Local Government Energy Audit: Energy Audit Report

Russ Hall

1 Normal Avenue

Montclair, New Jersey 07043

Montclair State University

July 18, 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 Russ Hall.

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

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

1.1 Facility Summary

Russ Hall is a 38,794-square foot facility. The four-story building primarily includes dorm rooms, lounges, offices, and mechanical spaces.

Lighting at Russ Hall consists primarily of a mixture of T8 fluorescent sources, which are inefficient as compared to currently available alternatives. Cooling and ventilation are provided by an absorption chiller serving three (3) air handling units (AHUs). The fuel source for the chiller is steam from the campus central plant. There are also a packaged unit and five (5) split systems (DX units) serving offices and server rooms. The chiller is 14 years old and the DX units are six (6) years old, all with remaining useful service life. Heating hot water (HHW) is provided to the AHUs and zone terminal units through a steam to water heat exchanger (HX). Domestic hot water (DHW) is produced through its own steam to water HX. 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 and recommends seven (7) measures that together represent an opportunity for Russ Hall to reduce annual energy costs by roughly $24,056 and annual greenhouse gas emissions by 143,824 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in roughly 2.7 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 Russ Hall's annual energy use by 8%.

Figure 1 – Previous 12 Month Utility Costs

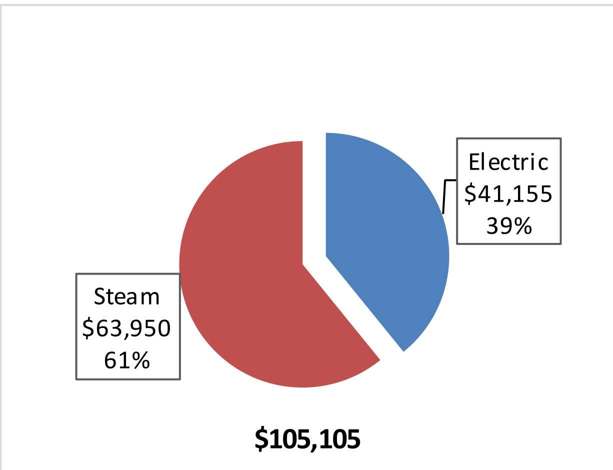
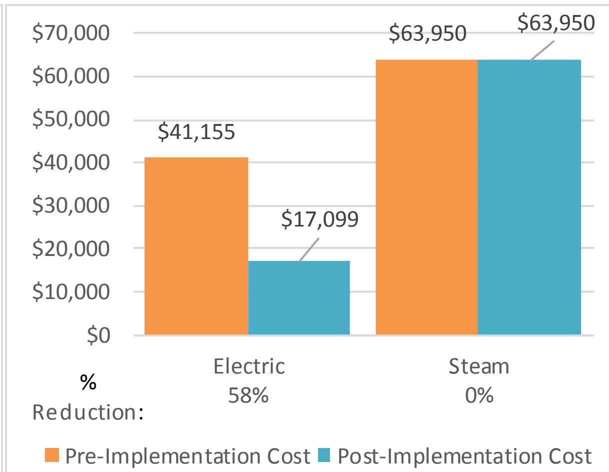


Figure 2 – Potential Post-Implementation Costs



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

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

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		High Priority?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**85,562**	**8.1**	**0.0**	**$14,411.23**	**$36,852.51**	**$2,545.00**	**$34,307.51**	**2.4**	**86,160**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	140	0.0	0.0	$23.61	$50.00	$0.00	$50.00	2.1	141
ECM 2	Retrofit Fixtures with LED Lamps	Yes	85,422	8.1	0.0	$14,387.62	$36,802.51	$2,545.00	$34,257.51	2.4	86,019
Lighting Control Measures			**11,201**	**1.1**	**0.0**	**$1,886.63**	**$5,400.00**	**$525.00**	**$4,875.00**	**2.6**	**11,280**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	11,201	1.1	0.0	$1,886.63	$5,400.00	$525.00	$4,875.00	2.6	11,280
Motor Upgrades			**11,340**	**1.4**	**0.0**	**$1,909.96**	**$7,579.28**	**$0.00**	**$7,579.28**	**4.0**	**11,419**
ECM 4	Premium Efficiency Motors	Yes	11,340	1.4	0.0	$1,909.96	$7,579.28	$0.00	$7,579.28	4.0	11,419
Variable Frequency Drive (VFD) Measures			**25,510**	**3.7**	**0.0**	**$4,296.57**	**$19,233.60**	**$3,100.00**	**$16,133.60**	**3.8**	**25,688**
ECM 5	Install VFD on Variable Air Volume (VAV) HVAC	Yes	25,510	3.7	0.0	$4,296.57	$19,233.60	$3,100.00	$16,133.60	3.8	25,688
Domestic Water Heating Upgrade			**5,989**	**0.0**	**0.0**	**$1,008.66**	**$179.25**	**$0.00**	**$179.25**	**0.2**	**6,031**
ECM 6	Install Low-Flow Domestic Hot Water Devices	Yes	5,989	0.0	0.0	$1,008.66	$179.25	$0.00	$179.25	0.2	6,031
Plug Load Equipment Control - Vending Machine			**3,224**	**0.0**	**0.0**	**$542.96**	**$690.00**	**$0.00**	**$690.00**	**1.3**	**3,246**
ECM 7	Vending Machine Control	Yes	3,224	0.0	0.0	$542.96	$690.00	$0.00	$690.00	1.3	3,246
TOTALS FOR HIGH PRIORITY MEASURES			**142,825**	**14.4**	**0.0**	**$24,056.02**	**$69,934.64**	**$6,170.00**	**$63,764.64**	**2.7**	**143,824**
TOTALS FOR ALL EVALUATED MEASURES			**142,825**	**14.4**	**0.0**	**$24,056.02**	**$69,934.64**	**$6,170.00**	**$63,764.64**	**2.7**	**143,824**

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

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

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

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

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.

