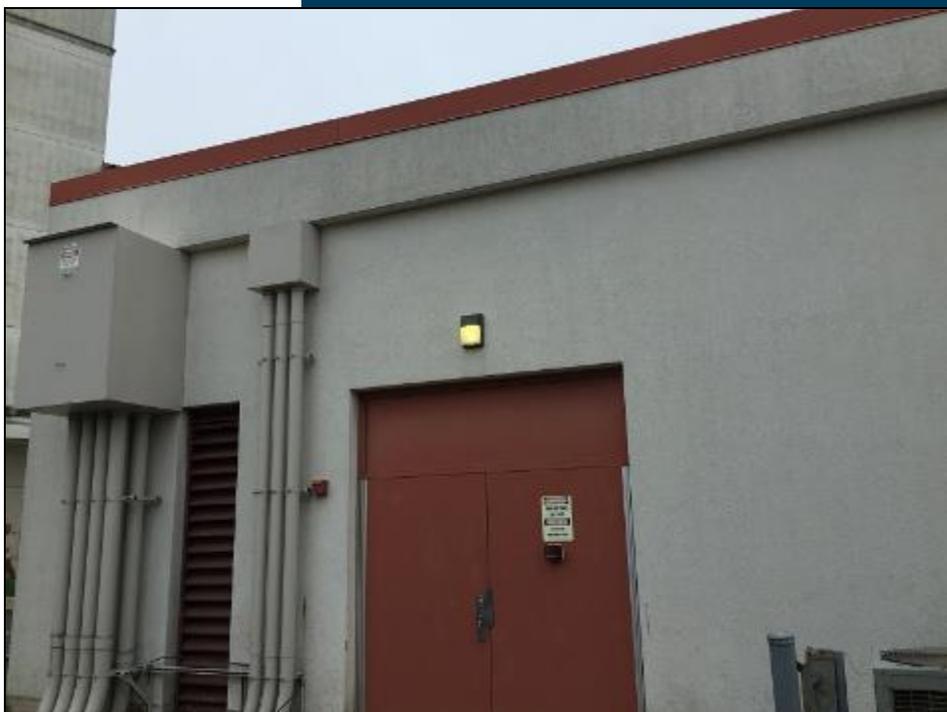




Local Government Energy Audit: Energy Audit Report



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Electrical Substation

1 Normal Ave

Montclair, New Jersey 07043

Montclair State University

July 11, 2018

Final Report by:

TRC Energy Services

Disclaimer

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

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

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

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

Table of Contents

- 1 Executive Summary.....4**

 - 1.1 Facility Summary 4
 - 1.2 Your Cost Reduction Opportunities..... 4
 - Energy Conservation Measures.....4
 - Energy Efficient Practices6
 - On-Site Generation Measures.....6
 - 1.3 Implementation Planning..... 6

- 2 Facility Information and Existing Conditions8**

 - 2.1 Project Contacts 8
 - 2.2 General Site Information..... 8
 - 2.3 Building Occupancy 8
 - 2.4 Building Envelope 8
 - 2.5 On-Site Generation..... 9
 - 2.6 Energy-Using Systems 9
 - Lighting System9
 - Direct Expansion Air Conditioning System (DX)10
 - Building Plug Load10

- 3 Site Energy Use and Costs.....11**

 - 3.1 Total Cost of Energy 11
 - 3.2 Electricity Usage 12
 - 3.3 Benchmarking..... 13
 - 3.4 Energy End-Use Breakdown 14

- 4 Energy Conservation Measures15**

 - 4.1 High Priority ECMs..... 15
 - 4.2 Lighting Upgrades..... 16
 - ECM 1: Retrofit Fixtures with LED Lamps..... 16
 - 4.3 Lighting Control Measures 17
 - ECM 2: Install Occupancy Sensor Lighting Controls17

- 5 Energy Efficient Practices18**

 - Perform Proper Lighting Maintenance.....18
 - Develop a Lighting Maintenance Schedule18
 - Clean Evaporator/Condenser Coils on AC Systems18
 - Clean and/or Replace HVAC Filters18
 - Plug Load Controls.....18

