Energy Audit Report:

Office Building
123 Colorado Boulevard
Denver, Colorado 80209

Building Picture

Prepared for:

123 Colorado Boulevard
Denver, Colorado 80209

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EXECUTIVE SUMMARY

OVERVIEW OF RESULTS

Enser Consulting, LLC has performed a Level I walk-through energy evaluation and audit of an office building located at 123 Colorado Boulevard. The purpose of this energy audit is to determine any capital improvements to the building, and changes to operating standards and maintenance procedures, along with potential utility cost savings. This report presents the results of these efforts. All measures and findings are summarized below.

Operation and Maintenance Measures (O&Ms):

Three operation and maintenance measures were identified. Two of these measures are low-cost/no cost and could be implemented by in-house staff. The total estimated annual savings for these three measures are 16,183 kWh, 152 therms, and $1,864 in utility costs. The total estimated implementation cost of these three measures is estimated at $1,600. Paybacks for the individual measures are outlined in the table below.

Capital Improvement Measures:

Four capital improvement measures were identified. The total estimated annual savings for these measures are 21,884 kWh, 140 therms, and $2,453 in utility costs. The total estimated implementation cost of these measures is estimated at $3,850. Paybacks for the individual measures are outlined in the table below.

Project Summary:

The nine measures identified have a total estimated annual savings of 38,067 kWh, 292 therms, and $4,317 in utility costs. The total implementation cost is estimated at $5,450. The individual measures, energy savings, cost savings, and payback periods are outlined in the tables below. Implementation of the measures is outlined under the Energy Conservation Measures section.

Verification of Energy Savings:

Energy usage should be tracked following the implementation of these nine measures to verify energy savings. The dates the measures are implemented should be recorded. The energy usage for one year before the implementation of measures and one year after should be analyzed. Differences in energy use are likely attributable to the audit and resulting implemented measures barring any significant changes in building operations and year-to-year weather.

ENERGY CONSERVATION MEASURES (ECMs)

ID	Finding	ECM	Type
1	No economizer control on rooftop HVAC units	Install thermostats with economizer control	CI
2	No programmable thermostats for rooftop HVAC units	Install programmable thermostats	CI
3	Lights are on when spaces are unoccupied	Install occupancy sensors	CI
4	Computers/office equipment left on overnight/weekends	Implement energy awareness program	O&M
5	Dirty filters on rooftop HVAC units	Change filters more frequently	O&M
6	No preventative maintenance on rooftop HVAC units	Implement preventative maintenance program	O&M
7	Lavatory exhaust fans run continuously	Install timer on exhaust fan controls	CI

Notes:

1. CI = Capital Improvement; O&M = Operation and Maintenance
2. ECM 1 & 2 can be accomplished simultaneously

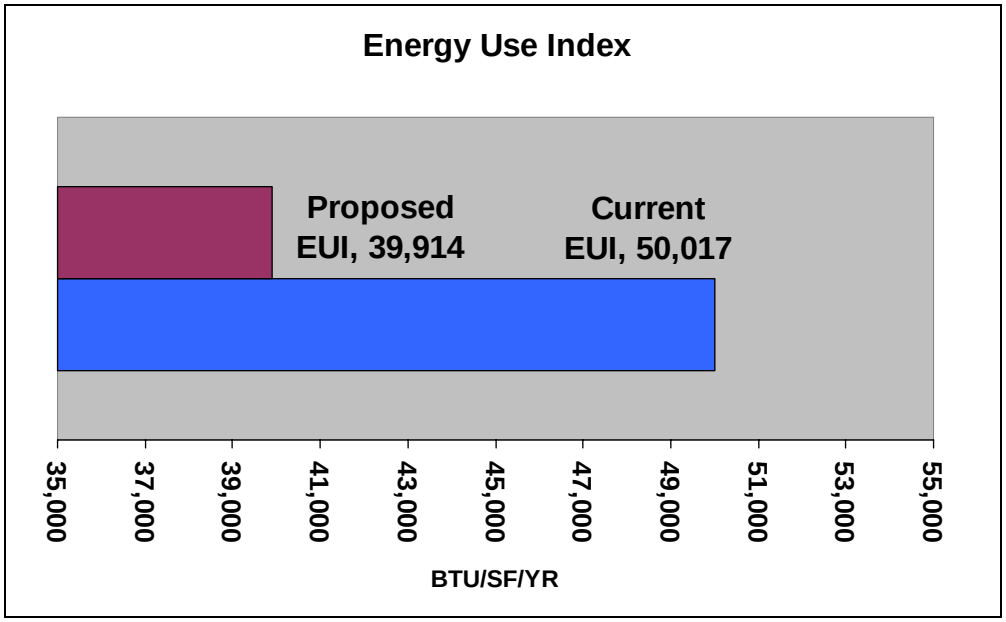
ENERGY CONSERVATION MEASURES (ECMs)

