ASHRAE LEVEL II ENERGY AUDIT

STOPWASTE.ORG

PROJECT NUMBER 0313.020

Prepared For:

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Oakland, CA 94612

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1.0 EXECUTIVE SUMMARY

This report presents the results of an ASHRAE Level II building energy assessment. This energy assessment conforms to the requirements of an ASHRAE Level II – Energy Survey and Analysis. This report presents the results of the lighting upgrades and improvements, mechanical upgrades, and water conservation opportunities for the 2-story StopWaste.org building at 1537 Webster Street, Oakland, CA 94612.

Enovity, Inc. conducted this assessment beginning on June 5th, 2013 for StopWaste.org to identify energy and water saving projects to comply with the San Francisco Existing Commercial Building Energy Performance Ordinance. An investigation of the current building energy consumption was performed by analyzing utility bills, estimating energy end uses, and benchmarking the building against similar buildings via Energy Star. Energy loads and energy efficiency measures were evaluated using pertinent energy and equipment data, and spreadsheet calculations. Implementation costs and annual utility cost savings are used to calculate a simple payback period, which forms the basis for the recommending measures. Table 1.1 summarizes potential measures.

Table 1.1: Energy Savings Results

Measure Number	Measure Description	Annual Resource and Cost Savings					Payback with Incentive					
		Peak Demand Savings (kW)	Electricity Savings (kWh)	Gas/Fuel Savings (therms)	Water Savings (kGal)	Total Cost Savings	Measure Cost	Potential Utility Incentive	Measure Life (years)	Net Measure Cost	NPV*	Simple Payback (yr)
EEM 1	Reduce AC RTU operating schedules	0.0	3,100	60	0	$636	$200	$100	5	$100	$3,000	0.2
EEM 2	Reduce lighting run time	0.0	2,664	0	0	$501	$200	$100	5	$100	$2,343	0.2
EEM 3	Repair and re-enable economizers	0.0	2,100	410	0	$756	$5,800	$168	10	$5,632	$1,874	7.5
EEM 4	New Premium Efficiency Roof Top Units	0.0	3,900	0		$733	$32,800	$873	20	$31,927	($16,822)	43.6
EEM 5	Lower lights and install individual fixture Occ. Sensors	0.7	1,300	0	0	$244	$10,700	$105	10	$10,595	($8,167)	43.4
SGM 1	Install 7.7 kW DC Solar PV Array	7.7	10,200	0	0	$1,918	$28,500	$1,540	25	$26,960	$12,556	14.1
WCM 1	Install low flow aerators on restoom faucets	0.0	0	0	0.4	$7	$100	$0	20	$100	$43	14.4
O&M 1	Calibrate Therma Fuser VAV boxes	-	-	-	0	-	$2,700	-	-	$2,700	-	
O&M 2	Install filters upstream of OA sensors	-	-	-	0	-	$700	-	-	$700	-	
TOTALS		**8.4**	**23,264.0**	**470.0**	**0.4**	**4,794.0**	**81,700.0**	**2,886.0**		**$78,814**	**($5,216)**	**16.4**

*Net Present Value (NPV) assumes a discount rate of 4%

1.1 METHODOLOGY

This building energy assessment includes evaluation of all building HVAC, lighting, water, and renewable energy systems, where applicable, in addition to energy metering devices and opportunities. Inputs to previously developed excel calculation spreadsheets include existing equipment data and measured parameters to evaluate current and future system efficiencies and energy consumption. Energy Efficiency Measures (EEMs) were evaluated for electrical consumption savings (kWh), peak-period demand savings (kW), and gas savings (therms). Capital cost estimates include the following: material, labor, and where applicable design (5-10% of materials and labor), construction/project management (5-10% of materials and labor), commissioning (5-10% of materials and labor), contractor profit and overhead (20-30% of materials and labor), and contingency (5-10%). The capital cost estimates are based on information from suppliers and contractors, experience with similar projects, and published sources such as RS Means.

2.0 BUILDING DESCRIPTION

2.1 OVERVIEW

The original construction for 1537 Webster Street occurred in 1926 as a 2-story building. The building underwent renovations in 2007. The building is a concrete structure with an open floor plan. A cool roof and a 5.2-kilowatt photovoltaic system have been installed on the roof. Flooring consists of stained concrete on the ground floor and carpeting in the boardroom and on the second floor. The north, west, and east façades feature large dual paned operable windows on both the first and second floor. There are no windows on the south façade. Figure 2-1 shows a picture of the east elevation of the building.

The building is primarily used as office space with many structural and mechanical elements such as ducts, steel beams, and concrete columns left exposed. A large boardroom on the ground floor can accommodate as many as 75 people. The building's gross square footage is 14,000 square feet. The building operation schedule is 7:30 am to 6:00 pm, Monday through Friday.

