Local Government Energy Audit Report

Dr. Frank Calabria Education Center (Board Office)

February 18, 2022

Prepared for:

Parsippany - Troy Hills Board of Education

292 Parsippany Road

Parsippany, NJ 07054

Prepared by:

TRC

317 George Street

New Brunswick, NJ 08901

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.

Table of Contents

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.

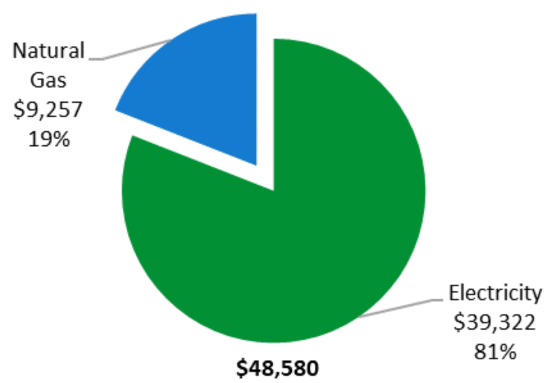
These "next generation" energy efficiency programs feature new ways of managing and delivering programs historically administered by New Jersey's Clean Energy Program™ (NJCEP). All of the investor-owned gas and electric utility companies will now also offer complementary energy efficiency programs and 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 expected to start rolling out in the spring and summer of 2021. 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 Dr. Frank Calabria Education Center (Board Office). 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: $48,580 Electricity: 330,048 kWh Natural Gas: 7,752 Therms	
ENERGY STAR® Benchmarking Score	44 *(1-100 scale)*	This building performs at or below the national average. This report contains suggestions about how to improve building performance and reduce energy costs.

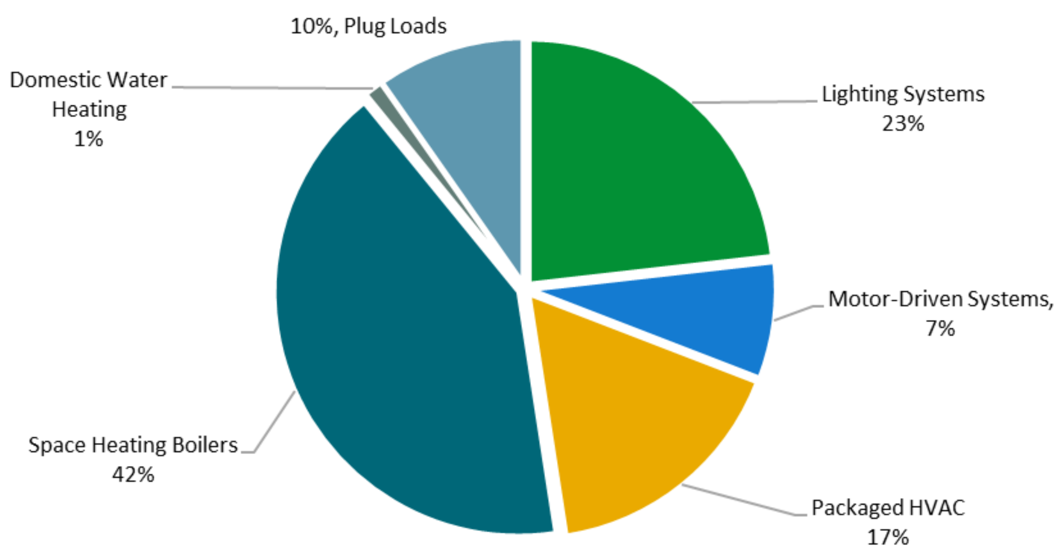


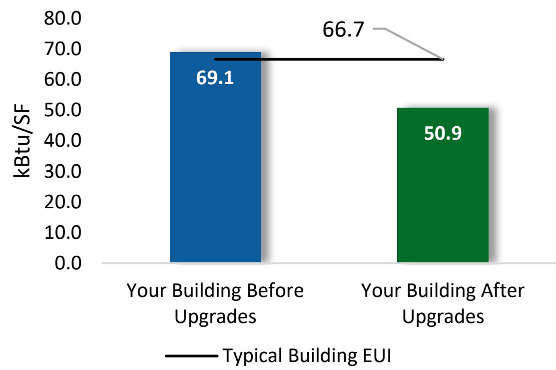
Figure 1 - Energy Use by System

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.

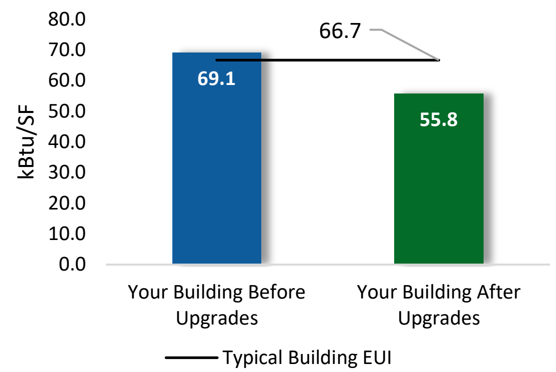
Scenario 1: Full Package (all evaluated measures)

Installation Cost	$174,106
Potential Rebates & Incentives[1]	$12,246
Annual Cost Savings	$16,473
Annual Energy Savings	Electricity: 133,696 kWh Natural Gas: 456 Therms
Greenhouse Gas Emission Savings	70 Tons
Simple Payback	9.8 Years
Site Energy Savings (all utilities)	26%



Scenario 2: Cost Effective Package[2]

Installation Cost	$58,998
Potential Rebates & Incentives	$10,371
Annual Cost Savings	$11,788
Annual Energy Savings	Electricity: 94,373 kWh Natural Gas: 456 Therms
Greenhouse Gas Emission Savings	50 Tons
Simple Payback	4.1 Years
Site Energy Savings (all utilities)	19%



On-site Generation Potential

Photovoltaic	Low
Combined Heat and Power	None

[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			**67,284**	**17.1**	**-14**	**$7,851**	**$25,893**	**$5,941**	**$19,952**	**2.5**	**66,137**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	65	0.1	0	$8	$69	$10	$59	7.8	64
ECM 2	Retrofit Fixtures with LED Lamps	Yes	67,219	17.0	-14	$7,844	$25,824	$5,931	$19,893	2.5	66,073
Lighting Control Measures			**20,288**	**5.2**	**-4**	**$2,366**	**$14,665**	**$2,900**	**$11,765**	**5.0**	**19,933**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	18,853	4.9	-4	$2,199	$12,190	$1,500	$10,690	4.9	18,523
ECM 4	Install High/Low Lighting Controls	Yes	1,435	0.3	0	$167	$2,475	$1,400	$1,075	6.4	1,410
Variable Frequency Drive (VFD) Measures			**19,276**	**3.2**	**0**	**$2,297**	**$46,354**	**$875**	**$45,479**	**19.8**	**19,410**
ECM 5	Install VFDs on Constant Volume (CV) Fans	No	13,780	2.7	0	$1,642	$26,710	$600	$26,110	15.9	13,876
ECM 6	Install VFDs on Chilled Water Pumps	No	990	0.2	0	$118	$4,510	$75	$4,435	37.6	997
ECM 7	Install VFDs on Heating Water Pumps	No	4,506	0.3	0	$537	$15,134	$200	$14,934	27.8	4,538
Unitary HVAC Measures			**3,283**	**1.1**	**0**	**$391**	**$6,521**	**$525**	**$5,996**	**15.3**	**3,306**
ECM 8	Install High Efficiency Air Conditioning Units	Yes	3,283	1.1	0	$391	$6,521	$525	$5,996	15.3	3,306
Electric Chiller Replacement			**20,048**	**13.4**	**0**	**$2,388**	**$68,753**	**$1,000**	**$67,753**	**28.4**	**20,188**
ECM 9	Install High Efficiency Chillers	No	20,048	13.4	0	$2,388	$68,753	$1,000	$67,753	28.4	20,188
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**64**	**$760**	**$11,554**	**$901**	**$10,653**	**14.0**	**7,449**
ECM 10	Install High Efficiency Hot Water Boilers	Yes	0	0.0	64	$760	$11,554	$901	$10,653	14.0	7,449
HVAC System Improvements			**1,130**	**0.0**	**0**	**$135**	**$92**	**$32**	**$60**	**0.4**	**1,138**
ECM 11	Install Pipe Insulation	Yes	1,130	0.0	0	$135	$92	$32	$60	0.4	1,138
Domestic Water Heating Upgrade			**777**	**0.0**	**0**	**$93**	**$43**	**$22**	**$21**	**0.2**	**782**
ECM 12	Install Low-Flow DHW Devices	Yes	777	0.0	0	$93	$43	$22	$21	0.2	782
Food Service & Refrigeration Measures			**1,612**	**0.2**	**0**	**$192**	**$230**	**$50**	**$180**	**0.9**	**1,623**
ECM 13	Vending Machine Control	Yes	1,612	0.2	0	$192	$230	$50	$180	0.9	1,623
TOTALS (COST EFFECTIVE MEASURES)			**94,373**	**23.6**	**46**	**$11,788**	**$58,998**	**$10,371**	**$48,627**	**4.1**	**100,368**
TOTALS (ALL MEASURES)			**133,696**	**40.3**	**46**	**$16,473**	**$174,106**	**$12,246**	**$161,859**	**9.8**	**139,966**

* - All incentives presented in this table are included as placeholders 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 and 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.

