Local Government Energy Audit Report

Heywood Avenue School

March 23, 2023

Prepared for:
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Disclaimer

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

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

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

Incentive values provided in this report are estimated based on 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.

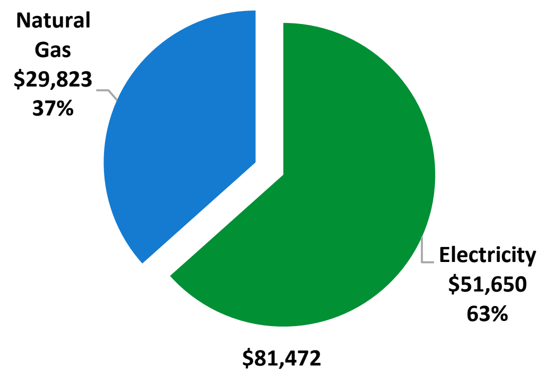
The customer and their respective contractor(s) are responsible to implement energy conservation measures in complete conformance with all applicable local, state, and federal requirements.

Table of Contents

1 Executive Summary

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Heywood Avenue School. 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: $81,472 Electricity: 339,699 kWh Natural Gas: 22,637 Therms	
ENERGY STAR® Benchmarking Score	67 *(1-100 scale)*	This building performs below the national average. This report contains suggestions about how to improve building performance and reduce energy costs.

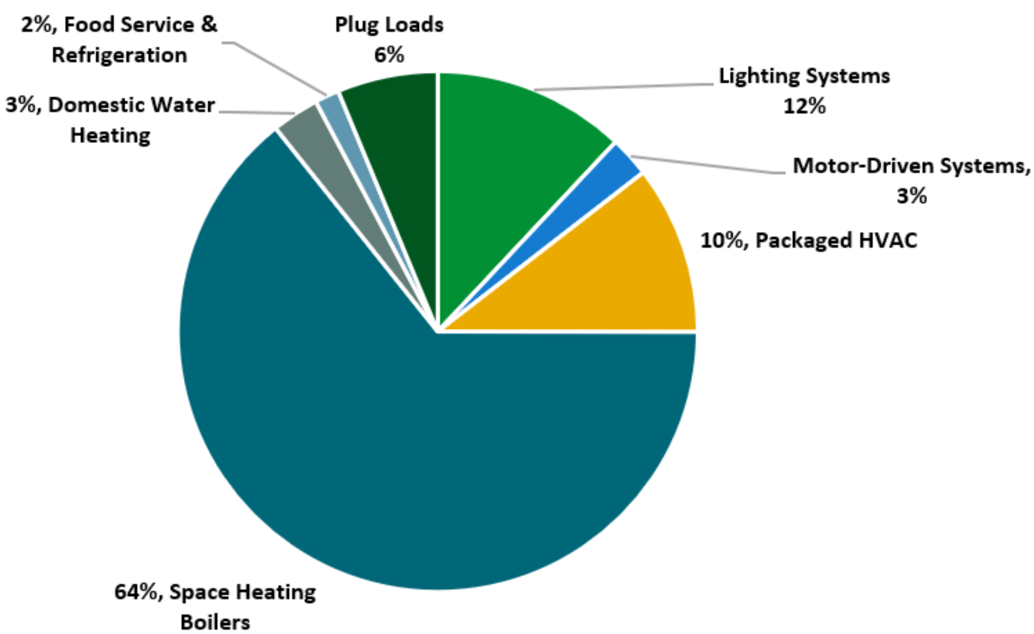


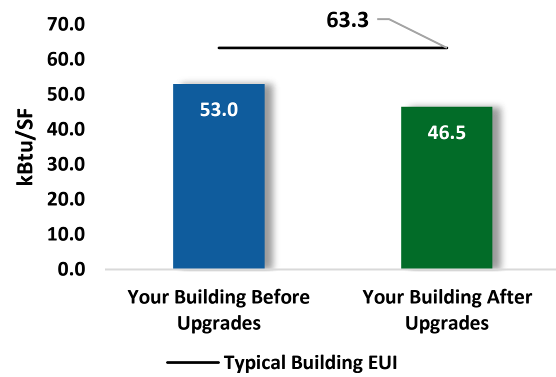
Figure 1 - Energy Use by System

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.

