Local Government Energy Audit Report

Armstrong Hall

May 6, 2021

Prepared for:

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Disclaimer

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information about financial incentives that may be available. Most energy conservation measures have received preliminary analysis of feasibility that identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to establish a basis for further discussion and to help prioritize energy measures.

TRC reviewed the energy conservation measures and estimates of energy savings for technical accuracy. Actual, achieved energy savings depend on behavioral factors and other uncontrollable variables and, therefore, estimates of final energy savings are not guaranteed. TRC and the New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

TRC bases estimated material and labor costs primarily on RS Means cost manuals as well as on our experience at similar facilities. This approach is based on standard cost estimating manuals and is vendor neutral. Cost estimates include material and labor pricing associated with one for one equipment replacements. Cost estimates do not include demolition or removal of hazardous waste. The actual implementation costs for energy savings projects are anticipated to be significantly higher based on the specific conditions at your site(s). We strongly recommend that you work with your design engineer or contractor to develop actual project costs for your specific scope of work for the installation of high efficiency equipment. We encourage you to obtain multiple estimates when considering measure installations. Actual installation costs can vary widely based on selected products and installers. TRC and NJBPU do not guarantee cost estimates and shall in no event be held liable should actual installed costs vary from these material and labor 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. Please review all available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

The customer and their respective contractor(s) are responsible to implement energy conservation measures in complete conformance with all applicable local, state, and federal requirements.

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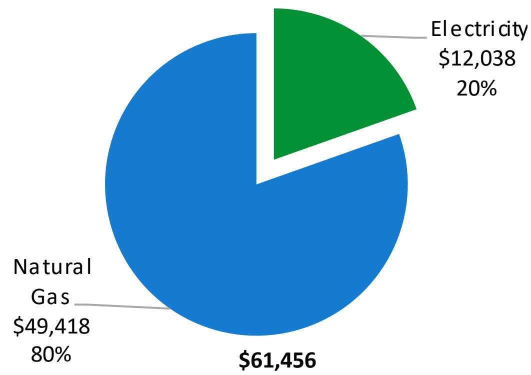
1 Executive Summary

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Armstrong Hall. This report provides you with information about your facility's energy use, identifies energy conservation measures (ECMs) that can reduce your energy use, and provides information and assistance to help make changes in your facility. TRC conducted this study as part of a comprehensive effort to assist New Jersey school districts and local governments in controlling their energy costs and to help protect our environment by reducing statewide energy consumption.

BUILDING PERFORMANCE REPORT

Annual Utilities	Costs: $61,456 Electricity: 422,557 kWh Natural Gas: 111,759 Therms	
ENERGY STAR® Benchmarking Score	N/A *(1-100 scale)*	A standard energy use benchmark is not available for this facility type. This report contains suggestions about how to improve building performance and reduce energy costs.

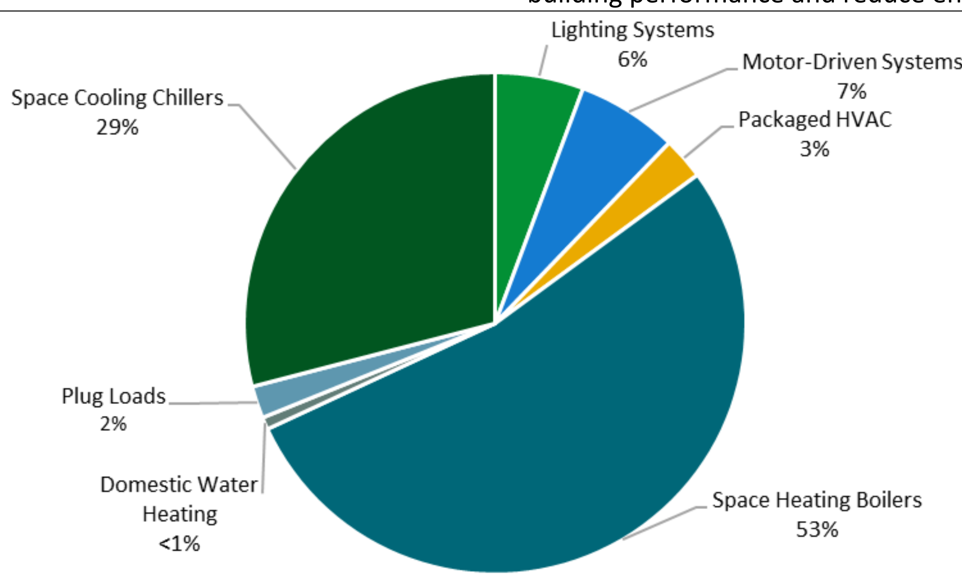


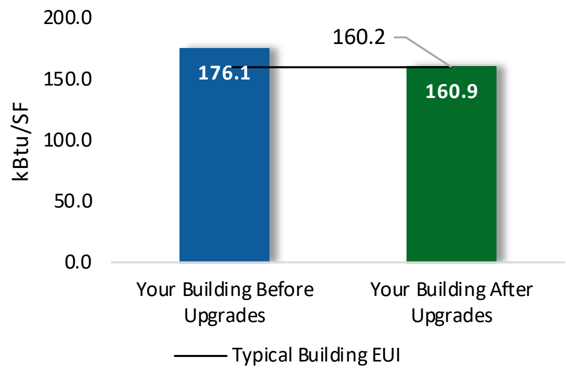
Figure 1 - Energy Use by System

POTENTIAL IMPROVEMENTS

This energy audit considered a range of potential energy improvements in your building. Costs and savings will vary between improvements. Presented below are two potential scopes of work for your consideration.

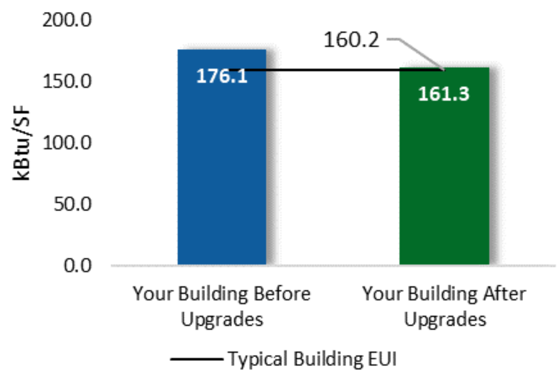
Scenario 1: Full Package (all evaluated measures)

Installation Cost	$230,076
Potential Rebates & Incentives[1]	$29,149
Annual Cost Savings	$33,743
Annual Energy Savings	Electricity: 219,019 kWh Natural Gas: 3,440 Therms
Greenhouse Gas Emission Savings	130 Tons
Simple Payback	6.0 Years
Site Energy Savings (all utilities)	9%



Scenario 2: Cost Effective Package[2]

Installation Cost	$186,039
Potential Rebates & Incentives	$27,313
Annual Cost Savings	$32,507
Annual Energy Savings	Electricity: 210,742 kWh Natural Gas: 3,400 Therms
Greenhouse Gas Emission Savings	126 Tons
Simple Payback	4.9 Years
Site Energy Savings (all utilities)	8%



On-site Generation Potential

Photovoltaic	High
Combined Heat and Power	None

[1] Incentives are based on current SmartStart Prescriptive incentives. Other program incentives may apply.

[2] A cost-effective measure is defined as one where the simple payback does not exceed two-thirds of the expected proposed equipment useful life. Simple payback is based on the net measure cost after potential incentives.

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**107,371**	**30.0**	**-22**	**$15,701**	**$54,687**	**$11,489**	**$43,198**	**2.8**	**105,594**
ECM 1	Install LED Fixtures	Yes	33,431	9.0	-6	$4,890	$20,650	$3,075	$17,575	3.6	32,915
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	519	0.2	0	$76	$361	$55	$306	4.0	510
ECM 3	Retrofit Fixtures with LED Lamps	Yes	73,421	20.7	-15	$10,735	$33,675	$8,359	$25,316	2.4	72,169
Lighting Control Measures			**31,517**	**7.5**	**-6**	**$4,610**	**$31,367**	**$9,159**	**$22,208**	**4.8**	**31,035**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	20,378	6.0	-4	$2,979	$24,354	$3,559	$20,795	7.0	20,021
ECM 5	Install High/Low Lighting Controls	Yes	11,139	1.6	-2	$1,631	$7,013	$5,600	$1,413	0.9	11,014
Motor Upgrades			**6,553**	**2.0**	**0**	**$964**	**$4,832**	**$0**	**$4,832**	**5.0**	**6,599**
ECM 6	Premium Efficiency Motors	Yes	6,553	2.0	0	$964	$4,832	$0	$4,832	5.0	6,599
Variable Frequency Drive (VFD) Measures			**57,463**	**17.0**	**0**	**$8,454**	**$71,405**	**$6,900**	**$64,505**	**7.6**	**57,865**
ECM 7	Install VFD on Variable Air Volume (VAV) Fans	Yes	29,385	11.9	0	$4,323	$32,470	$3,775	$28,695	6.6	29,590
ECM 8	Install VFDs on Constant Volume (CV) Fans	No	3,921	1.3	0	$577	$17,085	$325	$16,760	29.1	3,949
ECM 9	Install VFDs on Heating Water Pumps	Yes	24,157	3.8	0	$3,554	$21,850	$2,800	$19,050	5.4	24,326
Unitary HVAC Measures			**4,356**	**4.1**	**4**	**$659**	**$26,952**	**$1,511**	**$25,441**	**38.6**	**4,878**
ECM 10	Install High Efficiency Air Conditioning Units	No	4,356	4.1	4	$659	$26,952	$1,511	$25,441	38.6	4,878
HVAC System Improvements			**0**	**0.0**	**1**	**$6**	**$14**	**$4**	**$10**	**1.8**	**150**
ECM 11	Install Pipe Insulation	Yes	0	0.0	1	$6	$14	$4	$10	1.8	150
Domestic Water Heating Upgrade			**0**	**0.0**	**4**	**$19**	**$65**	**$36**	**$29**	**1.5**	**500**
ECM 12	Install Low-Flow DHW Devices	Yes	0	0.0	4	$19	$65	$36	$29	1.5	500
Food Service & Refrigeration Measures			**1,551**	**0.2**	**0**	**$228**	**$460**	**$50**	**$410**	**1.8**	**1,562**
ECM 13	Vending Machine Control	Yes	1,551	0.2	0	$228	$460	$50	$410	1.8	1,562
Custom Measures			**10,208**	**0.0**	**362**	**$3,102**	**$40,294**	**$0**	**$40,294**	**13.0**	**52,643**
ECM 14	Retro-Commissioning Study	Yes	5,983	0.0	213	$1,820	$21,494	$0	$21,494	11.8	30,905
ECM 15	Sub Metering	Yes	4,226	0.0	149	$1,282	$18,800	$0	$18,800	14.7	21,737
TOTALS (COST EFFECTIVE MEASURES)			**210,742**	**55.4**	**340**	**$32,507**	**$186,039**	**$27,313**	**$158,726**	**4.9**	**251,999**
TOTALS (ALL MEASURES)			**219,019**	**60.8**	**344**	**$33,743**	**$230,076**	**$29,149**	**$200,927**	**6.0**	**260,826**

* - All incentives presented in this table are based on NJ SmartStart 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).

Figure 2 – Evaluated Energy Improvements

For more detail on each evaluated energy improvement and a break out of cost-effective improvements, see **Section 4: Energy Conservation Measures**.

1.1 Planning Your Project

Careful planning makes for a successful energy project. When considering this scope of work, you will have some decisions to make, such as:

- How will the project be funded and/or financed?
- Is it best to pursue individual ECMs, groups of ECMs, or use a comprehensive approach where all ECMs are installed together?
- Are there other facility improvements that should happen at the same time?

Pick Your Installation Approach

New Jersey's Clean Energy Programs give you the flexibility to do a little or a lot. Rebates, incentives, and financing are available to help reduce both your installation costs and your energy bills. If you are planning to take advantage of these programs, make sure to review incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives before purchasing materials or starting installation.

The potential ECMs identified for this building likely qualify for multiple incentive and funding programs. Based on current program rules and requirements, your measures are likely to qualify for the following programs:

Energy Conservation Measure		SmartStart	Direct Install	Pay For Performance
ECM 1	Install LED Fixtures	x		x
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	x		x
ECM 3	Retrofit Fixtures with LED Lamps	x		x
ECM 4	Install Occupancy Sensor Lighting Controls	x		x
ECM 5	Install High/Low Lighting Controls	x		x
ECM 6	Premium Efficiency Motors			x
ECM 7	Install VFD on Variable Air Volume (VAV) Fans	x		x
ECM 8	Install VFDs on Constant Volume (CV) Fans	x		x
ECM 9	Install VFDs on Heating Water Pumps	x		x
ECM 10	Install High Efficiency Air Conditioning Units	x		x
ECM 11	Install Pipe Insulation	x		x
ECM 12	Install Low-Flow DHW Devices	x		x
ECM 13	Vending Machine Control	x		x
ECM 14	Retro-Commissioning Study			
ECM 15	Sub Metering			

Figure 3 – Funding Options

New Jersey’s Clean Energy Programs At-A-Glance

	SmartStart Flexibility to install at your own pace	**Direct Install** Turnkey installation	**Pay for Performance** Whole building upgrades
Who should use it?	Buildings installing individual measures or small group of measures.	Small to mid-size facilities that can bundle multiple measures together. Average peak demand should be below 200 kW. Not suitable for significant building shell issues.	Mid to large size facilities looking to implement as many measures as possible at one time. Peak demand should be over 200 kW.
How does it work?	Use in-house staff or your preferred contractor.	Pre-approved contractors pass savings along to you via reduced material and labor costs.	Whole-building approach to energy upgrades designed to reduce energy use by at least 15%. The more you save, the higher the incentives.
What are the Incentives?	Fixed incentives for specific energy efficiency measures.	Incentives pay up to 70% of eligible costs, up to $125,000 per project. You pay the remaining 30% directly to the contractor.	Incentives are paid out in three installments. The first installment is meant to help offset the costs of the initial engineering study. The subsequent incentives are paid based on the level of energy savings up to 50% of the total project cost. See Section 7.3 for all incentive details.
How do I participate?	Submit an application for the specific equipment to be installed.	Contact a participating contractor in your region.	Contact a pre-qualified Partner to develop your Energy Reduction Plan and set your energy savings targets.

Take the next step by visiting **www.njcleanenergy.com** for
program details, applications, and to contact a qualified contractor.

Individual Measures with SmartStart

For facilities wishing 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, you can use internal resources or an outside firm or contractor to perform the final design of the ECM(s) and install the equipment. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation.

Turnkey Installation with Direct Install

The Direct Install program provides turnkey installation of multiple measures through an authorized network of participating contractors. This program can provide substantially higher incentives than SmartStart, up to 70 percent of the cost of selected measures. Direct Install contractors will assess and verify individual measure eligibility and, in most cases, they perform the installation work. The Direct Install program is available to sites with an average peak demand of less than 200 kW.

Whole Building Approach with Pay for Performance

Pay for Performance can be a good option for medium to large sized facilities to achieve deep energy savings. Pay for Performance allows you to install as many measures as possible under a single project as well as address measures that may not qualify for other programs. Many facilities pursuing an Energy Savings Improvement Program (ESIP) loan also use this program. Pay for Performance works for larger customers with a peak demand over 200 kW. The minimum installed scope of work must include at least two unique measures resulting in at least 15 percent energy savings, where lighting cannot make up the majority of the savings.

More Options from Around the State

Financing and Planning Support with the Energy Savings Improvement Program (ESIP)

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the 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. You have already taken the first step as an LGEA customer, because this report is required to participate in ESIP.

Resiliency with Return on Investment through Combined Heat & Power (CHP)

The CHP program provides incentives for combined heat and power (aka cogeneration) and waste heat to power projects. Combined heat and power systems generate power on-site and recover heat from the generation system to meet on-site thermal loads. Waste heat to power systems use waste heat to generate power. You will work with a qualified developer who will design a system that meets your building's heating and cooling needs.

Ongoing Electric Savings with Demand Response

The Demand Response Energy Aggregator program reduces 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. By enabling commercial facilities to reduce electric demand 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 demand response (DR) programs. Program participation is voluntary, and facilities receive payments regardless of whether they are called upon to curtail their load during times of peak demand.

2 Existing Conditions

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Armstrong Hall. This report provides information on how your facility uses energy, identifies energy conservation measures (ECMs) that can reduce your energy use, and provides information and assistance to help you implement the ECMs. This report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

TRC conducted this study as part of a comprehensive effort to assist New Jersey educational and local government facilities in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

2.1 Site Overview

On November 10, 2020, TRC performed an energy audit at Armstrong Hall located in Ewing, New Jersey. TRC met with Sean Rust to review the facility operations and help focus our investigation on specific energy-using systems.

Armstrong Hall is a one-story, 71,647 square foot building built in 1961. Spaces include classrooms, offices, corridors, computer labs, laboratories, shops, locker rooms, lounges, conference rooms, copy rooms, rest rooms, server rooms, hallways, vestibules, electrical rooms, mechanical rooms, storage rooms, closets, and a parking garage.

Facility concerns include installing utility sub-meters, which is addressed in Section 4.0.

2.2 Building Occupancy

The facility is occupied from September through June. Typical weekday occupancy is 974 staff and 58 students.

Typical building occupancy is from 7:00 AM to 10:00 PM during the weekday. Weekend use is minimal and varied, while summer occupancy includes continuing maintenance activities.

Building Name	Weekday/Weekend	Operating Schedule
Armstrong Hall	Weekday	7:00 AM - 10:00 PM
	Weekend	Varies
	Summer	Closed

Figure 4 - Building Occupancy Schedule

2.3 Building Envelope

Building walls are concrete masonry units over structural steel with a brick façade with some stone features. The section of the roof that is flat is covered with a single ply membrane, while the pitched section of the roof is covered in natural slate shingles. Overall, the roof is in fair condition.

Most of the windows are double pane, clear, operable, and have aluminum frames with insulating glass. Many of the windows have internal shading. The glass-to-frame seals are in fair condition. The operable window weather seals are in fair condition, showing little evidence of excessive wear. Exterior doors have steel frames and are in fair condition with undamaged door seals. Degraded window and door seals increase drafts and outside air infiltration.

