ASHRAE LEVEL I ENERGY AUDIT

STOPWASTE.ORG

PROJECT NUMBER 0313.020

Prepared For:

StopWaste.org
1537 Webster Street
Oakland, CA 94612

Prepared By:

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1.0 EXECUTIVE SUMMARY

This report presents the results of an ASHRAE Level I building energy assessment. This energy assessment conforms to the requirements of an ASHRAE Level I – 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

Table 1.1: Energy Savings Results

Measure Number	Measure Description				Payback with Incentive				
		Electricity Savings (kWh)	Gas/Fuel Savings (therms)	Total Cost Savings	Measure Cost	Potential Utility Incentive	Net Measure Cost	NPV*	Simple Payback (yr)
EEM 1	Reduce AC RTU operating schedules	3,100	60	$636	$200	$155	$45	$3,055	0.1
EEM 2	Repair and re-enable economizers	2,800	370	$852	$6,900	$140	$6,760	$1,703	7.9
EEM 3	Reduce lighting run time	2,664	-40	$466	$200	$133	$67	$2,204	0.1
EEM 4	New Premium Efficiency Roof Top Units	3,900	0	$733	$32,800	$873	$31,927	($16,818)	43.5
TOTALS (EEM 1, EEM 2, EEM 3, EEM 4)		**8,564**	**390**	**$2,686**	**$40,100**	**$1,341**	**$38,799**	**($9,855)**	**14.4**