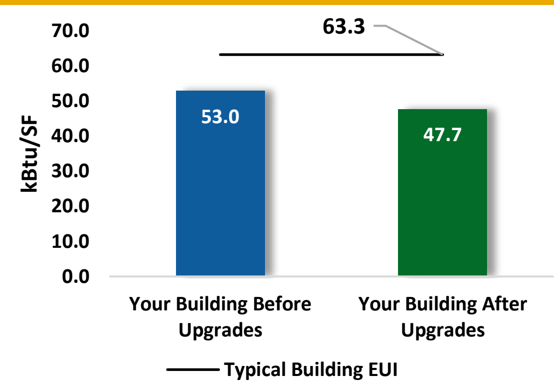
Scenario 1: Full Package (All Evaluated Measures)

Installation Cost	$115,863
Potential Rebates & Incentives[1]	$14,319
Annual Cost Savings	$16,007
Annual Energy Savings	Electricity: 97,960 kWh Natural Gas: 845 Therms
Greenhouse Gas Emission Savings	54 Tons
Simple Payback	6.3 Years
Site Energy Savings (All Utilities)	12%



Scenario 2: Cost Effective Package[2]

Installation Cost	$65,919
Potential Rebates & Incentives	$12,436
Annual Cost Savings	$15,418
Annual Energy Savings	Electricity: 102,242 kWh Natural Gas: -97 Therms
Greenhouse Gas Emission Savings	51 Tons
Simple Payback	3.5 Years
Site Energy Savings (all utilities)	10%



On-site Generation Potential

Photovoltaic	High
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			**68,448**	**19.9**	**-14**	**$10,225**	**$37,171**	**$8,367**	**$28,804**	**2.8**	**67,310**
ECM 1	Install LED Fixtures	Yes	13,090	3.7	-2	$1,960	$8,476	$950	$7,526	3.8	12,908
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	1,106	0.4	0	$165	$819	$130	$689	4.2	1,086
ECM 3	Retrofit Fixtures with LED Lamps	Yes	54,252	15.8	-11	$8,101	$27,876	$7,287	$20,589	2.5	53,316
Lighting Control Measures			**16,534**	**4.8**	**-3**	**$2,468**	**$14,394**	**$3,685**	**$10,709**	**4.3**	**16,245**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	11,888	4.0	-2	$1,775	$11,244	$1,500	$9,744	5.5	11,680
ECM 5	Install High/Low Lighting Controls	Yes	4,646	0.9	-1	$694	$3,150	$2,185	$965	1.4	4,565
Motor Upgrades			**148**	**0.0**	**0**	**$22**	**$1,257**	**$0**	**$1,257**	**56.0**	**149**
ECM 6	Premium Efficiency Motors	No	148	0.0	0	$22	$1,257	$0	$1,257	56.0	149
Unitary HVAC Measures			**12,045**	**7.2**	**0**	**$1,831**	**$25,531**	**$923**	**$24,608**	**13.4**	**12,129**
ECM 7	Install High Efficiency Air Conditioning Units	No	1,677	1.0	0	$255	$13,677	$683	$12,995	51.0	1,688
ECM 8	Install High Efficiency PTAC/PTHP	Yes	10,369	6.3	0	$1,576	$11,854	$240	$11,614	7.4	10,441
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**29**	**$384**	**$31,875**	**$1,200**	**$30,675**	**80.0**	**3,409**
ECM 9	Install High Efficiency Hot Water Boilers	No	0	0.0	29	$384	$31,875	$1,200	$30,675	80.0	3,409
Domestic Water Heating Upgrade			**1,586**	**0.0**	**8**	**$341**	**$201**	**$94**	**$107**	**0.3**	**2,486**
ECM 10	Install Low-Flow DHW Devices	Yes	1,586	0.0	8	$341	$201	$94	$107	0.3	2,486
Food Service & Refrigeration Measures			**1,612**	**0.2**	**0**	**$245**	**$230**	**$50**	**$180**	**0.7**	**1,623**
ECM 11	Vending Machine Control	Yes	1,612	0.2	0	$245	$230	$50	$180	0.7	1,623
Custom Measures			**-2,413**	**0.0**	**65**	**$490**	**$5,205**	**$0**	**$5,205**	**10.6**	**5,181**
ECM 12	Replace Electric Water Heater with Heat Pump Water Heater	Yes	3,693	0.0	0	$562	$2,070	$0	$2,070	3.7	3,719
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater	No	-6,106	0.0	65	-$72	$3,135	$0	$3,135	-43.5	1,462
TOTALS (COST EFFECTIVE MEASURES)			**102,242**	**31.2**	**-10**	**$15,418**	**$65,919**	**$12,436**	**$53,483**	**3.5**	**101,825**
TOTALS (ALL MEASURES)			**97,960**	**32.2**	**84**	**$16,007**	**$115,863**	**$14,319**	**$101,545**	**6.3**	**108,533**