Building Envelope

Roof Material

Exterior Window

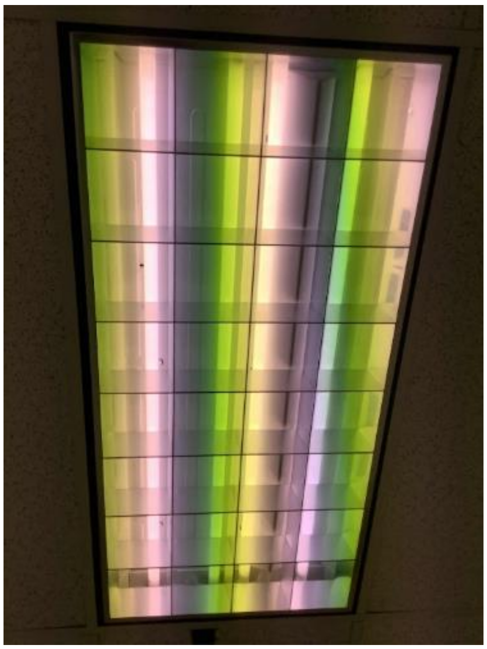
Exterior Door

2.4 Lighting Systems

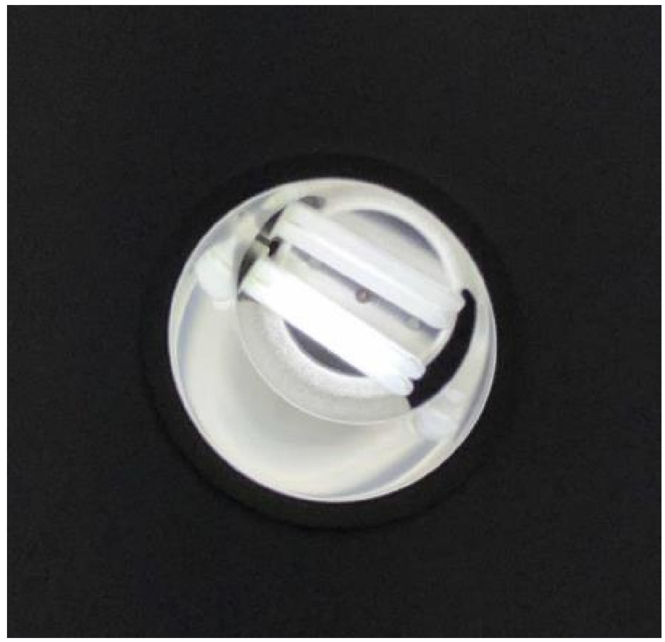
The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. There are also several 40-Watt T12 fixtures. Additionally, there are some compact fluorescent lamps, metal halide, and LED general purpose lamps. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts.

Fixture types include 2- 3- or 4-lamp, 2- or 4-foot troffer and recessed fixtures. Additionally, there are several other fixture types including wall sconce fixtures, recessed can fixtures, pendent mounted fixtures, high bay fixtures, surface mounted fixtures, and 2-foot fixtures with U-bend tube lamps.

Most fixtures are in fair condition. Interior lighting levels were generally sufficient. All exit signs are LED.



Linear Recessed Fixture



Recessed Can Fixture

High Bay Fixture

Pendent Mounted Fixtures

Most lighting fixtures are controlled manually by wall switches and the remainder by occupancy sensors and dimming switches.

Ceiling Mounted Occupancy Sensor

Wall Switch

Exterior fixtures include wall packs, under canopy fixtures, pole mounted fixtures, arm mounted fixtures, and surface mounted parking garage fixtures with high intensity discharge (HID), incandescent, compact fluorescent lamps, and LED lamps.

Exterior light fixtures are controlled by a time clock or photocell, depending on the fixture.

The pole mounted flood fixtures have LED lamps and are controlled through a central campus timeclock.

The parking garage is illuminated with high bay LED fixtures and are timeclock controlled, although they were observed as operating during daylight hours.

Parking Garage Fixture

Pole Mounted Fixture

Wall Pack

Under Canopy Recessed Fixture

2.5 Air Handling Systems

Cabinet Unit Heaters & Fan Coil Units

There are several cabinet unit heaters and fan coil units, each equipped with hot water coils and fractional hp supply fan motors. The fan coil units serve the classrooms and mechanical rooms while the cabinet unit heaters serve the hallways and vestibules.

The heating, ventilation, and air conditioning (HVAC) system is partially pneumatically controlled. A two motor, 1.5 hp air compressor located in mechanical room 115 serves the pneumatic system.

Packaged Units

Many areas of the building are conditioned by packaged air conditioning units. Each of these units are equipped with direct expansion coils, a supply fan motor, an exhaust fan motor, and an outdoor air damper. Please see following section for systems that incorporate chilled water coils.

Several of the packaged air conditioners are equipped with hot water coils. Air handling unit-4 (AHU), however, is equipped with a gas-fired furnace. Also, RTU-4 through RTU-8 are not equipped with integral heating capabilities, but their supply air is fed through ductwork that is equipped with hot water coils used for space heating. Those five packaged ACs have supply fan motors equipped with VFDs.

There are also a significant number of VAV boxes equipped with fractional hp supply fan motors, according to site personnel. These packaged ACs are controlled by the facility energy management system (EMS).

Additional information about each unit is provided below.

Area Served	Unit Tag	Cooling Capacity (Tons)	Cooling Efficiency (EER)	Heating Capacity (MBh)	Heating Efficiency	Supply Fan Motor (HP)	Exhaust Fan Motor (HP)
Astronomy Lab 133	RTU-1	4.46	9.55	-	-	0.75	0.25
Geology Lab 133F	RTU-2	4.46	9.55	-	-	0.75	0.25
Main Entrance	AHU-4	7.50	8.90	137.60	80.0%	1.50	0.50
CAD Labs 102 & 106	RTU-1	10.00	12.50	-	-	3.00	0.75
Classroom 105 & Offices 101B-101G	RTU-2	8.50	12.50	-	-	3.00	0.75
Graphics Lab 101, 103, Magazine Areas, Offices 101H-101M, 107A-C, Room 104 & 108	RTU-3	12.50	11.30	-	-	5.00	1.00
Concrete Lab 133E	RTU-4	4.00	19.40*	-	-	1.00	0.50
Materials & Soils 129	RTU-5	6.00	23.20**	-	-	3.00	0.75
Structures 127	RTU-6	10.00	23.00**	-	-	3.00	0.75
Shop 123D	RTU-7	3.00	20.10**	-	-	0.75	0.33
Project Space 123	RTU-8	6.00	23.20**	-	-	3.00	0.75

*Please note that the units marked with an asterisk have been rated in SEER instead of EER.

**Please note that the units marked with a double asterisk has been rated in IEER instead of EER.

Refer to Appendix A for detailed information about each unit.

RTU-4

RTU-1

AHUs

Two AHUs are used to condition portions of the building, each equipped with variable frequency drive (VFD) controlled supply fan motors, constant speed return fan motors, hot water coils, chilled water coils, economizers, and outdoor air dampers. The facility EMS controls these AHUs.

Additional information about these two units is provided below:

Area Served	Unit Tag	Supply Fan Motor (HP)	Return Fan Motor (HP)
East Side Classrooms & Offices	AHU-1	40.0	15.0
West Side Classrooms & Offices	AHU-2	40.0	10.0

AHU-1

AHU-1 Return Fan Control

AHU HW & CHW Piping

Supply Fan VFD Control

Unitary Electric HVAC Equipment

A Comfort Star ductless mini-split system air conditioning unit is used to condition a portion of the building. This unit has a cooling capacity of 1.0-ton with an efficiency of 21.00 SEER.

Ductless Mini Split System Air Conditioner

2.6 Steam System

Steam is supplied by boilers and the cogeneration heat recovery system located in the Power House/Cogen Building. Steam is used in this building to produce space heating water and domestic hot water through steam heat exchangers. Space heating water is circulated to air handling units, packaged air conditioners, and fin tube radiators by two 15.0 hp hot water pumps and two 3.0 hp hot water pumps. There are also four fractional hp condensate pumps.

Domestic hot water is circulated throughout the building by two fractional hp circulation pumps. Energy use associated with producing steam was allocated to individual buildings served by the cogeneration system and boilers. Please see the Power House/Cogen building report for details regarding the steam system.

Heating Hot Water Pumps

Heating Hot Water Pumps

Condensate Pumps

DHW Circulation Pumps

2.7 Chilled Water Systems

Chilled water is supplied by chillers located in the Power House/Cogen Building. Energy use associated with the steam engine and electric chillers used to produce chilled water was allocated to the individual buildings served by the chiller plant.

There are two 15.0 hp, VFD controlled chilled water pumps. Site staff indicated that since the chilled water system plant shifted from tertiary to secondary distribution, the building CHW pumps are not used. Chilled water is provided by the chilled water pumps located at the Power House/Cogen Building.

Please see the Power House/Cogen Building report for details regarding the chiller plant.

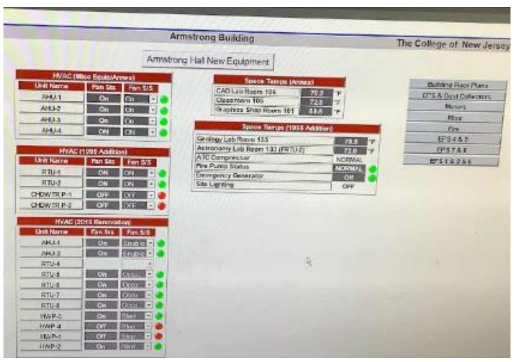
Chilled Water Pumps

Chilled Water Pump Control

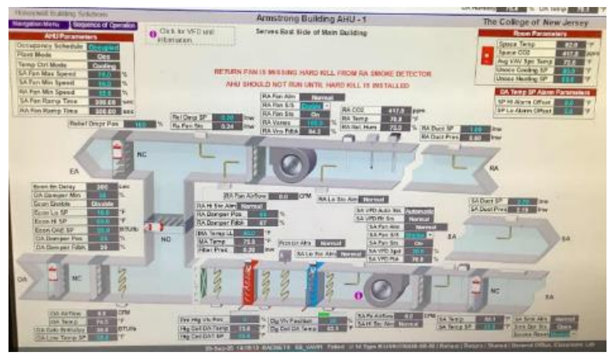
2.8 Building EMS

A Honeywell EMS controls the packaged ACs, air handling units, fin tube radiators, VAV boxes, exhaust fan motors, heating hot water system, and chilled water system. The EMS provides equipment scheduling control and monitors and controls space temperatures, supply air temperatures, return air temperatures, CO2 levels, humidity, supply fan motor operation status, exhaust fan motor operation status, return fan motor operation status, heating and cooling operation status, economizer operation status, outdoor air damper position, heating water loop temperatures, motor speed, motor operation status, and chilled water loop temperatures.

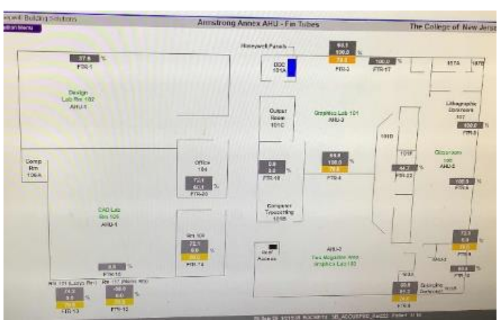
The site staff is pleased with the current EMS, but we are recommending that a retro-commissioning study to be done which is addressed in Section 4.



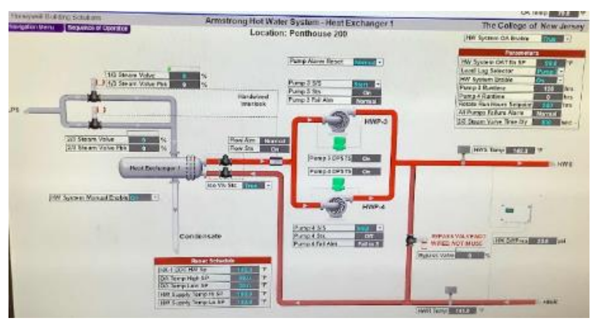
Armstrong Hall EMS Display



AHU-1 EMS Display



Fin Tube Radiators EMS Display



Hot Water Loop EMS Display

2.9 Domestic Hot Water

Hot water is produced by a heat exchanger using steam from the Power House/Cogen Building's space heating boiler.

Two fractional hp circulation pumps distribute water to end uses. The circulation pumps operate continuously.

The domestic hot water pipes are partially insulated, and the insulation is in good condition.

DHW Heat Exchanger

DHW Heat Exchanger Control

DHW Circulation Pump

DHW Circulation Pump

2.10 Plug Load & Vending Machines

The location is doing a great job managing their electrical plug loads. This report makes additional suggestions for ECMs in this area as well as energy efficient best practices.

There are approximately 181 computer workstations throughout the facility. Plug loads throughout the building include general classroom, office, and café equipment. There are typical loads such as coffee machines, dehumidifiers, fans, microwaves, paper shredders, printers, projectors, mini fridges, speakers, televisions, and toaster ovens.

There is also a large amount of equipment that is not typical, such as lab equipment, laser printers, 3D printers, shop equipment, a forklift charger, sifters, a lab oven, a laser CNC machine, dust collectors, an air purifier, cement mixers, and a milling machine.

There are several residential style refrigerators throughout the building that are used to store personal food and beverage items. These vary in condition and efficiency.

There is one refrigerated beverage vending machine and one non-refrigerated vending machine. Vending machines are not equipped with occupancy-based controls.

3D Printer

Welding Machine

Refrigerated Vending Machine

Drill Press

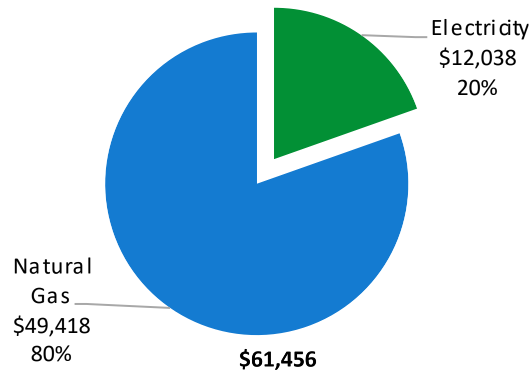
2.11 Water-Using Systems

There are four restrooms with toilets, urinals, and sinks. Faucet flow rates are at 2.2 gallons per minute (gpm) or higher.

3 Energy Use and Costs

Twelve months of utility billing data are used to develop annual energy consumption and cost data. This information creates a profile of the annual energy consumption and energy costs.

Utility Summary		
Fuel	**Usage**	**Cost**
Electricity	422,557 kWh	$12,038
Natural Gas	111,759 Therms	$49,418
Total		**$61,456**



An energy balance identifies and quantifies energy use in your various building systems. This can highlight areas with the most potential for improvement. This energy balance was developed using calculated energy use for each of the end uses noted in the figure.

The energy auditor collects information regarding equipment operating hours, capacity, efficiency, and other operational parameters from facility staff, drawings, and on-site observations. This information is used as the inputs to calculate the existing conditions energy use for the site. The calculated energy use is then compared to the historical energy use and the initial inputs are revised, as necessary, to balance the calculated energy use to the historical energy use.

Based on the very low equipment operating hours that would be required to balance the electric use for Armstrong Hall, it appears that the site sub-meter is providing inaccurate readings that are lower than the actual building use.

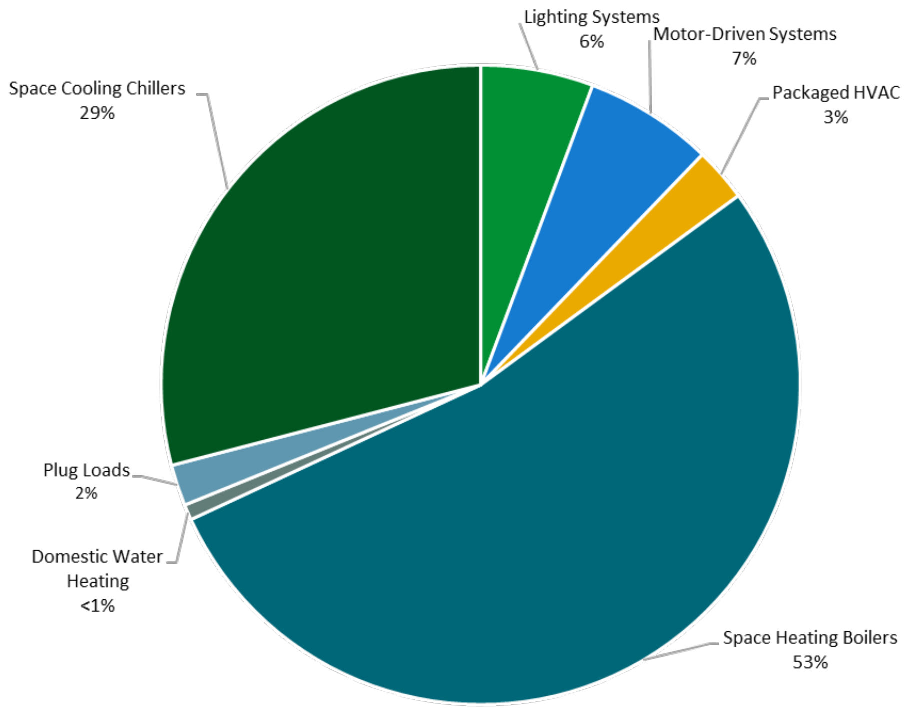
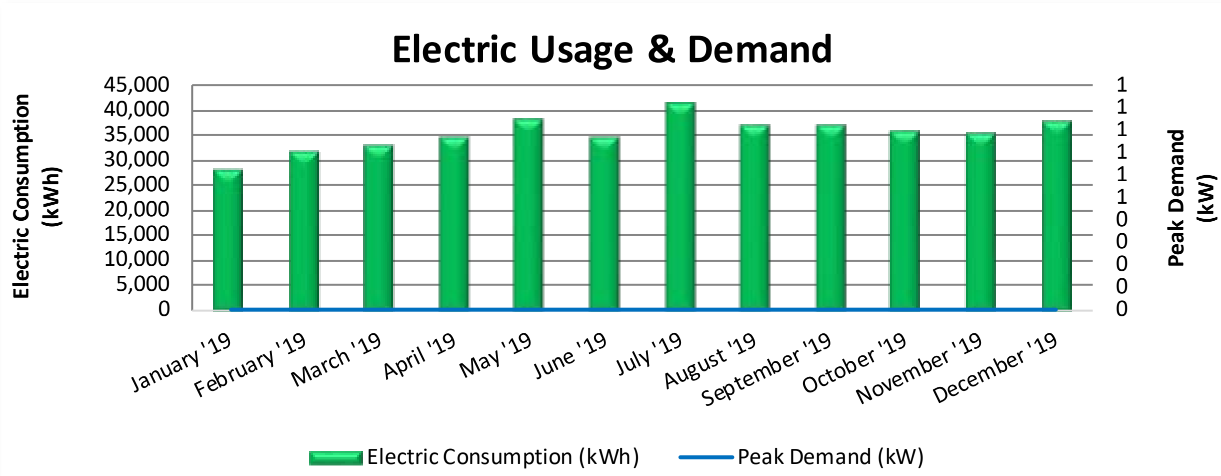


Figure 5 - Energy Balance

3.1 Electricity

PSE&G delivers electricity under rate class High Tension Service (HTS). Electricity for the building is supplemented by the cogeneration plant.