Figure 2-1: East Elevation

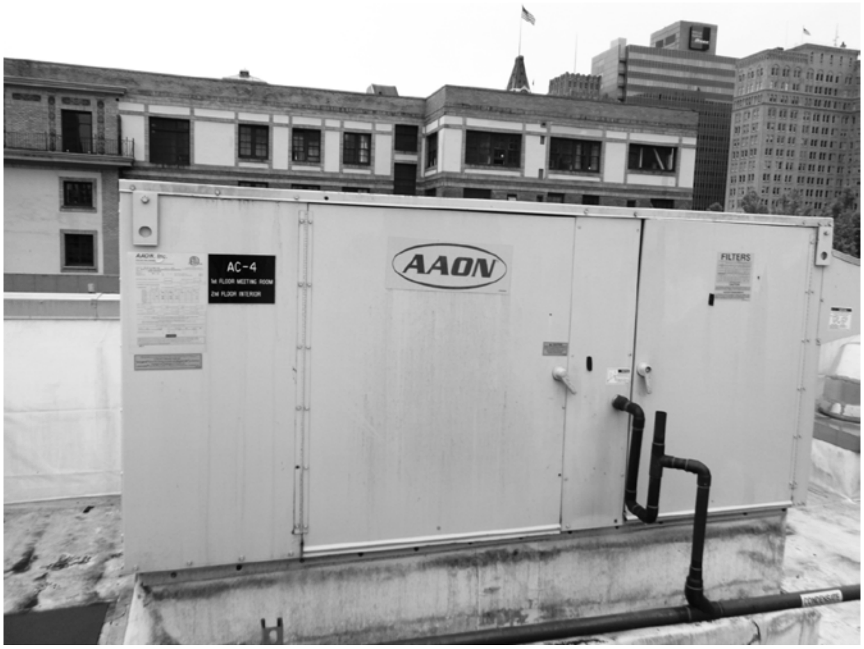
2.2 AIR-SIDE HVAC SYSTEMS

The cooling system for the building consists of four roof top packaged AC units; three systems feature a gas heating mode and variable frequency drives. All four roof top units feature an outside air (OA) economizer with flow measuring stations to provide free cooling and ventilation. The OA dampers on two units (AC units 1&3) have been locked open at 100%; this may be due to faulty flow stations. The flow stations will override any command based on the measured airflow and will continue to open the OA dampers until the OA minimum setpoint has been satisfied. AC 4 economizer is 100% closed; this is due to humidity control in the IT room. AC 2 economizer appears to be fully functional. These HVAC systems provide temperature control and ventilation for the building; see Table 2.1 below. Figure 2-2 shows a typical packaged AC unit with OA economizer. There are two exhaust fans located on the roof, EF-1 for general exhaust and EF-2 that serves the elevator room with thermostatic temperature control. A third exhaust fan that serves the shower room is interlocked with the light switch.

Table 2.1: Summary HVAC Equipment

Unit #	Manufacturer	Model / Type	# of Units	Heat Capacities / Efficiency	Supply Fan HP System FLA	Control
AC-1	AAON	RM-013/ PRTU	1	Output: 132.2 MBH	7.5 HP	BMS
				Eff.: 10.8 EER	21 amps	
AC-2	AAON	RM-006/PRTU	1	Output: 94.5 MBH	3 HP	BMS
				Eff.: 11.8 EER	34 amps	
AC-3	AAON	RM-006/PRTU	1	Output: 51.2 MBH	3 HP	BMS
				Eff.: 11.8 EER	23 amps	
AC-4	AAON	RM-A01/PRTU	1	N/A	1 HP	BMS
				Eff.: 12.8 EER	21 amps	

Figure 2-2: Typical Roof Top Packaged AC Unit



2.3 LIGHTING SYSTEMS

The lighting control system controls interior, exterior, and exhaust fan on/off schedules. The lighting throughout the building area is composed of multiple types of fluorescent lamps. There is one skylight that provides natural lighting to the main stairwell and entry area. The primary space lighting on the first floor are 36 and 42 watt CFL's. The primary lighting for the second floor open office space and private offices is primarily composed of 4-foot fluorescent luminaries' lit with 28-watt T5 lamps; see Figure 2-3.

Figure 2-3: Second Floor Open Office space

2.4 BUILDING AUTOMATION SYSTEM

The buildings HVAC systems are controlled by Reliable Controls building automation system (BAS). This system is an internet connected BACnet type control system that can also be accessed locally. The front end allows the facilities personnel to monitor set points, critical temperatures and unit statuses, schedule equipment, and enable trending and monitoring of certain system points. Additionally the BAS provides a signal output to the occupant's computer network of the advisability to utilize to the operable windows as a cooling or ventilation resource.

2.5 WATER FIXTURES

The water fixtures throughout the building consist of the following types;

1. 7 Dual flush toilets rated at 1.1 and 1.6 gallons per flush.
2. 1 Waterless urinal.
3. 6 Low flow restroom faucets rated at 2.2 gallons per minute.
4. 2 Break rooms with faucets that rate at 2.5 gallons per minute.
5. 1 Shower

Because most of the water fixtures at the StopWaste.org building are already low flow or waterless, there is limited opportunity for water conservation retrofits.

2.6 DOMESTIC HOT WATER SYSTEM

The domestic hot water is provided by one domestic extra high efficiency gas hot water heater; see Table 2.2.

Table 2.2: DHW Systems

Unit #	Manufacturer	Model / Type	# of Units	Size	BTU input	Control	Serves
DHW-1	AO Smith	BTH-120	1	60 Gallons	125,000	Temperature	Whole building

2.7 COMFORT & OPERATIONAL ISSUES

During the site visit Enovity noted that a portable dehumidifier is being used in room 204 to help control humidity levels and that the OA damper has been manually closed via the BAS. This has been implemented in an effort to better control humidity levels. Possible causes:

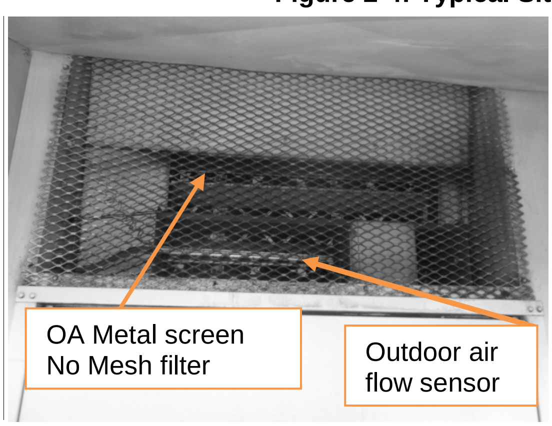
1. Over sized AC unit: this can cause the unit to run for a short period of time which in turn will lower room temperature, but will not allow enough run time to remove moisture.
2. Poor condensate removal

