Local Government Energy Audit:
Energy Audit Report

Blanton Hall

1 Normal Avenue

Montclair, New Jersey 07043

Montclair State University

July 9, 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 savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

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

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

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

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1 Executive Summary

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

Blanton Hall is a 158,862 square foot facility. The six-story building includes dorm rooms, lounges, and offices as well as the restaurants Chili's, Dunkin Donuts, and Which Wich.

Lighting at Blanton Hall consists primarily of a mixture of T8 and T12 fluorescent sources, compact fluorescent lamps (CFLs), and some incandescent fixtures, all of which are inefficient as compared to currently available alternatives. Cooling is provided by chilled water (CHW) from the District Energy Plant to Blanton Hall's mechanical room, where it is distributed by pumps to the building's air handling equipment. There are eight main air handling units (AHUs) for the building. Steam is provided from the District Energy Plant to Blanton Hall's mechanical room, where it is converted to heating and domestic hot water by steam to water heat exchangers. Heating hot water is distributed to the building's AHUs and terminal reheat coils. 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 eight measures which together represent an opportunity for Blanton Hall to reduce annual energy costs by $67,055 and annual greenhouse gas emissions by 402,929 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in 1.9 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 Blanton Hall's annual energy use by 4%.

Figure 1 – Previous 12 Month Utility Costs

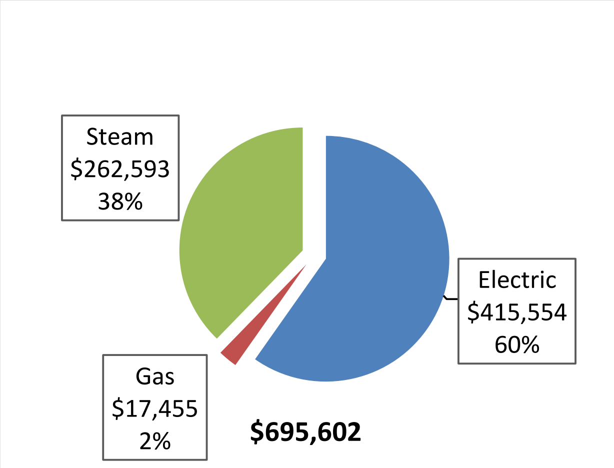
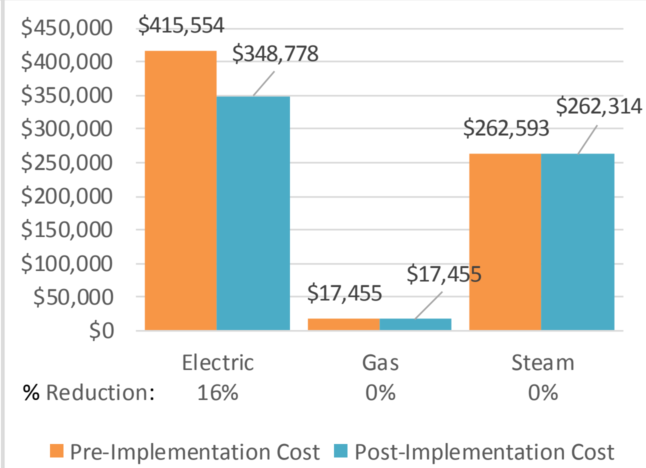


Figure 2 – Potential Post-Implementation Costs



A detailed description of Blanton 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			**351,469**	**42.0**	**0.0**	**$59,046.86**	**$127,513.15**	**$19,055.00**	**$108,458.15**	**1.8**	**353,927**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	3,302	0.4	0.0	$554.77	$1,960.00	$100.00	$1,860.00	3.4	3,325
ECM 2	Retrofit Fixtures with LED Lamps	Yes	344,593	41.3	0.0	$57,891.64	$124,262.49	$18,955.00	$105,307.49	1.8	347,002
ECM 3	Install LED Exit Signs	Yes	3,574	0.3	0.0	$600.45	$1,290.66	$0.00	$1,290.66	2.1	3,599
Lighting Control Measures			**10,158**	**1.0**	**0.0**	**$1,706.59**	**$6,520.00**	**$560.00**	**$5,960.00**	**3.5**	**10,229**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	5,294	0.6	0.0	$889.40	$4,320.00	$560.00	$3,760.00	4.2	5,331
ECM 5	Install High/Low Lighitng Controls	Yes	4,864	0.4	0.0	$817.19	$2,200.00	$0.00	$2,200.00	2.7	4,898
Variable Frequency Drive (VFD) Measures			**29,400**	**6.9**	**0.0**	**$4,939.28**	**$13,765.30**	**$2,000.00**	**$11,765.30**	**2.4**	**29,606**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	Yes	29,400	6.9	0.0	$4,939.28	$13,765.30	$2,000.00	$11,765.30	2.4	29,606
Domestic Water Heating Upgrade			**0**	**0.0**	**18.3**	**$278.88**	**$250.30**	**$0.00**	**$250.30**	**0.9**	**2,674**
ECM 7	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	18.3	$278.88	$250.30	$0.00	$250.30	0.9	2,674
Plug Load Equipment Control - Vending Machine			**6,447**	**0.0**	**0.0**	**$1,083.16**	**$920.00**	**$0.00**	**$920.00**	**0.8**	**6,492**
ECM 8	Vending Machine Control	Yes	6,447	0.0	0.0	$1,083.16	$920.00	$0.00	$920.00	0.8	6,492
TOTALS FOR HIGH PRIORITY MEASURES			**397,475**	**49.9**	**18.3**	**$67,054.76**	**$148,968.75**	**$21,615.00**	**$127,353.75**	**1.9**	**402,929**
TOTALS FOR ALL EVALUATED MEASURES			**397,475**	**49.9**	**18.3**	**$67,054.76**	**$148,968.75**	**$21,615.00**	**$127,353.75**	**1.9**	**402,929**

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

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

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

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

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

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 outlets when not in use.

