Local Government Energy Audit:
Energy Audit Report

Chapin Hall

1 Normal Ave.

Montclair, NJ 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 Chapin 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

Chapin Hall is a five story, 56,492 square foot facility comprised of classrooms, academic offices, rehearsal rooms, hallways, a recital hall, and various service spaces. Chapin Hall houses many of the Music Department's activities. Lighting at Chapin Hall consists primarily of fluorescent sources using 32-Watt linear T8 and 25-Watt T5 lamps, mainly in two-lamp configurations. Service spaces are illuminated by compact fluorescent lighting although some incandescent fixtures were noted. Exit signage is provided by LED sources.

The building has five air handling units (AHUs) for ventilation and distribution of conditioned air. Cooling is provided by chilled water (CHW) generated by a constant speed water cooled screw chiller located in mechanical room. Chilled water is distributed by pumps to air handling units and to terminal fan coil units. Steam is provided from the District Energy Plant to the facility'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 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 seven measures including six high priority measures which together represent an opportunity for Chapin Hall to reduce annual energy costs by $20,060 and annual greenhouse gas emissions by 120,897 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in 3.8 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 Chapin Hall's annual energy use by 5%.

Figure 1 – Previous 12 Month Utility Costs

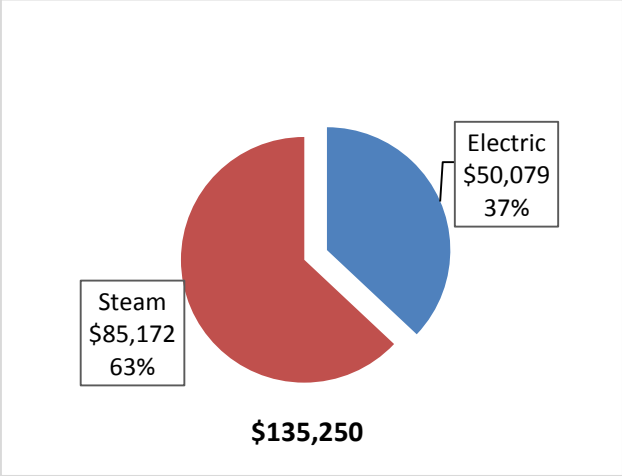
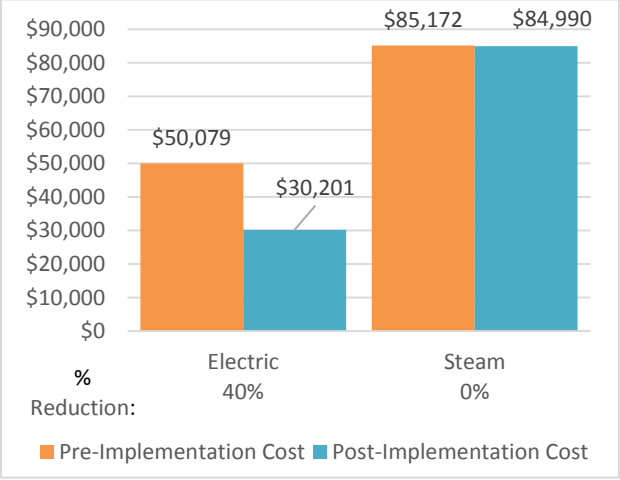


Figure 2 – Potential Post-Implementation Costs



A detailed description of Chapin 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)	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			**77,022**	**0**	**0**	**14.6**	**0.0**	**$12,939.74**	**$46,617.12**	**$5,045.00**	**$41,572.12**	**3.2**	**77,561**
ECM 1	Install LED Fixtures	Yes	19,001			5.6	0.0	$3,192.13	$16,356.79	$340.00	$16,016.79	5.0	19,134
ECM 2	Retrofit Fixtures with LED Lamps	Yes	58,021			9.0	0.0	$9,747.60	$30,260.33	$4,705.00	$25,555.33	2.6	58,427
Lighting Control Measures			**8,397**	**0**	**0**	**1.2**	**0.0**	**$1,410.70**	**$8,250.00**	**$525.00**	**$7,725.00**	**5.5**	**8,456**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	4,788			0.7	0.0	$804.42	$4,050.00	$525.00	$3,525.00	4.4	4,822
ECM 4	Install High/Low Lighitng Controls	Yes	3,609			0.5	0.0	$606.29	$4,200.00	$0.00	$4,200.00	6.9	3,634
Motor Upgrades			**4,581**	**0**	**0**	**1.0**	**0.0**	**$769.54**	**$18,679.02**	**$0.00**	**$18,679.02**	**24.3**	**4,613**
	Premium Efficiency Motors	No	4,581			1.0	0.0	$769.54	$18,679.02	$0.00	$18,679.02	24.3	4,613
Variable Frequency Drive (VFD) Measures			**32,902**	**0**	**0**	**9.5**	**0.0**	**$5,527.61**	**$31,180.90**	**$4,440.00**	**$26,740.90**	**4.8**	**33,132**
ECM 5	Install VFDs on Constant Volume (CV) HVAC	Yes	32,902			9.5	0.0	$5,527.61	$31,180.90	$4,440.00	$26,740.90	4.8	33,132
Domestic Water Heating Upgrade			**0**	**0**	**0**	**0.0**	**11.9**	**$182.25**	**$50.19**	**$0.00**	**$50.19**	**0.3**	**1,748**
ECM 6	Install Low-Flow Domestic Hot Water Devices	Yes	0			0.0	11.9	$182.25	$50.19	$0.00	$50.19	0.3	1,748
TOTALS FOR HIGH PRIORITY MEASURES			**118,322**	**0**	**0**	**25.3**	**11.9**	**$20,060.30**	**$86,098.21**	**$10,010.00**	**$76,088.21**	**3.8**	**120,897**
TOTALS FOR ALL EVALUATED MEASURES			**122,902**	**0**	**0**	**26.3**	**11.9**	**$20,829.84**	**$104,777.23**	**$10,010.00**	**$94,767.23**	**4.5**	**125,509**

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

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

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

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

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

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

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.

