



# Local Government Energy Audit: Energy Audit Report



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## Millicent Fenwick Hall

1 Normal Ave.

Montclair, New Jersey 07043

Montclair State University

August 3, 2018

Final Report by:

**TRC Energy Services**

## Disclaimer

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The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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# I EXECUTIVE SUMMARY

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The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Millicent Fenwick Hall.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey higher education facilities in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

## I.1 Facility Summary

Millicent Fenwick Hall is a 99,943 square foot facility constructed in 2003. The building is a seven-story student residential facility containing several types of spaces including apartment areas, lobbies, bathrooms, hallways, electrical, and storage rooms.

Lighting at Fenwick hall consists primarily of 17-Watt and 32-Watt T8 fluorescent fixtures, which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to the linear fluorescent lamps, the facility also uses compact fluorescent (CFL) and metal halide (MH) sources. Exit lighting is provided by compact fluorescent sources. Exterior lighting is provided by metal halide fixtures. Lighting control for interior lighting is provided by switches. Exterior lighting is subject to photocell controls.

Cooling is provided by chilled water (CHW) produced by a roof mounted 225-ton air cooled constant speed scroll chiller. Chilled water is distributed by two (2) 15 hp chilled water pumps to the building's air handling equipment. Building space heating is provided by two (2) 1,189 MBtu output non-condensing boilers. The heating hot water (HHW) is distributed by two (2) hot water pumps to the building's AHUs.

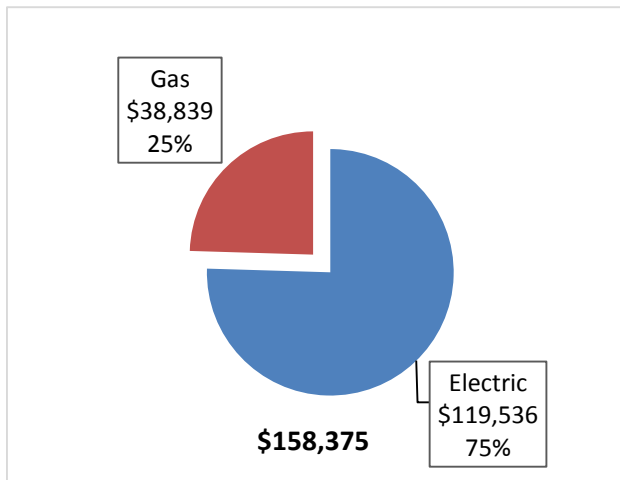
A thorough description of the facility and our observations are located in Section 2.

## I.2 Your Cost Reduction Opportunities

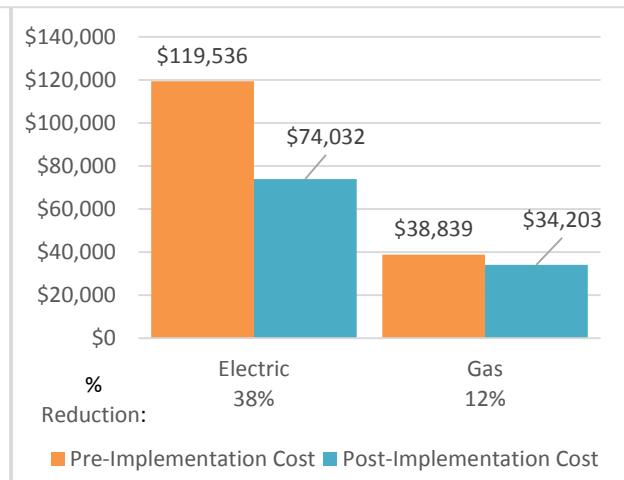
### Energy Conservation Measures

TRC evaluated and recommended 10 measures that together represent an opportunity for Millicent Fenwick Hall to reduce annual energy costs by roughly \$50,141 and annual greenhouse gas emissions by 372,949 lbs CO<sub>2</sub>e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in roughly 6.6 years. TRC has defined high priority measures as the evaluated measures that have a simple payback less than the typical equipment life of the proposed equipment. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce Millicent Fenwick Hall's annual energy use by 21%.

**Figure 1 – Previous 12 Month Utility Costs**



**Figure 2 – Potential Post-Implementation Costs**



A detailed description of Millicent Fenwick Hall's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the evaluated energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		High Priority?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Lighting Upgrades</b>			<b>96,069</b>	<b>17.5</b>	<b>0.0</b>	<b>\$14,726.53</b>	<b>\$89,160.80</b>	<b>\$6,600.00</b>	<b>\$82,560.80</b>	<b>5.6</b>	<b>96,741</b>
ECM 1	Install LED Fixtures	Yes	5,766	0.8	0.0	\$883.84	\$3,439.80	\$30.00	\$3,409.80	3.9	5,806
ECM 2	Retrofit Fixtures with LED Lamps	Yes	88,341	16.5	0.0	\$13,541.90	\$84,321.00	\$6,570.00	\$77,751.00	5.7	88,959
ECM 3	Install LED Exit Signs	Yes	1,962	0.1	0.0	\$300.79	\$1,400.00	\$0.00	\$1,400.00	4.7	1,976
<b>Lighting Control Measures</b>			<b>11,747</b>	<b>1.2</b>	<b>0.0</b>	<b>\$1,800.64</b>	<b>\$11,800.00</b>	<b>\$350.00</b>	<b>\$11,450.00</b>	<b>6.4</b>	<b>11,829</b>
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	1,875	0.4	0.0	\$287.45	\$5,400.00	\$350.00	\$5,050.00	17.6	1,888
ECM 5	Install High/Low Lighting Controls	Yes	9,871	0.8	0.0	\$1,513.20	\$6,400.00	\$0.00	\$6,400.00	4.2	9,940
<b>Variable Frequency Drive (VFD) Measures</b>			<b>28,209</b>	<b>3.6</b>	<b>0.0</b>	<b>\$4,324.16</b>	<b>\$7,615.90</b>	<b>\$1,600.00</b>	<b>\$6,015.90</b>	<b>1.4</b>	<b>28,406</b>
ECM 6	Install VFDs on Constant Volume (CV) HVAC	Yes	28,209	3.6	0.0	\$4,324.16	\$7,615.90	\$1,600.00	\$6,015.90	1.4	28,406
<b>Electric Chiller Replacement</b>			<b>158,870</b>	<b>78.3</b>	<b>0.0</b>	<b>\$24,353.35</b>	<b>\$191,966.45</b>	<b>\$20,700.00</b>	<b>\$171,266.45</b>	<b>7.0</b>	<b>159,981</b>
ECM 7	Install High Efficiency Chillers	Yes	158,870	78.3	0.0	\$24,353.35	\$191,966.45	\$20,700.00	\$171,266.45	7.0	159,981
<b>Gas Heating (HVAC/Process) Replacement</b>			<b>0</b>	<b>0.0</b>	<b>412.9</b>	<b>\$3,028.51</b>	<b>\$57,080.14</b>	<b>\$5,231.60</b>	<b>\$51,848.54</b>	<b>17.1</b>	<b>48,351</b>
ECM 8	Install High Efficiency Hot Water Boilers	Yes	0	0.0	412.9	\$3,028.51	\$57,080.14	\$5,231.60	\$51,848.54	17.1	48,351
<b>Domestic Water Heating Upgrade</b>			<b>0</b>	<b>0.0</b>	<b>219.3</b>	<b>\$1,608.03</b>	<b>\$6,561.26</b>	<b>\$0.00</b>	<b>\$6,561.26</b>	<b>4.1</b>	<b>25,673</b>
ECM 9	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	219.3	\$1,608.03	\$6,561.26	\$0.00	\$6,561.26	4.1	25,673
<b>Plug Load Equipment Control - Vending Machine</b>			<b>1,954</b>	<b>0.0</b>	<b>0.0</b>	<b>\$299.58</b>	<b>\$460.00</b>	<b>\$0.00</b>	<b>\$460.00</b>	<b>1.5</b>	<b>1,968</b>
ECM 10	Vending Machine Control	Yes	1,954	0.0	0.0	\$299.58	\$460.00	\$0.00	\$460.00	1.5	1,968
<b>TOTALS FOR HIGH PRIORITY MEASURES</b>			<b>296,849</b>	<b>100.6</b>	<b>632.2</b>	<b>\$50,140.81</b>	<b>\$364,644.54</b>	<b>\$34,481.60</b>	<b>\$330,162.94</b>	<b>6.6</b>	<b>372,949</b>
<b>TOTALS FOR ALL EVALUATED MEASURES</b>			<b>296,849</b>	<b>100.6</b>	<b>632.2</b>	<b>\$50,140.81</b>	<b>\$364,644.54</b>	<b>\$34,481.60</b>	<b>\$330,162.94</b>	<b>6.6</b>	<b>372,949</b>

\* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

\*\* - Simple Payback Period is based on net measure costs (i.e. after incentives).