*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

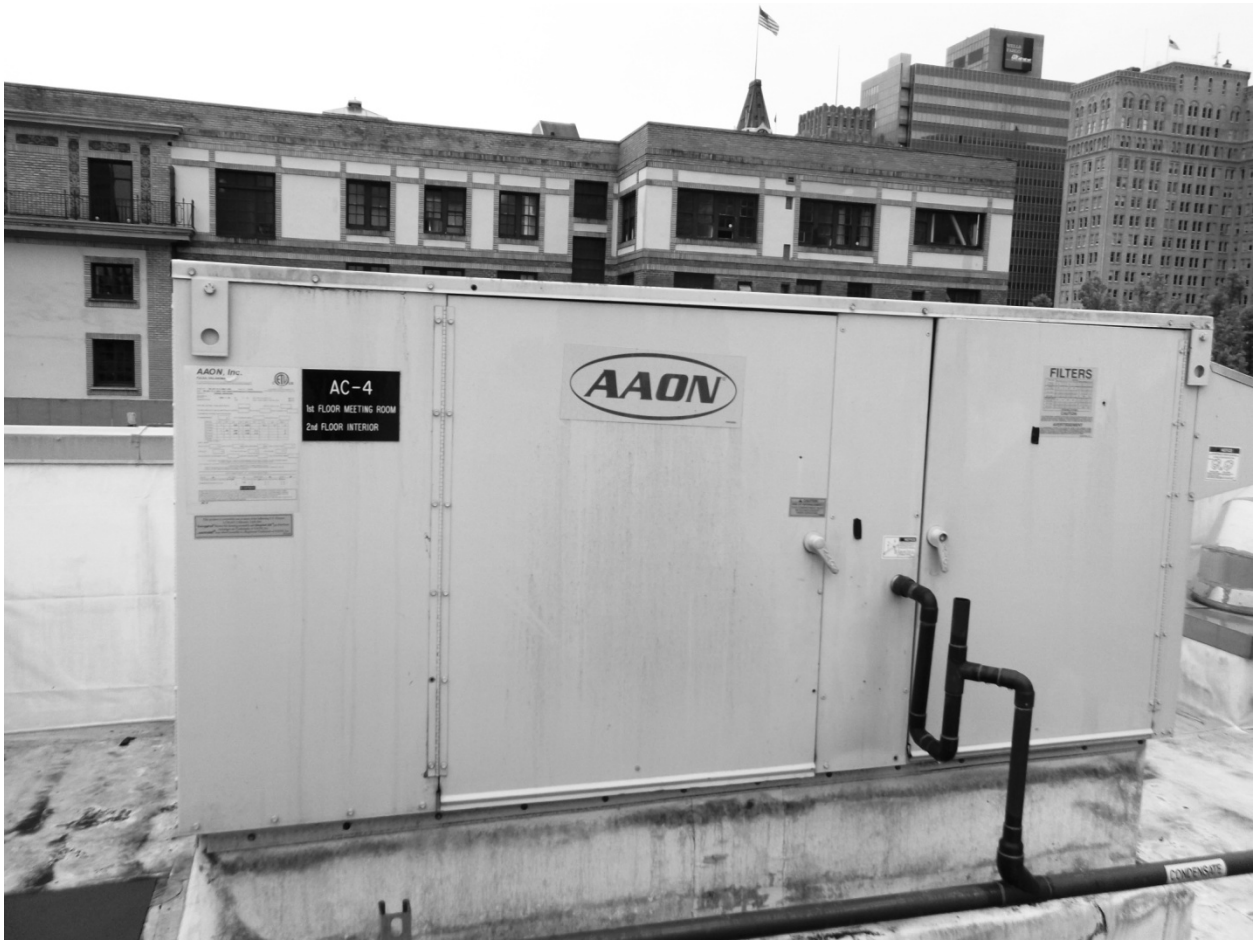
2.2 AIR-SIDE HVAC SYSTEMS

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
Roof						
AC-1	AAON	RM-013/ PRTU	1	Output: 132.2 MBH Eff.: 10.8 EER	7.5 HP 21 amps	BMS
AC-2	AAON	RM-006/PRTU	1	Output: 94.5 MBH Eff.: 11.8 EER	3 HP 34 amps	BMS
AC-3	AAON	RM-006/PRTU	1	Output: 51.2 MBH Eff.: 11.8 EER	3 HP 23 amps	BMS
AC-3	AAON	RM-A01/PRTU	1	N/A Eff.: 12.8 EER	1 HP 21 amps	BMS

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 a internet connected BACnet type control system that can also be accessed locally. The front end allows the facilities personnel to monitor setpoints, 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 0.5 gallons per minute.
4. 2 Break rooms with faucets that rate at 2.5 gallons per minute.
5. 1 Shower

2.6 DOMESTIC HOT WATER SYSTEM

The domestic hot water is provided by one domestic extra high efficiency gas hot water heater; see Figure 2.4.

Figure 2.4: 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:

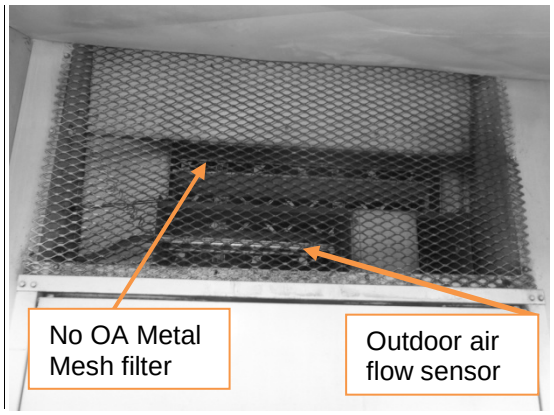
1. Over sized AC unit: this can the unit to run for a short period of time which in turn will lower room temperature, but will not allow enough run time to remove moister.
2. Poor condensate removal

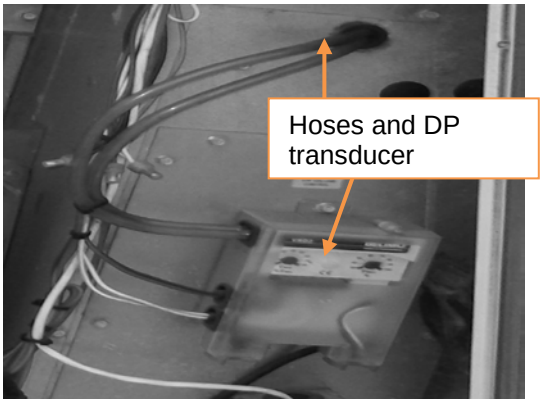
All major mechanical equipment inspected is in good working condition with the exception of the outdoor air flow stations on AC's 1 and 3. The outdoor airflow stations monitor outdoor air flow to the spaces served and override any commands based on the amount of minimum outdoor air needed for proper 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 2.5: Typical Site AC unit Operational Issues





