Local Government Energy Audit Report

Central Plant

June 10, 2022

Prepared for:
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Disclaimer

The goal of this audit report is to identify potential energy efficiency opportunities and help prioritize specific measures for implementation. 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.

Incentive values provided in this report are estimated based of previously run state efficiency programs. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. Please review all available utility 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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ENERGY EFFICIENCY INCENTIVE & REBATE TRANSITION

For the purposes of your LGEA, estimated incentives and rebates are included as placeholders for planning purposes. New Jersey utilities are rolling out their own energy efficiency programs, which your project may be eligible for depending on individual measures, quantities, and size of the building.

In 2018, Governor Murphy signed into law the landmark legislation known as the Clean Energy Act. The law called for a significant overhaul of New Jersey's clean energy systems by building sustainable infrastructure in order to fight climate change and reduce carbon emissions, which will in turn create well-paying local jobs, grow the state's economy, and improve public health while ensuring a cleaner environment for current and future residents.

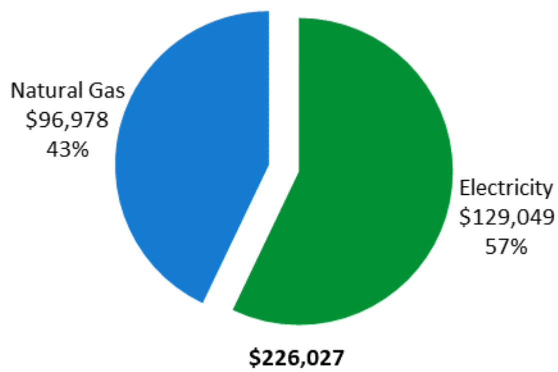
These next generation energy efficiency programs feature new ways of managing and delivering programs historically administered by New Jersey's Clean Energy Program™ (NJCEP). All of the investor-owned gas and electric utility companies will now also offer complementary energy efficiency programs and incentives directly to customers like you. NJCEP will still offer programs for new construction, renewable energy, the Energy Savings Improvement Program (ESIP), and large energy users.

New utility programs are under development. Keep up to date with developments by visiting the NJCEP website.

1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Central Plant. 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: $226,027 Electricity: 1,159,998 kWh Natural Gas: 145,999 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.

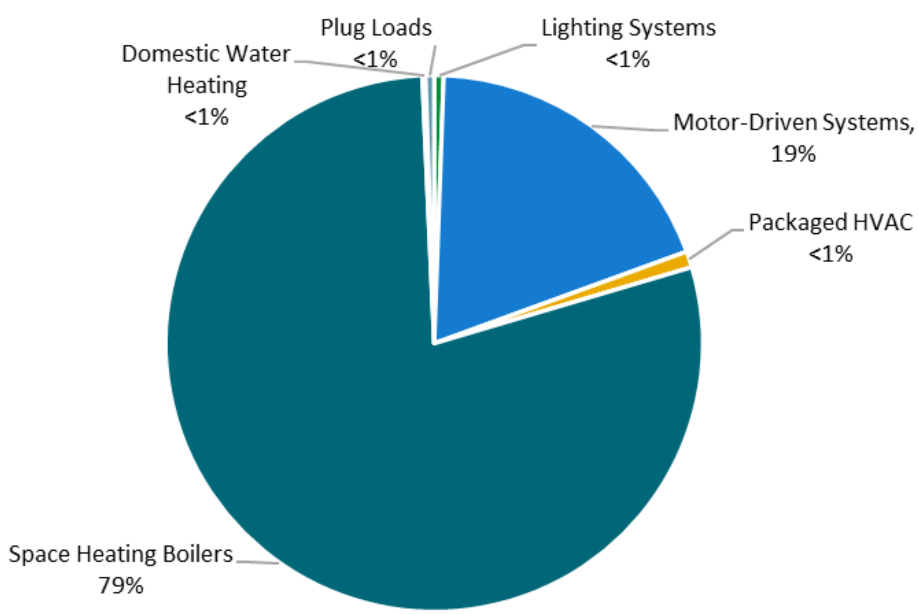


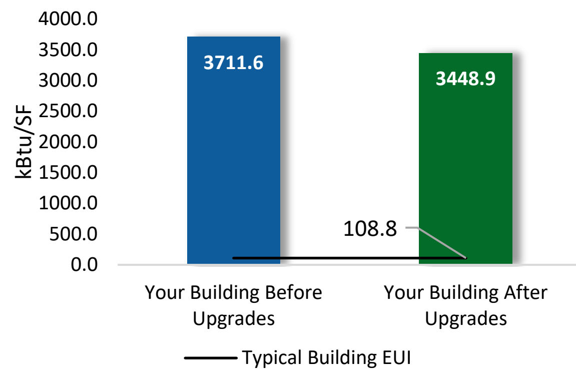
Figure 1 - Energy Use by System

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.

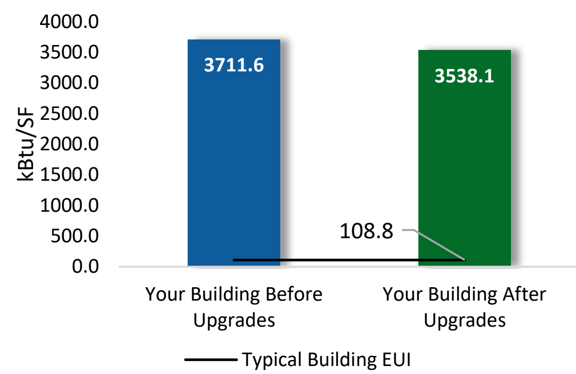
Scenario 1: Full Package (All Evaluated Measures)

Installation Cost	$346,632
Potential Rebates & Incentives[1]	$15,178
Annual Cost Savings	$31,613
Annual Energy Savings	Electricity: 258,366 kWh Natural Gas: 4,320 Therms
Greenhouse Gas Emission Savings	155 Tons
Simple Payback	10.5 Years
Site Energy Savings (All Utilities)	7%



Scenario 2: Cost Effective Package[2]

Installation Cost	$90,587
Potential Rebates & Incentives	$14,653
Annual Cost Savings	$28,373
Annual Energy Savings	Electricity: 255,253 kWh Natural Gas: -36 Therms
Greenhouse Gas Emission Savings	128 Tons
Simple Payback	2.7 Years
Site Energy Savings (all utilities)	5%



On-site Generation Potential

Photovoltaic	None
Combined Heat and Power	High

[1] Incentives are based on previously run state rebate programs. Contact your utility provider for current program incentives that 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			**18,093**	**1.5**	**-4**	**$1,988**	**$3,505**	**$479**	**$3,026**	**1.5**	**17,776**
ECM 1	Install LED Fixtures	Yes	1,060	0.2	0	$116	$471	$50	$421	3.6	1,041
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	17,033	1.3	-4	$1,871	$3,034	$429	$2,605	1.4	16,735
Lighting Control Measures			**4,508**	**0.4**	**-1**	**$495**	**$2,887**	**$370**	**$2,517**	**5.1**	**4,429**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	4,335	0.3	-1	$476	$2,662	$300	$2,362	5.0	4,259
ECM 4	Install High/Low Lighting Controls	Yes	173	0.0	0	$19	$225	$70	$155	8.1	170
Variable Frequency Drive (VFD) Measures			**232,652**	**66.1**	**0**	**$25,882**	**$84,188**	**$13,800**	**$70,388**	**2.7**	**234,279**
ECM 5	Install VFDs on Constant Volume (CV) Fans	Yes	42,426	8.1	0	$4,720	$22,577	$2,000	$20,577	4.4	42,723
ECM 6	Install Boiler Draft Fan VFDs	Yes	21,136	6.0	0	$2,351	$10,303	$2,200	$8,103	3.4	21,283
ECM 7	Install VFDs on Boiler Feedwater Pumps	Yes	150,403	49.8	0	$16,732	$35,003	$6,000	$29,003	1.7	151,455
ECM 8	Install VFDs on Condensate Pumps	Yes	18,687	2.2	0	$2,079	$16,305	$3,600	$12,705	6.1	18,818
Unitary HVAC Measures			**3,113**	**1.0**	**0**	**$346**	**$6,521**	**$525**	**$5,996**	**17.3**	**3,135**
ECM 9	Install High Efficiency Air Conditioning Units	No	3,113	1.0	0	$346	$6,521	$525	$5,996	17.3	3,135
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**436**	**$2,894**	**$249,525**	**$0**	**$249,525**	**86.2**	**51,005**
ECM 10	Install High Efficiency Steam Boilers	No	0	0.0	436	$2,894	$249,525	$0	$249,525	86.2	51,005
Domestic Water Heating Upgrade			**0**	**0.0**	**1**	**$7**	**$7**	**$4**	**$4**	**0.5**	**131**
ECM 11	Install Low-Flow DHW Devices	Yes	0	0.0	1	$7	$7	$4	$4	0.5	131
TOTALS (COST EFFECTIVE MEASURES)			**255,253**	**67.9**	**-4**	**$28,373**	**$90,587**	**$14,653**	**$75,934**	**2.7**	**256,615**
TOTALS (ALL MEASURES)			**258,366**	**69.0**	**432**	**$31,613**	**$346,632**	**$15,178**	**$331,454**	**10.5**	**310,755**

* - All incentives presented in this table are included as placeholders for planning purposes and are based on previously run state rebate programs. Contact your utility provider for details on current programs.

** - 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

Utility-run energy efficiency programs, such as 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.

For details on these programs please visit New Jersey's Clean Energy Program website or contact your utility provider.

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 and Power (CHP)

The CHP program provides incentives for combined heat and power (i.e., 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.

Successor Solar Incentive Program (SuSI)

New Jersey is committed to supporting solar energy. Solar projects help the state reach the renewable goals outlined in the state's Energy Master Plan. The SuSI program is used to register and certify solar projects in New Jersey. Rebates are not available, but certified solar projects are able to earn one SREC II (Solar Renewable Energy Certificates II) for each megawatt-hour of solar electricity produced from a qualifying solar facility.

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.

Large Energy User Program (LEUP)

LEUP designed to promote self-investment in energy efficiency and combined heat and power or fuel cell projects. It incentivizes owners/users of buildings to upgrade or install energy conserving measures in existing buildings to help offset the capital costs associated with the project. The efficiency upgrades are customized to meet the requirements of the customers' existing facilities, while advancing the State's energy efficiency, conservation, and greenhouse gas reduction goals.

2 Existing Conditions

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

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 October 21, 2021, TRC performed an energy audit at Central Plant located in Jersey City, New Jersey. TRC met with Andre Pearson to review the facility operations and help focus our investigation on specific energy-using systems.

The Central Plant is a three-story, 5,000 square foot building built in 1929. Spaces include the lower-level mechanical spaces housing boilers and their related equipment, control office, upper-level housing chilled water and condenser water pumps as well as old and abandoned absorption chillers. There is a ground space housing the new chiller. The building is a section of the Hepburn Hall. Much of the campus-wide heating load is met by this facility. Additionally, it houses the campus main electric meters that serve most of the campus buildings. Steam and electricity are supplied to eight and nine additional campus buildings, respectively, through campus-wide distribution systems.