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.

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

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

Ongoing Electric Savings with Demand Response

The Demand Response Energy Aggregator program reduces electric loads at commercial facilities when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. By enabling commercial facilities to reduce electric demand during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment service providers provide regular payments to medium and large consumers of electric power for their participation in demand response (DR) programs. Program participation is voluntary, and facilities receive payments regardless of whether they are called upon to curtail their load during times of peak demand.

2 Existing Conditions

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Dr. Frank Calabria Education Center (Board Office). 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 June 29, 2021, TRC performed an energy audit at Dr. Frank Calabria Education Center (Board Office) located in Parsippany, New Jersey. TRC met with facility staff to review the facility operations and help focus our investigation on specific energy-using systems.

The Dr. Frank Calabria Education Center (Board Office) is a two-story, 27,500 square foot building built in 1979. Spaces include offices, corridors, stairwells, kitchen, and basement mechanical space. Its primary use is to house the board offices and provide meeting space.

2.2 Building Occupancy

The facility is occupied year-round.

Building Name	Weekday/Weekend	Operating Schedule
Dr. Frank Calabria Education Center (Board Office)	Weekday	6:30 AM - 8:00 PM
	Weekend	Closed

Figure 3 - Building Occupancy Schedule

2.3 Building Envelope

Building walls are concrete block over structural steel with a stone and metal standing seam facade. Part of the roof is flat and covered with black membrane and it is in poor condition. Most of the roof is comprised of metal truss with a metal deck, covered in standing seam metal roofing in poor condition.


Building Exterior

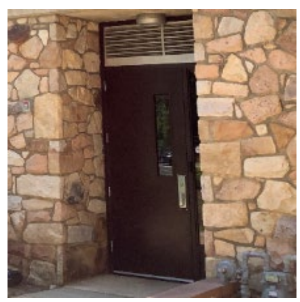

Flat Roof


Exterior and Standing Seam Roof

Most of the windows are double glazed and have aluminum frames with a thermal break with aluminum frames. The glass-to-frame seals are in fair condition. Exterior doors have aluminum frames and are in good condition with undamaged door seals. Degraded window and door seals increase drafts and outside air infiltration.


Window and Window Glazing


Window and Window Glazing


Exterior Doors


Exterior Doors

2.4 Lighting Systems

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

Fixture types include 1-lamp, 2-lamp, or 4-lamp, 2-foot or 4-foot-long troffer, recessed, surface mounted fixtures and 2-foot fixtures with U-bend tube lamps. Most fixtures are in fair condition. All exit signs are LED. Interior lighting levels were generally sufficient lit. Lighting fixtures are controlled manually.

Linear Fluorescent Fixtures

Linear Fluorescent Fixtures

U-bend Fluorescent Fixture

Exterior fixtures include wall mount and canopy lights with CFL, Incandescent, and LED lamps. They are timer controlled. The site has LED pole mounted fixtures illuminating parking lot. Fixtures are controlled by a timeclock.

Wall Mount Fixture

Canopy Fixture

Pole Top Fixture

2.5 Air Handling Systems

Unitary Electric HVAC Equipment

The office in the lower level is served in part by a 1.5-ton ductless mini split heat pump. The unit is in good condition. A 5-Ton split system AC unit serves offices in the facility. It is in poor condition.

Split System AC

Split System Unit Label

Ductless Mini Split Heat Pump

Air Handling Units (AHUs)

The building is mainly conditioned by air handling units, each equipped with a supply fan motor, hot water heating coil, and a refrigerant coil for cooling. Several of the units were accessible. The supply fans had constant speed, standard efficiency motors ranging between ¾ hp and 1.5 hp. Units 7 and 8 were inaccessible at the time of the audit. These supply fan motors are assumed to be 1 hp, constant speed, and standard efficiency.

Hot water coils are fed from the boiler through a circulation loop while chilled water is supplied by the chiller and distributed through a separate loop. The HVAC system is pneumatically controlled. Two, 1 hp air compressors located in the basement mechanical room serve the pneumatic system.


Air Handling Units


Air Handling Units


Air Handling Units


Pneumatic Controls


Pneumatic Controls


Air Compressor

2.6 Heating Hot Water Systems

One HB Smith - 2500L, 515 MBh hot water boiler located in the basement mechanical room serves the building's heating load. The burner is non-modulating with a nominal efficiency of 78%. Installed in 1991, it is in poor condition. The boiler serves a primary-only distribution system with one constant speed 3 hp heating hot water pump.


Hot Water Boiler

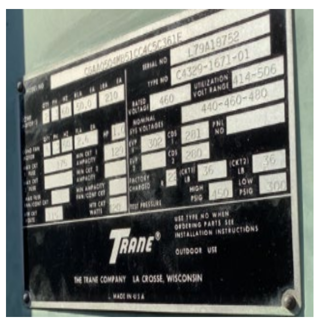

HHW Pump


Combustion Air Fan

2.7 Chilled Water Systems

The chiller plant consists of one, 50-ton Carrier, R-22, roof mounted air-cooled scroll chiller. The chiller has one constant flow 1 hp chilled water circulation pump in the basement mechanical room.


Chiller on Roof



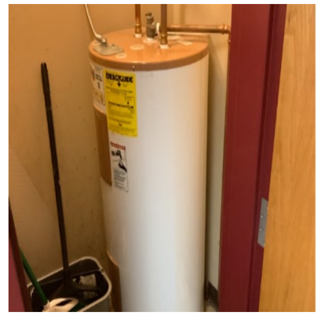
Unit Label


Chilled Water Circulation Pump

2.8 Domestic Hot Water

Hot water is produced by one, 15-gallon 1.5 kW electric storage water heater, and one, 40-gallon 4.5 kW electric storage water heater. The domestic hot water pipes are uninsulated.

Domestic Tank Water Heater



Domestic Tank Water Heater

2.9 Plug Load & Vending Machines

You may wish to consider paying particular attention to minimizing your plug load usage. This report makes suggestions for ECMs in this area as well as Energy Efficient Best Practices.

There are 26 computer workstations throughout the facility. Plug loads throughout the building include general café and office equipment.

There are several residential-style refrigerators throughout the building. These vary in condition and efficiency.

Coffee Machines

Residential-style Refrigerator

Copier

2.10 Water-Using Systems

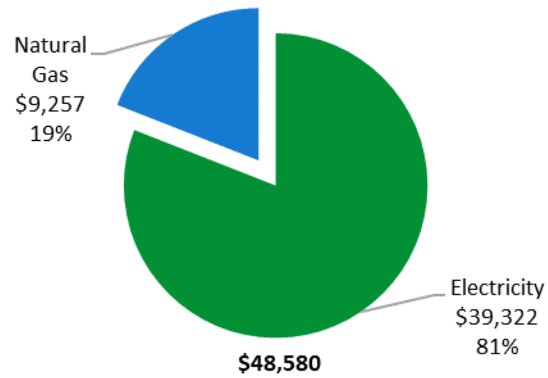
There are four restrooms with toilets and sinks. Faucet flow rates are at 2.2 gallons per minute (gpm) or higher.

Restroom Sink

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	330,048 kWh	$39,322
Natural Gas	7,752 Therms	$9,257
Total		**$48,580**



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.