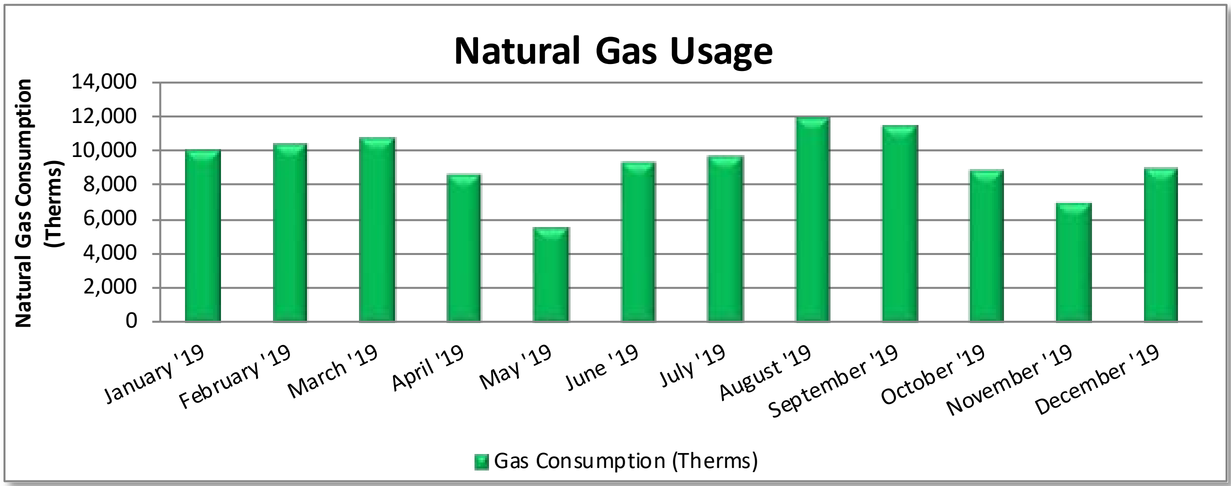
Electric Billing Data						
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost	TRC Estimated Usage?
1/28/19	31	28,143	0	$0	$614	Yes
2/28/19	31	31,764	0	$0	$782	Yes
3/28/19	28	32,860	0	$0	$714	Yes
4/28/19	31	34,524	0	$0	$777	Yes
5/29/19	31	37,916	0	$0	$1,398	Yes
6/27/19	29	34,260	0	$0	$1,089	Yes
7/29/19	32	41,365	0	$0	$1,491	Yes
8/27/19	29	36,742	0	$0	$1,043	Yes
9/26/19	30	36,722	0	$0	$1,142	Yes
10/25/19	29	35,486	0	$0	$985	Yes
11/25/19	31	35,149	0	$0	$849	Yes
12/11/19	33	37,626	0	$0	$1,154	Yes
Totals	**365**	**422,557**	**0**	**$0**	**$12,038**	
Annual	**365**	**422,557**	**0**	**$0**	**$12,038**	

Notes:

- Electric data has been estimated based on a campus wide approach and utilization of sub metered data. Please refer to the Power House/Cogen Building report for details regarding utility baseline and campus building utility desegregation.
- The peak demand for this facility was unavailable because the building is served with electricity from the master meter.
- The average purchased electric cost over the past 12 months was $0.147/kWh, which is the blended rate that includes energy supply, distribution, demand, and other charges. This report uses this blended rate to estimate energy cost savings.
- Effectively all of the electricity generated on-site is used on-site.

3.2 Natural Gas

The following charts provide the total estimated gas usage based on a percentage of the central plant gas use plus the usage associated with a dedicated gas meter that serves this building.



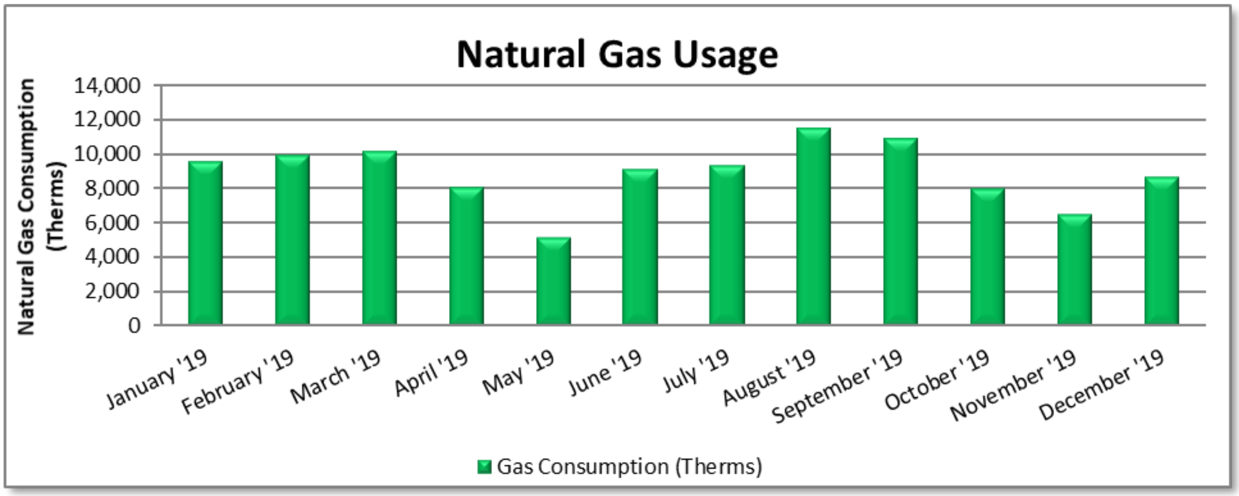
Gas Billing Data				
Period Ending	**Days in Period**	**Natural Gas Usage (Therms)**	**Natural Gas Cost**	**TRC Estimated Usage?**
1/31/19	31	9,929	$3,931	Yes
2/28/19	28	10,291	$5,031	Yes
3/31/19	31	10,632	$4,960	Yes
4/30/19	30	8,564	$3,795	Yes
5/31/19	31	5,496	$2,505	Yes
6/30/19	30	9,274	$4,075	Yes
7/31/19	31	9,662	$4,019	Yes
8/31/19	31	11,823	$4,747	Yes
9/30/19	30	11,406	$4,892	Yes
10/31/19	31	8,866	$4,166	Yes
11/30/19	30	6,945	$3,224	Yes
12/31/19	31	8,872	$4,075	Yes
Totals	**365**	**111,759**	**$49,418**	
Annual	**365**	**111,759**	**$49,418**	

Notes:

- The average gas cost for the past 12 months is $0.442/therm, which is the blended rate used throughout the analysis.

CUP Natural Gas Usage

PSE&G delivers natural gas for the main boiler meter under rate class TSGNF. The following charts represent the central utility plant (CUP) natural gas usage, estimated based on a campus wide approach.



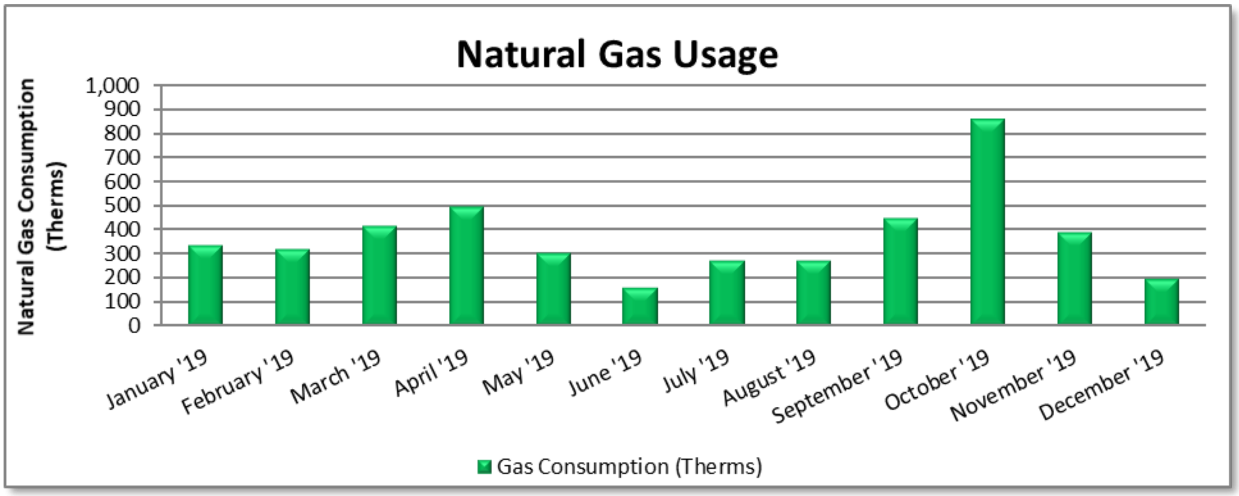
Gas Billing Data				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
1/31/19	31	9,589	$3,597	Yes
2/28/19	28	9,970	$4,744	Yes
3/31/19	31	10,216	$4,585	Yes
4/30/19	30	8,067	$3,377	Yes
5/31/19	31	5,190	$2,245	Yes
6/30/19	30	9,114	$3,932	Yes
7/31/19	31	9,387	$3,795	Yes
8/31/19	31	11,548	$4,523	Yes
9/30/19	30	10,954	$4,385	Yes
10/31/19	31	8,004	$3,418	Yes
11/30/19	30	6,553	$2,884	Yes
12/31/19	31	8,673	$3,900	Yes
Totals	**365**	**107,265**	**$45,385**	
Annual	**365**	**107,265**	**$45,385**	

Notes:

- Natural gas data has been estimated based on a campus wide approach. Please refer to the Power House/Cogen Building report for details regarding the utility baseline and campus building utility desegregation analysis.
- The average gas cost for the past 12 months for the CUP natural gas is $0.423/therm.

Armstrong Hall Metered Natural Gas Usage

This is the dedicated natural gas usage from meter 1613301 serving Armstrong Hall.



Gas Billing Data				
Period Ending	**Days in Period**	**Natural Gas Usage (Therms)**	**Natural Gas Cost**	**TRC Estimated Usage?**
1/31/19	31	340	$334	Yes
2/28/19	28	321	$287	Yes
3/31/19	31	416	$375	Yes
4/30/19	30	497	$418	Yes
5/31/19	31	306	$260	Yes
6/30/19	30	160	$143	Yes
7/31/19	31	275	$224	Yes
8/31/19	31	275	$224	Yes
9/30/19	30	452	$507	Yes
10/31/19	31	862	$748	Yes
11/30/19	30	392	$340	Yes
12/31/19	31	199	$175	Yes
Totals	**365**	**4,494**	**$4,033**	
Annual	**365**	**4,494**	**$4,033**	

Notes:

- The average gas cost for the past 12 months for the metered natural gas is $0.897/therm.

3.3 Benchmarking

Your building was benchmarked using the United States Environmental Protection Agency's (EPA) *Portfolio Manager®* software. Benchmarking compares your building's energy use to that of similar buildings across the country, while neutralizing variations due to location, occupancy, and operating hours. Some building types can be scored with a 1-100 ranking of a building's energy performance relative to the national building market. A score of 50 represents the national average and a score of 100 is best.

This ENERGY STAR® benchmarking score provides a comprehensive snapshot of your building's energy performance. It assesses the building's physical assets, operations, and occupant behavior, which is compiled into a quick and easy-to-understand score.

Benchmarking Score	N/A

Due to its unique characteristics, this building type is not able to receive a benchmarking score. This report contains suggestions about how to improve building performance and reduce energy costs.

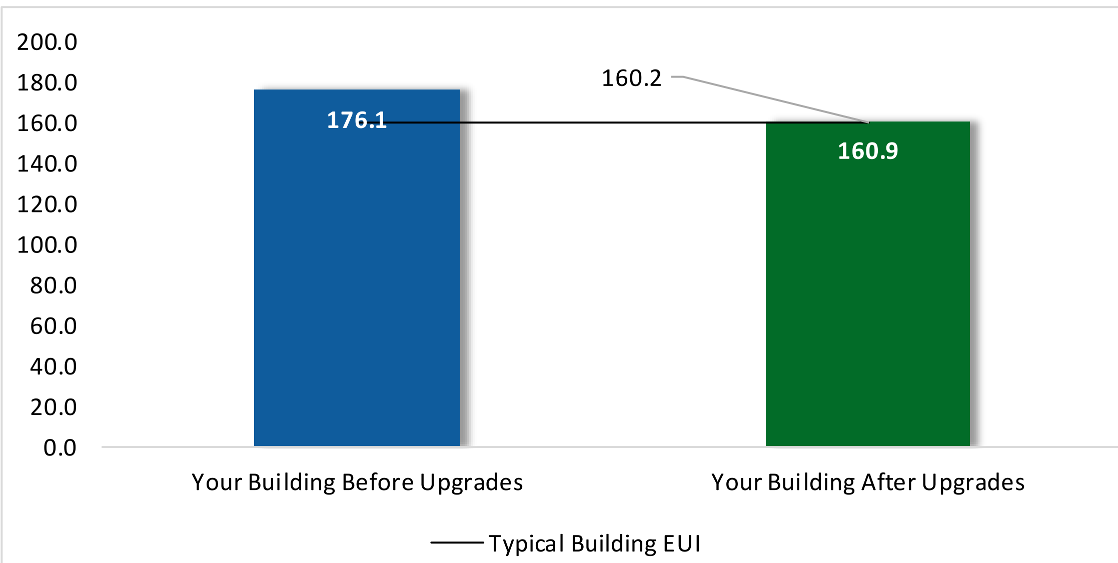


Figure 6 - Energy Use Intensity Comparison[3]

Energy use intensity (EUI) measures energy consumption per square foot and is the standard metric for comparing buildings' energy performance. A lower EUI means better performance and less energy consumed. A number of factors can cause a building to vary from the "typical" energy usage. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and occupant behavior all contribute to a building's energy use and the benchmarking score.

Benchmarking is provided for The College of New Jersey's campus. Please refer to the Power House/Cogen report for additional details regarding the benchmarking approach within Portfolio Manager®.

[3] Based on all evaluated ECMs

Tracking Your Energy Performance

Keeping track of your energy use on a monthly basis is one of the best ways to keep energy costs in check. Update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance.

We have created a Portfolio Manager® account for your facility and we have already entered the monthly utility data shown above for you. Account login information for your account will be sent via email.

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.

For more information on ENERGY STAR® and Portfolio Manager®, visit their website[4].

[4] https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

4 Energy Conservation Measures

The goal of this audit report is to identify and evaluate potential energy efficiency improvements, provide information about the cost effectiveness of those improvements, and recognize potential financial incentives from NJBPU. Most energy conservation measures have received preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is typically sufficient to demonstrate project cost-effectiveness and help prioritize energy measures.

Calculations of energy use and savings are based on the current version of the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings*, which is approved by the NJBPU. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances.

Operation and maintenance costs for the proposed new equipment will generally be lower than the current costs for the existing equipment—especially if the existing equipment is at or past its normal useful life. We have conservatively assumed there to be no impact on overall maintenance costs over the life of the equipment.

Financial incentives are based on the current NJCEP prescriptive SmartStart program. A higher level of investigation may be necessary to support any SmartStart Custom, Pay for Performance, or Direct Install incentive applications. Some measures and proposed upgrades may be eligible for higher incentives than those shown below through other NJCEP programs described in a following section of this report.

For a detailed list of the locations and recommended energy conservation measures for all inventoried equipment, see **Appendix A: Equipment Inventory & Recommendations.**

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**107,371**	**30.0**	**-22**	**$15,701**	**$54,687**	**$11,489**	**$43,198**	**2.8**	**105,594**
ECM 1	Install LED Fixtures	Yes	33,431	9.0	-6	$4,890	$20,650	$3,075	$17,575	3.6	32,915
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	519	0.2	0	$76	$361	$55	$306	4.0	510
ECM 3	Retrofit Fixtures with LED Lamps	Yes	73,421	20.7	-15	$10,735	$33,675	$8,359	$25,316	2.4	72,169
Lighting Control Measures			**31,517**	**7.5**	**-6**	**$4,610**	**$31,367**	**$9,159**	**$22,208**	**4.8**	**31,035**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	20,378	6.0	-4	$2,979	$24,354	$3,559	$20,795	7.0	20,021
ECM 5	Install High/Low Lighting Controls	Yes	11,139	1.6	-2	$1,631	$7,013	$5,600	$1,413	0.9	11,014
Motor Upgrades			**6,553**	**2.0**	**0**	**$964**	**$4,832**	**$0**	**$4,832**	**5.0**	**6,599**
ECM 6	Premium Efficiency Motors	Yes	6,553	2.0	0	$964	$4,832	$0	$4,832	5.0	6,599
Variable Frequency Drive (VFD) Measures			**57,463**	**17.0**	**0**	**$8,454**	**$71,405**	**$6,900**	**$64,505**	**7.6**	**57,865**
ECM 7	Install VFD on Variable Air Volume (VAV) Fans	Yes	29,385	11.9	0	$4,323	$32,470	$3,775	$28,695	6.6	29,590
ECM 8	Install VFDs on Constant Volume (CV) Fans	No	3,921	1.3	0	$577	$17,085	$325	$16,760	29.1	3,949
ECM 9	Install VFDs on Heating Water Pumps	Yes	24,157	3.8	0	$3,554	$21,850	$2,800	$19,050	5.4	24,326
Unitary HVAC Measures			**4,356**	**4.1**	**4**	**$659**	**$26,952**	**$1,511**	**$25,441**	**38.6**	**4,878**
ECM 10	Install High Efficiency Air Conditioning Units	No	4,356	4.1	4	$659	$26,952	$1,511	$25,441	38.6	4,878
HVAC System Improvements			**0**	**0.0**	**1**	**$6**	**$14**	**$4**	**$10**	**1.8**	**150**
ECM 11	Install Pipe Insulation	Yes	0	0.0	1	$6	$14	$4	$10	1.8	150
Domestic Water Heating Upgrade			**0**	**0.0**	**4**	**$19**	**$65**	**$36**	**$29**	**1.5**	**500**
ECM 12	Install Low-Flow DHW Devices	Yes	0	0.0	4	$19	$65	$36	$29	1.5	500
Food Service & Refrigeration Measures			**1,551**	**0.2**	**0**	**$228**	**$460**	**$50**	**$410**	**1.8**	**1,562**
ECM 13	Vending Machine Control	Yes	1,551	0.2	0	$228	$460	$50	$410	1.8	1,562
Custom Measures			**10,208**	**0.0**	**362**	**$3,102**	**$40,294**	**$0**	**$40,294**	**13.0**	**52,643**
ECM 14	Retro-Commissioning Study	Yes	5,983	0.0	213	$1,820	$21,494	$0	$21,494	11.8	30,905
ECM 15	Sub Metering	Yes	4,226	0.0	149	$1,282	$18,800	$0	$18,800	14.7	21,737
TOTALS			**219,019**	**60.8**	**344**	**$33,743**	**$230,076**	**$29,149**	**$200,927**	**6.0**	**260,826**

* - All incentives presented in this table are based on NJ SmartStart 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).