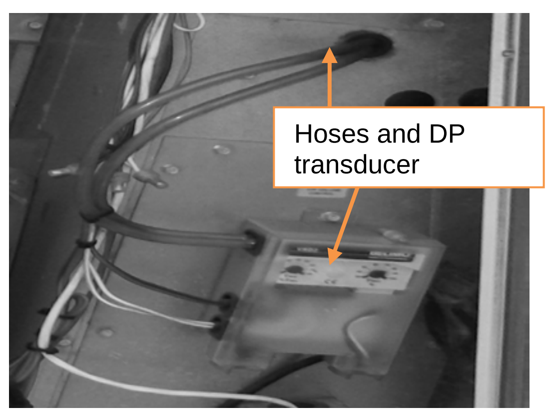
All major mechanical equipment inspected is in good working condition with the exception of the outdoor air flow stations on AC's 1 and 3. The outdoor airflow stations monitor outdoor air flow to the spaces served and override any commands based on the amount of minimum outdoor air needed for proper space ventilation. The air flow stations on AC units 1&3 are not working properly and are forcing the outdoor air dampers to 100% open. Possible causes may be:

1. Clogged air flow sensors: there are no filters upstream of the sensors to help keep them from clogging up.
2. Faulty differential pressure transducers
3. Improper transducer settings
4. Cracked and/or loose hoses

   See photo's below

Figure 2-4: Typical Site AC unit Operational Issues





3.0 HISTORICAL ENERGY USE

This section provides a summary of the building's electrical energy consumption. Electricity is supplied by PG&E.. The monthly electrical usage and costs for March 2012 through February 2013 were acquired from the building's Energy Star portfolio manager account. Table 3.1 provides a summary of the annual utility consumption and costs based on PG&E utility bills from March 2012 through February 2013. The annual electrical energy usage intensity and cost usage intensity is 6.3 kilowatt-hour (kWh) per square foot (ft^2) and $1.18 per square foot, respectively. The average electric cost is $0.188 per kWh. Table 3.1 shows the monthly electricity usage and costs.

Table 3.1: Utility Bill Data Summary

Annual Electricity			(per square foot)	
Consumption	86,889	*kWh/yr*	6.3	kWh/ft^2
Maximum Demand	24	*kW*	1.7	W/ft^2
Cost	16,335	*$/yr*	1.18	$\$/ft^2$
Cost/ Unit	0.188	*$/kWh*		
Annual Gas (Natural Gas + Steam)			***(per square foot)***	
Consumption	1,169	therms/yr	0.08	$therms/ft^2$
Gas Cost	966	$/yr	0.07	$\$/ft^2$
Cost/ Unit	0.83	$/therm		
Total Annual Energy Cost	**17,302**	$/yr	**1.25**	$\$/ft^2$

Figure 3-1: Electrical consumption and cost at the StopWaste.org building

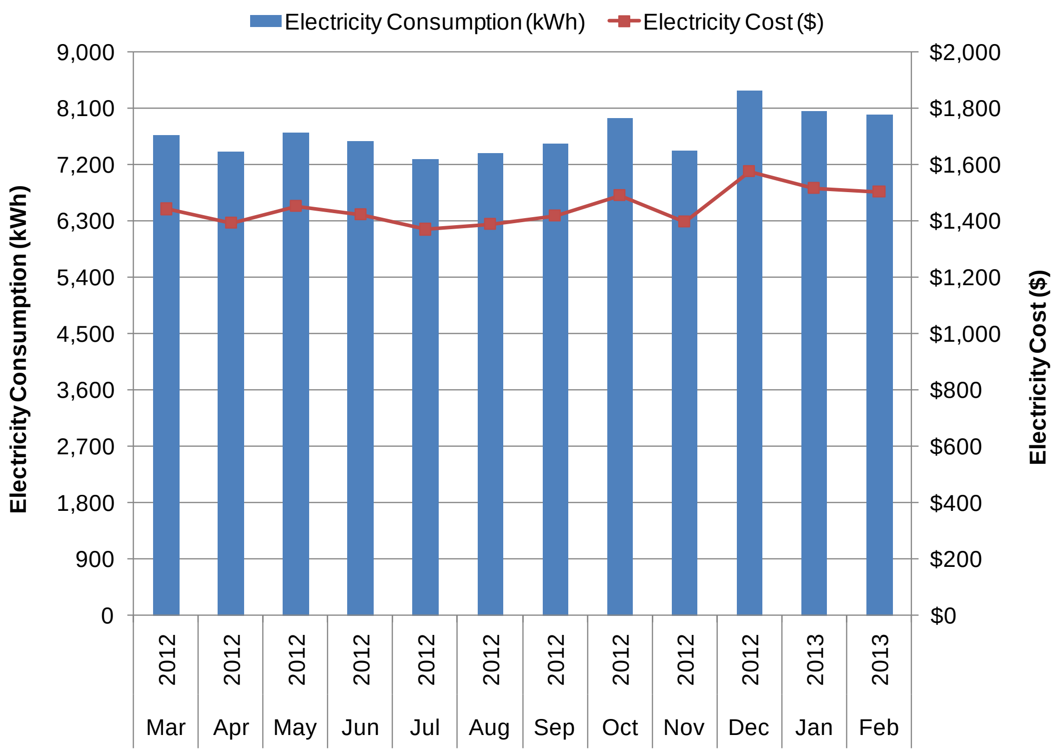
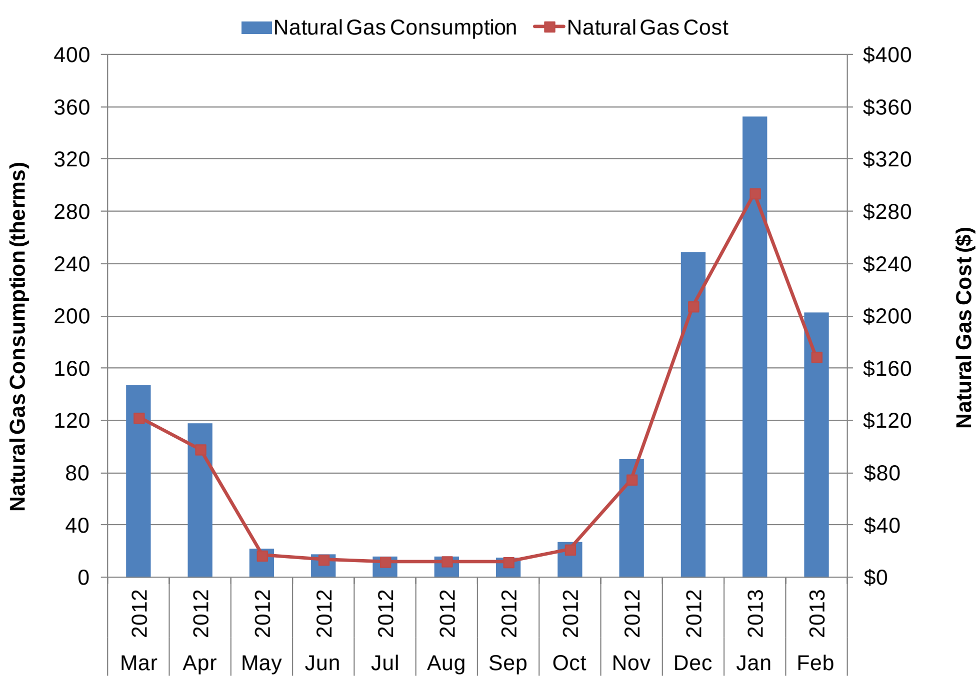