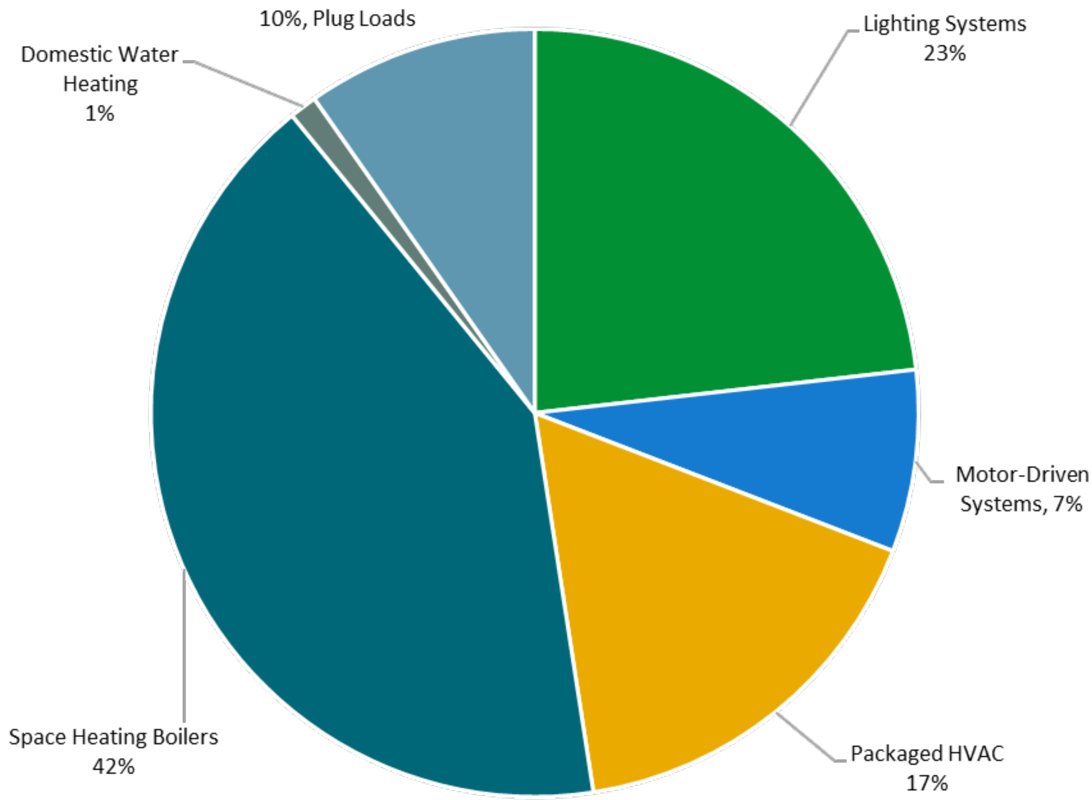
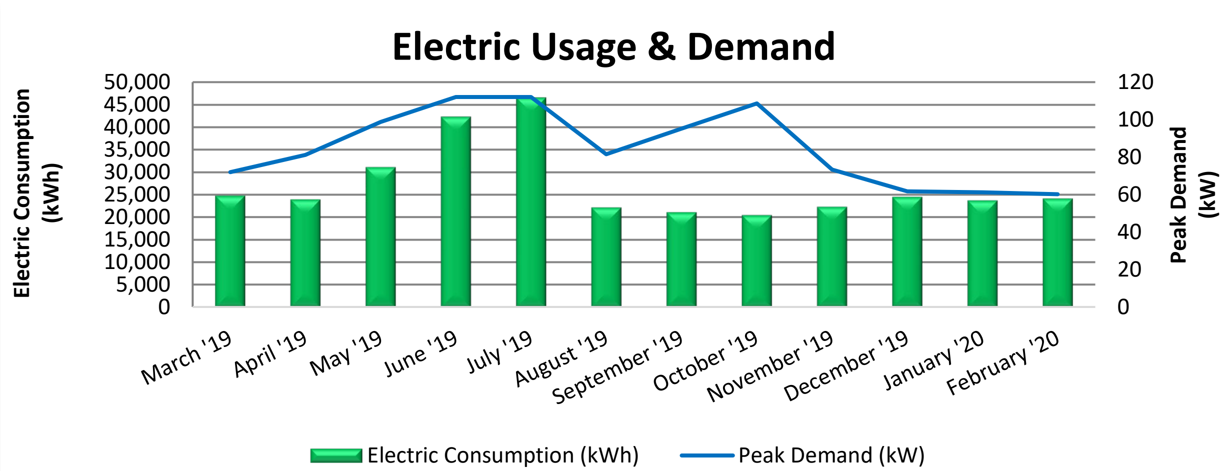


Figure 4 - Energy Balance

3.1 Electricity

JCP&L delivers electricity under rate class General Service Secondary, with electric production provided by Constellation Energy, a third-party supplier.



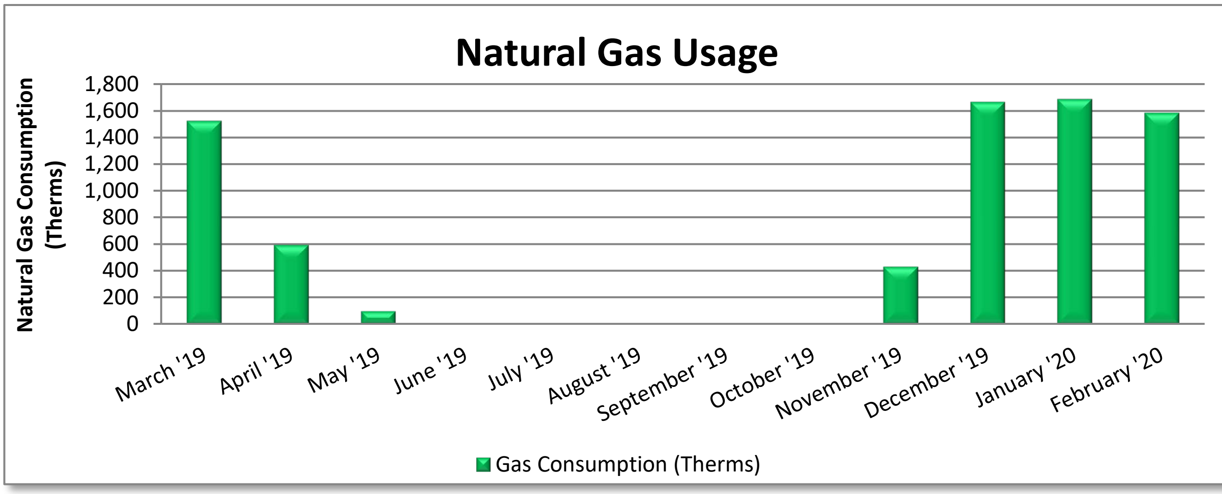
Electric Billing Data					
Period Ending	**Days in Period**	**Electric Usage (kWh)**	**Demand (kW)**	**Demand Cost**	**Total Electric Cost**
3/28/19	28	24,840	72	$451	$2,692
4/29/19	32	24,000	81	$510	$2,887
5/29/19	30	31,160	99	$660	$4,156
6/28/19	30	42,440	112	$743	$4,571
7/29/19	31	46,720	112	$1,723	$5,102
8/28/19	30	22,280	82	$540	$3,024
9/28/19	31	21,200	95	$587	$2,544
10/29/19	31	20,600	109	$671	$2,654
11/26/19	28	22,440	73	$453	$2,942
12/30/19	34	24,560	62	$381	$3,085
1/28/20	29	23,760	61	$378	$2,752
2/26/20	29	24,240	60	$371	$2,697
Totals	**363**	**328,240**	**112**	**$7,469**	**$39,107**
Annual	**365**	**330,048**	**112**	**$7,511**	**$39,322**

Notes:

- Peak demand of 112 kW occurred in July 2019.
- Average demand over the past 12 months was 85 kW.
- The average electric cost over the past 12 months was $0.119/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.

3.2 Natural Gas

NJ Natural Gas delivers natural gas under rate class GSL.



Gas Billing Data			
Period Ending	**Days in Period**	**Natural Gas Usage (Therms)**	**Natural Gas Cost**
3/22/19	29	1,528	$1,528
4/18/19	27	598	$715
5/22/19	34	99	$281
6/21/19	30	0	$198
7/24/19	33	0	$198
8/19/19	26	0	$159
9/19/19	31	0	$198
10/17/19	28	0	$203
11/14/19	28	433	$581
12/17/19	33	1,669	$1,719
1/17/20	31	1,689	$1,715
2/14/20	28	1,588	$1,583
Totals	**358**	**7,604**	**$9,080**
Annual	**365**	**7,752**	**$9,257**

Notes:

- The average gas cost for the past 12 months is $1.194/therm, which is the blended rate used throughout the analysis.

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	44

This building performs at, or below the national average. This report contains suggestions about how to improve building performance and reduce energy costs.