Figure 7 – All Evaluated ECMs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**107,371**	**30.0**	**-22**	**$15,701**	**$54,687**	**$11,489**	**$43,198**	**2.8**	**105,594**
ECM 1	Install LED Fixtures	33,431	9.0	-6	$4,890	$20,650	$3,075	$17,575	3.6	32,915
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	519	0.2	0	$76	$361	$55	$306	4.0	510
ECM 3	Retrofit Fixtures with LED Lamps	73,421	20.7	-15	$10,735	$33,675	$8,359	$25,316	2.4	72,169
Lighting Control Measures		**31,517**	**7.5**	**-6**	**$4,610**	**$31,367**	**$9,159**	**$22,208**	**4.8**	**31,035**
ECM 4	Install Occupancy Sensor Lighting Controls	20,378	6.0	-4	$2,979	$24,354	$3,559	$20,795	7.0	20,021
ECM 5	Install High/Low Lighting Controls	11,139	1.6	-2	$1,631	$7,013	$5,600	$1,413	0.9	11,014
Motor Upgrades		**6,553**	**2.0**	**0**	**$964**	**$4,832**	**$0**	**$4,832**	**5.0**	**6,599**
ECM 6	Premium Efficiency Motors	6,553	2.0	0	$964	$4,832	$0	$4,832	5.0	6,599
Variable Frequency Drive (VFD) Measures		**53,542**	**15.7**	**0**	**$7,877**	**$54,321**	**$6,575**	**$47,746**	**6.1**	**53,917**
ECM 7	Install VFD on Variable Air Volume (VAV) Fans	29,385	11.9	0	$4,323	$32,470	$3,775	$28,695	6.6	29,590
ECM 9	Install VFDs on Heating Water Pumps	24,157	3.8	0	$3,554	$21,850	$2,800	$19,050	5.4	24,326
HVAC System Improvements		**0**	**0.0**	**1**	**$6**	**$14**	**$4**	**$10**	**1.8**	**150**
ECM 11	Install Pipe Insulation	0	0.0	1	$6	$14	$4	$10	1.8	150
Domestic Water Heating Upgrade		**0**	**0.0**	**4**	**$19**	**$65**	**$36**	**$29**	**1.5**	**500**
ECM 12	Install Low-Flow DHW Devices	0	0.0	4	$19	$65	$36	$29	1.5	500
Food Service & Refrigeration Measures		**1,551**	**0.2**	**0**	**$228**	**$460**	**$50**	**$410**	**1.8**	**1,562**
ECM 13	Vending Machine Control	1,551	0.2	0	$228	$460	$50	$410	1.8	1,562
Custom Measures		**10,208**	**0.0**	**362**	**$3,102**	**$40,294**	**$0**	**$40,294**	**13.0**	**52,643**
ECM 14	Retro-Commissioning Study	5,983	0.0	213	$1,820	$21,494	$0	$21,494	11.8	30,905
ECM 15	Sub Metering	4,226	0.0	149	$1,282	$18,800	$0	$18,800	14.7	21,737
TOTALS		**210,742**	**55.4**	**340**	**$32,507**	**$186,039**	**$27,313**	**$158,726**	**4.9**	**251,999**

* - All incentives presented in this table are based on NJ SmartStart 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).

Figure 8 – Cost Effective ECMs

4.1 Lighting

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**107,371**	**30.0**	**-22**	**$15,701**	**$54,687**	**$11,489**	**$43,198**	**2.8**	**105,594**
ECM 1	Install LED Fixtures	33,431	9.0	-6	$4,890	$20,650	$3,075	$17,575	3.6	32,915
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	519	0.2	0	$76	$361	$55	$306	4.0	510
ECM 3	Retrofit Fixtures with LED Lamps	73,421	20.7	-15	$10,735	$33,675	$8,359	$25,316	2.4	72,169

When considering lighting upgrades, we suggest using a comprehensive design approach that simultaneously upgrades lighting fixtures and controls to maximize energy savings and improve occupant lighting. Comprehensive design will also consider appropriate lighting levels for different space types to make sure that the right amount of light is delivered where needed. If conversion to LED light sources are proposed, we suggest converting all of a specific lighting type (e.g. linear fluorescent) to LED lamps to minimize the number of lamp types in use at the facility, which should help reduce future maintenance costs.

ECM 1: Install LED Fixtures

Replace existing fixtures containing HID lamps with new LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

In some cases, HID fixtures can be retrofit with screw-based LED lamps. Replacing an existing HID fixture with a new LED fixture will generally provide better overall lighting optics; however, replacing the HID lamp with a LED screw-in lamp is typically a less expensive retrofit. We recommend you work with your lighting contractor to determine which retrofit solution is best suited to your needs and will be compatible with the existing fixtures.

Maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often.

Affected building areas: classrooms, laboratories, and exterior fixtures.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Retrofit fluorescent fixtures by removing the fluorescent tubes and ballasts and replacing them with LED tubes and LED drivers (if necessary), which are designed to be used in retrofitted fluorescent fixtures.

The measure uses the existing fixture housing but replaces the electric components with more efficient lighting technology which use less power than other lighting technologies but provides equivalent lighting output. Maintenance savings may also be achieved since LED tubes last longer than fluorescent tubes and therefore do not need to be replaced as often.

Affected building areas: electrical rooms, Office 102, and storage rooms with fluorescent fixtures with T12 tubes.

ECM 3: Retrofit Fixtures with LED Lamps

Replace fluorescent and incandescent lamps with LED lamps. Many LED tubes are direct replacements for existing fluorescent tubes and can be installed while leaving the fluorescent fixture ballast in place. LED lamps 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. Maintenance savings may also be available, as longer-lasting LEDs lamps will not need to be replaced as often as the existing lamps.

Affected building areas: hallways, conference room, corridors, offices, and vestibules, exterior fixtures, and all areas with fluorescent fixtures with T8 tubes.

4.2 Lighting Controls

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**31,517**	**7.5**	**-6**	**$4,610**	**$31,367**	**$9,159**	**$22,208**	**4.8**	**31,035**
ECM 4	Install Occupancy Sensor Lighting Controls	20,378	6.0	-4	$2,979	$24,354	$3,559	$20,795	7.0	20,021
ECM 5	Install High/Low Lighting Controls	11,139	1.6	-2	$1,631	$7,013	$5,600	$1,413	0.9	11,014

Lighting controls reduce energy use by turning off or lowering lighting fixture power levels when not in use. A comprehensive approach to lighting design should upgrade the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

ECM 4: Install Occupancy Sensor Lighting Controls

Install occupancy sensors to control lighting fixtures in areas that are frequently unoccupied, even for short periods. For most spaces, we recommend that lighting controls use dual technology sensors, which reduce the possibility of lights turning off unexpectedly.

Occupancy sensors detect occupancy using ultrasonic and/or infrared sensors. When an occupant enters the space, the lighting fixtures switch to full lighting levels. Most occupancy sensor lighting controls allow users to manually turn fixtures on/off, as needed. Some controls can also provide dimming options.

Occupancy sensors can be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are best suited to single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in large spaces, locations without local switching, and where wall switches are not in the line-of-sight of the main work area.

This measure provides energy savings by reducing the lighting operating hours.

Affected building areas: classrooms, computer labs, conference rooms, copy rooms, laboratories, locker rooms, lounges, offices, and rest rooms.

ECM 5: Install High/Low Lighting Controls

Install 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.

Lighting fixtures with these controls operate at default low levels when the area is unoccupied to provide minimal lighting to meet security or safety code requirements for egress. Sensors detect occupancy using ultrasonic and/or infrared sensors. When an occupant enters the space, the lighting fixtures switch to full lighting levels. Fixtures automatically switch back to low level after a predefined period of vacancy. In parking lots and parking garages with significant ambient lighting, this control can sometimes be combined with photocell controls to turn the lights off when there is sufficient daylight.

The controller lowers the light level by dimming the fixture output. Therefore, the controlled fixtures need to have a dimmable ballast or driver. This will need to be considered when selecting retrofit lamps and bulbs for the areas proposed for high/low control.

This measure provides energy savings by reducing the light fixture power draw when reduced light output is appropriate.

Affected building areas: hallways, vestibules, and the parking garage.

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

4.3 Motors

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**6,553**	**2.0**	**0**	**$964**	**$4,832**	**$0**	**$4,832**	**5.0**	**6,599**
ECM 6	Premium Efficiency Motors	6,553	2.0	0	$964	$4,832	$0	$4,832	5.0	6,599

ECM 6: Premium Efficiency Motors

Replace standard efficiency motors with IHP 2014 efficiency motors. This evaluation assumes that existing motors will be replaced with motors of equivalent size and type. In some cases, additional savings may be possible by downsizing motors to better meet the motor's current load requirements.

Affected motors:

Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Additional Motor Description
Main Mechanical Room	West Side Classrooms & Offices (AHU-2)	1	Supply Fan	40.0	AHU-2 Supply Fan Motor
Roof	Mechanical Room	1	Exhaust Fan	1.0	Exhaust Fan Motor (EF-1)
Roof	Mechanical Room	1	Supply Fan	0.5	Supply Fan Motor (SF-1)

Savings are based on the difference between baseline and proposed efficiencies and the assumed annual operating hours. The base case motor energy consumption is estimated using the efficiencies found on nameplates or estimated based on the age of the motor and our best estimates of motor run hours. Efficiencies of proposed motor upgrades are obtained from the current *New Jersey's Clean Energy Program Protocols to Measure Resource Savings*.

4.4 VFDs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**57,463**	**17.0**	**0**	**$8,454**	**$71,405**	**$6,900**	**$64,505**	**7.6**	**57,865**
ECM 7	Install VFD on Variable Air Volume (VAV) Fans	29,385	11.9	0	$4,323	$32,470	$3,775	$28,695	6.6	29,590
ECM 8	Install VFDs on Constant Volume (CV) Fans	3,921	1.3	0	$577	$17,085	$325	$16,760	29.1	3,949
ECM 9	Install VFDs on Heating Water Pumps	24,157	3.8	0	$3,554	$21,850	$2,800	$19,050	5.4	24,326

Variable frequency drives control motors for fans, pumps, and process equipment based on the actual output required of the driven equipment. Energy savings result from more efficient control of motor energy usage when equipment operates at partial load. The magnitude of energy savings depends on the estimated amount of time that the motor would operate at partial load. For equipment with proposed VFDs, we have included replacing the controlled motor with a new inverter duty rated motor to conservatively account for the cost of an inverter duty rated motor.

ECM 7: Install VFD on Variable Air Volume (VAV) Fans

Replace existing air volume control devices on variable volume fans, such as inlet vanes and variable pitch fan blades, with VFDs. Inlet guide vanes and variable pitch fan blades are an inefficient means of controlling the air volume compared to VFDs. The existing volume control device will be removed or permanently disabled, and the control signal will be redirected to the VFD to determine proper fan motor speed.

Energy savings result from using a more efficient control device to regulate the air flow provided by the fan. Additional maintenance savings may result from this measure. VFDs are solid state electronic devices, which generally requires less maintenance than mechanical air volume control devices.

Affected air handlers: AHU-1 & AHU-2 return fan motors, RTU-1 (CAD Labs 102 & 106), RTU-2 (Classroom 105 & Offices 101B-101G) & RTU-3 (Graphics Lab 101, 103, Magazine Areas, Offices 101H-101M, 107A-C, Room 104 & 108) supply and exhaust fan motors.

ECM 8: Install VFDs on Constant Volume (CV) Fans

We evaluated installing VFDs to control constant volume fan motor speeds. This converts a constant-volume, single-zone air handling system into a variable-air-volume (VAV) system. A separate VFD is usually required to control the return fan motor or dedicated exhaust fan motor if the air handler has one.

Zone thermostats signal the VFD to adjust fan speed to maintain the appropriate temperature in the zone, while maintaining a constant supply air temperature.

For air handlers with direct expansion cooling systems, the minimum air flow across the cooling coil required to prevent the coil from freezing must be determined during the final project design. The control system programming should maintain the minimum air flow whenever the compressor is operating. Prior to implementation, verify minimum fan speed in cooling mode with the manufacturer. Note that savings will vary depending on the operating characteristics of each AHU.

Energy savings result from reducing the fan speed (and power) when conditions allow for reduced air flow.

Affected air handlers: RTU-1 (Astronomy Lab 133), RTU-2 (Geology Lab 133F) & AHU-4 (Main Entrance) supply and exhaust fan motors.

ECM 9: Install VFDs on Heating Water Pumps

Install VFDs to control heating water pumps. Two-way valves must serve the hot water coils and the hot water loop must have a differential pressure sensor installed. If three-way valves or a bypass leg are used in the hot water distribution they will need to be modified when this measure is implemented. As the hot water valves close, the differential pressure increases and the VFD modulates the pump speed to maintain a differential pressure setpoint.

Energy savings result from reducing pump motor speed (and power) as hot water valves close. The magnitude of energy savings is based on the estimated amount of time that the system will operate at reduced load.

Affected pumps: (2) 15.0 hp hot water pumps and (2) 3.0 hp hot water pumps.

4.5 Unitary HVAC

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Unitary HVAC Measures		**4,356**	**4.1**	**4**	**$659**	**$26,952**	**$1,511**	**$25,441**	**38.6**	**4,878**
ECM 10	Install High Efficiency Air Conditioning Units	4,356	4.1	4	$659	$26,952	$1,511	$25,441	38.6	4,878

Replacing the unitary HVAC units has a long payback period and may not be justifiable based simply on energy considerations. However, most of the units are nearing or have reached the end of their normal useful life. Typically, the marginal cost of purchasing a high efficiency unit can be justified by the marginal savings from the improved efficiency. When the packaged ACs are eventually replaced, consider purchasing equipment that exceeds the minimum efficiency required by building codes.

ECM 10: Install High Efficiency Air Conditioning Units

We evaluated replacing standard efficiency packaged air conditioning units with high efficiency packaged air conditioning units. Some of the replacement units will incorporate efficient gas furnaces. The magnitude of energy savings for this measure depends on the relative efficiency of the older unit versus the new high efficiency unit, the average cooling and heating load and the estimated annual operating hours.

Affected units: RTU-1 (Astronomy Lab 133), RTU-2 (Geology Lab 133F) & AHU-4 (Main Entrance)

4.6 HVAC Improvements

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
HVAC System Improvements		**0**	**0.0**	**1**	**$6**	**$14**	**$4**	**$10**	**1.8**	**150**
ECM 11	Install Pipe Insulation	0	0.0	1	$6	$14	$4	$10	1.8	150

ECM 11: Install Pipe Insulation

Install insulation on domestic hot water system piping. Distribution system losses are dependent on system fluid temperature, the size of the distribution system, and the level of insulation of the piping. Significant energy savings can be achieved when insulation has not been well maintained. When the insulation is exposed to water, when the insulation has been removed from some areas of the pipe, or when valves have not been properly insulated system efficiency can be significantly reduced. This measure saves energy by reducing heat transfer in the distribution system.

Affected Systems: domestic hot water piping in Shop 123D.

4.7 Domestic Water Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**4**	**$19**	**$65**	**$36**	**$29**	**1.5**	**500**
ECM 12	Install Low-Flow DHW Devices	0	0.0	4	$19	$65	$36	$29	1.5	500

ECM 12: Install Low-Flow DHW Devices

Install low-flow devices to reduce overall hot water demand. The following low flow devices are recommended to reduce hot water usage:

Device	Flow Rate
Faucet aerators (lavatory)	0.5 gpm

Low-flow devices reduce the overall water flow from the fixture, while still providing adequate pressure for washing. Additional cost savings may result from reduced water usage.

4.8 Food Service & Refrigeration Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Food Service & Refrigeration Measures		**1,551**	**0.2**	**0**	**$228**	**$460**	**$50**	**$410**	**1.8**	**1,562**
ECM 13	Vending Machine Control	1,551	0.2	0	$228	$460	$50	$410	1.8	1,562

ECM 13: Vending Machine Control

Vending machines operate continuously, even during unoccupied hours. Install occupancy sensor controls to reduce energy use. These controls power down vending machines when the vending machine area has been vacant for some time, and they power up the machines at necessary regular intervals or when the surrounding area is occupied. Energy savings are dependent on the vending machine and activity level in the area surrounding the machines.