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

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

Negative payback explained in section 4.8

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.

Options from Your Utility Company

Prescriptive and Custom Rebates

For facilities wishing to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the Prescriptive and Custom Rebates program. To participate, you can use internal resources or an outside firm or contractor to perform the final design of the ECM(s) and install the equipment. Program pre-approval may be required for some incentives. Contact your utility company for more details prior to project installation.

Direct Install

The Direct Install program provides turnkey installation of multiple measures through an authorized contractor. This program can provide incentives up to 70% or 80% of the cost of selected measures. A Direct Install contractor will assess and verify individual measure eligibility and perform the installation work. The Direct Install program is available to sites with an average peak demand of less than 200 kW.

Engineered Solutions

The Engineered Solutions program provides tailored energy-efficiency assistance and turnkey engineering services to municipalities, universities, schools, hospitals, and healthcare facilities (MUSH), non-profit entities, and multifamily buildings. The program provides all professional services from audit, design, construction administration, to commissioning and measurement and verification for custom whole-building energy-efficiency projects. Engineered Solutions allows you to install as many measures as possible under a single project as well as address measures that may not qualify for other programs.

For more details on these programs please contact your utility provider.

Options from New Jersey's Clean Energy Program

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

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the ESIP. Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as attractive financing for implementing ECMs. You have already taken the first step as an LGEA customer, because this report is required to participate in ESIP.

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

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

Successor Solar Incentive Program (SuSI)

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

Ongoing Electric Savings with Demand Response

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

Large Energy User Program (LEUP)

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

For more details on these programs please visit [New Jersey's Clean Energy Program website](https://www.njcleanenergy.com) .

2 Existing Conditions

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Heywood Avenue School. 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 September 29, 2022, TRC performed an energy audit at Heywood Avenue School located in Orange, New Jersey. TRC met with facility staff to review the facility operations and help focus our investigation on specific energy-using systems.

Heywood Avenue School is a two-story, 64,600 square foot building built in 1930 including an addition built in the late 1990's. Spaces include classrooms, multipurpose, auditorium, offices, corridors, stairwells, kitchen, and mechanical space. A detached modular building houses classrooms and restrooms.

2.2 Building Occupancy

The school is fully occupied from September through June. Typical weekday occupancy is 70 staff and 400 students. Summer occupancy includes a summer day camp and continuing maintenance activities. There are no weekend activities.

Building Name	Weekday/Weekend	Operating Schedule
Heywood Avenue School	Weekday	6:30 AM - 10:00 PM
	Weekend	Varied

Figure 3 - Building Occupancy Schedule

2.3 Building Envelope

Building walls are brick over structural steel. The roof is flat and covered with black membrane, and it is in poor condition. The addition has a brick exterior with a partial standing seam roof. The main roof of the addition is flat covered with silver paint. It appears to be in poor condition. The trailer has pitched roof with wood siding.

