Local Government Energy Audit: Energy Audit Report

School of Business

1 Normal Avenue

Montclair, New Jersey 07043

Montclair State University

July 30, 2018

Final Report by:

TRC Energy Services

Disclaimer

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

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

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

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

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1 Executive Summary

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

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

The School of Business is a 143,679-square foot facility. The six-story building includes classrooms, lecture halls, offices, and mechanical spaces.

Lighting at the School of Business consists of a mixture of T5 and T8 linear fluorescent sources, LED lamps, and compact fluorescent lamps (CFLs). LEDs are currently the most efficient technology available. Cooling is provided by chilled water (CHW) from the District Energy Plant to the building's mechanical room, where it is distributed by pumps to the building's air handling equipment. There are four (4) main air handling units (AHUs) for the building. Two (2) of the units use natural gas for space heating. Steam is provided from the District Energy Plant to the School of Business' 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 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 (7) measures that together represent an opportunity for School of Business to reduce annual energy costs by roughly $15,365 and annual greenhouse gas emissions by 78,682 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in roughly 6.4 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 School of Business's annual energy use by 1%.

Figure 1 – Previous 12 Month Utility Costs

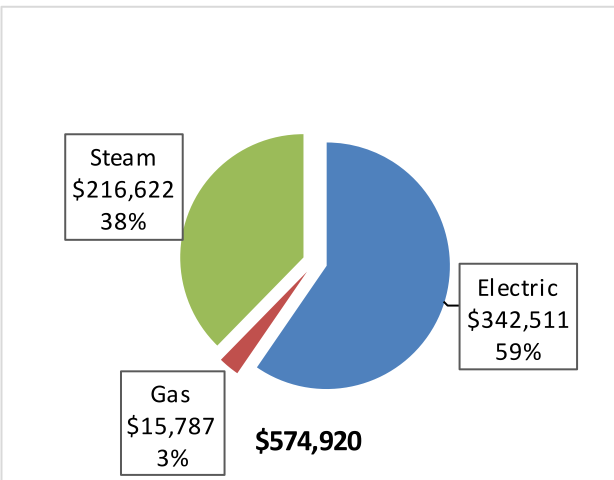
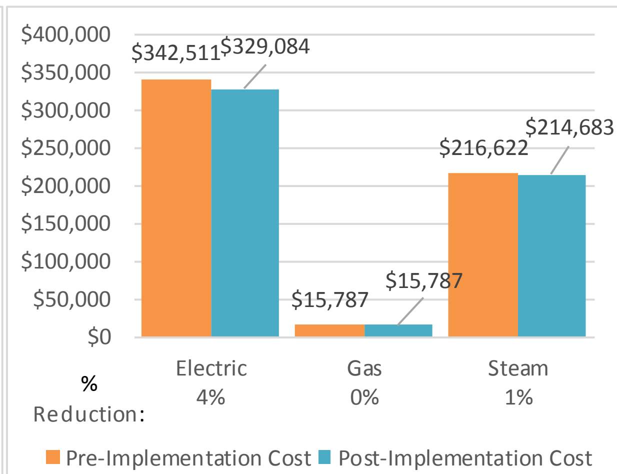


Figure 2 – Potential Post-Implementation Costs



A detailed description of School of Business'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)	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			**45,837**	**0**	**11.7**	**0.0**	**$7,700.59**	**$38,134.45**	**$5,990.00**	**$32,144.45**	**4.2**	**46,157**
ECM 1	Install LED Fixtures	Yes	4,510	0	0.9	0.0	$757.67	$2,734.74	$700.00	$2,034.74	2.7	4,541
ECM 2	Retrofit Fixtures with LED Lamps	Yes	41,327	0	10.8	0.0	$6,942.92	$35,399.71	$5,290.00	$30,109.71	4.3	41,616
Lighting Control Measures			**11,880**	**0**	**2.4**	**0.0**	**$1,995.87**	**$14,260.00**	**$9,655.00**	**$4,605.00**	**2.3**	**11,963**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	3,284	0	0.7	0.0	$551.78	$4,410.00	$571.67	$3,838.33	7.0	3,307
ECM 4	Install Daylight Dimming Controls	Yes	966	0	0.2	0.0	$162.36	$250.00	$250.00	$0.00	0.0	973
ECM 5	Install High/Low Lighitng Controls	Yes	7,629	0	1.6	0.0	$1,281.73	$9,600.00	$8,833.33	$766.67	0.6	7,683
HVAC System Improvements			**0**	**10,400**	**0.0**	**127.0**	**$5,340.62**	**$61,173.90**	**$0.00**	**$61,173.90**	**11.5**	**18,593**
ECM 6	Implement Demand Control Ventilation	Yes	0	10,400	0.0	127.0	$5,340.62	$61,173.90	$0.00	$61,173.90	11.5	18,593
Plug Load Equipment Control - Vending Machine			**1,954**	**0**	**0.0**	**0.0**	**$328.33**	**$460.00**	**$0.00**	**$460.00**	**1.4**	**1,968**
ECM 7	Vending Machine Control	Yes	1,954	0	0.0	0.0	$328.33	$460.00	$0.00	$460.00	1.4	1,968
TOTALS FOR HIGH PRIORITY MEASURES			**59,671**	**10,400**	**14.1**	**127.0**	**$15,365.41**	**$114,028.35**	**$15,645.00**	**$98,383.35**	**6.4**	**78,682**
TOTALS FOR ALL EVALUATED MEASURES			**59,671**	**10,400**	**14.1**	**127.0**	**$15,365.41**	**$114,028.35**	**$15,645.00**	**$98,383.35**	**6.4**	**78,682**

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

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

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

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

HVAC System Improvements generally involve the installation of automated controls to reduce heating and cooling demand during periods of reduced demand. These measures could encompass changing temperature setpoints, using outside air for free cooling, or limiting excessive outside air during extreme outdoor air temperature conditions. These measures save energy by reducing the demand on HVAC systems and the amount of time systems operate.