Energy Efficient Practices

TRC also identified 10 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 Chapin Hall include:

- Close Doors and Windows
- Use Window Treatments/Coverings
- Perform Proper Lighting Maintenance
- Ensure Lighting Controls Are Operating Properly
- Perform Routine Motor Maintenance
- Practice Proper Use of Thermostat Schedules and Temperature Resets
- Assess Chillers & Request Tune-Ups
- Perform Maintenance on Compressed Air Systems
- Replace Computer Monitors
- Water Conservation

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

On-Site Generation Measures

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 details on the 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.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

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

2.2 General Site Information

On April 25, 2017, TRC performed an energy audit at Chapin 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.

Chapin Hall is a 5 story, 56,492 square foot facility comprised of classrooms, academic offices, rehearsal rooms, hallways, a recital hall, and various service spaces. Chapin Hall houses many of the Music Department's activities.

The building was constructed in 1927, however, a major refurbishment was undertaken in 2007, including a 20,000 square foot addition. Most of the mechanical equipment and light fixture inventory was updated in the comprehensive renovation and addition.

2.3 Building Occupancy

The school building is typically used every day from approximately 8:00 AM to 8:00 PM all year round. Actual space use is variable; practice, rehearsal, and recital activities may occur outside of the typical scheduled operations. The University estimates typical building occupancy of the building at 70 staff and students combined.

Figure 5 - Building Schedule

Building Occupancy Schedule		
Building Name	**Weekday/Weekend**	**Operating Schedule**
Chapin Hall	Weekday	8:00 AM - 8:00 PM
Chapin Hall	Weekend	8:00 AM - 8:00 PM

2.4 Building Envelope

According to the original drawings, Chapin Hall was originally designed as a 28,000 square foot residence hall. The structural system consists of concrete encased steel columns and girders, concrete floor slabs and timber roof framing. The addition is erected on a slab and pier foundation.

The building envelope has been updated with double pane windows and doors permitting minimal infiltration. The building exterior is finished stucco with tile deck roofing.

Image 1: Building Envelope

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.

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

2.6 Energy-Using Systems

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

Lighting System

Lighting at Chapin Hall consists primarily of fluorescent sources using 32-Watt linear T8 and 25-Watt T5 lamps, mainly in two-lamp configurations. Service spaces, including some hallways, are illuminated by recessed compact fluorescent lighting fixtures. Incandescent lamps were noted in the stairwell. House and stage lighting in the Recital Hall appears to be halogen incandescent, controlled by a dimming system. Exit signage is provided by LED sources.

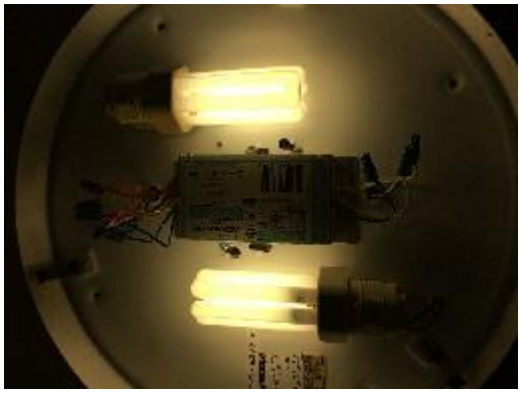



Image 2: Lighting Systems

Chilled Water System

The facility is served by a chilled water plant. The chiller plant consists of one Carrier 146 ton water cooled screw chiller that is approximately nine years old. The chiller is configured in a primary- secondary distribution loop with two constant flow primary pumps and variable flow secondary pumps. One of the two primary pumps serves solely as a backup. A condenser water pump circulates water to the roof mounted cooling tower, which is equipped with a variable speed fan.

The chiller plant supplies chilled water to five air handler units. Chilled water is also distributed to individual fan coil units located in the various zones.

Image 3: Chilled Water System

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 to AHUs and fan coil units by two 5 hp variable speed pumps.

Image 4: Hot Water System

Air Distribution System

There are five air handling units that distribute air to the facility. AHUs 1 -4 are equipped with constant speed supply and return fans and serve major building areas including the Recital Hall (AHU-1), the multipurpose area (AHU-2), and two rehearsal areas (AHU-3 and AHU-4). AHU-5 provides ventilation air to the fan coil units and is equipped with a constant speed supply fan and a relief/exhaust fan. Restroom ventilation is provided by roof mounted exhaust fans.

Image 5: Air Distribution System

Building Energy Management System (BEMS)

Facility equipment is controlled by a Johnson Controls Metasys BEMS. The system provides for control and monitoring of the steam to hot water system, chilled water system, air handling units, and fan coils.

Building Plug Load

There are 30 computer work stations throughout the facility and assorted office equipment including printers and copiers. The facility has several small refrigerators and microwaves located in break rooms.

The facility has a large number of refrigerated beverage vending machines (estimated to be 12 machines in total).

2.7 Water-Using Systems

Seven lavatory sinks were noted at the facility. A sampling of restrooms found the aerators to be rated at approximately 2.0 gallons per minute (gpm).

3 SITE ENERGY USE AND COSTS

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

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

3.1 Total Cost of Energy

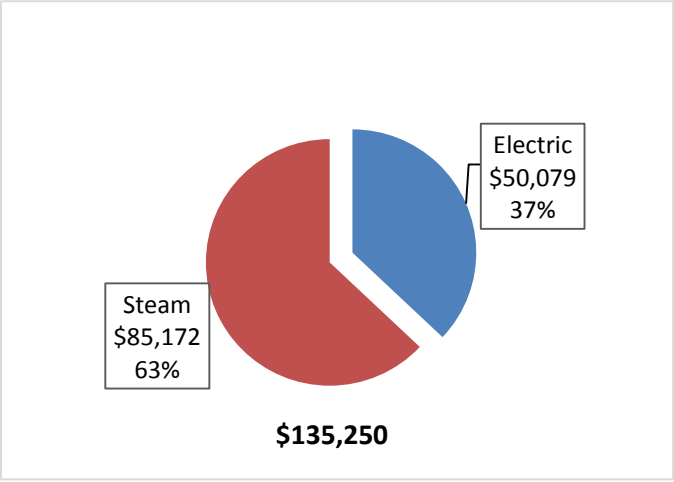
The following energy consumption and cost data is based on data that was provided by the campus for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 6 - Utility Summary

Utility Summary for Chapin Hall		
Fuel	**Usage**	**Cost**
Electricity	731,780 kWh	$50,079
Steam	4,673 kLbs	$85,172
Total		**$135,250**

