Local Government Energy Audit:
Energy Audit Report

Machuga Heights and

Dinallo Heights

Montclair, New Jersey 07043

Montclair State University

July 25, 2018

Final Report by:

TRC Energy Services

Disclaimer

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 saving 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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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Machuga Heights and Dinallo Heights.

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.

1.1 Facility Summary

Machuga Heights and Dinallo Heights make up a 567,271-square foot 7-story student housing complex of eight (8) residence halls. The majority of the building area is comprised of dorm rooms, lounges, offices, restrooms, and mechanical spaces, however approximately 24,000 square feet is devoted to Sam's Restaurant and food service facilities.

Lighting at the Heights is provided mostly by linear LED tube lamps with electronic drivers, as well as some compact fluorescent lamps (CFLs). Most of the fixtures are 2-lamp or 3-lamp, 4-foot long troffers with diffusers. Staff indicated that the LED replacement was conducted in the past two years. Sam's Restaurant is primarily lit by linear fluorescent T8 lamps with electronic ballasts. These fixtures consist of 2-foot and 4-foot fixtures containing between two (2) and four (4) lamps.

Cooling, heating, and ventilation are provided by multiple water source heat pumps (WSHP), packaged units, and furnaces. Aside from the heat pumps, the fuel source for heating is natural gas. A cooling tower provides heat rejection for the WSHPs. A condensing boiler provides supplemental heat to the WSHPs for cold weather conditions. The units are six (6) years old with remaining useful service life. Domestic hot water (DHW) is produced by four (4) condensing boilers each with 130 gallon storage tanks.

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

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated seven (7) measures, that together represent an opportunity for Machuga Heights and Dinallo Heights to reduce annual energy costs by $108,601 and annual greenhouse gas emissions by 650,954 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in roughly 2.3 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 Machuga Heights and Dinallo Heights's annual energy use by 6%.

Figure 1 – Previous 12 Month Utility Costs

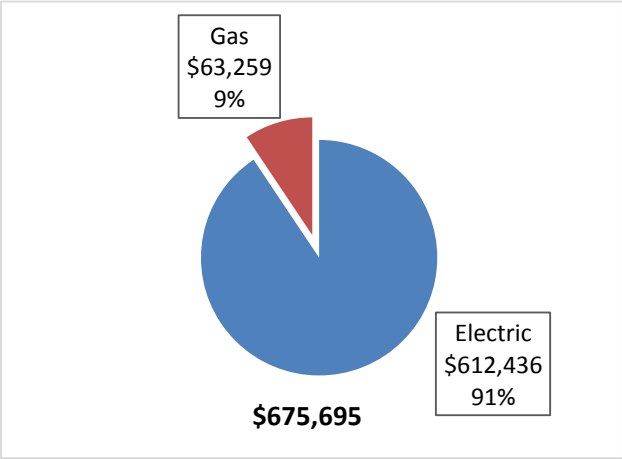
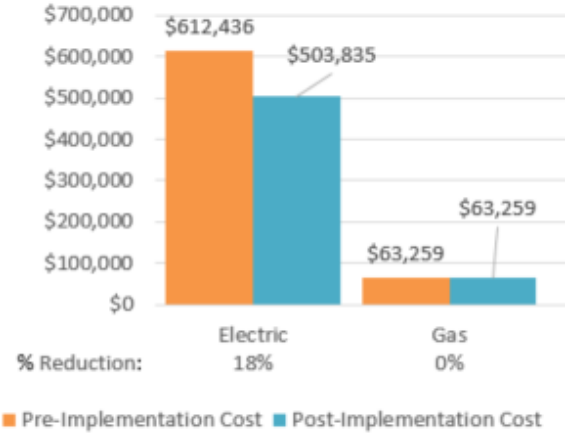


Figure 2 – Potential Post-Implementation Costs



A detailed description of Machuga Heights and Dinallo Heights'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 Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**427,633**	**52.6**	**$71,842.40**	**$182,554.21**	**$4,360.00**	**$178,194.21**	**2.5**	**430,623**
ECM 1	Install LED Fixtures	Yes	16,236	2.4	$2,727.62	$7,032.19	$1,800.00	$5,232.19	1.9	16,349
ECM 2	Retrofit Fixtures with LED Lamps	Yes	411,397	50.3	$69,114.77	$175,522.03	$2,560.00	$172,962.03	2.5	414,274
Lighting Control Measures			**11,495**	**1.4**	**$1,931.24**	**$4,860.00**	**$420.00**	**$4,440.00**	**2.3**	**11,576**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	11,495	1.4	$1,931.24	$4,860.00	$420.00	$4,440.00	2.3	11,576
Motor Upgrades			**7,620**	**1.1**	**$1,280.21**	**$7,815.40**	**$0.00**	**$7,815.40**	**6.1**	**7,674**
ECM 4	Premium Efficiency Motors	Yes	7,620	1.1	$1,280.21	$7,815.40	$0.00	$7,815.40	6.1	7,674
Variable Frequency Drive (VFD) Measures			**192,553**	**14.2**	**$32,348.86**	**$77,667.55**	**$18,975.00**	**$58,692.55**	**1.8**	**193,899**
ECM 5	Install VFD on Variable Air Volume (VAV) HVAC	Yes	99,886	14.2	$16,780.90	$52,330.35	$14,175.00	$38,155.35	2.3	100,585
ECM 6	Install VFDs on Cooling Tower Fans	Yes	92,666	0.0	$15,567.95	$25,337.20	$4,800.00	$20,537.20	1.3	93,314
Plug Load Equipment Control - Vending Machine			**7,132**	**0.0**	**$1,198.24**	**$1,380.00**	**$0.00**	**$1,380.00**	**1.2**	**7,182**
ECM 7	Vending Machine Control	Yes	7,132	0.0	$1,198.24	$1,380.00	$0.00	$1,380.00	1.2	7,182
TOTALS FOR HIGH PRIORITY MEASURES			**646,434**	**69.4**	**$108,600.94**	**$274,277.16**	**$23,755.00**	**$250,522.16**	**2.3**	**650,954**
TOTALS FOR ALL EVALUATED MEASURES			**646,434**	**69.4**	**$108,600.94**	**$274,277.16**	**$23,755.00**	**$250,522.16**	**2.3**	**650,954**

* - 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 measure 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.

Motor Upgrades generally involve replacing older standard efficiency motors with high efficiency standard (IHP 2014). Motors replacements generally assume the same size motors, just higher efficiency. Although occasionally additional savings can be achieved by downsizing motors to better meet current load requirements. This measure saves energy by reducing the power used by the motors, due to improved electrical efficiency.

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.

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 outlets when not in use.

Energy Efficient Practices

TRC also identified 11 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 Machuga Heights and Dinallo Heights include:

- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Perform Routine Motor Maintenance
- 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 Machuga Heights and Dinallo Heights. 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.

1.3 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.

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.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Ana Pinto	Director of Energy Management	pintoa@mail.montclair.edu	(973) 655-3244
TRC Energy Services			
Michael Smith	Auditor	MJSmith@trcsolutions.com	(518) 688-3137

2.2 General Site Information

On April 20, 2017, TRC performed an energy audit at Machuga Heights and Dinallo Heights located in Montclair, New Jersey. The TRC team met with Ana Pinto to review the facility operations and help focus our investigation on specific energy-using systems.