Recent improvement includes installation of a new magnetic bearing water cooled chiller that serves Hepburn Hall and Karnoutsos Hall and the rebuilding of the deaerator tank which occurred two years ago.

The facility has many concerns including aging boilers which are beyond their useful life and the condensate receivers.

NJCU is interested in building a cogeneration (Cogen) plant and performed a scoping study five years ago. Based on the current central plant configuration, a Cogen would not fit in the plant, as a result, a new central plant would have to be built, with modifications to campus heating and electric distribution systems. The central plant steady thermal load usage and the ability to use all the campus waste heat could make a Cogen plant with absorption chillers a viable option. We recommend a more thorough study of Cogen plant feasibility.

The following additional buildings receive steam and are electrically fed from the central plant master meter:

Buildings	Gross Floor Area (sf)	Central Plant Produced Steam	Central Plant Main Electric Meter
Hepburn Hall	104,523	Yes	No
Fries Hall	27,833	Yes	Yes
Gilligan Students Union (GSUB)	247,603	Yes	Yes
Grossnickle Hall	65,478	No	Yes
Guarini Library	78,770	Yes	Yes
Karnoutsos Hall	82,580	Yes	Yes
Rossey Hall	83,715	Yes	Yes
Science Hall	114,659	Yes	Yes
Professional Studies Building (PSB)	58,738	Yes	Yes
Vodra Hall	59,286	No	Yes

2.2 Building Occupancy

The central plant is in operational year-round, continuously, and has five staff.

Building Name	Weekday/Weekend	Operating Schedule
Central Plant	Weekday	12:00 AM - 12:00 AM
	Weekend	12:00 AM - 12:00 AM

Figure 3 - Building Occupancy Schedule

2.3 Building Envelope

Building walls are concrete block over structural steel with a brick veneer facade. The roof is flat and covered with white membrane, and it is in fair condition.

The flat roof is supported with steel trusses and reinforced concrete deck. Exterior doors are constructed of metal and in good condition.

Building Wall & Roof

2.4 Lighting Systems

The primary interior lighting system uses linear fluorescent T12 lamps with magnetic ballasts. Fixture types include 1-lamp or 2-lamp, 2-foot or 4-foot-long fixtures, mainly surfaced mounted. There are also some LED linear tubes. Exit signs are LED lamps. Most fixtures are in good condition and are controlled via manual wall switches. The high-pressure sodium (HPS) lamp in the south boiler room is controlled by a timer.

Linear T12, LED tubes, HPS & LED Exit Sign

2.5 Air Handling Systems

Unitary Electric HVAC Equipment

The boiler room office uses a window air conditioning (AC) unit that is in good condition. The mechanical spaces are conditioned by one, 5-ton and two, 10-ton condensing units located on the roof. The 5-ton unit has passed its useful life and has been evaluated for replacement. It appears that the 10-ton condensing units is serving other areas of the Hepburn Hall.


Window AC & 5 tons Condensing Unit

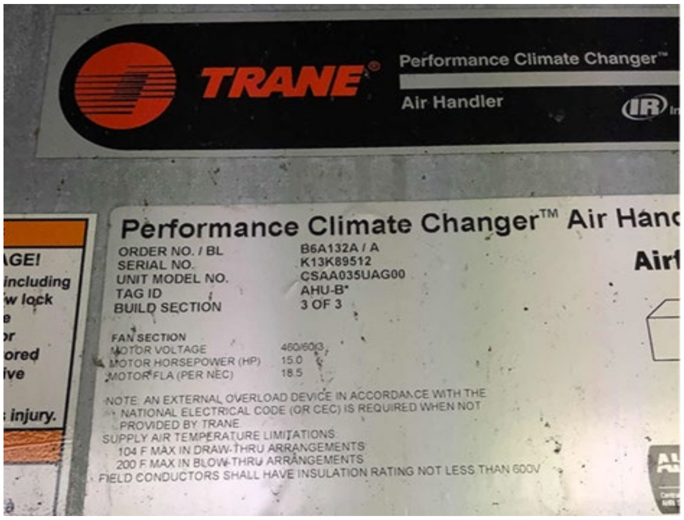
Unitary Heating Equipment

The chiller room is heated by a 7.5 kW suspended electric resistance heater that is controlled by a self-contained local thermostat.

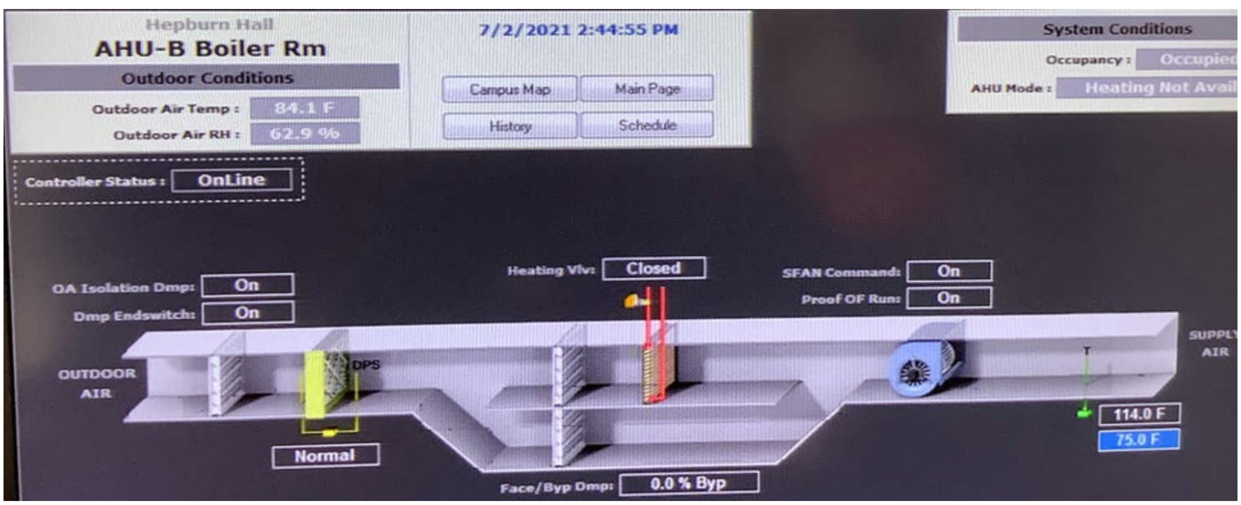
Electric Resistance Heater

Air Handling Units (AHUs)

The lower-level boiler room is served by a Trane AHU that is labelled as AHU-B. This unit is equipped with a 15 hp supply fan motor and a hot water heating coil. It is physically located in the boiler room and was not completely accessible during the energy audit. The unit provides constant air volume to the boiler room and is controlled by the facility energy management system (EMS).



Trane AHU



AHU-B - EMS Screenshot

2.6 Steam Space Conditioning Systems

The central plant is comprised of the following major equipment:

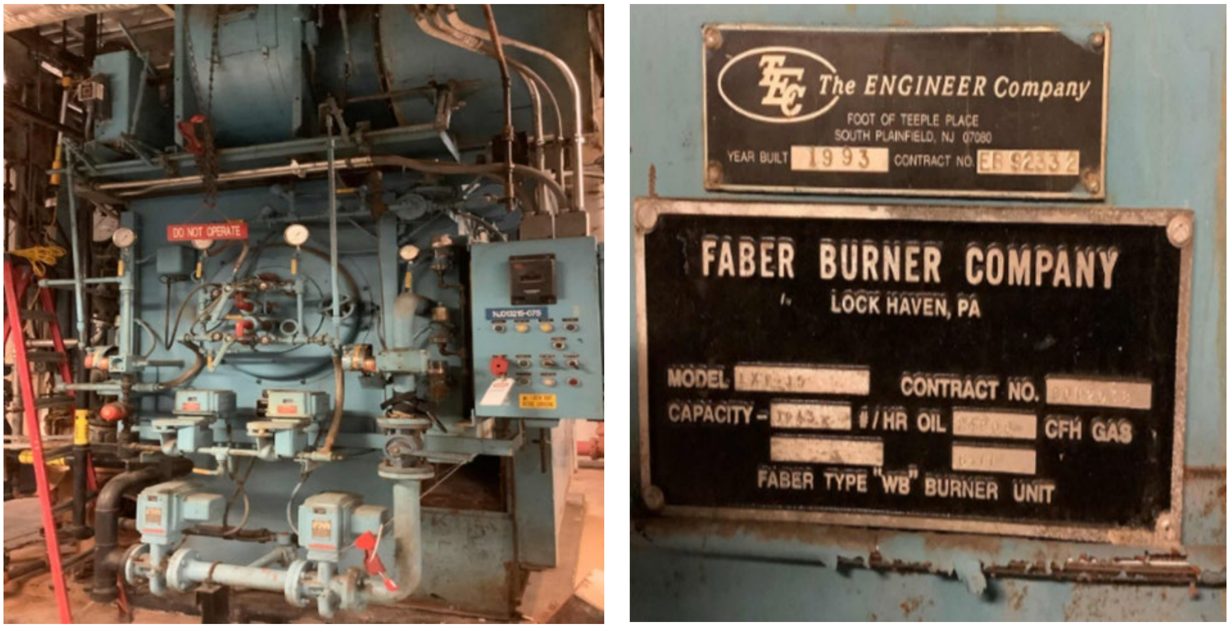
- South Boiler room:
  - ✓ Water tube boiler #1: 14,562 MBh operational
  - ✓ Water tube boiler #4: 19,416 MBh operational
  - ✓ Condensate receiver and condensate pumps
  - ✓ Glycol tanks
  - ✓ Booster water pump
- North Boiler Room:
  - ✓ Water tube boiler #2: non-operational (abandoned)
  - ✓ Water tube boiler #3: non-operational (abandoned)
  - ✓ Two air compressors
  - ✓ Deaerator
  - ✓ Boiler Feedwater tank and pumps
  - ✓ Condensate receiver and pumps
  - ✓ Boiler blowdown tank
- Upper-level absorption chiller room:
  - ✓ Two absorption chillers: non-operational (abandoned)
  - ✓ Chilled water and condenser water pumps
  - ✓ Two heating hot water pumps

Water Tube Steam Boilers

Trane boilers #1 and #4 were installed in 1975 and 1993, respectively. Each boiler has a 10 hp constant speed combustion air fan motor. The boilers are not equipped with flue gas heat recovery units. Boiler #1 has reached it useful life and has been evaluated for replacement.

The boilers operate year-around. In the winter they provide space heating. During the summer, they provide reheat and serve absorption chillers in Science Hall and Rossi Hall. Both boilers are needed during very cold temperatures. Under these conditions, either boiler can be the lead boiler. Only a few buildings use steam directly for heat. For most buildings, steam is converted to hot water using local heat exchangers.

Steam is produced at 50 psi during the summer months as one absorption chiller requires steam at that pressure and is produced at 25 psi during the winter months. There are no campus process steam loads served by the central plant. The boilers are controlled by the facility EMS.



South Boiler Room - Boiler #1

South Boiler Room - Boiler #4

Condensate Receivers and Pumps

The central plant has two condensate receivers, each equipped with two, 5 hp constant speed condensate pumps. The pumps, motors, and condensate piping insulation are in good condition. We have evaluated variable frequency drives (VFDs) for the condensate pumps.