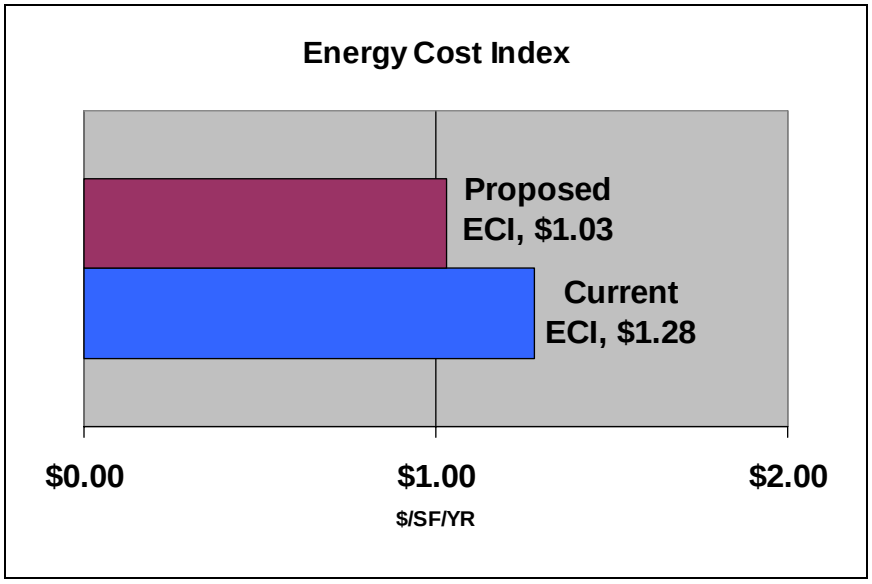
ID	ECM	Electric Energy Savings (kWh/Yr)	Gas Energy Savings (therms/Yr)	Annual Cost Savings	Implementation Cost	Simple Payback (Yrs)	% Utility Cost Reduction
1	Install thermostats with economizer control	4,920	0	$519	$500	0.96	2.56%
2	Install programmable thermostats	7,000	140	$884	$500	0.57	4.37%
3	Install occupancy sensors	7,200	0	$759	$2,200	2.90	3.75%
4	Implement energy awareness program	3,523	0	$371	$0	0.00	1.84%
5	Change filters more frequently	2,360	32	$282	$200	0.71	1.40%
6	Implement preventative maintenance program	10,300	120	$1,211	$1,400	1.16	5.99%
7	Install timers on exhaust fan controls	2,764	0	$291	$650	2.23	1.44%
		38,067	292	$4,317	$5,450		21.35%

Notes:

1. Cost of ECM 1 & 2 divided between both

Energy Usage and Cost Index Comparison





	Current kW/Yr	Current therms/Yr	Current Millions of BTUs			Current ECI	Current EUI
			Electric	Gas	Combined	$/SF	BTU/SF
	176,141	1,866	601.17	186.60	787.77	1.283746	50,017

	Proposed kW/Yr	Proposed therms/Yr	Proposed Millions of BTUs			ECI	EUI
			Electric	Gas	Combined	$/SF	BTU/SF
	138,074	1,574	471.25	157.40	628.65	$1.0282	39,914
% Reduction	22%	16%	22%	16%	20%	20%	20%

BUILDING INFORMATION

GENERAL INFORMATION

The facility is an office building located in Denver, Colorado. The building has an operating schedule and requirements that is typical of an office-type environment. The building was constructed in 1992 and includes approximately 15,750 square feet of office spaces and a lobby. Basic construction for the building is metal frame with stucco exterior and flat EPDM roofing. The roof insulation is R-15 fiberglass batt insulation, and the walls are assumed to be insulated with R-11 fiberglass batt insulation. All windows are double pane.

General occupancy for the building is 7 am – 6 pm. The tenants generally do not work weekends and holidays. There are typically around 120 employees working in the building.