Machuga Heights and Dinallo Heights make up a 567,271-square foot 7-story student housing complex of eight (8) residence halls. The majority of the building area is comprised of dorm rooms, lounges, offices, restrooms, and mechanical spaces, however approximately 24,000 square feet is devoted to Sam's Restaurant and food service facilities. The building was constructed in 2010.

Lighting at the Heights is provided mostly by linear LED tube lamps with electronic drivers, as well as some compact fluorescent lamps (CFLs). Most of the fixtures are 2-lamp or 3-lamp, 4-foot long troffers with diffusers. Staff indicated that the LED replacement was conducted in the past two years. Sam's Restaurant is primarily lit by linear fluorescent T8 lamps with electronic ballasts. These fixtures consist of 2-foot and 4-foot fixtures containing between two (2) and four (4) lamps.

Cooling, heating, and ventilation are provided by multiple water source heat pumps (WSHP), packaged units, and furnaces. Aside from the heat pumps, the fuel source for heating is natural gas. A cooling tower provides heat rejection for the WSHPs. A condensing boiler provides supplemental heat to the WSHPs for cold weather conditions. The units are six (6) years old with remaining useful service life. Domestic hot water (DHW) is produced by four (4) condensing boilers each with 130 gallon storage tanks.

2.3 Building Occupancy

The dormitories are open all day for 52 weeks a year. Sam's Restaurant is open from 8:00 AM – 8:00 PM 42 weeks a year. During a typical day, the facilities are occupied by approximately 2,000 students and staff.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Machuga & Dinallo Heights	Weekday	All day
Machuga & Dinallo Heights	Weekend	All day

2.4 Building Envelope

Both buildings are constructed of concrete block, and structural steel with a white stone facade. The buildings have flat roofs covered with white rubber membranes that are in good condition. The buildings have double pane windows which are in good condition and show little sign of excessive infiltration. The exterior doors are constructed of aluminum with center glass and are in good condition.

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.

Machuga Heights and Dinallo Heights do not have any on-site electric generation capacity but do currently receive electricity from the cogeneration plant.

2.6 Energy-Using Systems

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

Lighting System

Lighting is provided mostly by linear LED tube lamps with electronic drivers, as well as some compact fluorescent lamps (CFLs). Most of the fixtures are 2-lamp or 3-lamp, 4-foot long troffers with diffusers. Staff indicated that the LED replacement was conducted in the past two years.

Sam's Restaurant is primarily lit by linear fluorescent T8 lamps with electronic ballasts. These fixtures consist of 2-foot and 4-foot fixtures containing between two (2) and four (4) lamps.

Lighting control in most spaces is provided by wall switch. Stairwells, elevator lobbies, hallways and main lobby areas do not contain any controls and operate 24 hours per day throughout the year.

The building's exterior lighting is minimal and consists primarily of wall mounted metal halide and pin base CFL fixtures that are controlled by timers.

Direct Expansion Cooling and Heating System (DX)

Space heating and cooling for dorm rooms, elevator, lobbies, laundry rooms, offices, IT closets, electrical rooms and elevator rooms is provided by Climate Master water source heat pumps which range from 9,400 to 135,000 btu/hr. These water source heat pumps are served by central heat pumps loops driven by 25 HP pump motors. Dinallo Heights and Machuga Heights each have two (2) heat pump loops. During warmer months, cooling towers are used to reject heat from these loops to maintain appropriate loop temperature. During cooler months, a series on condensing boilers located on each building's rooftop inject heated water into the heat pump loops to raise loop temperature.

Corridors, conference rooms and other common spaces are heated and cooled by packaged heat/AC units. Upper level corridors are served by a total of four (4) 26-ton Aaon (model RN-026-8-0) packaged units. Lower level corridors and common spaces are served by a total of 11 Lennox packaged units.

Heating and cooling for Sam's Restaurant is provided by six (6) Aaon packaged units.

Building Energy Management System (BEMS)

Facility operation at the Heights is controlled with an Advanced Logic Controls (ALC) building energy management system (BEMS). The BEMS aggregates the DDC points from throughout the building. The BEMS is capable of scheduling and setting back building space temperatures based upon space occupancy. Localized thermostats in some areas allow for manual override by staff. Per discussions with facility staff, dorm rooms have no occupancy or time based temperature setback in place.

Domestic Hot Water Heating System

Domestic hot water for the Heights is provided by four (4) AO Smith model BTH 300A 100 natural gas fired condensing storage water heaters. Faucet aerators in the Heights were measured to have flow rates between 1.0 and 1.3 gallons per minute (gpm). Showerheads were measured to have flow rates between 1.6 and 1.8 gpm.

The domestic hot water heater for Sam's Restaurant was in a locked area and was not able to be observed.

Food Service Equipment

Sam's Restaurant has a full array of kitchen equipment in use. The equipment includes gas steamers, griddles, rack oven, steam cookers, and a high-temperature commercial dishwasher. Electric kitchen equipment includes convection ovens and food preparation appliances.

Refrigeration

Sam's Restaurant kitchen has three (3) walk-in refrigerators totaling approximately 3.5 tons and three (3) walk-in freezers with 4.7 tons of cooling capacity. The kitchen also 12 free-standing commercial refrigerators ranging in size from 20 to 49 cubic feet. There are two (2) commercial ice makers with harvest rates of 300 and 200 lbs/day respectively. The restaurant also has five (5) novelty display coolers with nameplate wattages ranging from 720 to 2000 watts.

Building Plug Load

There are 70 Alliance Speed Queen laundry dryers and 52 Alliance Speed Queen clothes washers in place in the Heights laundry rooms. There are 16 computer office work stations in the facility, the majority with two (2) LCD monitors each. Other facility plug loads include copiers, printers, mini-refrigerators, and water fountains. A breakroom includes two (2) refrigerators, a freezer, and an electric range. There are also two (2) refrigerated and one (1) non-refrigerated vending machines on site. Due to the nature of the use of the facility, TRC also added a factor of 0.3 Wsf to account for residents' miscellaneous electronics.

2.7 Water-Using Systems

Kitchen faucets have a 2.5 gallons per minute (gpm) rating. The common men's and women's restroom faucets have respective ratings of 2.2 and 1.5 gpm.

3 SITE ENERGY USE AND COSTS

This building receives electricity through a master meter. It also receives electricity from the campus central cogeneration plant. These utilities were prorated for individual buildings based on building size and function.