Condensate Pumps

Deaerator

The 1979 deaerator was rebuilt two years ago. It is very old and mostly needs a replacement according to the plant operator. The deaerator removes dissolved gases from the boiler feedwater and protects the steam system from the effects of corrosive gases.

Boiler Feedwater Tank and Pump

There is a boiler feedwater tank equipped with two, 50 hp base-mounted constant speed pumps (P1 & P2). The pumps and motors are in good condition. We have evaluated VFDs for the pumps.

Boiler Feedwater Tank & Pumps

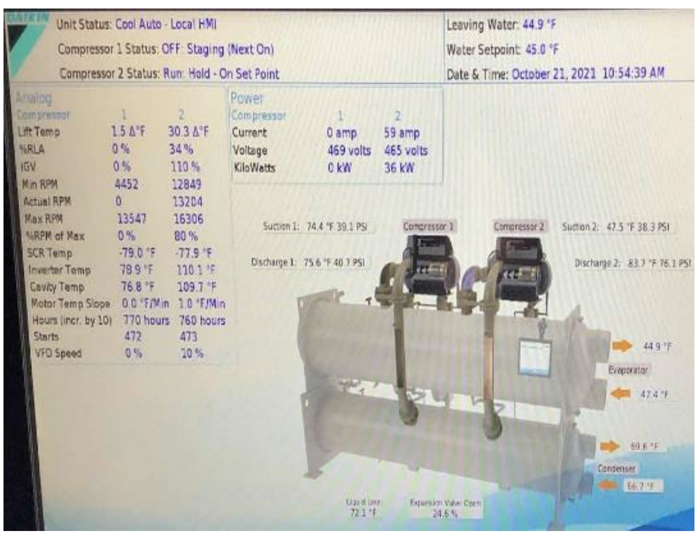
2.7 Chilled Water Systems

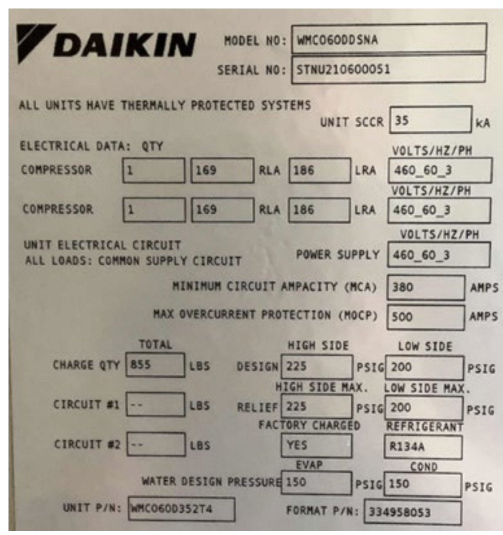
Chilled water is produced by a 370-ton water-cooled Daikin centrifugal chiller located in the chiller room. The chiller is new and uses a direct drive technology, integral variable drives, and R134a refrigerant. The chiller serves the Hepburn Hall and Karnoutsos Hall. Chilled water is distributed to these buildings, respectively, by 40 hp and 50 hp variable speed chilled water pumps located in the upper-level absorption chiller room. The chiller has its own onboard interface control system.

The chilled water setpoint is maintained at 45°F. At the time of the audit, the chiller leaving water temperature was 44.9°F while the return water temperature was 47.4°F. The chilled water distribution system is two-pipe, cooling-only.

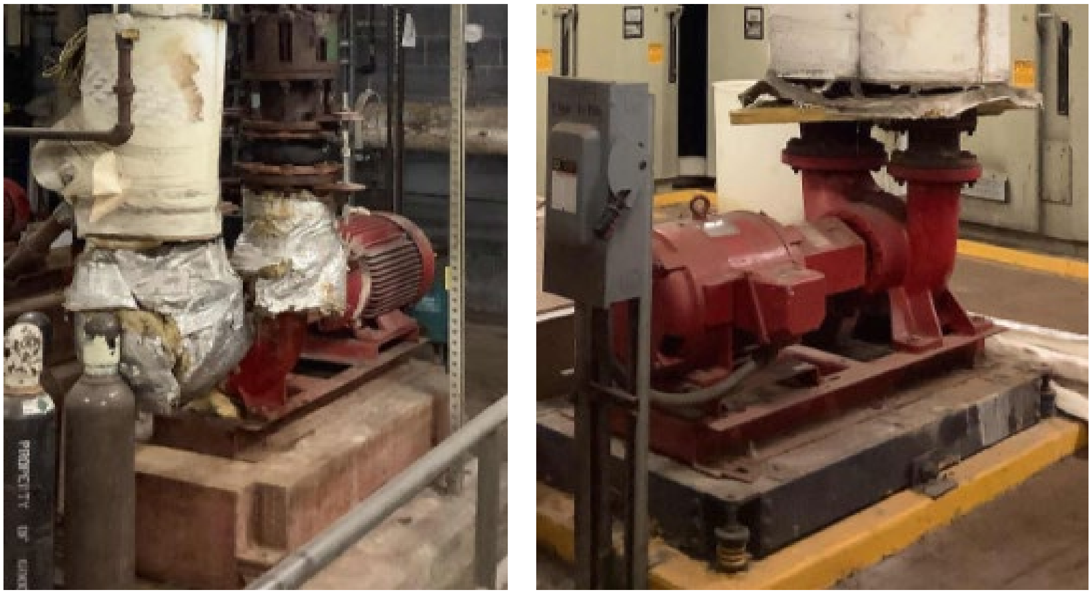
There are two cooling towers, each consisting of one cell with induced draft flow. They are located on the roof. One tower was disconnected during the audit and was not in service. Each tower has a 25 hp variable speed cooling fan.

There is one, 40 hp (CWP-1K) and one, 20 hp (CWP-1H) constant speed condenser water pumps that serve Karnoutsos Hall and Hepburn Hall, respectively. The pumps are in the absorption chillers room. The pumps and motors appear in good condition.





Daikin Magnetic Bearing Centrifugal Chiller



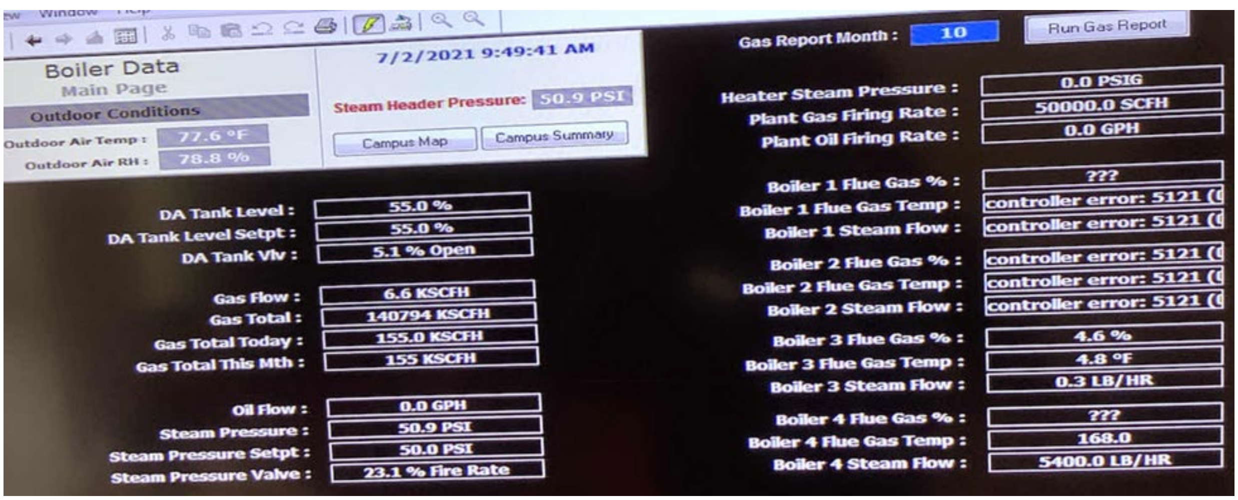
Chilled Water Pumps 1H & 1K

Cooling Tower

Condenser Water Pumps

2.8 Building Energy Management Systems (EMS)

An Andover Triumph building EMS controls the boilers. The system monitors the gas flow and consumption, gas-firing rate, steam flow and pressure, and flue gases.



Boiler Systems Monitoring Main Screen

2.9 Domestic Hot Water

According to the facility supervisor, domestic hot water for the Hepburn Hall is produced through a heat exchanger located in the central plant. However, we were not able to physically locate the heat exchanger.

2.10 Plug Load and Vending Machines

There are two computer workstations in the facility. There is general office equipment such as microwave, desktop printer, a mini refrigerator as well as a residential-style refrigerator. There is additional miscellaneous plug load equipment.

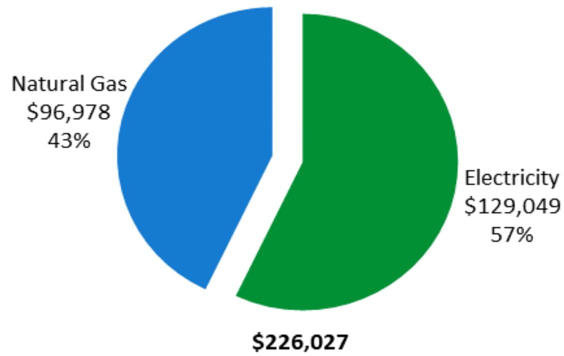
2.11 Water-Using Systems

The boiler room has a restroom with a toilet and a sink. Faucet flow rate is at 2.2 gallons per minute (gpm) or higher. The toilet is rated at 2.5 gallons per flush (gpf).

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	1,159,998 kWh	$129,049
Natural Gas	145,999 Therms	$96,978
Total		**$226,027**



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.