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

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

Energy Efficient Practices

TRC also identified 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 Russ Hall include:

- Reduce Air Leakage
- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Perform Routine Motor Maintenance
- Assess Chillers & Request Tune-Ups
- Clean Evaporator/Condenser Coils on AC Systems
- Check for and Seal Duct Leakage
- Repair/Replace Steam Traps
- 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 Russ Hall. Based on the configuration of the site and its loads there is a low potential for installing any PV and combined heat and power self-generation measures.

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

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)
- Demand Response Energy Aggregator

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

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

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

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

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

2 Facility Information and Existing Conditions

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Ana Pinto	Director of Energy Management	pintoa@mail.montclair.edu	973-655-3244
TRC Energy Services			
Smruti Srinivasan	Auditor	SSrinivasan@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On May 30, 2017, TRC performed an energy audit at Russ Hall located in Montclair, New Jersey. TRC met with Ana Pinto to review the facility operations and help focus our investigation on specific energy-using systems.

Russ Hall is a 38,794-square foot facility. The building was constructed in 1912. The four-story building primarily includes dorm rooms, lounges, offices, and mechanical spaces.

Lighting at Russ Hall consists primarily of a mixture of T8 fluorescent sources, which are inefficient as compared to currently available alternatives. Cooling and ventilation are provided by an absorption chiller serving three (3) air handling units. The fuel source for the chiller is steam from the campus central plant. There are also a packaged unit and five (5) split systems (DX units) serving offices and server rooms. The chiller is 14 years old and the DX units are 6 years old, all with remaining useful service life. Heating hot water (HHW) is provided to the AHUs and zone terminal units through a steam to water heat exchanger (HX). Domestic hot water (DHW) is produced through its own steam to water HX.

2.3 Building Occupancy

The dormitory is open every day of the week for 40 weeks a year. During a typical day, the facility is occupied by approximately 100 students and staff.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Russ Hall	Weekday	All day
Russ Hall	Weekend	All day

2.4 Building Envelope

Russ Hall is constructed of concrete block and structural steel with a concrete facade. The building has a pitched, tile-covered roof that is in good condition. The building has double-pane windows, which are in good condition and show little sign of excessive infiltration. The exterior doors are constructed of metal and are in good condition.

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.

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

2.6 Energy-Using Systems

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

Lighting System

Interior lighting at the facility is provided mostly by linear fluorescent T8 lamps with electronic ballasts and compact fluorescent screw-in lamps. The linear fluorescent fixtures are located in all areas of the building. The site has upgraded some fixture to more efficient LED technology including the building exit sings. The interior lighting controls use a combination of occupancy sensors and manually operated switches.

Chilled Water and Condenser Water System

The facility is served by its own chilled water plant. The chiller plant contains a 130-ton absorption chiller (CH1). The absorption chiller uses steam from the campus steam loop. The absorption chiller is served by two dedicated 15 hp primary pumps (CHWP 1) that operate in a lead/lag configuration. The pumps are piped in parallel and equipped with VFDs. The chiller plant supplies chilled water to AHUs 1, 2, and 3.

The condenser water system consists of a one-cell cooling tower (CT1). The CT fan motor is variable speed. Condenser water is supplied to the chiller by a 15 hp, constant flow pump (CWP1). The condenser water has a set point of 83°F and a cooling tower bypass temperature of 72°F.

The chiller is in good condition and well maintained.

Hot Water and Steam Heating System

The hot water system consists of a steam to water heat exchanger that receives steam from the campus loop. The HX has an estimated capacity of 1,730 MBH. The HHW is distributed to the three (3) AHUs and multiple terminal units by two (2) 5 hp pumps piped in parallel and equipped with VFDs.

The HHW has a set point of 190°F at an outside temperature (OAT) of 30°F and resets to 130°F when the OAT is greater than 60°F.

The heat exchanger is in good condition and well maintained.

Chilled Water Air Conditioning System (CHW)

There are three (3) air handling units (AHU1, 2, & 3) that serve the majority of the building. The AHU are single zone constant air volume (CAV) systems. Each AHU has a supply fan ranging from 5 to 7.5 hp and a return fan ranging from 2 to 3 hp. The air is distributed via ducts to terminal units in the zones. The 1st floor units have re-heat coils and the units in the 2nd – 4th floors have both cooling and heating coils.

Direct Expansion Air Conditioning System (DX)

There is one (1) 5-ton packaged unit and one (1) 4-ton split system serving office spaces in the building. The units are six years old and have efficiencies of 12 and 13 SEER respectively. There are also four (4) ductless mini heat pumps also providing cooling to office spaces. These units are one year old and with a SEER rating of 10.7.