Energy Efficient Practices

TRC also identified nine 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 Blanton Hall include:

- Reduce Air Leakage
- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Perform Routine Motor Maintenance
- Clean and/or Replace HVAC Filters
- Check for and Seal Duct Leakage
- 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 Blanton 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)

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 or: [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
Kevin Johnson	Supervisor of Building Repairs, Facilities, Maintenance and Energy Management	johnsonke@mail.montclair.edu	973-655-4505
TRC Energy Services			
Smruti Srinivasan	Auditor	SSrinivasan@trcsolutions.com	732-855-2897

2.2 General Site Information

On April 19, 2017, TRC performed an energy audit at Blanton Hall located in Montclair, New Jersey. TRC's team met with Ana Pinto to review the facility operations and help focus our investigation on specific energy-using systems.

Blanton Hall is a 158,862 square foot facility. The six-story building includes dorm rooms, lounges, and offices as well as the restaurants, Chili's, Dunkin Donuts, and Which Wich.

Lighting at Blanton Hall consists primarily of a mixture of T8 and T12 fluorescent sources, compact fluorescent lamps (CFLs), and some incandescent fixtures, all of which are inefficient as compared to currently available alternatives. Cooling is provided by chilled water (CHW) from the District Energy Plant to Blanton Hall's mechanical room, where it is distributed by pumps to the building's air handling equipment. There are eight main air handling units (AHUs) for the building. Steam is provided from the District Energy Plant to Blanton Hall's mechanical room, where it is converted to heating and domestic hot water by steam to water heat exchangers. Heating hot water is distributed to the building's AHUs and terminal reheat coils.

2.3 Building Occupancy

The facility is open every day for 52 weeks a year. During a typical day, the facility is occupied by approximately 650 students and staff.

Figure 5 - Building Schedule

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

2.4 Building Envelope

Blanton Hall is a six-story building constructed of concrete and structural steel with a masonry facade. The building has a flat built-up roof that is in good condition. The building has double pane windows which are in good condition and show little signs of infiltration. The exterior doors are constructed of metal and glass that are in good condition.

Building envelope measures generally consist of improving the following aspects of the walls, roofs, windows and in some cases floor or foundation:

- Increase resistance to heat transfer by improving the insulation quality.
- Reduce the loss of conditioned air or introduction of outside air by sealing the components of the envelope.
- Reduce heat gain be improving the reflectance of components of the envelope.

Quantifying the savings associated with implementing these changes is difficult primarily due to the transient nature of the energy use and because the savings do not occur at the envelope components but rather at the supporting heating, air conditioning and ventilation systems. In addition, most building envelope measures are expensive to implement and as a result have long paybacks.

Although this energy audit did not identify any envelope specific issues related to any of the Montclair University buildings the following should be included during the normal facility maintenance and planning.

A cost effective alternative to address some envelope issues is known as weatherization, which generally involves sealing cracks and gaps around windows, doors, and wall and roof penetrations. Weatherization measures are typically inexpensive, can be done by on-site staff, result in relatively low energy savings, and can improve occupant comfort by reducing drafts and hot/cold spots. Maintaining caulking and weather stripping are almost always cost effective and should be part of the on-going maintenance program.

Installing window film can be one of the relatively less expensive envelope measures. Window films can be successful when installed correctly and in the right application. Window film generally reduces solar heat gain by restricting the transmittance of specific parts of the solar spectrum. In some cases solar film can also increase the overall R-value of the window resulting in reduced heat loss. Some window films will also reduce the light transmittance which can cause the interior space to be darker. Two factors that make a good application for window film are cooling dominant buildings and buildings with clear, single pane windows. Buildings orientations that are significantly shaded are generally not a good application for window film. The installed cost for window film can range from $5 to $20 per square foot of window depending on the quality of the film, the size of the job, and arrangement of the windows.

Most other improvements to the building envelope only become cost effective when done in conjunction with other renovations. The most common example is increasing the insulation value of a roof or installing a “cool-roof” as part of an overall roof replacement project.

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.

Blanton 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 fixtures which contain linear fluorescent T8 lamps with electronic ballasts, T12 lamps with magnetic ballasts or fixtures with compact fluorescent plug-in lamps. The linear fluorescent fixtures are located in all areas of the building. Most of the fixtures are 2-lamp or 4-lamp with 2-foot and 4-foot long troffers and also some U-bend lamps. The site has upgraded some fixtures to more efficient LED technology, including some of the building exit signs. Interior lighting fixtures are mostly controlled by manually operated switches. Some occupancy sensors have also been installed.

Exterior lighting is provided by linear and U-bend T8 fluorescents with controls.

Chilled Water System

Chilled water (CHW) is provided from the District Energy Plant to Blanton Hall's mechanical room, where it is distributed to the building's air handling equipment. The water is distributed by two variable speed 25 hp pumps.

It was noted at the site visit that the chilled water supply and return temperatures were 54°F and 61°F respectively.

The equipment is well-maintained and in good condition.

Steam to Hot Water Heating System

The heating hot water (HHW) system consists of a steam to water heat exchanger in the mechanical room that receives steam from the District Energy Plant. From there, the HHW is distributed to the building's AHUs and terminal heating coils. The HHW is distributed by two 7.5 hp pumps equipped with variable speed drives (VFDs).

The equipment is well-maintained in good condition.

Air Distribution System

There are eight main air handling units (AHUs) for the building that provide space conditioning and ventilation. The sizes for supply fans range from 3 to 7.5 horsepower. AHUs 1 & 2 are variable speed and the others are constant volume. There are no return fans for any of the units.

It was noted at the site visit that the AHU supply air temperatures were set to 61°F and that zone space temperatures were between 72°F and 74°F. There is also an outside air economizer lockout of 52°F.

The equipment is well-maintained and in good condition.

Direct Expansion Air Conditioning System (DX)

There is one split-system AC unit that serves the elevator room. The unit is a Lennox XC model with a 5 ton cooling capacity and a 16 SEER efficiency.

Building Energy Management System (BEMS)

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

Food Service & Laundry Equipment

Food service equipment includes gas steamers, convection ovens, and griddles. The electric equipment includes ovens, steamer cookers, and convection ovens. The brands include Belshaw, Blodett, and Oliver.

Refrigeration

There are four walk-in coolers and three walk-in medium temperature freezer located in Chili's and Which Wich. The total evaporator fans loads for the units range from 460 to 575 kW. All units have fan control and electric defrost.