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

Energy Efficient Practices

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

- Close Doors and Windows
- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Turn Off Unneeded Motors
- Reduce Motor Short Cycling
- Perform Routine Motor Maintenance
- Practice Proper Use of Thermostat Schedules and Temperature Resets
- Ensure Economizers are Functioning Properly
- Clean and/or Replace HVAC Filters
- Check for and Seal Duct Leakage
- Perform Maintenance on Compressed Air Systems
- Water Conservation

For details on these Energy Efficient Practices, please refer to Section 5.

On-Site Generation Measures

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

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

1.3 Implementation Planning

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

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

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

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

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

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

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

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

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

2 Facility Information and Existing Conditions

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Ana Pinto	Director of Energy Management	pintoa@mail.montclair.edu	973-655-3244
TRC Energy Services			
Moussa Traore	Auditor	MTraore@trcsolutions.com	732-902-1797

2.2 General Site Information

On June 13, 2017, TRC performed an energy audit at Montclair State University's School of Business located in Montclair, New Jersey. TRC met with Ana Pinto to review the facility operations and help focus our investigation on specific energy-using systems.

The School of Business is a 143,679-square foot facility. The six-story building includes classrooms, lecture halls, offices, and mechanical spaces. The building was constructed in 2015.

Lighting at the School of Business consists of a mixture of T5 and T8 linear fluorescent sources, LED lamps, and compact fluorescent lamps (CFLs). Cooling is provided by chilled water (CHW) from the District Energy Plant to the building's mechanical room, where it is distributed by pumps to the building's air handling equipment. There are four (4) main air handling units (AHUs) for the building. Two (2) of the units use natural gas for space heating. Steam is provided from the District Energy Plant to the School of Business' 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 terminal reheat coils.

2.3 Building Occupancy

The facility is open Monday through Friday for 52 weeks a year. During a typical day, the facility is occupied by approximately 225 students and staff.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
School of Business	Weekday	7 AM - 7 PM
School of Business	Weekend	Closed

2.4 Building Envelope

The School of Business is a six-story building constructed of concrete and structural steel with a masonry facade. The building has a pitched roof on the perimeter and a flat built-up roof in the center that is in good condition. The building has double-pane, operable windows that are in good condition and show little signs of infiltration. The exterior doors are constructed of metal and glass and are in good condition.

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.

The School of Business does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

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

Lighting System

Interior lighting at the facility is provided by fixtures that contain linear fluorescent T5 and T8 lamps with electronic ballasts, LED linear fixtures, and LED and CFL screw-in lamps. Most of the linear fixtures are 1-lamp or 2-lamp with 4-foot long troffers. The building exit signs have LED lamps. Some interior lighting fixtures are controlled by manually operated switches, while others using occupancy sensors.

Exterior lighting is provided by linear and compact fluorescents and metal halide HID fixtures, the majority of which are controlled with daylight-dimming photocell sensors.

Chilled Water System

Chilled water (CHW) is provided from the District Energy Plant to the School of Business' mechanical room, where it is distributed to the building's air handling equipment. The water is distributed by two (2) variable speed, redundant 30 hp pumps.

The equipment is well-maintained and in good condition.

Steam to Hot Water Heating System

The heating hot water (HHW) system consists of a steam-to-water heat exchanger in the mechanical room that receives steam from the District Energy Plant. From there, the HHW is distributed to the building's AHUs and terminal heating coils. The HHW is distributed by two (2) redundant 10 hp pumps equipped with variable speed drives (VFDs).

The equipment is well-maintained in good condition.

Air Distribution System

There are four (4) main air handling units (AHUs) for the building that provide space conditioning and ventilation. The sizes for supply fans range from 15 to 25 horsepower. AHU-1 is the only unit with a return fan. AHU-2 and AHU-3 have four (4) supply fans each. All the fan motors are variable speed. The rooftop AHU has heat recovery supplemented with natural gas for heating. Supply air is distributed to variable air volume (VAV) boxes with hot water reheat at the zone level.

The equipment is well-maintained and in good condition.

Direct Expansion Air Conditioning System (DX)

There are 11 split-system AC units that serve the data and telcom rooms. The Mitsubishi units each have a 3-ton cooling capacity and a 14 SEER efficiency.

The equipment is two years old and is in good condition.

Building Energy Management System (BEMS)

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

Domestic Hot Water Heating System

DHW for the building is provided by one (1) steam-to-water heat exchanger. The equipment is in good condition.

Building Plug Load

Plug load equipment includes multiple computers, printers, displays, and other office equipment. Other plug load equipment a refrigerator, microwaves, and drinking fountains. The facility also has data closets containing servers.

2.7 Water-Using Systems

There are approximately 12 restrooms at the School of Business. A sampling of restrooms found that many faucets are rated for 0.5 gallons per minute (gpm).

3 SITE ENERGY USE AND COSTS

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

Prorated utility data were evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.6 for additional information.