Figure 3-2: Natural Gas consumption at the StopWaste.org building



3.1 MONTHLY ENERGY USAGE PATTERNS

No major monthly irregularities have been noted. The monthly usage for the most part consistently stays between 7200 and 7600 kWh with the exception of December through February. Possible causes:

1. End of the year board room holiday parties and meetings
2. Beginning of the year board room meetings, training, and new developments.

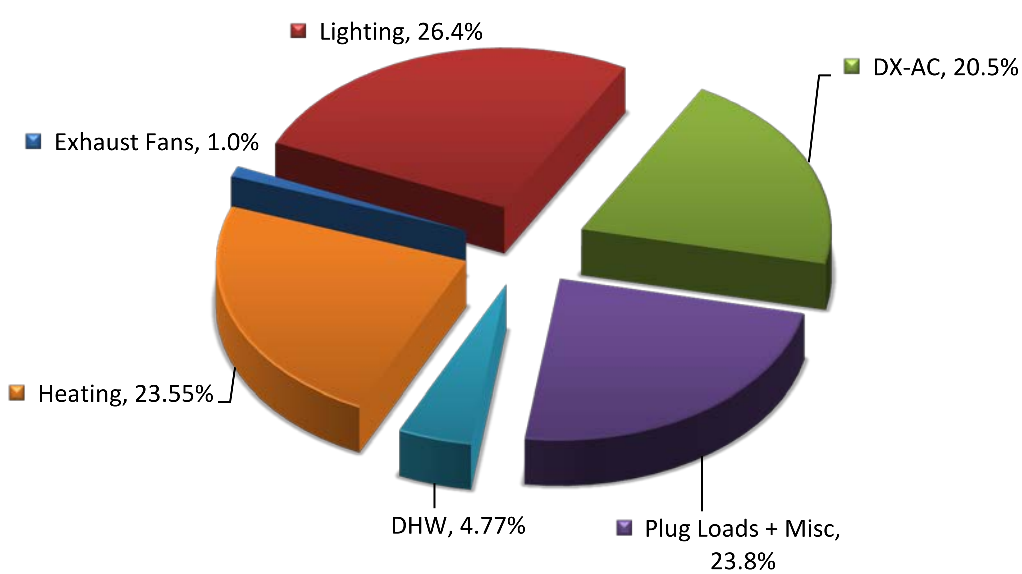
3.2 ENERGY END-USE BREAKDOWN

Enovity estimated energy end-use for this facility by collecting nameplate data, spot measurements, utility data analysis, and approximate annual operating hours. Table 3.2 shows the estimated energy end uses and their associated costs. Figure 3-3 presents a chart of the total energy (BTU) end-use breakdown for this facility.

Table 3.2: Summary of energy end use breakdown

End Use	Onsite Use (kBtu/yr)	Energy Use Intensity (kBtu/sq.ft/year)	% of Total	Energy Cost Intensity ($/sq.ft./yr)
Roof Top AC Units	85,257	6.2	20%	$0.34
Lighting (Interior)	110,271	8.0	26%	$0.44
Plug Loads	99,140	7.2	24%	$0.39
Exhaust Fans	4,294	0.3	1%	$0.02
DHW	19,886	1.4	5%	$0.01
Heating	98,181	7.1	24%	$0.06
Total	417,029	30.12	100%	$1.26