**Lighting Upgrades** generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

**Lighting Controls** measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

**Variable Frequency Drives (VFDs)** are motor control devices. These measures control the speed of a motor so that the motor spins at peak efficiency during partial load conditions. Sensors adapt the speed to flow, temperature, or pressure settings which is much more efficient than using a valve or damper to control flow rates, or running the motor at full speed when only partial power is needed. These measures save energy by controlling motor usage more efficiently.

**Electric Chiller** measures generally involve replacing older inefficient hydronic chillers with modern energy efficient systems. New chillers can provide equivalent cooling compared to older chillers at a reduced energy cost. These measures save energy by reducing chiller energy usage, due to improved electrical and heat transfer efficiency.

**Gas Heating (HVAC/Process)** measures generally involve replacing older inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide equivalent heating compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel demands for heating, due to improved combustion and heat transfer efficiency.

**Domestic Hot Water** upgrade measures generally involve replacing older inefficient domestic water heating systems with modern energy efficient systems. New domestic hot water heating systems can provide equivalent, or greater, water heating capacity compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel used for domestic hot water heating due to improved heating efficiency or reducing standby losses.

**Plug Load Equipment** control measures generally involve installing automated devices that limit the power usage or operation of equipment that is plugged into an electric outlet when not in use.



## **Energy Efficient Practices**

TRC also identified 13 low cost or no cost energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at Millicent Fenwick Hall include:

- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Perform Routine Motor Maintenance
- Use Fans to Reduce Cooling Load
- Assess Chillers & Request Tune-Ups
- Clean Evaporator/Condenser Coils on AC Systems
- Clean and/or Replace HVAC Filters
- Perform Proper Boiler Maintenance
- Perform Proper Furnace Maintenance
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

## **On-Site Generation Measures**

TRC evaluated the potential for installing on-site generation for Millicent Fenwick Hall. Based on the configuration of the site and its loads there is a low potential for installing any PV and combined heat and power self-generation measures.

For details on our evaluation and on-site generation potential, please refer to Section 6.

### I.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Pay for Performance - Existing Building (P4P)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

Larger facilities with an interest in a more comprehensive whole building approach to energy conservation should consider participating in the Pay for Performance (P4P) program. Projects eligible for this project program must meet minimum savings requirements. Final incentives are calculated based on actual measured performance achieved at the end of the project. The application process is more involved, and it requires working with a qualified P4P contractor, but the process may result in greater energy savings overall and more lucrative incentives, up to 50% of project's total cost.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.3 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8. You may also check the following website for more details: [www.njcleanenergy.com/ci](http://www.njcleanenergy.com/ci).

## 2 FACILITY INFORMATION AND EXISTING CONDITIONS

### 2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
<b>Customer</b>			
Ana Pinto	Director of Energy Management	pintoa@mail.montclair.edu	973-655-3244
<b>TRC Energy Services</b>			
Moussa Traore	Auditor	MTraore@trcsolutions.com	(732) 855-0033

### 2.2 General Site Information

On July 12, 2017, TRC performed an energy audit at Millicent Fenwick Hall located in Montclair, New Jersey. TRC met with Ana Pinto to review the facility operations and help focus our investigation on specific energy-using systems.

Millicent Fenwick Hall is a 99,943 square foot facility constructed in 2003. The building is a seven story student residential facility containing several types of spaces including apartment areas, lobbies, bathrooms, hallways, electrical, and storage rooms.

Lighting at Fenwick hall consists primarily of 17-Watt and 32-Watt T8 fluorescent fixtures, which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to the linear fluorescent lamps, the facility also uses compact fluorescent (CFL) and metal halide (MH) sources. Exit lighting is provided by compact fluorescent sources. Exterior lighting is provided by (MH fixtures. Lighting control for interior lighting is provided by switches. Exterior lighting is subject to photocells controls.

Cooling is provided by chilled water (CHW) produced by a roof mounted 225-ton air cooled constant speed scroll chiller. The chilled water from the chiller is distributed by two (2) 15 hp chilled water pumps to the building's air handling equipment. Building space heating is provided by two (2) 1,189 MBtu output non-condensing boilers. The heating hot water (HHW) is distributed by two (2) hot water pumps to the building's AHUs.

### 2.3 Building Occupancy

The typical schedule is presented in the table below.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Millicent Fenwick Hall	Weekday	12:00 AM - 12:00 AM
Millicent Fenwick Hall	Weekend	12:00 AM - 12:00 AM

## 2.4 Building Envelope

Millicent Fenwick hall is a seven-story building. The building is constructed of concrete block and structural steel with a concrete facade. The building has a pitched, corrugated steel roof that is in good condition. The building has double pane windows which are in good condition and show little sign of excessive infiltration. The exterior doors are constructed of metal and are in good condition.

*Figure 6 – Building Facade*



## 2.5 On-Site Generation

The campus has a central cogeneration plant. The cogeneration plant uses natural gas fired turbines to produce electricity. Waste heat from the turbines is used to produce steam. The steam is delivered to some of the buildings on campus and used to produce chilled water which is delivered to some of the buildings on campus. See the campus summary report for additional information regarding the campus cogeneration plant.

Millicent Fenwick Hall does not have any on-site electric generation capacity.

## 2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

### Lighting System

Lighting at the facility is provided mostly by 17-Watt and 32-Watt linear fluorescent T8 lamps with electronic ballasts. Fluorescent fixtures provide illumination in corridors, restrooms, and other areas.

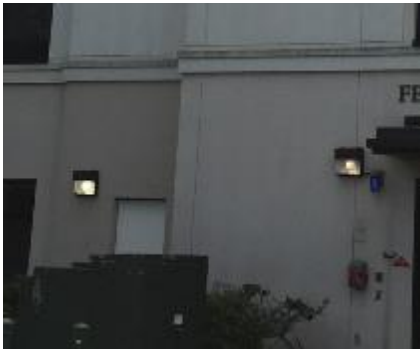
In addition to linear fluorescent fixtures, the building also has a considerable number of compact fluorescent lamps (CFL) of varying sizes which provide lighting to spaces such as apartments, lobbies, and corridors. All the exit signs are compact fluorescent fixtures.

Lighting control in all interior spaces is provided by manual switches with exit signs operating 24 hours for security reasons.

The building's exterior lighting consists of 250-Watt metal halide lighting fixtures. Based on the audit, all the exterior fixtures are controlled to operate from dusk to dawn.

*Figure 7 - Building Lighting Systems*

*Typical Exterior Wallpacks*



*Exterior Pole Fixtures*



## **Chilled Water (CHW) System**

The facility is served by a single chilled water plant located on the building rooftop. The chiller plant contains a nominal 225-ton air-cooled, scroll chiller (CH1). The chiller provides chilled water to the apartment fan coil units and air handler units via a 2-pipe network that is shared with the space heating hot water system (boiler). The 2-pipe system changes over between the boiler and the chiller (heating and cooling season). The chiller is connected in a primary variable flow configuration through two (2) 15 hp chilled/hot water pumps that are piped in parallel and operate in a lead/lag configuration. The pumps are controlled by variable frequency drives (VFDs). The pump VFD maintains a set differential water pressure setpoint (13 psi) across the 2-pipe network. The chilled water (CHW) supply set point is 44°F with an outside air temperature (OAT) chiller lockout of 55°F.

The chiller is 14 years old and in fair condition.

*Figure 8 – Chilled Water Systems*

*Air Cooled Chiller*



*Chilled Water Pumps*



## **Hot Water Heating System**

The heating hot water (HHW) system consists of two (2) Peerless 1,189 kBtu/hr output, forced draft boilers (Boilers 1 & 2). The boilers have a nominal combustion efficiency of 80.9%. Each boiler has a 0.33 hp forced draft fan. The boilers can operate in parallel or individually. The boilers are configured in a constant flow primary distribution employing the same distribution pumps which are used to distribute the chilled water.

The boilers are 14 years old and in need of replacement.

*Figure 9 – Hot Water Systems*

*Heating Hot Water Boiler*



*Hot Water Pumps*



## Air Handling Units

There are two (2) air handling units that serve the facility. Each AHU draws air from outside air dampers and there are no return ducts.

Each AHU is a constant air volume (CAV) system. The AHU has one (1) 10 hp supply fan and no return fans. All the fans are constant speed with no VFDs. The AHUs are 100% outside air systems. Air handling units have both chilled and hot water coils. Supply air temperature is set at 50°F during cooling and at 65°F during heating.

*Figure 10 – Hot Water Systems*

*Air Handling Unit 1A*



*Air Handling Unit 2A*



## Direct Expansion Air Conditioning System (DX)

The facility is also served by two (2) 3 ton Carrier cooling-only split systems. The fans and evaporators are located in the office areas. The compressors and condensing units are located on the rooftop. The units utilize scroll compressors and a direct-expansion (DX) coils.

## Building Energy Management System (BEMS)

The facility is controlled by Automated Logic Corporation's WebCTRL building energy management system (BEMS). The BEMS aggregates the DDC points from throughout the building. The system is capable of providing trends for individual DDC points.