Original 1930 Building

Addition

Trailer

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


Windows


Exterior Door

Windows

2.4 Lighting Systems

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. There are also several 34-Watt T12 fixtures. Fixture types include 1-lamp, 2-lamp, 3-lamp, or 4-lamp, 4-foot-long recessed troffer, and surface mounted fixtures and 2-foot fixtures with U-bend tube lamps. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use less efficient magnetic ballasts. Additionally, there are some incandescent and LED general purpose lamps.

Gymnasium fixtures have manually controlled high intensity discharge (HID) lamps. Auditorium fixtures have chandeliers with LED lamps and are manually controlled. All exit signs are LED. Most fixtures are in fair condition. Interior lighting levels were generally sufficient. Lighting fixtures are controlled by wall switches or circuit breakers.


Linear Fluorescent Fixtures


Linear Fluorescent Fixtures


Gymnasium Surface Mounted Fixtures

Exterior fixtures include wall packs, flood lights, canopy lights with high intensity discharge (HID), incandescent, or LED lamps. Exterior light fixtures are controlled by a switch, or photocell, depending on the fixture.


Wall Pack Fixture


Wall Pack Fixture


Canopy Fixture

2.5 Air Handling Systems

Unit Ventilators

Unit ventilators in the addition are equipped with supply fan motors and electronically controlled outside air dampers and fan coil valves connected to the hot water distribution system. Each unit has its own compressor for cooling. They provide heating, cooling, and ventilation to classrooms. These systems are original to the building and appear to be in fair operating condition.


Unit Ventilators

Thermostat

Unit Ventilators

Unitary Electric HVAC Equipment

Classrooms and offices in the original building use window air conditioning (AC) units. These vary in capacity between 0.5 tons and 2-tons. Most of the units are in fair condition. They range in efficiency between 9 EER to 10.8 EER. Several of them are ENERGY STAR® labeled.

Window AC Units of Varying Age and Size

The school has a few ductless mini split AC systems. They approximately 1.5 tons with an EER of 10.8.

Exterior Condenser

Interior Evaporator

Unit Label

The trailer has two packaged terminal air source heat pumps. They are estimated to be 3 tons with an EER of 11. The units are in poor condition. The addition has two split systems for the corridor. They are 5 tons with an EER of 10-12. They are in poor condition.

Packaged Heat Pumps

Packaged Heat Pumps

Outdoor Condensing Units

2.6 Heating Hot Water & Steam Systems

Two HB Smith 3,662 MBh steam boilers serve the original building heating load with a nominal efficiency of 83%. The boilers are configured in a manual control scheme. Multiple boilers are required under high load conditions. They are in good condition.

Steam Boilers

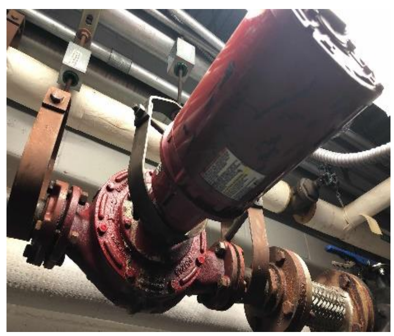
Steam Boilers

Controls

Three, 300 MBh modular hot water boilers which serve the hot water needs for the addition. The hydronic distribution system is a two-pipe heating only system.

The boilers are configured in a constant flow primary distribution with two, 1.5 hp constant speed hot water pumps operating with an automated control scheme. The boilers provide hot water to unit ventilators, convectors, and air handling units throughout the addition. Multiple boilers are required under high load conditions. They are in good condition.

Boilers



Heating Hot Water Pumps

Controls

Boilers, Heating Hot Water Pumps, and Controls

2.7 Domestic Hot Water

Three storage tank water heaters serve the complex. A 74 gallon, 75.10 MBh gas-fired storage water heater with an efficiency of 80% and two electric storage water heaters, with a 50-gallon and 40-gallon capacity each are rated at 4.5 kW.

One fractional hp continuously operating pump circulates water to end uses.