4.9 Custom Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Custom Measures		**10,208**	**0.0**	**362**	**$3,102**	**$40,294**	**$0**	**$40,294**	**13.0**	**52,643**
ECM 14	Retro-Commissioning Study	5,983	0.0	213	$1,820	$21,494	$0	$21,494	11.8	30,905
ECM 15	Sub Metering	4,226	0.0	149	$1,282	$18,800	$0	$18,800	14.7	21,737

ECM 14: Retro-Commissioning Study

Due to the complexity of today's HVAC systems and controls a thorough analysis and rebalance of heating, ventilation, and cooling systems should periodically be conducted. There are indications at this site that systems may be not be operating correctly or as efficiently as they could be. One important tool available to building operators to ensure proper system operation is retro-commissioning.

Retro-commissioning is a common practice recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) to be implemented every few years. We recommend that you contact a reputable engineering firm that specializes in energy control systems and retro-commissioning. Ask them to propose a scope of work and an outline of the procedures and processes to be implemented, including a schedule and the roles of all responsible parties.

Once goals and responsibilities are established, the objective of the investigation process is to understand how the building is currently operating, identify the issues, and determine the most cost-effective way to improve performance. The retro-commissioning agent will review building documentation, interview building occupants, and inspect and test the equipment. Information is then compiled into a report and shared with facility staff, who will select which recommendations to implement after reviewing the findings.

The implementation phase puts the selected processes into place. Typical measures may include sensor calibration, equipment schedule changes, damper linkage repair and similar relatively low-cost adjustments -- although more expensive sophisticated programming and building control system upgrades may be warranted. Approved measures may be implemented by the agent, the building staff, or by subcontractors. Typically, a combination of these individuals makes up the retro-commissioning team.

After the approved measures are implemented, the team will verify that the changes are working as expected. Baseline and post-case measurements will allow building staff to monitor equipment and ensure that the benefits are maintained.

A high-level evaluation of potential savings and costs is provided for demonstration purposes only. It is a screening evaluation for the potential in HVAC Control Improvements. Based on industry standards and previous project experience, the potential energy savings may be up to 15% of existing HVAC energy use. The average cost of retro-commissioning studies and control improvements is $0.30 per square foot. Actual savings and costs will need to be outlined by the specific contractor engaged to perform the study. For the purposes of this report, we have conservatively estimated savings to be 2% of the total HVAC energy consumption baseline.

ECM 15: Sub Metering

Facility staff expressed interest in utility sub metering key buildings which are currently served by a master meter and the central plant. Utility submeters alone do not save energy, but they are a useful tool under the right circumstances. Utility sub-meters can provide facility staff with real-time energy use data for specific buildings, information that enhances the potential for greater energy management activities. Revenue grade submeters are a tool that allow owners to bill tenants or departments for the energy consumed in the spaces they occupy. Better resolution on building system performance can lead to occupant behavioral changes which often result in reduced energy use.

A high-level evaluation of potential savings and costs is provided for demonstration purposes only. Based on industry standards and case studies, the potential energy savings may be up to 5% of existing energy usage. For the purposes of this report, a conservative assumed savings of 1% was applied to building allocated electrical and natural gas consumption of the sub metered buildings based on the premise of occupant behavioral changes. For this building the following submeters are proposed: smart electric meter, steam flow meter, and chilled water flow meter. Meter costs for the evaluation are based on average building use across the campus: smart electric meter $2,400, steam flow meter $6,700, and chilled water flow meter $9,700. The actual scope of work and implementation costs must be provided by a contractor in the future. This measure is recommended for implementation based on the initial energy and economic results but primarily for enhancing the potential for greater energy management activities.

5 Energy Efficient Best Practices

A whole building maintenance plan will extend equipment life; improve occupant comfort, health, and safety; and reduce energy and maintenance costs.

Operation and maintenance (O&M) plans enhance the operational efficiency of HVAC and other energy intensive systems and could save between 5 to 20 percent of the energy usage in your building without substantial capital investment. A successful plan includes your records of energy usage trends and costs, building equipment lists, current maintenance practices, planned capital upgrades, and incorporates your ideas for improved building operation. Your plan will address goals for energy-efficient operation, provide detail on how to reach the goals, and will outline procedures for measuring and reporting whether goals have been achieved.

You may already be doing some of these things— see our list below for potential additions to your maintenance plan. Be sure to consult with qualified equipment specialists for details on proper maintenance and system operation.

Energy Tracking with ENERGY STAR® Portfolio Manager®

You've heard it before - you can't manage what you don't measure. ENERGY STAR® Portfolio Manager® is an online tool that you can use to measure and track energy and water consumption, as well as greenhouse gas emissions[5] . Your account has already been established. Now you can continue to keep tabs on your energy performance every month.

Lighting Maintenance

- Clean lamps, reflectors and lenses of dirt, dust, oil, and smoke buildup every six to twelve months. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust. Together, this can reduce total light output by up to 60% while still drawing full power.

In addition to routine cleaning, developing a maintenance schedule can ensure that maintenance is performed regularly, and it can reduce the overall cost of fixture re-lamping and re-ballasting. Group re-lamping and re-ballasting maintains lighting levels and minimizes the number of site visits by a lighting technician or contractor, decreasing the overall cost of maintenance.

Lighting Controls

As part of a lighting maintenance schedule, test lighting controls to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight and photocell sensors, maintenance involves cleaning sensor lenses and confirming that setpoints and sensitivity are configured properly. Adjust exterior lighting time clock controls seasonally as needed to match your lighting requirements.

[5] https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager.

Motor Controls

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. Whenever possible, use automatic devices such as twist timers or occupancy sensors to turn off motors when they are not needed.

Motor Maintenance

Motors have many moving parts. As these parts degrade over time, the efficiency of the motor is reduced. Routine maintenance prevents damage to motor components. Routine maintenance should include 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.

Fans to Reduce Cooling Load

Install ceiling fans to supplement your cooling system. Thermostat settings can typically be increased by 4°F with no change in overall occupant comfort due to the wind chill effect of moving air.

Economizer Maintenance

Economizers can significantly reduce cooling system load. A malfunctioning economizer can increase the amount of heating and mechanical cooling required by introducing excess amounts of cold or hot outside air. Common economizer malfunctions include broken outdoor thermostat or enthalpy control, or dampers that are stuck or improperly adjusted.

Periodic inspection and maintenance will keep economizers working in sync with the heating and cooling system. This maintenance should be part of annual system maintenance, and it 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.

Air Conditioner System Evaporator/Condenser Coil Cleaning

Dirty evaporator and condenser coils restrict air flow and restrict heat transfer. This increases the loads on the evaporator and condenser fan and decreases overall cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

HVAC Filter Cleaning and Replacement

Air filters should be checked regularly (often monthly) and cleaned or replaced when appropriate. Air filters reduce indoor air pollution, increase occupant comfort, and help keep equipment operating efficiently. If the building has a building management system, consider installing a differential pressure switch across filters to send an alarm about premature fouling or overdue filter replacement. Over time, filters become less and less effective as particulate buildup increases. Dirty filters also restrict air flow through the air conditioning or heat pump system, which increases the load on the distribution fans.

Steam Trap Repair and Replacement

Steam traps are a crucial part of delivering heat from the boiler to the space heating units. Steam traps are automatic valves that remove condensate from the system. If the traps fail closed, condensate can build up in the steam supply side of the trap which reduces the flow in the steam lines and thermal capacity of the radiators. Or they may fail open, allowing steam into the condensate return lines resulting in wasted energy, water and hammering. Losses can be significantly reduced by testing and replacing equipment as they start to fail. Repair or replace traps that are blocked or allowing steam to pass. Inspect steam traps as part of a regular steam system maintenance plan.

Furnace Maintenance

Preventative maintenance can extend the life of the system, maintain energy efficiency, and ensure safe operation. Following the manufacturer's instructions, a yearly tune-up should: check for gas / carbon monoxide leaks; change the air and fuel filters; check components for cracks, corrosion, dirt, or debris build-up; ensure the ignition system is working properly; test and adjust operation and safety controls; inspect electrical connections; and lubricate motors and bearings.

Optimize HVAC Equipment Schedules

Energy Management Systems (EMS) typically provide advanced controls for building HVAC systems, including chillers, boilers, air handling units, rooftop units and exhaust fans. The EMS monitors and reports operational status, schedules equipment 'start' and 'stop' times, locks out equipment operation based on outside air or space temperature, and often optimizes damper and valve operation based on complex algorithms. These EMS features, when in proper adjustment, can improve comfort for building occupants and save substantial energy.

Know your EMS scheduling capabilities. Regularly monitor HVAC equipment operating schedules and match them to building operating hours in order to eliminate unnecessary equipment operation and save energy. Monitoring should be performed often at sites with frequently changing usage patterns – daily in some cases. We recommend using the 'Optimal Start' feature of the EMS, if available, to optimize the building warmup sequence. Most EMS scheduling programs provide for "Holiday" schedules which can be used during reduced use or shutdown periods. Finally, many systems are equipped with a one-time override function which can be used to provide additional space conditioning due to a one-time, special event. When available this override feature should be used rather than changing the base operating schedule.

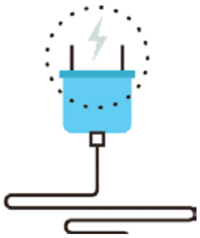
Compressed Air System Maintenance

Compressed air systems require periodic maintenance to operate at peak efficiency. A maintenance plan for compressed air systems should 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
- Check for leaks and adjust loose connections
- Overall system cleaning

Contact a qualified technician for help with setting up periodic maintenance schedule.

Plug Load Controls



Reducing plug loads is a common way to decrease your electrical use. Limiting the energy use of plug loads can include increasing occupant awareness, removing under-used equipment, installing hardware controls, and using software controls. Consider enabling the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips[6]. Your local utility may offer incentives or rebates for this equipment.

Water Conservation

Installing dual flush or low-flow toilets and low-flow/waterless urinals are ways to reduce water use. The EPA WaterSense® ratings for urinals is 0.5 gallons per flush (gpf) and for flush valve toilets is 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

For more information regarding water conservation go to the EPA's WaterSense® website[7] or download a copy of EPA's "WaterSense® at Work: Best Management Practices for Commercial and Institutional Facilities"[8] to get ideas for creating a water management plan and best practices for a wide range of water using systems.

Water conservation devices that do not reduce hot water consumption will not provide energy savings at the site level, but they may significantly affect your water and sewer usage costs. 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.

If the facility has detached buildings with a master water meter for the entire campus, check for unnatural wet areas in the lawn or water seeping in the foundation at water pipe penetrations through the foundation. Periodically check overnight meter readings when the facility is unoccupied, and there is no other scheduled water usage.

Manage irrigation systems to use water more effectively outside the building. Adjust spray patterns so that water lands on intended lawns and plantings and not on pavement and walls. Consider installing an evapotranspiration irrigation controller that will prevent over-watering.

Procurement Strategies

Purchasing efficient products reduces energy costs without compromising quality. Consider modifying your procurement policies and language to require ENERGY STAR® or WaterSense® products where available.

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[6] For additional information refer to "Assessing and Reducing Plug and Process Loads in Office Buildings" http://www.nrel.gov/docs/fy13osti/54175.pdf, or "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

[7] https://www.epa.gov/watersense.

[8] https://www.epa.gov/watersense/watersense-work-0.

6 On-site Generation

You don't have to look far in New Jersey to see one of the thousands of solar electric systems providing clean power to homes, businesses, schools, and government buildings. On-site generation includes both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) technologies that generate power to meet all or a portion of the facility's electric energy needs. Also referred to as distributed generation, these systems contribute to greenhouse gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, which results in improved electric grid reliability through better use of transmission and distribution systems.

Preliminary screenings were performed to determine if an on-site generation measure could be a cost-effective solution for your facility. Before deciding to install an on-site generation system, we recommend conducting a feasibility study to analyze 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.

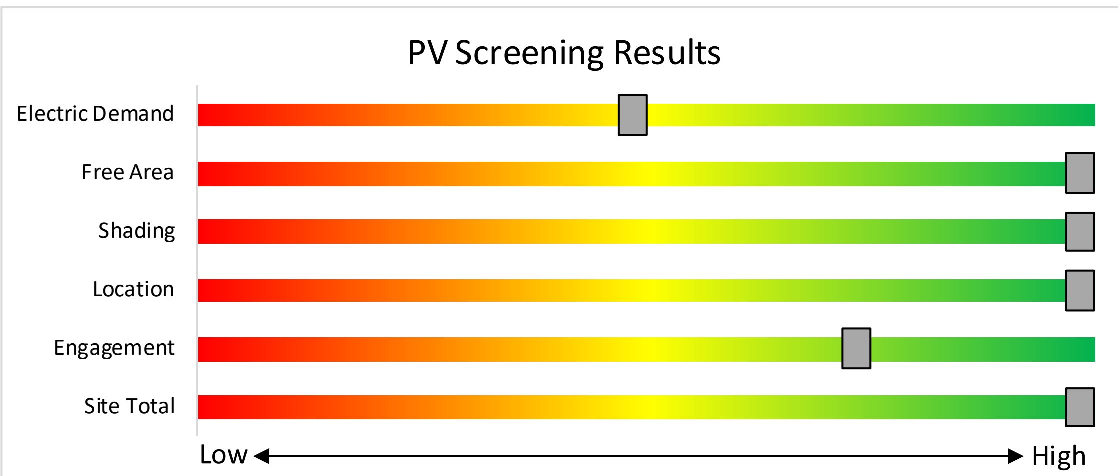
6.1 Solar Photovoltaic

Photovoltaic (PV) panels convert sunlight into electricity. Individual panels are combined into an array that produces direct current (DC) electricity. The DC current is converted to alternating current through an inverter. The inverter is then connected to the building's electrical distribution system.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has **high** potential for installing a PV array.

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the **high** potential. A PV array located on the roof may be feasible. If you are interested in pursuing the installation of PV, we recommend conducting a full feasibility study.

The graphic below displays the results of the PV potential screening conducted as a part of this audit. The position of each slider indicates the potential (potential increases to the right) that each factor contributes to the overall site potential.



Potential	High	
System Potential	96	kW DC STC
Electric Generation	114,371	kWh/yr
Displaced Cost	$16,830	/yr
Installed Cost	$249,600	

Figure 9 - Photovoltaic Screening

Transition Incentive (TI) Program

The TI program is a bridge between the Legacy SREC Program and a to-be determined Successor Incentive Program. The program is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects *must* register their projects prior to the start of construction to establish the project's eligibility to earn TRECs (Transition Incentive Renewable Energy Certificates). The Transition Incentive is structured as a factorized renewable energy certificate. The factors allow the TI Program to provide differentiated financial incentives for different types of solar installation.

Get more information about solar power in New Jersey or find a qualified solar installer who can help you decide if solar is right for your building:

Transition Incentive (TI) Program: https://www.njcleanenergy.com/renewable-energy/programs/transition-incentive-program

- **Basic Info on Solar PV in New Jersey**: www.njcleanenergy.com/whysolar.
- **New Jersey Solar Market FAQs**: www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs.
- **Approved Solar Installers in the New Jersey Market**: 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) generates electricity at the facility and puts waste heat energy to good use. Common types of CHP systems are reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines.

CHP systems typically produce a portion of the electric power used on-site, with the balance of electric power needs supplied by the local utility company. The heat is used to supplement (or replace) existing boilers and provide space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for space cooling.

The key criteria used for screening is the amount of time that the CHP system would operate at full load and the facility's ability to use the recovered heat. Facilities with a continuous need for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has **no** potential for installing a cost-effective CHP system.

Based on a preliminary analysis, the facility **does not** appear to meet the minimum requirements for a cost-effective CHP installation. The lack of gas service, low or infrequent thermal load, and lack of space for siting the equipment are the most significant factors contributing to the lack of CHP potential.

The graphic below displays the results of the CHP potential screening conducted as a part of this audit. The position of each slider indicates the potential (potential increases to the right) that each factor contributes to the overall site potential.

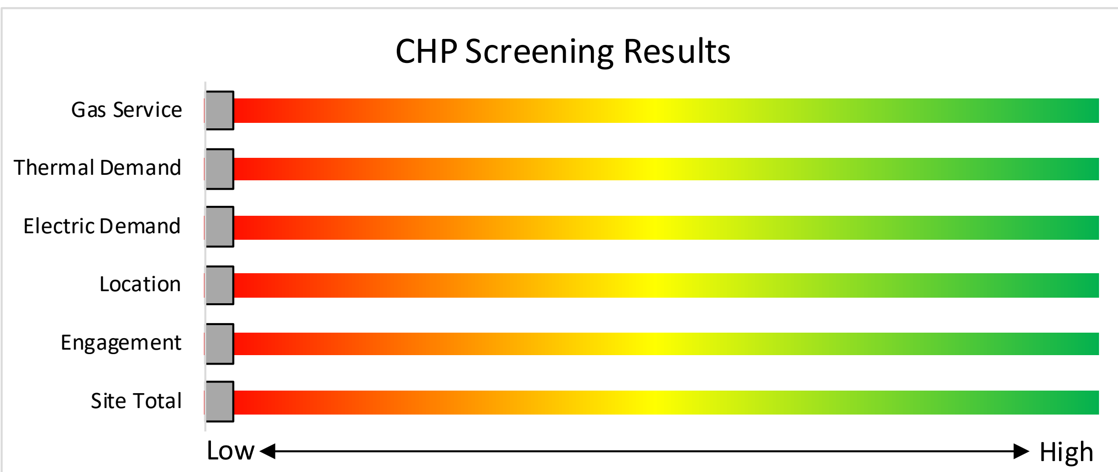


Figure 10 - Combined Heat and Power Screening

Find a qualified firm that specializes in commercial CHP cost assessment and installation: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/

7 Project Funding and Incentives

Ready to improve your building's performance? New Jersey's Clean Energy Programs can help. Pick the program that works best for you. Incentive programs that may apply to this facility are identified in the Executive Summary. This section provides an overview of currently available New Jersey's Clean Energy Programs.

	SmartStart *Flexibility to install at your own pace*	**Direct Install** *Turnkey installation*	**Pay for Performance** *Whole building upgrades*
Who should use it?	Buildings installing individual measures or small group of measures.	Small to mid-size facilities that can bundle multiple measures together. Average peak demand should be below 200 kW. Not suitable for significant building shell issues.	Mid to large size facilities looking to implement as many measures as possible at one time. Peak demand should be over 200 kW.
How does it work?	Use in-house staff or your preferred contractor.	Pre-approved contractors pass savings along to you via reduced material and labor costs.	Whole-building approach to energy upgrades designed to reduce energy use by at least 15%. The more you save, the higher the incentives.
What are the Incentives?	Fixed incentives for specific energy efficiency measures.	Incentives pay up to 70% of eligible costs, up to $125,000 per project. You pay the remaining 30% directly to the contractor.	Incentives are paid out in three installments. The first installment is meant to help offset the costs of the initial engineering study. The subsequent incentives are paid based on the level of energy savings up to 50% of the total project cost. See Section 7.3 for all incentive details.
How do I participate?	Submit an application for the specific equipment to be installed.	Contact a participating contractor in your region.	Contact a pre-qualified Partner to develop your Energy Reduction Plan and set your energy savings targets.