The current annual energy cost for this facility is $135,250 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

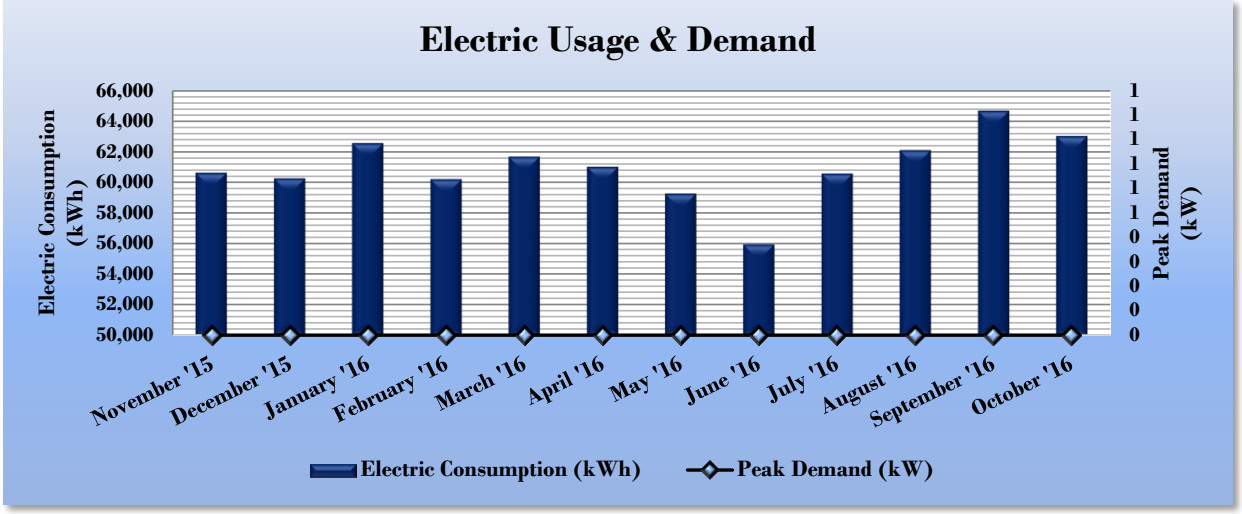


Figure 9 - Electric Usage & Demand

Electric Billing Data for Chapin Hall				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
11/30/15	30	60,622	$ 3,574	Yes
12/31/15	31	60,246	$ 4,526	Yes
1/31/16	31	62,551	$ 3,725	Yes
2/28/16	28	60,184	$ 8,644	Yes
3/31/16	31	61,662	$ 3,463	Yes
4/30/16	30	61,007	$ 3,455	Yes
5/31/16	31	59,245	$ 3,382	Yes
6/30/16	30	55,942	$ 3,640	Yes
7/31/16	31	60,553	$ 3,849	Yes
8/31/16	31	62,094	$ 4,084	Yes
9/30/16	30	64,660	$ 3,984	Yes
10/31/16	31	63,015	$ 3,751	Yes
Totals	**365**	**731,780**	**$50,079**	12
Annual	**365**	**731,780**	**$50,079**	

3.3 Steam Usage

Steam is provided by the campus cogeneration plant. The average steam cost for the past 12 months is $18.226/kLb, which is the blended rate used throughout the analyses in this report. The steam consumption is shown in the graph and table below.

Figure 10 - Steam Usage

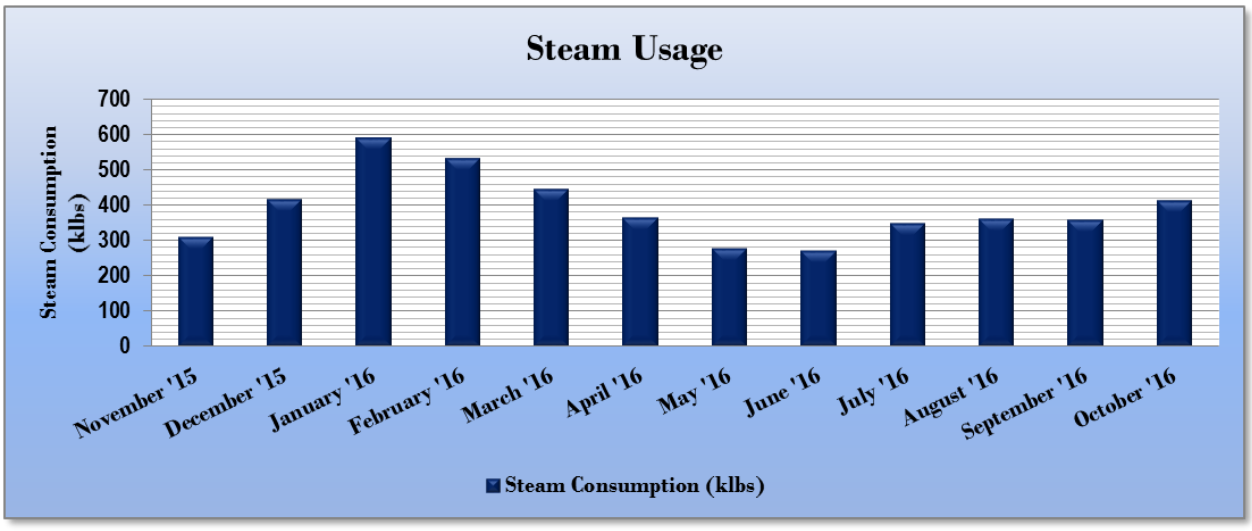


Figure 11 - Steam Usage

Steam Billing Data for Chapin Hall				
Period Ending	Days in Period	Steam Usage (kLbs)	Fuel Cost	TRC Estimated Usage?
11/30/15	30	309	$ 4,711	Yes
12/31/15	31	414	$ 6,367	Yes
1/31/16	31	589	$ 9,196	Yes
2/28/16	28	531	$ 22,029	Yes
3/31/16	31	444	$ 6,745	Yes
4/30/16	30	363	$ 5,459	Yes
5/31/16	31	276	$ 4,305	Yes
6/30/16	30	269	$ 4,086	Yes
7/31/16	31	347	$ 5,220	Yes
8/31/16	31	362	$ 5,455	Yes
9/30/16	30	356	$ 5,337	Yes
10/31/16	31	413	$ 6,262	Yes
Totals	**365**	**4,673**	**$85,172**	12
Annual	**365**	**4,673**	**$85,172**	

3.4 Benchmarking

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

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

Figure 12 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Chapin Hall	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	257.3	262.6
Site Energy Use Intensity (kBtu/ft^2)	143.0	130.7

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

Figure 13 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Chapin Hall	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	234.6	262.6
Site Energy Use Intensity (kBtu/ft^2)	135.6	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 accounts were shared between various buildings, it was not possible to benchmark these buildings and provide a score individually. A campus wide Portfolio Manager Statement of Energy Performance (SEP) was generated.