- 6 On-Site Generation Measures19**

 - 6.1 Photovoltaic..... 19
 - 6.2 Combined Heat and Power 20

- 7 Demand Response21**
- 8 Project Funding / Incentives22**

8.1	SmartStart	23
8.2	Pay for Performance - Existing Buildings.....	24
8.3	Energy Savings Improvement Program	25
9	Energy Purchasing and Procurement Strategies	26
9.1	Retail Electric Supply Options.....	26
9.2	Retail Natural Gas Supply Options	26

Appendix A: Equipment Inventory & Recommendations

Appendix B: ENERGY STAR® Statement of Energy Performance

Table of Figures

Figure 1 – Previous 12 Month Utility Costs..... 5

Figure 2 – Potential Post-Implementation Costs 5

Figure 3 – Summary of Energy Reduction Opportunities 5

Figure 4 – Project Contacts 8

Figure 5 - Building Schedule..... 8

Figure 6 – Building Façade 8

Figure 7 - Building Lighting Systems 9

Figure 8 – Split System DX Air Conditioner 10

Figure 9 - Utility Summary 11

Figure 10 - Energy Cost Breakdown 11

Figure 11 - Electric Usage & Demand..... 12

Figure 12 - Electric Usage & Demand..... 12

Figure 13 - Energy Use Intensity Comparison – Existing Conditions..... 13

Figure 14 - Energy Use Intensity Comparison – Following Installation of Recommended Measures 13

Figure 15 - Energy Balance (% and kBtu/SF) 14

Figure 16 – Summary of High Priority ECMs 15

Figure 17 – Summary of Lighting Upgrade ECMs..... 16

Figure 18 – Summary of Lighting Control ECMs 17

Figure 19 - ECM Incentive Program Eligibility..... 22

I EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPUB) has sponsored this Local Government Energy Audit (LGEA) Report for Electrical Substation.

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.

I.1 Facility Summary

Electrical Substation is a 3,364-square foot facility constructed in the year 1972. The building is a one-story facility housing electrical equipment such as breakers and transformers.

Lighting at electrical substation consists of 32-Watt T8 fluorescent fixtures which are inefficient in performance when compared to the latest lighting technology available in the market. Exterior lighting is provided by 26-Watt compact fluorescent fixtures. Lighting control is provided by manual switches for both interior fixtures and exterior fixtures. In addition, the substation also has LED based exit signs.

Cooling is provided by a DX based split system air conditioner. There is no heating at the facility.

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

I.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated and recommends two (2) measures which together represent an opportunity for Electrical Substation to reduce annual energy costs by roughly \$150 and annual greenhouse gas emissions by 901 lbs CO₂e. We estimate that if all the measures are implemented as recommended, the project will pay for itself in roughly 18.9 years. 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 Electrical Substation's annual energy use by 5%.

Figure 1 – Previous 12 Month Utility Costs

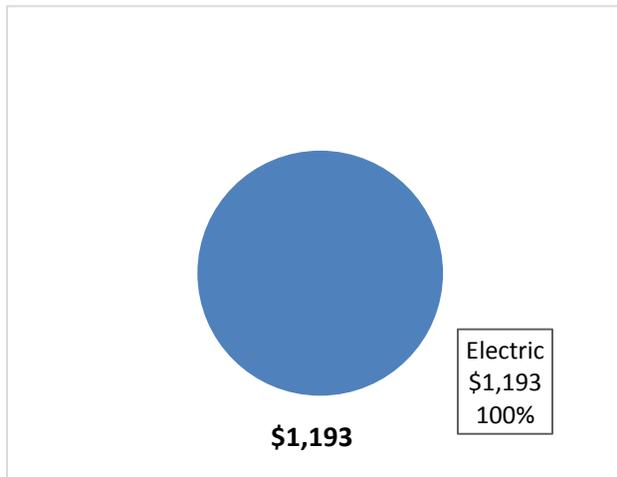
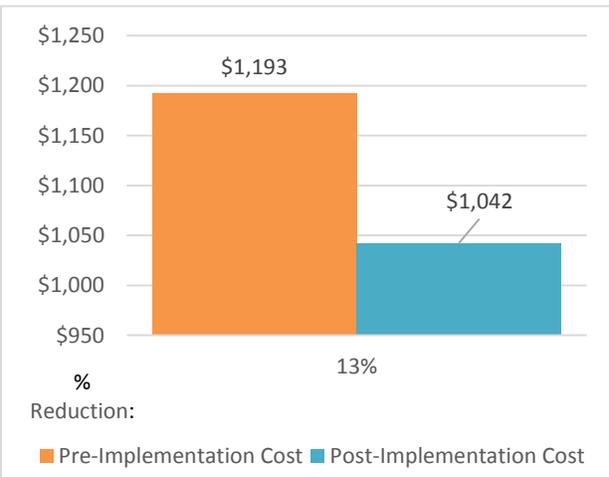


Figure 2 – Potential Post-Implementation Costs



A detailed description of Electrical Substation’s existing energy use can be found in Section 3.