Figure 3-3: Energy end use breakdown



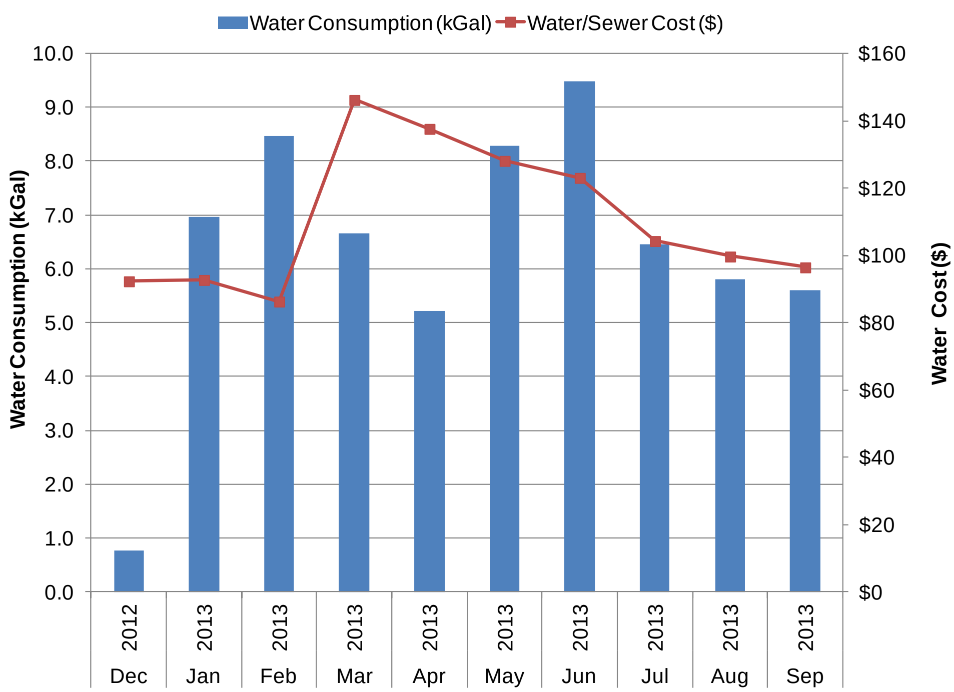
3.3 HISTORICAL WATER USE

East Bay Municipal Utility District (EBMUD) provides domestic water and sewer services to 1537 Webster Street. There is one domestic water meter for the building. Table 3.3 provides a summary of water consumption and cost for December 2012 through September 2013. Figure 3-4 shows the water consumption data for the facility from February 2012 through January 2013.

Table 3.3: Water use summary

Annual Water			*(per square foot)*	
Consumption	59	kGal	4.25	Gal/ft^2
Water Cost	1,003	$	0.072	$/ft^2
Cost/ Unit	17.04	$/kGal		
Total Annual Water Cost	**1,003**	$	**0.072**	$/ft^2

Figure 3-4: Water usage cost over the last 10 months for the StopWaste.org building



3.4 ENERGY STAR BENCHMARKING AND ENERGY INDEX GOALS

The Energy Star Portfolio Manager is an online tool developed by the U.S. Environmental Protection Agency (EPA) to track and assess energy and water consumption across an entire portfolio of buildings. Some facility types also qualify for an Energy Star performance rating, which can help a facility obtain an Energy Star label, communicate energy performance with tenants, owners and customers, document performance in energy service contracts, and satisfy LEED for Existing Buildings: Operations and Maintenance (EBOM) requirements. ENERGY STAR energy performance ratings are available for buildings with a gross floor area of 50% or greater of the following eligible space types:

- Bank/Financial Institution
- Courthouses
- Dormitories
- Hospitals
- Hotels
- Houses of Worship
- K-12 Schools
- Medical Offices
- Office Space
- Retail Stores
- Supermarkets
- Warehouses
- Wastewater Treatment Plants

Energy performance ratings take into account 12 consecutive months of utility bills for all fuel types used in the building. The performance rating normalizes for operation to avoid bias by assigning attributes such as required hours of operation, number of occupants, gross floor area, and weather. The Energy Star rating is provided within the building's peer group, which is defined by those buildings that have the same primary business function and similar operating characteristics*.

This rating is a benchmark indicating the energy efficiency of a building on a score from 1 to 100, where a score of 50 is average relative to the building's peer group. A rating of 75 or better indicates above average performance, indicating that the building performs better than 75% of its peers and may be eligible to earn the Energy Star® label.

*For more information on how an energy performance rating is calculated, please see Energy Star® performance ratings technical methodology located online at http://www.energystar.gov/.

3.4.1 Benchmark Results and Energy Star Score

Using the EPA Energy Star® portfolio manager tool, the building has an energy-usage-intensity (EUI) of 40 kBtu/ft^2. This is below the national average for similar buildings at 77 kBtu/ft^2. This building received an Energy Star® energy performance rating of 91 out of a possible 100.

Figure 3-5 ENERGY STAR® Statement of Energy Performance

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
StopWaste.Org Headquarters

Building ID: 1803382
For 12-month Period Ending: November 30, 2011[1]
Date SEP becomes Ineligible: N/A

Date SEP Generated: June 21, 2013

Facility
StopWaste.Org Headquarters
1537 Webster Street
Oakland CA 94612

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 2007
Gross Floor Area (ft²): 14,000

Energy Performance Rating[2] **(1-100)** 91

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	369,678
Natural Gas (kBtu)[4]	191,264
Total Energy (kBtu)	560,942
Energy Intensity[4]	
Site (kBtu/ft²/yr)	40
Source (kBtu/ft²/yr)	102
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	44
Electric Distribution Utility	
Pacific Gas & Electric Co [PG&E Corp]	
National Median Comparison	
National Median Site EUI	77
National Median Source EUI	196
% Difference from National Median Source EUI	-48%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[5] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16?

4.0 ENERGY EFFICIENCY MEASURE RESULTS

Energy Efficiency Measures (EEMs) were evaluated using spreadsheet engineering analysis for electrical consumption (kWh), peak-period demand (kW) savings, and gas (therms) savings. Measures have been organized according to project cost in three tiers:

1. No-cost / Low Capital cost: Less than $5,000
2. Moderate Capital Cost: $5,000 - $10,000
3. Significant Capital Cost: Greater than $10,000

Each energy efficiency measure (EEM) has the following sections;

4. Description
5. Existing Conditions
6. Proposed Efficiency & Performance Assumptions
7. Savings Summary

4.1 TIER ONE MEASURES: NO TO LOW CAPITAL INVESTMENT

Measures in this category include low cost and no cost measures available for implementation at the StopWaste.org office.

4.1.1 EEM 1 – Reduce AC RTU operating schedule

Existing Schedule:

The building is typically occupied from 7:30am to 5:30pm Monday through Friday and AC units 1, 2, and 3 operate from 3am to 6pm on Mondays and from 4am to 6pm Tuesday through Saturday.

Proposed schedule:

The proposed operating schedule is from 4am to 6pm Mondays and from 5am to 6pm Tuesday through Friday. No weekend operation is scheduled.