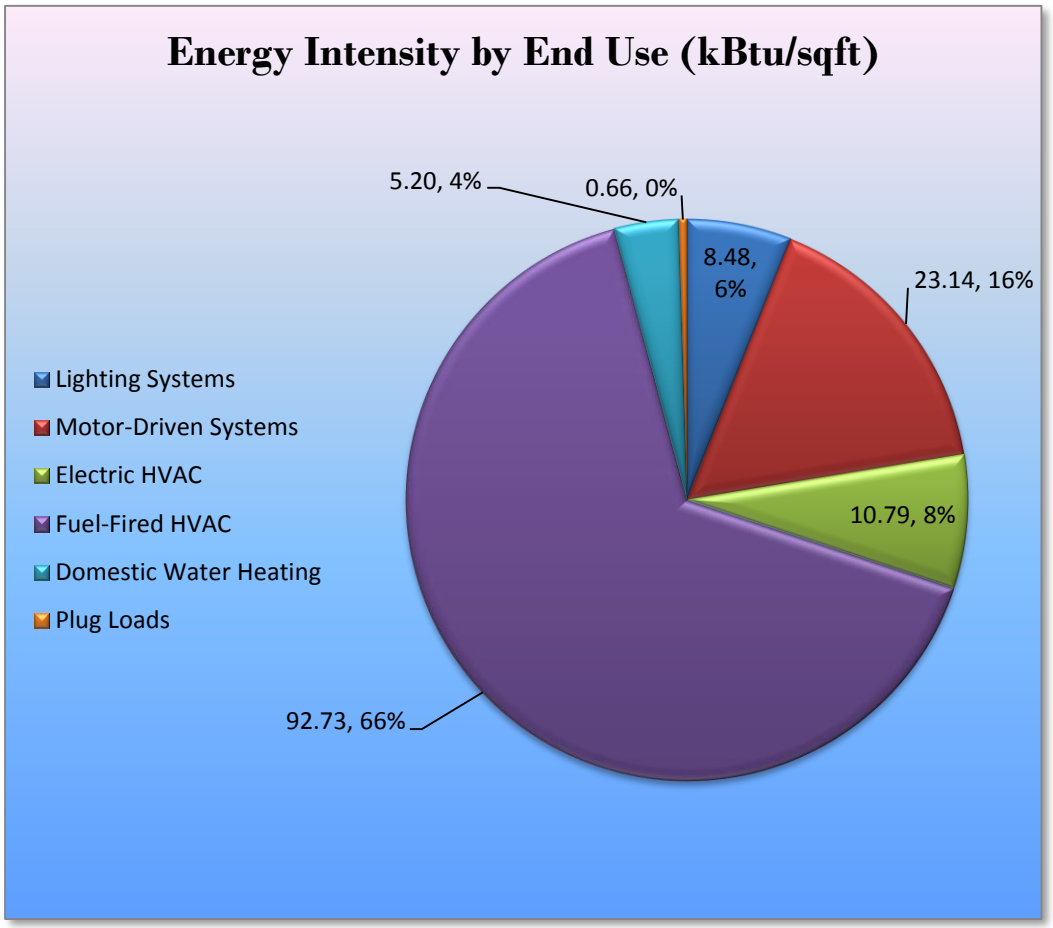
For more information on ENERGY STAR® certification go to:
https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

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

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed 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 14 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

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

The following sections describe the evaluated measures.

4.1 High Priority ECMs

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

Figure 15 – Summary of High Priority ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**77,022**	**14.6**	**0.0**	**$12,939.74**	**$46,617.12**	**$5,045.00**	**$41,572.12**	**3.2**	**77,561**
ECM 1	Install LED Fixtures	19,001	5.6	0.0	$3,192.13	$16,356.79	$340.00	$16,016.79	5.0	19,134
ECM 2	Retrofit Fixtures with LED Lamps	58,021	9.0	0.0	$9,747.60	$30,260.33	$4,705.00	$25,555.33	2.6	58,427
Lighting Control Measures		**8,397**	**1.2**	**0.0**	**$1,410.70**	**$8,250.00**	**$525.00**	**$7,725.00**	**5.5**	**8,456**
ECM 3	Install Occupancy Sensor Lighting Controls	4,788	0.7	0.0	$804.42	$4,050.00	$525.00	$3,525.00	4.4	4,822
ECM 4	Install High/Low Lighitng Controls	3,609	0.5	0.0	$606.29	$4,200.00	$0.00	$4,200.00	6.9	3,634
Variable Frequency Drive (VFD) Measures		**32,902**	**9.5**	**0.0**	**$5,527.61**	**$31,180.90**	**$4,440.00**	**$26,740.90**	**4.8**	**33,132**
ECM 5	Install VFDs on Constant Volume (CV) HVAC	32,902	9.5	0.0	$5,527.61	$31,180.90	$4,440.00	$26,740.90	4.8	33,132
Domestic Water Heating Upgrade		**0**	**0.0**	**11.9**	**$182.25**	**$50.19**	**$0.00**	**$50.19**	**0.3**	**1,748**
ECM 6	Install Low-Flow Domestic Hot Water Devices	0	0.0	11.9	$182.25	$50.19	$0.00	$50.19	0.3	1,748
TOTALS		**118,322**	**25.3**	**11.9**	**$20,060.30**	**$86,098.21**	**$10,010.00**	**$76,088.21**	**3.8**	**120,897**

* - 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 16 below.