Building Plug Load

Plug load equipment includes multiple student computers, printers, and displays. Other plug load equipment includes 16 washers and dryers, a dishwasher, refrigerators, an ice maker, coffee machines, and microwaves.

2.7 Water-Using Systems

There are approximately 200 dorm room bathrooms and common restrooms at this facility. A sampling of restrooms found that many faucets are rated for 2.2 gallons per minute (gpm) and showerheads at 2.5 gpm.

3 SITE ENERGY USE AND COSTS

This building receives electricity and natural gas through master meters. It also receives electricity, steam and chilled water from the campus central cogeneration plant. These utilities were prorated for individual buildings based on building size and function.

Prorated 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 3.6 for additional information.

3.1 Total Cost of Energy

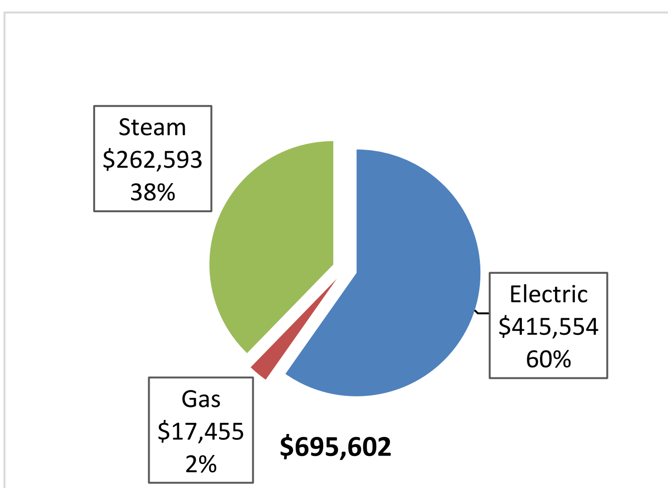
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 6 - Utility Summary

Utility Summary for Blanton Hall		
Fuel	**Usage**	**Cost**
Electricity	5,009,541 kWh	$415,554
Natural Gas	23,750 Therms	$17,455
Steam	14,406 kLbs	$262,593
Total		**$695,602**

The current annual energy cost for this facility is $695,602 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 cogeneration plant generation, therefore, kW totals would be incomplete for this facility. The monthly electricity consumption is shown in the chart below.

Figure 8 - Electric Usage & Demand

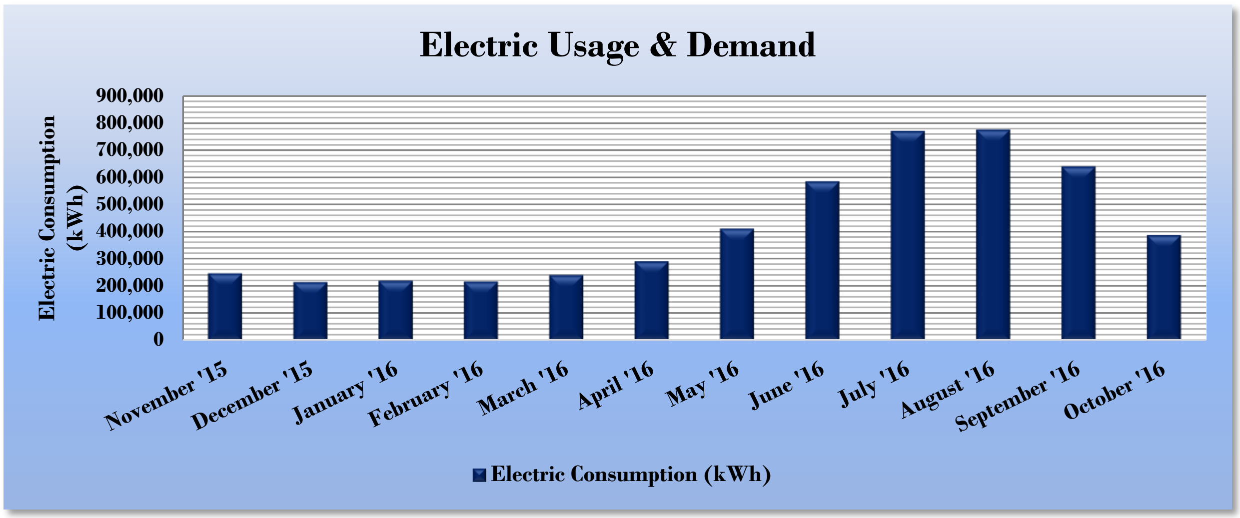


Figure 9 - Electric Usage & Demand

Electric Billing Data for Blanton Hall				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
11/30/15	30	247,381	$17,210	Yes
12/31/15	31	215,149	$17,008	Yes
1/31/16	31	220,464	$14,694	Yes
2/28/16	28	217,396	$29,916	Yes
3/31/16	31	240,943	$16,009	Yes
4/30/16	30	292,480	$20,863	Yes
5/31/16	31	411,813	$32,703	Yes
6/30/16	30	586,325	$50,063	Yes
7/31/16	31	771,990	$66,378	Yes
8/31/16	31	776,323	$67,091	Yes
9/30/16	30	641,203	$53,498	Yes
10/31/16	31	388,074	$30,121	Yes
Totals	**365**	**5,009,541**	**$415,554**	12
Annual	**365**	**5,009,541**	**$415,554**	