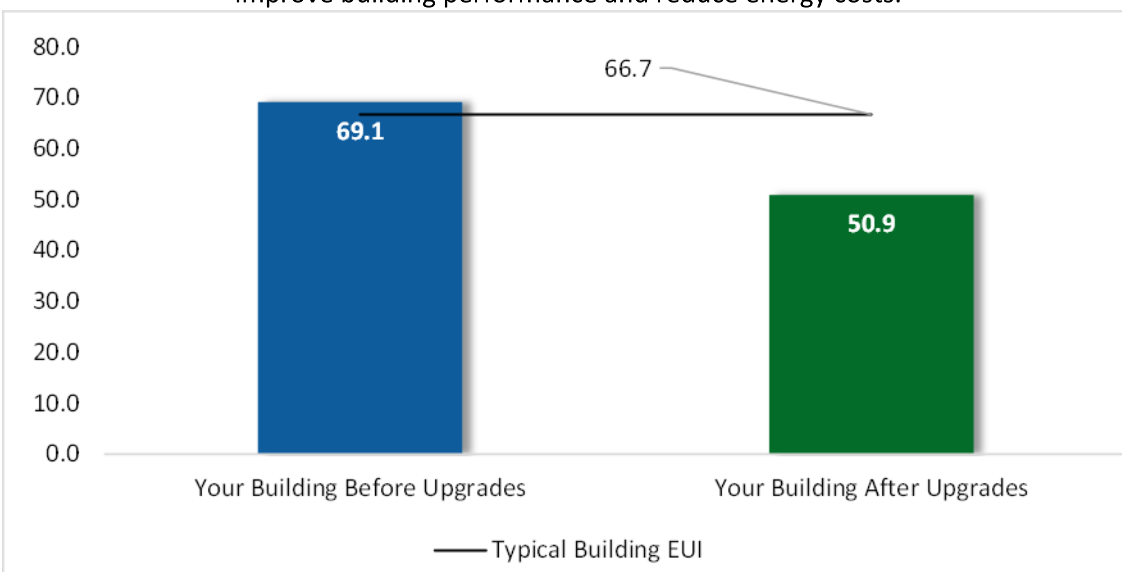


Figure 5 - Energy Use Intensity Comparison[3]

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. A number of factors can cause a building to vary from the "typical" energy usage. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and occupant behavior all contribute to a building's energy use and the benchmarking score.

[3] Based on all evaluated ECMs

Tracking Your Energy Performance

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

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

Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

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

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

4 Energy Conservation Measures

The goal of this audit report is to identify and evaluate potential energy efficiency improvements 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			**67,284**	**17.1**	**-14**	**$7,851**	**$25,893**	**$5,941**	**$19,952**	**2.5**	**66,137**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	65	0.1	0	$8	$69	$10	$59	7.8	64
ECM 2	Retrofit Fixtures with LED Lamps	Yes	67,219	17.0	-14	$7,844	$25,824	$5,931	$19,893	2.5	66,073
Lighting Control Measures			**20,288**	**5.2**	**-4**	**$2,366**	**$14,665**	**$2,900**	**$11,765**	**5.0**	**19,933**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	18,853	4.9	-4	$2,199	$12,190	$1,500	$10,690	4.9	18,523
ECM 4	Install High/Low Lighting Controls	Yes	1,435	0.3	0	$167	$2,475	$1,400	$1,075	6.4	1,410
Variable Frequency Drive (VFD) Measures			**19,276**	**3.2**	**0**	**$2,297**	**$46,354**	**$875**	**$45,479**	**19.8**	**19,410**
ECM 5	Install VFDs on Constant Volume (CV) Fans	No	13,780	2.7	0	$1,642	$26,710	$600	$26,110	15.9	13,876
ECM 6	Install VFDs on Chilled Water Pumps	No	990	0.2	0	$118	$4,510	$75	$4,435	37.6	997
ECM 7	Install VFDs on Heating Water Pumps	No	4,506	0.3	0	$537	$15,134	$200	$14,934	27.8	4,538
Unitary HVAC Measures			**3,283**	**1.1**	**0**	**$391**	**$6,521**	**$525**	**$5,996**	**15.3**	**3,306**
ECM 8	Install High Efficiency Air Conditioning Units	Yes	3,283	1.1	0	$391	$6,521	$525	$5,996	15.3	3,306
Electric Chiller Replacement			**20,048**	**13.4**	**0**	**$2,388**	**$68,753**	**$1,000**	**$67,753**	**28.4**	**20,188**
ECM 9	Install High Efficiency Chillers	No	20,048	13.4	0	$2,388	$68,753	$1,000	$67,753	28.4	20,188
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**64**	**$760**	**$11,554**	**$901**	**$10,653**	**14.0**	**7,449**
ECM 10	Install High Efficiency Hot Water Boilers	Yes	0	0.0	64	$760	$11,554	$901	$10,653	14.0	7,449
HVAC System Improvements			**1,130**	**0.0**	**0**	**$135**	**$92**	**$32**	**$60**	**0.4**	**1,138**
ECM 11	Install Pipe Insulation	Yes	1,130	0.0	0	$135	$92	$32	$60	0.4	1,138
Domestic Water Heating Upgrade			**777**	**0.0**	**0**	**$93**	**$43**	**$22**	**$21**	**0.2**	**782**
ECM 12	Install Low-Flow DHW Devices	Yes	777	0.0	0	$93	$43	$22	$21	0.2	782
Food Service & Refrigeration Measures			**1,612**	**0.2**	**0**	**$192**	**$230**	**$50**	**$180**	**0.9**	**1,623**
ECM 13	Vending Machine Control	Yes	1,612	0.2	0	$192	$230	$50	$180	0.9	1,623
TOTALS			**133,696**	**40.3**	**46**	**$16,473**	**$174,106**	**$12,246**	**$161,859**	**9.8**	**139,966**

* - All incentives presented in this table are included as placeholders 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		**67,284**	**17.1**	**-14**	**$7,851**	**$25,893**	**$5,941**	**$19,952**	**2.5**	**66,137**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	65	0.1	0	$8	$69	$10	$59	7.8	64
ECM 2	Retrofit Fixtures with LED Lamps	67,219	17.0	-14	$7,844	$25,824	$5,931	$19,893	2.5	66,073
Lighting Control Measures		**20,288**	**5.2**	**-4**	**$2,366**	**$14,665**	**$2,900**	**$11,765**	**5.0**	**19,933**
ECM 3	Install Occupancy Sensor Lighting Controls	18,853	4.9	-4	$2,199	$12,190	$1,500	$10,690	4.9	18,523
ECM 4	Install High/Low Lighting Controls	1,435	0.3	0	$167	$2,475	$1,400	$1,075	6.4	1,410
Unitary HVAC Measures		**3,283**	**1.1**	**0**	**$391**	**$6,521**	**$525**	**$5,996**	**15.3**	**3,306**
ECM 8	Install High Efficiency Air Conditioning Units	3,283	1.1	0	$391	$6,521	$525	$5,996	15.3	3,306
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**64**	**$760**	**$11,554**	**$901**	**$10,653**	**14.0**	**7,449**
ECM 10	Install High Efficiency Hot Water Boilers	0	0.0	64	$760	$11,554	$901	$10,653	14.0	7,449
HVAC System Improvements		**1,130**	**0.0**	**0**	**$135**	**$92**	**$32**	**$60**	**0.4**	**1,138**
ECM 11	Install Pipe Insulation	1,130	0.0	0	$135	$92	$32	$60	0.4	1,138
Domestic Water Heating Upgrade		**777**	**0.0**	**0**	**$93**	**$43**	**$22**	**$21**	**0.2**	**782**
ECM 12	Install Low-Flow DHW Devices	777	0.0	0	$93	$43	$22	$21	0.2	782
Food Service & Refrigeration Measures		**1,612**	**0.2**	**0**	**$192**	**$230**	**$50**	**$180**	**0.9**	**1,623**
ECM 13	Vending Machine Control	1,612	0.2	0	$192	$230	$50	$180	0.9	1,623
TOTALS		**94,373**	**23.6**	**46**	**$11,788**	**$58,998**	**$10,371**	**$48,627**	**4.1**	**100,368**

* - All incentives presented in this table are included as placeholders 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		**67,284**	**17.1**	**-14**	**$7,851**	**$25,893**	**$5,941**	**$19,952**	**2.5**	**66,137**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	65	0.1	0	$8	$69	$10	$59	7.8	64
ECM 2	Retrofit Fixtures with LED Lamps	67,219	17.0	-14	$7,844	$25,824	$5,931	$19,893	2.5	66,073

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

ECM 1: 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: T-12 lamps in storage 4.

ECM 2: Retrofit Fixtures with LED Lamps

Replace fluorescent, CFL, or incandescent lamps with LED lamps. Many LED tubes are direct replacements for existing fluorescent tubes and can be installed while leaving the fluorescent fixture ballast in place. LED lamps can be used in existing fixtures as a direct replacement for most other lighting technologies.

This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space. Maintenance savings may also be available, as longer-lasting LEDs lamps will not need to be replaced as often as the existing lamps.

Affected building areas: all areas with fluorescent fixtures with T8 tubes, CFL, or incandescent lamps.

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		**20,288**	**5.2**	**-4**	**$2,366**	**$14,665**	**$2,900**	**$11,765**	**5.0**	**19,933**
ECM 3	Install Occupancy Sensor Lighting Controls	18,853	4.9	-4	$2,199	$12,190	$1,500	$10,690	4.9	18,523
ECM 4	Install High/Low Lighting Controls	1,435	0.3	0	$167	$2,475	$1,400	$1,075	6.4	1,410

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: offices, conference rooms, restrooms, and storage rooms.

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.

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

Affected building areas: hallways and stairwells.