3.1 Total Cost of Energy

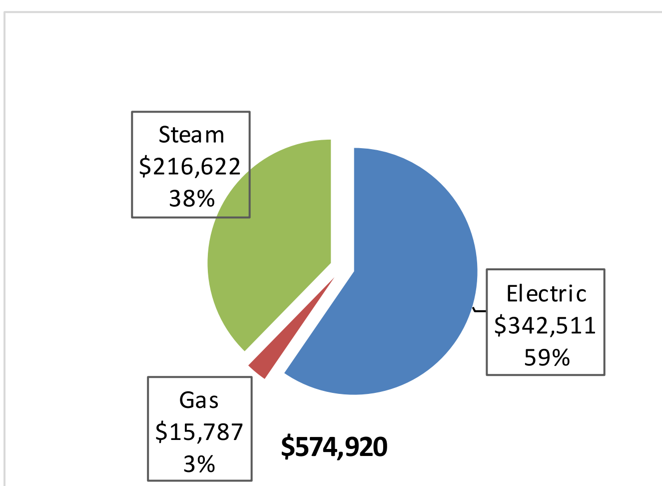
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 6 - Utility Summary

Utility Summary for School of Business		
Fuel	**Usage**	**Cost**
Electricity	6,423,976 kWh	$342,511
Natural Gas	21,480 Therms	$15,787
Steam	11,884 kLbs	$216,622
Total		**$574,920**

The current annual energy cost for this facility is $574,920 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

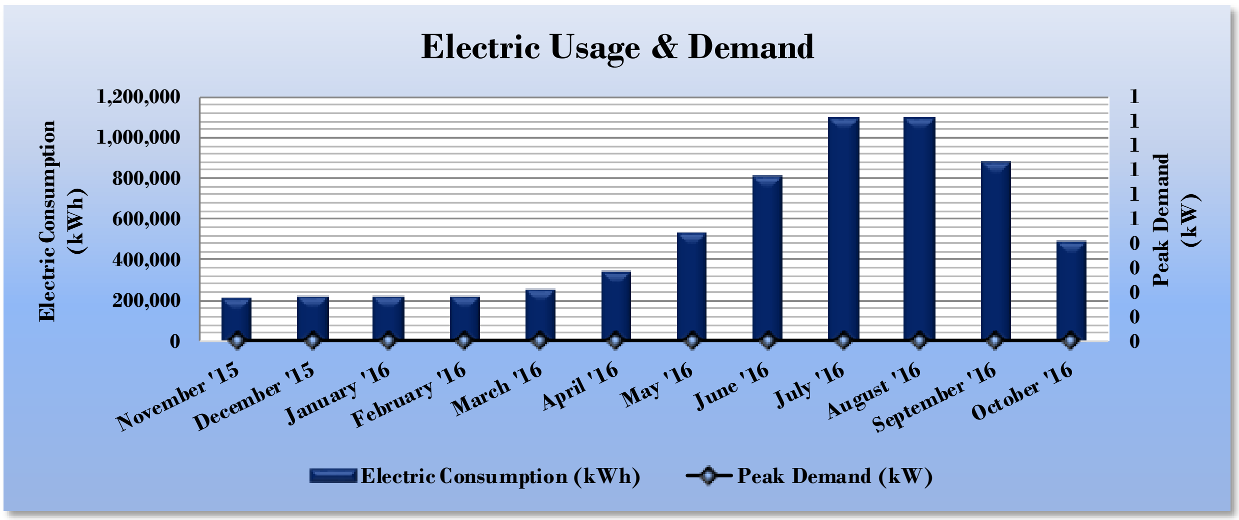


Figure 9 - Electric Usage & Demand

Electric Billing Data for School of Business				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
11/30/15	30	214,409	$14,695	Yes
12/31/15	31	224,848	$14,845	Yes
1/31/16	31	228,886	$12,723	Yes
2/28/16	28	228,487	$25,494	Yes
3/31/16	31	262,613	$13,730	Yes
4/30/16	30	344,552	$17,602	Yes
5/31/16	31	534,737	$26,475	Yes
6/30/16	30	814,210	$40,528	Yes
7/31/16	31	1,096,422	$53,647	Yes
8/31/16	31	1,100,342	$54,243	Yes
9/30/16	30	883,932	$43,617	Yes
10/31/16	31	490,538	$24,911	Yes
Totals	**365**	**6,423,976**	**$342,511**	12
Annual	**365**	**6,423,976**	**$342,511**	