Building Energy Management System (BEMS)

The majority of the facility is controlled with an Advanced Logic Controls (ALC) building energy management system (BEMS). The BEMS provides controls for the chiller, fans, pumps, and terminal units.

Domestic Hot Water Heating System

The domestic hot water heating for the facility is also provided by a dedicated steam to water HX. The water is distributed throughout the building with a fractional horsepower constant speed pump.

Building Plug Load

There are five (5) computer office work stations in the facility, the majority with LCD monitors. The facility plug loads includes several copiers, printers, other office equipment, microwaves, washers and dryers. 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 0.3w/sf to account for residents' miscellaneous electronics.

2.7 Water-Using Systems

Kitchen faucets have a 2.5 gallon 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 and 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

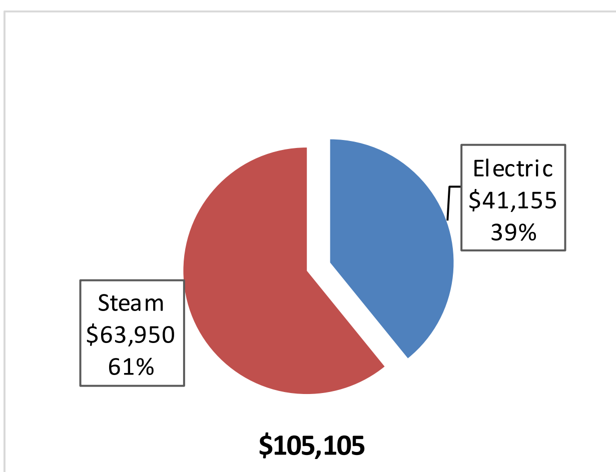
The following energy consumption and cost data is based on data that was provided by the campus for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 6 - Utility Summary

Utility Summary for Russ Hall		
Fuel	**Usage**	**Cost**
Electricity	601,381 kWh	$41,155
Steam	3,508 kLbs	$63,950
Total		**$105,105**

The current annual energy cost for this facility is $105,105 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

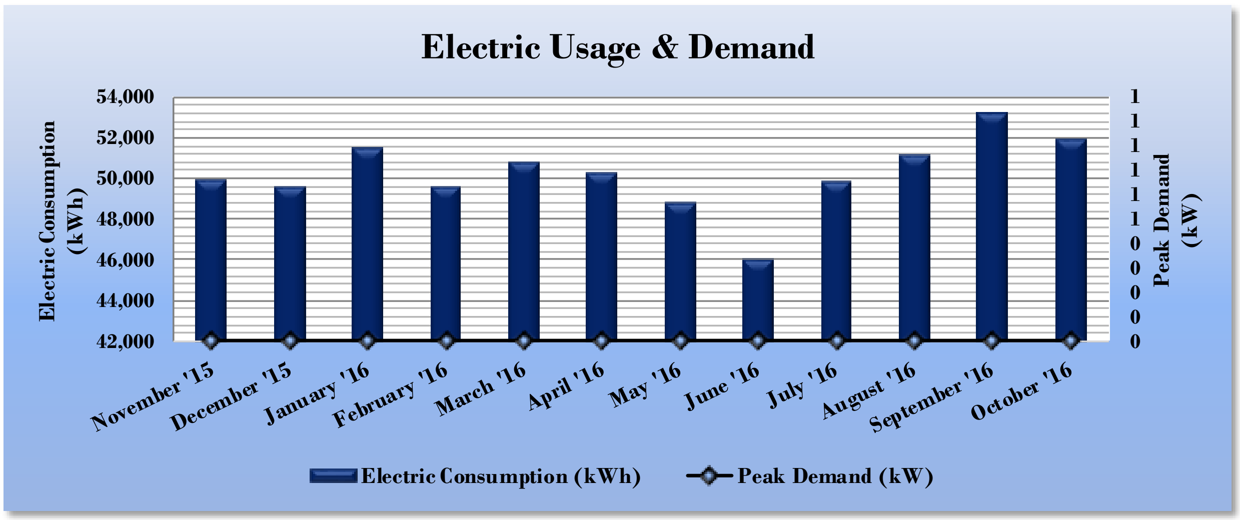


Figure 9 - Electric Usage & Demand

Electric Billing Data for Russ Hall				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
11/30/15	30	49,956	$2,945	Yes
12/31/15	31	49,646	$3,730	Yes
1/31/16	31	51,545	$3,070	Yes
2/28/16	28	49,595	$7,123	Yes
3/31/16	32	50,813	$2,853	Yes
4/30/16	30	50,273	$2,847	Yes
5/31/16	31	48,821	$2,787	Yes
6/30/16	30	46,099	$3,000	Yes
7/31/16	31	49,899	$3,172	Yes
8/31/16	31	51,169	$3,365	Yes
9/30/16	30	53,283	$3,283	Yes
10/31/16	31	51,928	$3,091	Yes
Totals	**366**	**603,029**	**$41,268**	12
Annual	**365**	**601,381**	**$41,155**	

3.3 Steam Usage

Steam is provided by campus CHP. The average steam cost for the past 12 months is $18.227/kLb, which is the blended rate used throughout the analyses in this report. The steam consumption is shown in the table below.