3.3 Natural Gas Usage

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

Figure 10 - Natural Gas Usage

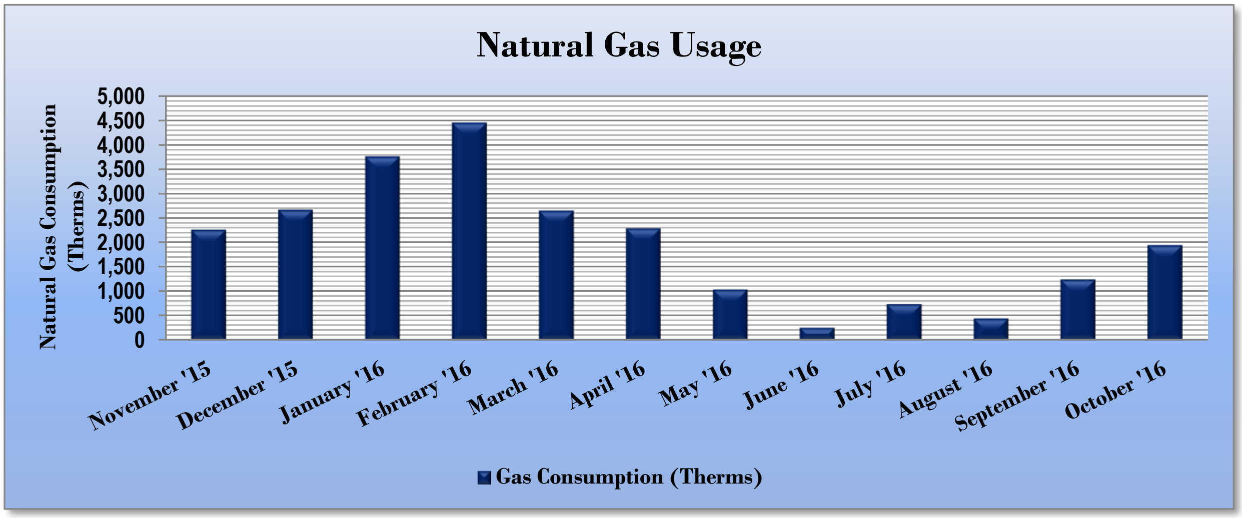


Figure 11 - Natural Gas Usage

Gas Billing Data for Blanton Hall				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
11/30/15	30	2,259	$2,670	Yes
12/31/15	31	2,670	$2,259	Yes
1/31/16	31	3,765	$2,913	Yes
2/28/16	28	4,455	$3,058	Yes
3/31/16	31	2,654	$1,298	Yes
4/30/16	30	2,290	$1,162	Yes
5/31/16	31	1,035	$537	Yes
6/30/16	30	252	$142	Yes
7/31/16	31	738	$455	Yes
8/31/16	31	444	$269	Yes
9/30/16	30	1,243	$762	Yes
10/31/16	31	1,945	$1,928	Yes
Totals	**365**	**23,750**	**$17,455**	12
Annual	**365**	**23,750**	**$17,455**	

3.4 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 12 –Steam Usage

Steam Billing Data for Blanton Hall				
Period Ending	Days in Period	Steam Usage (kLbs)	Fuel Cost	TRC Estimated Usage?
11/30/15	30	953	$14,525	Yes
12/31/15	31	1,278	$19,629	Yes
1/31/16	31	1,816	$28,352	Yes
2/28/16	28	1,638	$67,917	Yes
3/31/16	31	1,369	$20,795	Yes
4/30/16	30	1,120	$16,832	Yes
5/31/16	31	851	$13,272	Yes
6/30/16	30	830	$12,597	Yes
7/31/16	31	1,068	$16,093	Yes
8/31/16	31	1,115	$16,820	Yes
9/30/16	30	1,097	$16,455	Yes
10/31/16	31	1,272	$19,305	Yes
Totals	**365**	**14,406**	**$262,593**	12
Annual	**365**	**14,406**	**$262,593**	

3.5 Chilled Water Usage

Chilled water is provided by the campus cogeneration plant. The average chilled water cost is $0.327/ton-hr, which is the blended rate used throughout the analyses in this report. The chilled water consumption is shown in the table below. Chilled water is produced by steam engine chillers at the cogeneration plant, however, for ease of analysis and reporting chilled water use and cost has been combined with electricity use and cost in this report in the summary graphics.

Figure 13 –Chilled Water Usage

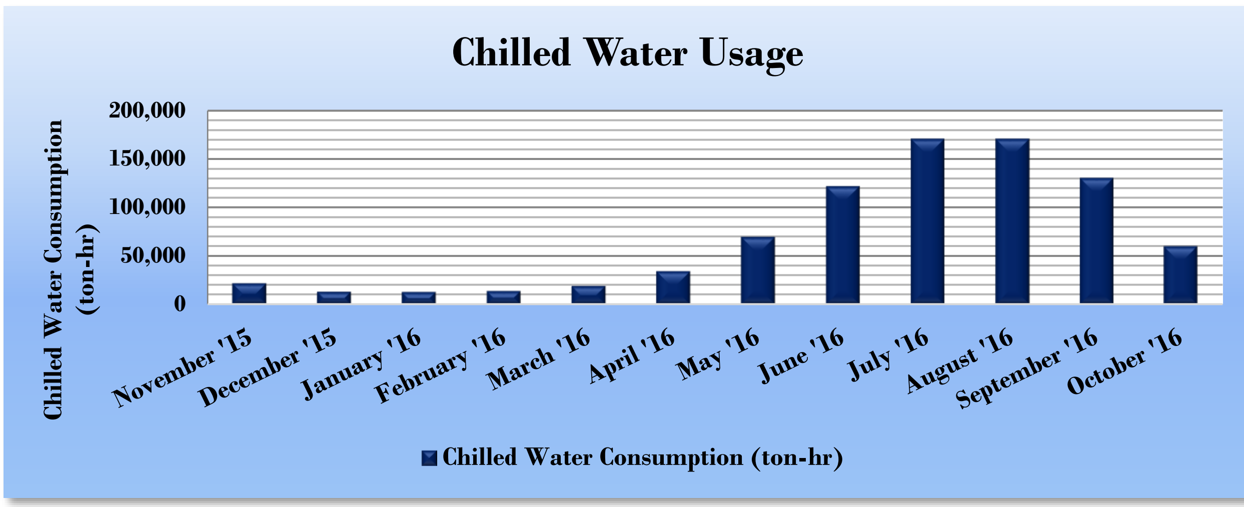


Figure 14 –Chilled Water Usage

Chilled Water Billing Data for Blanton Hall				
Period Ending	Days in Period	Chilled Water Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
11/30/15	30	76,904	$7,160	Yes
12/31/15	31	45,729	$4,280	Yes
1/31/16	31	44,565	$4,218	Yes
2/28/16	28	48,153	$5,609	Yes
3/31/16	31	67,542	$6,272	Yes
4/30/16	30	120,923	$11,146	Yes
5/31/16	31	245,209	$23,192	Yes
6/30/16	30	429,010	$39,826	Yes
7/31/16	31	601,708	$55,553	Yes
8/31/16	31	601,708	$55,607	Yes
9/30/16	30	459,373	$42,293	Yes
10/31/16	31	210,868	$19,572	Yes
Totals	**365**	**2,951,692**	**$274,727**	12
Annual	**365**	**2,951,692**	**$274,727**	

3.6 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 15 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Blanton Hall	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	483.5	262.6
Site Energy Use Intensity (kBtu/ft^2)	230.8	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 16 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Blanton Hall	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	456.5	262.6
Site Energy Use Intensity (kBtu/ft^2)	222.2	130.7

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

As the electric and gas accounts were shared between various buildings, it was not possible to benchmark these buildings and provide a score individually. A campus wide Portfolio Manager Statement of Energy Performance (SEP) was generated.