Prorated and direct purchase utility data were 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

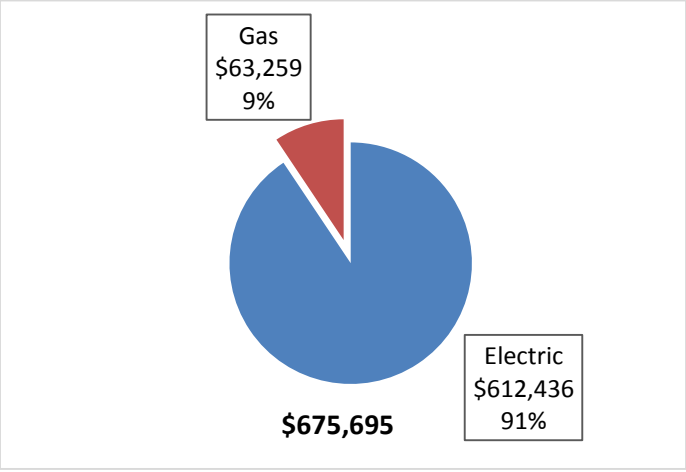
The following energy consumption and cost data is based on data that was provided by the campus for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 6 - Utility Summary

Utility Summary for Machuga Heights and Dinallo Heights		
Fuel	**Usage**	**Cost**
Electricity	8,949,294 kWh	$612,436
Natural Gas	86,072 Therms	$63,259
Total		**$675,695**

The current annual energy cost for this facility is $675,695 as shown in the chart below.

Figure 7 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G and the campus cogeneration plant. The average cost for electricity purchased from PSE&G was $0.168/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. Demand data (kW) is absent from the table below because it was not provided for the electric cogen plant generation and therefore kW totals would be incomplete for this facility. The monthly electricity consumption is shown in the chart below.

Figure 8 - Electric Usage & Demand

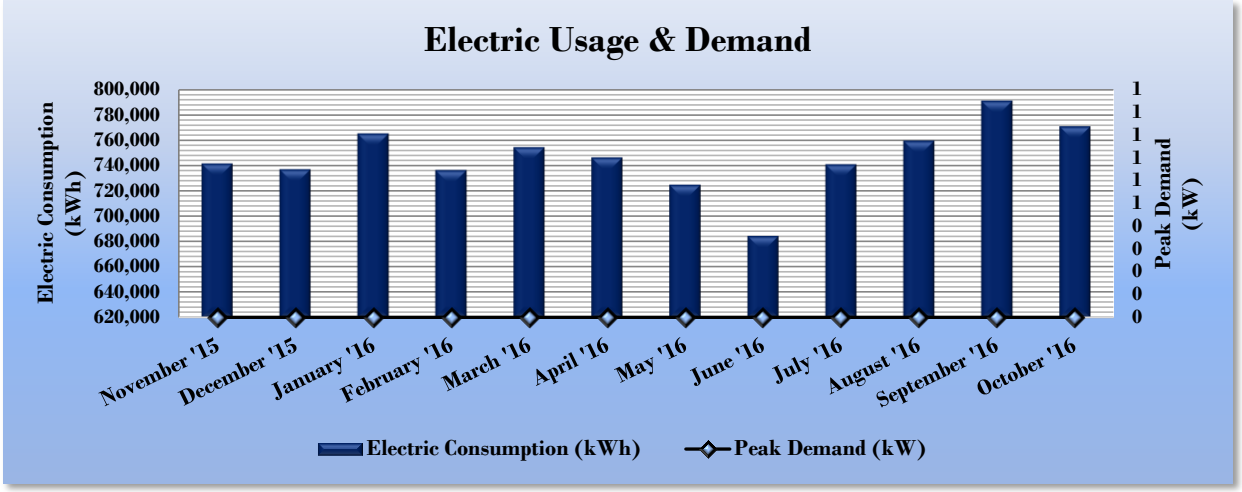


Figure 9 - Electric Usage & Demand

Electric Billing Data for Machuga Heights and Dinallo Heights			
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost
11/30/15	30	741,382	$43,707
12/31/15	31	736,782	$55,354
1/31/16	31	764,961	$45,558
2/28/16	28	736,014	$105,710
3/31/16	31	754,097	$42,347
4/30/16	30	746,078	$42,258
5/31/16	31	724,534	$41,364
6/30/16	30	684,140	$44,516
7/31/16	31	740,529	$47,076
8/31/16	31	759,377	$49,941
9/30/16	30	790,756	$48,726
10/31/16	31	770,645	$45,879
Totals	**365**	**8,949,294**	**$612,436**
Annual	**365**	**8,949,294**	**$612,436**

3.3 Natural Gas Usage

Natural Gas is provided by PSE&G. The average gas cost for the past 12 months is $0.735/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Figure 10 - Natural Gas Usage

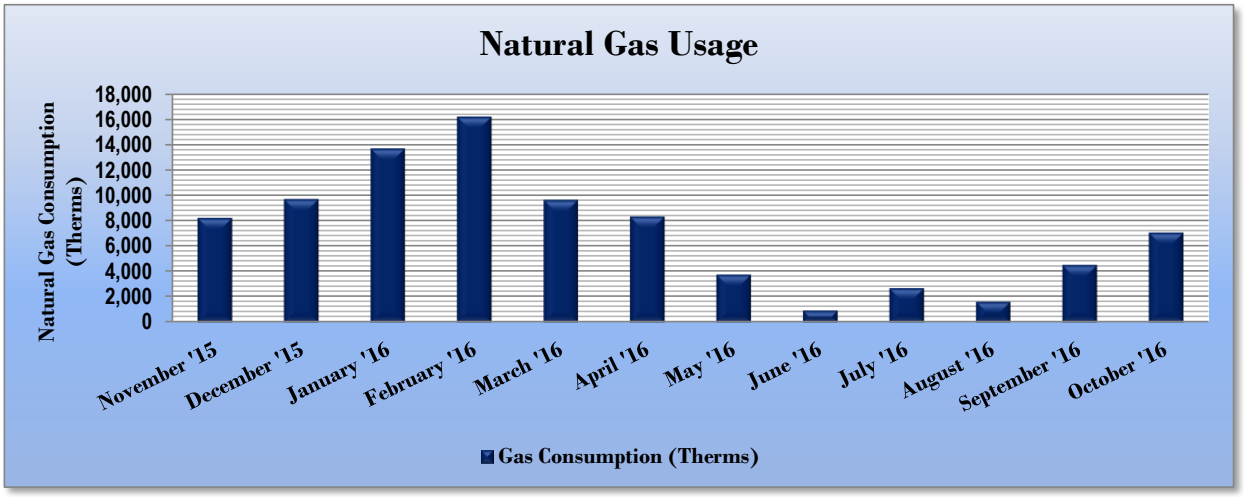


Figure 11 - Natural Gas Usage

Gas Billing Data for Machuga Heights and Dinallo Heights			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
11/30/15	30	8,187	$9,678
12/31/15	31	9,678	$8,187
1/31/16	31	13,645	$10,558
2/28/16	28	16,145	$11,084
3/31/16	31	9,617	$4,706
4/30/16	30	8,298	$4,212
5/31/16	31	3,750	$1,947
6/30/16	30	915	$514
7/31/16	31	2,673	$1,650
8/31/16	31	1,609	$974
9/30/16	30	4,505	$2,762
10/31/16	31	7,050	$6,987
Totals	**365**	**86,072**	**$63,259**
Annual	**365**	**86,072**	**$63,259**

3.4 Benchmarking

This facility was benchmarked using *Portfolio Manager*, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® 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® 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 12 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Machuga Heights and Dinallo Heights	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	185.0	262.6
Site Energy Use Intensity (kBtu/ft^2)	69.0	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 13 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Machuga Heights and Dinallo Heights	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	174.6	262.6
Site Energy Use Intensity (kBtu/ft^2)	65.7	130.7

Many types of commercial buildings are also eligible to receive an ENERGY STAR® 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® certification.