Figure 16 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**77,022**	**14.6**	**0.0**	**$12,939.74**	**$46,617.12**	**$5,045.00**	**$41,572.12**	**3.2**	**77,561**
ECM 1	Install LED Fixtures	19,001	5.6	0.0	$3,192.13	$16,356.79	$340.00	$16,016.79	5.0	19,134
ECM 2	Retrofit Fixtures with LED Lamps	58,021	9.0	0.0	$9,747.60	$30,260.33	$4,705.00	$25,555.33	2.6	58,427

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

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	19,001	5.6	0.0	$3,192.13	$16,356.79	$340.00	$16,016.79	5.0	19,134
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend replacing existing fixtures containing halogen incandescent lamps with new high performance LED light fixtures in the Recital Hall. Compatibility with the existing dimming system should be verified prior to implementation. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than 10 times longer than many incandescent lamps.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	58,021	9.0	0.0	$9,747.60	$30,260.33	$4,705.00	$25,555.33	2.6	58,427
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

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

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

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 18 below.

Figure 17 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**8,397**	**1.2**	**0.0**	**$1,410.70**	**$8,250.00**	**$525.00**	**$7,725.00**	**5.5**	**8,456**
ECM 3	Install Occupancy Sensor Lighting Controls	4,788	0.7	0.0	$804.42	$4,050.00	$525.00	$3,525.00	4.4	4,822
ECM 4	Install High/Low Lighitng Controls	3,609	0.5	0.0	$606.29	$4,200.00	$0.00	$4,200.00	6.9	3,634

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

ECM 3: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
4,788	0.7	0.0	$804.42	$4,050.00	$525.00	$3,525.00	4.4	4,822

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in many storage rooms, classrooms, and offices. 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 4: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
3,609	0.5	0.0	$606.29	$4,200.00	$0.00	$4,200.00	6.9	3,634

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 stairwells, interior corridors, parking lots, and parking garages. The candidate areas at this facility are the 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 18 below.

Figure 18 – Summary of Variable Frequency Drive ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**32,902**	**9.5**	**0.0**	**$5,527.61**	**$31,180.90**	**$4,440.00**	**$26,740.90**	**4.8**	**33,132**
ECM 5	Install VFDs on Constant Volume (CV) HVAC	32,902	9.5	0.0	$5,527.61	$31,180.90	$4,440.00	$26,740.90	4.8	33,132

ECM 5: Install VFDs on Constant Volume (CV) HVAC

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
32,902	9.5	0.0	$5,527.61	$31,180.90	$4,440.00	$26,740.90	4.8	33,132

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.

During the design phase for this measure the existing motors should be evaluated to confirm that they are inverter duty rated. If they are not inverter duty rated, they should be replaced when the VFDs are installed.

4.1.4 Domestic Hot Water Heating System Upgrades

Our recommendations for domestic water heating system improvements are summarized in Figure 19 below.

Figure 19 - Summary of Domestic Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**11.9**	**$182.25**	**$50.19**	**$0.00**	**$50.19**	**0.3**	**1,748**
ECM 6	Install Low-Flow Domestic Hot Water Devices	0	0.0	11.9	$182.25	$50.19	$0.00	$50.19	0.3	1,748

ECM 6: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	11.9	$182.25	$50.19	$0.00	$50.19	0.3	1,748

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 can reduce hot water usage, relative to standard showerheads and aerators, which saves energy.

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

4.2 Other Evaluated ECMs

The measures below have been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in each measure description section.

Figure 20 – Summary of Other Evaluated ECMs

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades	**4,072**	**0.9**	**0.0**	**$684.10**	**$18,679.02**	**$0.00**	**$18,679.02**	**27.3**	**4,100**
Premium Efficiency Motors	4,072	0.9	0.0	$684.10	$18,679.02	$0.00	$18,679.02	27.3	4,100
TOTALS	**4,072**	**0.9**	**0.0**	**$684.10**	**$18,679.02**	**$0.00**	**$18,679.02**	**27.3**	**4,100**

* - 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).

Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
4,072	0.9	0.0	$684.10	$18,679.02	$0.00	$18,679.02	27.3	4,100

Measure Description

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

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

However, as noted in the text of ECM 5, motor replacement may be required in conjunction with the implementation of variable speed drive upgrades, specifically recommended for AHUs 1, 2, 3, and 5. Associated motors should be evaluated for whether they are currently inverter rated and replaced if necessary.

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.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Use Window Treatments/Coverings

A substantial amount of heat gain can occur through uncovered or untreated windows, especially older single pane windows and east or west-facing windows. Treatments such as high-reflectivity films or covering windows with shades or shutters can reduce solar heat gain and, consequently, cooling load and can reduce internal heat loss and the associated heating load.

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.

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.

Practice Proper Use of Thermostat Schedules and Temperature Resets

Ensure thermostats are correctly set back. By employing proper set back temperatures and schedules, facility heating and cooling costs can be reduced dramatically during periods of low or no occupancy. As such, thermostats should be programmed for a setback of 5-10°F during low occupancy hours (reduce heating setpoints and increase cooling setpoints). Cooling load can be reduced further by increasing the facility's occupied setpoint temperature. In general, during the cooling season, thermostats should be set as high as possible without sacrificing occupant comfort.

Assess Chillers & Request Tune-Ups

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

Perform Maintenance on Compressed Air Systems

Like all electro-mechanical equipment, compressed air systems require periodic maintenance to operate at peak efficiency. A maintenance plan should be developed for process related compressed air systems to include inspection, cleaning, and replacement of inlet filter cartridges, cleaning of drain traps, daily inspection of lubricant levels to reduce unwanted friction, inspection of belt condition and tension, checking for system leaks and adjustment of loose connections, and overall system cleaning. Contact a qualified technician for help with setting up periodic maintenance schedule.

Replace Computer Monitors

Replacing old computer monitors or displays with efficient monitors will reduce energy use. ENERGY STAR® rated monitors have specific requirements for on mode power consumption as well as idle and sleep mode power. According to the ENERGY STAR® website monitors that have earned the ENERGY STAR® label are 25% more efficient than standard monitors.

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

6.2 Combined Heat and Power

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

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

7 DEMAND RESPONSE

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

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

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

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

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

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

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

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

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 21 for a list of the eligible programs identified for each recommended ECM.