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

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		High Priority?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Lighting Upgrades			714	0.9	0.0	\$119.98	\$2,297.01	\$400.00	\$1,897.01	15.8	719
ECM 1	Retrofit Fixtures with LED Lamps	Yes	714	0.9	0.0	\$119.98	\$2,297.01	\$400.00	\$1,897.01	15.8	719
Lighting Control Measures			181	0.2	0.0	\$30.40	\$1,080.00	\$140.00	\$940.00	30.9	182
ECM 2	Install Occupancy Sensor Lighting Controls	Yes	181	0.2	0.0	\$30.40	\$1,080.00	\$140.00	\$940.00	30.9	182
TOTALS FOR HIGH PRIORITY MEASURES			895	1.1	0.0	\$150.38	\$3,377.01	\$540.00	\$2,837.01	18.9	901
TOTALS FOR ALL EVALUATED MEASURES			895	1.1	0.0	\$150.38	\$3,377.01	\$540.00	\$2,837.01	18.9	901

* - 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.

Energy Efficient Practices

TRC also identified five (5) 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 Electrical Substation include:

- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Clean Evaporator/Condenser Coils on AC Systems
- Clean and/or Replace HVAC Filters
- Install Plug Load Controls

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 Electrical Substation. 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.

I.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			
Smruti Srinivasan	Auditor	SSrinivasan@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On April 26, 2017, TRC performed an energy audit at Electrical Substation 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.

Electrical Substation is a 3,364-square foot facility constructed in the year 1972. The building is a one-story facility having electrical equipment such as breakers and transformers.

Lighting at electrical substation consists of 32-Watt T8 fluorescent fixtures which are inefficient in performance when compared to the latest lighting technology available in the market. Exterior lighting is provided by 26-Watt compact fluorescent fixtures. Lighting control is provided by manual switches for both interior fixtures and exterior fixtures. In addition, the substation also has LED based exit signs.

Cooling is provided by a DX based split system air conditioner. There is no heating at the facility.

2.3 Building Occupancy

The typical operating schedule is presented in the table below, however the building is only intermittently occupied.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Electrical Substation	Weekday	12:00 AM - 12:00 AM
Electrical Substation	Weekend	12:00 AM - 12:00 AM

2.4 Building Envelope

The electrical substation is a one-story building. The construction is of concrete masonry block with finished painted exterior. The flat roof is constructed of built-up roofing material.

Figure 6 – Building Façade



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.

Electrical Substation does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

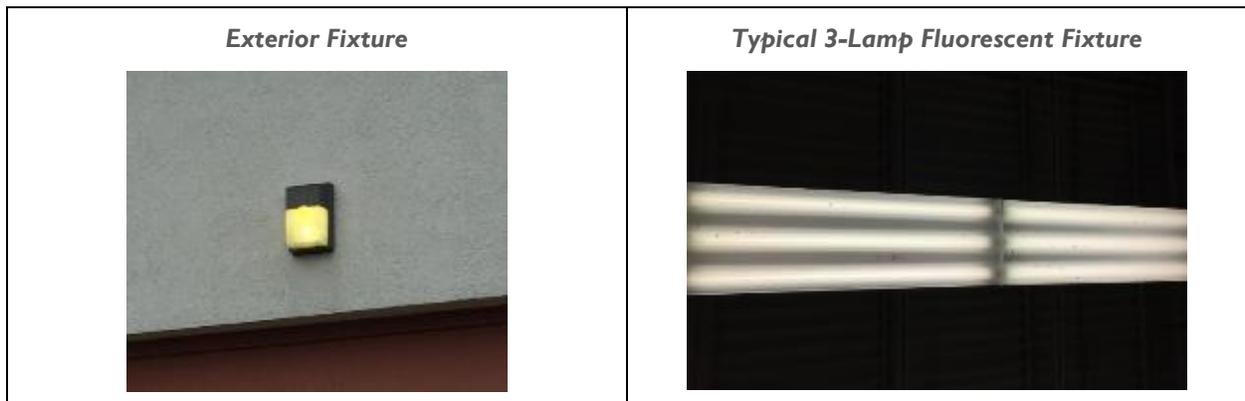
Please see **Appendix A: Equipment Inventory & Recommendations** for a detailed list of the locations and recommended upgrades for each measure.