*Figure 11 – Building Energy Management System*

*CHWIHW Water Loop EMS*



*Air Handling EMS*



## **Domestic Hot Water Heating System**

The domestic hot water heating system for the facility consists of three (3) Raypak gas fired condensing hot water heaters, each with an input rating of 1,250 kBtu/hr and a nominal efficiency of 90%. Each water heater has a 300-gallon storage tank. Three (3) 1 hp recirculation pumps distribute water to the entire facility.

*Figure 12 – Domestic Hot Water System*

*Domestic Hot Water Boilers*



*Storage Tanks*



## **Building Plug Load**

The building office has a desktop computer work station and students have additional computer equipment located in their dorm rooms. The facility contains other systems which contribute to plug load including printers, microwaves, washing machines, dish washers, etc. at the facility. In addition to the typical plug load equipment, the facility also has refrigerated and non-refrigerated vending machines.



### 3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the “typical” energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

#### 3.1 Total Cost of Energy

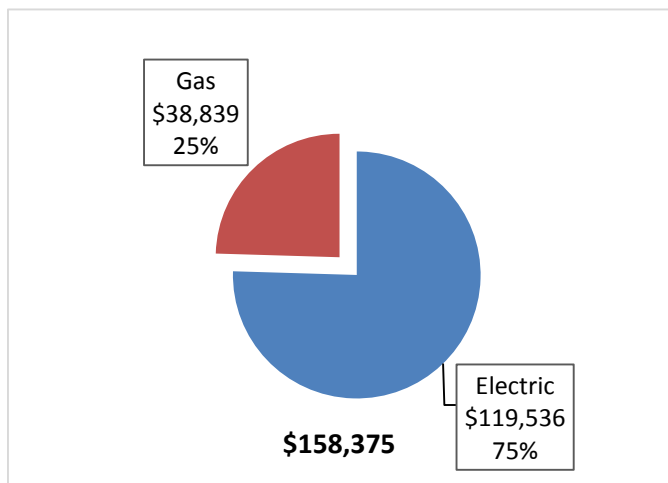
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

*Figure 13 - Utility Summary*

Utility Summary for Millicent Fenwick Hall		
Fuel	Usage	Cost
Electricity	779,799 kWh	\$119,536
Natural Gas	52,958 Therms	\$38,839
Total		\$158,375

The current annual energy cost for this facility is \$158,375 as shown in the chart below.

*Figure 14 - Energy Cost Breakdown*



## 3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months was \$0.153/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Figure 15 - Electric Usage & Demand

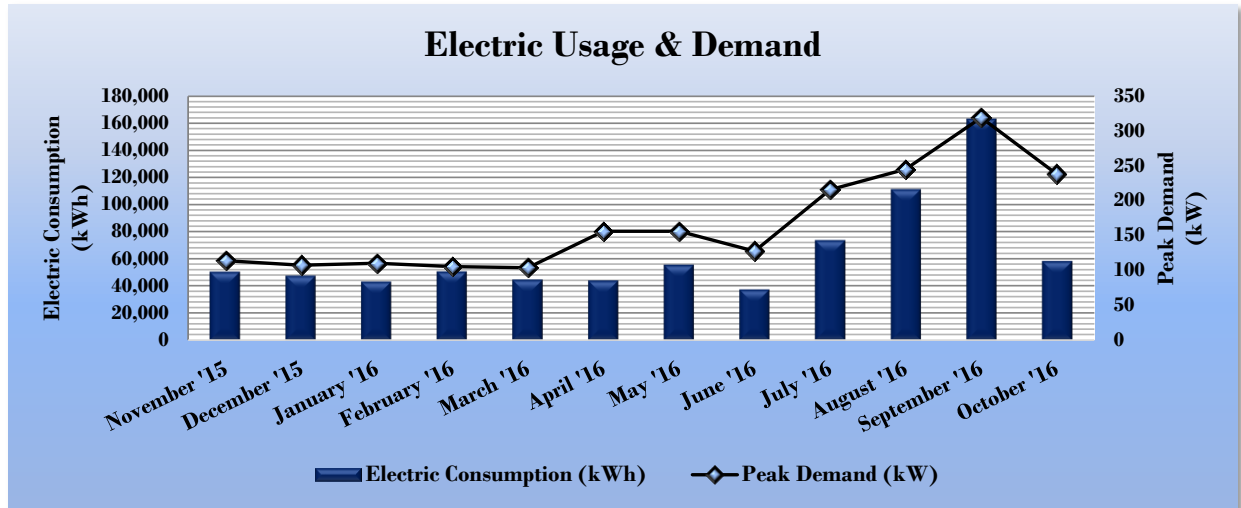


Figure 16 - Electric Usage & Demand

Electric Billing Data for Millicent Fenwick Hall					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
12/4/15	31	50,492	114	\$4,078	\$8,488
1/6/16	33	47,627	108	\$4,014	\$8,099
2/4/16	29	43,226	110	\$3,839	\$7,644
3/7/16	32	50,679	106	\$3,869	\$8,175
4/6/16	30	44,673	104	\$4,038	\$7,948
5/5/16	29	44,025	156	\$4,229	\$8,028
6/6/16	32	55,690	156	\$5,644	\$10,170
7/6/16	30	37,320	128	\$5,518	\$8,673
8/4/16	29	73,617	216	\$6,606	\$12,313
9/2/16	29	111,200	245	\$6,979	\$15,047
10/4/16	32	162,952	319	\$5,125	\$16,114
11/2/16	29	58,298	238	\$4,817	\$8,837
<b>Totals</b>	<b>365</b>	<b>779,799</b>	<b>319.3</b>	<b>\$58,755</b>	<b>\$119,536</b>
<b>Annual</b>	<b>365</b>	<b>779,799</b>	<b>319.3</b>	<b>\$58,755</b>	<b>\$119,536</b>

### 3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is \$0.733/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Figure 17 - Natural Gas Usage

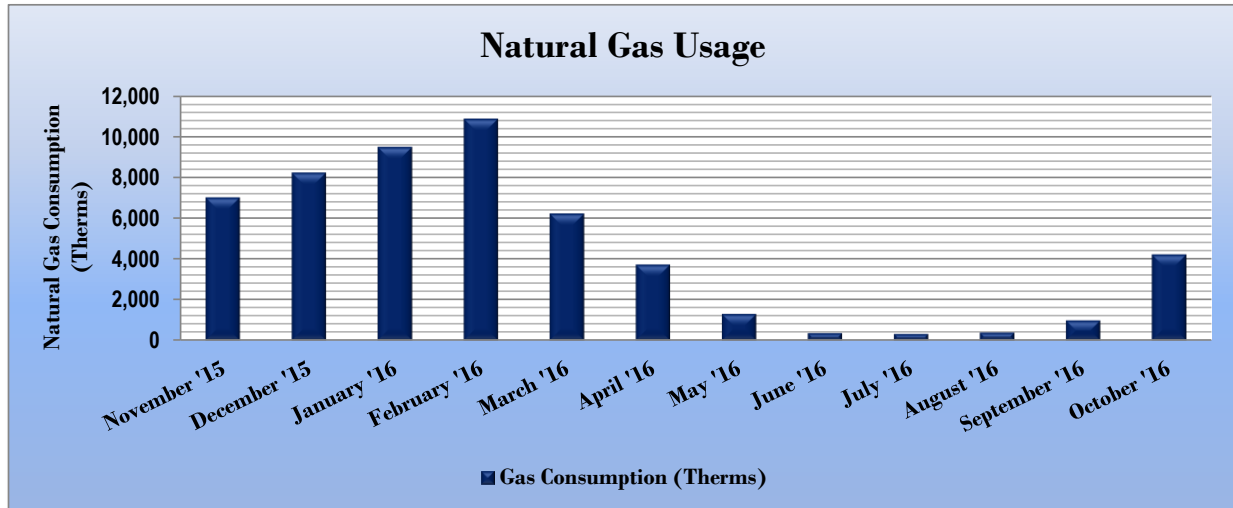


Figure 18 - Natural Gas Usage

Gas Billing Data for Millicent Fenwick Hall			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
12/4/15	31	6,992	\$5,573
1/6/16	33	8,217	\$6,529
2/4/16	29	9,473	\$7,092
3/7/16	32	10,845	\$7,646
4/6/16	30	6,212	\$3,128
5/5/16	29	3,710	\$1,980
6/6/16	32	1,286	\$768
7/6/16	30	358	\$298
8/4/16	29	317	\$301
9/2/16	29	376	\$329
10/4/16	32	968	\$700
11/2/16	29	4,204	\$4,496
<b>Totals</b>	<b>365</b>	<b>52,958</b>	<b>\$38,839</b>
<b>Annual</b>	<b>365</b>	<b>52,958</b>	<b>\$38,839</b>

### 3.4 Benchmarking

This facility was benchmarked using *Portfolio Manager*<sup>®</sup>, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR<sup>®</sup> program. Portfolio Manager analyzes your building’s consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR<sup>®</sup> score for select building types.