Figure 10 - Steam Usage

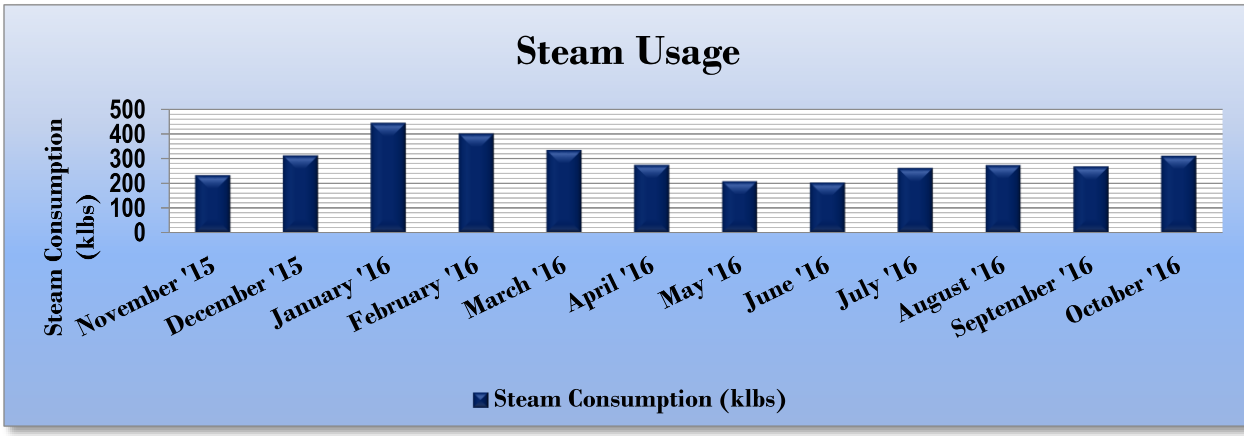


Figure 11 – Steam Usage

Steam Billing Data for Russ Hall				
Period Ending	Days in Period	Steam Usage (kLbs)	Fuel Cost	TRC Estimated Usage?
11/30/15	30	233	$3,547	Yes
12/31/15	31	312	$4,793	Yes
1/31/16	31	443	$6,924	Yes
2/28/16	28	400	$16,585	Yes
3/31/16	32	334	$5,078	Yes
4/30/16	30	274	$4,110	Yes
5/31/16	31	208	$3,241	Yes
6/30/16	30	203	$3,076	Yes
7/31/16	31	261	$3,930	Yes
8/31/16	31	272	$4,107	Yes
9/30/16	30	268	$4,018	Yes
10/31/16	31	311	$4,714	Yes
Totals	**366**	**3,518**	**$64,125**	12
Annual	**365**	**3,508**	**$63,950**	

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		
	Russ Hall	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	295.7	262.6
Site Energy Use Intensity (kBtu/ft^2)	160.9	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		
	Russ Hall	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	256.2	262.6
Site Energy Use Intensity (kBtu/ft^2)	148.3	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.

Your building is not one of the building categories that are eligible to receive a score. As the electric and gas accounts were shared between various buildings, it was not possible to benchmark these buildings and provide a score individually.

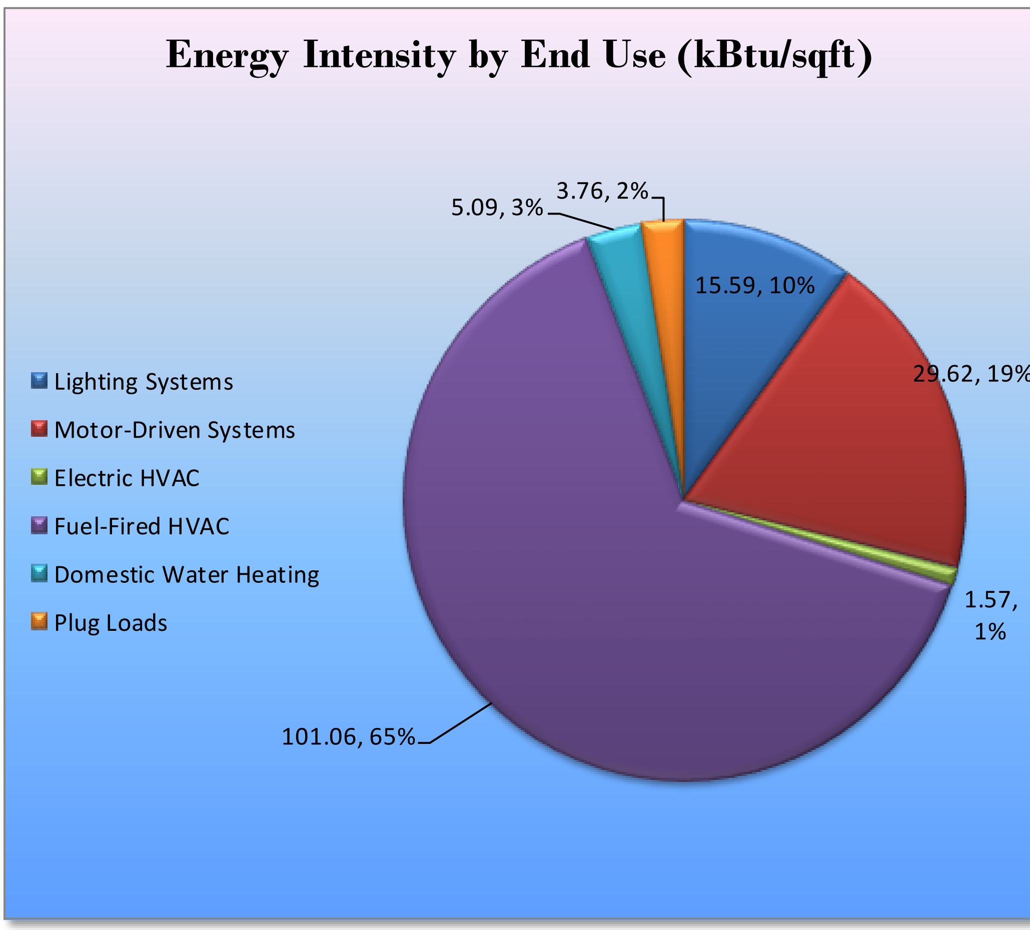
A campus wide Portfolio Manager® Statement of Energy Performance (SEP) was generated. For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