Take the next step by visiting **www.njcleanenergy.com** for

program details, applications, and to contact a qualified contractor.

7.1 SmartStart

SmartStart offers incentives for installing prescriptive and custom energy efficiency measures at your facility. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades. This program serves most common equipment types and sizes.

SmartStart routinely adds, removes, or modifies incentives from year-to-year for various energy efficient 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

Incentives

The SmartStart Prescriptive program provides fixed incentives for specific energy efficiency measures. Prescriptive incentives vary by equipment type.

SmartStart Custom provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentives. Custom incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings. Incentives are 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

Submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. You can work with your preferred contractor or use internal staff to install measures.

Visit www.njcleanenergy.com/SSB for a detailed program description, instructions for applying, and applications.

7.2 Direct Install

Direct Install is a turnkey program available to existing small to medium-sized facilities with an average peak electric demand that does not exceed 200 kW over the recent 12-month period. You work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and provide a clear scope of work for installation of selected measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives, and controls.

Based on the site building and utility data provided, the facility does not meet the requirements of the current Direct Install program.

Incentives

The program pays up to 70 percent of the total installed cost of eligible measures, up to $125,000 per project. Each entity is limited to incentives up to $250,000 per fiscal year.

How to Participate

To participate in Direct Install, you will need to contact the participating contractor assigned to the region of the state where your facility is located. A complete list of Direct Install program partners is provided on the Direct Install website linked below. The contractor will be paid the measure incentives directly by the program, which will pass on to you in the form of reduced material and implementation costs. This means up to 70 percent of eligible costs are covered by the program, subject to program caps and eligibility, while the remaining 30 percent of the cost is paid to the contractor by the customer.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

7.3 Pay for Performance - Existing Buildings

Pay for Performance works for larger customers with a peak demand over 200 kW. The minimum installed scope of work must include at least two unique measures that results in at least 15 percent source energy savings, and 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 to achieve deep energy savings. This program has an added benefit of addressing measures that may not qualify for other programs. Many facilities pursuing an Energy Savings Improvement Program loan also use this program.

For master metered campuses, such as The College of New Jersey, P4P eligibility is evaluated at the campus level. For the purposes of reporting P4P eligibility is being presented at all of the buildings. Final eligibility will be assessed once all of the reports are completed and will be addressed at the Exit Meeting. If the campus does not meet the 15% savings threshold based on measures identified during the LGEA Program process it is possible that additional measures could be identified at a later point in time, for example through further evaluation or the Energy Savings Improvement Program process.

Incentives

Incentives are 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

Contact one of the pre-approved consultants and contractors (“Partners”). Under direct contract to you, they will help further evaluate the measures identified in this report through development of the energy reduction plan), assist you in implementing selected measures, and verify actual savings one year after the installation. Your Partner will also help you apply for incentives.

Approval of the final scope of work is required by the program prior to installation. Installation can be done by the contractor of your choice (some P4P Partners are also contractors) or by internal staff, but the Partner remains involved throughout construction to ensure compliance with the program requirements.

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

7.4 Combined Heat and Power

The Combined Heat & Power (CHP) program provides incentives for eligible CHP or waste heat to power (WHP) projects. Eligible CHP or WHP projects must achieve an annual system efficiency of at least 65% (lower heating value, or LHV), based on total energy input and total utilized energy output. Mechanical energy may be included in the efficiency evaluation.

Incentives

Eligible Technologies	Size (Installed Rated Capacity)[1]	Incentive ($/kW)	% of Total Cost Cap per Project[3]	$ Cap per Project[3]
Powered by non-renewable or renewable fuel source[4]	≤500 kW	$2,000	30-40%[2]	$2 million
Gas Internal Combustion Engine	>500 kW - 1 MW	$1,000		
Gas Combustion Turbine	> 1 MW - 3 MW	$550	30%	$3 million
Microturbine	>3 MW	$350		
Fuel Cells with Heat Recovery				
Waste Heat to Power*	<1 MW	$1,000	30%	$2 million
	> 1MW	$500		$3 million

*Waste Heat to Power: Powered by non-renewable fuel source, heat recovery or other mechanical recovery from existing equipment utilizing new electric generation equipment (e.g. steam turbine).

Check the NJCEP website for details on program availability, current incentive levels, and requirements.

How to Participate

You work with a qualified developer or consulting firm to complete the CHP application. Once the application is approved the project can be installed. Information about the CHP program can be found at www.njcleanenergy.com/CHP.

7.5 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) serves New Jersey's government agencies by financing energy projects. 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. Annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive for the life of the contract.

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 described above can also be used to help further reduce the total project cost of eligible measures.

How to Participate

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 used 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. Carefully consider all alternatives to develop an approach that best meets your needs. A detailed program descriptions and application can be found at www.njcleanenergy.com/ESIP.

ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you can use NJCEP incentive programs to help further reduce costs when developing the energy savings plan. Refer to the ESIP guidelines at the link above for further information and guidance on next steps.

7.6 Transition Incentive (TI) Program

The TI program is a bridge between the Legacy SREC Program and a to-be determined Successor Incentive Program. The program is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects *must* register their projects prior to the start of construction to establish the project's eligibility to earn TRECs (Transition Incentive Renewable Energy Certificates). The Transition Incentive is structured as a factorized renewable energy certificate. The factors allow the TI Program to provide differentiated financial incentives for different types of solar installations. NJBPU calculates the value of a Transition Renewable Energy Certificate (TREC) by multiplying the base compensation rate ($152/MWh) by the project's assigned factor (i.e. $152 x 0.85 = $129.20/MWh). The TREC factors are defined based on the chart below:

Project Type	Factor
Subsection (t): landfill, brownfield, areas of historic fill	1.00
Grid supply (Subsection (r)) rooftop	1.00
Net metered non-residential rooftop and carport	1.00
Community solar	0.85
Grid supply (Subsection (r)) ground mount	0.60
Net metered residential ground mount	0.60
Net metered residential rooftop and carport	0.60
Net metered non-residential ground mount	0.60

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number, which enables it to generate New Jersey TRECs.

Eligible projects may generate TRECs for 15 years following the commencement of commercial operations (also referred to as the "Transition Incentive Qualification Life"). After 15 years, projects may be eligible for a New Jersey Class I REC.

TRECs will be used by the identified compliance entities to satisfy a compliance obligation tied to a new Transition Incentive Renewable Portfolio Standard ("Tl-RPS"), which will exist in parallel with, and completely separate from, the existing Solar RPS for Legacy SRECs. The Tl-RPS is a carve-out of the current Class I RPS requirement. The creation of TRECs is based upon metered generation supplied to PJM-EIS General Attribute Tracking System ("GATS") by the owners of eligible facilities or their agents. GATS would create one TREC for each MWh of energy produced from a qualified facility.

TRECs will be purchased monthly by a TREC Administrator who will allocate the TRECs to the Load Serving Entities (BGS Providers and Third-Party Suppliers) annually based on their market share of retail electricity sold during the relevant Energy Year.

Solar projects help the State of New Jersey reach renewable energy goals outlined in the state's Energy Master Plan. The Transition Incentive Program online portal is now open to new applications effective May 1, 2020. There are instructions on "How and When to Transfer my SRP Registration to the Transition Incentive Program". If you are considering installing solar photovoltaics on your building, visit the following link for more information:

https://www.njcleanenergy.com/renewable-energy/programs/transition-incentive-program

8 PROJECT DEVELOPMENT

Energy conservation measures (ECMs) have been identified for your site and their energy and economic analyses are provided within this LGEA report. The next steps with project development are to set goals and create a comprehensive project plan. The graphic below provides an overview of the process flow for a typical energy efficiency or renewable energy project. We recommend implementing as many ECMs as possible prior to undertaking a feasibility study for a renewable project. The cyclical nature of this process flow demonstrates the ongoing work required to continually improve building energy efficiency over time. If your building(s) scope of work is relatively simple to implement or small in scope, the measurement and verification (M&V) step may not be required. It should be noted through a typical project cycle, there will be changes in costs based on specific scopes of work, contractor selections, design considerations, construction, etc. The estimated costs provided throughout this LGEA report demonstrate the unburdened turn-key material and labor cost only. There will be contingencies and additional costs at the time of implementation. We recommend comprehensive project planning includes the review of multiple bids for project work, incorporate potential operational & maintenance (O&M) cost savings and maximize your incentive potential.

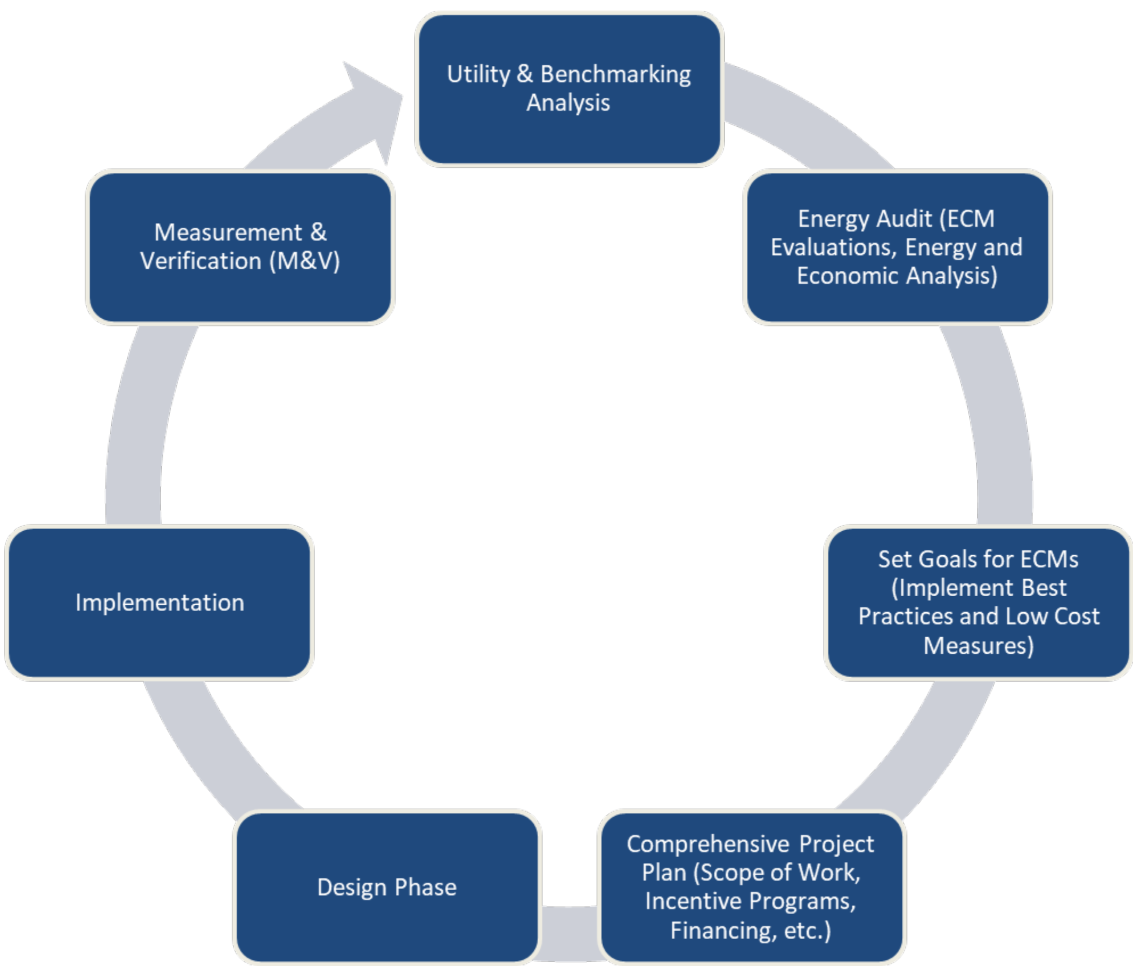


Figure 11 – Project Development Cycle

9 Energy Purchasing and Procurement Strategies

9.1 Retail Electric Supply Options

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 already buys electricity from a third-party supplier, review and compare prices at the end of each contract year.

A list of licensed third-party electric suppliers is available at the NJBPU website[9].

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey is also deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate monthly. 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 typically depends on whether a customer prefers 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 does not already purchase natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility already purchases natural gas from a third-party supplier, review and compare prices at the end of each contract year.

A list of licensed third-party natural gas suppliers is available at the NJBPU website[10].

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[9] www.state.nj.us/bpu/commercial/shopping.html.

[10] 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	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Armstrong Parking Garage	25	LED - Fixtures: Ceiling Mount	Timeclock		40	8,760	5	None	Yes	25	LED - Fixtures: Ceiling Mount	High/Low Control	40	6,044	0.0	2,716	0	$400	$1,125	$875	0.6
Armstrong Parking Garage	2	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock		60	3,276		None	No	2	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock	60	3,276	0.0	0	0	$0	$0	$0	0.0
Armstrong Parking Garage	4	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock		30	3,276	5	None	Yes	4	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	High/Low Control	30	2,260	0.0	122	0	$18	$0	$0	0.0
Cafe Hallway	20	Compact Fluorescent: (2) 18W Biaxial Plug-In Lamps	Wall Switch	S	36	8,760	3, 5	Relamp	Yes	20	LED Lamps: (2) 13W Plug-In Lamps	High/Low Control	25	6,044	0.3	3,587	-1	$524	$1,400	$740	1.3
Cafe Hallway	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 102	23	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	23	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	1.0	3,442	-1	$503	$1,800	$415	2.8
Classroom 105	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 105	15	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	60	2,160	4	None	Yes	15	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	60	1,490	0.2	663	0	$97	$270	$35	2.4
Classroom 112	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 112	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	S	114	2,160	3	Relamp	No	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,160	0.5	1,597	0	$233	$876	$240	2.7
Classroom 120	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.4	1,347	0	$197	$763	$170	3.0
Classroom 122	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.5	1,796	0	$263	$927	$215	2.7
Classroom 123	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 123	4	LED - Fixtures: Ceiling Mount	Wall Switch	S	60	2,160	4	None	Yes	4	LED - Fixtures: Ceiling Mount	Occupancy Sensor	60	1,490	0.1	177	0	$26	$0	$0	0.0
Classroom 123	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,160	3, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,490	0.1	299	0	$44	$110	$30	1.8
Classroom 123	8	Metal Halide: (1) 400W Lamp	Wall Switch	S	458	2,160	1, 4	Fixture Replacement	Yes	8	LED - Fixtures: High-Bay	Occupancy Sensor	137	1,490	2.1	6,904	-1	$1,009	$5,789	$880	4.9
Classroom 123A	6	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.3	898	0	$131	$599	$125	3.6
Classroom 127	10	LED - Fixtures: Ceiling Mount	Wall Switch	S	80	2,160	4	None	Yes	10	LED - Fixtures: Ceiling Mount	Occupancy Sensor	80	1,490	0.2	589	0	$86	$0	$0	0.0
Classroom 127	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,160	3, 4	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,490	0.1	399	0	$58	$146	$40	1.8
Classroom 127	10	Metal Halide: (1) 400W Lamp	Wall Switch	S	458	2,160	1, 4	Fixture Replacement	Yes	10	LED - Fixtures: High-Bay	Occupancy Sensor	137	1,490	2.6	8,629	-2	$1,262	$7,237	$1,100	4.9
Classroom 128	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,160	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,490	0.6	2,109	0	$308	$1,146	$275	2.8
Classroom 129	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 129	15	Metal Halide: (1) 400W Lamp	Wall Switch	S	458	2,160	1, 4	Fixture Replacement	Yes	15	LED - Fixtures: High-Bay	Occupancy Sensor	137	1,490	3.9	12,944	-3	$1,892	$10,855	$1,650	4.9
Classroom 133	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 133	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,160	3, 4	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,490	0.1	399	0	$58	$146	$40	1.8

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Classroom 133	21	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	21	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	1.0	3,143	-1	$459	$1,690	$385	2.8
Classroom 134	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,160	3, 4	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,490	0.1	399	0	$58	$146	$40	1.8
Classroom 134	6	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.3	898	0	$131	$599	$125	3.6
Classroom 135	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 135	19	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	19	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.9	2,843	-1	$416	$1,581	$355	2.9
Classroom 135	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	2,160	3, 4	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,490	0.0	93	0	$14	$72	$10	4.6
Classroom 136	16	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,160	3, 4	Relamp	Yes	16	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,490	0.9	2,812	-1	$411	$1,708	$390	3.2
Classroom 137	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.4	1,197	0	$175	$708	$155	3.2
Classroom 144	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.6	2,095	0	$306	$1,037	$245	2.6
Classroom 144A	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 144A	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,160	3, 4	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,490	0.3	1,055	0	$154	$708	$155	3.6
Classroom 144B	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 144B	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,160	3, 4	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,490	0.3	1,055	0	$154	$708	$155	3.6
Classroom 148	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.6	2,095	0	$306	$1,037	$245	2.6
Classroom 150	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom 150	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.5	1,497	0	$219	$818	$185	2.9
Classroom 154	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.7	2,245	0	$328	$1,092	$260	2.5
Classroom 156	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.7	2,245	0	$328	$1,092	$260	2.5
Classroom 187	1	LED Lamps: (10) 10W Track Working Lights	Wall Switch	S	100	2,160		None	No	1	LED Lamps: (10) 10W Track Working Lights	Wall Switch	100	2,160	0.0	0	0	$0	$0	$0	0.0
Classroom 187	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.4	1,197	0	$175	$708	$155	3.2
Computer Lab 106	24	LED - Fixtures: Linear Strip	High/Low Control	S	72	2,160		None	No	24	LED - Fixtures: Linear Strip	High/Low Control	72	2,160	0.0	0	0	$0	$0	$0	0.0
Computer Lab 2	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,160	3, 4	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,490	0.5	1,497	0	$219	$818	$185	2.9
Conference 1	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Conference 1	4	LED - Fixtures: Linear Strip	Wall Switch	S	72	1,680	4	None	Yes	4	LED - Fixtures: Linear Strip	Occupancy Sensor	72	1,159	0.1	165	0	$24	$270	$35	9.7
Conference 130A	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	1,680	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,159	0.1	233	0	$34	$226	$50	5.2