Lighting System

Lighting at electrical substation consists primarily of 32-Watt T8 fluorescent fixtures which are inefficient in performance when compared to the latest lighting technology available in the market. All the fixtures are 4-foot long with wraparound lenses and in 1 and 3-lamp configurations. In addition to the fluorescent fixtures, the facility is also served by LED based exit fixtures.

Interior lighting control in the building is provided by manual switches.

Figure 7 - Building Lighting Systems

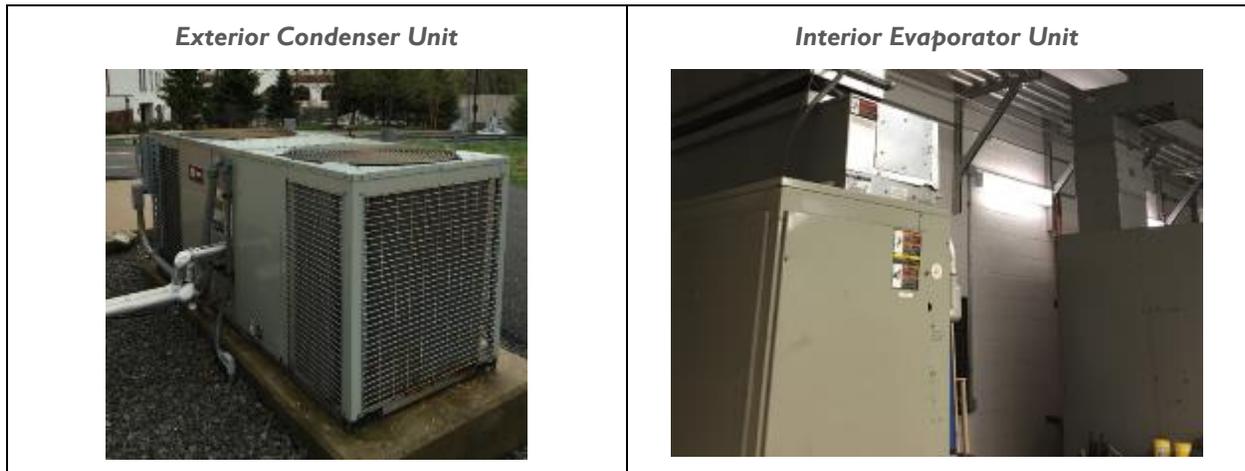


The building's exterior lighting consists of 26-Watt compact fluorescent fixtures. The exterior lamps are controlled by manual switches.

Direct Expansion Air Conditioning System (DX)

A 15-ton Trane cooling-only split system is used to condition the electrical substation. The fan and evaporator are located in the substation area. The compressor and condensing unit are located on the ground outside the building. The unit provides constant air volume air flow with a single 3 hp supply fan. The unit utilizes two (2) scroll compressors, two (2) condenser fan units, and a direct-expansion (DX) coil.

Figure 8 – Split System DX Air Conditioner



Building Plug Load

The facility has one (1) LCD monitor connected to the substation. The monitor is operated rarely around two (2) hours per week. This analysis neglects the power consumption of the substation equipment, attributed to transformer and other equipment inefficiencies and part of overall campus power distribution. The utility prorata for this building does not incorporate system distribution losses which fall outside the scope of this building assessment.

3 SITE ENERGY USE AND COSTS

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

Prorated and direct purchase utility data were evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the “typical” energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.3 for additional information.

