled variable frequency drive to reduce motor RPM. ('Demand control ventilation.')

This rooftop condensing unit is for the CZ kitchen cooler. It is a 20 years old SEER 8 unit. Replace with a new SEER 16.

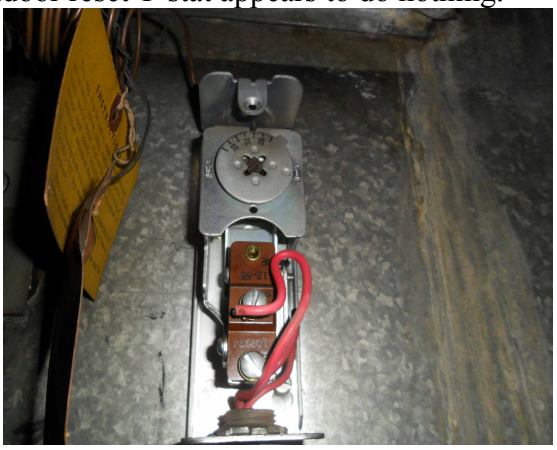


Maintenance: Clogged screens restrict air flow. Clean screens in condenser room regularly.

| | |
|---|---|
| Pneumatic controls on the heating system are obsolete, difficult to maintain, and provide no real time system monitoring. Replace with digital controls.<br>  | Air compressor serves pneumatic controls. It goes away when pneumatic controls are replaced.<br>  |
| Larger ventilation fan motors run at continuous high speed. Install VFD drives to regulate speed and set demand schedules.<br>  | CZ kitchen exhaust fans run continuously. Install a Me-Link automatic control system like the one at Cloyne.<br>  |
| Replace fluerescent lamps with LEDs.<br>  | Including cooler lighting.<br>  |

| | |
|---|---|
| Air vents on bedroom radiators must be checked for failure.<br>  | Many of the thermostatically controlled valves in the bedrooms have failed. Some are stuck open. Some stuck closed.<br>  |
| Operations: We recommend creating an operations manual for the heating system. These instructions are hard to read.<br>  | Instructions written on the wall.<br>  |

Outdoor reset T-stat appears to do nothing.



Replacement of dorm room windows is recommended, although payback is long term.

This type of ceiling mounted occupt sensor is effective for controlling lighting (CK break room). Wall mounted units in CZ dining and lounge are less effective.

Some of the solar collectors may have to be replaced. First step is to get existing system operating correctly with real time monitoring.

*Cooler Retrofit estimate provided by Frigitek.*

| energy control equipment, inc (877) 522-6924 | Frigitek® ECMotor Savings Summary | | | | Summary Sheet 1 | |
|---|---|---|---|---|---|---|
| | Date - | March 7, 2014 | | | | |
| Rev Date | Customer - | Peralta Energy for Berkeley Student Co-Op | | | | |
| 12/23/13 | Address - | | | | | |
| | City, St, ZIP - | Berkeley, CA | | | | |
| Sales Rep - | Contact - | Ben Thompson | | | | |
| **Joe Simko** | Phone - | 510-459-0827 | | | | |
| ========== | | | | | | |
| *** ***Overall Summary*** *** | | | | Summary Sheets - | 2 | |
| | **Total Cost -** | $6,858.94 | | **ROI -** | 39.43 | Mo |
| | **Total Cost w/ Rebate -** | $5,188.97 | | **ROI w/ Rebate -** | 29.83 | Mo |
| | **Total Dollar Savings -** | $173.95 | /Mo | $2,087.46 | /Yr | |
| | **Total kWh Savings -** | 1,739.5 | kWh/Mo | 20,874.6 | kWh/Yr | |
| | **$CO_2$ Reduction -** | 11,272.3 | Lbs/Yr | $CO_2$ Factor - | 0.54 | |
| ========== | | | | | | |