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

4.3 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		**19,276**	**3.2**	**0**	**$2,297**	**$46,354**	**$875**	**$45,479**	**19.8**	**19,410**
ECM 5	Install VFDs on Constant Volume (CV) Fans	13,780	2.7	0	$1,642	$26,710	$600	$26,110	15.9	13,876
ECM 6	Install VFDs on Chilled Water Pumps	990	0.2	0	$118	$4,510	$75	$4,435	37.6	997
ECM 7	Install VFDs on Heating Water Pumps	4,506	0.3	0	$537	$15,134	$200	$14,934	27.8	4,538

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

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

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

VAV system controls should not raise the supply air temperature at the expense of the fan power. A common mistake is to reset the supply air temperature to achieve chiller energy savings, which can lead to additional air flow requirements. Supply air temperature should be kept low (e.g. 55°F) until the minimum fan speed (typically about 50%) is met. At this point, it is efficient to raise the supply air temperature as the load decreases, but not such that additional air flow and thus fan energy is required.

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

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

Affected air handlers: AHU 1-8.

ECM 6: Install VFDs on Chilled Water Pumps

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

For systems with variable chilled water flow through the chiller, the minimum flow to prevent the chiller from tripping off will need to be determined during the final project design. The control system should be programmed to maintain the minimum flow through the chiller and to prevent pump cavitation.

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

Affected pumps: chilled water pump.

ECM 7: Install VFDs on Heating Water Pumps

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

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

Affected pumps: heating hot water pump.

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		**3,283**	**1.1**	**0**	**$391**	**$6,521**	**$525**	**$5,996**	**15.3**	**3,306**
ECM 8	Install High Efficiency Air Conditioning Units	3,283	1.1	0	$391	$6,521	$525	$5,996	15.3	3,306

ECM 8: Install High Efficiency Air Conditioning Units

Replace standard efficiency packaged air conditioning units with high efficiency packaged air conditioning units. 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: offices in board office.

4.5 Electric Chillers

#	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)
Electric Chiller Replacement		**20,048**	**13.4**	**0**	**$2,388**	**$68,753**	**$1,000**	**$67,753**	**28.4**	**20,188**
ECM 9	Install High Efficiency Chillers	20,048	13.4	0	$2,388	$68,753	$1,000	$67,753	28.4	20,188

ECM 9: Install High Efficiency Chillers

We evaluated replacing the older inefficient electric chiller with a new high efficiency chiller. The type of chiller to be installed depends on the magnitude of the cooling load and variability of the cooling load profile, for example:

- Positive displacement chillers are usually under 600 tons of cooling capacity and centrifugal chillers generally start at 150 tons of cooling capacity.
- Constant speed chillers should be used to meet cooling loads with little or no variation while variable speed chillers are more efficient for variable cooling load profiles.
- Water cooled chillers are more efficient than air cooled chillers but require cooling towers and additional pumps to circulate the cooling water.
- In any given size range, variable speed chillers tend to have better partial load efficiency, but worse full load efficiency, than constant speed chillers.

Energy savings result from the improvement in chiller efficiency and matching the right type of chiller to the cooling load. The energy savings are calculated based on the cooling capacity of the new chiller, the improvement in efficiency compared with the base case equipment, the cooling load profile, and the estimated annual operating hours of the chiller before and after the upgrade.

For the purposes of this analysis, we evaluated the replacement of chillers on a one-for-one basis with equipment of the same capacity. We recommend that you work with your design team to select chillers that are sized appropriately for the cooling load at this facility. In some cases, the plant energy use can be reduced by selecting multiple chillers that match the facility load profile rather than one or two large chillers. This can also improve the chiller plant reliability through increased redundancy. Energy savings are maximized by proper selection of new equipment based on the cooling load profile.

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

4.6 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**	**64**	**$760**	**$11,554**	**$901**	**$10,653**	**14.0**	**7,449**
ECM 10	Install High Efficiency Hot Water Boilers	0	0.0	64	$760	$11,554	$901	$10,653	14.0	7,449

ECM 10: Install High Efficiency Hot Water Boilers

Replace the older inefficient hot water boiler with a high efficiency hot water boiler. Energy savings results from improved combustion efficiency and reduced standby losses at low loads.

For the purposes 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 at this facility. 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 and may not be justifiable based simply on energy considerations. However, the boiler has reached the end of normal useful life. Typically, the marginal cost of purchasing high efficiency boilers can be justified by the marginal savings from the improved efficiency. When the boiler is eventually replaced, consider purchasing boilers that exceed the minimum efficiency required by building codes. We also recommend working with your mechanical design team to determine whether the heating system can operate with return water temperatures below 130°F, which would allow the use of condensing boilers.

4.7 HVAC Improvements

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
HVAC System Improvements		**1,130**	**0.0**	**0**	**$135**	**$92**	**$32**	**$60**	**0.4**	**1,138**
ECM 11	Install Pipe Insulation	1,130	0.0	0	$135	$92	$32	$60	0.4	1,138

ECM 11: Install Pipe Insulation

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

Affected Systems: domestic hot water piping.

4.8 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		**777**	**0.0**	**0**	**$93**	**$43**	**$22**	**$21**	**0.2**	**782**
ECM 12	Install Low-Flow DHW Devices	777	0.0	0	$93	$43	$22	$21	0.2	782

ECM 12: Install Low-Flow DHW Devices

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

Device	Flow Rate
Faucet aerators (lavatory)	0.5 gpm
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.

4.9 Food Service & Refrigeration Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Food Service & Refrigeration Measures		**1,612**	**0.2**	**0**	**$192**	**$230**	**$50**	**$180**	**0.9**	**1,623**
ECM 13	Vending Machine Control	1,612	0.2	0	$192	$230	$50	$180	0.9	1,623

ECM 13: Vending Machine Control

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

5 Energy Efficient Best Practices

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

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

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

Energy Tracking with ENERGY STAR® Portfolio Manager®

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

Lighting Maintenance

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

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

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.

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

Economizer Maintenance

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

Periodic inspection and maintenance will keep economizers working in sync with the heating and cooling system. This maintenance should be part of annual system maintenance, and it should include proper setting of the outdoor thermostat/enthalpy control, inspection of control and damper operation, lubrication of damper connections, and adjustment of minimum damper position.

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 5% to 10% 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 check for fire dampers or balancing dampers that have failed closed.

Duct leakage in commercial buildings can account for 5% to 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.

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.

Label HVAC Equipment

For improved coordination in maintenance practices, we recommend labeling or re-labeling the site HVAC equipment. Maintain continuity in labeling by following labeling conventions as indicated in the facility drawings or EMS building equipment list. Use weatherproof or heatproof labeling or stickers for permanence, but do not cover over original equipment nameplates, which should be kept clean and readable whenever possible. Besides equipment, label piping for service and direction of flow when possible. Ideally, maintain a log of HVAC equipment, including nameplate information, asset tag designation, areas served, installation year, service dates, and other pertinent information.

This investment in your equipment will enhance collaboration and communication between your staff and your contracted service providers and may help you with regulatory compliance.

Water Heater Maintenance

The lower the supply water temperature that is used for hand washing sinks, the less energy is needed to heat the water. Reducing the temperature results in energy savings and the change is often unnoticeable to users. Be sure to review the domestic water temperature requirements for sterilizers and dishwashers as you investigate reducing the supply water temperature.

Also, preventative maintenance can extend the life of the system, maintain energy efficiency, and ensure safe operation. At least once a year, follow manufacturer instructions to drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Annual checks should include checks for:

- Leaks or heavy corrosion on the pipes and valves.
- Corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot, or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional.
- For electric water heaters, look for signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank.
- For water heaters more than three years old, have a technician inspect the sacrificial anode annually.

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[6] or download a copy of EPA's "WaterSense® at Work: Best Management Practices for Commercial and Institutional Facilities"[7] 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.

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

[7] 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 low 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 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.

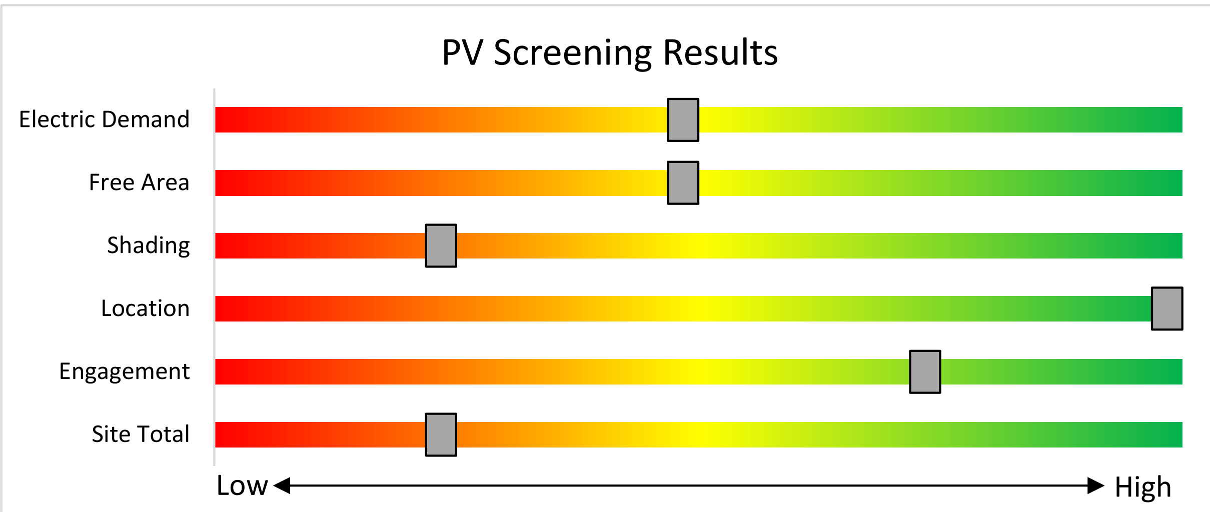


Figure 8 - Photovoltaic Screening

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 the facility has no potential for installing a cost-effective CHP system.