Storage Tank Water Heaters

2.8 Food Service Equipment

The kitchen has all electric equipment that is used to prepare meals for students. Most cooking is done using a conventional oven. Bulk prepared foods are held in an electric holding cabinet. Equipment is not high efficiency and is in fair condition.

Visit https://www.energystar.gov/products/commercial_food_service_equipment for the latest information on high efficiency food service equipment.

Oven

Holding Cabinet

Steam Table

2.9 Refrigeration

The kitchen has an energy efficient stand-up refrigerator and freezer with double solid doors. There is also a refrigerator chest. All equipment is high efficiency and in fair condition.

Visit https://www.energystar.gov/products/commercial_food_service_equipment for the latest information on high efficiency food service equipment.

Stand-up Refrigerator

Freezer

Refrigerator Chest

2.10 Plug Load and 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 80 computer workstations throughout the facility. Plug loads include general cafe and office equipment. There are classroom typical loads such as smart boards, projectors, and fans. There are several mini refrigerators and residential-style refrigerators throughout the building. These vary in condition.

There is one refrigerated beverage vending machine. It is not equipped with occupancy-based controls.

Copier

Vending Machine/Refrigerators

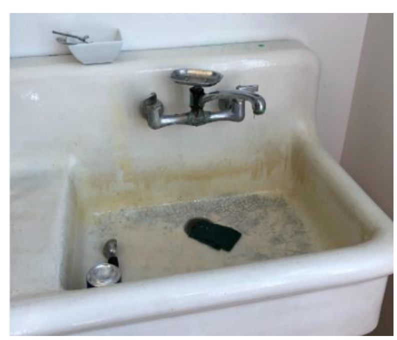
Smart Board

2.11 Water-Using Systems

There are 13 restrooms with toilets, and sinks. Faucet flow rates are at 2.2 gallons per minute (gpm) or higher.

Kitchen Sink

Restroom Sink

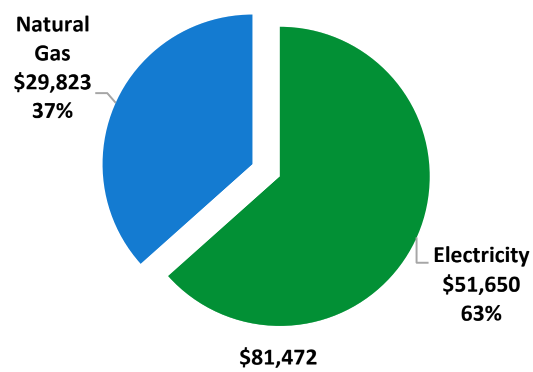


Utility Sink

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	339,699 kWh	$51,650
Natural Gas	22,637 Therms	$29,823
Total		**$81,472**