Proposed Efficiency & Performance Assumptions:

Energy savings are calculated using the Building Optimization Analysis (BOA) ‘AHU Schedule’ Tool. The BOA Tool is approved by PG&E for calculating energy savings for common HVAC energy efficiency measures. The inputs for this calculation tool are as follows:

1. Climate Zone
   a. For this facility, the climate zone is 3
2. Building Type
   a. The building type is an office
3. Year of building construction
   a. 1927
4. Square footage

   a. 14,000 square feet

5. Reduction in Operating Hours
   a. 884
6. HVAC system type
   a. Packaged VAV
7. Nameplate supply fan HP
   a. 7.5,3,3

Savings Summary:

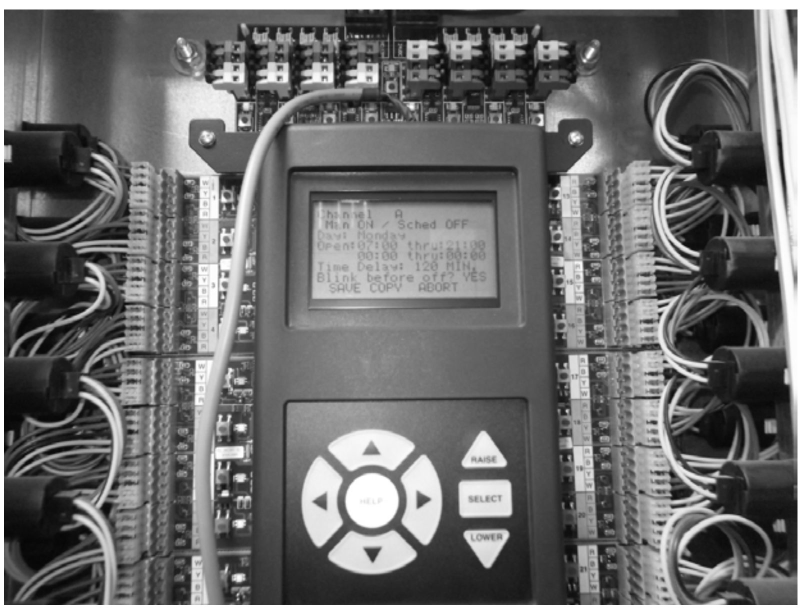
The energy and cost savings are based on the reduced operating schedule. There is no additional maintenance costs associated with this measure. This EEM results in an estimated peak demand reduction of 0 kW and annual electric savings of 3,100 kWh per year. There will also be a gas savings of 60 therms. The total estimated annual energy cost savings are $636. With a potential incentive of $100, and an estimated project cost of $200 the simple payback is 0.2 years. The final incentive amount will be determined based on the final verified energy savings.

4.1.2 EEM 2 – Reduce interior lighting run time

Existing Schedule:

The building is typically occupied from 7:30am to 5:30pm Monday through Friday and interior lighting operates from 7am to 9pm Mondays through Friday.

Figure 4-1: Interior lighting schedule



Proposed Schedule:

7am to 7pm Monday through Friday.

Proposed Efficiency & Performance Assumptions:

Energy savings are calculated using the Building Optimization Analysis (BOA) 'Lighting Schedule' Tool. The BOA Tool is approved by PG&E for calculating energy savings for common HVAC energy efficiency measures. The inputs for this calculation tool are as follows:

1. Climate Zone
    a. For this facility, the climate zone is 3
2. Building Type
    a. The building type is an office
3. Square footage
    a. 14,000 square feet
4. Reduction in operating hours
    a. 520
5. Affected lighting power
    a. 9 kW

Savings Summary:

There is no additional maintenance cost associated with this measure. This EEM results in an estimated peak demand reduction of 0 kW and annual electric savings of 2,664 kWh per year. The total estimated annual energy cost savings are $501. With a potential incentive of $100, and an estimated project cost of $200 the simple payback is 0.2 years. The final incentive amount will be determined based on the final verified energy savings.

4.2 TIER TWO MEASURES: MODERATE CAPITAL INVESTMENT

Measures in this tier are measures that require some capital investment.

4.2.1 EEM 3 – Repair and enable economizers

Existing Conditions:

The outdoor airflow stations monitor outdoor air flow to the spaces served and override any commands based on the amount of minimum outdoor air needed for proper space ventilation. The air flow stations on AC units 1&3 are not working properly and are forcing the outdoor air dampers to stay at 100% open. AC 4 economizer is 100% closed; this is due to humidity control issues in room 204.

Figure 4-2: AC 1 outdoor air damper

Proposed Conditions:

Reconfigure economizer control:

1. Check outdoor air sampling tube operation (Clean and measure delta P)
2. Install filters upstream of the airflow sampling tubes.
3. Disconnect stand alone outdoor air damper override control.
4. Reprogram BAS economizer control to include outdoor airflow readings (utilizing existing differential pressure transducer) and control outdoor air dampers based on outdoor airflow readings.
5. Have BAS generate an alarm through occupant computer network: if minimum outdoor airflow readings are over/under expected outdoor airflows based on outdoor air temperatures and economizer mode for more than 1 hour.
6. If alarm is generated open outdoor air damper to 100% outdoor airflow, check outdoor air sampling tube, differential pressure transducer and damper operation.

Proposed Efficiency & Performance Assumptions:

The energy savings are calculated using an Excel Spreadsheet utilizing weather bin data. The total energy use for each Air Conditioning unit (AC unit) is calculated with this spreadsheet. The analysis for the AC units requires the following inputs:

- Total airflow of AC unit – See Table 2.1
- Total Fan HP – See Table 2.1
- Operational hours are from 4am to 6pm Mondays and from 5am to 6pm Tuesday through Friday.