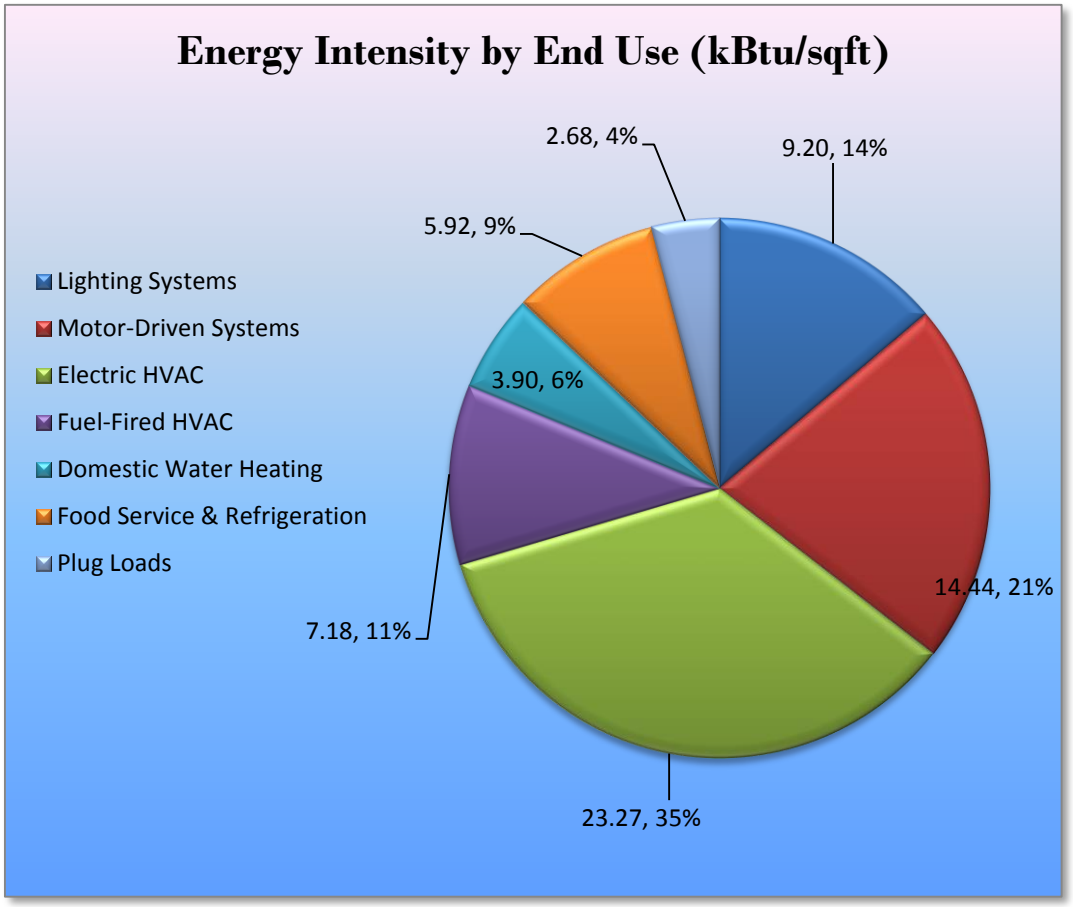
As the electric and gas accounts were shared between various buildings, it was not possible to benchmark these buildings and provide a score individually. A campus wide Portfolio Manager Statement of Energy Performance (SEP) was generated. For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager 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® Portfolio Manager 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 14 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Machuga Heights and Dinallo Heights 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 15 – 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_2e Emissions Reduction (lbs)
Lighting Upgrades		**427,633**	**52.6**	**0.0**	**$71,842.40**	**$182,554.21**	**$4,360.00**	**$178,194.21**	**2.5**	**430,623**
ECM 1	Install LED Fixtures	16,236	2.4	0.0	$2,727.62	$7,032.19	$1,800.00	$5,232.19	1.9	16,349
ECM 2	Retrofit Fixtures with LED Lamps	411,397	50.3	0.0	$69,114.77	$175,522.03	$2,560.00	$172,962.03	2.5	414,274
Lighting Control Measures		**11,495**	**1.4**	**0.0**	**$1,931.24**	**$4,860.00**	**$420.00**	**$4,440.00**	**2.3**	**11,576**
ECM 3	Install Occupancy Sensor Lighting Controls	11,495	1.4	0.0	$1,931.24	$4,860.00	$420.00	$4,440.00	2.3	11,576
Motor Upgrades		**7,620**	**1.1**	**0.0**	**$1,280.21**	**$7,815.40**	**$0.00**	**$7,815.40**	**6.1**	**7,674**
ECM 4	Premium Efficiency Motors	7,620	1.1	0.0	$1,280.21	$7,815.40	$0.00	$7,815.40	6.1	7,674
Variable Frequency Drive (VFD) Measures		**192,553**	**14.2**	**0.0**	**$32,348.86**	**$77,667.55**	**$18,975.00**	**$58,692.55**	**1.8**	**193,899**
ECM 5	Install VFD on Variable Air Volume (VAV) HVAC	99,886	14.2	0.0	$16,780.90	$52,330.35	$14,175.00	$38,155.35	2.3	100,585
ECM 6	Install VFDs on Cooling Tower Fans	92,666	0.0	0.0	$15,567.95	$25,337.20	$4,800.00	$20,537.20	1.3	93,314
Plug Load Equipment Control - Vending Machine		**7,132**	**0.0**	**0.0**	**$1,198.24**	**$1,380.00**	**$0.00**	**$1,380.00**	**1.2**	**7,182**
ECM 7	Vending Machine Control	7,132	0.0	0.0	$1,198.24	$1,380.00	$0.00	$1,380.00	1.2	7,182
TOTALS		**646,434**	**69.4**	**0.0**	**$108,600.94**	**$274,277.16**	**$23,755.00**	**$250,522.16**	**2.3**	**650,954**

* - 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 16 below.

Figure 16 – 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_2e Emissions Reduction (lbs)
Lighting Upgrades		**427,633**	**52.6**	**0.0**	**$71,842.40**	**$182,554.21**	**$4,360.00**	**$178,194.21**	**2.5**	**430,623**
ECM 1	Install LED Fixtures	16,236	2.4	0.0	$2,727.62	$7,032.19	$1,800.00	$5,232.19	1.9	16,349
ECM 2	Retrofit Fixtures with LED Lamps	411,397	50.3	0.0	$69,114.77	$175,522.03	$2,560.00	$172,962.03	2.5	414,274

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_2e Emissions Reduction (lbs)
Interior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0
Exterior	16,236	2.4	0.0	$2,727.62	$7,032.19	$1,800.00	$5,232.19	1.9	16,349

Measure Description

We recommend replacing existing fixtures containing fluorescent, HID, or incandescent 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 an HID lamp.