The EUI is a measure of a facility’s energy consumption per square foot, and it is the standard metric for comparing buildings’ energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of “site energy” and “source energy.” Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

**Figure 19 - Energy Use Intensity Comparison – Existing Conditions**

Energy Use Intensity Comparison - Existing Conditions		
	Millicent Fenwick Hall	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft <sup>2</sup> )	139.2	262.6
Site Energy Use Intensity (kBtu/ft <sup>2</sup> )	79.6	130.7

Implementation of all recommended measures in this report would improve the building’s estimated EUI significantly, as shown in the table below:

**Figure 20 - Energy Use Intensity Comparison – Following Installation of Recommended Measures**

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Millicent Fenwick Hall	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft <sup>2</sup> )	100.8	262.6
Site Energy Use Intensity (kBtu/ft <sup>2</sup> )	63.2	130.7

Many types of commercial buildings are also eligible to receive an ENERGY STAR<sup>®</sup> score. This score is a percentile ranking from 1 to 100. It compares your building’s energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR<sup>®</sup> certification. This facility has a current score of 65.

A Portfolio Manager<sup>®</sup> Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR<sup>®</sup> Statement of Energy Performance.

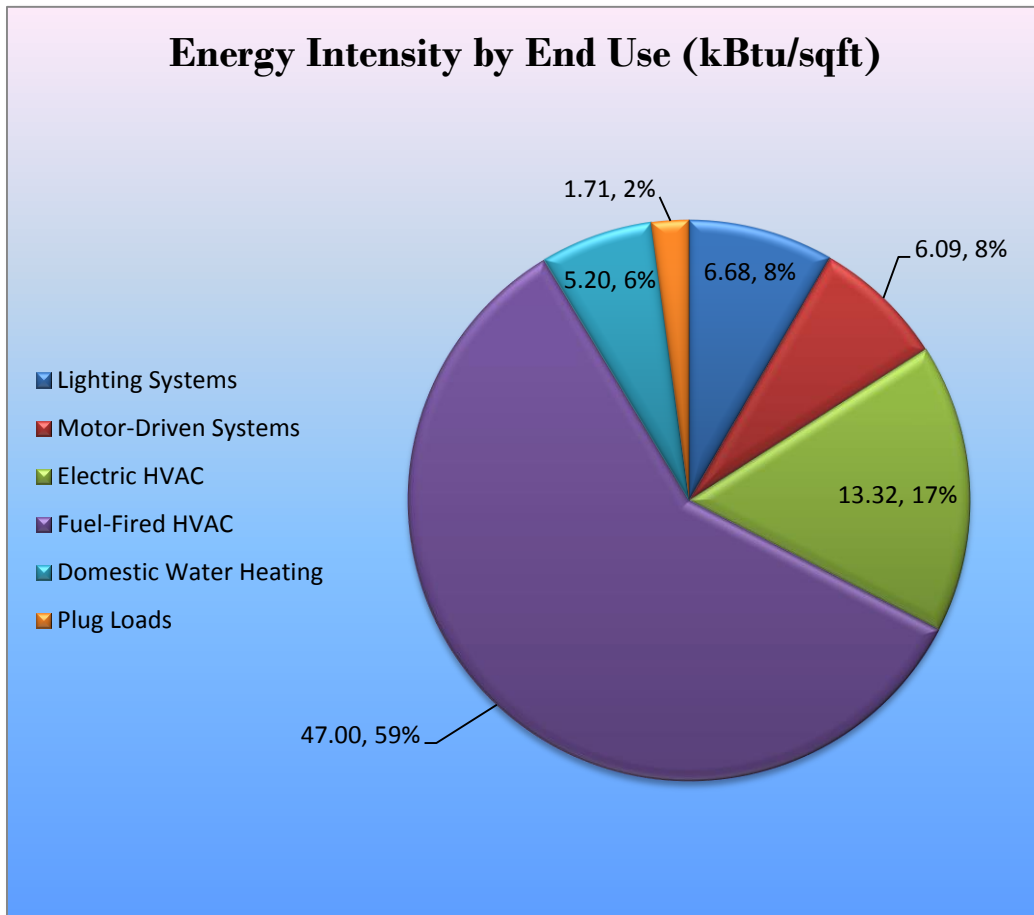
For more information on ENERGY STAR<sup>®</sup> certification go to: <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1>.

A Portfolio Manager<sup>®</sup> account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager regularly, so that you can keep track of your building’s performance. Free online training is available to help you use ENERGY STAR<sup>®</sup> Portfolio Manager<sup>®</sup> to track your building’s performance at: <https://www.energystar.gov/buildings/training>.

### 3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 21 - Energy Balance (% and kBtu/SF)



## 4 ENERGY CONSERVATION MEASURES

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Millicent Fenwick Hall regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

### 4.1 High Priority ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 22 – Summary of High Priority ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Lighting Upgrades</b>		<b>96,069</b>	<b>17.5</b>	<b>0.0</b>	<b>\$14,726.53</b>	<b>\$89,160.80</b>	<b>\$6,600.00</b>	<b>\$82,560.80</b>	<b>5.6</b>	<b>96,741</b>
ECM 1	Install LED Fixtures	5,766	0.8	0.0	\$883.84	\$3,439.80	\$30.00	\$3,409.80	3.9	5,806
ECM 2	Retrofit Fixtures with LED Lamps	88,341	16.5	0.0	\$13,541.90	\$84,321.00	\$6,570.00	\$77,751.00	5.7	88,959
ECM 3	Install LED Exit Signs	1,962	0.1	0.0	\$300.79	\$1,400.00	\$0.00	\$1,400.00	4.7	1,976
<b>Lighting Control Measures</b>		<b>11,747</b>	<b>1.2</b>	<b>0.0</b>	<b>\$1,800.64</b>	<b>\$11,800.00</b>	<b>\$350.00</b>	<b>\$11,450.00</b>	<b>6.4</b>	<b>11,829</b>
ECM 4	Install Occupancy Sensor Lighting Controls	1,875	0.4	0.0	\$287.45	\$5,400.00	\$350.00	\$5,050.00	17.6	1,888
ECM 5	Install High/Low Lighting Controls	9,871	0.8	0.0	\$1,513.20	\$6,400.00	\$0.00	\$6,400.00	4.2	9,940
<b>Variable Frequency Drive (VFD) Measures</b>		<b>28,209</b>	<b>3.6</b>	<b>0.0</b>	<b>\$4,324.16</b>	<b>\$7,615.90</b>	<b>\$1,600.00</b>	<b>\$6,015.90</b>	<b>1.4</b>	<b>28,406</b>
ECM 6	Install VFDs on Constant Volume (CV) HVAC	28,209	3.6	0.0	\$4,324.16	\$7,615.90	\$1,600.00	\$6,015.90	1.4	28,406
<b>Electric Chiller Replacement</b>		<b>158,870</b>	<b>78.3</b>	<b>0.0</b>	<b>\$24,353.35</b>	<b>\$191,966.45</b>	<b>\$20,700.00</b>	<b>\$171,266.45</b>	<b>7.0</b>	<b>159,981</b>
ECM 7	Install High Efficiency Chillers	158,870	78.3	0.0	\$24,353.35	\$191,966.45	\$20,700.00	\$171,266.45	7.0	159,981
<b>Gas Heating (HVAC/Process) Replacement</b>		<b>0</b>	<b>0.0</b>	<b>412.9</b>	<b>\$3,028.51</b>	<b>\$57,080.14</b>	<b>\$5,231.60</b>	<b>\$51,848.54</b>	<b>17.1</b>	<b>48,351</b>
ECM 8	Install High Efficiency Hot Water Boilers	0	0.0	412.9	\$3,028.51	\$57,080.14	\$5,231.60	\$51,848.54	17.1	48,351
<b>Domestic Water Heating Upgrade</b>		<b>0</b>	<b>0.0</b>	<b>219.3</b>	<b>\$1,608.03</b>	<b>\$6,561.26</b>	<b>\$0.00</b>	<b>\$6,561.26</b>	<b>4.1</b>	<b>25,673</b>
ECM 9	Install Low-Flow Domestic Hot Water Devices	0	0.0	219.3	\$1,608.03	\$6,561.26	\$0.00	\$6,561.26	4.1	25,673
<b>Plug Load Equipment Control - Vending Machine</b>		<b>1,954</b>	<b>0.0</b>	<b>0.0</b>	<b>\$299.58</b>	<b>\$460.00</b>	<b>\$0.00</b>	<b>\$460.00</b>	<b>1.5</b>	<b>1,968</b>
ECM 10	Vending Machine Control	1,954	0.0	0.0	\$299.58	\$460.00	\$0.00	\$460.00	1.5	1,968
<b>TOTALS</b>		<b>296,849</b>	<b>100.6</b>	<b>632.2</b>	<b>\$50,140.81</b>	<b>\$364,644.54</b>	<b>\$34,481.60</b>	<b>\$330,162.94</b>	<b>6.6</b>	<b>372,949</b>

\* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

\*\* - Simple Payback Period is based on net measure costs (i.e. after incentives).