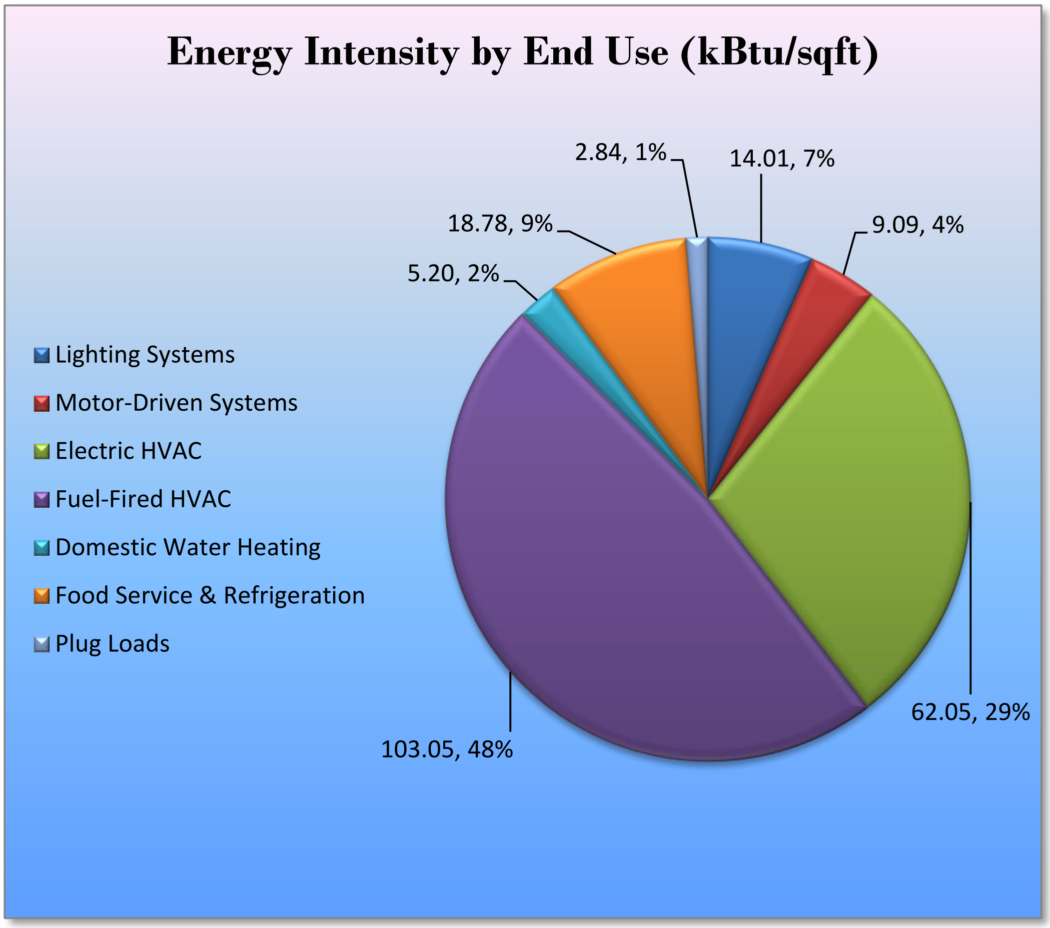
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

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

3.7 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. 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 17 - 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 Blanton 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 18 – 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		**351,469**	**42.0**	**0.0**	**$59,046.86**	**$127,513.15**	**$19,055.00**	**$108,458.15**	**1.8**	**353,927**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	3,302	0.4	0.0	$554.77	$1,960.00	$100.00	$1,860.00	3.4	3,325
ECM 2	Retrofit Fixtures with LED Lamps	344,593	41.3	0.0	$57,891.64	$124,262.49	$18,955.00	$105,307.49	1.8	347,002
ECM 3	Install LED Exit Signs	3,574	0.3	0.0	$600.45	$1,290.66	$0.00	$1,290.66	2.1	3,599
Lighting Control Measures		**10,158**	**1.0**	**0.0**	**$1,706.59**	**$6,520.00**	**$560.00**	**$5,960.00**	**3.5**	**10,229**
ECM 4	Install Occupancy Sensor Lighting Controls	5,294	0.6	0.0	$889.40	$4,320.00	$560.00	$3,760.00	4.2	5,331
ECM 5	Install High/Low Lighitng Controls	4,864	0.4	0.0	$817.19	$2,200.00	$0.00	$2,200.00	2.7	4,898
Variable Frequency Drive (VFD) Measures		**29,400**	**6.9**	**0.0**	**$4,939.28**	**$13,765.30**	**$2,000.00**	**$11,765.30**	**2.4**	**29,606**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	29,400	6.9	0.0	$4,939.28	$13,765.30	$2,000.00	$11,765.30	2.4	29,606
Domestic Water Heating Upgrade		**0**	**0.0**	**18.3**	**$278.88**	**$250.30**	**$0.00**	**$250.30**	**0.9**	**2,674**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	18.3	$278.88	$250.30	$0.00	$250.30	0.9	2,674
Plug Load Equipment Control - Vending Machine		**6,447**	**0.0**	**0.0**	**$1,083.16**	**$920.00**	**$0.00**	**$920.00**	**0.8**	**6,492**
ECM 8	Vending Machine Control	6,447	0.0	0.0	$1,083.16	$920.00	$0.00	$920.00	0.8	6,492
TOTALS		**397,475**	**49.9**	**18.3**	**$67,054.76**	**$148,968.75**	**$21,615.00**	**$127,353.75**	**1.9**	**402,929**

* - 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).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 19 below.