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_2e Emissions Reduction (lbs)
Interior	409,888	50.0	0.0	$68,861.16	$174,818.78	$2,560.00	$172,258.78	2.5	412,754
Exterior	1,510	0.2	0.0	$253.61	$703.25	$0.00	$703.25	2.8	1,520

Measure Description

We recommend retrofitting existing incandescent, halogen, HID or other 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 fluorescent or HID sources and more than 10 times longer than many incandescent lamps.

4.3 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 17 below.

Figure 17 – 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_2e Emissions Reduction (lbs)
Lighting Control Measures		**11,495**	**1.4**	**0.0**	**$1,931.24**	**$4,860.00**	**$420.00**	**$4,440.00**	**2.3**	**11,576**
ECM 3	Install Occupancy Sensor Lighting Controls	11,495	1.4	0.0	$1,931.24	$4,860.00	$420.00	$4,440.00	2.3	11,576

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 3: 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_2e Emissions Reduction (lbs)
11,495	1.4	0.0	$1,931.24	$4,860.00	$420.00	$4,440.00	2.3	11,576

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in all restrooms, corridors, storage rooms, and offices areas. 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.

4.4 Motor Upgrades

Our recommendations for motor upgrades are summarized in Figure 18 below.

Figure 18 – 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_2e Emissions Reduction (lbs)
Motor Upgrades		**7,620**	**1.1**	**0.0**	**$1,280.21**	**$7,815.40**	**$0.00**	**$7,815.40**	**6.1**	**7,674**
ECM 4	Premium Efficiency Motors	7,620	1.1	0.0	$1,280.21	$7,815.40	$0.00	$7,815.40	6.1	7,674

ECM 4: Premium Efficiency Motors

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_2e Emissions Reduction (lbs)
7,620	1.1	0.0	$1,280.21	$7,815.40	$0.00	$7,815.40	6.1	7,674

Measure Description

We recommend replacing standard efficiency motors with IHP 2014 efficiency motors. Our evaluation assumes that existing motors will be replaced with motors of equivalent size and type. Although occasionally additional savings can be achieved by downsizing motors to better meet the motor's current load requirements. The base case motor efficiencies are estimated from nameplate information and our best estimates of motor run hours. Efficiencies of proposed motor upgrades are obtained from the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016)*. Savings are based on the difference between baseline and proposed efficiencies and the assumed annual operating hours.

4.5 Variable Frequency Drive Measures

Our recommendations for variable frequency drive (VFD) measures are summarized in Figure 19 below.

Figure 19 – 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_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**192,553**	**14.2**	**0.0**	**$32,348.86**	**$77,667.55**	**$18,975.00**	**$58,692.55**	**1.8**	**193,899**
ECM 5	Install VFD on Variable Air Volume (VAV) HVAC	99,886	14.2	0.0	$16,780.90	$52,330.35	$14,175.00	$38,155.35	2.3	100,585
ECM 6	Install VFDs on Cooling Tower Fans	92,666	0.0	0.0	$15,567.95	$25,337.20	$4,800.00	$20,537.20	1.3	93,314

ECM 5: Install VFD on Variable Air Volume (VAV) 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_2e Emissions Reduction (lbs)
99,886	14.2	0.0	$16,780.90	$52,330.35	$14,175.00	$38,155.35	2.3	100,585

Measure Description

We recommend replacing existing air volume control devices on air handling units (AHUs), such as inlet vanes and variable pitch fan blades, with variable frequency drives (VFDs). Inlet guide vanes and variable pitch fan blades are an inefficient means of controlling the air volume compared to VFDs. The existing volume control device would be removed, or permanently disabled, and the control signal would be redirected to the VFD to determine proper fan motor speed. Energy savings results from more efficient control of motor energy usage when fan motors are operated at partial load. The magnitude of energy savings is based on the estimated amount of time that fan motors would be operated at partial load.

Additional maintenance savings may result from this measure as well, since VFDs are solid state electronic device, which generally requires less maintenance than mechanical air volume control devices.

ECM 6: Install VFDs on Cooling Tower Fans

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_2e Emissions Reduction (lbs)
92,666	0.0	0.0	$15,567.95	$25,337.20	$4,800.00	$20,537.20	1.3	93,314

Measure Description

We recommend installing a variable frequency drives (VFD) to control the cooling tower fan motors. The VFD will allow the cooling tower fan to operate at the minimum speed necessary to maintain the temperature of the condenser water returning to the chiller. Energy savings results from reducing fan speed (and power) when there is a reduced load on the chiller and outside air wet bulb temperatures are depressed. The magnitude of energy savings is based on the estimated amount of time that the system will operate at reduced load.

4.6 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment controls are summarized in Figure 20 below.

Figure 20 – 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_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**7,132**	**0.0**	**0.0**	**$1,198.24**	**$1,380.00**	**$0.00**	**$1,380.00**	**1.2**	**7,182**
ECM 7	Vending Machine Control	7,132	0.0	0.0	$1,198.24	$1,380.00	$0.00	$1,380.00	1.2	7,182

ECM 7: 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_2e Emissions Reduction (lbs)
7,132	0.0	0.0	$1,198.24	$1,380.00	$0.00	$1,380.00	1.2	7,182

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

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.

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 "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 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).

6 On-Site Generation Measures

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 campus' electric demand and the size and location of free areas on campus was performed and is addressed in the campus level summary report.

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

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

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 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 21 for a list of the eligible programs identified for each recommended ECM.

Figure 21 - 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 Occupancy Sensor Lighting Controls	X			X		
ECM 4	Premium Efficiency Motors				X		
ECM 5	Install VFD on Variable Air Volume (VAV) HVAC	X			X		
ECM 6	Install VFDs on Cooling Tower Fans				X		
ECM 7	Vending Machine Control				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.

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.

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.

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.

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

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.

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.