The existing and proposed energy usage was calculated using the following formulas:

Cooling Load (Btu) = 1.08 x Airflow x (MAT – SAT)

Cooling Load (Tons) = Cooling (Btu) / 12000

Cooling Load (kW) = Cooling Tons x AC unit Cooling Efficiency

Fan Power (kW) = HP x Fan Load Factor x 0.746 x (% Airflow)$^{2.2}$ / Motor Efficiency

Heating Energy (Btu) = 1.08 x Airflow x % Air Reheated x (SAT - MAT) / AC unit Heating Efficiency

Heating Energy (Therms) = Heating Energy (Btu) /100000

MAT – Mixed Air Temperature

SAT – Supply Air Temperature

Reheat Temp – Average Discharge Air Temperature into Space

1.08 – Constant to convert CFM*°F to Btuh

0.746 – Constant to convert Horsepower (HP) to Kilowatts (kW)

Savings Summary:

There is additional maintenance costs associated with this measure. This EEM results in an estimated peak demand reduction of 0 kW and annual electric savings of 2,100 kWh per year. There will also be a gas savings of 410 therms. The total estimated annual energy cost savings are $756. With a potential incentive of $168, and an estimated project cost of $5,800 the simple payback is 7.5 years. The final incentive amount will be determined based on the final verified energy savings.

4.3 TIER THREE MEASURES: SIGNIFICANT CAPITAL INVESTMENT

Measures in this tier require significant capital investment to implement.

4.3.1 EEM 4 – New Premium Efficiency Roof Top Units

Existing Condition:

The existing roof top units have a rated energy efficiency ratio (EER) of 10.8,. R-22 is an ozone depleting refrigerant and it is no longer produced in accordance with the Montreal Protocol and the Clean Air Act.

http://www.epa.gov/ozone/title6/phaseout/22phaseout.html

Proposed Condition:

This measure involves replacing the existing roof top units with roof top units that use R-410a refrigerant and improved EER/SEER. Each unit will have the same functionality as the existing systems. Table 4.1 shows existing and proposed units.

Table 4.1: Summary of AC unit efficiencies

Existing					Proposed		
Unit	Net-Tonage	EER/SEER	Refrigerant	BTUs	EER/IEER	Refrigerant	% Improved EER
AC-1	7.5	10.8	R-22	90000	12.5/14	R-410A	16%
AC-2	5	11.8	R-22	60000	12.5/15.5	R-410A	6%
AC-3	5	11.8	R-22	60000	12.5/15.5	R-410A	6%

Proposed Efficiency & Performance Assumptions:

The spreadsheet analysis required the following inputs to calculate energy savings:

6. Existing Efficiency (EER): 10.8
7. Existing Air Flow: Variable
8. Annual cooling Operating Hours: 1430
9. Proposed Efficiency (EER): 12.5
10. Proposed Seasonal Efficiency(SEER):14 to 15.5

Savings Summary:

There is no additional maintenance cost associated with this measure. This EEM results in an estimated peak demand reduction of 0 kW and annual electric savings of 3,900 kWh per year. The total estimated annual energy cost savings are $733. With a potential incentive of $873, and an estimated project cost of $32,800 the simple payback is 43.6 years. The final incentive amount will be determined based on the final verified energy savings.

4.3.2 EEM 5 – Lower lighting in open office spaces, and install individual occupancy sensors for each cubicle

Existing Condition:

Currently all the lighting at the StopWaste.org office is connected to occupancy sensors, however in the open office areas, multiple lights are connected to a single sensor. In order for the lights in a given area to turn off, none of the cubicles in that area can be occupied.

Figure 4-3: Open office lighting

Proposed Condition:

It is recommended that the existing lights be lowered and individual occupancy sensors be installed so that each work space is on a separate circuit. By separating the lighting occupancy controls, when a specific work space is unoccupied, lights serving that work space will shut off while lights serving occupied work spaces will not.

Proposed Efficiency & Performance Assumptions:

It is assumed that due to the current arrangement of lights and sensors, the occupancy sensors in the open office areas rarely shut off lights during occupied hours. Energy savings are calculated using the Building Optimization Analysis (BOA) 'Lighting Occ Sensor' Tool. The BOA Tool is approved by PG&E for calculating energy savings for common HVAC energy efficiency measures. The inputs for this calculation tool are as follows:

11. Climate Zone
    a. For this facility, the climate zone is 3
12. Building Type and space type
    a. The building type is an office
    b. The space type is open office
13. Year the building was built
    a. 1927
14. Affected lighting power
    a. 3.6 kW

Savings Summary:

There is no additional This EEM results in estimated peak demand reduction of 0.7 kW and annual electric savings of 1,311 kWh per year. The total estimated annual energy cost savings are $244. With a potential incentive of $104, and an estimated project cost of $28,500 the simple payback is 43.4 years. The final incentive amount will be determined based on the final verified energy savings.

4.3.3 SGM 1 – Increase solar PV array size on roof

Existing Condition:

Currently there is a 5.2 kW solar PV array on the roof of the StopWaste.org building sized to meet 10% of the building electrical load. There is additional space on the roof that is unused. By increasing the size of the solar PV array, StopWaste.org can further reduce the building electrical energy consumption. A reduction in peak demand and annual energy consumption can be expected, as well as a reduced need to purchase renewable power certificates to maintain carbon neutral standing.

Figure 4-4: Solar Array at the StopWaste.org building

Proposed Condition:

There is enough unused roof space to install 7.7 kW of additional PV panels on the StopWaste building if the same panel type is used. The proposed additional array will not restrict access to other roof top systems. Figure 4-4 shows potential space for additional solar PV indicated by the green boxes. The additional solar PV panels will provide for 30% of the building peak demand, and reduce annual energy use by 15%. When the existing system is included, total reduction in demand due to solar PV will be greater than 50% and total reduction in energy about 25%.