HVAC SYSTEMS

The facility is served by 6 packaged rooftop HVAC (heating, ventilating and air conditioning) units. Each unit has a supply fan, a direct expansion (DX) cooling coil, and a natural gas fueled heating section. Details of the systems are below.

Cooling

The cooling capacity for each of the 6 packaged rooftop HVAC units is 5 tons, for a total connected load of 30 tons. The cooling efficiency (EER) for each unit has been estimated at 8.0 BTU/watt.

Heating

The heating capacity of for each of the 6 packaged rooftop HVAC units is 50 kBTUH, for a total connected load of 300 kBTUH. The combustion efficiency for each unit has been estimated at 70%.

Fans

The supply fan horsepower for each of the 6 package rooftop HVAC units is 2 horsepower (HP), for a total connected load of 12 HP. The total amount of air delivered to the building is estimated at 11,500 cubic feet per minute (CFM). The 6 packaged rooftop HVAC units bring in approximately 2,700 CFM, or 23%, of outside air for ventilation.

There are 4 bathroom rooftop exhaust fans that exhaust approximately 800 CFM total. The 4 bathroom rooftop exhaust fans are rated at 1/6 HP, for a total connected load of 2/3 HP. The exhaust fans currently run continuously.

HVAC Controls

All 6 packaged rooftop HVAC units are controlled by thermostats located throughout the facility. Heating and cooling setpoints for the HVAC units are the 72 °F and 75 °F, respectively. The thermostats do not have a programmable feature, and it is currently the responsibility of the maintenance staff to perform any temperature setback at night and on the weekends.

ELECTRICAL SYSTEMS

Interior Lighting

The interior lighting for the building includes fluorescent, incandescent, and compact fluorescent fixtures. A majority of the fixtures have T8 lamps with electronic ballasts. Based on the electrical plans, the interior of the building has an average lighting load of 1.3 watts per square foot.

Exterior Lighting

The exterior lighting for the building includes high intensity discharge (HID) light fixtures for the parking lot, and compact fluorescent light fixtures at the perimeter of the building. There are 12 HID light fixtures in the parking lot that contain 150-watt high-pressure sodium lamps. The building perimeter has 9 compact fluorescent light fixtures that contain 26-watt compact fluorescent lamps.

Lighting Controls

The interior lights are controlled by light switches, and the exterior lights are controlled by photocells with an emergency override.

Miscellaneous Electrical Systems

Miscellaneous electrical equipment includes common office equipment including computers, printers, etc. There are also small kitchenette areas that contain refrigerators, microwaves, and coffee makers. These loads are estimated at approximately 11 kW.

FOSSIL FUEL SYSTEMS

Domestic Hot Water

120 °F domestic hot water is provided by a natural gas-fired 80 gallon hot water heater that provides hot water to the restrooms and kitchenette sinks throughout the building. Hot water is recirculated via a pump rated at 1/25 HP.

UTILITY SUMMARY

The building uses electricity and natural gas to meet its energy needs. The building used 176,141 kWh of electricity ($18,638) and 1,866 therms of natural gas ($1,581) for the period from January 2007 through December 2007. This corresponds to an energy use index (EUI) of 50,017 BTU/SF/Year and an energy cost index of $1.28/SF/Year. The utility history, energy used index, and energy cost index are tabulated below.

Building Utility History

	Electrical				Natural Gas		
Date	KWH	KW	$	Avg $/KWH	Therm	$	Avg $/Therm
Jan-07	11,544	50	$1,210	$0.1048	413	$314	$0.7603
Feb-07	11,293	49	$1,188	$0.1052	336	$260	$0.7738
Mar-07	14,294	60	$1,457	$0.1019	209	$170	$0.8134
Apr-07	14,494	60	$1,452	$0.1002	106	$97	$0.9151
May-07	14,403	64	$1,520	$0.1055	46	$54	$1.1739
Jun-07	16,979	73	$1,880	$0.1107	34	$46	$1.3529
Jul-07	18,706	79	$2,032	$0.1086	29	$42	$1.4483
Aug-07	19,003	77	$2,008	$0.1057	29	$42	$1.4483
Sep-07	16,687	76	$1,920	$0.1151	39	$49	$1.2564
Oct-07	13,972	62	$1,482	$0.1061	79	$77	$0.9747
Nov-07	12,260	52	$1,257	$0.1025	200	$164	$0.8200
Dec-07	12,506	50	$1,232	$0.0985	346	$266	$0.7688
Totals	176,141	752	$18,638	N/A	1,866	$1,581	N/A
Average	14,678	63	$1,553	$0.1054	156	$132	$1.0422