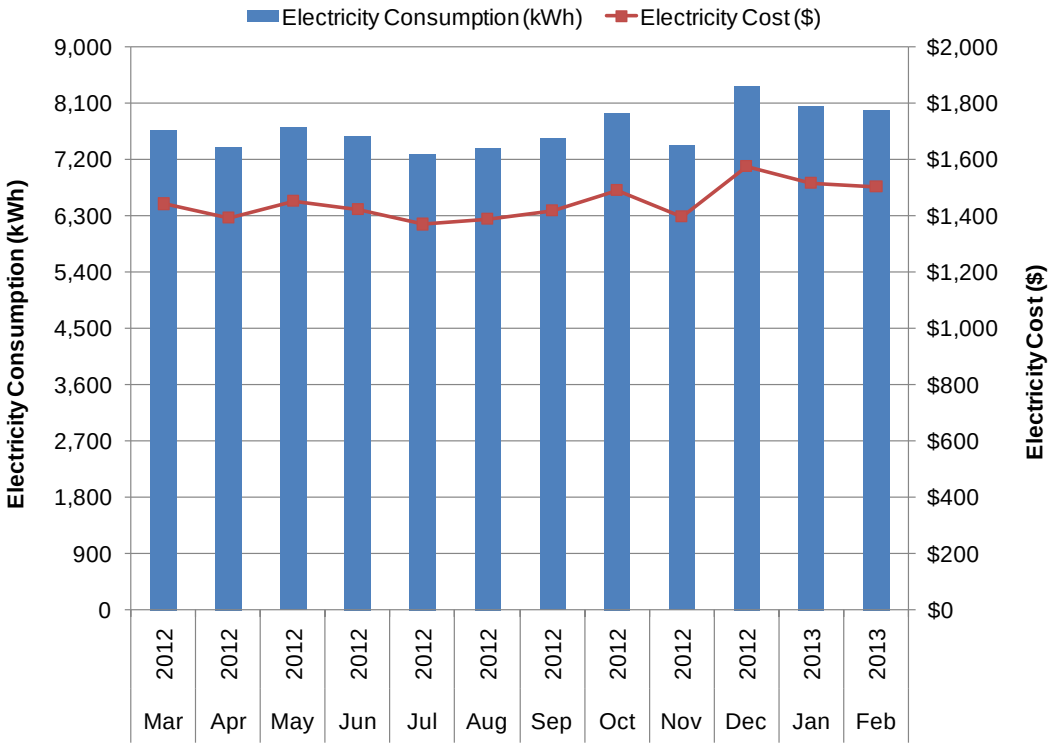
3.0 HISTORICAL ENERGY USE

This section provides a summary of the building's electrical energy consumption. Electricity is supplied by PG&E; natural gas service from PG&E has been disconnected. 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 3.2 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$

Table 3.2: Monthly Electricity Cost and Consumption



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.

Figure 3.1 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 [illegible] (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.

Each energy efficiency measures (EEMs) has the following sections;

1. Description
2. Existing Conditions
3. Proposed Efficiency & Performance Assumptions
4. Savings Summary

4.1 TIER ONE MEASURES: NO TO LOW CAPITAL INVESTMENT

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:

4am to 6pm Mondays and 5am to 6pm Tuesday through Firday

Savings Summary:

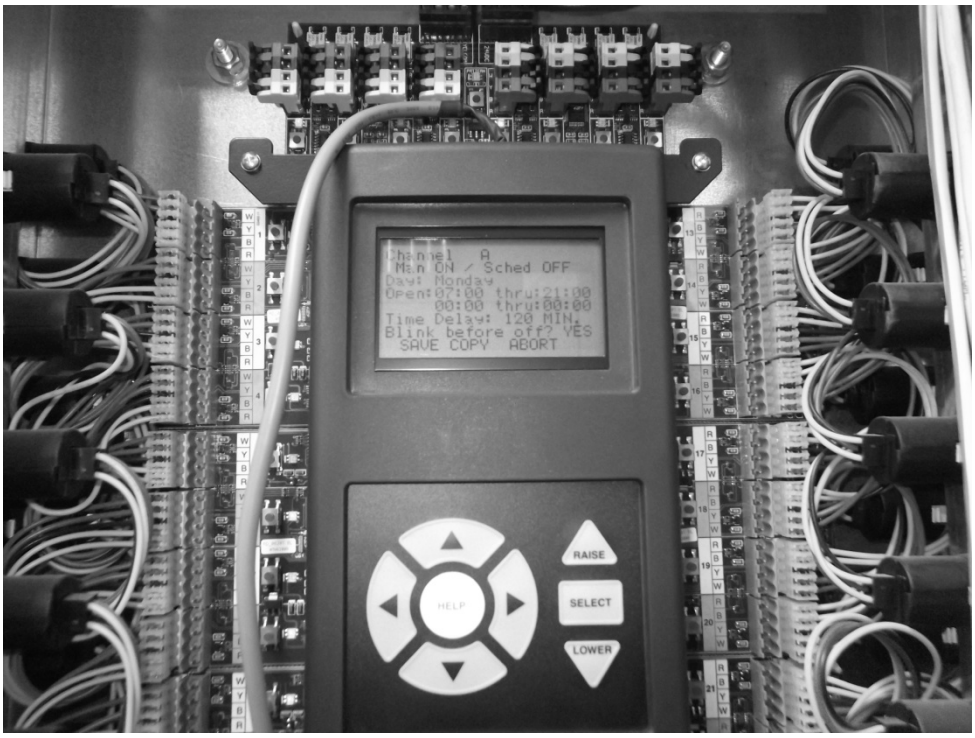
The energy and cost savings are based on the reduced operating schedule. There are no additional maintenance costs associated with this measure. See Table 1.1 in the executive summary for the savings for this measure.

4.1.2 EEM 3 – 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

Savings Summary:

There are no additional maintenance costs associated with this measure. See Table 1.1 in the executive summary for the savings for this measure.

4.2 TIER TWO MEASURES: MODERATE CAPITAL INVESTMENT

4.2.1 EEM 2 – 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.

Savings Summary:

There is additional maintenance costs associated with this measure. See Table 1.1 in the executive summary for the savings for this measure.

4.3 TIER THREE MEASURES: SIGNIFICANT CAPITAL INVESTMENT

4.3.1 EEM 3B – 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.

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;

1. Existing Efficiency (EER): 10.8
2. Existing Air Flow: Variable
3. Annual cooling Operating Hours: 1430
4. Proposed Efficiency (EER): 12.5
5. Proposed Seasonal Efficiency(SEER):14 to 15.5

Savings Summary:

There are no additional maintenance costs associated with this measure. See Table 1.1

5.0 MEASUREMENTS AND VERIFICATION PLAN

A measurement and verification (M&V) plan can assure optimal performance over the life time 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.