Figure 21 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	Pay For Performance Existing Buildings
ECM 1	Install LED Fixtures	X	X
ECM 2	Retrofit Fixtures with LED Lamps	X	X
ECM 3	Install Occupancy Sensor Lighting Controls	X	X
ECM 4	Install High/Low Lighitng Controls		X
ECM 5	Install VFDs on Constant Volume (CV) HVAC	X	X
ECM 6	Install Low-Flow Domestic Hot Water Devices		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. 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.

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
Mech Rm	13	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	13	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.27	1,874	0.0	$314.81	$760.50	$130.00	2.00
Mech Rm	36	Compact Fluorescent: 2Lx26W	Wall Switch	52	4,368	Relamp	No	36	LED Screw-In Lamps: LED screw in	Wall Switch	36	4,368	0.42	2,893	0.0	$486.09	$3,164.62	$360.00	5.77
Mech Rm	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Loading	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	332	0.0	$55.70	$117.00	$20.00	1.74
Loading	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Hallway	16	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	16	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	3,058	0.26	1,756	0.0	$295.03	$974.40	$80.00	3.03
Hallway	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Electric Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.10	663	0.0	$111.39	$234.00	$40.00	1.74
Telecom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	332	0.0	$55.70	$117.00	$20.00	1.74
Hallway	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	3,058	0.18	1,257	0.0	$211.14	$551.00	$60.00	2.33
Hallway	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Elec Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	332	0.0	$55.70	$117.00	$20.00	1.74
G48	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	311	0.0	$52.32	$117.00	$20.00	1.85
G46	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	311	0.0	$52.32	$117.00	$20.00	1.85
Stairwell	1	Incandescent: 3Lx40W	Wall Switch	120	4,368	Relamp	No	1	LED Screw-In Lamps: LED screw-in 1L	Wall Switch	18	4,368	0.08	512	0.0	$86.08	$131.86	$15.00	1.36
Rm 149	4	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.09	436	0.0	$73.25	$234.00	$40.00	2.65
Rm 148, 146	6	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.14	654	0.0	$109.88	$351.00	$60.00	2.65
WRR	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	332	0.0	$55.70	$117.00	$20.00	1.74
WRR	2	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	No	2	LED Screw-In Lamps: LED screw in	Wall Switch	18	4,368	0.01	80	0.0	$13.50	$87.91	$10.00	5.77
MRR	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	332	0.0	$55.70	$117.00	$20.00	1.74
MRR	3	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.07	467	0.0	$78.48	$175.50	$30.00	1.85
142	2	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	No	2	LED Screw-In Lamps: LED screw in	Wall Switch	18	4,368	0.01	80	0.0	$13.50	$87.91	$10.00	5.77
Hallway	15	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	15	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	3,058	0.24	1,646	0.0	$276.59	$938.50	$75.00	3.12
141	6	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.18	1,197	0.0	$201.02	$621.00	$95.00	2.62
Stair C	3	Incandescent: 3Lx40W	Wall Switch	120	4,368	Relamp	No	3	LED Screw-In Lamps: LED screw-in 1L	Wall Switch	18	4,368	0.23	1,537	0.0	$258.23	$395.58	$45.00	1.36

	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
131	4	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.09	436	0.0	$73.25	$234.00	$40.00	2.65
Comp Lab	10	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.29	1,994	0.0	$335.03	$855.00	$135.00	2.15
129	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.05	218	0.0	$36.63	$117.00	$20.00	2.65
120	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	311	0.0	$52.32	$117.00	$20.00	1.85
Piano Repair	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	311	0.0	$52.32	$117.00	$20.00	1.85
Hallway	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	3,058	0.08	549	0.0	$92.20	$379.50	$25.00	3.85
Hallway	11	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	Yes	11	LED Screw-In Lamps: LED screw in	High/Low Control	18	3,058	0.11	740	0.0	$124.39	$683.48	$55.00	5.05
Hallway	10	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	10	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	3,058	0.16	1,098	0.0	$184.39	$759.00	$50.00	3.85
Hallway	2	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	Yes	2	LED Screw-In Lamps: LED screw in	High/Low Control	18	3,058	0.02	135	0.0	$22.62	$87.91	$10.00	3.44
206	4	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.12	798	0.0	$134.01	$504.00	$75.00	3.20
202	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,058	0.06	439	0.0	$73.76	$413.60	$55.00	4.86
202	8	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.23	1,595	0.0	$268.02	$738.00	$115.00	2.32
202	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
201	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,058	0.06	439	0.0	$73.76	$413.60	$55.00	4.86
201	3	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.09	598	0.0	$100.51	$445.50	$65.00	3.79
Hallway	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	3,058	0.09	628	0.0	$105.57	$375.50	$30.00	3.27
Hallway	5	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	Yes	5	LED Screw-In Lamps: LED screw in	High/Low Control	18	3,058	0.05	337	0.0	$56.54	$219.77	$25.00	3.44
Hallway	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Elev	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.02	166	0.0	$27.85	$58.50	$10.00	1.74
Elev	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Hallway	16	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	16	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	3,058	0.26	1,756	0.0	$295.03	$974.40	$80.00	3.03
Hallway	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
220	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	311	0.0	$52.32	$117.00	$20.00	1.85
221, 222	4	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.09	623	0.0	$104.64	$234.00	$40.00	1.85
224	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	311	0.0	$52.32	$117.00	$20.00	1.85