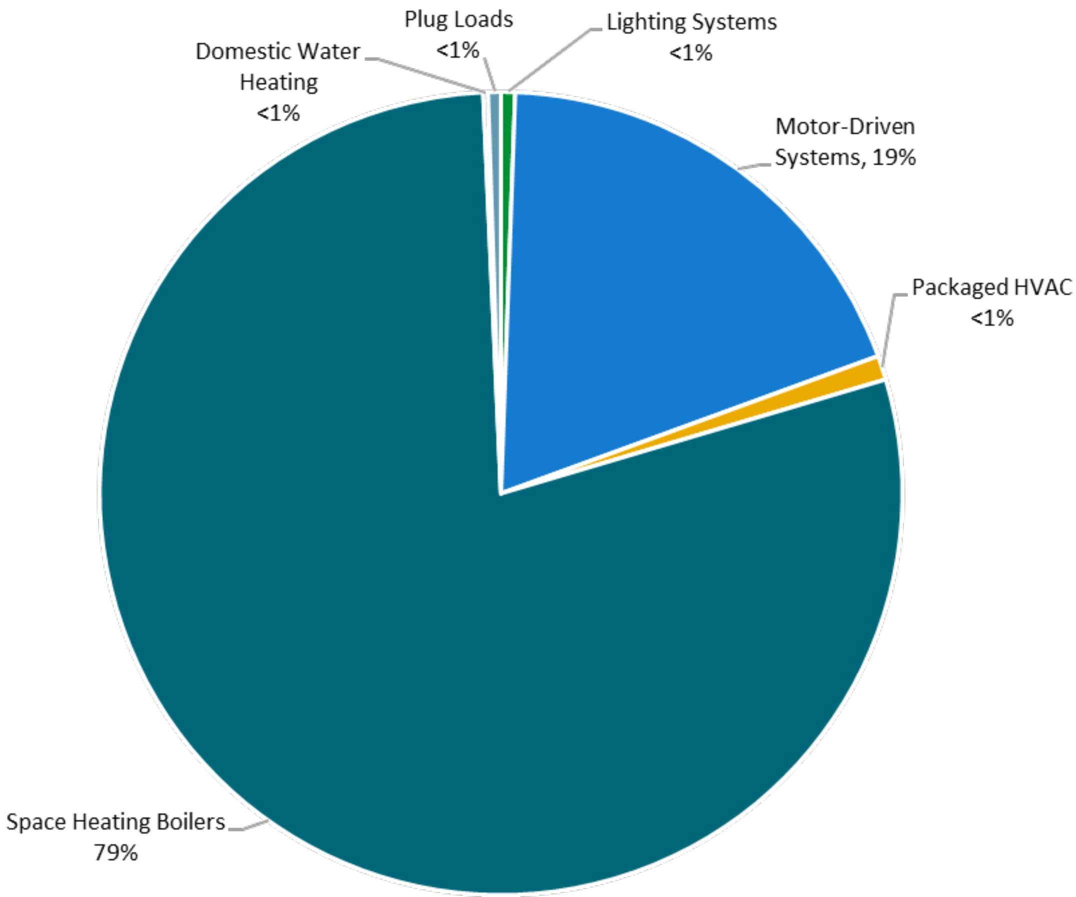
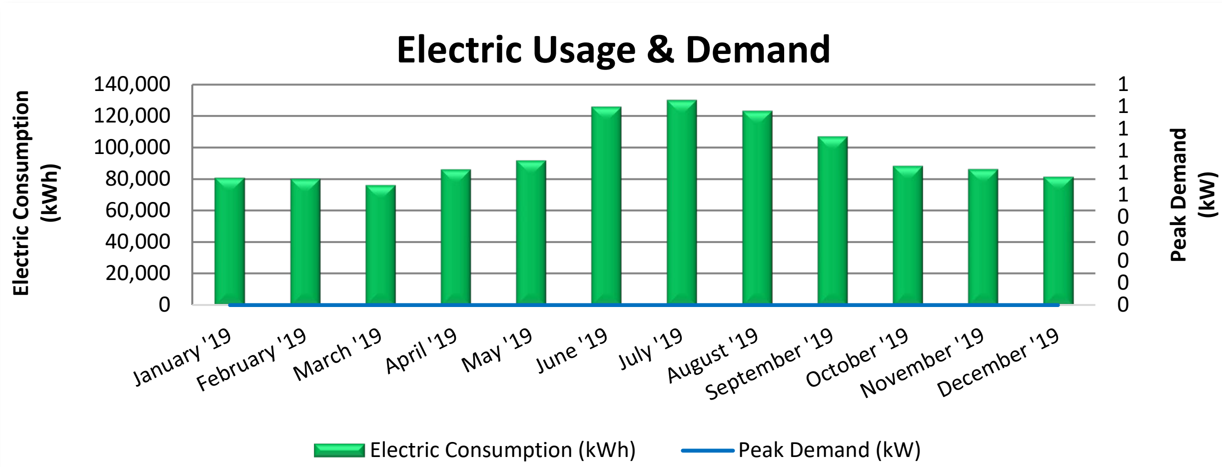


Figure 4 - Energy Balance

3.1 Electricity

PSE&G delivers electricity under rate class Large Power & Lighting Primary (LP&LP), with electric production provided by Direct Energy, a third-party supplier.

Prorated Central Plant Electric Data

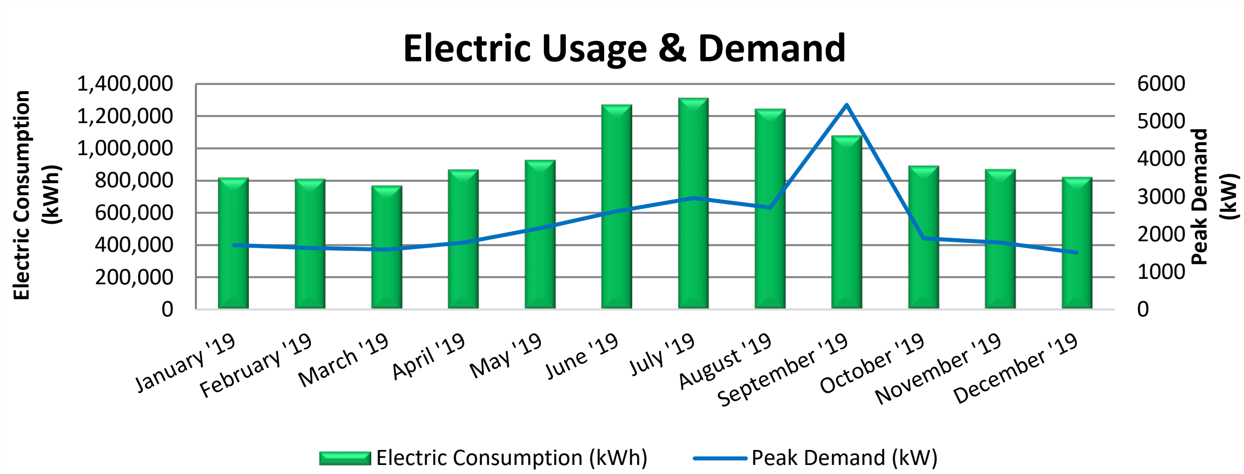


Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
2/12/19	29	81,178	0	$0	$8,034
3/14/19	30	80,354	0	$0	$7,942
4/12/19	29	76,390	0	$0	$7,560
5/14/19	32	86,229	0	$0	$8,836
6/13/19	30	92,097	0	$0	$11,634
7/15/19	32	126,037	0	$0	$15,519
8/13/19	29	130,263	0	$0	$16,362
9/12/19	30	123,568	0	$0	$15,416
10/11/19	29	107,237	0	$0	$11,184
11/11/19	31	88,551	0	$0	$9,181
12/12/19	31	86,409	0	$0	$8,947
1/14/20	33	81,685	0	$0	$8,434
Totals	**365**	**1,159,998**	**0**	**$0**	**$129,049**
Annual	**365**	**1,159,998**	**0**	**$0**	**$129,049**

Notes:

- Electric data has been estimated based on a campus wide approach and utilization of the Central Plant metered data.
- The peak demand for this facility was unavailable because the building electric consumption is prorated from the electric master meter.
- The average purchased electric cost over the past 12 months was $0.111/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.

Master Meter Electric Data



Electric Billing Data					
Period Ending	**Days in Period**	**Electric Usage (kWh)**	**Demand (kW)**	**Demand Cost**	**Total Electric Cost**
2/12/19	29	816,459	1,714	$2,995	$80,805
3/14/19	30	808,172	1,633	$2,854	$79,878
4/12/19	29	768,304	1,596	$2,788	$76,031
5/14/19	32	867,255	1,780	$3,110	$88,872
6/13/19	30	926,277	2,166	$24,794	$117,007
7/15/19	32	1,267,626	2,612	$29,905	$156,083
8/13/19	29	1,310,134	2,964	$33,926	$164,557
9/12/19	30	1,242,795	2,713	$31,059	$155,048
10/11/19	29	1,078,546	5,443	$4,762	$112,487
11/11/19	31	890,610	1,895	$3,322	$92,339
12/12/19	31	869,069	1,777	$3,115	$89,988
1/14/20	33	821,556	1,512	$2,651	$84,827
Totals	**365**	**11,666,803**	**5,443**	**$145,281**	**$1,297,924**
Annual	**365**	**11,666,803**	**5,443**	**$145,281**	**$1,297,924**

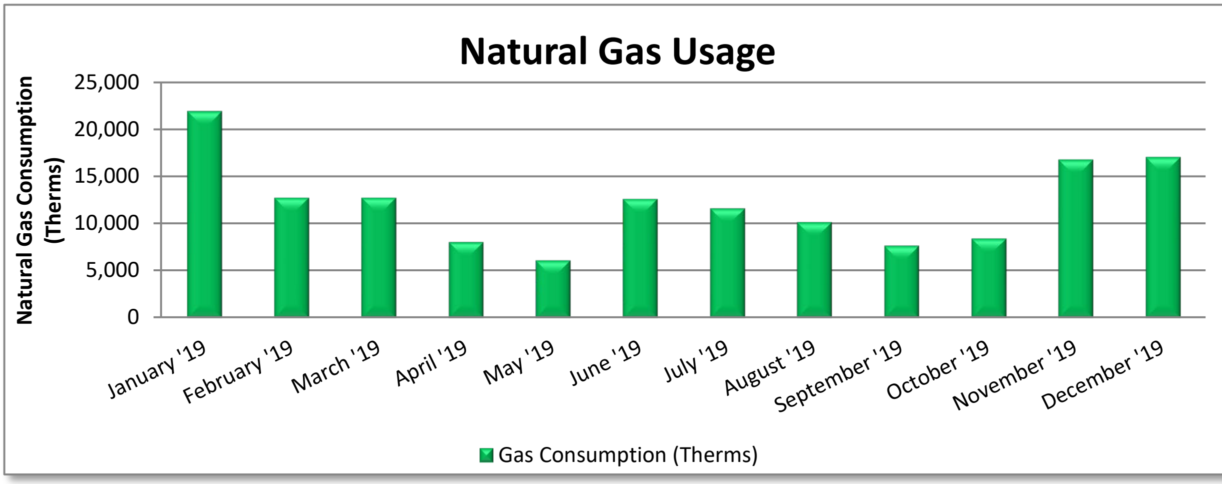
Notes:

- Peak demand of 5,443 kW occurred in October 2019.
- Average demand over the past 12 months was 2,317 kW.
- The average electric cost over the past 12 months was $0.111/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.
- This electric data has been prorated to nine other campus buildings.

3.2 Natural Gas

PSE&G delivers natural gas under rate class Large Volume Gas (LVG), with natural gas supply provided by Direct Energy, a third-party supplier.