Proposed Efficiency & Performance Assumptions:

1. The cost of PV array installation is based on the NREL national average for commercial installations of $3.70 per watt
2. Array azimuth is assumed to be SW facing (225 degrees)
3. Proposed Array tilt is the same as existing array tilt. (37.8 degrees)

Savings Summary:

This EEM results in an estimated peak demand reduction of 7.7 kW and annual electric savings of 10,200 kWh per year. The total estimated annual energy cost savings is $1,918. With a potential incentive of $1,540, and an estimated project cost of $28,500 the simple payback is 14.1 years. The final incentive amount will be determined based on the final verified energy savings.

4.4 WATER CONSERVATION MEASURES

4.4.1 WCM 1 – Install Low-Flow Water Fixtures

Existing Condition:

The kitchen faucets in the building are not the most efficient fixtures available.

Proposed Condition:

- Kitchen Faucet: Replace 2.5 GPM aerator with a 1.5 GPM aerator.

Proposed Efficiency & Performance Assumptions

A custom calculation tool is based on standards found in LEED BD&C Reference Manual Water Efficiency Prerequisite 1. The required inputs for this measure include:

- Proposed Kitchen Faucet: 1.5 GPM
- Building Type: Office
- Number of Full Time Employees: 50
- Primary DHW Heating Source: Natural Gas
- DHW Heating Efficiency: 88%
- Building Area: 14,000 square feet

Savings Summary:

There is no additional maintenance cost with this measure. This measure results in an annual water savings of 0.4 kgal. per year. The total estimated annual utility cost savings is $7,with a potential incentive of $0, and an estimated project cost of $100 the simple payback is 14.4 years. The final incentive amount will be determined based on the final verified energy savings.

4.5 OPERATION AND MAINTENANCE MEASURES

Recommended O&M improvements measures are aimed at improving the operations, safety, and maintenance and/or the environmental, comfort, and aesthetic conditions of the buildings. Generally, these measures result in little or no energy savings.

4.5.1 O&M 1 –Balance Therma Fusers^{tm}

Existing Condition:

The buildings' air distribution is a Therma Fuser^{tm} type variable flow diffuser. Therma Fuser^{tm} boxes use thermal wax in a cylinder that expands and contracts as the wax heats or cools. The expansion / contraction of the wax opens or closes the damper in the box to maintain air flow and thermostat set points. Thermostats are located at the diffuser. From discussion with building occupants, these boxes regularly become un-calibrated, and deliver too much or too little air to maintain space comfort.

Figure 4-5: Therma Fuser^{tm}

Proposed Condition:

This measure involves regular balancing of the Therma Fuser^{tm} registers to ensure proper calibration and space comfort. Annual balancing is recommended, however more frequent balancing may be required.

Efficiency & Performance Assumptions:

1. All Therma Fuser are functional and operating as intended.
2. Thermostats are functioning properly
3. Changes in airflow due to improved t-stat calibration will balance out and result in minimal energy savings
4. Balancing will take 2 HVAC technicians 2 days to complete

Savings Summary:

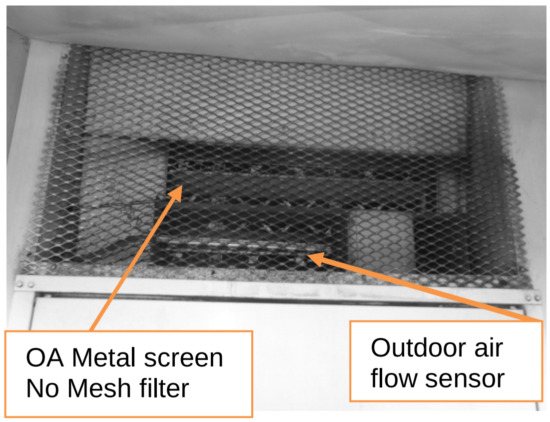
This measure results in minimal energy savings. Based on flow through the box, energy costs could change depending on whether the calibrated boxes increase or decrease airflow. There will be associated maintenance costs totaling $2,700 annually. This measure will primarily improve tenant comfort.

4.5.2 O&M 2 – Install filters upstream of Outside Air sensors at AC units

Existing Condition:

Currently the outside air flow sensors on AC units 1 and 3 are not functioning properly, resulting in the outside air dampers for those units to be commanded to 100% all of the time. One factor contributing to the poor economizer performance is the filters being clogged. Currently there is a metal screen at the OA sensor, but no finer mesh filter.

Figure 4.6: OA intake and flow sensor with metal mesh filter



Proposed Condition:

It is recommended that StopWaste.org install metal mesh filters upstream of the OA sensors in order to ensure they remain clean and functional.

Proposed Efficiency & Performance Assumptions

1. Installation a fine metal mesh filter will not adversely affect air flow through the unit.

Savings Summary:

This measure results in no energy savings by itself, however is a necessary component of EEM 3. The total cost for this measure will be $1,660.

5.0 MEASUREMENTS AND VERIFICATION PLAN

A measurement and verification (M&V) plan can assure optimal performance over the lifetime of the building through continuous monitoring of the buildings energy usage systems. M&V provides a framework for benchmarking and a baseline to determine energy savings of an energy efficiency measure (EEM).

The International Performance Measurement and Verification Protocol (IPMVP) shall be employed for this task and is the standardized procedure in any verification of energy efficiency projects. There are four M&V options titled A, B, C and D, where option A and B focuses on the performance of specific EEMs. Option C assesses the energy savings at the whole building level by analyzing utility bills before and after implementation of EEM(s). Option D is based on calibrated simulation (energy modeling) of the energy performance of a system or whole building.

The predicted energy savings from the energy efficiency measures are large (greater than 5% of the whole building energy usage), so option C is the recommended approach and simpler option to use in terms of verifying energy savings.

After installation, an energy service provider shall perform an onsite inspection to verify the proper operation of the measure. The provider shall also conduct post-installation measurement and verification (M&V) to verify the installed energy savings and to determine the final incentive amount for non-prescriptive measures. The measurements will be compared to the performance parameters used in the savings calculation and if necessary the calculations will be updated based on the post-installation measurements.