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

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

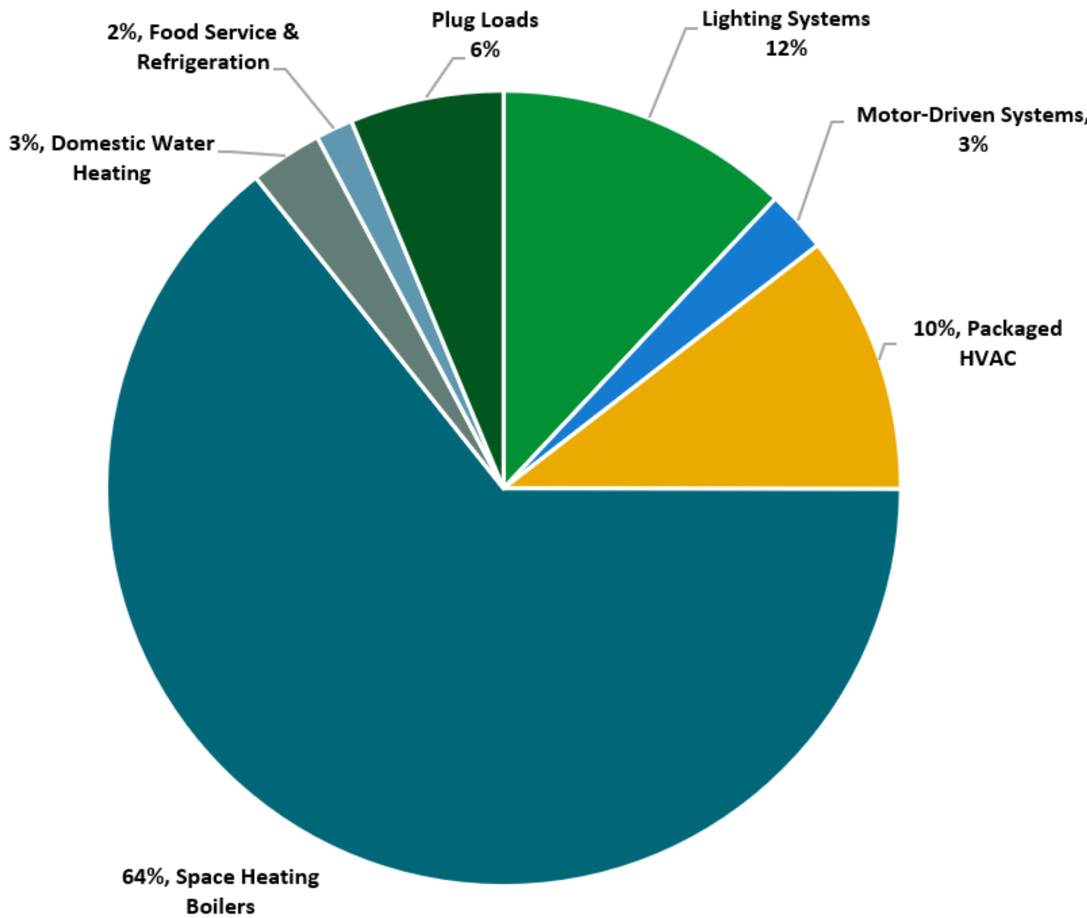
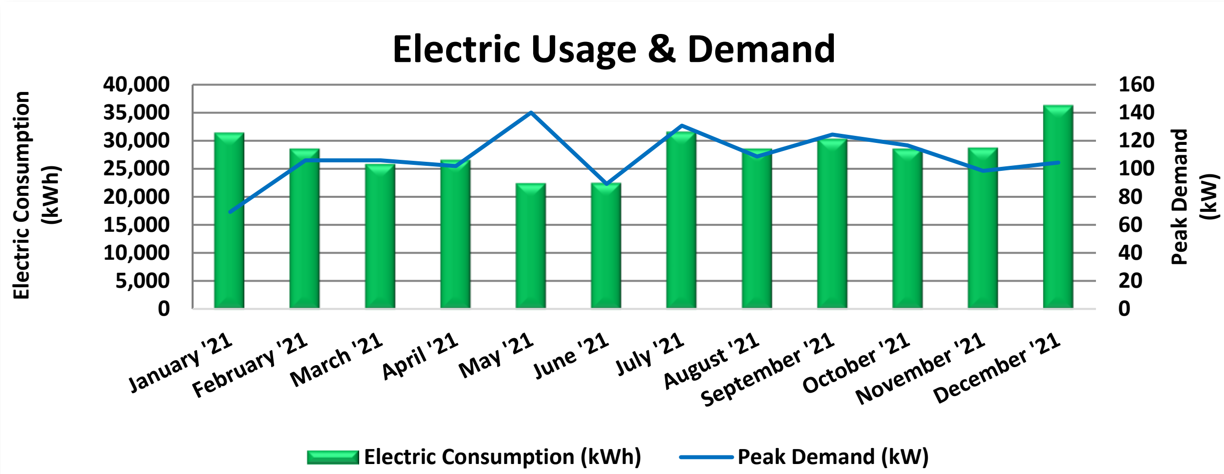


Figure 4 - Energy Balance

3.1 Electricity

PSE&G delivers electricity under general lighting & power rate class.