Building Energy Use

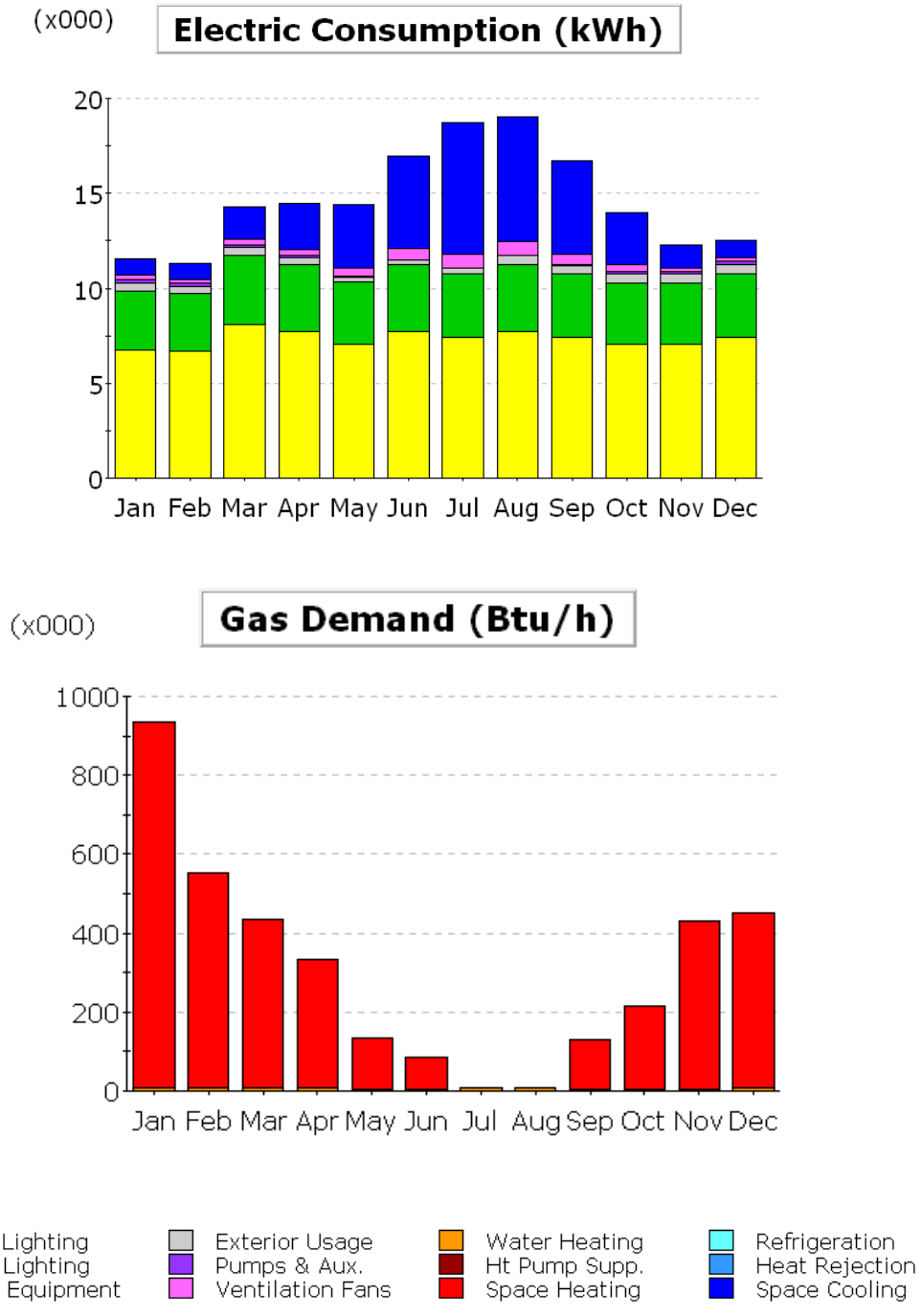
	Millions of BTUs			ECI	EUI
Date	Electric	Gas	Combined	$/SF	BTU/SF
Jan-07	39.40	41.30	80.70	$0.0968	5,124
Feb-07	38.54	33.60	72.14	$0.0919	4,581
Mar-07	48.79	20.90	69.69	$0.1033	4,424
Apr-07	49.47	10.60	60.07	$0.0983	3,814
May-07	49.16	4.60	53.76	$0.0999	3,413
Jun-07	57.95	3.40	61.35	$0.1223	3,895
Jul-07	63.84	2.90	66.74	$0.1317	4,238
Aug-07	64.86	2.90	67.76	$0.1302	4,302
Sep-07	56.95	3.90	60.85	$0.1250	3,864
Oct-07	47.69	7.90	55.59	$0.0990	3,529
Nov-07	41.84	20.00	61.84	$0.0902	3,927
Dec-07	42.68	34.60	77.28	$0.0951	4,907
Totals	601.17	186.60	787.77	$1.2837	50,017
Average	50.10	15.55	65.65	$0.11	4,168