3.3 Natural Gas Usage

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

Figure 10 - Natural Gas Usage

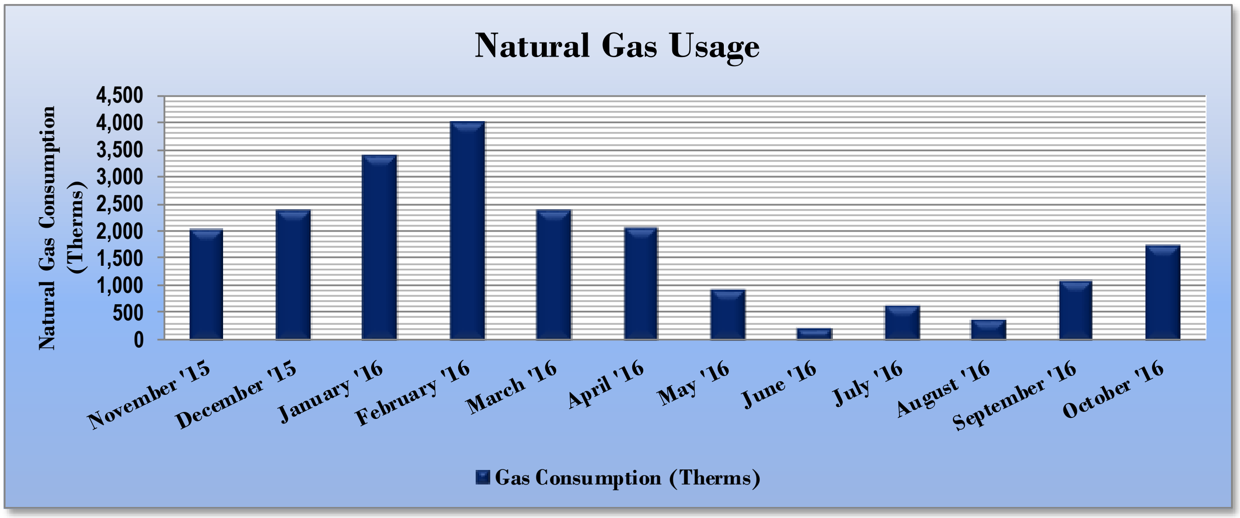


Figure 11 - Natural Gas Usage

Gas Billing Data for School of Business				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
11/30/15	30	2,043	$2,415	Yes
12/31/15	31	2,415	$2,043	Yes
1/31/16	31	3,405	$2,635	Yes
2/28/16	28	4,029	$2,766	Yes
3/31/16	31	2,400	$1,174	Yes
4/30/16	30	2,071	$1,051	Yes
5/31/16	31	936	$486	Yes
6/30/16	30	228	$128	Yes
7/31/16	31	667	$412	Yes
8/31/16	31	402	$243	Yes
9/30/16	30	1,124	$689	Yes
10/31/16	31	1,759	$1,744	Yes
Totals	**365**	**21,480**	**$15,787**	12
Annual	**365**	**21,480**	**$15,787**	

3.4 Steam Usage

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

Figure 12 – Steam Usage

Steam Billing Data for School of Business				
Period Ending	Days in Period	Steam Usage (kLbs)	Fuel Cost	TRC Estimated Usage?
11/30/15	30	786	$11,982	Yes
12/31/15	31	1,054	$16,193	Yes
1/31/16	31	1,498	$23,389	Yes
2/28/16	28	1,351	$56,027	Yes
3/31/16	31	1,129	$17,155	Yes
4/30/16	30	924	$13,885	Yes
5/31/16	31	702	$10,948	Yes
6/30/16	30	684	$10,392	Yes
7/31/16	31	881	$13,276	Yes
8/31/16	31	920	$13,875	Yes
9/30/16	30	905	$13,574	Yes
10/31/16	31	1,049	$15,925	Yes
Totals	**365**	**11,884**	**$216,622**	12
Annual	**365**	**11,884**	**$216,622**	

3.5 Chilled Water Usage

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

Figure 13 – Chilled Water Usage

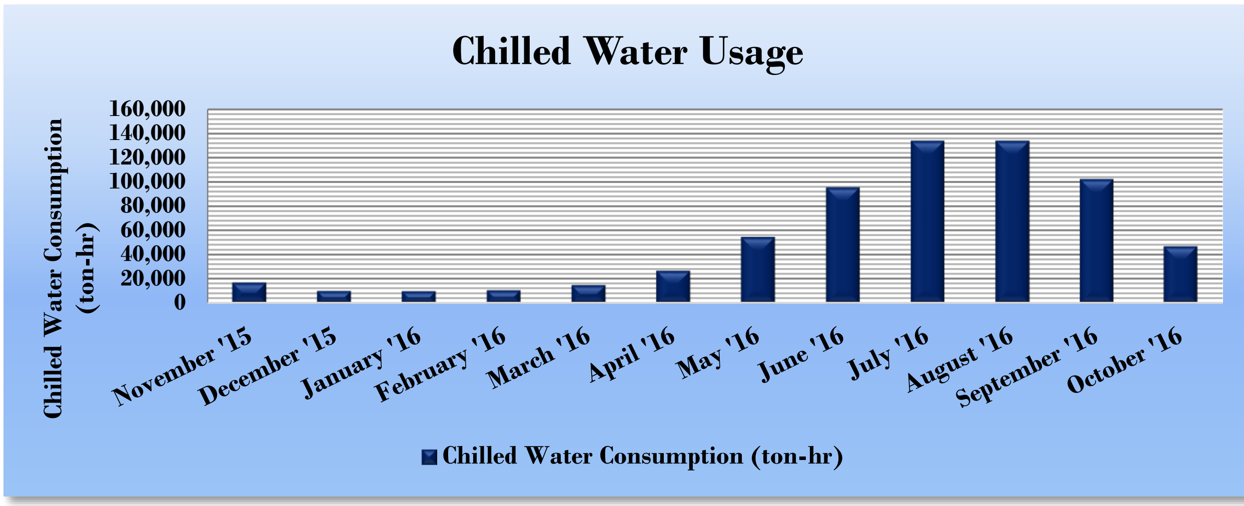


Figure 14 – Chilled Water Usage

Electric Billing Data for School of Business				
Period Ending	Days in Period	Chilled Water Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
11/30/15	30	60,225	$5,605	Yes
12/31/15	31	35,810	$3,333	Yes
1/31/16	31	34,899	$3,248	Yes
2/28/16	28	37,709	$3,510	Yes
3/31/16	31	52,892	$4,923	Yes
4/30/16	30	94,695	$8,814	Yes
5/31/16	31	192,028	$17,873	Yes
6/30/16	30	335,965	$31,270	Yes
7/31/16	31	471,208	$43,857	Yes
8/31/16	31	471,208	$43,857	Yes
9/30/16	30	359,740	$33,483	Yes
10/31/16	31	165,134	$15,370	Yes
Totals	**365**	**2,311,513**	**$215,143**	12
Annual	**365**	**2,311,513**	**$215,143**	

3.6 Benchmarking

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

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

Figure 15 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	School of Business	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	613.2	262.6
Site Energy Use Intensity (kBtu/ft^2)	266.3	130.7