Figure 19 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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		**351,469**	**0**	**42.0**	**0.0**	**$59,046.86**	**$127,513.15**	**$19,055.00**	**$108,458.15**	**1.8**	**353,927**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	3,302	0	0.4	0.0	$554.77	$1,960.00	$100.00	$1,860.00	3.4	3,325
ECM 2	Retrofit Fixtures with LED Lamps	344,593	0	41.3	0.0	$57,891.64	$124,262.49	$18,955.00	$105,307.49	1.8	347,002
ECM 3	Install LED Exit Signs	3,574	0	0.3	0.0	$600.45	$1,290.66	$0.00	$1,290.66	2.1	3,599

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)	Chilled Water Savings (Ton-Hr)	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	3,302	0	0.4	0.0	$554.77	$1,960.00	$100.00	$1,860.00	3.4	3,325
Exterior	0	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 T12 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 a fluorescent tubes.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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	339,041	0	40.5	0.0	$56,958.95	$121,573.09	$18,895.00	$102,678.09	1.8	341,412
Exterior	5,552	0	0.8	0.0	$932.69	$2,689.40	$60.00	$2,629.40	2.8	5,591

Measure Description

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

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 3: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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	3,574	0	0.3	0.0	$600.45	$1,290.66	$0.00	$1,290.66	2.1	3,599
Exterior	0	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

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

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized Figure 20 below.

Figure 20 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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		**10,158**	**0**	**1.0**	**0.0**	**$1,706.59**	**$6,520.00**	**$560.00**	**$5,960.00**	**3.5**	**10,229**
ECM 4	Install Occupancy Sensor Lighting Controls	5,294	0	0.6	0.0	$889.40	$4,320.00	$560.00	$3,760.00	4.2	5,331
ECM 5	Install High/Low Lighitng Controls	4,864	0	0.4	0.0	$817.19	$2,200.00	$0.00	$2,200.00	2.7	4,898

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

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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)
5,294	0	0.6	0.0	$889.40	$4,320.00	$560.00	$3,760.00	4.2	5,331

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in the basement and office 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.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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)
4,864	0	0.4	0.0	$817.19	$2,200.00	$0.00	$2,200.00	2.7	4,898

Measure Description

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

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

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

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

4.1.3 Variable Frequency Drive Measures

Our recommendations for variable frequency drive (VFD) measures are summarized in Figure 21 below.

Figure 21 – Summary of Variable Frequency Drive ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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		**29,400**	**0**	**6.9**	**0.0**	**$4,939.28**	**$13,765.30**	**$2,000.00**	**$11,765.30**	**2.4**	**29,606**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	29,400	0	6.9	0.0	$4,939.28	$13,765.30	$2,000.00	$11,765.30	2.4	29,606

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

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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)
29,400	0	6.9	0.0	$4,939.28	$13,765.30	$2,000.00	$11,765.30	2.4	29,606

Measure Description

We recommend installing variable frequency drives (VFDs) to control supply fan motor speeds to convert a constant-volume, single-zone air handling system into a variable-air-volume (VAV) system. A separate VFD is usually required to control the return fan motor or dedicated exhaust fan motor, if the air handler has one. Zone thermostats will cause the VFD to modulate fan speed to maintain the appropriate temperature in the zone, while maintaining a constant supply air temperature. Energy savings results from reducing fan speed (and power) when there is a reduced load required for the zone. The magnitude of energy savings is based on the estimated amount of time that fan motors operate at partial load.

VAV systems should not be controlled such that the supply air temperature is raised at the expense of the fan power. A common mistake is to reset the supply air temperature to achieve chiller energy savings, which can lead to additional air flow requirements. Supply air temperature should be kept low, e.g. 55°F, until the minimum fan speed (typically about 50%) is met. At this point, it is efficient to raise the supply air temperature as the load decreases, but not such that additional air flow and thus fan energy is required.

4.1.4 Domestic Hot Water Heating System Upgrades

Our recommendations for domestic water heating system improvements are summarized in Figure 22 below.

Figure 22 - Summary of Domestic Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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		**0**	**0**	**0.0**	**18.3**	**$278.88**	**$250.30**	**$0.00**	**$250.30**	**0.9**	**2,674**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0	0.0	18.3	$278.88	$250.30	$0.00	$250.30	0.9	2,674

ECM 7: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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)
0	0	0.0	18.3	$278.88	$250.30	$0.00	$250.30	0.9	2,674

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.

4.1.5 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment controls are summarized in Figure 23 below.

Figure 23 - Summary of Plug Load Equipment Controls 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		6,447	0.0	0.0	$1,083.16	$920.00	$0.00	$920.00	0.8	6,492
ECM 8	Vending Machine Control	6,447	0.0	0.0	$1,083.16	$920.00	$0.00	$920.00	0.8	6,492

ECM 8: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	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)
6,447	0	0.0	0.0	$1,083.16	$920.00	$0.00	$920.00	0.8	6,492

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.

Clean and/or Replace HVAC Filters

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

Check for and Seal Duct Leakage

Duct leakage in commercial buildings typically accounts for 5% to 25% 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.

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 4.1.4 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 24 for a list of the eligible programs identified for each recommended ECM.