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

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

The following sections describe the evaluated measures.

4.1 High Priority ECMs

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

Figure 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		**85,562**	**8.1**	**0.0**	**$14,411.23**	**$36,852.51**	**$2,545.00**	**$34,307.51**	**2.4**	**86,160**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	140	0.0	0.0	$23.61	$50.00	$0.00	$50.00	2.1	141
ECM 2	Retrofit Fixtures with LED Lamps	85,422	8.1	0.0	$14,387.62	$36,802.51	$2,545.00	$34,257.51	2.4	86,019
Lighting Control Measures		**11,201**	**1.1**	**0.0**	**$1,886.63**	**$5,400.00**	**$525.00**	**$4,875.00**	**2.6**	**11,280**
ECM 3	Install Occupancy Sensor Lighting Controls	11,201	1.1	0.0	$1,886.63	$5,400.00	$525.00	$4,875.00	2.6	11,280
Motor Upgrades		**11,340**	**1.4**	**0.0**	**$1,909.96**	**$7,579.28**	**$0.00**	**$7,579.28**	**4.0**	**11,419**
ECM 4	Premium Efficiency Motors	11,340	1.4	0.0	$1,909.96	$7,579.28	$0.00	$7,579.28	4.0	11,419
Variable Frequency Drive (VFD) Measures		**25,510**	**3.7**	**0.0**	**$4,296.57**	**$19,233.60**	**$3,100.00**	**$16,133.60**	**3.8**	**25,688**
ECM 5	Install VFD on Variable Air Volume (VAV) HVAC	25,510	3.7	0.0	$4,296.57	$19,233.60	$3,100.00	$16,133.60	3.8	25,688
Domestic Water Heating Upgrade		**5,989**	**0.0**	**0.0**	**$1,008.66**	**$179.25**	**$0.00**	**$179.25**	**0.2**	**6,031**
ECM 6	Install Low-Flow Domestic Hot Water Devices	5,989	0.0	0.0	$1,008.66	$179.25	$0.00	$179.25	0.2	6,031
Plug Load Equipment Control - Vending Machine		**3,224**	**0.0**	**0.0**	**$542.96**	**$690.00**	**$0.00**	**$690.00**	**1.3**	**3,246**
ECM 7	Vending Machine Control	3,224	0.0	0.0	$542.96	$690.00	$0.00	$690.00	1.3	3,246
TOTALS		**142,825**	**14.4**	**0.0**	**$24,056.02**	**$69,934.64**	**$6,170.00**	**$63,764.64**	**2.7**	**143,824**

* - 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		**85,562**	**8.1**	**0.0**	**$14,411.23**	**$36,852.51**	**$2,545.00**	**$34,307.51**	**2.4**	**86,160**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	140	0.0	0.0	$23.61	$50.00	$0.00	$50.00	2.1	141
ECM 2	Retrofit Fixtures with LED Lamps	85,422	8.1	0.0	$14,387.62	$36,802.51	$2,545.00	$34,257.51	2.4	86,019

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: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

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	140	0.0	0.0	$23.61	$50.00	$0.00	$50.00	2.1	141
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend retrofitting existing fluorescent fixtures by removing fluorescent tubes and ballasts and replacing them with LEDs and LED drivers (if necessary), which are designed to be used retrofitted fluorescent fixtures. The measure uses the existing fixture housing but replaces the rest of the components with more efficient lighting technology. 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 tubes and more than 10 times longer than many incandescent lamps.

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	85,422	8.1	0.0	$14,387.62	$36,802.51	$2,545.00	$34,257.51	2.4	86,019
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend retrofitting existing incandescent, halogen, 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 tubes 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		**11,201**	**1.1**	**0.0**	**$1,886.63**	**$5,400.00**	**$525.00**	**$4,875.00**	**2.6**	**11,280**
ECM 3	Install Occupancy Sensor Lighting Controls	11,201	1.1	0.0	$1,886.63	$5,400.00	$525.00	$4,875.00	2.6	11,280

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)
11,201	1.1	0.0	$1,886.63	$5,400.00	$525.00	$4,875.00	2.6	11,280