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

Figure 16 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	School of Business	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	607.7	262.6
Site Energy Use Intensity (kBtu/ft^2)	264.0	130.7

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

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

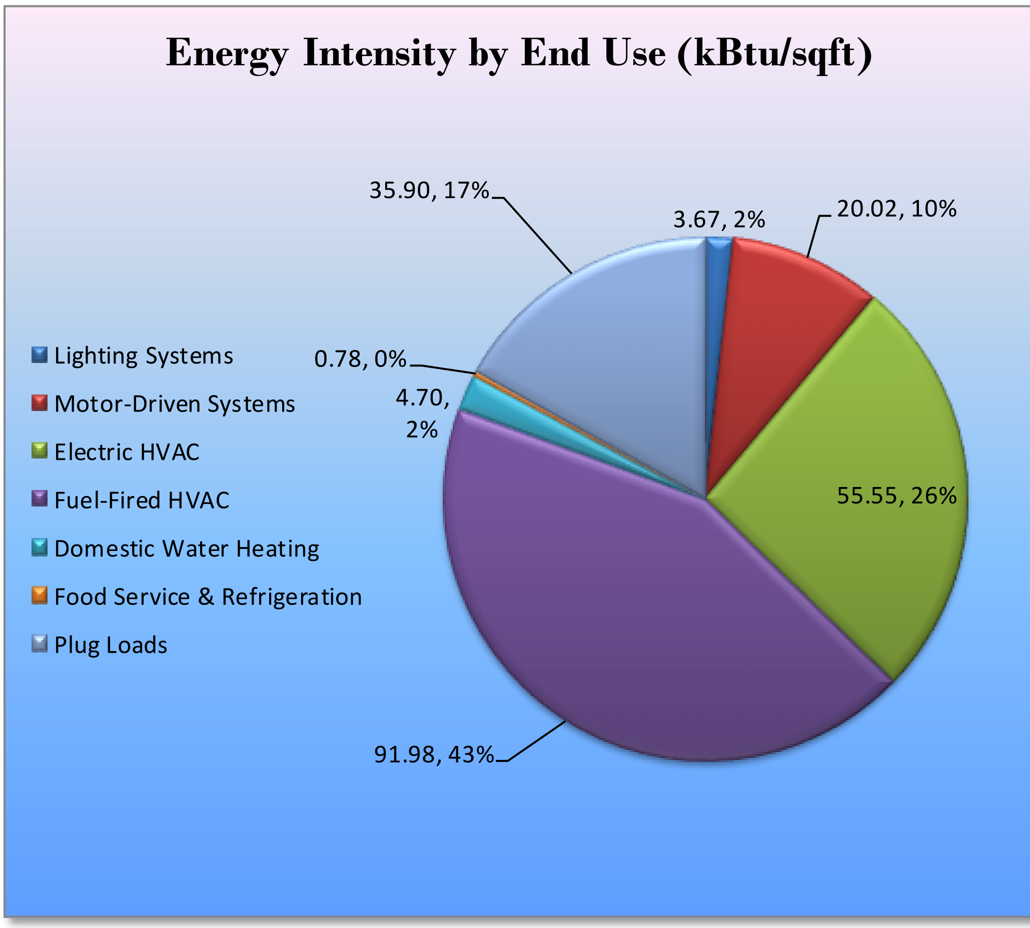
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

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

3.7 Energy End-Use Breakdown

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

Figure 17 - Energy Balance (% and kBtu/SF)



4 Energy Conservation Measures

Level of Analysis

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

The following sections describe the evaluated measures.

4.1 High Priority ECMs

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

Figure 18 – Summary of High Priority ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	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		**45,837**	**0**	**11.7**	**0.0**	**$7,700.59**	**$38,134.45**	**$5,990.00**	**$32,144.45**	**4.2**	**46,157**
ECM 1	Install LED Fixtures	4,510	0	0.9	0.0	$757.67	$2,734.74	$700.00	$2,034.74	2.7	4,541
ECM 2	Retrofit Fixtures with LED Lamps	41,327	0	10.8	0.0	$6,942.92	$35,399.71	$5,290.00	$30,109.71	4.3	41,616
Lighting Control Measures		**11,880**	**0**	**2.4**	**0.0**	**$1,995.87**	**$14,260.00**	**$9,655.00**	**$4,605.00**	**2.3**	**11,963**
ECM 3	Install Occupancy Sensor Lighting Controls	3,284	0	0.7	0.0	$551.78	$4,410.00	$571.67	$3,838.33	7.0	3,307
ECM 4	Install Daylight Dimming Controls	966	0	0.2	0.0	$162.36	$250.00	$250.00	$0.00	0.0	973
ECM 5	Install High/Low Lighitng Controls	7,629	0	1.6	0.0	$1,281.73	$9,600.00	$8,833.33	$766.67	0.6	7,683
HVAC System Improvements		**0**	**10,400**	**0.0**	**127.0**	**$5,340.62**	**$61,173.90**	**$0.00**	**$61,173.90**	**11.5**	**18,593**
ECM 6	Implement Demand Control Ventilation	0	10,400	0.0	127.0	$5,340.62	$61,173.90	$0.00	$61,173.90	11.5	18,593
Plug Load Equipment Control - Vending Machine		**1,954**	**0**	**0.0**	**0.0**	**$328.33**	**$460.00**	**$0.00**	**$460.00**	**1.4**	**1,968**
ECM 7	Vending Machine Control	1,954	0	0.0	0.0	$328.33	$460.00	$0.00	$460.00	1.4	1,968
TOTALS		**59,671**	**10,400**	**14.1**	**127.0**	**$15,365.41**	**$114,028.35**	**$15,645.00**	**$98,383.35**	**6.4**	**78,682**