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

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

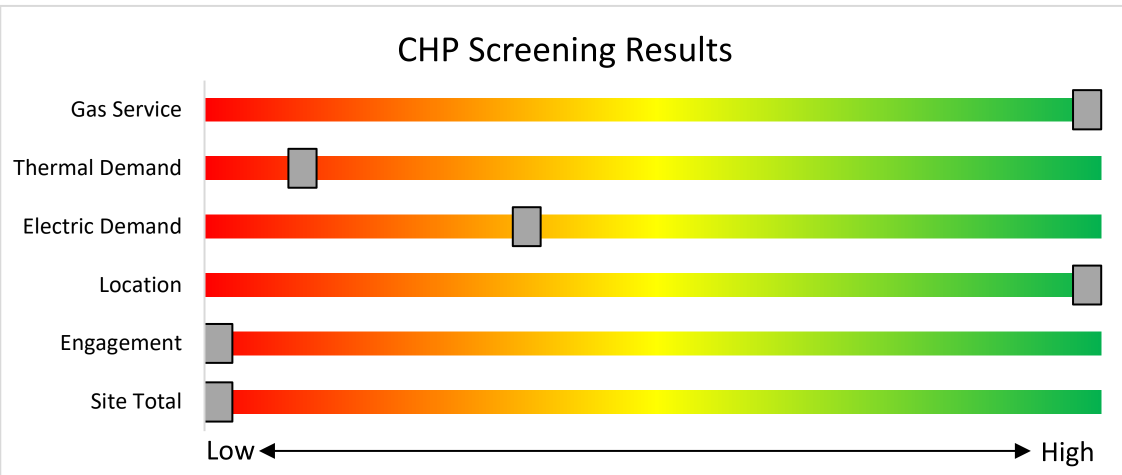


Figure 9 - Combined Heat and Power Screening

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/.](http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/)

7 PROJECT FUNDING AND INCENTIVES

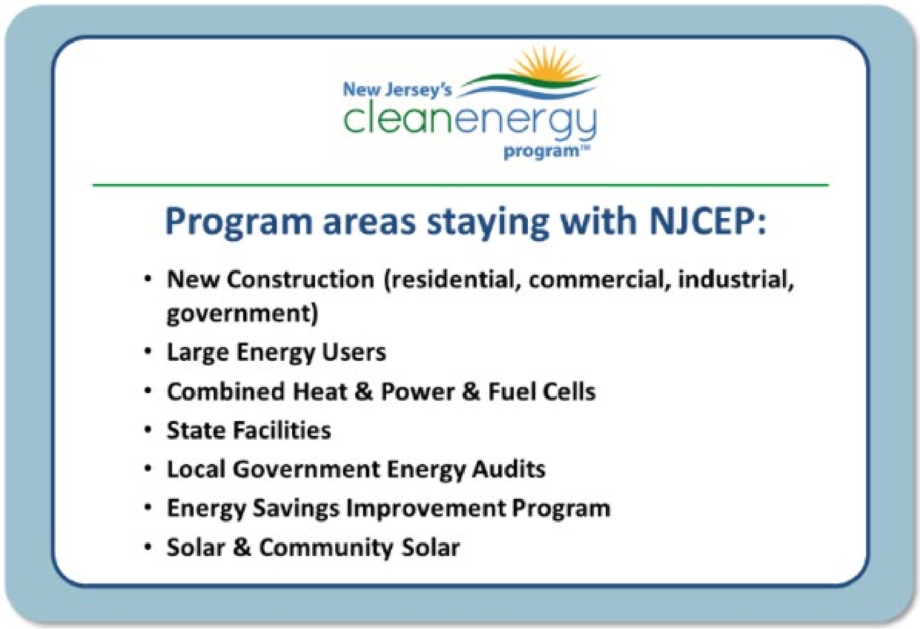
Ready to improve your building's performance? Your utility provider may be able to help.

7.1 Utility Energy Efficiency Programs

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.

8 New Jersey's Clean Energy Programs

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



8.1 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 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.

8.2 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 ECMs, ensuring that ESIP projects are cash flow positive for the life of the contract.

ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs described above can also be used to help further reduce the total project cost of eligible measures.

How to Participate

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

(1) Use an energy services company or "ESCO."

(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.

(3) Use a hybrid approach of the two options described above where the ESCO is used for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

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

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Carefully consider all alternatives to develop an approach that best meets your needs. A detailed program description 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.

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.

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

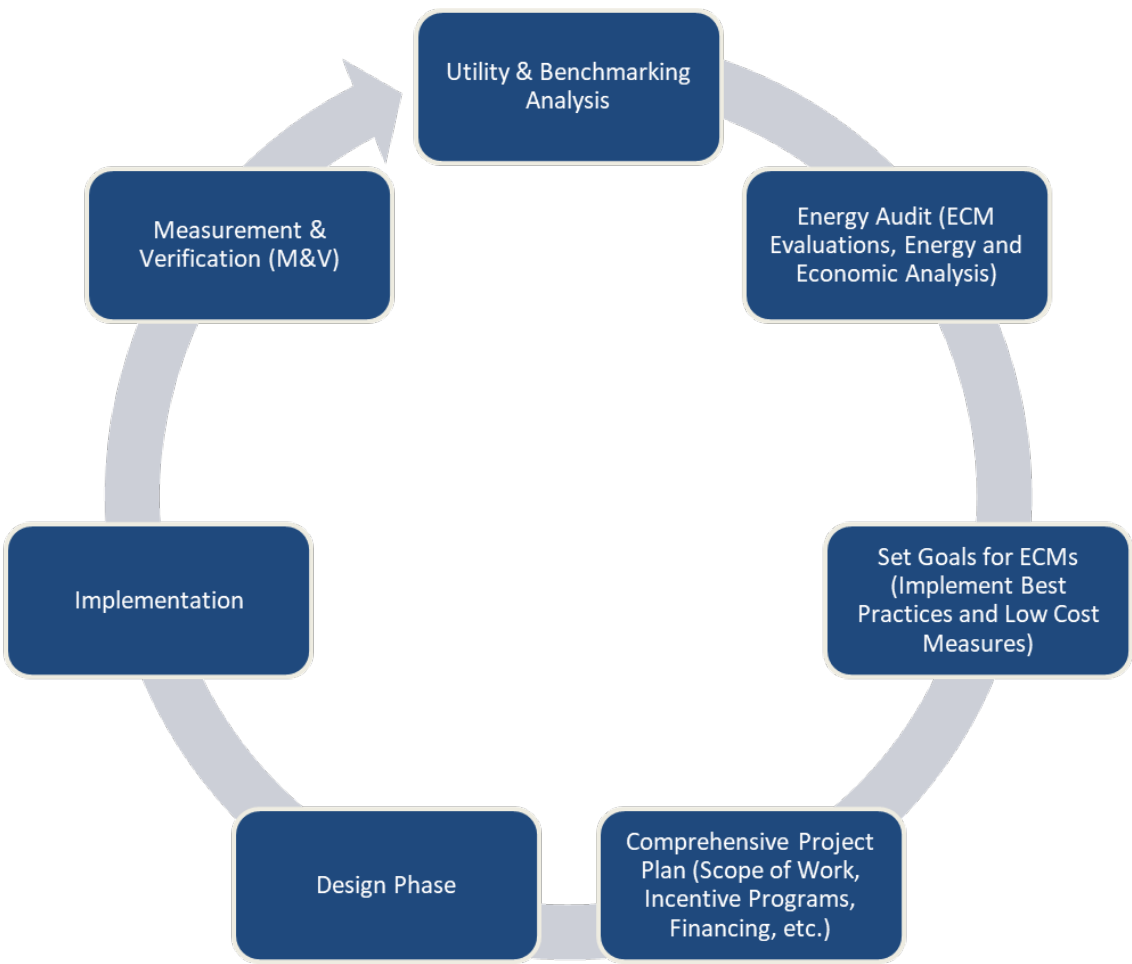


Figure 10 – Project Development Cycle

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. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility already buys electricity from a third-party supplier, review and compare prices at the end of each contract year.