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in classrooms 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 Motor 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)
Motor Upgrades		**11,340**	**1.4**	**0.0**	**$1,909.96**	**$7,579.28**	**$0.00**	**$7,579.28**	**4.0**	**11,419**
ECM 4	Premium Efficiency Motors	11,340	1.4	0.0	$1,909.96	$7,579.28	$0.00	$7,579.28	4.0	11,419

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)
11,340	1.4	0.0	$1,909.96	$7,579.28	$0.00	$7,579.28	4.0	11,419

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		**25,510**	**3.7**	**0.0**	**$4,296.57**	**$19,233.60**	**$3,100.00**	**$16,133.60**	**3.8**	**25,688**
ECM 5	Install VFD on Variable Air Volume (VAV) HVAC	25,510	3.7	0.0	$4,296.57	$19,233.60	$3,100.00	$16,133.60	3.8	25,688

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)
25,510	3.7	0.0	$4,296.57	$19,233.60	$3,100.00	$16,133.60	3.8	25,688

Measure Description

We recommend replacing existing air volume control devices on air handling units, such as inlet vanes and variable pitch fan blades, with 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 that generally requires less maintenance than mechanical air volume control devices.

4.6 Domestic Hot Water Heating System Upgrades

Our recommendations for domestic water heating system improvements are summarized in Figure 20 below.

Figure 20 - Summary of Domestic Water Heating ECMs

	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
	Domestic Water Heating Upgrade	**5,989**	**0.0**	**0.0**	**$1,008.66**	**$179.25**	**$0.00**	**$179.25**	**0.2**	**6,031**
ECM 6	Install Low-Flow Domestic Hot Water Devices	5,989	0.0	0.0	$1,008.66	$179.25	$0.00	$179.25	0.2	6,031

ECM 6: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
5,989	0.0	0.0	$1,008.66	$179.25	$0.00	$179.25	0.2	6,031

Measure Description

We recommend installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators and low-flow showerheads can reduce hot water usage, relative to standard showerheads and aerators, which saves energy. Pre-rinse spray valves (PRSVs)—often used in commercial and institutional kitchens—are designed to remove food waste from dishes prior to dishwashing. Replacing standard pre-rinse spray valves with low flow PRSVs will reduce hot water usage and save energy.

Low-flow devices reduce the overall water flow from the fixture, while still providing adequate pressure for washing. This reduces the amount of water used per day resulting in energy and water savings.

4.7 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment control measures are summarized in Figure 21 below.

Figure 21 - 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		**3,224**	**0.0**	**0.0**	**$542.96**	**$690.00**	**$0.00**	**$690.00**	**1.3**	**3,246**
ECM 7	Vending Machine Control	3,224	0.0	0.0	$542.96	$690.00	$0.00	$690.00	1.3	3,246

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)
3,224	0.0	0.0	$542.96	$690.00	$0.00	$690.00	1.3	3,246

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.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

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.

Assess Chillers & Request Tune-Ups

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

Clean Evaporator/Condenser Coils on AC Systems

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

Check for and Seal Duct Leakage

Duct leakage in commercial buildings typically accounts for 5 to 25 percent of the supply airflow. In the case of rooftop air handlers, duct leakage can occur to the outside of the building, significantly increasing cooling and heating costs. By sealing sources of leakage, cooling, heating, and ventilation energy use can be reduced significantly, depending on the severity of air leakage.

Repair/Replace Steam Traps

Properly functioning steam traps ensure that all latent heat in the steam is delivered to the end use by preventing pressurized steam from leaking. Steam traps should be inspected as part of the regular steam system maintenance. Traps that are blocked, venting, or allowing steam to leak through should be repaired or replaced. Repairing or replacing existing steam traps will reduce steam losses.

Plug Load Controls

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

Water Conservation

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

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

Refer to Section 4.6 for any low-flow ECM recommendations.

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

Figure 22 - 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	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	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 Low-Flow Domestic Hot Water Devices				X		
ECM 7	Vending Machine Control	X			X		

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

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

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

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.

8.4 Demand Response Energy Aggregator

The first step toward participation in a Demand Response (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 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 the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

See Section 7 for additional information.