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Conference 147	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	1,680	3, 4	Relamp	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,159	0.1	349	0	$51	$434	$80	6.9
Conference 165B	6	Compact Fluorescent: (2) 42W Biaxial Plug-In Lamps	Wall Switch	S	84	1,680	3, 4	Relamp	Yes	6	LED Lamps: (2) 29W Plug-In Lamps	Occupancy Sensor	59	1,159	0.2	482	0	$70	$432	$47	5.5
Conference 166	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	1,680	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,159	0.1	233	0	$34	$226	$50	5.2
Conference 181C	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	1,680	3, 4	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,159	0.2	466	0	$68	$489	$95	5.8
Copy Room	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	1,680	3, 4	Relamp	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,159	0.1	349	0	$51	$434	$80	6.9
Corridor 5	1	Compact Fluorescent: (2) 42W Biaxial Plug-In Lamps	Wall Switch	S	84	3,024	3	Relamp	No	1	LED Lamps: (2) 29W Plug-In Lamps	Wall Switch	59	3,024	0.0	84	0	$12	$27	$2	2.0
Electrical Room 1	1	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	S	127	500	2	Relamp & Reballast	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	500	0.1	46	0	$7	$98	$15	12.3
Electrical Room 122B	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	500	3	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	500	0.1	54	0	$8	$110	$30	10.0
Electrical Room 188	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	500	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	500	0.0	27	0	$4	$55	$15	10.0
Electrical Room 189	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.1	73	0	$11	$146	$40	10.0
Exterior Ground Level	12	Compact Fluorescent: (2) 18W Biaxial Plug-In Lamps	Timeclock		36	4,380	3	Relamp	No	12	LED Lamps: (2) 13W Plug-In Lamps	Timeclock	25	4,380	0.0	568	0	$84	$300	$24	3.3
Exterior Ground Level	2	Incandescent: (1) 100W A19 Screw-In Lamp	Timeclock		100	4,380	3	Relamp	No	2	LED Lamps: (1) 15W Screw-In Lamp	Timeclock	15	4,380	0.0	745	0	$110	$34	$2	0.3
Exterior Ground Level	3	LED Lamps: (1) 15W A19 Screw-In Lamp	Timeclock		15	4,380		None	No	3	LED Lamps: (1) 15W A19 Screw-In Lamp	Timeclock	15	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Ground Level	2	LED - Fixtures: Ceiling Mount	Timeclock		20	4,380		None	No	2	LED - Fixtures: Ceiling Mount	Timeclock	20	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Ground Level	21	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock		80	3,276		None	No	21	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock	80	3,276	0.0	0	0	$0	$0	$0	0.0
Exterior Ground Level	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell		15	4,380		None	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	15	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Ground Level	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell		20	4,380		None	No	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	20	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Ground Level	3	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell		20	4,380		None	No	3	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	20	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Ground Level	2	Metal Halide: (1) 400W Lamp	Timeclock		458	4,380	1	Fixture Replacement	No	2	LED - Fixtures: High-Bay	Timeclock	137	4,380	0.0	2,808	0	$413	$1,007	$150	2.1
Hallway	59	Compact Fluorescent: (2) 42W Biaxial Plug-In Lamps	Wall Switch	S	84	3,024	3, 5	Relamp	Yes	59	LED Lamps: (2) 29W Plug-In Lamps	High/Low Control	59	2,087	1.8	8,523	-2	$1,246	$3,806	$2,183	1.3
Hallway	12	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	12	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Hallway	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,087	3	Relamp	No	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,087	0.1	454	0	$66	$219	$60	2.4
Hallway	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,024	3, 5	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	2,087	0.3	1,477	0	$216	$663	$330	1.5
Hallway	23	Compact Fluorescent: (2) 26W Biaxial Plug-In Lamps	Wall Switch	S	52	3,024	3, 5	Relamp	Yes	23	LED Lamps: (2) 18W Plug-In Lamps	High/Low Control	36	2,087	0.4	2,057	0	$301	$1,438	$851	2.0
Hallway	3	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Hallway 2	27	Compact Fluorescent: (2) 42W Biaxial Plug-In Lamps	Wall Switch	S	84	3,024	3, 5	Relamp	Yes	27	LED Lamps: (2) 29W Plug-In Lamps	High/Low Control	59	2,087	0.8	3,900	-1	$570	$1,742	$999	1.3
Hallway 2	4	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Janitorial 131	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	18	0	$3	$37	$10	10.0
Laboratory 112	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Laboratory 112	38	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,592	3, 4	Relamp	Yes	38	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,788	1.7	6,824	-1	$998	$2,765	$659	2.1
Laboratory 129A	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,592	3, 4	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,788	0.2	838	0	$123	$526	$105	3.4
Laboratory Concrete	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Laboratory Concrete	6	Metal Halide: (1) 400W Lamp	Wall Switch	S	458	2,592	1, 4	Fixture Replacement	Yes	6	LED - Fixtures: High-Bay	Occupancy Sensor	137	1,788	1.6	6,213	-1	$908	$4,342	$660	4.1
Locker Room 125A	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,592	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,788	0.1	359	0	$53	$226	$50	3.3
Lounge 163	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	33	2,592	3, 4	Relamp	Yes	1	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,788	0.0	61	0	$9	$33	$6	3.0
Lounge 163	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,592	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,788	0.1	359	0	$53	$380	$65	6.0
Mechanical 113	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	18	0	$3	$37	$10	10.0
Mechanical 115	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Mechanical 115	9	LED - Fixtures: Linear Strip	Wall Switch	S	20	500		None	No	9	LED - Fixtures: Linear Strip	Wall Switch	20	500	0.0	0	0	$0	$0	$0	0.0
Mechanical 4	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.1	54	0	$8	$110	$30	10.0
Mechanical Fire Pump Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	36	0	$5	$73	$20	10.0
Mechanical Generator Room	2	LED - Fixtures: Linear Strip	Wall Switch	S	20	500		None	No	2	LED - Fixtures: Linear Strip	Wall Switch	20	500	0.0	0	0	$0	$0	$0	0.0
Mechanical Main	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,000	3	Relamp	No	16	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.4	581	0	$85	$584	$160	5.0
Office - Enclosed 125B	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,400	3, 4	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	665	0	$97	$489	$95	4.1
Office 101	21	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	21	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	1.0	3,492	-1	$510	$1,690	$385	2.6
Office 101D	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 101H	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 101K	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 101L	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 101M	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.2	665	0	$97	$489	$95	4.1

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Office 102	2	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	S	127	2,400	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	512	0	$75	$311	$50	3.5
Office 116	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.4	1,330	0	$194	$708	$155	2.8
Office 122C	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 123B	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,400	0.0	131	0	$19	$55	$15	2.1
Office 124	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Office 124	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,400	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,400	0.0	87	0	$13	$37	$10	2.1
Office 124	24	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	S	114	2,087	3	Relamp	No	24	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,087	1.0	3,085	-1	$451	$1,753	$480	2.8
Office 130B	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 132	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 133A	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,400	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,400	0.0	87	0	$13	$37	$10	2.1
Office 139	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 141	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 143	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 143A	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 147B	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,087	3	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,087	0.1	227	0	$33	$110	$30	2.4
Office 147C	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,087	3	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,087	0.1	227	0	$33	$110	$30	2.4
Office 149	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 151	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 153	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 155	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 157	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 159	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 161	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 165	6	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	30	2,400	4	None	Yes	6	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	30	1,656	0.0	147	0	$22	$270	$35	10.9
Office 165A	4	Compact Fluorescent: (2) 42W Biaxial Plug-In Lamps	Wall Switch	S	84	2,400	3, 4	Relamp	Yes	4	LED Lamps: (2) 29W Plug-In Lamps	Occupancy Sensor	59	1,656	0.1	459	0	$67	$378	$43	5.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Office 167	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 169	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 171	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 173	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 175	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 177	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 181A	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	499	0	$73	$434	$80	4.9
Office 181B	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office 181D	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.1	333	0	$49	$226	$50	3.6
Office Department	6	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3, 4	Relamp	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,656	0.3	998	0	$146	$599	$125	3.2
Office IE	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,400	0.0	131	0	$19	$55	$15	2.1
Office IF	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,400	0.0	131	0	$19	$55	$15	2.1
Office IG	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,400	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,400	0.0	131	0	$19	$55	$15	2.1
Restroom - Female 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,024	3, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,087	0.1	419	0	$61	$380	$65	5.1
Restroom - Female 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	3,024	3, 4	Relamp	Yes	1	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,087	0.0	210	0	$31	$55	$15	1.3
Restroom - Female 2	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,024	3, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,087	0.1	419	0	$61	$380	$65	5.1
Restroom - Male 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,024	3, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,087	0.1	419	0	$61	$380	$65	5.1
Server Room 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,024	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,024	0.0	110	0	$16	$37	$10	1.7
Shop 123D	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Shop 123D	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,592	3	Relamp	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,592	0.2	941	0	$138	$365	$100	1.9
Storage 1	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	500	3	Relamp	No	4	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	500	0.1	109	0	$16	$219	$60	10.0
Storage 10	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	18	0	$3	$37	$10	10.0
Storage 114B	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	500	3	Relamp	No	3	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	500	0.1	82	0	$12	$164	$45	10.0
Storage 122A	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	18	0	$3	$37	$10	10.0
Storage 123C	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.1	54	0	$8	$110	$30	10.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Storage 127A	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	36	0	$5	$73	$20	10.0
Storage 140	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	18	0	$3	$37	$10	10.0
Storage 142	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	18	0	$3	$37	$10	10.0
Storage 2	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	500	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	32	0	$5	$69	$10	12.4
Storage 4	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	500	3	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	500	0.1	54	0	$8	$110	$30	10.0
Storage 8	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	500	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	18	0	$3	$37	$10	10.0
Storage Wood Shop	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	500	3	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	500	0.1	54	0	$8	$110	$30	10.0
Vestibule	8	Compact Fluorescent: (2) 18W Biaxial Plug-In Lamps	Wall Switch	S	36	3,024	3, 5	Relamp	Yes	8	LED Lamps: (2) 13W Plug-In Lamps	High/Low Control	25	2,087	0.1	495	0	$72	$875	$16	11.9
Vestibule	2	Compact Fluorescent: (1) 26W Biaxial Plug-In Lamp	Wall Switch	S	26	3,024	3, 5	Relamp	Yes	2	LED Lamps: (1) 18W Plug-In Lamp	High/Low Control	18	2,087	0.0	89	0	$13	$25	$2	1.8
Vestibule	4	LED Lamps: (1) 15W A19 Screw-In Lamp	Wall Switch	S	15	3,024	5	None	Yes	4	LED Lamps: (1) 15W A19 Screw-In Lamp	High/Low Control	15	2,087	0.0	62	0	$9	$0	$0	0.0
Vestibule	2	Compact Fluorescent: (2) 18W Biaxial Plug-In Lamps	Wall Switch	S	36	3,024	3, 5	Relamp	Yes	2	LED Lamps: (2) 13W Plug-In Lamps	High/Low Control	25	2,087	0.0	124	0	$18	$50	$4	2.5
Exterior Ground Level	9	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock		30	3,276		None	No	9	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock	30	3,276	0.0	0	0	$0	$0	$0	0.0

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?	Manufacturer	Model	Remaining Useful Life	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Main Mechanical Room	East Side Classrooms & Offices (AHU-1)	1	Supply Fan	40.0	93.0%	Yes	MagneTek	6-370162-02	W	2,400		No	93.0%	No		0.0	0	0	$0	$0	$0	0.0
Main Mechanical Room	East Side Classrooms & Offices (AHU-1)	1	Return Fan	15.0	87.5%	No	GE Motors	SGK2A015D33	B	2,400	7	No	93.0%	Yes	1	4.8	11,886	0	$1,749	$7,041	$1,200	3.3
Main Mechanical Room	West Side Classrooms & Offices (AHU-2)	1	Supply Fan	40.0	84.0%	Yes	MagneTek	6-370162-02	B	2,400	6	Yes	94.1%	No		2.0	6,406	0	$942	$4,006	$0	4.3
Main Mechanical Room	West Side Classrooms & Offices (AHU-2)	1	Return Fan	10.0	89.5%	No	MagneTek	6-355822-01	W	2,400	7	No	91.7%	Yes	1	3.1	7,304	0	$1,075	$5,152	$1,100	3.8
Classrooms & Mechanical Rooms	Classrooms & Mechanical Rooms	5	Fan Coil Unit	0.1	65.0%	No			B	1,800		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Hallways & Vestibules	Hallways & Vestibules	6	Supply Fan	0.1	65.0%	No			B	1,800		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Building	Building	70	Supply Fan	0.1	65.0%	No			B	1,500		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Astronomy Lab 133 (RTU-1)	1	Supply Fan	0.8	70.0%	No	Lennox	CHA16-653-5Y	B	2,400	8	No	81.1%	Yes	1	0.3	837	0	$123	$2,756	$50	22.0
Roof	Astronomy Lab 133 (RTU-1)	1	Exhaust Fan	0.3	65.0%	No	Lennox	CHA16-653-5Y	B	2,400	8	No	69.5%	Yes	1	0.1	269	0	$40	$2,743	$50	68.0
Roof	Geology Lab 133F (RTU-2)	1	Supply Fan	0.8	70.0%	No	Lennox	CHA16-653-5Y	B	2,400	8	No	81.1%	Yes	1	0.3	837	0	$123	$2,756	$50	22.0
Roof	Geology Lab 133F (RTU-2)	1	Exhaust Fan	0.3	65.0%	No	Lennox	CHA16-653-5Y	B	2,400	8	No	69.5%	Yes	1	0.1	269	0	$40	$2,743	$50	68.0
Roof	Main Entrance (AHU-4)	1	Supply Fan	1.5	84.0%	No	Carrier	48TJE008-521GA	B	2,400	8	No	86.5%	Yes	1	0.4	1,177	0	$173	$3,391	$75	19.1
Roof	Main Entrance (AHU-4)	1	Exhaust Fan	0.5	70.0%	No	Carrier	48TJE008-521GA	B	2,400	8	No	78.2%	Yes	1	0.2	532	0	$78	$2,696	$50	33.8
Roof	CAD Labs 102 & 106 (RTU-1)	1	Supply Fan	3.0	89.5%	No	Trane	THC120E3R0A0	W	2,400	7	No	89.5%	Yes	1	0.9	2,100	0	$309	$3,884	$200	11.9
Roof	CAD Labs 102 & 106 (RTU-1)	1	Exhaust Fan	0.8	70.0%	No	Trane	THC120E3R0A0	W	2,400	7	No	81.1%	Yes	1	0.3	837	0	$123	$2,756	$50	22.0
Roof	Classroom 105 & Offices 101B-101G (RTU-2)	1	Supply Fan	3.0	91.0%	No	Trane	THC102E3R0A0	W	2,400	7	No	91.0%	Yes	1	0.9	2,066	0	$304	$3,884	$200	12.1
Roof	Classroom 105 & Offices 101B-101G (RTU-2)	1	Exhaust Fan	0.8	70.0%	No	Trane	THC102E3R0A0	W	2,400	7	No	81.1%	Yes	1	0.3	837	0	$123	$2,756	$50	22.0
Roof	Graphics Lab 101, 103, Magazine Areas, Offices 101H-101M, 107A-C, Room 104 & 108 (RTU-3)	1	Supply Fan	5.0	86.5%	No	Trane	TCD151E30CAC	W	2,400	7	No	86.5%	Yes	1	1.4	3,622	0	$533	$3,987	$900	5.8
Roof	Graphics Lab 101, 103, Magazine Areas, Offices 101H-101M, 107A-C, Room 104 & 108 (RTU-3)	1	Exhaust Fan	1.0	85.5%	No	Trane	TCD151E30CAC	W	2,400	7	No	85.5%	Yes	1	0.3	733	0	$108	$3,010	$75	27.2
Roof	Concrete Lab 133E (RTU-4)	1	Supply Fan	1.0	85.5%	Yes	Trane	TZC048F3R0A0	N	2,400		No	85.5%	No		0.0	0	0	$0	$0	$0	0.0

		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?	Manufacturer	Model	Remaining Useful Life	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Concrete Lab 133E (RTU-4)	1	Exhaust Fan	0.5	70.0%	No	Trane	TZC048F3R0A0	N	2,400		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Materials & Soils 129 (RTU-5)	1	Supply Fan	3.0	89.5%	Yes	Trane	TZC072F3R0A0	N	2,400		No	89.5%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Materials & Soils 129 (RTU-5)	1	Exhaust Fan	0.8	70.0%	No	Trane	TZC072F3R0A0	N	2,400		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Structures 127 (RTU-6)	1	Supply Fan	3.0	89.5%	Yes	Trane	TZC120F3R0A0	N	2,400		No	89.5%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Structures 127 (RTU-6)	1	Exhaust Fan	0.8	70.0%	No	Trane	TZC120F3R0A0	N	2,400		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Shop 123D (RTU-7)	1	Supply Fan	0.8	70.0%	Yes	Trane	TZC036E3R0A0	N	2,400		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Shop 123D (RTU-7)	1	Exhaust Fan	0.3	65.0%	No	Trane	TZC036E3R0A0	N	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Project Space 123 (RTU-8)	1	Supply Fan	3.0	89.5%	Yes	Trane	TZC072F3R0A0	N	2,400		No	89.5%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Project Space 123 (RTU-8)	1	Exhaust Fan	0.8	70.0%	No	Trane	TZC072F3R0A0	N	2,400		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room 115	Pneumatic Controls	2	Air Compressor	1.5	86.5%	No	Baldor	35E960L079G1	W	500		No	86.5%	No		0.0	0	0	$0	$0	$0	0.0
Shop 123D	Shop Equipment	1	Air Compressor	10.0	89.5%	No	Ingersol Rand	1UTOIF4NXH01 004E	W	250		No	89.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Chilled Water System	1	Chilled Water Pump	15.0	93.0%	Yes	Baldor	EM2513T-8	B	339		No	93.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Chilled Water System	1	Chilled Water Pump	15.0	93.0%	Yes	Baldor	EM2513T-8	B	339		No	93.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room 115	Heating System	1	Condensate Pump	0.3	65.0%	No	Aurora Pumps	RQH534DPO5F	B	420		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room 115	Heating System	1	Condensate Pump	0.3	65.0%	No	Marathon Electric	KQC 56C34D5526F	B	420		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Main Mechanical Room	Heating System	1	Condensate Pump	0.8	70.0%	No	AO Smith	H492	B	420		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Main Mechanical Room	Heating System	1	Condensate Pump	0.8	70.0%	No	AO Smith	P48K2EB7	B	420		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Building Ventilation	1	Exhaust Fan	0.3	65.0%	No		FX8B	B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Science Fume Hood	1	Exhaust Fan	3.0	89.5%	No	Strobic Air Technologies	BS00218FS	N	2,304		No	89.5%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Building Ventilation	1	Exhaust Fan	0.3	65.0%	No		DX13B	B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0