## 4.2 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 23 below.

*Figure 23 – Summary of Lighting Upgrade ECMs*

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Lighting Upgrades</b>		<b>96,069</b>	<b>17.5</b>	<b>0.0</b>	<b>\$14,726.53</b>	<b>\$89,160.80</b>	<b>\$6,600.00</b>	<b>\$82,560.80</b>	<b>5.6</b>	<b>96,741</b>
ECM 1	Install LED Fixtures	5,766	0.8	0.0	\$883.84	\$3,439.80	\$30.00	\$3,409.80	3.9	5,806
ECM 2	Retrofit Fixtures with LED Lamps	88,341	16.5	0.0	\$13,541.90	\$84,321.00	\$6,570.00	\$77,751.00	5.7	88,959
ECM 3	Install LED Exit Signs	1,962	0.1	0.0	\$300.79	\$1,400.00	\$0.00	\$1,400.00	4.7	1,976

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

### **ECM 1: Install LED Fixtures**

#### *Summary of Measure Economics*

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
Interior	0	0.0	0.0	\$0.00	\$0.00	\$0.00	\$0.00	0.0	0
Exterior	5,766	0.8	0.0	\$883.84	\$3,439.80	\$30.00	\$3,409.80	3.9	5,806

#### *Measure Description*

We recommend replacing exterior fixtures containing metal halide lamps with new high-performance LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of HID lamps such as metal halide sources.

## **ECM 2: Retrofit Fixtures with LED Lamps**

### *Summary of Measure Economics*

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
Interior	88,341	16.5	0.0	\$13,541.90	\$84,321.00	\$6,570.00	\$77,751.00	5.7	88,959
Exterior	0	0.0	0.0	\$0.00	\$0.00	\$0.00	\$0.00	0.0	0

### *Measure Description*

We recommend retrofitting existing T8 linear fluorescent and compact fluorescent lighting technologies with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a fluorescent tubes.

## **ECM 3: Install LED Exit Signs**

### *Summary of Measure Economics*

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
Interior	1,962	0.1	0.0	\$300.79	\$1,400.00	\$0.00	\$1,400.00	4.7	1,976
Exterior	0	0.0	0.0	\$0.00	\$0.00	\$0.00	\$0.00	0.0	0

### *Measure Description*

We recommend replacing all incandescent or compact fluorescent exit signs with LED exit signs. LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output.



### 4.3 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 24 below.

**Figure 24 – Summary of Lighting Control ECMs**

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Lighting Control Measures</b>		<b>11,747</b>	<b>1.2</b>	<b>0.0</b>	<b>\$1,800.64</b>	<b>\$11,800.00</b>	<b>\$350.00</b>	<b>\$11,450.00</b>	<b>6.4</b>	<b>11,829</b>
ECM 4	Install Occupancy Sensor Lighting Controls	1,875	0.4	0.0	\$287.45	\$5,400.00	\$350.00	\$5,050.00	17.6	1,888
ECM 5	Install High/Low Lighting Controls	9,871	0.8	0.0	\$1,513.20	\$6,400.00	\$0.00	\$6,400.00	4.2	9,940

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

#### **ECM 4: Install Occupancy Sensor Lighting Controls**

##### *Summary of Measure Economics*

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
1,875	0.4	0.0	\$287.45	\$5,400.00	\$350.00	\$5,050.00	17.6	1,888

##### *Measure Description*

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in many storage rooms, laundry rooms, etc. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

## **ECM 5: Install High/Low Lighting Controls**

### *Summary of Measure Economics*

<b>Annual Electric Savings (kWh)</b>	<b>Peak Demand Savings (kW)</b>	<b>Annual Fuel Savings (MMBtu)</b>	<b>Annual Energy Cost Savings (\$)</b>	<b>Estimated Install Cost (\$)</b>	<b>Estimated Incentive (\$)</b>	<b>Estimated Net Cost (\$)</b>	<b>Simple Payback Period (yrs)</b>	<b>CO<sub>2</sub>e Emissions Reduction (lbs)</b>
9,871	0.8	0.0	\$1,513.20	\$6,400.00	\$0.00	\$6,400.00	4.2	9,940

### *Measure Description*

We recommend installing occupancy sensors to provide dual level lighting control for lighting fixtures in spaces that are infrequently occupied but may require some level of continuous lighting for safety or security reasons. Typical areas for such lighting control are interior corridors.

Lighting fixtures with these controls operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared sensors. The lighting systems are switched to full lighting levels whenever an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period of time. Energy savings results from only providing full lighting levels when it is required.

For this type of measure the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage needs to be provided to ensure that lights turn on in each area as an occupant approaches.

Additional savings from reduced lighting maintenance may also result from this measure, due to reduced lamp operation.

## 4.4 Variable Frequency Drive Measures

Our recommendations for variable frequency drive (VFD) measures are summarized in Figure 25 below.

*Figure 25 – Summary of Variable Frequency Drive ECMs*

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Variable Frequency Drive (VFD) Measures</b>		<b>28,209</b>	<b>3.6</b>	<b>0.0</b>	<b>\$4,324.16</b>	<b>\$7,615.90</b>	<b>\$1,600.00</b>	<b>\$6,015.90</b>	<b>1.4</b>	<b>28,406</b>
ECM 6	Install VFDs on Constant Volume (CV) HVAC	28,209	3.6	0.0	\$4,324.16	\$7,615.90	\$1,600.00	\$6,015.90	1.4	28,406

### ECM 6: Install VFDs on Constant Volume (CV) HVAC

#### *Summary of Measure Economics*

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
28,209	3.6	0.0	\$4,324.16	\$7,615.90	\$1,600.00	\$6,015.90	1.4	28,406

#### *Measure Description*

We recommend installing variable frequency drives (VFDs) to control supply fan motor speeds to convert a constant-volume, single-zone air handling system into a variable-air-volume (VAV) system. Candidate systems include AHU 1A and AHU 2A. Motors should be evaluated to determine whether they are inverter rated. If not, the motors should be replaced.

Zone thermostats will cause the VFD to modulate fan speed to maintain the appropriate temperature in the zone, while maintaining a constant supply air temperature. Energy savings results from reducing fan speed (and power) when there is a reduced load required for the zone. The magnitude of energy savings is based on the estimated amount of time that fan motors operate at partial load.

## 4.5 Electric Chiller Replacement

Our recommendations for electric chiller replacement are summarized in Figure 26 below.

*Figure 26 – Summary of Electric Chiller Replacement ECMs*

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Electric Chiller Replacement</b>		<b>158,870</b>	<b>78.3</b>	<b>0.0</b>	<b>\$24,353.35</b>	<b>\$191,966.45</b>	<b>\$20,700.00</b>	<b>\$171,266.45</b>	<b>7.0</b>	<b>159,981</b>
ECM 7	Install High Efficiency Chillers	158,870	78.3	0.0	\$24,353.35	\$191,966.45	\$20,700.00	\$171,266.45	7.0	159,981

### ECM 7: Install High Efficiency Chillers

#### *Summary of Measure Economics*

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
158,870	78.3	0.0	\$24,353.35	\$191,966.45	\$20,700.00	\$171,266.45	7.0	159,981

#### *Measure Description*

We recommend replacing older inefficient electric chillers with new high efficiency chillers. The type of chiller to be installed depends on the magnitude of the cooling load and variability of the cooling load profile. Positive displacement chillers are usually under 600 tons of cooling capacity and centrifugal chillers generally start at 150 tons of cooling capacity. Constant speed chillers should be used to meet cooling loads with little or no variation while variable speed chillers are more efficient for variable cooling load profiles. Water cooled chillers are more efficient than air cooled chillers but require cooling towers and additional pumps to circulate the cooling water. In any given size range variable speed chillers tend to have better partial load efficiency, but worse full load efficiency, than constant speed chillers.

The savings result from the improvement in chiller efficiency and matching the right type of chiller to the cooling load. The energy savings associated with this measure is based on the cooling capacity of the new chiller, the improvement in efficiency compared with the base case equipment, the cooling load profile, and the estimated annual operating hours of the chiller before and after the upgrade. Energy savings are maximized by proper selection of new equipment based on the cooling load profile.

## 4.6 Gas-Fired Heating System Replacements

Our recommendations for gas-fired heating system replacements are summarized in Figure 27 below.