The average cost of electricity is calculated to be $0.1054/kWh, which includes demand costs. The average cost of natural gas is calculated to be $1.0422/therm. The electricity and natural gas

profiles appear to be normal, with a bell-shaped profile in the summer for electricity and in the winter for natural gas. The electrical demand profile indicates a base load of about 50 kW. The natural gas profile indicates a base load of 29 therms (2,900,000 BTUH) for domestic hot water heating.

END-USE BREAKDOWN

The graphs below (from eQuest software report) represent the monthly electricity and natural gas consumption by end-uses.



ENERGY CONSERVATION MEASURES

DETAILED FINDINGS & RECOMMENDATIONS

1 – Install Thermostats with Economizer Control

Description
During the site visit, it was discovered that the economizers on the HVAC rooftop units were never enabled. This is due to the installed/existing thermostats not having the capability of controlling the economizers.

Finding Impacts

Energy Savings – Yes	Occupant Comfort – Yes
Demand Savings – No	Indoor Air Quality – Yes
Natural Gas Savings – No	

Estimated Utility and Cost Impact

Estimated Annual Energy Savings	4,920 kWh
Estimated Peak Demand Savings	0 kW
Estimated Annual Natural Gas Savings	0 therms
Estimated Annual Cost Savings	$519
Estimated Implementation Cost	$500
Simple Payback	0.96 years

Recommendation
It is recommended that the existing thermostats be replaced with thermostats capable of economizer control. Additional savings will be achieved due to programmable capabilities outlined in ECM #2.

Implementation
Install new thermostats outlined above according to the manufacturer installation instructions. Ensure new thermostats have economizer control capability and are programmable. Each rooftop unit must be tested to ensure proper operation. All work to be performed by licensed HVAC contractor.

2 – Install Programmable Thermostats

Description
During the site visit, it was noted that the thermostats are currently being controlled by the maintenance staff. This subjects the night and weekend temperature setback to human error, which could result in unnecessary energy costs.

Finding Impacts

Energy Savings – Yes	Occupant Comfort – No
Demand Savings – No	Indoor Air Quality – No
Natural Gas Savings – Yes	

Estimated Utility and Cost Impact

Estimated Annual Energy Savings	7,000 kWh
Estimated Peak Demand Savings	0 kW
Estimated Annual Natural Gas Savings	140 therms
Estimated Annual Cost Savings	$884
Estimated Implementation Cost	$500
Simple Payback	0.57 years

Recommendation

It is recommended that the existing thermostats be replaced with programmable thermostats capable of night and weekend temperature setback. Additional savings will be achieved due to economizer capabilities outlined in ECM #1.

Implementation

Install new thermostats outlined above according to the manufacturer installation instructions. Ensure new thermostats have economizer control capability and are programmable. Each rooftop unit must be tested to ensure proper operation. All work to be performed by licensed HVAC contractor.

3 – Install Occupancy Sensors

Description

During the site visit, it was discovered that lights in unoccupied areas were left on.

Finding Impacts

Energy Savings – Yes	Occupant Comfort – No
Demand Savings – No	Indoor Air Quality – No
Natural Gas Savings – No	

Estimated Utility and Cost Impact

Estimated Annual Energy Savings	7,200 kWh
Estimated Peak Demand Savings	0 kW
Estimated Annual Natural Gas Savings	0 therms
Estimated Annual Cost Savings	$759
Estimated Implementation Cost	$2,200
Simple Payback	2.90 years

Recommendation

It is recommended that occupancy sensors be installed on the lighting in areas that are not continually occupied during normal business operations, including conference rooms, lavatories, copy rooms and kitchenettes.

Implementation

Install occupancy sensors outlined above according to the manufacturer installation instructions. Each sensor must be tested to ensure proper operation. All work to be performed by licensed electrician.