APPENDIX A: EQUIPMENT INVENTORY & RECOMMENDATIONS

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	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
Exterior	8	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	4,368	Fixture Replacement	No	8	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	89	4,368	1.06	7,216	0.0	$1,212.28	$3,125.42	$800.00	1.92
Exterior	16	Compact Fluorescent: CFL Pin	Daylight Dimming	72	4,368	Relamp	No	16	LED Screw-In Lamps: LED (1L) 50W	Daylight Dimming	50	4,368	0.25	1,736	0.0	$291.65	$703.25	$0.00	2.41
Entry	2	Compact Fluorescent: 2L CFL Pin	Wall Switch	72	5,242	Relamp	No	2	LED Screw-In Lamps: LED (2L) 25W	Wall Switch	50	5,242	0.03	260	0.0	$43.75	$175.81	$0.00	4.02
Lobby	22	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	22	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.08	676	0.0	$113.62	$270.00	$35.00	2.07
Front Desk	2	Compact Fluorescent: Pendant	Wall Switch	36	5,242	Relamp	No	2	LED Screw-In Lamps: LED (1L) 25W	Wall Switch	25	5,242	0.02	130	0.0	$21.87	$87.91	$0.00	4.02
Lobby	1	Compact Fluorescent: 2L CFL Pin	Wall Switch	72	5,242	Relamp	No	1	LED Screw-In Lamps: LED (2L) 25W	Wall Switch	50	5,242	0.02	130	0.0	$21.87	$87.91	$0.00	4.02
Electric Room	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	10	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	4,368	Fixture Replacement	No	10	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	89	4,368	1.52	10,373	0.0	$1,742.65	$3,906.77	$1,000.00	1.67
Elevators - Entire Heights	48	LED Screw-In Lamps: MR16	Occupancy Sensor	5	6,115	None	No	48	LED Screw-In Lamps: MR16	Occupancy Sensor	5	6,115	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
LDF	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Electric Room	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Pump Room	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lounge Hall	16	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	16	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lounge Hall	15	Compact Fluorescent: 2L CFL Pin	Wall Switch	72	5,242	Relamp	No	15	LED Screw-In Lamps: LED (2L) 25W	Wall Switch	50	5,242	0.24	1,953	0.0	$328.11	$1,318.59	$0.00	4.02
Kitchen	3	Compact Fluorescent: Pendant	Wall Switch	36	5,242	Relamp	Yes	3	LED Screw-In Lamps: LED (1L) 25W	Occupancy Sensor	25	3,669	0.04	332	0.0	$55.78	$401.86	$0.00	7.20
Kitchen	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.01	61	0.0	$10.33	$0.00	$0.00	0.00
Lounge Hall	8	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	8	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Game Room	9	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	9	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.03	277	0.0	$46.48	$270.00	$0.00	5.81
1512	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
1514	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
1511	12	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	12	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
1510	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Open Area	5	Compact Fluorescent: CFL Pin	Wall Switch	72	5,242	Relamp	Yes	5	LED Screw-In Lamps: LED (1L) 50W	Occupancy Sensor	50	3,669	0.14	1,107	0.0	$185.93	$489.77	$35.00	2.45
Open Area	5	Compact Fluorescent: Pendant	Wall Switch	36	5,242	Relamp	Yes	5	LED Screw-In Lamps: LED (1L) 25W	Occupancy Sensor	25	3,669	0.07	553	0.0	$92.96	$219.77	$35.00	1.99
1F Men's Room	6	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	6	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.02	184	0.0	$30.99	$270.00	$0.00	8.71

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	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
1F Women's Room	7	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	7	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.03	215	0.0	$36.15	$270.00	$0.00	7.47
2F Lounge	14	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	14	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.05	430	0.0	$72.31	$270.00	$35.00	3.25
2509	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2514	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2513	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2511	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2510	6	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	6	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2512	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2507	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2500	22	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	22	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2F Einstein/Basilone Lobby	15	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	15	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.06	461	0.0	$77.47	$270.00	$35.00	3.03
2F Einstein/Basilone Lobby	3	Compact Fluorescent: CFL Pin	Wall Switch	72	5,242	Relamp	Yes	3	LED Screw-In Lamps: LED (1L) 50W	Occupancy Sensor	50	3,669	0.08	664	0.0	$111.56	$131.86	$35.00	0.87
2152	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2151	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2155 - IDF	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2156 - Janitor	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2153 - Electrical Room	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2F Parker/Whitman Elevator Hall	9	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	9	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2F Parker/Whitman Elevator Hall	1	Compact Fluorescent: CFL Pin	Wall Switch	72	5,242	Relamp	No	1	LED Screw-In Lamps: LED (1L) 50W	Wall Switch	50	5,242	0.02	130	0.0	$21.87	$43.95	$0.00	2.01
2F Parker/Whitman Elevator Hall	1	Compact Fluorescent: 3L Ceiling Mount CFL Fixture	Wall Switch	78	5,242	Relamp	No	1	LED Screw-In Lamps: LED (1L) 25W	Wall Switch	55	5,242	0.02	141	0.0	$23.70	$131.86	$0.00	5.56
Men's Room	6	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	6	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.02	184	0.0	$30.99	$270.00	$0.00	8.71
Women's Room	7	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	7	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.03	215	0.0	$36.15	$270.00	$0.00	7.47
3F Parker/Whitman Lobby	24	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	24	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.09	738	0.0	$123.95	$270.00	$35.00	1.90
3F Parker/Whitman Lobby	2	Compact Fluorescent: CFL Pin	Wall Switch	72	5,242	Relamp	Yes	2	LED Screw-In Lamps: LED (1L) 50W	Occupancy Sensor	50	3,669	0.05	443	0.0	$74.37	$87.91	$35.00	0.71
3353	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	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
3354	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
3F Vestibule	8	Compact Fluorescent: CFL Pin	Wall Switch	72	5,242	Relamp	Yes	8	LED Screw-In Lamps: LED (1L) 50W	Occupancy Sensor	50	3,669	0.22	1,771	0.0	$297.48	$621.62	$35.00	1.97
3F Einstein/Basilone Lounge	14	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	14	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.05	430	0.0	$72.31	$270.00	$35.00	3.25
3F Einstein/Basilone Lounge	3	Compact Fluorescent: CFL Pin	Wall Switch	72	5,242	Relamp	Yes	3	LED Screw-In Lamps: LED (1L) 50W	Occupancy Sensor	50	3,669	0.08	664	0.0	$111.56	$131.86	$35.00	0.87
3151	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
3152	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
3153 - Electrical Room	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
3155 - IDF	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
3156 - Janitor	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Basilone 1F Hall	19	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	19	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
1102 Elevator	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Basilone 1F Trash Room	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.07	597	0.0	$100.26	$175.50	$30.00	1.45
Stairs 1	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Basilone 2F-6F Halls	95	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	95	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2fF-6F Trash Rooms	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.12	995	0.0	$167.09	$292.50	$50.00	1.45
Stair 5	17	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	17	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Stair 2	13	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	13	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Einstein 2F-6F Hall	70	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	70	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Stair 3	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Parker 1F Hall	19	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	19	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Parker 1F Trash Room	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.07	597	0.0	$100.26	$175.50	$30.00	1.45
Parker 2F-8F Hall	133	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	133	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Parker 2F-8F Trash Room	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.17	1,392	0.0	$233.93	$409.50	$70.00	1.45
Whitman 3F Hall	14	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	14	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whitman 4F Hall	13	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	13	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	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
Whitman 5F-8F Hall	56	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	No	56	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whitman/Parkers 4F-8F Lounge	95	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	95	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.36	2,920	0.0	$490.64	$270.00	$35.00	0.48
Whitman/Parker Study Rooms	20	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	20	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.08	615	0.0	$103.29	$270.00	$35.00	2.28
Whitman/Parker Large Study Rooms	20	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	20	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.08	615	0.0	$103.29	$270.00	$35.00	2.28
Whitman/Parker Electric Rooms	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whitman/Parker IDFs	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whitman/Parker Janitor Closets	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Stairs 4	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Stairs 6	13	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	13	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Einstein/Basilone 4F-6F Lounge	42	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	42	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.16	1,291	0.0	$216.92	$270.00	$35.00	1.08
Einstein/Basilone 4F-6F Lounge	9	Compact Fluorescent: CFL Pin	Wall Switch	78	5,242	Relamp	Yes	9	LED Screw-In Lamps: LED (1L) 55W	Occupancy Sensor	55	3,669	0.26	2,158	0.0	$362.56	$665.58	$35.00	1.74
Einstein/Basilone Study Rooms	24	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	None	Yes	24	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	3,669	0.09	738	0.0	$123.95	$0.00	$35.00	-0.28
Einstein/Basilone IDFs	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Einstein/Basilone Electrical Closets	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Einstein/Basilone Janitor Closets	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	None	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Single Suite Rooms - Common Area	614	Compact Fluorescent: CFL Pin	Wall Switch	78	5,242	Relamp	No	614	LED Screw-In Lamps: LED (1L) 55W	Wall Switch	55	5,242	10.57	86,606	0.0	$14,549.74	$26,987.14	$0.00	1.85
Single Suite Rooms - Bathroom	614	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	None	No	614	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Single Suite Rooms - Bathroom	614	Compact Fluorescent: CFL Pin	Wall Switch	78	5,242	Relamp	No	614	LED Screw-In Lamps: LED (1L) 55W	Wall Switch	55	5,242	10.57	86,606	0.0	$14,549.74	$26,987.14	$0.00	1.85
Single Suite Rooms - Bedrooms	1,228	Compact Fluorescent: CFL Pin	Wall Switch	52	5,242	Relamp	No	1,228	LED Screw-In Lamps: LED (1L) 36W	Wall Switch	36	5,242	14.10	115,474	0.0	$19,399.65	$53,974.28	$0.00	2.78
Double Rooms	390	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	None	No	390	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Double Rooms	390	Compact Fluorescent: CFL Pin	Wall Switch	78	5,242	Relamp	No	390	LED Screw-In Lamps: LED (1L) 55W	Wall Switch	55	5,242	6.72	55,010	0.0	$9,241.69	$17,141.67	$0.00	1.85
Double Rooms	390	Compact Fluorescent: CFL Pin	Wall Switch	78	5,242	Relamp	No	390	LED Screw-In Lamps: LED (1L) 55W	Wall Switch	55	5,242	6.72	55,010	0.0	$9,241.69	$17,141.67	$0.00	1.85
Double Rooms	390	Compact Fluorescent: CFL Pin	Wall Switch	52	5,242	Relamp	No	390	LED Screw-In Lamps: LED (1L) 36W	Wall Switch	36	5,242	4.48	36,673	0.0	$6,161.13	$17,141.67	$0.00	2.78
Sam's Restaurant - Kitchen	29	Linear Fluorescent - T8: 2' T8 (17W) - 4L	Wall Switch	63	5,242	Relamp	No	29	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,242	0.62	5,069	0.0	$851.66	$2,219.47	$580.00	1.93
Sam's Restaurant - Walk In	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.12	995	0.0	$167.09	$292.50	$50.00	1.45