		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?	Manufacturer	Model	Remaining Useful Life	Annual Operating Hours	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Woodshop Dust Collector	1	Other	30.0	94.1%	No			W	144		No	94.1%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Building Ventilation	1	Exhaust Fan	0.3	65.0%	No		DX13B	B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Shop Area	1	Exhaust Fan	0.2	65.0%	No			B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Mechanical Room	1	Exhaust Fan	1.0	82.5%	No	Greenheck	GB-330-50	B	2,400	6	Yes	85.5%	No		0.0	53	0	$8	$474	$0	60.5
Roof	Rest Room	1	Exhaust Fan	0.3	65.0%	No			B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Garage Area	1	Exhaust Fan	0.3	65.0%	No	AO Smith	ER39028	W	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Building Ventilation	1	Exhaust Fan	0.1	65.0%	No	Greenheck	G-095-D	W	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Building Ventilation	1	Exhaust Fan	0.3	65.0%	No		DX13B	B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Rest Room	1	Exhaust Fan	0.3	65.0%	No		DX13B	B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Janitorial Room	1	Exhaust Fan	0.1	65.0%	No	Greenheck	G-095-D	W	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Fire Pump Room	Mechanical Fire Pump Room	1	Exhaust Fan	0.1	65.0%	No			B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Main Mechanical Room	Main Mechanical Room	1	Exhaust Fan	0.3	65.0%	No			B	2,400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Main Mechanical Room	Heating Hot Water System	1	Heating Hot Water Pump	15.0	91.0%	No	U.S. Electrical Motors		B	1,764	9	No	93.0%	Yes	1	1.6	8,449	0	$1,243	$7,041	$1,200	4.7
Main Mechanical Room	Heating Hot Water System	1	Heating Hot Water Pump	15.0	91.0%	No	U.S. Electrical Motors		B	1,764	9	No	93.0%	Yes	1	1.6	8,449	0	$1,243	$7,041	$1,200	4.7
Mechanocal Room 115	Heating Hot Water System	1	Heating Hot Water Pump	3.0	86.5%	No	U.S. Electrical Motors		B	3,528	9	No	89.5%	Yes	1	0.3	3,630	0	$534	$3,884	$200	6.9
Mechanocal Room 115	Heating Hot Water System	1	Heating Hot Water Pump	3.0	86.5%	No	U.S. Electrical Motors		B	3,528	9	No	89.5%	Yes	1	0.3	3,630	0	$534	$3,884	$200	6.9
Roof	Mechanical Room	1	Supply Fan	0.5	70.0%	No	Greenheck	RSA-30-621-B20	B	2,400	6	Yes	78.2%	No		0.0	94	0	$14	$352	$0	25.5
Shop 123D	Domestic Hot Water System	1	DHW Circulation Pump	0.2	65.0%	No	B&G	PL-30B	W	8,760		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Shop 123D	Domestic Hot Water System	1	DHW Circulation Pump	0.1	65.0%	No	Taco	0010-SF3	W	8,760		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0

Packaged 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 (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Exterior Ground Level	Building	1	Ductless Mini-Split AC	1.00		21.00		Comfort Star	CCS012CA-2B	W		No							0.0	0	0	$0	$0	$0	0.0
Roof	Astronomy Lab 133 (RTU-1)	1	Package Unit	4.46	55.73	9.55		Lennox	CHA16-653-5Y	B	10	Yes	1	Package Unit	4.46	55.73	16.00		1.1	1,199	0	$176	$7,778	$459	41.5
Roof	Geology Lab 133F (RTU-2)	1	Package Unit	4.46	55.73	9.55		Lennox	CHA16-653-5Y	B	10	Yes	1	Package Unit	4.46	55.73	16.00		1.1	1,199	0	$176	$7,778	$459	41.5
Roof	Main Entrance (AHU-4)	1	Package Unit	7.50	137.60	8.90	0.8 Et	Carrier	48TJE008-521GA	B	10	Yes	1	Package Unit	7.50	137.60	14.00	0.82 Et	1.8	1,958	4	$307	$11,397	$593	35.2
Roof	CAD Labs 102 & 106 (RTU-1)	1	Package Unit	10.00	125.00	12.50		Trane	THC120E3R0A0	W		No							0.0	0	0	$0	$0	$0	0.0
Roof	Classroom 105 & Offices 101B-101G (RTU-2)	1	Package Unit	8.50	106.25	12.50		Trane	THC102E3R0A0	W		No							0.0	0	0	$0	$0	$0	0.0
Roof	Graphics Lab 101, 103, Magazine Areas, Offices 101H-101M, 107A-C, Room 104 & 108 (RTU-3)	1	Package Unit	12.50	156.25	11.30		Trane	TCD151E30CAC	W		No							0.0	0	0	$0	$0	$0	0.0
Roof	Concrete Lab 133E (RTU-4)	1	Package Unit	4.00		19.40		Trane	TZC048F3R0A0	N		No							0.0	0	0	$0	$0	$0	0.0
Roof	Materials & Soils 129 (RTU-5)	1	Package Unit	6.00		23.20		Trane	TZC072F3R0A0	N		No							0.0	0	0	$0	$0	$0	0.0
Roof	Structures 127 (RTU-6)	1	Package Unit	10.00		23.00		Trane	TZC120F3R0A0	N		No							0.0	0	0	$0	$0	$0	0.0
Roof	Shop 123D (RTU-7)	1	Package Unit	3.00		20.10		Trane	TZC036E3R0A0	N		No							0.0	0	0	$0	$0	$0	0.0
Roof	Project Space 123 (RTU-8)	1	Package Unit	6.00		23.20		Trane	TZC072F3R0A0	N		No							0.0	0	0	$0	$0	$0	0.0

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)	Manufacturer	Model	Remaining Useful Life	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Central Plant	Building Chilled Water	1	Water-Cooled Centrifugal Chiller	156.00	Central Plant	Proxy Chiller	W		No							0.0	0	0	$0	$0	$0	0.0

Space Heating Boiler 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)	Manufacturer	Model	Remaining Useful Life	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Central Plant	Building Space Heating	1	Forced Draft Steam Boiler	3,781	Central Plant	Proxy Boiler	W		No						0.0	0	0	$0	$0	$0	0.0
Central Plant	Building Chilled Water	1	Other	1,872	Central Plant	Proxy Steam Chiller	W		No						0.0	0	0	$0	$0	$0	0.0

Pipe Insulation Recommendations

		Recommendation Inputs			Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Affected	ECM #	Length of Uninsulated Pipe (ft)	Pipe Diameter (in)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Shop 123D	Domestic Hot Water System	11	2	1.50	0.0	0	1	$6	$14	$4	1.8

DHW Inventory & Recommendations

		Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Manufacturer	Model	Remaining Useful Life	ECM #	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	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Central Plant	Building	1	Indirect System	Central Plant	Proxy Boiler	W		No						0.0	0	0	$0	$0	$0	0.0

Low-Flow Device Recommendations

	Recommendation Inputs					Energy Impact & Financial Analysis						
Location	ECM #	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Rest Rooms	12	9	Faucet Aerator (Lavatory)	2.20	0.50	0.0	0	4	$19	$65	$36	1.5

Plug Load Inventory

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Labs	5	Misc. Lab Equipment	1,000			
Building	2	Coffee Machine	800			
Building	7	Dehumidifier	280			
Building	181	Computer	125			
Building	1	Portable Fan	130			
Building	3	Microwave	800			
Building	3	Paper Shredder	150			
Building	20	Small/Medium Printer	150			
Building	5	Large Printer/Copier	300			
Building	10	Projector	175			
Building	2	Mini Fridge	260			
Lounge 163	1	Residential Refrigerator	800			
Building	4	Small/Medium Speaker	250			
Building	16	TV	150			
Lounge 163	1	Toaster Oven	1,200			
Classroom 120	1	Laser Printer	200		Universal Laser Systems	
Classroom 120	6	3D Printer	100		Flash Forge	
Classroom 127	2	Saw	746			
Classroom 127	1	Compression Machine	660		Forney	FX 600
Classroom 127	1	Grinder	1,491			
Classroom 127	1	Welder	11,000		Hobart	AD 264
Classroom 127	1	Band Saw	1,200			
Classroom 127	1	Fork Lift Charger	6,960		Applied Energy	24R1050E3D
Classroom 129	1	Shop Equipment	249			
Classroom 129	2	Sifter	2,000			
Classroom 129	2	Microprocessor	300			
Classroom 133	1	Lab Test Equipment	2,000			
Labs	6	Lab Test Equipment	300			
Classroom 135	1	Lab Test Equipment	373			
Classroom 187	1	Lab Oven	600			
Lab 112	1	Spindle	2,237			
Lab 112	1	Planer	3,729			
Lab 112	1	Table Saw	1,400			
Lab 112	2	Lathe	373			
Lab 112	1	Laser CNC Machine	1,500			

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Lab 112	6	Drill Press	360			
Lab 112	5	Band Saw	749			
Lab 112	1	Air Purifier	149			
Lab 112	1	ShopBot	1,700			
Lab 112	2	Dust Collector	1,119			
Lab 112	1	Jointer	2,237			
Lab 112	1	Saw	3,729			
Lab 112	1	Sander	280			
Lab 112	1	Steel Sander	1,491			
Lab 112	4	Sander	559			
Lab 112	1	Saw	559			
Concrete Lab	2	Cement Mixer	249			
Concrete Lab	2	Sifter	2,000			
Office 116	1	3D Printer	1,100			
Office 116	2	CNC Machine	450			
Office 116	1	Milling Machine	95			

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	ECM #	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Hallway	1	Glass Fronted Refrigerated	13	Yes	0.1	1,209	0	$178	$230	$50	1.0
Hallway	1	Non-Refrigerated	13	Yes	0.0	343	0	$50	$230	$0	4.6

Custom (High Level) Measure Analysis

Retro-Commissioning Study

Building Square Footage	71,647	Fuel Utility Rate	$4.422 MMBtu
Percent of Conditioned Area Impacted	100%	Blended Electric Utility Rate	$0.147 kWh

Existing Conditions						Proposed Conditions					Energy Impact & Financial Analysis						
Description	Area(s)/System(s) Served	Remaining Useful Life	Total HVAC Motor Usage kWh	Total HVAC Electric Usage kWh	Total HVAC Fuel Usage MMBtu	Description	% Savings HVAC Motor Usage kWh	% Savings HVAC Electric Usage kWh	% Savings HVAC Fuel Usage MMBtu	Estimated Cost per Sqft	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
HVAC Controls Not Currently Optimized	HVAC Equipment & Systems	3	246,415	52,715	10,625	Retro-Commissioning Study	2%	2%	2%	$0.30	0.00	5,983	213	$1,820	$21,494	$0	11.81

Existing Conditions					Proposed Conditions					Energy Impact & Financial Analysis						
Description	Existing Main Meter Annual kWh	Electric (kWh)	Steam (MMBtu)	Chilled Water (MMBtu)	Description	% Electric Savings	% Gas Savings	Number of Meters	Estimated Unit Cost	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Payback w/ Incentives in Years
Campus Wide Metering	No Current Metering	422,557	11,176	3,755	Electric Smart Sub Meter, Steam Flow and Chilled Water Meters	1%	1%	3	Varies	0.00	4,226	149	$1,282	$18,800	$0	14.66

APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

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.

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ENERGY STAR® Statement of Energy Performance

N/A

ENERGY STAR® Score[1]

The College of New Jersey

Primary Property Type: College/University
Gross Floor Area (ft²): 2,830,421
Built: 1855

For Year Ending: January 31, 2020
Date Generated: December 13, 2020

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
The College of New Jersey 2000 Pennington Road Ewing, New Jersey 08628	The College of New Jersey 2000 Pennington Rd Ewing, NJ 08628 609-771-2874	David Matlack 2000 Pennington Road Ewing, NJ 08628 609-771-2874 sstewart@trccompanies.com

Property ID: 5984875

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
229 kBtu/ft²

Source EUI
258.3 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	619,522,872 (96%)
Electric - Grid (kBtu)	28,774,949 (4%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	160.2
National Median Source EUI (kBtu/ft²)	180.6
% Diff from National Median Source EUI	43%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	35,660

Signature & Stamp of Verifying Professional

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

LP Signature: ______________________Date: ___________

Licensed Professional

____ _________
,
(____)____-______
____

Professional Engineer or Registered Architect Stamp
(if applicable)

APPENDIX C: GLOSSARY

TERM	DEFINITION
Blended Rate	Used to calculate fiscal savings associated with measures. The blended rate is calculated by dividing the amount of your bill by the total energy use. For example, if your bill is $22,217.22, and you used 266,400 kilowatt-hours, your blended rate is 8.3 cents per kilowatt-hour.
Btu	*British thermal unit*: a unit of energy equal to the amount of heat required to increase the temperature of one pound of water by one-degree Fahrenheit.
CHP	*Combined heat and power*. Also referred to as cogeneration.
COP	*Coefficient of performance*: a measure of efficiency in terms of useful energy delivered divided by total energy input.
Demand Response	Demand response reduces or shifts electricity usage at or among participating buildings/sites during peak energy use periods in response to time-based rates or other forms of financial incentives.
DCV	*Demand control ventilation*: a control strategy to limit the amount of outside air introduced to the conditioned space based on actual occupancy need.
US DOE	*United States Department of Energy*
EC Motor	*Electronically commutated motor*
ECM	*Energy conservation measure*
EER	*Energy efficiency ratio*: a measure of efficiency in terms of cooling energy provided divided by electric input.
EUI	*Energy Use Intensity:* measures energy consumption per square foot and is a standard metric for comparing buildings' energy performance.
Energy Efficiency	Reducing the amount of energy necessary to provide comfort and service to a building/area. Achieved through the installation of new equipment and/or optimizing the operation of energy use systems. Unlike conservation, which involves some reduction of service, energy efficiency provides energy reductions without sacrifice of service.
ENERGY STAR®	ENERGY STAR® is the government-backed symbol for energy efficiency. The ENERGY STAR® program is managed by the EPA.
EPA	*United States Environmental Protection Agency*
Generation	The process of generating electric power from sources of primary energy (e.g., natural gas, the sun, oil).
GHG	*Greenhouse gas* gases that are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, thus preventing long-wave radiant energy from leaving Earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.
gpf	*Gallons per flush*

gpm	*Gallon per minute*
HID	*High intensity discharge:* high-output lighting lamps such as high-pressure sodium, metal halide, and mercury vapor.
hp	*Horsepower*
HPS	*High-pressure sodium*: a type of HID lamp
HSPF	*Heating seasonal performance factor:* a measure of efficiency typically applied to heat pumps. Heating energy provided divided by seasonal energy input.
HVAC	*Heating, ventilating, and air conditioning*
IHP 2014	US DOE Integral Horsepower rule. The current ruling regarding required electric motor efficiency.
IPLV	*Integrated part load value:* a measure of the part load efficiency usually applied to chillers.
kBtu	One thousand British thermal units
kW	*Kilowatt*: equal to 1,000 Watts.
kWh	*Kilowatt-hour*: 1,000 Watts of power expended over one hour.
LED	*Light emitting diode*: a high-efficiency source of light with a long lamp life.
LGEA	*Local Government Energy Audit*
Load	The total power a building or system is using at any given time.
Measure	A single activity, or installation of a single type of equipment, that is implemented in a building system to reduce total energy consumption.
MH	*Metal halide*: a type of HID lamp
MBh	*Thousand Btu per hour*
MBtu	*One thousand British thermal units*
MMBtu	*One million British thermal units*
MV	*Mercury Vapor:* a type of HID lamp
NJBPU	*New Jersey Board of Public Utilities*
NJCEP	*New Jersey's Clean Energy Program:* NJCEP is a statewide program that offers financial incentives, programs and services for New Jersey residents, business owners and local governments to help them save energy, money and the environment.
psig	Pounds per square inch gauge
Plug Load	Refers to the amount of power used in a space by products that are powered by means of an ordinary AC plug.
PV	*Photovoltaic:* refers to an electronic device capable of converting incident light directly into electricity (direct current).

SEER	*Seasonal energy efficiency ratio:* a measure of efficiency in terms of annual cooling energy provided divided by total electric input.
SEP	*Statement of energy performance:* a summary document from the ENERGY STAR® Portfolio Manager®.
Simple Payback	The amount of time needed to recoup the funds expended in an investment or to reach the break-even point between investment and savings.
SREC	*Solar renewable energy credit*: a credit you can earn from the state for energy produced from a photovoltaic array.
TREC	*Transition Incentive Renewable Energy Certificate:* a factorized renewable energy certificate you can earn from the state for energy produced from a photovoltaic array.
T5, T8, T12	A reference to a linear lamp diameter. The number represents increments of $1/8^{th}$ of an inch.
Temperature Setpoint	The temperature at which a temperature regulating device (thermostat, for example) has been set.
therm	100,000 Btu. Typically used as a measure of natural gas consumption.
tons	A unit of cooling capacity equal to 12,000 Btu/hr.
Turnkey	Provision of a complete product or service that is ready for immediate use
VAV	*Variable air volume*
VFD	*Variable frequency drive*: a controller used to vary the speed of an electric motor.
WaterSense®	The symbol for water efficiency. The WaterSense® program is managed by the EPA.
Watt (W)	Unit of power commonly used to measure electricity use.