4 – Implement Energy Awareness Program

Description
During the site visit, it was discovered that computers and other office equipment were left on overnight and on weekends.

Finding Impacts

Energy Savings – Yes	Occupant Comfort – No
Demand Savings – No	Indoor Air Quality – No
Natural Gas Savings – No	

Estimated Utility and Cost Impact (Estimated at 2%)

Estimated Annual Energy Savings	3,523 kWh
Estimated Peak Demand Savings	0 kW
Estimated Annual Natural Gas Savings	0 therms
Estimated Annual Cost Savings	$371
Estimated Implementation Cost	$0
Simple Payback	0.00 years

Recommendation
It is recommended that a formal energy awareness program be implemented. This program should include seminars/education for employees of the company on conservation opportunities including turning off their computers and other office equipment at the end of the work day. An energy reduction "contest" could be held for attaining certain reduction goals with prizes and/or parties for the employees.

Implementation
Implement energy awareness program outlined above. Contact Xcel Energy for free training and workshops.

5 – Change Filters More Frequently

Description
During the site visit, it was discovered that the outside air and return air filters on the HVAC rooftop units were very dirty impeding airflow. The dirty filters cause the supply fan to compensate for the higher pressure drop across the filter, reduce the amount of air delivered to the conditioned space, and can cause indoor air quality issues. The dirty filters are assumed to add 0.2 in. wc. of static pressure resistance for each rooftop unit's supply fan to overcome.

Finding Impacts

Energy Savings – Yes	Occupant Comfort – Yes
Demand Savings – No	Indoor Air Quality – Yes
Natural Gas Savings – Yes	

Estimated Utility and Cost Impact

Estimated Annual Energy Savings	2,360 kWh
Estimated Peak Demand Savings	0 kW
Estimated Annual Natural Gas Savings	32 therms
Estimated Annual Cost Savings	$282
Estimated Implementation Cost	$200
Simple Payback	0.71 Years

Recommendation

It is recommended that the disposable filters be changed and the re-usable filters be cleaned on a regular basis.

Implementation

The filters should be changed/cleaned on a regular basis. This work can be performed by the in-house maintenance worker or during the preventative maintenance outlined in ECM #6.

6 – Implement Preventative Maintenance Program

Description

There currently is no preventative maintenance program in place for the rooftop HVAC units. A preventative maintenance program will ensure the HVAC units are running at peak performance, the refrigerant level is properly charged, the thermal expansion valve is properly adjusted, and the condensing pressure is properly set. Energy savings associated with a properly maintained HVAC unit can be 5% or higher.

Finding Impacts

Energy Savings – Yes	Occupant Comfort – No
Demand Savings – No	Indoor Air Quality – No
Natural Gas Savings – Yes	

Estimated Utility and Cost Impact

Estimated Annual Energy Savings	17,600 kWh
Estimated Peak Demand Savings	0 kW
Estimated Annual Natural Gas Savings	180 therms
Estimated Annual Cost Savings	$1,211
Estimated Implementation Cost	$1,400
Simple Payback	1.16 years

Recommendation

It is recommended to implement preventative maintenance program via a licensed HVAC contractor. Option is to have a tune-up on HVAC units, although an ongoing program is recommended.

Implementation

Bids should be requested for preventative maintenance program and one-time tune-up bids from 3 local licensed HVAC contractors. Select contractor based on references, as well as maintenance costs. Keep records of service and maintenance performed for each HVAC unit.

7 – Install Timers on Exhaust Fan Controls

Description
During the site visit, it was discovered that the lavatory exhaust fans run continuously. By installing timers, the exhaust fans will only operate during building-occupied hours resulting in energy savings.

Finding Impacts

Energy Savings – Yes	Occupant Comfort – No
Demand Savings – No	Indoor Air Quality – No
Natural Gas Savings – No	

Estimated Utility and Cost Impact

Estimated Annual Energy Savings	2,764 kWh
Estimated Peak Demand Savings	0 kW
Estimated Annual Natural Gas Savings	0 therms
Estimated Annual Cost Savings	$291
Estimated Implementation Cost	$650
Simple Payback	2.23 years

Recommendation
It is recommended that timers be installed to control the operation of the lavatory exhaust fans.

Implementation
Install timers on the lavatory exhaust fans. Timers should be programmed to operate the exhaust fans during occupied hours. All work to performed by licensed electrician.