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	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
Sam's Restaurant - Walk In	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.15	1,194	0.0	$200.51	$351.00	$60.00	1.45
Sam's Restaurant - Storage Rooms	11	Linear Fluorescent - T8: 2' T8 (17W) - 4L	Wall Switch	63	5,242	Relamp	No	11	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,242	0.23	1,923	0.0	$323.04	$841.87	$220.00	1.93
Sam's Restaurant - 2016	2	Linear Fluorescent - T8: 2' T8 (17W) - 4L	Wall Switch	63	5,242	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,242	0.04	350	0.0	$58.74	$153.07	$40.00	1.93
Sam's Restaurant - 2015	2	Linear Fluorescent - T8: 2' T8 (17W) - 4L	Wall Switch	63	5,242	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,242	0.04	350	0.0	$58.74	$153.07	$40.00	1.93
Sam's Restaurant - Locker Hall	7	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	5,242	Relamp	No	7	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.08	675	0.0	$113.42	$337.40	$70.00	2.36
Sam's Restaurant - 2109	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.02	199	0.0	$33.42	$58.50	$10.00	1.45
Sam's Restaurant - Women's Room	2	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	5,242	Relamp	No	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.02	193	0.0	$32.41	$96.40	$20.00	2.36
Sam's Restaurant - Men's Room	2	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	5,242	Relamp	No	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.02	193	0.0	$32.41	$96.40	$20.00	2.36
Sam's Restaurant - Front Kitchen	2	LED Screw-In Lamps: MR16	Wall Switch	5	5,242	None	No	2	LED Screw-In Lamps: MR16	Wall Switch	5	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Restaurant - Front Kitchen	6	Halogen Incandescent: MR16	Wall Switch	50	5,242	Relamp	No	6	LED Screw-In Lamps: LED (1L) 25W	Wall Switch	35	5,242	0.07	543	0.0	$91.14	$263.72	$0.00	2.89
Sam's Restaurant - Front Kitchen	5	LED Screw-In Lamps: Screw In	Wall Switch	9	5,242	None	No	5	LED Screw-In Lamps: Screw In	Wall Switch	9	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Restaurant - Front Kitchen	12	Incandescent: Heat Lamp	Wall Switch	100	5,242	None	No	12	Incandescent: Heat Lamp	Wall Switch	100	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Restaurant - Stair Landing	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	5,242	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	5,242	0.01	96	0.0	$16.20	$48.20	$10.00	2.36
Sam's Restaurant - Main Area	63	Linear Fluorescent - T8: 2' T8 (17W) - 4L	Wall Switch	63	5,242	Relamp	No	63	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,242	1.34	11,013	0.0	$1,850.16	$4,821.60	$1,260.00	1.93
Sam's Restaurant - Innovations	26	Halogen Incandescent: MR16	Wall Switch	50	5,242	Relamp	No	26	LED Screw-In Lamps: LED (1L) 25W	Wall Switch	35	5,242	0.29	2,351	0.0	$394.94	$1,142.78	$0.00	2.89
Whole building	150	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	150	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	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
Upper Rooftop	Cooling Tower Fan	4	Cooling Tower Fan	20.0	95.0%	No	3,391	No	95.0%	Yes	4	0.00	92,666	0.0	$15,567.95	$25,337.20	$4,800.00	1.32
Rooftop Mech Room	Main Building Loop Pump	4	Water-Source Heat Pump Circulation Pump	25.0	92.4%	Yes	6,570	No	92.4%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rooftop Mech Room	Backup Building Loop Pump	4	Water-Source Heat Pump Circulation Pump	25.0	92.4%	Yes	1,000	No	92.4%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rooftop Mech Room	HW Primary Pump	12	Heating Hot Water Pump	0.8	70.0%	No	8,760	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rooftop Mech Room	HW Secondary Loop Pump	8	Heating Hot Water Pump	10.0	91.7%	Yes	8,760	No	91.7%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rooftop Mech Room	Loop Injection Pump	8	Heating Hot Water Pump	1.5	84.0%	No	3,500	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rooftop Mech Room	Cooling Tower Pump	4	Condenser Water Pump	3.0	87.5%	No	3,500	No	87.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
1F Mech Rooms	Water Booster Pump	6	Water Supply Pump	7.5	84.0%	No	5,000	Yes	88.5%	No		1.13	7,620	0.0	$1,280.21	$7,815.40	$0.00	6.10
Lower Rooftop	Level 1-3 Common Area	2	Exhaust Fan	1.5	82.0%	No	8,760	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Upper Rooftop	Bathrooms	48	Exhaust Fan	0.3	66.0%	No	8,760	No	66.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Upper Rooftop	Bathrooms	32	Exhaust Fan	0.3	66.0%	No	8,760	No	66.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Elevator Rooms	Elevators	8	Other	15.0	95.0%	Yes	3,391	No	95.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Roof	Sam's	7	Exhaust Fan	0.3	66.0%	No	5,840	No	66.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whole Building	Dorm rooms/Common areas	1,068	Supply Fan	0.0	82.0%	Yes	7,008	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whole Building	Dorm rooms/Common areas	15	Supply Fan	0.8	82.0%	Yes	7,008	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Roof	Sam's	6	Supply Fan	10.0	89.5%	No	5,840	No	89.5%	Yes	6	8.10	52,572	0.0	$8,832.05	$22,847.70	$7,200.00	1.77
Lower Rooftop	Lower Level Common Areas	9	Supply Fan	5.0	89.5%	No	7,008	No	89.5%	Yes	9	6.08	47,315	0.0	$7,948.85	$29,482.65	$6,975.00	2.83