Prorated Central Plant Natural Gas Data

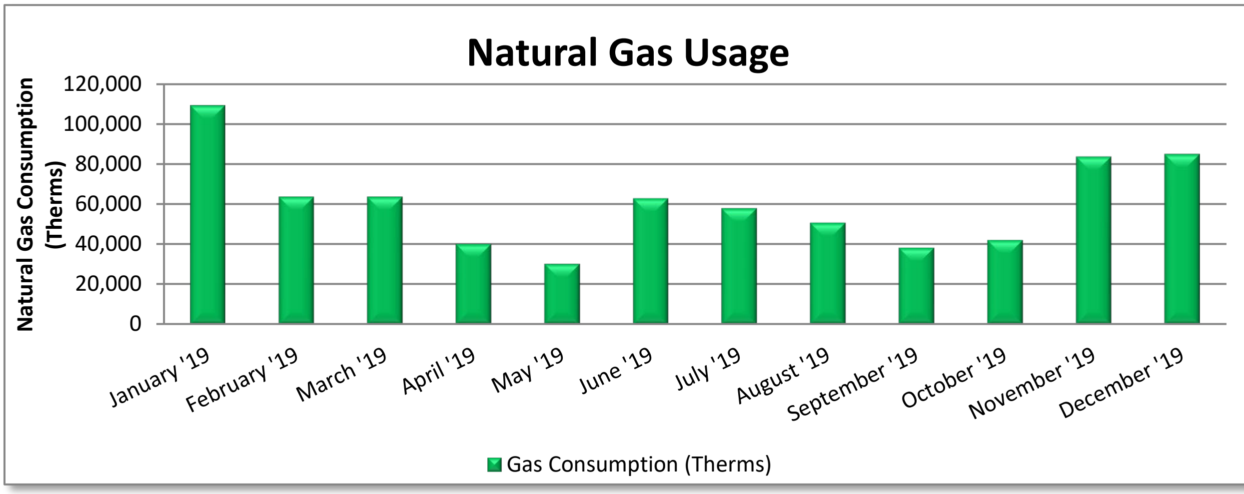


Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
2/12/19	29	21,936	$15,717
3/14/19	30	12,769	$10,670
4/12/19	29	12,769	$6,981
5/14/19	32	8,059	$4,416
6/13/19	30	6,082	$3,339
7/15/19	32	12,627	$6,886
8/13/19	29	11,618	$6,318
9/12/19	30	10,171	$5,545
10/11/19	29	7,678	$4,209
11/11/19	31	8,436	$7,486
12/12/19	31	16,799	$12,653
1/14/20	33	17,055	$12,758
Totals	**365**	**145,999**	**$96,978**
Annual	**365**	**145,999**	**$96,978**

Notes:

- Natural gas data for steam production has been estimated based on a campus wide approach, allocated to the buildings that receive steam.
- The utility graph above comprises an estimate of total building gas use.
- The average gas cost for the past 12 months is $0.664 therm, which is the blended rate used throughout the analysis.

Central Plant Main Natural Gas Data



Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
2/12/19	29	109,388	$78,376
3/14/19	30	63,675	$53,208
4/12/19	29	63,675	$34,812
5/14/19	32	40,187	$22,021
6/13/19	30	30,329	$16,652
7/15/19	32	62,967	$34,336
8/13/19	29	57,933	$31,507
9/12/19	30	50,717	$27,650
10/11/19	29	38,285	$20,989
11/11/19	31	42,068	$37,330
12/12/19	31	83,772	$63,097
1/14/20	33	85,046	$63,620
Totals	**365**	**728,040**	**$483,597**
Annual	**365**	**728,040**	**$483,597**

Notes:

- The average gas cost for the past 12 months is $0.664/therm, which is the blended rate used throughout the analysis.
- This natural gas data has been prorated to eight other campus buildings.

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.

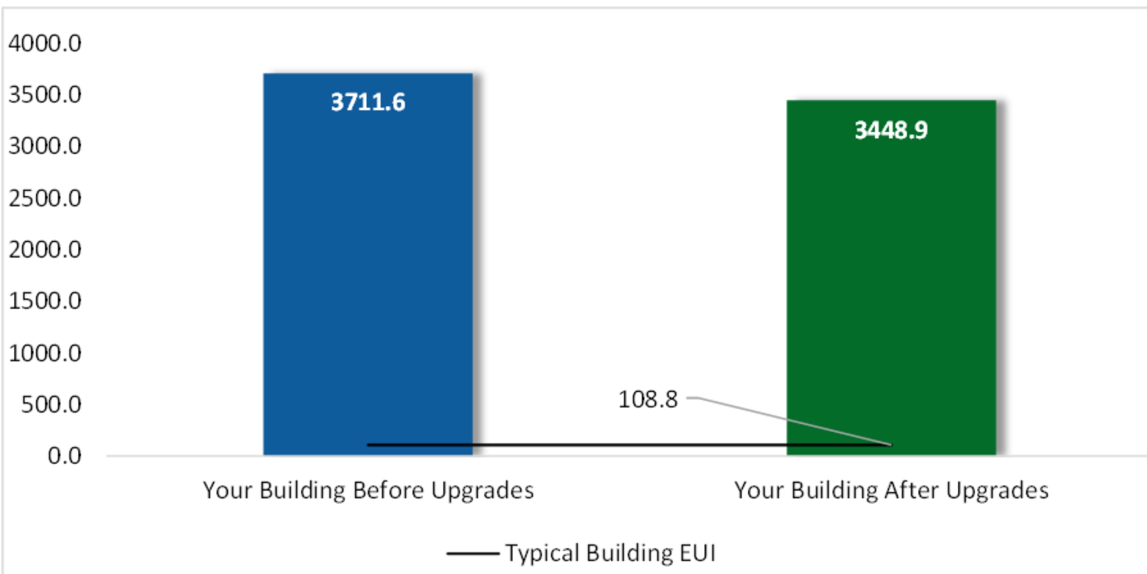


Figure 5 - Energy Use Intensity Comparison[3]

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. Several factors can cause a building to vary from 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.

[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 Energy Conservation Measures

The goal of this audit report is to identify and evaluate potential energy efficiency improvements and provide information about the cost effectiveness of those improvements. Most energy conservation measures have received preliminary analysis of feasibility, which identifies expected ranges of savings. 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 previously run state rebate programs. New utility programs are expected to start rolling out in the spring and summer of 2021. Keep up to date with developments by visiting the NJCEP website. Some measures and proposed upgrades may be eligible for higher incentives than those shown below.

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			**18,093**	**1.5**	**-4**	**$1,988**	**$3,505**	**$479**	**$3,026**	**1.5**	**17,776**
ECM 1	Install LED Fixtures	Yes	1,060	0.2	0	$116	$471	$50	$421	3.6	1,041
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	17,033	1.3	-4	$1,871	$3,034	$429	$2,605	1.4	16,735
Lighting Control Measures			**4,508**	**0.4**	**-1**	**$495**	**$2,887**	**$370**	**$2,517**	**5.1**	**4,429**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	4,335	0.3	-1	$476	$2,662	$300	$2,362	5.0	4,259
ECM 4	Install High/Low Lighting Controls	Yes	173	0.0	0	$19	$225	$70	$155	8.1	170
Variable Frequency Drive (VFD) Measures			**232,652**	**66.1**	**0**	**$25,882**	**$84,188**	**$13,800**	**$70,388**	**2.7**	**234,279**
ECM 5	Install VFDs on Constant Volume (CV) Fans	Yes	42,426	8.1	0	$4,720	$22,577	$2,000	$20,577	4.4	42,723
ECM 6	Install Boiler Draft Fan VFDs	Yes	21,136	6.0	0	$2,351	$10,303	$2,200	$8,103	3.4	21,283
ECM 7	Install VFDs on Boiler Feedwater Pumps	Yes	150,403	49.8	0	$16,732	$35,003	$6,000	$29,003	1.7	151,455
ECM 8	Install VFDs on Condensate Pumps	Yes	18,687	2.2	0	$2,079	$16,305	$3,600	$12,705	6.1	18,818
Unitary HVAC Measures			**3,113**	**1.0**	**0**	**$346**	**$6,521**	**$525**	**$5,996**	**17.3**	**3,135**
ECM 9	Install High Efficiency Air Conditioning Units	No	3,113	1.0	0	$346	$6,521	$525	$5,996	17.3	3,135
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**436**	**$2,894**	**$249,525**	**$0**	**$249,525**	**86.2**	**51,005**
ECM 10	Install High Efficiency Steam Boilers	No	0	0.0	436	$2,894	$249,525	$0	$249,525	86.2	51,005
Domestic Water Heating Upgrade			**0**	**0.0**	**1**	**$7**	**$7**	**$4**	**$4**	**0.5**	**131**
ECM 11	Install Low-Flow DHW Devices	Yes	0	0.0	1	$7	$7	$4	$4	0.5	131
TOTALS			**258,366**	**69.0**	**432**	**$31,613**	**$346,632**	**$15,178**	**$331,454**	**10.5**	**310,755**

* - All incentives presented in this table are included as placeholders for planning purposes and are based on previously run state rebate programs. Contact your utility provider for details on current programs.

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

Figure 6 – 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		**18,093**	**1.5**	**-4**	**$1,988**	**$3,505**	**$479**	**$3,026**	**1.5**	**17,776**
ECM 1	Install LED Fixtures	1,060	0.2	0	$116	$471	$50	$421	3.6	1,041
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	17,033	1.3	-4	$1,871	$3,034	$429	$2,605	1.4	16,735
Lighting Control Measures		**4,508**	**0.4**	**-1**	**$495**	**$2,887**	**$370**	**$2,517**	**5.1**	**4,429**
ECM 3	Install Occupancy Sensor Lighting Controls	4,335	0.3	-1	$476	$2,662	$300	$2,362	5.0	4,259
ECM 4	Install High/Low Lighting Controls	173	0.0	0	$19	$225	$70	$155	8.1	170
Variable Frequency Drive (VFD) Measures		**232,652**	**66.1**	**0**	**$25,882**	**$84,188**	**$13,800**	**$70,388**	**2.7**	**234,279**
ECM 5	Install VFDs on Constant Volume (CV) Fans	42,426	8.1	0	$4,720	$22,577	$2,000	$20,577	4.4	42,723
ECM 6	Install Boiler Draft Fan VFDs	21,136	6.0	0	$2,351	$10,303	$2,200	$8,103	3.4	21,283
ECM 7	Install VFDs on Boiler Feedwater Pumps	150,403	49.8	0	$16,732	$35,003	$6,000	$29,003	1.7	151,455
ECM 8	Install VFDs on Condensate Pumps	18,687	2.2	0	$2,079	$16,305	$3,600	$12,705	6.1	18,818
Domestic Water Heating Upgrade		**0**	**0.0**	**1**	**$7**	**$7**	**$4**	**$4**	**0.5**	**131**
ECM 11	Install Low-Flow DHW Devices	0	0.0	1	$7	$7	$4	$4	0.5	131
TOTALS		**255,253**	**67.9**	**-4**	**$28,373**	**$90,587**	**$14,653**	**$75,934**	**2.7**	**256,615**

* - All incentives presented in this table are included as placeholders for planning purposes and are based on previously run state rebate programs. Contact your utility provider for details on current programs.

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

Figure 7 – 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		**18,093**	**1.5**	**-4**	**$1,988**	**$3,505**	**$479**	**$3,026**	**1.5**	**17,776**
ECM 1	Install LED Fixtures	1,060	0.2	0	$116	$471	$50	$421	3.6	1,041
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	17,033	1.3	-4	$1,871	$3,034	$429	$2,605	1.4	16,735

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 is 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 high pressure sodium 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 fixture.

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: south boiler room.

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: all areas with fluorescent fixtures with T12 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		**4,508**	**0.4**	**-1**	**$495**	**$2,887**	**$370**	**$2,517**	**5.1**	**4,429**
ECM 3	Install Occupancy Sensor Lighting Controls	4,335	0.3	-1	$476	$2,662	$300	$2,362	5.0	4,259
ECM 4	Install High/Low Lighting Controls	173	0.0	0	$19	$225	$70	$155	8.1	170

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 3: 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: chiller room, electrical room, and storage room.