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

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

4.2 Lighting Upgrades

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

Figure 19 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**45,837**	**0**	**11.7**	**0.0**	**$7,700.59**	**$38,134.45**	**$5,990.00**	**$32,144.45**	**4.2**	**46,157**
ECM 1	Install LED Fixtures	4,510	0	0.9	0.0	$757.67	$2,734.74	$700.00	$2,034.74	2.7	4,541
ECM 2	Retrofit Fixtures with LED Lamps	41,327	0	10.8	0.0	$6,942.92	$35,399.71	$5,290.00	$30,109.71	4.3	41,616

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)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	0	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0
Exterior	4,510	0	0.9	0.0	$757.67	$2,734.74	$700.00	$2,034.74	2.7	4,541

Measure Description

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

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are much longer that HID lamps.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	39,404	0	10.0	0.0	$6,619.90	$32,423.49	$4,715.00	$27,708.49	4.2	39,680
Exterior	1,923	0	0.8	0.0	$323.01	$2,976.22	$575.00	$2,401.22	7.4	1,936

Measure Description

We recommend retrofitting existing T5, T8, 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 fluorescent tubes.

4.3 Lighting Control Measures

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

Figure 20 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		11,880	0	2.4	0.0	$1,995.87	$14,260.00	$9,655.00	$4,605.00	2.3	11,963
ECM 3	Install Occupancy Sensor Lighting Controls	3,284	0	0.7	0.0	$551.78	$4,410.00	$571.67	$3,838.33	7.0	3,307
ECM 4	Install Daylight Dimming Controls	966	0	0.2	0.0	$162.36	$250.00	$250.00	$0.00	0.0	973
ECM 5	Install High/Low Lighitng Controls	7,629	0	1.6	0.0	$1,281.73	$9,600.00	$8,833.33	$766.67	0.6	7,683

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)	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)
3,284	0	0.7	0.0	$551.78	$4,410.00	$571.67	$3,838.33	7.0	3,307

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in restrooms and classrooms. 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 Daylight Dimming Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
966	0	0.2	0.0	$162.36	$250.00	$250.00	$0.00	0.0	973

Measure Description

We recommend installing daylight dimming controls that use photosensors to reduce electric lighting in areas when ample daylight lighting is present. Photosensor controls are recommended for fixtures that are adjacent to windows that receive lots of sunlight. As sunlight level increase in the room, fixture lighting is decreased or turned off. This measure reduces energy use in spaces where sufficient lighting levels can be met by ambient daylight.

Optimum light levels and the method of dimming should be determined during lighting design. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
7,629	0	1.6	0.0	$1,281.73	$9,600.00	$8,833.33	$766.67	0.6	7,683

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. A typical area for such lighting controls are interior corridors.

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

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

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

4.4 HVAC System Upgrades

Our recommendation for HVAC system improvement are summarized in Figure 21 below.

Figure 21 - Summary of HVAC System Improvement ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
HVAC System Improvements		**0**	**10,400**	**0.0**	**127.0**	**$5,340.62**	**$61,173.90**	**$0.00**	**$61,173.90**	**11.5**	**18,593**
ECM 6	Implement Demand Control Ventilation	0	10,400	0.0	127.0	$5,340.62	$61,173.90	$0.00	$61,173.90	11.5	18,593

ECM 6: Implement Demand Control Ventilation (DCV)

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	10,400	0.0	127.0	$5,340.62	$61,173.90	$0.00	$61,173.90	11.5	18,593

Measure Description

Demand control ventilation (DCV) monitors indoor air CO_2 content to measure room occupancy. This data is used to regulate the amount of outdoor provided to the space for ventilation. In order to ensure adequate air quality, standard ventilation systems often provide outside air based on a space's estimated maximum occupancy. However, during low occupancy periods, the space may be over ventilated. This wastes energy through cost to heat and cool the excessive air flow. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual occupancy levels, saving significant amounts of energy. DCV is most suited for facilities where occupancy levels vary significantly hour to hour and day to day.

Energy savings associated with DCV are based on hours of operation, space occupancy, system air flow, outside air reduction, and other factors. Energy savings results from eliminating unnecessary ventilation and space conditioning.

4.5 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment controls are summarized in Figure 22 below.

Figure 22 - Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		1,954	0	0.0	0.0	$328.33	$460.00	$0.00	$460.00	1.4	1,968
ECM 7	Vending Machine Control	1,954	0	0.0	0.0	$328.33	$460.00	$0.00	$460.00	1.4	1,968

ECM 7: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,954	0	0.0	0.0	$328.33	$460.00	$0.00	$460.00	1.4	1,968

Measure Description

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

5 Energy Efficient Practices

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.

Perform Proper Lighting Maintenance

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

Develop a Lighting Maintenance Schedule

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

Ensure Lighting Controls Are Operating Properly

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

Turn Off Unneeded Motors

Electric motors often run unnecessarily, and this is an overlooked opportunity to save energy. These motors should be identified and turned off when appropriate. For example, exhaust fans often run unnecessarily when ventilation requirements are already met. Reducing run hours for these motors can result in significant energy savings. Whenever possible, use automatic devices such as twist timers or occupancy sensors to ensure that motors are turned off when not needed.

Reduce Motor Short Cycling

Frequent stopping and starting of motors subjects rotors and other parts to substantial stress. This can result in component wear, reducing efficiency, and increasing maintenance costs. Adjust the load on the motor to limit the amount of unnecessary stopping and starting to improve motor performance.

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.