3.1 Total Cost of Energy

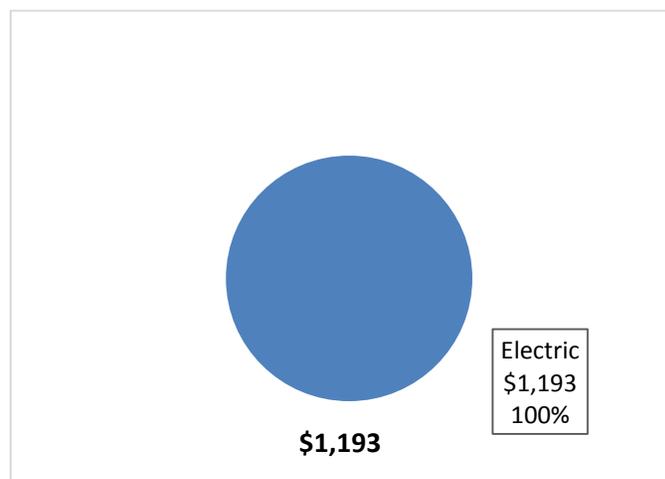
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 9 - Utility Summary

Utility Summary for Electrical Substation		
Fuel	Usage	Cost
Electricity	17,430 kWh	\$1,193
Total		\$1,193

The current annual energy cost for this facility is \$1,193 as shown in the chart below.

Figure 10 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months 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. The monthly electricity consumption and peak demand are shown in the chart below.

Figure 11 - Electric Usage & Demand

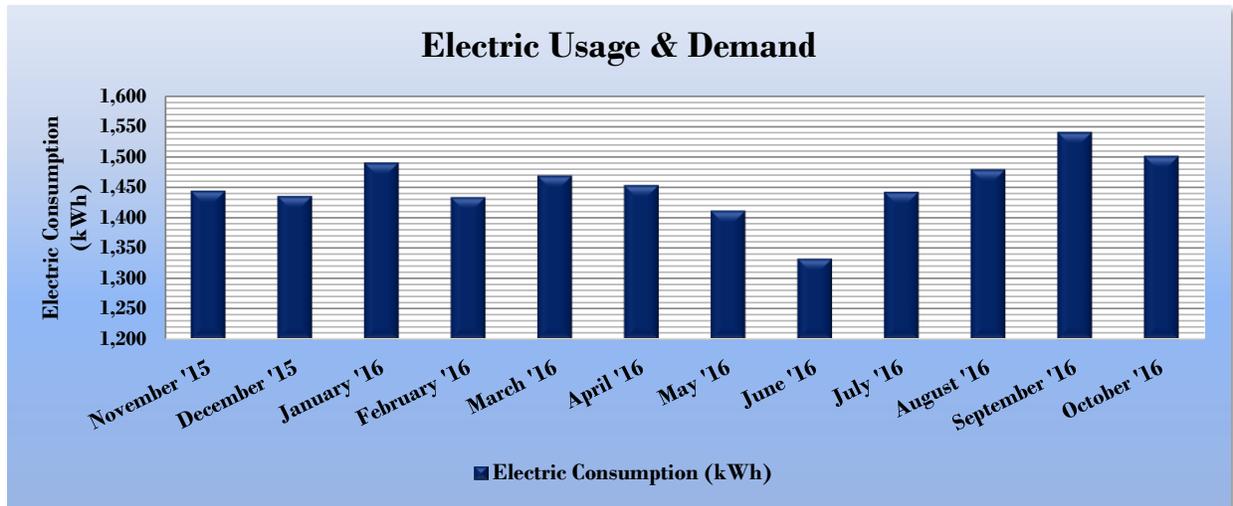


Figure 12 - Electric Usage & Demand

Electric Billing Data for Electrical Substation				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
11/30/15	30	1,444	\$85	Yes
12/31/15	31	1,435	\$108	Yes
1/31/16	31	1,490	\$89	Yes
2/28/16	28	1,434	\$206	Yes
3/31/16	31	1,469	\$82	Yes
4/30/16	30	1,453	\$82	Yes
5/31/16	31	1,411	\$81	Yes
6/30/16	30	1,332	\$87	Yes
7/31/16	31	1,442	\$92	Yes
8/31/16	31	1,479	\$97	Yes
9/30/16	30	1,540	\$95	Yes
10/31/16	31	1,501	\$89	Yes
Totals	365	17,430	\$1,193	12
Annual	365	17,430	\$1,193	

3.3 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 13 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Electrical Substation	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft ²)	55.5	262.6
Site Energy Use Intensity (kBtu/ft ²)	17.7	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 14 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Electrical Substation	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft ²)	52.7	262.6
Site Energy Use Intensity (kBtu/ft ²)	16.8	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.