ECM 4: 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.

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 occupants approach the area.

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

Affected Building Areas: stairs.

4.3 Variable Frequency Drives (VFD)

#	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		**232,652**	**66.1**	**0**	**$25,882**	**$84,188**	**$13,800**	**$70,388**	**2.7**	**234,279**
ECM 5	Install VFDs on Constant Volume (CV) Fans	42,426	8.1	0	$4,720	$22,577	$2,000	$20,577	4.4	42,723
ECM 6	Install Boiler Draft Fan VFDs	21,136	6.0	0	$2,351	$10,303	$2,200	$8,103	3.4	21,283
ECM 7	Install VFDs on Boiler Feedwater Pumps	150,403	49.8	0	$16,732	$35,003	$6,000	$29,003	1.7	151,455
ECM 8	Install VFDs on Condensate Pumps	18,687	2.2	0	$2,079	$16,305	$3,600	$12,705	6.1	18,818

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 5: Install VFDs on Constant Volume (CV) Fans

Install 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.

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

Affected Air Handlers: AHU-B & exhaust fans.

ECM 6: Install Boiler Draft Fan VFDs

Replace existing volume control devices on boiler draft fans, such as inlet vanes or dampers, with VFDs. Inlet vanes or dampers 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 reducing the draft fan speed (and power) when conditions allow for reduced combustion air flow.

Additional maintenance savings may result from this measure. VFDs are solid state electronic devices, which generally require less maintenance than mechanical air volume control devices.

Affected Units: Boiler #1 and #4 combustion fans.

ECM 7: Install VFDs on Boiler Feedwater Pumps

Install VFDs to control boiler feedwater pumps. The existing level control valve will need to be maintained fully open and its control signal used by the VFD to modulate the feedwater speed.

Energy savings result from reducing the pump motor speed (and power) at reduced feedwater flow. The magnitude of energy savings is based on the estimated amount of time that the pumping system will operate at reduced load.

Affected Units: Boiler feedwater pumps P12 and P2.

ECM 8: Install VFDs on Condensate Pumps

Install VFDs to control the condensate return pumps. The condensate pump flow will have to be controlled to work in conjunction with the boiler feed water pump. The VFD control feedback should be based on a pressure transducer located in the main steam header. Before implementing this measure co-ordinate with the pump and boiler manufacturer.

Energy savings result from reducing the pump motor speed (and power) at reduced condensate flow from the condensate receiver. The magnitude of energy savings is based on the estimated amount of time that the pumping system will operate at reduced load.

4.4 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		**3,113**	**1.0**	**0**	**$346**	**$6,521**	**$525**	**$5,996**	**17.3**	**3,135**
ECM 9	Install High Efficiency Air Conditioning Units	3,113	1.0	0	$346	$6,521	$525	$5,996	17.3	3,135

Replacing the unitary HVAC unit 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 unitary HVAC is eventually replaced, consider purchasing equipment that exceeds the minimum efficiency required by building codes.

ECM 9: Install High Efficiency Air Conditioning Units

We evaluated replacing a standard efficiency condensing unit with high efficiency condensing unit. 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: 5-ton condensing unit.

4.5 Gas-Fired 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)
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**436**	**$2,894**	**$249,525**	**$0**	**$249,525**	**86.2**	**51,005**
ECM 10	Install High Efficiency Steam Boilers	0	0.0	436	$2,894	$249,525	$0	$249,525	86.2	51,005

ECM 10: Install High Efficiency Steam Boilers

Replace older inefficient steam boilers with high-efficiency steam boilers. Energy savings results from improved combustion efficiency and reduced standby losses at low loads.

For the purpose of this analysis, we evaluated the replacement of boilers on a one-for-one basis with equipment of the same capacity. We recommend that you work with your mechanical design team to select boilers that are sized appropriately for the heating load. In many cases installing multiple modular boilers, rather than one or two large boilers, will result in higher overall plant efficiency while providing additional system redundancy.

Replacing the boiler has a long payback based on energy savings and may not be justifiable based simply on energy considerations. However, the boiler has reached the end of its normal useful life. Typically, the marginal cost of purchasing high-efficiency boiler can be justified by the marginal savings from the improved efficiency. When the boiler is eventually replaced, consider purchasing boiler that exceed the minimum efficiency required by building codes.

Central plant natural gas use was allocated to individual buildings to determine energy use at the building level. The boiler replacement savings shown in the summary tables is based on natural gas use allocated to the Central Plant rather than the actual natural gas used by the boilers. An alternative calculation of the savings for replacing the oldest boiler, based on total Central Plant gas use, shows that the payback for the replacement would be over 30 years.

4.6 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**	**1**	**$7**	**$7**	**$4**	**$4**	**0.5**	**131**
ECM 11	Install Low-Flow DHW Devices	0	0.0	1	$7	$7	$4	$4	0.5	131

ECM 11: 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
Faucet aerator (kitchen)	1.5 gpm
Showerhead	2.0 gpm
Pre-rinse spray valve (kitchen)	1.28 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.

4.7 Measures for Future Consideration

There are additional opportunities for improvement that New Jersey City University may wish to consider. These potential upgrades typically require further analysis, involve substantial capital investment, and/or include significant system reconfiguration. These measures are therefore beyond the scope of this energy audit. These measures are described here to support a whole building approach to energy efficiency and sustainability.

New Jersey City University may wish to consider the Energy Savings Improvement Program (ESIP) or other whole building approach. With interest in implementing comprehensive, largescale and/or complex system wide projects, these measures may be pursued during development of a future energy savings plan. We recommend that you work with your energy service company (ESCO) and/or design team to:

- Evaluate these measures further.
- Develop firm costs.
- Determine measure savings.
- Prepare detailed implementation plans.

Other modernization or capital improvement funds may be leveraged for these types of refurbishments. As you plan for capital upgrades, be sure to consider the energy impact of the building systems and controls being specified.

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 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.

Note that a full retro-commissioning effort will extend to major air handling, pumping, distribution and controls throughout the campus. The sub-metering measure listed below would provide per-building consumption information, very useful in identifying where energy is consumed.

Building Sub Metering

Facility staff expressed interest in sub metering key buildings, which are currently served by a master meter. Electric submeters alone do not save energy, but they are a useful tool under the right circumstances. Electric 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.

Steam is distributed to a number of campus buildings. Metering is available for steam production and distribution systems. Such equipment can help facility staff pinpoint problem areas, including where steam leaks may be occurring.

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 5% –20% 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, and planned capital upgrades, and it 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 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 cannot manage what you do not 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[4]. 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.

Motor Controls

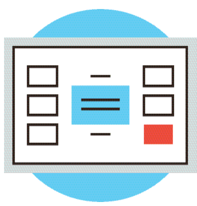
Electric motors often run unnecessarily, and this is an overlooked opportunity to save energy. These motors should be identified and turned off when appropriate. For example, exhaust fans often run unnecessarily when ventilation requirements are already met. Whenever possible, use automatic devices such as twist timers or occupancy sensors to turn off motors when they are not needed.

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

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.

Thermostat Schedules and Temperature Resets



Use thermostat setback temperatures and schedules to reduce heating and cooling energy use during periods of low or no occupancy. Thermostats should be programmed for a setback of 5°F-10°F during low occupancy hours (reduce heating setpoints and increase cooling setpoints). Cooling load can be reduced by increasing the facility's occupied setpoint temperature. In general, during the cooling season, thermostats should be set as high as possible without sacrificing occupant comfort.

Chiller Maintenance

Service chillers regularly to keep them operating properly. Chillers are responsible for a substantial portion of a commercial building's overall energy usage, and when they do not work well, there is usually a noticeable increase in energy bills and increased occupant complaints. Regular diagnostics and service can save five to ten percent of the cost of operating your chiller. If you already have a maintenance contract in place, your existing service company should be able to provide these services.

AC 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.

Ductwork Maintenance

Duct maintenance has two primary goals: keep the ducts clean to avoid air quality problems and seal leaks to save energy. Check for cleanliness, obstructions that block airflow, water damage, and leaks. Ducts should be inspected at least every two years.

The biggest symptoms of clogged air ducts are differing temperatures throughout the building and areas with limited airflow from supply registers. If a particular air duct is clogged, then air flow will only be cut off to some rooms in the building—not all of them. The reduced airflow will make it more difficult for those areas to reach the temperature setpoint, which will cause the HVAC system to run longer to cool or heat that area properly. If you suspect clogged air ducts, ensure that all areas in front of supply registers are clear of items that may block or restrict air flow, and you should check for fire dampers or balancing dampers that have failed closed.

Duct leakage in commercial buildings can account for 5%–25% of the supply airflow. In the case of rooftop air handlers, duct leakage can occur to the outside of the building wasting conditioned air. Check ductwork for leakage. Eliminating duct leaks can improve ventilation system performance and reduce heating and cooling system operation.

Distribution system losses are dependent on-air system temperature, the size of the distribution system, and the level of insulation of the ductwork. Significant energy savings can be achieved when insulation has not been well maintained. When the insulation is missing or worn, the system efficiency can be significantly reduced. This measure saves energy by reducing heat transfer in the distribution system.

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.

Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to keeping the heating system running efficiently and preventing expensive repairs. Annual tune-ups should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely and efficiently. Boilers should be cleaned according to the manufacturer's instructions to remove soot and scale from the boiler tubes to improve heat transfer.

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[5] or download a copy of EPA's "WaterSense™ at Work: Best Management Practices for Commercial and Institutional Facilities"[6] 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.

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

[6] 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 (AC) 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 no potential for installing a PV array.

This facility does not appear to meet the minimum criteria for a cost-effective solar PV installation. To be cost-effective, a solar PV array needs certain minimum criteria, such as sufficient and sustained electric demand and sufficient flat or south-facing rooftop or other unshaded space on which to place the PV panels.

The graphic below displays the results of the PV potential screening conducted for this building 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.