A list of licensed third-party electric suppliers is available at the NJBPU website[8].

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 that fluctuate monthly. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

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

If your facility does not already purchase natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility already purchases natural gas from a third-party supplier, review and compare prices at the end of each contract year.

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

---

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

[9] 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
Conference 4	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Conference 4	32	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	32	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	1.2	4,847	-1	$565	$2,859	$390	4.4
Conference board 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
Conference board room	66	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	66	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	2.6	10,700	-2	$1,248	$3,490	$800	2.2
Corridor 1	1	Compact Fluorescent: (1) 26W G25 Screw-In Lamp	Wall Switch	S	26	4,380	2, 3	Relamp	Yes	1	LED Lamps: Screw-in LED	Occupancy Sensor	19	3,022	0.0	62	0	$7	$25	$2	3.2
Corridor 1	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Corridor 1	4	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	4,380	2, 4	Relamp	Yes	4	LED - Linear Tubes: (2) U-Lamp	High/Low Control	33	3,022	0.1	756	0	$88	$515	$180	3.8
Dining Area 2	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.1	303	0	$35	$261	$40	6.3
Lobby 2	8	Compact Fluorescent: (1) 23W Spiral Screw-In Lamp	Wall Switch	S	23	3,510	2, 4	Relamp	Yes	8	LED Lamps: Screw-in LED	High/Low Control	17	2,422	0.1	348	0	$41	$588	$288	7.4
Lobby 2	14	Compact Fluorescent: (1) 32W Spiral Screw-In Lamp	Wall Switch	S	32	3,510	2, 4	Relamp	Yes	14	LED Lamps: Screw-in LED	High/Low Control	23	2,422	0.2	872	0	$102	$916	$504	4.1
Lobby 2	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Lobby 3	6	Compact Fluorescent: (1) 23W Spiral Screw-In Lamp	Wall Switch	S	23	3,510	2, 4	Relamp	Yes	6	LED Lamps: Screw-in LED	High/Low Control	17	2,422	0.1	261	0	$30	$103	$6	3.2
Lobby 3	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
Lobby 3	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	S	32	3,510	2, 4	Relamp	Yes	1	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	2,422	0.0	85	0	$10	$243	$40	20.5
Office - Enclosed 10	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	0.3	1,297	0	$151	$562	$115	3.0
Office - Enclosed 11	5	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	5	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.2	757	0	$88	$632	$85	6.2
Office - Enclosed 12	8	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	8	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.3	1,212	0	$141	$850	$115	5.2
Office - Enclosed 13	4	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.1	606	0	$71	$560	$75	6.9
Office - Enclosed 14	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Office - Enclosed 14	3	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	3,510		None	No	3	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	3,510	0.0	0	0	$0	$0	$0	0.0
Office - Enclosed 8	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	0.6	2,270	0	$265	$781	$175	2.3
Office - Enclosed 9	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	0.2	973	0	$113	$489	$95	3.5
Office - Open Plan 4	72	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	72	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	2.9	11,673	-2	$1,362	$3,979	$895	2.3
Office - Open Plan 5	40	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	40	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	1.6	6,485	-1	$756	$2,271	$505	2.3
Office - Open Plan 6	14	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	14	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.5	2,121	0	$247	$1,284	$175	4.5

	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
Restroom - Female 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	0.0	162	0	$19	$37	$10	1.4
Restroom - Female 1	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.1	303	0	$35	$415	$55	10.2
Restroom - Male 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	0.0	162	0	$19	$37	$10	1.4
Restroom - Male 1	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.1	303	0	$35	$415	$55	10.2
Restroom - Unisex 2	1	Compact Fluorescent: (1) 23W Spiral Screw-In Lamp	Wall Switch	S	23	3,510	2	Relamp	No	1	LED Lamps: Screw-in LED	Wall Switch	17	3,510	0.0	23	0	$3	$17	$1	6.0
Restroom - Unisex 2	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	33	3,510	2	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	3,510	0.0	62	0	$7	$33	$6	3.7
Storage 4	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	1,000	1	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.1	65	0	$8	$69	$10	7.8
Storage 5	1	Compact Fluorescent: (1) 26W G25 Screw-In Lamp	Wall Switch	S	26	1,000	2	Relamp	No	1	LED Lamps: Screw-in LED	Wall Switch	19	1,000	0.0	8	0	$1	$25	$2	25.9
Mechanical 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	200	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	7	0	$1	$37	$10	31.3
Office - Enclosed 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	0.1	324	0	$38	$343	$55	7.6
Office - Enclosed 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.1	286	0	$33	$73	$20	1.6
Office - Enclosed 2	3	Compact Fluorescent: (1) 32W Spiral Screw-In Lamp	Wall Switch	S	32	3,510	2, 3	Relamp	Yes	3	LED Lamps: Screw-in LED	Occupancy Sensor	23	2,422	0.0	187	0	$22	$322	$38	13.0
Office - Enclosed 2	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.1	286	0	$33	$73	$20	1.6
Office - Enclosed 2	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.1	303	0	$35	$145	$20	3.5
Office - Open Plan 1	3	Compact Fluorescent: (1) 23W Spiral Screw-In Lamp	Wall Switch	S	23	3,510	2, 3	Relamp	Yes	3	LED Lamps: Screw-in LED	Occupancy Sensor	17	2,422	0.0	131	0	$15	$52	$3	3.2
Office - Open Plan 1	3	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Office - Open Plan 1	42	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	SS	62	3,510	2, 3	Relamp	Yes	42	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	1.7	6,809	-1	$794	$2,344	$525	2.3
Storage 1	5	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch		62	1,000	2, 3	Relamp	Yes	5	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	690	0.2	216	0	$25	$632	$50	23.1
Conference 1	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Conference 1	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.8	3,428	-1	$400	$1,146	$275	2.2
Conference 2	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Conference 2	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.6	2,571	-1	$300	$927	$215	2.4
Dining Area 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.2	857	0	$100	$489	$95	3.9
Dining Area 1	3	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	3	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.1	454	0	$53	$217	$30	3.5
Elevator 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	8,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	8,760	0.0	318	0	$37	$37	$10	0.7

	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
Garage 1	2	Compact Fluorescent: (1) 23W Spiral Screw-In Lamp	Wall Switch	S	23	3,510	2, 3	Relamp	Yes	2	LED Lamps: Screw-in LED	Occupancy Sensor	17	2,422	0.0	87	0	$10	$150	$22	12.7
Garage 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	0.1	486	0	$57	$380	$65	5.5
Lobby 1	3	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Lobby 1	8	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 4	Relamp	Yes	8	LED - Linear Tubes: (2) U-Lamp	High/Low Control	33	2,422	0.3	1,212	0	$141	$1,030	$360	4.7
Mechanical 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	200	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	138	0.1	18	0	$2	$189	$40	69.2
Mechanical 3	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Mechanical 4	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	200	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	138	0.1	18	0	$2	$189	$40	69.2
Office - Enclosed 3	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.2	857	0	$100	$489	$95	3.9
Office - Enclosed 4	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.2	857	0	$100	$489	$95	3.9
Office - Enclosed 5	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,422	0.1	324	0	$38	$189	$40	3.9
Office - Enclosed 6	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.2	857	0	$100	$489	$95	3.9
Office - Enclosed 7	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.2	857	0	$100	$489	$95	3.9
Office - Open 2	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Office - Open 2	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	0.6	2,285	0	$267	$854	$195	2.5
Office - Open 2	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,510	2, 3	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,422	0.0	151	0	$18	$72	$10	3.5
Office - Open Plan 2	45	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,510	2, 3	Relamp	Yes	45	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,422	3.1	12,854	-3	$1,499	$4,096	$1,005	2.1
Restroom - Unisex 1	1	Compact Fluorescent: (1) 23W Spiral Screw-In Lamp	Wall Switch	S	23	3,510	2	Relamp	No	1	LED Lamps: Screw-in LED	Wall Switch	17	3,510	0.0	23	0	$3	$17	$1	6.0
Restroom - Unisex 1	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	33	3,510	2	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	3,510	0.0	62	0	$7	$33	$6	3.7
Storage 2	13	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	1,000	2, 3	Relamp	Yes	13	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	690	0.9	1,058	0	$123	$1,219	$260	7.8
Storage 3	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	1,000	2, 3	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	690	0.4	488	0	$57	$708	$120	10.3
Exterior 2	12	Compact Fluorescent: (1) 23W BR30 Screw-In Lamp	Timeclock		23	4,380	2	Relamp	No	12	LED Lamps: Screw-in LED	Timeclock	17	4,380	0.0	315	0	$38	$287	$36	6.7
Exterior 2	2	Incandescent: (1) 75W PAR30 Screw-In Lamp	Timeclock		75	4,380	2	Relamp	No	2	LED Lamps: PAR30 Lamps	Timeclock	12	4,380	0.0	552	0	$66	$46	$6	0.6
Exterior 2	4	LED Lamps: (1) 10W A19 Screw-In Lamp	Timeclock		10	4,380		None	No	4	LED Lamps: (1) 10W A19 Screw-In Lamp	Timeclock	10	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 2	5	LED Lamps: (1) 10W A19 Screw-In Lamp	Timeclock		10	4,380		None	No	5	LED Lamps: (1) 10W A19 Screw-In Lamp	Timeclock	10	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 2	2	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock		130	4,380		None	No	2	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock	130	4,380	0.0	0	0	$0	$0	$0	0.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Exterior 2	24	LED Lamps: (1) 10W PAR30 Screw-In Lamp	Timeclock		10	4,380		None	No	24	LED Lamps: (1) 10W PAR30 Screw-In Lamp	Timeclock	10	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch		62	3,510	2	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,510	0.0	347	0	$41	$110	$30	1.9
Stairs 1	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Stairs 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch		62	4,380	2, 4	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	3,022	0.1	405	0	$47	$298	$90	4.4
Stairs 1	3	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch		62	4,380	2, 4	Relamp	Yes	3	LED - Linear Tubes: (2) U-Lamp	High/Low Control	33	3,022	0.1	567	0	$66	$442	$135	4.6