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 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
Entrance hall	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	0.04	444	0.0	$74.70	$117.00	$20.00	1.30
Entrance hall	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
reception office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	6,720	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	4,704	0.09	967	0.0	$162.83	$420.40	$65.00	2.18
hallway	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.15	1,611	0.0	$271.39	$562.50	$85.00	1.76
118	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	6,720	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	4,704	0.18	1,934	0.0	$325.67	$570.80	$95.00	1.46
117	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	6,720	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	4,704	0.18	1,934	0.0	$325.67	$570.80	$95.00	1.46
120	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.25	2,578	0.0	$434.22	$738.00	$115.00	1.43
120	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	6,720	Relamp	No	4	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	6,720	0.15	1,530	0.0	$257.72	$300.80	$60.00	0.93
120	12	LED - Fixtures: Ceiling Mount	Wall Switch	6	6,720	None	No	12	LED - Fixtures: Ceiling Mount	Wall Switch	6	6,720	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
120	6	Compact Fluorescent: Screw-in (42W) - 1L	Wall Switch	42	6,720	Relamp	Yes	6	LED Screw-In Lamps: LED screw-in 29W	Occupancy Sensor	29	4,704	0.09	993	0.0	$167.29	$533.72	$35.00	2.98
120	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
stairwell	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	0.10	1,020	0.0	$171.81	$234.00	$40.00	1.13
stairwell	10	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	10	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	4,704	0.29	3,006	0.0	$506.33	$902.00	$0.00	1.78
laundry	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.18	1,934	0.0	$325.67	$621.00	$95.00	1.62
mens restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	0.05	510	0.0	$85.91	$117.00	$20.00	1.13
womens restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	0.05	510	0.0	$85.91	$117.00	$20.00	1.13
lounge	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	6,720	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	4,704	0.55	5,801	0.0	$977.00	$1,172.40	$215.00	0.98
lounge	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	6,720	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	4,704	0.09	967	0.0	$162.83	$420.40	$30.00	2.40
storage	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
stairwell	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.49	5,156	0.0	$868.45	$1,206.00	$160.00	1.20
double room	42	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	42	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	1.02	10,711	0.0	$1,804.06	$2,457.00	$420.00	1.13
double room	168	Compact Fluorescent: Screw-in (18W) - 2L	Wall Switch	36	6,720	Relamp	No	168	LED Screw-In Lamps: LED screw-in 25W	Wall Switch	25	6,720	1.34	14,022	0.0	$2,361.67	$14,768.21	$0.00	6.25
double room	42	Incandescent: Screw-in (40W) - 1L	Wall Switch	40	6,720	Relamp	No	42	LED Screw-In Lamps: LED screw-in 6W	Wall Switch	6	6,720	1.05	11,036	0.0	$1,858.72	$1,846.03	$210.00	0.88
single room	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	14	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	0.34	3,570	0.0	$601.35	$819.00	$140.00	1.13

	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
single room	28	Compact Fluorescent: Screw-in (18W) - 2L	Wall Switch	36	6,720	Relamp	No	28	LED Screw-In Lamps: LED screw-in 25W	Wall Switch	25	6,720	0.22	2,337	0.0	$393.61	$2,461.37	$0.00	6.25
single room	14	Incandescent: Screw-in (40W) - 1L	Wall Switch	40	6,720	Relamp	No	14	LED Screw-In Lamps: LED screw-in 6W	Wall Switch	6	6,720	0.35	3,679	0.0	$619.57	$615.34	$70.00	0.88
222	4	Incandescent: Screw-in (60W) - 1L	Wall Switch	60	6,720	Relamp	No	4	LED Screw-In Lamps: LED screw-in 9W	Wall Switch	9	6,720	0.15	1,577	0.0	$265.53	$175.81	$20.00	0.59
216	4	Compact Fluorescent: Screw-in (18W) - 2L	Wall Switch	36	6,720	Relamp	No	4	LED Screw-In Lamps: LED screw-in 25W	Wall Switch	25	6,720	0.03	334	0.0	$56.23	$351.62	$0.00	6.25
214	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	0.02	255	0.0	$42.95	$58.50	$10.00	1.13
214	2	Compact Fluorescent: Screw-in (18W) - 2L	Wall Switch	36	6,720	Relamp	No	2	LED Screw-In Lamps: LED screw-in 25W	Wall Switch	25	6,720	0.02	167	0.0	$28.12	$175.81	$0.00	6.25
214	1	Incandescent: Screw-in (60W) - 1L	Wall Switch	60	6,720	Relamp	No	1	LED Screw-In Lamps: LED screw-in 9W	Wall Switch	9	6,720	0.04	394	0.0	$66.38	$43.95	$5.00	0.59
214	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
hallway	13	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	13	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	4,704	0.37	3,908	0.0	$658.23	$1,091.60	$0.00	1.66
hallway	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
404, 406	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.06	645	0.0	$108.56	$387.00	$55.00	3.06
404, 406	8	Compact Fluorescent: Screw-in (18W) - 2L	Wall Switch	36	6,720	Relamp	No	8	LED Screw-In Lamps: LED screw-in 25W	Wall Switch	25	6,720	0.06	668	0.0	$112.46	$703.25	$0.00	6.25
housekeeping	1	Compact Fluorescent: Screw-in (18W) - 1L	Wall Switch	18	6,720	Relamp	No	1	LED Screw-In Lamps: LED screw-in 13W	Wall Switch	13	6,720	0.00	42	0.0	$7.03	$87.91	$0.00	12.51
storage	1	Compact Fluorescent: Screw-in (18W) - 1L	Wall Switch	18	6,720	Relamp	No	1	LED Screw-In Lamps: LED screw-in 13W	Wall Switch	13	6,720	0.00	42	0.0	$7.03	$87.91	$0.00	12.51
hallway	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.43	4,512	0.0	$759.89	$1,089.00	$140.00	1.25
hallway	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
psychology	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.68	7,090	0.0	$1,194.11	$1,557.00	$255.00	1.09
psychology	14	Compact Fluorescent: Screw-in (18W) - 2L	Wall Switch	36	6,720	Relamp	Yes	14	LED Screw-In Lamps: LED screw-in 25W	Occupancy Sensor	25	4,704	0.19	1,986	0.0	$334.57	$1,500.68	$35.00	4.38
psychology	4	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	6,720	Relamp	Yes	4	LED - Linear Tubes: (1) 2' Lamp	Occupancy Sensor	9	4,704	0.05	496	0.0	$83.56	$397.60	$55.00	4.10
103A-E, 104, 106, 111, 113	18	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	6,720	Relamp	Yes	18	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	4,704	0.83	8,701	0.0	$1,465.50	$1,623.60	$305.00	0.90
112	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.12	1,289	0.0	$217.11	$504.00	$75.00	1.98
112	1	Exit Signs: Fluorescent	None	18	8,760	Fixture Replacement	No	1	LED - Linear Tubes: 2 W Lamp	None	2	8,760	0.01	161	0.0	$27.15	$50.00	$0.00	1.84
115	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	4,704	0.18	1,934	0.0	$325.67	$621.00	$95.00	1.62
restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	0.05	510	0.0	$85.91	$117.00	$20.00	1.13
womens restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	6,720	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	6,720	0.02	255	0.0	$42.95	$58.50	$10.00	1.13