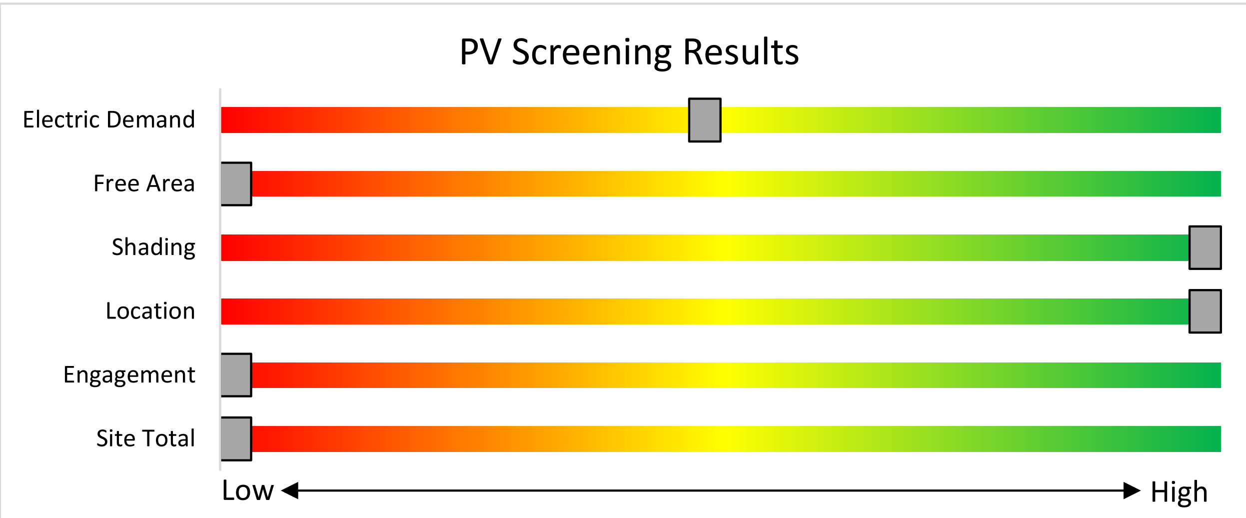


Figure 8 - Photovoltaic Screening

Successor Solar Incentive Program (SuSI)

The SuSI program replaces the SREC Registration Program (SRP) and the Transition Incentive (TI) program. The SuSI program is used to register and certify solar projects in New Jersey. Rebates are not available for solar projects. Solar projects may qualify to earn SREC- IIs (Solar Renewable Energy Certificates-II), however, the project owners *must* register their solar projects prior to the start of construction to establish the project's eligibility.

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:

Successor Solar Incentive Program (SuSI): https://www.njcleanenergy.com/renewable-energy/programs/susi-program

- **Basic Info on Solar PV in NJ**: www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs.
- **Approved Solar Installers in the NJ 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.

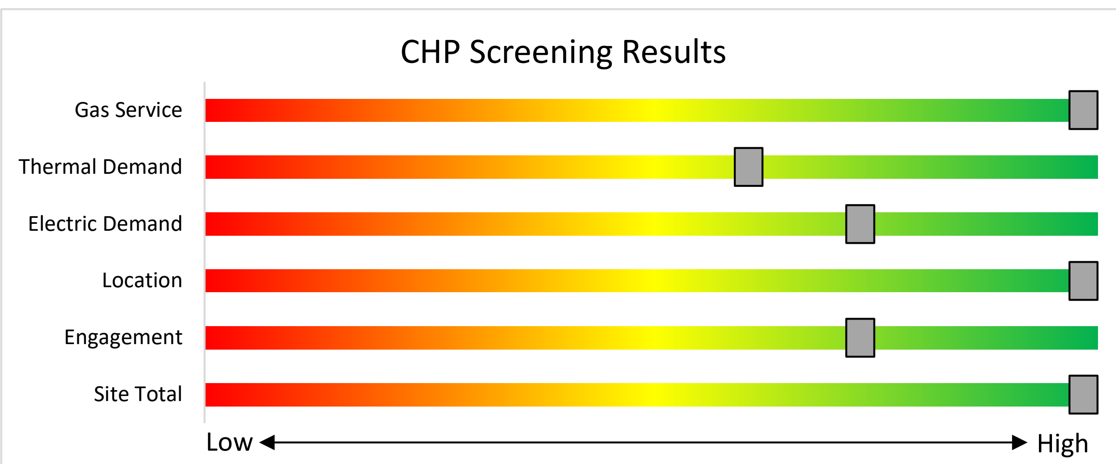
CHP systems typically produce a portion of the electric power used on-site, with the balance of electric power needs supplied by the local utility company. The heat is used to supplement (or replace) existing boilers and provide space heating and/or domestic hot water heating. Waste heat can also be 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 campus as a whole has high potential for installing a cost-effective CHP system.

The magnitude, type, and duration of the thermal demand, the coincident electric load, and the ease of interconnection contribute to the potential for CHP at the site. Based on the amount of steam used throughout the year and the concurrent electric demand a Reciprocating Engine may be feasible. If you are interested in pursuing CHP, we recommend performing a detailed feasibility study, which will provide a thorough understanding of the costs and savings associated with this technology.

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.



Potential	High	
System Type	Recip Engine	
System Potential	130	kW
Electric Generation	1,019,500	kWh/yr
Thermal Generation	6,369,836	MBtu/yr
Displaced Cost	$83,136	/yr
Installed Cost	$667,000	

Figure 9 - 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? Your utility provider may be able to help.

7.1 Utility Energy Efficiency Programs

The Clean Energy Act, signed into law by Governor Murphy in 2018, requires New Jersey's investor-owned gas and electric utilities to reduce their customers' use by set percentages over time. To help reach these targets the New Jersey Board of Public Utilities approved a comprehensive suite of energy efficiency programs to be run by the utility companies.

These new utility programs are rolling out in the spring and summer of 2021. Keep up to date with developments by visiting:

https://www.njcleanenergy.com/transition

8 New Jersey's Clean Energy Programs

New Jersey's Clean Energy Program will continue to offer some energy efficiency programs.

8.1 Large Energy Users

The Large Energy Users Program (LEUP) is designed to foster self-directed investment in energy projects. This program is offered to New Jersey's largest energy customers that annually contribute at least $200,000 to the NJCEP aggregate of all buildings/sites. This equates to roughly $5 million in energy costs in the prior fiscal year.

Incentives

Incentives are based on the specifications below. The maximum incentive per entity is the lesser of:

- $4 million
- 75% of the total project(s) cost
- 90% of total NJCEP fund contribution in previous year
- $0.33 per projected kWh saved; $3.75 per projected Therm saved annually

How to Participate

To participate in LEUP, you will first need submit an enrollment application. This program requires all qualified and approved applicants to submit an energy plan that outlines the proposed energy efficiency work for review and approval. Applicants may submit a Draft Energy Efficiency Plan (DEEP), or a Final Energy Efficiency Plan (FEEP). Once the FEEP is approved, the proposed work can begin.

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

8.2 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 Fuel Cells with Heat Recovery	>3 MW	$350		
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 will 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.

8.3 Successor Solar Incentive Program (SuSI)

The SuSI program replaces the SREC Registration Program (SRP) and the Transition Incentive (TI) program. The program is used to register and certify 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 SREC-IIs (Solar Renewable Energy Certificates-II). SuSI consists of two sub-programs. The Administratively Determined Incentive (ADI) Program and the Competitive Solar Incentive (CSI) Program.

Administratively Determined Incentive (ADI) Program

The ADI Program provides administratively set incentives for net metered residential projects, net metered non-residential projects 5 MW or less, and all community solar projects.

After the registration is accepted, construction is complete, and a complete final as-built packet has been submitted, the project is issued a New Jersey certification number, which enables it to generate New Jersey SREC- IIs.

Market Segments	Size MW dc	Incentive Value ($/SREC II)	Public Entities Incentive Value - $20 Adder ($/SRECII)
Net Metered Residential	All types and sizes	$90	N/A
Small Net Metered Non-Residential located on Rooftop, Carport, Canopy and Floating Solar	Projects smaller than 1 MW	$100	$120
Large Net Metered Non-Residential located on Rooftop, Carport, Canopy and Floating Solar	Projects 1 MW to 5 MW	$90	$110
Small Net Metered Non-Residential Ground Mount	Projects smaller than 1 MW	$85	$105
Large Net Metered Non-Residential Ground Mount	Projects 1 MW to 5 MW	$80	$100
LMI Community Solar	Up to 5 MW	$90	N/A
Non-LMI Community Solar	Up to 5 MW	$70	N/A
Interim Subsection (t)	All types and sizes	$100	N/A

Eligible projects may generate SREC-IIs for 15 years following the commencement of commercial operations which is defined as permission to operate (PTO) from the Electric Distribution Company. After 15 years, projects may be eligible for a NJ Class I REC.

SREC-IIs will be purchased monthly by the SREC-II Program Administrator who will allocate the SREC-IIs 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.

The ADI Program online portal is now open to new registrations effective August 28, 2021.

Competitive Solar Incentive Program

The Competitive Solar Incentive (CSI) Program will provide competitively set incentives for grid supply projects and net metered non-residential projects greater than 5MW. The program is currently under development with the goal of holding the first solicitation by early-to-mid 2022. For updates, please continue to check the Solar Proceedings page on the New Jersey's Clean Energy Program website.

Solar projects help the State of New Jersey reach renewable energy goals outlined in the state's Energy Master Plan.

If you are considering installing solar photovoltaics on your building, visit the following link for more information: https://njcleanenergy.com/renewable-energy/programs/susi-program.

8.4 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 into contracts to help finance building energy upgrades. Annual payments are lower than the savings projected from the energy conservation measures (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 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.

9 Project Development

Energy conservation measures (ECMs) have been identified for your site, and their energy and economic analyses are provided within this LGEA report. Note that some of the identified projects may be mutually exclusive, such as replacing equipment versus upgrading motors or controls. 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 that includes the review of multiple bids for project work, incorporates potential operations and maintenance (O&M) cost savings, and maximizes your incentive potential.

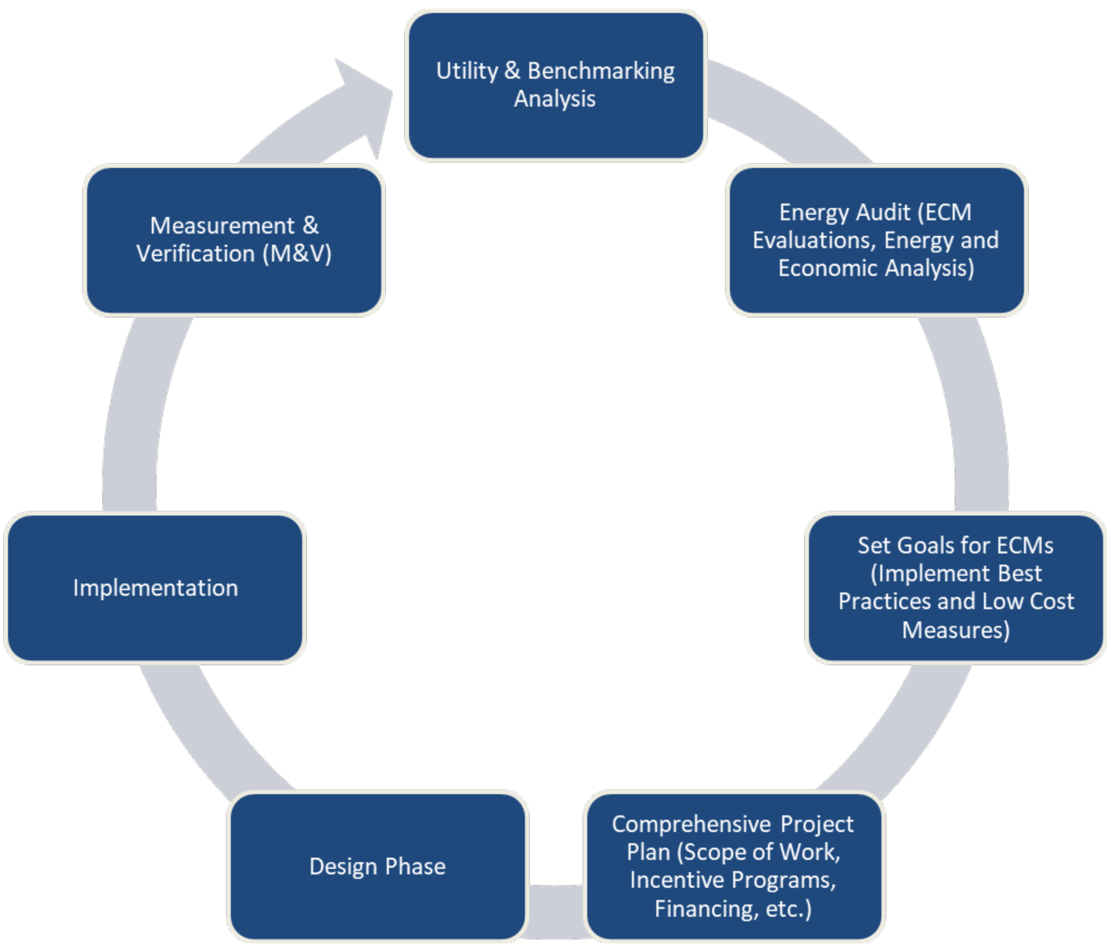


Figure 10 – Project Development Cycle

10 Energy Purchasing and Procurement Strategies

10.1 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. 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[7].