Ensure Economizers are Functioning Properly

Economizers, when properly configured, can be used to significantly reduce mechanical cooling. However, if the outdoor thermostat or enthalpy control is malfunctioning or the damper is stuck or improperly adjusted, benefits from the economizer may not be fully realized. As such, periodic inspection and maintenance is required to ensure proper operation. This maintenance should be scheduled with maintenance of the facility's air conditioning system and should include proper setting of the outdoor thermostat/enthalpy control, inspection of control and damper operation, lubrication of damper connections, and adjustment of minimum damper position. A malfunctioning economizer can significantly increase the amount of heating and mechanical cooling required by introducing excess amounts of cold or hot outside air.

Clean and/or Replace HVAC Filters

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

Check for and Seal Duct Leakage

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

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.

Water Conservation

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

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

6 On-Site Generation Measures

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

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

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

6.1 Photovoltaic

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

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

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

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

6.2 Combined Heat and Power

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

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

7 Demand Response

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

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

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

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

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

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

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

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

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 23 for a list of the eligible programs identified for each recommended ECM.

Figure 23 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	x			x		
ECM 2	Retrofit Fixtures with LED Lamps	x			x		
ECM 3	Install Occupancy Sensor Lighting Controls	x			x		
ECM 4	Install Daylight Dimming Controls				x		
ECM 5	Install High/Low Lighitng Controls				x		
ECM 6	Implement Demand Control Ventilation				x		
ECM 7	Vending Machine Control				x		

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

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

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

8.1 SmartStart

Overview

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

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

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

Incentives

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

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

How to Participate

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

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

8.2 Pay for Performance - Existing Buildings

Overview

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

Incentives

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

How to Participate

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

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

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

8.3 Energy Savings Improvement Program

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

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

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

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

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

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

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

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

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

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

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

9.2 Retail Natural Gas Supply Options

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

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

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

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

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Classrooms A	224	LED Screw-In Lamps: Screw-in	Occupancy Sensor	13	2,184	None	No	224	LED Screw-In Lamps: Screw-in	Occupancy Sensor	13	2,184	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Corridors	407	LED Screw-In Lamps: Screw-in	Wall Switch	13	3,120	None	Yes	407	LED Screw-In Lamps: Screw-in	High/Low Control	13	2,184	1.17	5,695	0.0	$956.80	$6,783.33	$14,245.00	-7.80
Stairwells	11	LED Screw-In Lamps: Screw-in	Wall Switch	13	3,120	None	No	11	LED Screw-In Lamps: Screw-in	Wall Switch	13	3,120	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lobby	18	LED Screw-In Lamps: Screw-in	Wall Switch	13	3,120	None	No	18	LED Screw-In Lamps: Screw-in	Wall Switch	13	3,120	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Cafeteria	30	LED Screw-In Lamps: Screw-in	Wall Switch	13	3,120	None	No	30	LED Screw-In Lamps: Screw-in	Wall Switch	13	3,120	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Exit signs B	143	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	143	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classrooms F	579	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,184	None	No	579	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,184	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Corridors C	22	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	3,120	Relamp	Yes	22	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	2,184	0.35	1,725	0.0	$289.76	$1,156.47	$110.00	3.61
Corridors D	4	Linear Fluorescent - T5: 3' T5 (21W) - 2L	Wall Switch	50	3,120	Relamp	Yes	4	LED - Linear Tubes: (3) 2' Lamps	High/Low Control	26	2,184	0.09	461	0.0	$77.52	$446.80	$60.00	4.99
Corridors E	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	3,120	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,184	0.37	1,795	0.0	$301.63	$902.00	$120.00	2.59
Corridors F	123	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	3,120	None	Yes	123	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	2,184	0.46	2,251	0.0	$378.13	$2,050.00	$4,305.00	-5.96
Stairwells	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	3,120	None	No	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	3,120	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Stairwells	4	Compact Fluorescent: Screw-in (13W) 2L	Wall Switch	26	3,120	Relamp	No	4	LED Screw-In Lamps: Screw-in (13W) 2L	Wall Switch	26	3,120	0.00	0	0.0	$0.00	$175.81	$0.00	0.00
Stairs (A,B,C)	39	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,184	None	No	39	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,184	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Restrooms (3)	12	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Occupancy Sensor	32	2,184	Relamp	No	12	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,184	0.15	527	0.0	$88.61	$430.80	$60.00	4.18
Restrooms (10)	150	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	3,120	Relamp	Yes	150	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,184	2.41	11,760	0.0	$1,975.62	$8,760.00	$1,187.50	3.83
Classrooms	90	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	2,184	Relamp	No	90	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,184	2.19	7,459	0.0	$1,253.19	$5,265.00	$900.00	3.48
Classrooms	158	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Occupancy Sensor	32	2,184	Relamp	No	158	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,184	2.04	6,945	0.0	$1,166.69	$5,672.20	$790.00	4.18
Classrooms C	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	3,120	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	3,120	0.03	126	0.0	$21.10	$71.80	$10.00	2.93
Classrooms E	46	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	3,120	Relamp	Yes	46	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,184	1.41	6,883	0.0	$1,156.26	$3,726.00	$594.17	2.71
Classrooms	75	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,184	None	No	75	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,184	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classrooms	23	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	2,184	Relamp	No	23	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,184	0.84	2,859	0.0	$480.39	$1,729.60	$345.00	2.88
Classrooms	18	Linear Fluorescent - T5: 4' T5 (28W) - 1L	Occupancy Sensor	30	2,184	Relamp	No	18	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,184	0.21	701	0.0	$117.72	$646.20	$90.00	4.72
Classrooms	84	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	2,184	Relamp	No	84	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,184	1.92	6,540	0.0	$1,098.75	$4,914.00	$840.00	3.71
Mechanical room	17	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	3,120	Relamp	No	17	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,120	0.41	2,013	0.0	$338.16	$994.50	$170.00	2.44