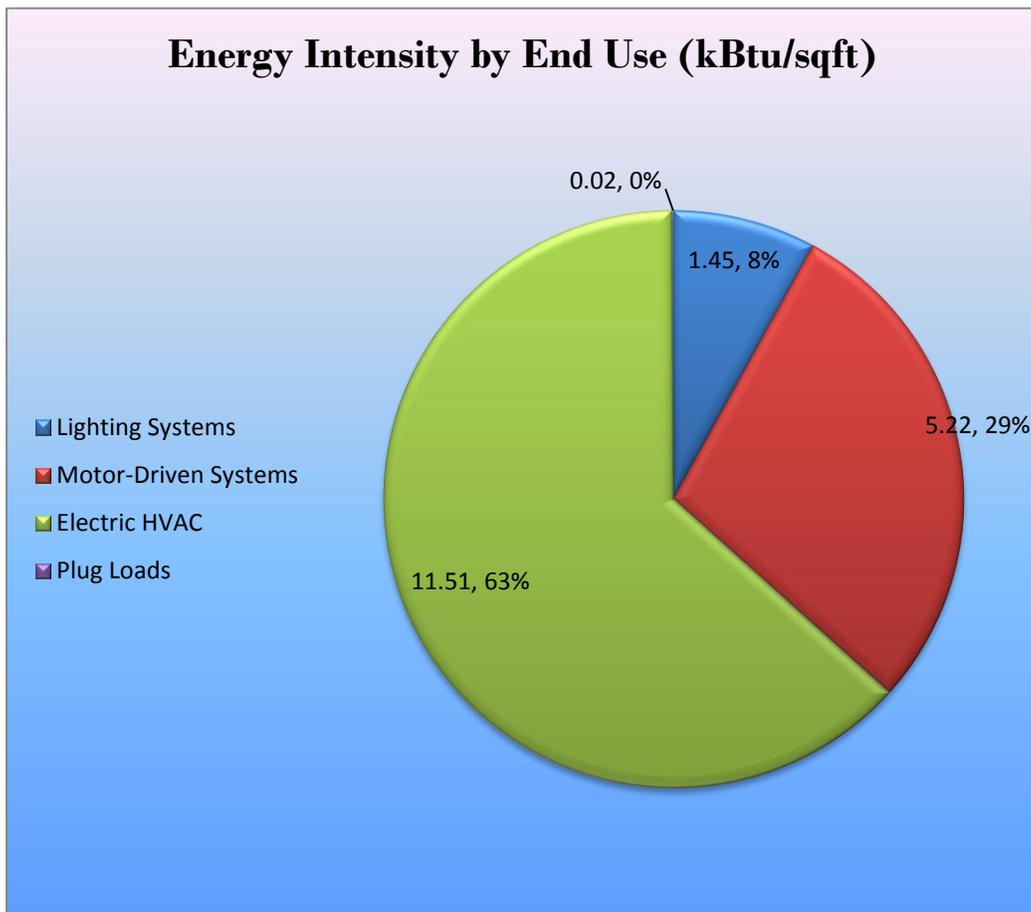
For more information on ENERGY STAR® certification go to: <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1>.

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>.

3.4 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 15 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the campus 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 16 – Summary of High Priority ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Lighting Upgrades		714	0.9	0.0	\$119.98	\$2,297.01	\$400.00	\$1,897.01	15.8	719
ECM 1	Retrofit Fixtures with LED Lamps	714	0.9	0.0	\$119.98	\$2,297.01	\$400.00	\$1,897.01	15.8	719
Lighting Control Measures		181	0.2	0.0	\$30.40	\$1,080.00	\$140.00	\$940.00	30.9	182
ECM 2	Install Occupancy Sensor Lighting Controls	181	0.2	0.0	\$30.40	\$1,080.00	\$140.00	\$940.00	30.9	182
TOTALS		895	1.1	0.0	\$150.38	\$3,377.01	\$540.00	\$2,837.01	18.9	901

* - 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 17 below.