10.2 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 fluctuate monthly. The utility provides basic gas supply service 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[8].

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

[8] 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
Mechanical Chiller Room	3	Linear Fluorescent - EST12: 4' T12 (34W) - 2L	Wall Switch	S	72	8,760	2, 3	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	6,044	0.1	1,503	0	$165	$476	$65	2.5
Restroom - Central Plant	1	Linear Fluorescent - EST12: 4' T12 (34W) - 2L	Wall Switch	S	72	4,380	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,380	0.0	207	0	$23	$69	$10	2.6
Stairs - Central Plant	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
Stairs - Central Plant	2	Linear Fluorescent - EST12: 4' T12 (34W) - 2L	Wall Switch	S	72	8,760	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	6,044	0.1	1,002	0	$110	$363	$90	2.5
Electrical Room	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	8,760	3	None	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	6,044	0.0	260	0	$29	$270	$35	8.2
North Boiler Room	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
North Boiler Room	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	8,760		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	8,760	0.0	0	0	$0	$0	$0	0.0
North Boiler Room	2	Linear Fluorescent - T12: 2' T12 (20W) - 1L	Wall Switch	S	25	8,760	2, 3	Relamp & Reballast	Yes	2	LED - Linear Tubes: (1) 2' Lamp	Occupancy Sensor	9	6,044	0.0	369	0	$41	$213	$26	4.6
North Boiler Room	18	Linear Fluorescent - EST12: 4' T12 (34W) - 2L	Wall Switch	S	72	8,760	2, 3	Relamp & Reballast	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	6,044	0.7	9,018	-2	$991	$1,778	$250	1.5
Office - Boiler Room	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	4,380	3	None	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	3,022	0.0	87	0	$10	$270	$0	28.4
South Boiler Room	1	High-Pressure Sodium: (1) 250W Lamp	Timeclock		295	4,380	1	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock	75	4,380	0.2	1,060	0	$116	$471	$50	3.6
South Boiler Room	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	8,760	3	None	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	6,044	0.0	173	0	$19	$270	$35	12.3
South Boiler Room	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	8,760	3	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	6,044	0.0	520	0	$57	$270	$35	4.1
South Boiler Room	1	Linear Fluorescent - T12: 2' T12 (20W) - 1L	Wall Switch	S	25	8,760	2	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	8,760	0.0	159	0	$17	$49	$3	2.6
South Boiler Room	16	Linear Fluorescent - EST12: 4' T12 (34W) - 2L	Wall Switch	S	72	8,760	2, 3	Relamp & Reballast	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	6,044	0.6	8,016	-2	$881	$1,640	$230	1.6
Storage Workshop	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,000		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,000	0.0	0	0	$0	$0	$0	0.0
Storage Workshop	2	Linear Fluorescent - EST12: 4' T12 (34W) - 2L	Wall Switch	S	72	2,000	2, 3	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	229	0	$25	$254	$20	9.3

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
North Boiler Room	AHU-B	1	Supply Fan	15.0	92.4%	No			W	8,760	5	No	93.0%	Yes	1	4.3	30,957	0	$3,444	$7,041	$1,200	1.7
Roof	Cooling Tower	2	Cooling Tower Fan	25.0	94.1%	Yes			W	4,067		No	94.1%	No		0.0	0	0	$0	$0	$0	0.0
Absorption Chiller Room	Absorption Chiller Room	2	Fan Coil Unit	0.1	65.0%	No			W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
North Boiler Room	Compressed Air System	1	Air Compressor	35.0	89.5%	No			N	3,285		No	89.5%	No		0.0	0	0	$0	$0	$0	0.0
North Boiler Room	Compressed Air System	1	Air Compressor	10.0	86.0%	No			N	3,285		No	86.0%	No		0.0	0	0	$0	$0	$0	0.0
North Boiler Room	Boilers Feed Water Pumps P1P2	2	Boiler Feed Water Pump	50.0	93.0%	No			B	5,000	7	No	93.0%	Yes	2	49.8	150,403	0	$16,732	$35,003	$6,000	1.7
Absorption Chiller Room	Chilled Water Pump 1H - Hepburn	1	Chilled Water Pump	50.0	94.1%	Yes			W	4,067		No	94.1%	No		0.0	0	0	$0	$0	$0	0.0
Absorption Chiller Room	Chilled Water Pump 1K - Karnoutsos Hall	1	Chilled Water Pump	40.0	94.1%	Yes			W	4,067		No	94.1%	No		0.0	0	0	$0	$0	$0	0.0
South Boiler Room	Combustion Air Boiler #1	1	Combustion Air Fan	10.0	91.0%	No			W	3,391	6	No	91.7%	Yes	1	3.0	10,568	0	$1,176	$5,152	$1,100	3.4
South Boiler Room	Combustion Air Boiler #4	1	Combustion Air Fan	10.0	91.0%	No			W	3,391	6	No	91.7%	Yes	1	3.0	10,568	0	$1,176	$5,152	$1,100	3.4
North Boiler Room	Condensate Pump	2	Condensate Pump	5.0	87.5%	No			W	2,745	8	No	89.5%	Yes	2	1.1	9,129	0	$1,016	$8,152	$1,800	6.3
North Boiler Room	Condensate Pump	2	Condensate Pump	5.0	86.0%	No			B	2,745	8	No	89.5%	Yes	2	1.1	9,558	0	$1,063	$8,152	$1,800	6.0
Absorption Chiller Room	Condenser Water Pump - CWP-1H	1	Condenser Water Pump	20.0	92.4%	No			B	4,067		No	92.4%	No		0.0	0	0	$0	$0	$0	0.0
Absorption Chiller Room	Condenser Water Pump - CWP-1K	1	Condenser Water Pump	40.0	94.1%	No			W	4,067		No	94.1%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Exhaust Fans	4	Exhaust Fan	3.0	86.0%	No			W	2,745	5	No	89.5%	Yes	4	3.8	11,469	0	$1,276	$15,536	$800	11.5
Absorption Chiller Room	Heating Hot Water Pumps (Hepburn Hall)	2	Heating Hot Water Pump	7.5	89.5%	Yes			W	3,391		No	89.5%	No		0.0	0	0	$0	$0	$0	0.0
South Boiler Room	Heating Hot Water	1	Heating Hot Water Pump	0.1	65.0%	No			W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
North Boiler Room	Sump Pump	1	Other	0.5	70.0%	No			W	2,745		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
South Boiler Room	Glycol Pumps	2	Other	0.1	65.0%	No			W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
South Boiler Room	Sump Pumps P1P2	2	Other	0.8	75.5%	No			W	1,095		No	75.5%	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
South Boiler Room	Sump Pumps P1P2	2	Other	0.8	75.5%	No			W	1,095		No	75.5%	No		0.0	0	0	$0	$0	$0	0.0
South Boiler Room	Booster Water Pump	1	Water Supply Pump	1.0	84.0%	No			W	2,745		No	84.0%	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
Roof	Mechanical Room	1	Split-System	5.00		10.30				B	9	Yes	1	Split-System	5.00		16.00		1.0	3,113	0	$346	$6,521	$525	17.3
Chiller Room	Chiller Room	1	Electric Resistance Heat		25.60		1 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Roof	Mechanical Room	2	Split-System	10.00		11.20		Thermal Zone	TZAA-120CA757	W		No							0.0	0	0	$0	$0	$0	0.0
Office - Boiler Room	Office - Boiler Room	1	Window AC	1.96		9.80				W		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
Mechanical Chiller Room	Chilled Water System	1	Water-Cooled Centrifugal Chiller	370.00	Daikin	WMC060DDSNA	N		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
South Boiler Room	Steam Boiler #1	1	Forced Draft Steam Boiler	14,562	TRANE		B	10	Yes	1	Forced Draft Steam Boiler	14,562	81.00%	Et	0.0	0	436	$2,894	$249,525	$0	86.2
South Boiler Room	Steam Boiler #4	1	Forced Draft Steam Boiler	19,416	TRANE		W		No						0.0	0	0	$0	$0	$0	0.0

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
Boiler Room South	Domestic Hot Water System	1	Indirect System	Central Plant	Heat Exchanger	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
Restroom	11	1	Faucet Aerator (Lavatory)	2.50	0.50	0.0	0	1	$7	$7	$4	0.5

Plug Load Inventory

	Existing Conditions					
Location	**Quantity**	**Equipment Description**	**Energy Rate (W)**	**ENERGY STAR Qualified?**	**Manufacturer**	**Model**
Office - Boiler Room	2	Desktop	270	No		
Office - Boiler Room	1	Fan (Large)	600	No		
South Boiler Room	1	Microwave	1,000	No		
Office - Boiler Room	2	Printer (Medium/Small)	224	No		
Office - Boiler Room	1	Refrigerator (Mini)	350	No		
South Boiler Room	1	Refrigerator (Residential)	500	No		
Office - Boiler Room	1	Television	224	No		
Central Plant	8	Miscellaneous Plug Load	1,000	No		

Appendix B: ENERGY STAR® Statement of Energy Performance

Energy use intensity (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]

Central Plant Buildings (10 Buildings + Plant)

Primary Property Type: College/University
Gross Floor Area (ft²): 928,185
Built: 1929

For Year Ending: December 31, 2019
Date Generated: December 12, 2021

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
Central Plant Buildings (10 Buildings + Plant) 2039 Kennedy Boulevard Jersey City, New Jersey 07305	New Jersey City University 2039 Kennedy Boulevard Grossnickle Hall, Suite 327 Jersey City, NJ 07305 (631) 334-1812	Andre Pearson 2039 Kennedy Boulevard Grossnickle Hall, Suite 327 Jersey City, NJ 07305 (631) 334-1812 apearson@njcu.edu

Property ID: 16905054

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
131.7 kBtu/ft²

Source EUI
218.7 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	42,641,944 (35%)
Natural Gas (kBtu)	79,599,191 (65%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	108.8
National Median Source EUI (kBtu/ft²)	180.6
% Diff from National Median Source EUI	21%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	8,187

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 1/8th 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.