*Figure 27 - Summary of Gas-Fired Heating Replacement ECMs*

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Gas Heating (HVAC/Process) Replacement</b>		<b>0</b>	<b>0.0</b>	<b>412.9</b>	<b>\$3,028.51</b>	<b>\$57,080.14</b>	<b>\$5,231.60</b>	<b>\$51,848.54</b>	<b>17.1</b>	<b>48,351</b>
ECM 8	Install High Efficiency Hot Water Boilers	0	0.0	412.9	\$3,028.51	\$57,080.14	\$5,231.60	\$51,848.54	17.1	48,351

### ECM 8: Install High Efficiency Hot Water Boilers

#### *Summary of Measure Economics*

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
0	0.0	412.9	\$3,028.51	\$57,080.14	\$5,231.60	\$51,848.54	17.1	48,351

#### *Measure Description*

We recommend replacing older inefficient hot water boilers with high efficiency hot water boilers. Significant improvements have been made in combustion technology resulting in increased overall boiler efficiency. Energy savings results from improved combustion efficiency and reduced standby losses at low loads.

The most notable efficiency improvement is condensing hydronic boilers that can achieve over 90% efficiency under the proper conditions. Condensing hydronic boilers typically operate at efficiencies between 85% and 87% (comparable to other high efficiency boilers) when the return water temperature is above 130°F. The boiler efficiency increases as the return water temperature drops below 130°F. Therefore, condensing hydronic boilers should be considered if the heating system can be configured to operate in an optimal manner when the return water temperature is typically less than 130°F during most of the operating hours. A boiler system study is recommended to determine optimal loop temperature and whether one large boiler or a system of modular boilers would be most suitable to efficiently meet the building's heating requirements.

## 4.7 Domestic Hot Water Heating System Upgrades

Our recommendations for domestic water heating system improvements are summarized in Figure 28 below.

*Figure 28 - Summary of Domestic Water Heating ECMs*

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Domestic Water Heating Upgrade</b>		<b>0</b>	<b>0.0</b>	<b>219.3</b>	<b>\$1,608.03</b>	<b>\$6,561.26</b>	<b>\$0.00</b>	<b>\$6,561.26</b>	<b>4.1</b>	<b>25,673</b>
ECM 9	Install Low-Flow Domestic Hot Water Devices	0	0.0	219.3	\$1,608.03	\$6,561.26	\$0.00	\$6,561.26	4.1	25,673

### ECM 9: Install Low-Flow DHW Devices

#### *Summary of Measure Economics*

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
0	0.0	219.3	\$1,608.03	\$6,561.26	\$0.00	\$6,561.26	4.1	25,673

#### *Measure Description*

We recommend installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators and low-flow showerheads can reduce hot water usage, relative to standard showerheads and aerators, which saves energy. Low-flow devices reduce the overall water flow from the fixture, while still providing adequate pressure for washing. This reduces the amount of water used per day resulting in energy and water savings.

## 4.8 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment controls are summarized in Figure 29 below.

*Figure 29 - Summary of Plug Load Equipment Control ECMs*

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO <sub>2</sub> e Emissions Reduction (lbs)
<b>Plug Load Equipment Control - Vending Machine</b>		1,954	0.0	0.0	\$299.58	\$460.00	\$0.00	\$460.00	1.5	1,968
ECM 10	Vending Machine Control	1,954	0.0	0.0	\$299.58	\$460.00	\$0.00	\$460.00	1.5	1,968

### **ECM 10: Vending Machine Control**

#### *Summary of Measure Economics*

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO <sub>2</sub> e Emissions Reduction (lbs)
1,954	0.0	0.0	\$299.58	\$460.00	\$0.00	\$460.00	1.5	1,968

#### *Measure Description*

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor controls to reduce the energy use. These controls power down vending machines when the vending machine area has been vacant for some time, then power up at regular intervals, as needed, to turn machine lights on or keep the product cool. Energy savings are a dependent on vending machine and activity level in the area surrounding the machines.

## 5 ENERGY EFFICIENT PRACTICES

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In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

### **Perform Proper Lighting Maintenance**

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

### **Develop a Lighting Maintenance Schedule**

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

### **Ensure Lighting Controls Are Operating Properly**

Lighting controls are very cost effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

### **Perform Routine Motor Maintenance**

Motors consist of many moving parts whose collective degradation can contribute to a significant loss of motor efficiency. In order to prevent damage to motor components, routine maintenance should be performed. This maintenance consists of cleaning surfaces and ventilation openings on motors to prevent overheating, lubricating moving parts to reduce friction, inspecting belts and pulleys for wear and to ensure they are at proper alignment and tension, and cleaning and lubricating bearings. Consult a licensed technician to assess these and other motor maintenance strategies.

### **Use Fans to Reduce Cooling Load**

Utilizing ceiling fans to supplement cooling is a low cost strategy to reduce cooling load considerably. Thermostat settings can be increased by 4°F with no change in overall occupant comfort when the wind chill effect of moving air is employed for cooling.



### **Assess Chillers & Request Tune-Ups**

Chillers are responsible for a substantial portion of a commercial building's overall energy usage. When components of a chiller are not optimized, this can quickly result in a noticeable increase in energy bills. Chiller diagnostics can produce a 5% to 10% cost avoidance potential from discovery and implementation of low/no cost optimization strategies.

### **Clean Evaporator/Condenser Coils on AC Systems**

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

### **Clean and/or Replace HVAC Filters**

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

### **Perform Proper Boiler Maintenance**

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

### **Perform Proper Furnace Maintenance**

Preventative furnace maintenance can extend the life of the system, maintain energy efficiency, and ensure safe operation. Following the manufacturer's instructions, a yearly tune-up should include tasks such as checking for gas / carbon monoxide leaks; changing the air and fuel filters; checking components for cracks, corrosion, dirt, or debris build-up; ensuring the ignition system is working properly; testing and adjusting operation and safety controls; inspecting the electrical connections; and ensuring proper lubrication for motors and bearings.

## **Perform Proper Water Heater Maintenance**

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

## **Plug Load Controls**

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to “Plug Load Best Practices Guide” <http://www.advancedbuildings.net/plug-load-best-practices-guide-offices>.

## **Water Conservation**

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (<http://www3.epa.gov/watersense/products>) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

Refer to Section 4.7 for any low-flow ECM recommendations.

## 6 ON-SITE GENERATION MEASURES

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On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

### 6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **Low** potential for installing a PV array.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ:** <http://www.njcleanenergy.com/whysolar>
- **NJ Solar Market FAQs:** <http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs>
- **Approved Solar Installers in the NJ Market:** [http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved\\_vendorsearch/?id=60&start=1](http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1)

## 6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

The campus has a CHP plant that uses natural gas fired turbines to generate electricity. Waste heat from the turbines is used to produce steam which is either delivered to buildings on campus or used to produce chilled water which is delivered to buildings on campus. Since the campus has a CHP that serves a significant portion of the campus further evaluation of individual building CHP applications were not done.

## 7 DEMAND RESPONSE

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Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (<http://www.pjm.com/markets-and-operations/demand-response/csps.aspx>). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (<http://www.pjm.com/training/training%20material.aspx>), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

**In our opinion this building is not is a good candidate for DR.**

## 8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey’s Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 30 for a list of the eligible programs identified for each recommended ECM.

*Figure 30 - ECM Incentive Program Eligibility*

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	X			X		
ECM 2	Retrofit Fixtures with LED Lamps	X			X		
ECM 3	Install LED Exit Signs				X		
ECM 4	Install Occupancy Sensor Lighting Controls	X			X		
ECM 5	Install High/Low Lighting Controls				X		
ECM 6	Install VFDs on Constant Volume (CV) HVAC	X			X		
ECM 7	Install High Efficiency Chillers	X			X		
ECM 8	Install High Efficiency Hot Water Boilers	X			X		
ECM 9	Install Low-Flow Domestic Hot Water Devices				X		
ECM 10	Vending Machine Control	X			X		

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a “whole-building” energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. This facility does not meet all of the criteria for participating in the P4P program based on the measures identified in this study. However, since additional measures may be identified during the P4P evaluation and the facility is close to meeting the P4P program criteria it is worth considering the P4P program for this site. The Large Energy Users Program (LEUP) is available to New Jersey’s largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity’s annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: [www.njcleanenergy.com/ci](http://www.njcleanenergy.com/ci).

## 8.1 SmartStart

### Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

### **Equipment with Prescriptive Incentives Currently Available:**

*Electric Chillers*

*Electric Unitary HVAC*

*Gas Cooling*

*Gas Heating*

*Gas Water Heating*

*Ground Source Heat Pumps*

*Lighting*

*Lighting Controls*

*Refrigeration Doors*

*Refrigeration Controls*

*Refrigerator/Freezer Motors*

*Food Service Equipment*

*Variable Frequency Drives*

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

### Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at \$0.16/kWh and \$1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at \$500,000 per electric account and \$500,000 per natural gas account, per fiscal year.

### How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: [www.njcleanenergy.com/SSB](http://www.njcleanenergy.com/SSB).