	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
WRR	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	332	0.0	$55.70	$117.00	$20.00	1.74
WRR	4	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	No	4	LED Screw-In Lamps: LED screw in	Wall Switch	18	4,368	0.02	161	0.0	$27.00	$175.81	$20.00	5.77
MRR	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.05	332	0.0	$55.70	$117.00	$20.00	1.74
MRR	4	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	No	4	LED Screw-In Lamps: LED screw in	Wall Switch	18	4,368	0.02	161	0.0	$27.00	$175.81	$20.00	5.77
(11) Rms 226-244	22	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	22	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.50	3,426	0.0	$575.54	$1,287.00	$220.00	1.85
Classroom	7	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.20	1,396	0.0	$234.52	$679.50	$105.00	2.45
248/249	4	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.09	623	0.0	$104.64	$234.00	$40.00	1.85
Hallway	3	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	3	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	3,058	0.05	329	0.0	$55.32	$307.70	$15.00	5.29
3- Hallway	15	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	15	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	3,058	0.24	1,646	0.0	$276.59	$938.50	$75.00	3.12
3- Hallway	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
(20) Rms 320-349	40	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	40	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.91	6,229	0.0	$1,046.43	$2,340.00	$400.00	1.85
CR 330	8	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.23	1,595	0.0	$268.02	$738.00	$115.00	2.32
MRR	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	3,058	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.05	232	0.0	$38.99	$117.00	$20.00	2.49
MRR	3	Compact Fluorescent: 1Lx26W	Occupancy Sensor	26	3,058	Relamp	No	3	LED Screw-In Lamps: LED screw in	Occupancy Sensor	18	3,058	0.02	84	0.0	$14.18	$131.86	$15.00	8.24
WRR	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	3,058	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.05	232	0.0	$38.99	$117.00	$20.00	2.49
WRR	3	Compact Fluorescent: 1Lx26W	Occupancy Sensor	26	3,058	Relamp	No	3	LED Screw-In Lamps: LED screw in	Occupancy Sensor	18	3,058	0.02	84	0.0	$14.18	$131.86	$15.00	8.24
Hallway	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	3,058	0.15	1,047	0.0	$175.95	$492.50	$50.00	2.51
4-Hallway	19	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	Yes	19	LED Screw-In Lamps: LED screw in	High/Low Control	18	3,058	0.19	1,279	0.0	$214.86	$1,235.11	$95.00	5.31
4-Hallway	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
421	1	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.02	109	0.0	$18.31	$58.50	$10.00	2.65
420	2	Compact Fluorescent: 1Lx26W	Occupancy Sensor	26	3,058	Relamp	No	2	LED Screw-In Lamps: LED screw in	Occupancy Sensor	18	3,058	0.01	56	0.0	$9.45	$87.91	$10.00	8.24
MRR	1	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,368	0.02	156	0.0	$26.16	$58.50	$10.00	1.85
424427428	3	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.07	327	0.0	$54.94	$175.50	$30.00	2.65
425426429	6	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.14	654	0.0	$109.88	$351.00	$60.00	2.65
(8) Rms 435-448	16	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.37	1,744	0.0	$293.00	$936.00	$160.00	2.65

	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
442	1	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.02	109	0.0	$18.31	$58.50	$10.00	2.65
450	3	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.07	327	0.0	$54.94	$175.50	$30.00	2.65
G42	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.05	218	0.0	$36.63	$117.00	$20.00	2.65
G33,G37,G39	18	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.41	1,962	0.0	$329.63	$1,053.00	$180.00	2.65
G22	8	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	3,058	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.18	872	0.0	$146.50	$468.00	$80.00	2.65
Sitting Area	4	Compact Fluorescent: 2Lx26W	Wall Switch	52	4,368	Relamp	No	4	LED Screw-In Lamps: LED screw in	Wall Switch	36	4,368	0.05	321	0.0	$54.01	$351.62	$40.00	5.77
Sitting Area	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Hallway	9	Compact Fluorescent: 1Lx26W	Wall Switch	26	4,368	Relamp	Yes	9	LED Screw-In Lamps: LED screw in	High/Low Control	18	3,058	0.09	606	0.0	$101.77	$595.58	$45.00	5.41
Hallway	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Janitor	1	Compact Fluorescent: 1Lx26W	Occupancy Sensor	26	3,058	Relamp	No	1	LED Screw-In Lamps: LED screw in	Occupancy Sensor	18	3,058	0.01	28	0.0	$4.73	$43.95	$5.00	8.24
WRR	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	3,058	Relamp	No	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.12	580	0.0	$97.47	$292.50	$50.00	2.49
WRR	2	Compact Fluorescent: 1Lx26W	Occupancy Sensor	26	3,058	Relamp	No	2	LED Screw-In Lamps: LED screw in	Occupancy Sensor	18	3,058	0.01	56	0.0	$9.45	$87.91	$10.00	8.24
Hallway	6	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	4,368	Relamp	Yes	6	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	3,058	0.28	1,885	0.0	$316.71	$651.20	$90.00	1.77
CR G02	6	Linear Fluorescent - T5: 4' T5 (28W) - 3L	Wall Switch	90	4,368	Relamp	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	3,058	0.26	1,795	0.0	$301.52	$721.20	$125.00	1.98
CR G02	4	Linear Fluorescent - T5: 4' T5 (28W) - 1L	Wall Switch	30	4,368	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,058	0.06	399	0.0	$67.01	$143.60	$20.00	1.84
G06	4	Linear Fluorescent - T5: 4' T5 (28W) - 3L	Wall Switch	90	4,368	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	3,058	0.18	1,197	0.0	$201.02	$570.80	$95.00	2.37
CR G01	8	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	4,368	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,058	0.23	1,595	0.0	$268.02	$738.00	$115.00	2.32
CR G01	8	Linear Fluorescent - T5: 4' T5 (28W) - 1L	Wall Switch	30	4,368	Relamp	Yes	8	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,058	0.12	798	0.0	$134.01	$287.20	$40.00	1.84
Hallway	3	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	4,368	Relamp	Yes	3	LED - Linear Tubes: (2) U-Lamp	High/Low Control	33	3,058	0.09	586	0.0	$98.48	$389.60	$0.00	3.96
Hallway	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
G55	3	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	4,368	Relamp	Yes	3	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,058	0.05	329	0.0	$55.32	$377.70	$50.00	5.92
G55	28	Linear Fluorescent - T5: 4' T5 (28W) - 3L	Wall Switch	90	4,368	Relamp	Yes	28	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	3,058	1.23	8,376	0.0	$1,407.11	$2,375.60	$455.00	1.36
G55	7	Linear Fluorescent - T5: 4' T5 (28W) - 1L	Wall Switch	30	4,368	Relamp	Yes	7	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,058	0.10	698	0.0	$117.26	$521.30	$70.00	3.85
G55	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Recital Hal - House	22	Halogen Incandescent: Pendant house lights	Daylight Dimming	250	2,184	Fixture Replacement	No	22	LED - Fixtures: Decorative Pendant	Daylight Dimming	40	2,184	3.40	11,604	0.0	$1,949.40	$10,583.80	$220.00	5.32