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
Mechanical 2	Board Office	1	Air Compressor	1.0	82.5%	No	GE	5K43PG8197	B	1,460		No	82.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 2	Board Office	1	Air Compressor	1.0	82.5%	No	Gould	8-331257903	B	1,460		No	82.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 2	Board Office	1	Chilled Water Pump	1.0	82.5%	No	Baldor	M311BT	B	2,745	6	No	85.5%	Yes	1	0.2	990	0	$118	$4,510	$75	37.6
Mechanical 2	Board Office	1	Combustion Air Fan	0.5	70.0%	No	AO Smith	K1052	W	2,340		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior 1	Board Office	1	Exhaust Fan	0.2	65.0%	No	Unknown	Unknown	W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 2	Board Office	1	Heating Hot Water Pump	3.0	86.5%	No	AO Smith	E226M	W	4,380	7	No	89.5%	Yes	1	0.3	4,506	0	$537	$15,134	$200	27.8
Elevator 1	Board Office	1	Other	10.0	77.0%	No	Unknown	Unknown	W	250		No	77.0%	No		0.0	0	0	$0	$0	$0	0.0
Garage 1	garage door	1	Other	0.5	70.0%	No	Westinghouse	DD78	W	500		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Elevator 1	Board Office	1	Exhaust Fan	0.3	65.0%	No	Westinghouse	JG78	W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 5	AHU 6	1	Supply Fan	1.5	84.0%	No	GE	5K45PG8004	W	4,200	5	No	86.5%	Yes	1	0.4	2,207	0	$263	$3,391	$75	12.6
Mechanical 5	AHU 5	1	Supply Fan	0.8	75.0%	No	Dayton	3N487C	W	4,200	5	No	81.1%	Yes	1	0.2	1,334	0	$159	$2,756	$50	17.0
Mechanical 5	AHU 4	1	Supply Fan	0.8	75.0%	No	Leland-Faraday	M672A	W	4,200	5	No	81.1%	Yes	1	0.2	1,334	0	$159	$2,756	$50	17.0
Mechanical 5	AHU 1	1	Supply Fan	0.8	75.0%	No	Unknown	Unknown	W	4,200	5	No	81.1%	Yes	1	0.2	1,334	0	$159	$2,756	$50	17.0
Mechanical 4	AHU 9	1	Supply Fan	1.0	82.5%	No	Dayton	3KW25G	W	4,200	5	No	85.5%	Yes	1	0.3	1,514	0	$180	$3,010	$75	16.3
Mechanical 1	AHU 3	1	Supply Fan	1.0	82.5%	No	Leland-Faraday	LFI-84010C	W	4,200	5	No	85.5%	Yes	1	0.3	1,514	0	$180	$3,010	$75	16.3
Mechanical 1	AHU 2	1	Supply Fan	1.0	82.5%	No	Dayton	3KW25G	W	4,200	5	No	85.5%	Yes	1	0.3	1,514	0	$180	$3,010	$75	16.3
Mechanical 3	AHU 8	1	Supply Fan	1.0	82.5%	No	Unknown	Unknown	W	4,200	5	No	85.5%	Yes	1	0.3	1,514	0	$180	$3,010	$75	16.3
Mechanical 3	AHU 7	1	Supply Fan	1.0	82.5%	No	Unknown	Unknown	W	4,200	5	No	85.5%	Yes	1	0.3	1,514	0	$180	$3,010	$75	16.3

Packaged HVAC Inventory & Recommendations

		Existing Conditions									Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Exterior 1	Board Office	1	Split-System	5.00		10.00		York	H2CB060S46C	B	8	Yes	1	Split-System	5.00		16.00		1.1	3,283	0	$391	$6,521	$525	15.3
Exterior 1/Office - Enclosed 10	Office - Enclosed 10	1	Split-System Air-Source HP	1.50	21.60	14.20	10.3 HSPF	Mitsubishi	MUZ-FE18NA	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
Roof	Board Office	1	Air-Cooled Scroll Chiller	50.00	Trane	CGAA0504MB51 CC4C5C361E	B	9	Yes	1	Air-Cooled Scroll Chiller	Constant	50.00	1.17	0.88	13.4	20,048	0	$2,388	$68,753	$1,000	28.4

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
Mechanical 2	Board Office	1	Non-Condensing Hot Water Boiler	515	HB Smith	2500L	B	10	Yes	1	Non-Condensing Hot Water Boiler	515	85.00%	Et	0.0	0	64	$760	$11,554	$901	14.0

Pipe Insulation Recommendations

		Recommendation Inputs			Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Affected	ECM #	Length of Uninsulated Pipe (ft)	Pipe Diameter (in)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical	DHW	11	10	0.75	0.0	633	0	$75	$58	$20	0.5
Storage	DHW	11	6	0.75	0.0	497	0	$59	$35	$12	0.4

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
Mechanical 2, 5	Board Office	2	Storage Tank Water Heater (≤ 50 Gal)	Bradford White	M11506SS-1NAL	W		No						0.0	0	0	$0	$0	$0	0.0
Storage	Board Office	1	Storage Tank Water Heater (≤ 50 Gal)	Ruud	PE40-2 C	W		No						0.0	0	0	$0	$0	$0	0.0

Low-Flow Device Recommendations

	Recommedation 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
Board Office	12	5	Faucet Aerator (Lavatory)	2.20	0.50	0.0	695	0	$83	$36	$20	0.2
Board Office	12	1	Faucet Aerator (Kitchen)	2.50	1.50	0.0	82	0	$10	$7	$2	0.5

Plug Load Inventory

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Board Office	4	Coffee Machine	700	No	Various	Various
Board Office	26	Desktop	270	No	Dell	Unknown
Board Office	23	Fan	200	No	Various	Various
Board Office	4	Microwave	800	No	Various	Various
Board Office	2	Paper Shredder	200	No	Unknown	Unknown
Board Office	26	Printer	600	No	Various	Various
Board Office	6	Copier	1,200	No	Various	Various
Board Office	4	Projector	400	No	Unknown	Unknown
Board Office	5	Mini Refrigerator	89	No	Various	Various
Board Office	2	Refrigerator	168	No	Various	Various
Board Office	3	Fax Machine	10	No	Unknown	Unknown
Board Office	1	Toaster Oven	405	No	Unknown	Unknown

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	ECM #	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Break room	1	Refrigerated	13	Yes	0.2	1,612	0	$192	$230	$50	0.9

APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

EUI is presented in terms of *site energy* and *source energy*. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

LEARN MORE AT energystar.gov

ENERGY STAR® Statement of Energy Performance

44

ENERGY STAR® Score[1]

Dr. Frank Calabria Education Center (Board Office)

Primary Property Type: Office
Gross Floor Area (ft²): 27,500
Built: 1977

For Year Ending: January 31, 2020
Date Generated: July 28, 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
Dr. Frank Calabria Education Center (Board Office)
292 Parsippany Road
Parsippany, New Jersey 07054

Property Owner
Parsippany - Troy Hills Board of Education
292 Parsippany Road
Parsippany, NJ 07054
(973) 263-7200

Primary Contact
Dr. Alfred Savio
292 Parsippany Road
Parsippany, NJ 07054
(973) 263-7200 x 7212
asavio@pthsd.net

Property ID: 16057052

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
71.1 kBtu/ft²

Source EUI
146.3 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	1,124,970 (58%)
Natural Gas (kBtu)	830,961 (42%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	66.7
National Median Source EUI (kBtu/ft²)	137.2
% Diff from National Median Source EUI	7%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	152

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.