Figure 17 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO ₂ e Emissions Reduction (lbs)
Lighting Upgrades		714	0.9	0.0	\$119.98	\$2,297.01	\$400.00	\$1,897.01	15.8	719
ECM 1	Retrofit Fixtures with LED Lamps	714	0.9	0.0	\$119.98	\$2,297.01	\$400.00	\$1,897.01	15.8	719

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 I: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO ₂ e Emissions Reduction (lbs)
Interior	695	0.9	0.0	\$116.80	\$2,189.50	\$400.00	\$1,789.50	15.3	700
Exterior	19	0.0	0.0	\$3.18	\$107.51	\$0.00	\$107.51	33.8	19

Measure Description

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

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes.

4.3 Lighting Control Measures

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

Figure 18 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO ₂ e Emissions Reduction (lbs)
Lighting Control Measures		181	0.2	0.0	\$30.40	\$1,080.00	\$140.00	\$940.00	30.9	182
ECM 2	Install Occupancy Sensor Lighting Controls	181	0.2	0.0	\$30.40	\$1,080.00	\$140.00	\$940.00	30.9	182

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 2: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)	Estimated Net Cost (\$)	Simple Payback Period (yrs)	CO ₂ e Emissions Reduction (lbs)
181	0.2	0.0	\$30.40	\$1,080.00	\$140.00	\$940.00	30.9	182

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in the main room of the electrical substation. However, staff is advised to consider occupant safety with respect to the electrical equipment and the switching layout when designing the automatic switching approach.

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.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Perform Proper Lighting Maintenance

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

Develop a Lighting Maintenance Schedule

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

Clean Evaporator/Condenser Coils on AC Systems

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

Clean and/or Replace HVAC Filters

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

Plug Load Controls

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

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 is 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 19 for a list of the eligible programs identified for each recommended ECM.

Figure 19 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	Pay For Performance Existing Buildings
ECM 1	Retrofit Fixtures with LED Lamps	X	X
ECM 2	Install Occupancy Sensor Lighting Controls	X	X

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

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

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

8.1 SmartStart

Overview

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

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers

Electric Unitary HVAC

Gas Cooling

Gas Heating

Gas Water Heating

Ground Source Heat Pumps

Lighting

Lighting Controls

Refrigeration Doors

Refrigeration Controls

Refrigerator/Freezer Motors

Food Service Equipment

Variable Frequency Drives

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

Incentives

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

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

How to Participate

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

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

8.2 Pay for Performance - Existing Buildings

Overview

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

Incentives

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

How to Participate

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

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

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

8.3 Energy Savings Improvement Program

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

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

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

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

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

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

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

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

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

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

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

9.2 Retail Natural Gas Supply Options

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

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

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

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

APPENDIX A: EQUIPMENT INVENTORY & RECOMMENDATIONS

Lighting Inventory & Recommendations

Location	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Exterior	2	Compact Fluorescent: CFL - 26W	Wall Switch	26	520	Relamp	No	2	LED Screw-In Lamps: LED - 8 W	Wall Switch	8	520	0.02	19	0.0	\$3.18	\$107.51	\$0.00	33.81
Main Room	21	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	520	Relamp	Yes	21	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	364	0.97	786	0.0	\$131.96	\$2,119.20	\$385.00	13.14
Main Room	17	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	520	Relamp	Yes	17	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	364	0.27	222	0.0	\$37.32	\$1,150.30	\$155.00	26.67
Main Room	2	Exit Signs: LED - 2 W Lamp	Wall Switch	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	Wall Switch	6	8,760	0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00

Motor Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
		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
Main Room	Electrical Substation	1	Supply Fan	3.0	89.5%	No	2,745	No	89.5%	No		0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00

Electric HVAC Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions							Proposed Conditions						Energy Impact & Financial Analysis					
		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
Building Exterior	Electrical Substation	1	Split-System AC	15.00		No							No	0.00	0	0.0	\$0.00	\$0.00	\$0.00	0.00

Plug Load Inventory

Location	Existing Conditions			
	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Main Room	1	Monitor	150.0	Yes

APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

N/A

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

ENERGY STAR® Score¹

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 State 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	Annual Energy by Fuel	National Median Comparison
172.3 kBtu/ft ²	District Chilled Water - 81,507,530 (16%) Other (kBtu)	National Median Site EUI (kBtu/ft ²) 147.6 National Median Source EUI (kBtu/ft ²) 262.6 % Diff from National Median Source EUI 17%
	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/ft ²		Annual Emissions Greenhouse Gas Emissions (Metric Tons CO ₂ e/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)