	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
Cafeteria	30	Compact Fluorescent: Screw-in (13W) 1L	Wall Switch	13	3,120	Relamp	No	30	LED Screw-In Lamps: Screw-in (13W) 1L	Wall Switch	13	3,120	0.00	0	0.0	$0.00	$2,637.18	$0.00	0.00
Cafeteria	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	3,120	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	3,120	0.03	126	0.0	$21.10	$71.80	$10.00	2.93
Terrace	20	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Daylight Dimming	60	1,560	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Daylight Dimming	29	1,560	0.46	1,112	0.0	$186.86	$1,170.00	$200.00	5.19
Exterior	6	Compact Fluorescent: Screw-in (13W) 2L	Daylight Dimming	26	1,560	Relamp	No	6	LED Screw-In Lamps: Screw-in (13W) 2L	Daylight Dimming	26	1,560	0.00	0	0.0	$0.00	$263.72	$0.00	0.00
Exterior	25	Linear Fluorescent - T5: 3' T5 (21W) - 2L	Daylight Dimming	50	1,560	Relamp	No	25	LED - Linear Tubes: (3) 2' Lamps	Daylight Dimming	26	1,560	0.45	1,099	0.0	$184.60	$1,542.50	$375.00	6.32
Exterior	7	Metal Halide: (1) 250W Lamp	Wall Switch	295	3,120	Fixture Replacement	Yes	7	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	89	1,560	1.29	6,298	0.0	$1,058.04	$2,984.74	$1,015.00	1.86
Exterior	15	LED - Linear Tubes: (2) 4' Lamps	Daylight Dimming	29	1,560	None	No	15	LED - Linear Tubes: (2) 4' Lamps	Daylight Dimming	29	1,560	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Whole building	2	Supply Fan	25.0	94.7%	Yes	4,067	No	94.7%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Whole building	2	Return Fan	15.0	93.0%	Yes	4,067	No	93.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whole building	Whole building	12	Ventilation Fan	0.1	65.0%	No	4,067	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	1	Supply Fan	20.0	94.0%	Yes	4,067	No	94.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	4	Supply Fan	15.0	93.0%	Yes	4,067	No	93.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	4	Supply Fan	20.0	94.0%	Yes	4,067	No	94.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	2	Chilled Water Pump	30.0	93.6%	Yes	4,067	No	93.6%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	2	Other	1.5	80.0%	No	2,745	No	80.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	2	Heating Hot Water Pump	10.0	91.7%	Yes	4,067	No	91.7%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	2	Ventilation Fan	5.0	87.5%	No	4,067	No	87.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	1	Air Compressor	1.0	80.0%	No	4,957	No	80.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
1st floor	1st floor	1	Other	5.0	87.5%	No	2,745	No	87.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical room	Whole building	2	Other	5.0	87.5%	No	2,745	No	87.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Data and Telco rooms	11	Split-System AC	3.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric Chiller Inventory & Recommendations

		Existing Conditions			Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Chiller Quantity	System Type	Cooling Capacity per Unit (Tons)	Install High Efficiency Chillers?	Chiller Quantity	System Type	Constant/ Variable Speed	Cooling Capacity (Tons)	Full Load Efficiency (kW/Ton)	IPLV Efficiency (kW/Ton)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Central plant	Whole building	1	Water-Cooled Centrifugal Chiller	410.00	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
Central plant	Whole building	1	Forced Draft Steam Boiler	7,010.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Whole building	2	Furnace	400.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Demand Control Ventilation Recommendations

		Recommendation Inputs				Energy Impact & Financial Analysis					
Location	Area(s)/System(s) Affected	Number of Zones	Cooling Capacity of Controlled System (Tons)	Electric Heating Capacity of Controlled System (kBtu/hr)	Output Heating Capacity of Controlled System (MBh)	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
45 classrooms	classrooms	45	130.00		1,939.67	10,400	127.0	$5,340.62	$61,173.90	$0.00	11.45

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical room	Whole building	1	Indirect System	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Cafeteria	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Cafeteria	2	Stand-Up Refrigerator, Glass Door (>50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Ice Maker Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Ice Maker Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Cafeteria	1	Ice Making Head (<450 lbs/day), Batch	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Novelty Cooler Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Cooler Description	Install Automatic Shutoff Control?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Cafeteria	17	Small cooler	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Whole building	363	Desktop computer with LCD	270.0	Yes
Whole building	59	Wall TV	150.0	Yes
Whole building	15	Copy machine	515.0	Yes
Whole building	17	Microwave	1,000.0	Yes
Whole building	9	Water fountain	400.0	No
Whole building	142	Printer	200.0	Yes
Whole building	11	Coffee machine	900.0	No
Data center	1	Servers	152,310.0	No

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Corridor	1	Refrigerated	Yes	0.00	1,612	0.0	$270.79	$230.00	$0.00	0.85
Corridor	1	Non-Refrigerated	Yes	0.00	343	0.0	$57.54	$230.00	$0.00	4.00

APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

N/A

ENERGY STAR® Score[1]

Montclair State University Campus (Buildings 1-41)

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

For Year Ending: October 31, 2016
Date Generated: October 10, 2017

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

Property & Contact Information

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

Property ID: 6069294

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
172.3 kBtu/ft²

Annual Energy by Fuel

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

Source EUI
306.4 kBtu/ft²

National Median Comparison

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

Annual Emissions

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

Signature & Stamp of Verifying Professional

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

Signature: ______________________ Date: __________

Licensed Professional

____ ________
,
(___)___-_____
____

Professional Engineer Stamp
(if applicable)