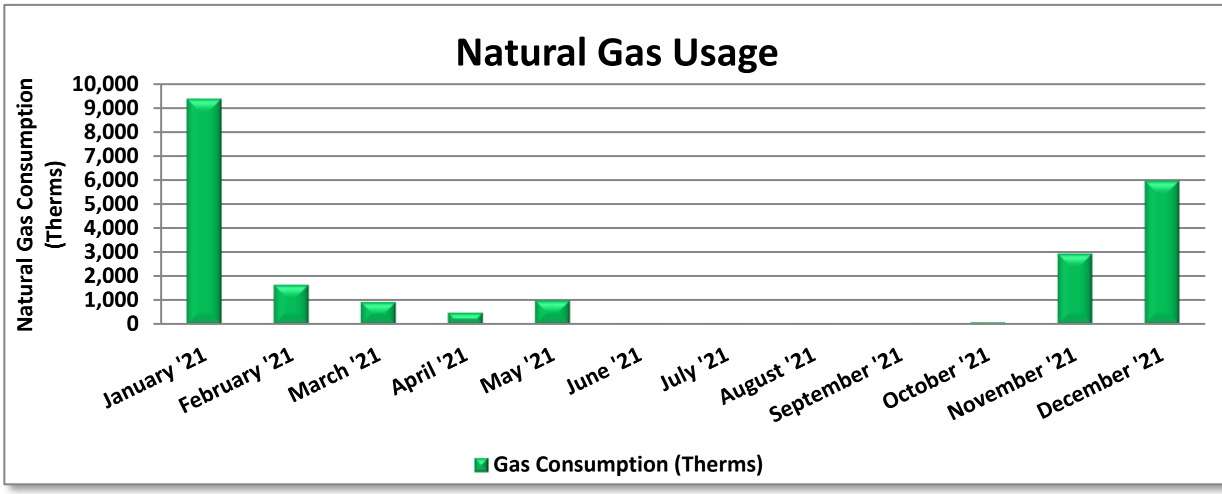
Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
1/22/21	35	31,440	69	545	4,142
2/19/21	28	28,560	106	701	4,242
3/22/21	31	25,860	106	701	3,942
4/22/21	31	26,560	102	685	4,099
5/21/21	29	22,460	140	1,293	3,402
6/21/21	31	22,520	89	1,238	4,401
7/21/21	30	31,600	131	1,810	5,617
8/20/21	30	28,600	109	1,813	5,058
9/20/21	31	30,360	124	1,726	5,164
10/19/21	29	28,560	117	462	3,859
11/17/21	29	28,720	98	472	3,800
12/20/21	33	36,320	104	495	4,207
Totals	**367**	**341,560**	**140**	**$11,941**	**$51,933**
Annual	**365**	**339,699**	**140**	**$11,876**	**$51,650**

Notes:

- Peak demand of 140 kW occurred in May 2021.
- Average demand over the past 12 months was 108 kW.
- The average electric cost over the past 12 months was $0.152/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

PSE&G delivers natural gas under large volume gas rate class.



Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
1/22/21	33	9,367	9,755
2/19/21	28	1,648	2,406
3/22/21	31	929	1,763
4/22/21	31	499	1,361
5/20/21	28	998	1,822
6/21/21	32	46	202
7/21/21	30	42	187
8/20/21	30	38	203
9/20/21	31	50	213
10/19/21	29	99	271
11/17/21	29	2,942	5,122
12/20/21	33	5,977	6,517
Totals	**365**	**22,637**	**$29,823**
Annual	**365**	**22,637**	**$29,823**

Notes:

- The average gas cost for the past 12 months is $1.317/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	67

Congratulations, your building performs better than the national average. This report has suggestions about how to keep your building running efficiently, further improve performance, and lower your energy bills even more.