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	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	Corridors - Upper levels	4	Packaged AC	26.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Lower Level Common Areas	2	Packaged AC	8.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Lower Level Common Areas	2	Packaged AC	7.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Lower Level Common Areas	4	Packaged AC	5.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Lower Level Common Areas	1	Packaged AC	15.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Lower Level Common Areas	1	Packaged AC	13.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Lower Level Common Areas	1	Packaged AC	17.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Roof	Sam's	3	Packaged AC	50.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Roof	Sam's	2	Packaged AC	11.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Roof	Sam's	1	Packaged AC	13.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Bedroom Suites	1,004	Water Source HP	0.75	9.40	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Study Rooms	27	Water Source HP	0.75	9.40	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Ceiling	Top Floor Lobbies, Elevator Rooms and IDF Rooms	37	Water Source HP	0.75	12.30	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Laundry Room	2	Water Source HP	1.25	11.90	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Laundry Room	3	Water Source HP	1.50	12.30	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Apartments	3	Water Source HP	1.50	23.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Offices/MDF	2	Water Source HP	2.00	30.80	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Offices/Apartment	2	Water Source HP	2.50	35.50	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Main Electrical Room	1	Water Source HP	3.00	40.40	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
In Room	Laundry Room	1	Water Source HP	5.83	82.10	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	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
In Room	Main Electrical Room	1	Water Source HP	10.00	135.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	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
Rooftop Mech Room	Building Wide	12	Condensing Hot Water Boiler	750.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Floor 1-3 Common Area	1	Furnace	144.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Floor 1-3 Common Area	3	Furnace	144.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Floor 1-3 Common Area	2	Furnace	84.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Floor 1-3 Common Area	1	Furnace	288.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Floor 1-3 Common Area	2	Furnace	120.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Floor 1-3 Common Area	1	Furnace	288.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lower Rooftop	Floor 1-3 Common Area	1	Furnace	288.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Roof	Sam's	3	Furnace	864.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Roof	Sam's	2	Furnace	234.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's Roof	Sam's	1	Furnace	234.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rooftop	Corridors - Upper levels	4	Furnace	350.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	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
Mechanical Room	Whole Building	4	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Walk-In Cooler/Freezer Inventory & Recommendations

	Existing Conditions		Proposed Conditions			Energy Impact & Financial Analysis						
Location	Cooler/ Freezer Quantity	Case Type/Temperature	Install EC Evaporator Fan Motors?	Install Electric Defrost Control?	Install Evaporator Fan Control?	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
Sam's	2	Cooler (35F to 55F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	2	Low Temp Freezer (-35F to -5F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Cooler (35F to 55F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Low Temp Freezer (-35F to -5F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	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
Sam's	3	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	2	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	2	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Stand-Up Refrigerator, Glass Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	2	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Ice Maker Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Ice Maker Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	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
Kitchen	1	Ice Making Head (<450 lbs/day), Batch	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Ice Making Head (<450 lbs/day), Continuous	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Novelty Cooler Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Cooler Description	Install Automatic Shutoff Control?	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
Sam's	1	Deli Display Cooler	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Display Cooler	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Display Cooler	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Display Cooler	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Display Cooler	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	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
Sam's	1	Gas Steamer	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Gas Griddle (5 Feet Width)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Gas Griddle (4 Feet Width)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Insulated Food Holding Cabinet (1/2 Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Insulated Food Holding Cabinet (Full Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Electric Convection Oven (Half Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Gas Griddle (≥6 Feet Width)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Gas Rack Oven (Double)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Gas Combination Oven/Steam Cooker (15 - 28 Pans)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	2	Insulated Food Holding Cabinet (Full Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	3	Electric Convection Oven (Full Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Sam's	1	Electric Convection Oven (Half Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Dishwasher Inventory & Recommendations

	Existing Conditions					Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Dishwasher Type	Water Heater Fuel Type	Booster Heater Fuel Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Payback w/ Incentives in Years
Sam's Restaurant	1	Single Tank Conveyor (High Temp)	Natural Gas	N/A	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Sam's	1	Electric Mixer	3,840.0	No
Sam's	1	Milk Dispenser	220.0	No
Sam's	6	Food Warmer	1,340.0	No
Sam's	1	Panini Press	1,500.0	No
Sam's	3	Juice Machine	220.0	No
Sam's	2	Mini Fridge	270.0	No
Heights Dorm Rooms	1,009	Dorm Room Plug Load	300.0	No
Laundry Rooms	70	Dryer	2,000.0	Yes
Laundry Rooms	52	Washer	750.0	Yes
Offices/Security Desks	16	PC	80.0	Yes
Offices/Security Desks	32	LCD Monitor	35.0	Yes
Student devices	1	misc	11,600.0	No

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	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
Lounges	4	Refrigerated	Yes	0.00	6,447	0.0	$1,083.16	$920.00	$0.00	0.85
Lounges	2	Non-Refrigerated	Yes	0.00	685	0.0	$115.09	$460.00	$0.00	4.00

APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

N/A

ENERGY STAR® Score[1]

Montclair State University Campus (Buildings 1-41)

Primary Property Type: College/University
Gross Floor Area (ft²): 2,925,896
Built: 1908

For Year Ending: October 31, 2016
Date Generated: October 10, 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

Property Address	Property Owner	Primary Contact
Montclair State University Campus (Buildings 1-41) 1 Normal Avenue Montclair, New Jersey 07043	Montclair Statet University 1 Normal Avenue Montclair, NJ 07043 973-655-3244	Ana Pinto 1 Normal Avenue Montclair, NJ 07043 973-655-3244 pintoa@montclair.edu

Property ID: 6069294

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
172.3 kBtu/ft²

Source EUI
306.4 kBtu/ft²

Annual Energy by Fuel

District Chilled Water -	81,507,530 (16%)
Other (kBtu)	
District Steam (kBtu)	223,798,259 (44%)
Electric - Grid (kBtu)	161,334,839 (32%)
Natural Gas (kBtu)	37,406,141 (7%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	147.6
National Median Source EUI (kBtu/ft²)	262.6
% Diff from National Median Source EUI	17%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	N/A

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)