	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
Recital Hall - House	12	Halogen Incandescent: Pendant house lights	Daylight Dimming	400	2,184	Fixture Replacement	No	12	LED - Fixtures: Decorative Pendant	Daylight Dimming	60	2,184	3.00	10,247	0.0	$1,721.55	$5,772.98	$120.00	3.28

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
Mechanical Rm	Building	2	Air Compressor	2.0	78.5%	No	2,000	No	78.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical Rm	Room Exhaust	1	Exhaust Fan	1.0	84.0%	No	2,745	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical Rm	AHU 5 fan coil vent air	1	Supply Fan	7.5	89.5%	No	3,391	Yes	91.7%	Yes	1	1.06	4,067	0.0	$683.34	$4,760.59	$600.00	6.09
Mechanical Rm	AHU 5 fan coil vent air	1	Return Fan	3.0	87.5%	No	2,745	No	87.5%	Yes	1	0.41	1,264	0.0	$212.31	$3,007.65	$240.00	13.04
Mechanical Rm	AHU 4 rehearsal	1	Supply Fan	3.0	87.5%	No	2,745	No	87.5%	Yes	1	0.41	1,264	0.0	$212.31	$3,007.65	$240.00	13.04
Mechanical Rm	AHU 4 rehearsal	1	Return Fan	1.0	84.0%	No	2,745	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical Rm	AHU 3 rehearsal	1	Supply Fan	5.0	87.5%	No	2,745	Yes	89.5%	Yes	1	0.72	2,236	0.0	$375.60	$4,196.91	$400.00	10.11
Mechanical Rm	AHU 3 rehearsal	1	Return Fan	2.0	84.0%	No	2,745	No	84.0%	Yes	1	0.29	878	0.0	$147.44	$2,728.85	$160.00	17.42
Mechanical Rm	AHU 2 Multipurpose	1	Supply Fan	10.0	89.5%	No	3,391	Yes	91.7%	Yes	1	1.42	5,423	0.0	$911.11	$5,375.00	$800.00	5.02
Mechanical Rm	AHU 2 Multipurpose	1	Return Fan	5.0	87.5%	No	2,745	Yes	89.5%	Yes	1	0.72	2,236	0.0	$375.60	$4,196.91	$400.00	10.11
Mechanical Rm	AHU 1 Recital	1	Supply Fan	15.0	91.0%	No	3,391	Yes	92.4%	Yes	1	4.16	15,056	0.0	$2,529.46	$7,085.87	$1,200.00	2.33
Mechanical Rm	AHU 1 Recital	1	Return Fan	5.0	87.5%	No	2,745	Yes	89.5%	Yes	1	0.72	2,236	0.0	$375.60	$4,196.91	$400.00	10.11
Mechanical Rm	HHW loop	2	Heating Hot Water Pump	5.0	90.2%	Yes	2,745	No	90.2%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical Rm	Chilled Water Primary	1	Chilled Water Pump	10.0	89.5%	No	3,391	Yes	91.7%	No		0.11	509	0.0	$85.44	$1,567.05	$0.00	18.34
Mechanical Rm	Chilled Water Secondary	2	Chilled Water Pump	10.0	91.7%	Yes	3,391	Yes	91.7%	No		0.00	0	0.0	$0.00	$3,134.10	$0.00	0.00
Mechanical Rm	Condenser Water	2	Condenser Water Pump	10.0	89.5%	No	3,391	Yes	91.7%	No		0.22	1,017	0.0	$170.88	$3,134.10	$0.00	18.34
Elevator	Elevator	2	Other	40.0	93.0%	No	500	No	93.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Elevator	Acc Elevator	1	Other	40.0	93.0%	No	500	No	93.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Cooling Tower	1	Cooling Tower Fan	25.0	92.4%	Yes	4,067	Yes	93.6%	No		0.14	789	0.0	$132.60	$3,468.33	$0.00	26.16
Various	Room fan coil Type FCA	7	Ventilation Fan	0.1	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	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
Various	Room fan coil Type FCB	8	Ventilation Fan	0.2	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Various	Room fan coil Type FCC	25	Ventilation Fan	0.2	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Various	Room fan coil Type FCD	42	Ventilation Fan	0.2	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Various	Room fan coil Type FCE	3	Ventilation Fan	0.2	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Various	Room fan coil Type FCF	5	Ventilation Fan	0.2	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Various	Room fan coil Type FCG	4	Ventilation Fan	0.5	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Various	Room fan coil Type FCH	1	Ventilation Fan	0.3	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	EF-1	1	Exhaust Fan	0.5	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	EF-2	1	Exhaust Fan	0.3	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	EF-3	1	Exhaust Fan	0.3	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	EF-4	1	Exhaust Fan	0.3	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	EF-5	1	Exhaust Fan	0.3	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	EF-6	1	Exhaust Fan	1.5	84.0%	No	2,745	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	EF-7	1	Exhaust Fan	0.8	70.0%	No	2,745	No	70.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	EF-8	1	Exhaust Fan	0.2	70.0%	No	2,745	No	70.0%	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
Mech Rm	Building	1	Water-Cooled Screw Chiller	146.00	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
Mech Room	4th Floor	1	Forced Draft Steam Boiler	4,000.00	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
Mech Rm	Building	1	Indirect System	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Low-Flow Device Recommendations

	Recommedation 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
WRR	3	Faucet Aerator (Lavatory)	2.00	1.00	0.00	0	5.1	$78.11	$21.51	$0.00	0.28
MRR	3	Faucet Aerator (Lavatory)	2.00	1.00	0.00	0	5.1	$78.11	$21.51	$0.00	0.28
MRR	1	Faucet Aerator (Lavatory)	2.00	1.00	0.00	0	1.7	$26.04	$7.17	$0.00	0.28

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Various	30	Computer	75.0	
Various	6	Laptop	40.0	
Various	9	Printer/Copier M	300.0	
Various	1	Printer/Copier L	515.0	
Various	1	Paper shredder	360.0	
Various	5	Projector	200.0	
Various	4	Microwave	1,000.0	
Various	3	Refigerator S	27.6	
Various	1	Refigerator M	50.0	
Various	4	Coffee Machine	400.0	
Various	1	TV 50"	150.0	
Various	1	H&C water dispenser	500.0	
Various	2	TV30"	130.0	
Theater	1	Stage Lighting	5,000.0	

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

Source EUI
306.4 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%)

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)