Figure 24 - 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 LED Exit Signs				X		
ECM 4	Install Occupancy Sensor Lighting Controls	X			X		
ECM 5	Install High/Low Lighitng Controls				X		
ECM 6	Install VFDs on Constant Volume (CV) HVAC	X			X		
ECM 7	Install Low-Flow Domestic Hot Water Devices				X		
ECM 8	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.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

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

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

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

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

9.2 Retail Natural Gas Supply Options

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

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

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

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

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Dorm room - single	32	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	5,242	Relamp	No	32	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	5,242	0.36	2,935	0.0	$493.13	$1,148.80	$160.00	2.01
Dorm room - single	64	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	64	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	1.55	12,731	0.0	$2,138.77	$3,744.00	$640.00	1.45
Dorm room - double	1,284	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	1,284	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	31.19	255,412	0.0	$42,909.15	$75,114.00	$12,840.00	1.45
Dorm room - double	642	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	5,242	Relamp	No	642	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	6.38	52,243	0.0	$8,776.87	$20,479.80	$3,210.00	1.97
Entrance lounge	30	Compact Fluorescent: 4-pin 2L	Wall Switch	26	5,242	Relamp	No	30	LED Screw-In Lamps: Plug-in LED (9W) 2L	Wall Switch	9	5,242	0.37	3,056	0.0	$513.43	$2,637.18	$0.00	5.14
Hallways	55	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	8,736	Relamp	Yes	55	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	6,115	1.69	23,041	0.0	$3,870.96	$4,817.50	$550.00	1.10
Hallways	18	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	8,736	Relamp	Yes	18	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	6,115	0.29	3,951	0.0	$663.81	$1,246.20	$90.00	1.74
Laundry rooms	40	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	5,242	Relamp	Yes	40	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,669	0.64	5,268	0.0	$885.08	$2,246.00	$305.00	2.19
Locker room	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	5,242	None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Basement	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,669	0.12	1,005	0.0	$168.91	$504.00	$75.00	2.54
Basement	7	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	5,242	Relamp	Yes	7	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,669	0.11	922	0.0	$154.89	$521.30	$70.00	2.91
Basement	20	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	5,242	Relamp & Reballast	Yes	20	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,669	0.53	4,322	0.0	$726.09	$2,500.00	$170.00	3.21
Electrical room	7	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	5,242	Relamp	No	7	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	5,242	0.09	738	0.0	$124.05	$251.30	$35.00	1.74
Squibb	13	Compact Fluorescent: 4-pin 2L	Wall Switch	26	5,242	Relamp	Yes	13	LED Screw-In Lamps: Plug-in LED (9W) 2L	Occupancy Sensor	9	3,669	0.19	1,538	0.0	$258.43	$1,682.78	$70.00	6.24
Squibb	7	Compact Fluorescent: 4-pin 2L	Wall Switch	42	5,242	Relamp	Yes	7	LED Screw-In Lamps: Plug-in LED (15W) 2L	Occupancy Sensor	15	3,669	0.16	1,338	0.0	$224.78	$885.34	$35.00	3.78
Squibb	20	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,242	Relamp	Yes	20	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	3,669	0.92	7,541	0.0	$1,266.86	$2,314.00	$405.00	1.51
Squibb	36	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	Yes	36	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	3,669	1.03	8,441	0.0	$1,418.15	$3,085.20	$105.00	2.10
1001	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,669	None	No	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,669	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
1002	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,669	None	No	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,669	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Health care center	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	5,242	Relamp	No	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	5,242	0.05	422	0.0	$70.89	$143.60	$20.00	1.74
Health care center	2	LED - Fixtures: Downlight Recessed	Wall Switch	8	5,242	None	No	2	LED - Fixtures: Downlight Recessed	Wall Switch	8	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Health care center	24	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	24	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	5,242	0.51	4,195	0.0	$704.82	$1,516.80	$0.00	2.15
Exterior	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Daylight Dimming	62	4,368	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Daylight Dimming	29	4,368	0.15	995	0.0	$167.09	$351.00	$60.00	1.74
Exterior	37	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Daylight Dimming	62	4,368	Relamp	No	37	LED - Linear Tubes: (2) U-Lamp	Daylight Dimming	33	4,368	0.79	5,390	0.0	$905.50	$2,338.40	$0.00	2.58
Whole building	50	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	50	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

	Existing Conditions					Proposed Conditions						Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Hallways	12	Exit Signs: Incandescent	None	40	8,760	Fixture Replacement	No	12	LED Exit Signs: 2 W Lamp	None	6	8,760	0.30	4,110	0.0	$690.51	$1,290.66	$0.00	1.87
Which Wich	28	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	None	No	28	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Which Wich	4	LED - Fixtures: Downlight Recessed	Wall Switch	8	5,242	None	No	4	LED - Fixtures: Downlight Recessed	Wall Switch	8	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Which Wich	9	Linear Fluorescent - T8: 2' T8 (17W) - 3L	Wall Switch	53	5,242	Relamp	No	9	LED - Linear Tubes: (3) 2' Lamps	Wall Switch	26	5,242	0.18	1,492	0.0	$250.64	$555.30	$135.00	1.68
Which Wich	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,242	Relamp	No	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	5,242	0.29	2,387	0.0	$401.02	$601.60	$120.00	1.20
Dunkin Dounuts	12	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	None	No	12	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Dunkin Dounuts	7	LED - Fixtures: Downlight Recessed	Wall Switch	8	5,242	None	No	7	LED - Fixtures: Downlight Recessed	Wall Switch	8	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Dunkin Dounuts	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,242	Relamp	No	10	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	5,242	0.36	2,984	0.0	$501.28	$752.00	$150.00	1.20
Chilis	2	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	None	No	2	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	17	LED - Fixtures: Downlight Recessed	Wall Switch	8	5,242	None	No	17	LED - Fixtures: Downlight Recessed	Wall Switch	8	5,242	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	2	Linear Fluorescent - T8: 2' T8 (17W) - 3L	Wall Switch	53	5,242	Relamp	No	2	LED - Linear Tubes: (3) 2' Lamps	Wall Switch	26	5,242	0.04	332	0.0	$55.70	$123.40	$30.00	1.68
Chilis	20	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,242	Relamp	No	20	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	5,242	0.73	5,968	0.0	$1,002.55	$1,504.00	$300.00	1.20
Chilis	15	Compact Fluorescent: 4-pin 2L	Wall Switch	26	5,242	Relamp	No	15	LED Screw-In Lamps: Plug-in LED (9W) 2L	Wall Switch	9	5,242	0.19	1,528	0.0	$256.71	$1,318.59	$0.00	5.14
Men's restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.05	398	0.0	$66.84	$117.00	$20.00	1.45
Men's restroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	5,242	0.02	175	0.0	$29.37	$63.20	$0.00	2.15
Women's restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	5,242	0.05	398	0.0	$66.84	$117.00	$20.00	1.45
Women's restroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	5,242	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	5,242	0.02	175	0.0	$29.37	$63.20	$0.00	2.15