## 8.2 Pay for Performance - Existing Buildings

### Overview

The Pay for Performance – Existing Buildings (P4P EB) program is designed for larger customers with a peak demand over 200 kW in any of the preceding 12 months. Under this program the minimum installed scope of work must include at least two unique measures resulting in at least 15% energy savings, where lighting cannot make up the majority of the savings. P4P is a generally a good option for medium to large sized facilities looking to implement as many measures as possible under a single project in order to achieve deep energy savings. This program has an added benefit of evaluating a broad spectrum of measures that may not otherwise qualify under other programs. Many facilities pursuing an Energy Savings Improvement Program (ESIP) loan also utilize the P4P program.

### Incentives

Incentives are calculated based on estimated and achieved energy savings ranging from \$0.18-\$0.22/kWh and \$1.80-\$2.50/therm, capped at the lesser of 50% total project cost, or \$1 million per electric account and \$1 million per natural gas account, per fiscal year, not to exceed \$2 million per project. An incentive of \$0.15/square foot is also available to offset the cost of developing the Energy Reduction Plan (see below) contingent on the project moving forward with measure installation.

### How to Participate

To participate in the P4B EB program you will need to contact one of the pre-approved consultants and contractors (“Partners”). Under direct contract to you, the Partner will help further evaluate the measures identified in this report through development of the Energy Reduction Plan (ERP), assist you in implementing selected measures, and verify actual savings one year after the installation. At each of these three milestones your Partner will also facilitate securing program incentives.

Approval of the final scope of work is required by the program prior to installation completion. Although installation can be accomplished by a contractor of your choice (some P4P Partners are also contractors) or by internal personnel, the Partner must remain involved to ensure compliance with the program guidelines and requirements.

Detailed program descriptions, instructions for applying, applications and list of Partners can be found at: [www.njcleanenergy.com/P4P](http://www.njcleanenergy.com/P4P).



### 8.3 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey’s government agencies to finance the implementation of energy conservation measures. An ESIP is a type of “performance contract,” whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

- (1) Use an Energy Services Company or “ESCO.”
- (2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
- (3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: [www.njcleanenergy.com/ESIP](http://www.njcleanenergy.com/ESIP).

*Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.*

## 9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

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### 9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: [www.state.nj.us/bpu/commercial/shopping.html](http://www.state.nj.us/bpu/commercial/shopping.html).

### 9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: [www.state.nj.us/bpu/commercial/shopping.html](http://www.state.nj.us/bpu/commercial/shopping.html).

# APPENDIX A: EQUIPMENT INVENTORY & RECOMMENDATIONS

## Lighting Inventory & Recommendations

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Main Lobby	5	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	Yes	5	LED Screw-In Lamps: LED -2Pin replacement	High/Low Control	27	1,967	0.06	282	0.0	\$43.30	\$1,006.30	\$0.00	23.24
Main Lobby	1	Exit Signs: Fluorescent	None	10	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	2	8,760	0.01	81	0.0	\$12.35	\$50.00	\$0.00	4.05
Corridor 1st Floor	6	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	6	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.09	1,275	0.0	\$195.50	\$489.20	\$60.00	2.20
Corridor 1st Floor	12	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	8,760	Relamp	Yes	12	LED Screw-In Lamps: LED -2Pin replacement	High/Low Control	27	6,132	0.18	2,430	0.0	\$372.47	\$880.00	\$0.00	2.36
Corridor 1st Floor	18	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	18	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.28	3,826	0.0	\$586.51	\$1,467.60	\$180.00	2.20
Corridor 1st Floor	5	Exit Signs: Fluorescent	None	10	8,760	Fixture Replacement	No	5	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	403	0.0	\$61.77	\$250.00	\$0.00	4.05
Apt 1A	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1A	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1A-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 1B	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1B	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1B-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 1C	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1C	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1C-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Laundry Rm - 1st Floor	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$75.00	5.19
Apt 1D	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1D	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1C-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Electrical Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 1E	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1E	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1E-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Lounge Rm	11	Compact Fluorescent: 23W CFL	Wall Switch	23	2,811	Relamp	Yes	11	LED Screw-In Lamps: LED A19 Bulb	Occupancy Sensor	15	1,967	0.10	444	0.0	\$68.12	\$861.28	\$35.00	12.13

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Lounge Rm	1	Exit Signs: Fluorescent	None	10	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	2	8,760	0.01	81	0.0	\$12.35	\$50.00	\$0.00	4.05
Lounge Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Kitchen	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.02	107	0.0	\$16.35	\$58.50	\$10.00	2.97
Storage Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.02	107	0.0	\$16.35	\$58.50	\$10.00	2.97
1st Floor Lobby	11	Compact Fluorescent: 23W CFL	Wall Switch	23	2,811	Relamp	Yes	11	LED Screw-In Lamps: LED A19 Bulb	High/Low Control	15	1,967	0.10	444	0.0	\$68.12	\$791.28	\$0.00	11.62
1st Floor Lobby	1	Exit Signs: Fluorescent	None	10	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	2	8,760	0.01	81	0.0	\$12.35	\$50.00	\$0.00	4.05
Mail Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.09	404	0.0	\$61.98	\$445.50	\$65.00	6.14
Storage Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.02	107	0.0	\$16.35	\$58.50	\$10.00	2.97
Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Trash Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.09	404	0.0	\$61.98	\$445.50	\$30.00	6.70
Spoungler Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$75.00	5.19
Apt 1F	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1F	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1F-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 1G	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1G	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1G-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 1H	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1H	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1H-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 1I	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 1I	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 1I-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2H	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Apt 2H	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2H-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2I	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2I	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2I-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2G	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2G	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2G-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2F	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2F	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2F-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$40.00	5.61
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Trash Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2J	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2J	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2J-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Electrical Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2K	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2K	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2K-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2E	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2E	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2E-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Data Closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2D	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2D	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2D-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Laundry Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$75.00	5.19
Apt 2C	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2C	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2C-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2A	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2A	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2A-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 2B	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 2B	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 2B-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Corridor 2nd Floor	6	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	6	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.09	1,275	0.0	\$195.50	\$489.20	\$60.00	2.20
Corridor 2nd Floor	12	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	8,760	Relamp	Yes	12	LED Screw-In Lamps: LED -2Pin replacement	High/Low Control	27	6,132	0.18	2,430	0.0	\$372.47	\$880.00	\$0.00	2.36
Corridor 2nd Floor	18	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	18	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.28	3,826	0.0	\$586.51	\$1,467.60	\$180.00	2.20
Corridor 2nd Floor	5	Exit Signs: Fluorescent	None	10	8,760	Fixture Replacement	No	5	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	403	0.0	\$61.77	\$250.00	\$0.00	4.05
Corridor 3rd Floor	6	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	6	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.09	1,275	0.0	\$195.50	\$489.20	\$60.00	2.20
Corridor 3rd Floor	12	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	8,760	Relamp	Yes	12	LED Screw-In Lamps: LED -2Pin replacement	High/Low Control	27	6,132	0.18	2,430	0.0	\$372.47	\$880.00	\$0.00	2.36
Corridor 3rd Floor	18	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	18	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.28	3,826	0.0	\$586.51	\$1,467.60	\$180.00	2.20
Corridor 3rd Floor	5	Exit Signs: Fluorescent	None	10	8,760	Fixture Replacement	No	5	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	403	0.0	\$61.77	\$250.00	\$0.00	4.05
Corridor 4th Floor	6	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	6	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.09	1,275	0.0	\$195.50	\$489.20	\$60.00	2.20
Corridor 4th Floor	12	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	8,760	Relamp	Yes	12	LED Screw-In Lamps: LED -2Pin replacement	High/Low Control	27	6,132	0.18	2,430	0.0	\$372.47	\$880.00	\$0.00	2.36

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Corridor 4th Floor	18	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	18	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.28	3,826	0.0	\$586.51	\$1,467.60	\$180.00	2.20
Corridor 4th Floor	5	Exit Signs: Fluorescent	None	10	8,760	Fixture Replacement	No	5	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	403	0.0	\$61.77	\$250.00	\$0.00	4.05
Corridor 5th Floor	6	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	6	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.09	1,275	0.0	\$195.50	\$489.20	\$60.00	2.20
Corridor 5th Floor	12	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	8,760	Relamp	Yes	12	LED Screw-In Lamps: LED -2Pin replacement	High/Low Control	27	6,132	0.18	2,430	0.0	\$372.47	\$880.00	\$0.00	2.36
Corridor 5th Floor	18	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	8,760	Relamp	Yes	18	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	6,132	0.28	3,826	0.0	\$586.51	\$1,467.60	\$180.00	2.20
Corridor 5th Floor	5	Exit Signs: Fluorescent	None	10	8,760	Fixture Replacement	No	5	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	403	0.0	\$61.77	\$250.00	\$0.00	4.05
Apt 3A	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3A	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3A-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 3B	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3B	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3B-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 3C	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3C	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3C-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Laundry Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$75.00	5.19
Apt 3D	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3D	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3D-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Data Closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 3E	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3E	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3E-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 3K	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Apt 3K	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3K-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Electrical Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 3J	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3J	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3J-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Trash Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.09	404	0.0	\$61.98	\$445.50	\$30.00	6.70
Storage Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$40.00	5.61
Apt 3F	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3F	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3F-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$40.00	5.61
Apt 3G	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3G	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3G-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 3H	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3H	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3H-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 3I	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 3I	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 3I-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 4H	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4H	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4H-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97



Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Apt 4I	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4I	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4I-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 4G	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4G	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4G-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$40.00	5.61
Apt 4F	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4F	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4F-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$40.00	5.61
Trash Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.09	404	0.0	\$61.98	\$445.50	\$30.00	6.70
Apt 4J	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4J	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4J-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 4K	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4K	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4K-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 4E	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4E	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4E-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Data Closet	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$75.00	5.19
Apt 4D	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4D	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4D-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Laundry Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$75.00	5.19
Electrical Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.02	107	0.0	\$16.35	\$58.50	\$10.00	2.97
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 4C	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4C	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4C-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 4A	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4A	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4A-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 4B	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 4B	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 4B-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 5A	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5A	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5A-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 5B	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5B	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5B-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 5C	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5C	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5C-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Laundry Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.12	539	0.0	\$82.64	\$504.00	\$75.00	5.19
Apt 5D	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5D	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5D-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Data Closet	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.09	404	0.0	\$61.98	\$445.50	\$65.00	6.14
Apt 5E	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5E	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5E-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 5K	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5K	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5K-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.02	107	0.0	\$16.35	\$58.50	\$10.00	2.97
Apt 5J	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5J	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5J-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Trash Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.09	404	0.0	\$61.98	\$445.50	\$30.00	6.70
Sprinkler Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.02	107	0.0	\$16.35	\$58.50	\$10.00	2.97
Storage Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Storage Rm	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,967	0.15	674	0.0	\$103.30	\$562.50	\$50.00	4.96
Apt 5F	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5F	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5F-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 5G	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5G	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5G-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Apt 5H	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5H	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5H-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Apt 5I	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.15	640	0.0	\$98.10	\$351.00	\$60.00	2.97
Apt 5I	6	Compact Fluorescent: 2pin - 3 lamps/fixture	Wall Switch	39	2,811	Relamp	No	5	LED Screw-In Lamps: LED -2Pin replacement	Wall Switch	27	2,811	0.07	320	0.0	\$49.05	\$806.30	\$0.00	16.44
Apt 5I-Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,811	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,811	0.05	213	0.0	\$32.70	\$117.00	\$20.00	2.97
Front Entrance	6	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	4,368	Fixture Replacement	No	6	LED - Fixtures: Outdoor Post-Mount	Daylight Dimming	75	4,368	0.97	6,631	0.0	\$1,016.41	\$3,439.80	\$30.00	3.35

### Motor Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
		Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Pent House	DHW System	3	Water Supply Pump	1.0	85.5%	No	2,745	No	85.5%	No		0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00
Pent House	Chilled Water System	1	Chilled Water Pump	15.0	93.0%	Yes	3,391	No	93.0%	No		0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00
Pent House	Chilled Water System	1	Chilled Water Pump	15.0	93.0%	Yes	3,391	No	93.0%	No		0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00
Pent House	Boilers	2	Heating Hot Water Pump	0.3	77.0%	No	2,745	No	77.0%	No		0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00
Pent House	AHU 1A	1	Supply Fan	10.0	91.7%	No	7,300	No	91.7%	Yes	1	1.82	14,104	0.0	\$2,162.08	\$3,807.95	\$800.00	1.39
Pent House	AHU 2A	1	Supply Fan	10.0	91.7%	No	7,300	No	91.7%	Yes	1	1.82	14,104	0.0	\$2,162.08	\$3,807.95	\$800.00	1.39
Pent House	Stairwell + Lobby	22	Other	0.2	82.5%	No	2,745	No	82.5%	No		0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00
Elevator Room	Elevators	2	Other	40.0	78.5%	No	1,095	No	78.5%	No		0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00
Elevator Room	Elevators	2	Ventilation Fan	0.3	77.0%	No	4,380	No	77.0%	No		0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00

### Electric HVAC Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions		Proposed Conditions								Energy Impact & Financial Analysis								
		System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rooftop	Office	1	Split-System AC	3.00		No							No	0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00
Rooftop	Office	1	Split-System AC	3.00		No							No	0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00

### Electric Chiller Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions		Proposed Conditions								Energy Impact & Financial Analysis						
		Chiller Quantity	System Type	Cooling Capacity per Unit (Tons)	Install High Efficiency Chillers?	Chiller Quantity	System Type	Constant/Variable Speed	Cooling Capacity (Tons)	Full Load Efficiency (kW/Ton)	IPLV Efficiency (kW/Ton)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rooftop	Fenwick Hall	1	Air-Cooled Scroll Chiller	225.00	Yes	1	Air-Cooled Centrifugal Chiller	Variable	225.00	1.24	0.73	78.27	158,870	0.0	\$24,353.35	\$191,966.45	\$20,700.00	7.03

### Fuel Heating Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions		Proposed Conditions							Energy Impact & Financial Analysis						
		System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Pent House	Heating Hot Water System	2	Non-Condensing Hot Water Boiler	1,189.00	Yes	2	Condensing Hot Water Boiler	1,189.00	91.00%	Et	0.00	0	412.9	\$3,028.51	\$57,080.14	\$5,231.60	17.12

### DHW Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis							
		System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years	
Pen House	Fenwick Hall	3	Storage Tank Water Heater (> 50 Gal)	No							0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00

### Low-Flow Device Recommendations

Location	Recommendation Inputs				Energy Impact & Financial Analysis						
	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchens	54	Faucet Aerator (Kitchen)	2.50	2.20	0.00	0	27.6	\$202.64	\$387.18	\$0.00	1.91
Bathrooms	64	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	131.0	\$960.65	\$458.88	\$0.00	0.48
Showers	64	Showerhead	2.50	2.00	0.00	0	60.6	\$444.74	\$5,715.20	\$0.00	12.85

### Plug Load Inventory

Location	Existing Conditions			
	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Laundry Room	15	Dryer	480.0	No
Laundry Room	15	Washing Machine	270.0	Yes
Lounge	5	Refrigerator	180.0	No
Lounge	5	Electric Oven	1,500.0	No
Storage Room	1	Microwave	300.0	No
Storage Room	1	Small Freezer	180.0	No
Office	1	Desktop + LCD Monitor	58.5	No
Office	1	Small Printer	6.0	No
Fenwick Hall	1	Refrigerator	180.0	No
Fenwick Hall	1	Dishwasher	300.0	No
Fenwick Hall	1	Fume Hood	150.0	No
Fenwick Hall	1	Electric Oven	1,500.0	No
Dorm Rooms	1	Misc Student Items	29,982.9	No

### Vending Machine Inventory & Recommendations

Location	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Laundry Room	1	Refrigerated	Yes	0.00	1,612	0.0	\$247.08	\$230.00	\$0.00	0.93
Laundry Room	1	Non-Refrigerated	Yes	0.00	343	0.0	\$52.50	\$230.00	\$0.00	4.38

# APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE



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## ENERGY STAR® Statement of Energy Performance

# 65

**ENERGY STAR® Score<sup>1</sup>**

### Millicent Fenwick Hall

Primary Property Type: Multifamily Housing  
 Gross Floor Area (ft<sup>2</sup>): 99,943  
 Built: 2003

For Year Ending: October 31, 2016  
 Date Generated: October 04, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information		
<b>Property Address</b> Millicent Fenwick Hall 125 Clove Road Little Falls, New Jersey 07424	<b>Property Owner</b> Montclair Statet University 1 Normal Avenue Montclair, NJ 07043 973-655-3244	<b>Primary Contact</b> Ana Pinto 1 Normal Avenue Montclair, NJ 07043 973-655-3244 pintoa@montclair.edu
Property ID: 6022768		

Energy Consumption and Energy Use Intensity (EUI)				
<b>Site EUI</b> 79.7 kBtu/ft <sup>2</sup>	<b>Annual Energy by Fuel</b>		<b>National Median Comparison</b>	
	Natural Gas (kBtu)	5,303,224 (67%)	National Median Site EUI (kBtu/ft <sup>2</sup> )	88
	Electric - Grid (kBtu)	2,683,683 (33%)	National Median Source EUI (kBtu/ft <sup>2</sup> )	153.9
			% Diff from National Median Source EUI	-9%
<b>Source EUI</b> 139.4 kBtu/ft <sup>2</sup>	<b>Annual Emissions</b>			
	Greenhouse Gas Emissions (Metric Tons CO <sub>2</sub> e/year)		577	

### Signature & Stamp of Verifying Professional

I \_\_\_\_\_ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Licensed Professional

\_\_\_\_\_  
 ( ) \_\_\_\_\_  
 \_\_\_\_\_



Professional Engineer Stamp  
(if applicable)