Motor Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions: Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Proposed Conditions: Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Energy Impact & Financial Analysis: 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
Ground	Cooling tower	1	Cooling Tower Fan	15.0	93.7%	Yes	3,391	No	93.7%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechnical room	Condenser water	1	Condenser Water Pump	15.0	91.0%	No	3,391	Yes	93.0%	No		0.15	673	0.0	$113.28	$1,846.72	$0.00	16.30
Mechnical room	Russ Hall HHW	2	Heating Hot Water Pump	5.0	89.5%	Yes	2,745	No	89.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechnical room	Russ Hall CHW	2	Chilled Water Pump	15.0	93.0%	Yes	3,391	No	93.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechnical room	Absorption chiller	2	Other	0.3	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechnical room	AH1	1	Supply Fan	7.5	82.0%	No	6,136	Yes	91.7%	Yes	1	1.35	9,728	0.0	$1,638.53	$4,760.59	$1,162.50	2.20
Mechnical room	AH1	1	Return Fan	3.0	80.0%	No	6,136	Yes	89.5%	Yes	1	0.55	3,992	0.0	$672.32	$3,812.49	$0.00	5.67
Mechnical room	AH2	1	Supply Fan	7.5	80.0%	No	6,136	Yes	91.7%	Yes	1	1.43	10,435	0.0	$1,757.53	$4,760.59	$1,162.50	2.05
Mechnical room	AH2	1	Return Fan	3.0	80.0%	No	6,136	Yes	89.5%	Yes	1	0.55	3,992	0.0	$672.32	$3,812.49	$0.00	5.67
Mechnical room	AH2	1	Heating Hot Water Pump	0.3	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechnical room	Air compressor	1	Air Compressor	0.3	77.0%	No	4,957	No	77.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechnical room	DHW	1	Water Supply Pump	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechnical room	AH3	1	Supply Fan	5.0	84.0%	No	6,136	Yes	89.5%	Yes	1	0.81	5,733	0.0	$965.65	$4,196.91	$775.00	3.54
Mechnical room	AH3	1	Return Fan	2.0	82.0%	No	6,136	Yes	86.5%	Yes	1	0.33	2,297	0.0	$386.90	$3,623.09	$0.00	9.36
Elevator room	Elevator	1	Other	50.0	94.0%	No	1,627	No	94.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whole building	Whole building	66	Supply Fan	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechnical room	Absorption chiller	1	Other	7.5	84.0%	No	3,391	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

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	Russ Hall	1	Packaged AC	5.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Ground floor	Russ Hall	1	Split-System AC	4.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Russ Hall	Russ Hall	4	Ductless Mini-Split HP	1.00	10.60	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
Central Plant	Russ Hall	1	Forced Draft Steam Boiler	1,729.95	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Central Plant	Russ Hall	1	Forced Draft Steam Boiler	1,263.65	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	Russ Hall	1	Indirect System	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Low-Flow Device Recommendations

	Recommendation Inputs				Energy Impact & Financial Analysis						
Location	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
kitchen	5	Faucet Aerator (Kitchen)	2.50	2.20	0.00	486	0.0	$81.78	$35.85	$0.00	0.44
men's restrooms	10	Faucet Aerator (Lavatory)	2.20	1.00	0.00	3,885	0.0	$654.27	$71.70	$0.00	0.11
women's restrooms	10	Faucet Aerator (Lavatory)	1.50	1.00	0.00	1,619	0.0	$272.61	$71.70	$0.00	0.26

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Whole building	5	Computer	110.0	Yes
Whole building	4	Printer/copier	300.0	Yes
Whole building	3	Microwave	1,000.0	Yes
Kitchen	1	Refrigerator/Freezer	600.0	Yes
Kitchen	1	Refrigerator (dbl door)	750.0	Yes
Kitchen	1	Toaster	1,200.0	No
Laundry room	4	Washer	900.0	Yes
Laundry room	6	Dryer	1,600.0	Yes
Whole building	1	CRT (24')	120.0	Yes
Whole building	1	LCD (50')	150.0	Yes
Whole building	1	Hot and Cold water dispenser	500.0	Yes
Kitchen	1	Electric range	3,000.0	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**
Break room	2	Refrigerated	Yes	0.00	3,224	0.0	$542.96	$460.00	$0.00	0.85
Break room	1	Non-Refrigerated	No	0.00	0	0.0	$0.00	$230.00	$0.00	0.00

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

Annual Energy by Fuel

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

Source EUI
306.4 kBtu/ft²

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)