Motor Inventory & Recommendations

		Existing Conditions							Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Basement	Pneumatic controls	2	Air Compressor	3.0	86.5%	No	4,957	No	86.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Basement	DHW heater	3	Water Supply Pump	0.8	85.5%	No	6,000	No	85.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Basement	AHUs	2	Chilled Water Pump	25.0	93.6%	Yes	4,067	No	93.6%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Exhaust	1	Exhaust Fan	5.0	89.5%	No	2,745	No	89.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Basement	Boiler	4	Other	1.0	77.0%	No	2,745	No	77.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Basement	Heating coils	2	Heating Hot Water Pump	7.5	88.5%	Yes	3,391	No	88.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	AHU 1 & 2	1	Supply Fan	3.0	89.5%	Yes	4,000	No	89.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Elevator	Elevator	2	Other	20.0	93.0%	Yes	3,391	No	93.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	AHU 7 & 8	2	Supply Fan	7.5	91.0%	Yes	4,000	No	91.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	AHU 5 & 6	2	Supply Fan	5.0	89.5%	No	4,000	No	89.5%	Yes	2	2.80	11,878	0.0	$1,995.45	$6,551.70	$800.00	2.88
Mechanical room	AHU 1 & 2	2	Supply Fan	7.5	91.0%	Yes	4,000	No	91.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	AHU 3	1	Supply Fan	7.5	91.0%	No	4,000	No	91.0%	Yes	1	2.07	8,761	0.0	$1,471.92	$3,606.80	$600.00	2.04
Mechanical room	AHU 4	1	Supply Fan	7.5	91.0%	No	4,000	No	91.0%	Yes	1	2.07	8,761	0.0	$1,471.92	$3,606.80	$600.00	2.04

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
Elevator room	Elevator room	1	Split-System AC	5.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	AHU-8	1	Electric Resistance Heat		126.28	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric Chiller Inventory & Recommendations

		Existing Conditions			Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Chiller Quantity	System Type	Cooling Capacity per Unit (Tons)	Install High Efficiency Chillers?	Chiller Quantity	System Type	Constant/ Variable Speed	Cooling Capacity (Tons)	Full Load Efficiency (kW/Ton)	IPLV Efficiency (kW/Ton)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Central plant	Whole building	1	Water-Cooled Centrifugal Chiller	600.00	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
Mechanical room	Whole building	1	Forced Draft Steam Boiler	12,500.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical room	Whole building	1	Indirect System	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Electrical room	Health care office backup	2	Storage Tank Water Heater (≤ 50 Gal)	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
Double	1	Showerhead	2.50	2.00	0.00	0	0.9	$14.46	$89.30	$0.00	6.17
Double	1	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	2.0	$31.24	$7.17	$0.00	0.23
Single	1	Showerhead	2.50	2.00	0.00	0	0.9	$14.46	$89.30	$0.00	6.17
Single	1	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	2.0	$31.24	$7.17	$0.00	0.23
Squibb	2	Faucet Aerator (Kitchen)	2.20	2.20	0.00	0	0.0	$0.00	$14.34	$0.00	0.00
Men's restroom	3	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	6.1	$93.73	$21.51	$0.00	0.23
Women's restroom	3	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	6.1	$93.73	$21.51	$0.00	0.23

Walk-In Cooler/Freezer Inventory & Recommendations

	Existing Conditions		Proposed Conditions			Energy Impact & Financial Analysis						
Location	Cooler/ Freezer Quantity	Case Type/Temperature	Install EC Evaporator Fan Motors?	Install Electric Defrost Control?	Install Evaporator Fan Control?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Which Wich	2	Cooler (35F to 55F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Which Wich	1	Medium Temp Freezer (0F to 30F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chili's	2	Cooler (35F to 55F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chili's	2	Medium Temp Freezer (0F to 30F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Dunkin Donuts	1	Gas Steamer	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Dunkin Donuts	2	Electric Combination Oven/Steam Cooker (<15 Pans)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	1	Electric Fryer	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	1	Gas Convection Oven (Full Size)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	1	Gas Griddle (3 Feet Width)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	2	Electric Combination Oven/Steam Cooker (<15 Pans)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	2	Electric Convection Oven (Full Size)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	1	Electric Steamer	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	2	Electric Convection Oven (Full Size)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chilis	1	Insulated Food Holding Cabinet (1/2 Size)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Dorms	1	Toaster	1,200.0	No
Dorms	1	Projector	200.0	No
Dorms	5	Microwave	1,000.0	Yes
Dorms	1	Refrigerator	50.0	Yes
Dorms	1	Refrigerator/Freezer	600.0	Yes
Laundry room	16	Washer	900.0	Yes
Laundry room	16	Dryer	1,600.0	Yes
Dorms	10	LCD (50')	150.0	Yes
Dorms	1	LED (50')	100.0	Yes
Which Wich	3	Refrigerator	50.0	Yes
Which Wich	2	Soda machine	40.0	Yes
Which Wich	1	Freezer	200.0	Yes
Which Wich	1	Dishwasher	1,500.0	Yes
Dunkin Donuts	3	Toaster	1,200.0	No
Dunkin Donuts	2	Refrigerator	50.0	Yes
Dunkin Donuts	4	Coffee machine	900.0	No
Dunkin Donuts	4	Refrigerator	750.0	Yes
Dunkin Donuts	1	Refrigerator	50.0	Yes
Dunkin Donuts	2	Soda machine	40.0	Yes
Dunkin Donuts	1	Ice maker	100.0	Yes
Chilis	4	Refrigerator	50.0	Yes
Chilis	1	Refrigerator	600.0	Yes
Chilis	1	Freezer	750.0	Yes
Chilis	1	Ice maker	100.0	Yes
Student devices	1	misc	47,700.0	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
Hallway	2	Refrigerated	Yes	0.00	3,224	0.0	$541.58	$460.00	$0.00	0.85
Hallway	2	Refrigerated	Yes	0.00	3,224	0.0	$541.58	$460.00	$0.00	0.85

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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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)