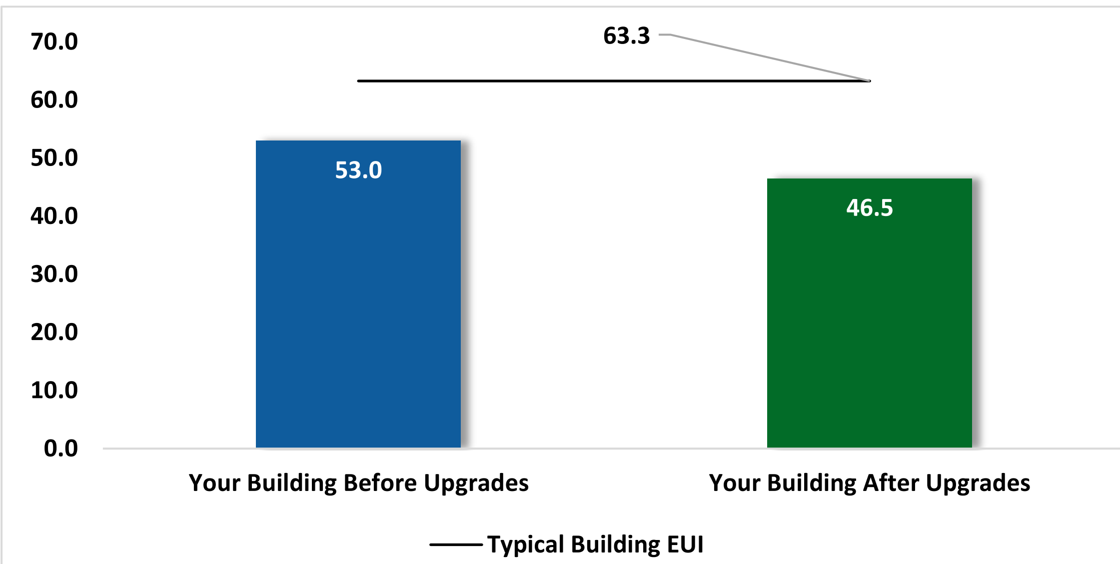


Figure 5 - Energy Use Intensity Comparison[3]

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

[3] Based on all evaluated ECMs

Tracking Your Energy Performance

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

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

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

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

4 Energy Conservation Measures

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

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

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

Financial incentives in this report are based on the previously run state rebate program SmartStart, which has been retired. Now, all investor-owned gas and electric utility companies are offering complementary energy efficiency programs directly to their customers. Some measures and proposed upgrades may be eligible for higher incentives than those shown below. The incentives in the summary tables should be used for high-level planning purposes. To verify incentives, reach out to your utility provider or visit the NJCEP website for more information.

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			**68,448**	**19.9**	**-14**	**$10,225**	**$37,171**	**$8,367**	**$28,804**	**2.8**	**67,310**
ECM 1	Install LED Fixtures	Yes	13,090	3.7	-2	$1,960	$8,476	$950	$7,526	3.8	12,908
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	1,106	0.4	0	$165	$819	$130	$689	4.2	1,086
ECM 3	Retrofit Fixtures with LED Lamps	Yes	54,252	15.8	-11	$8,101	$27,876	$7,287	$20,589	2.5	53,316
Lighting Control Measures			**16,534**	**4.8**	**-3**	**$2,468**	**$14,394**	**$3,685**	**$10,709**	**4.3**	**16,245**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	11,888	4.0	-2	$1,775	$11,244	$1,500	$9,744	5.5	11,680
ECM 5	Install High/Low Lighting Controls	Yes	4,646	0.9	-1	$694	$3,150	$2,185	$965	1.4	4,565
Motor Upgrades			**148**	**0.0**	**0**	**$22**	**$1,257**	**$0**	**$1,257**	**56.0**	**149**
ECM 6	Premium Efficiency Motors	No	148	0.0	0	$22	$1,257	$0	$1,257	56.0	149
Unitary HVAC Measures			**12,045**	**7.2**	**0**	**$1,831**	**$25,531**	**$923**	**$24,608**	**13.4**	**12,129**
ECM 7	Install High Efficiency Air Conditioning Units	No	1,677	1.0	0	$255	$13,677	$683	$12,995	51.0	1,688
ECM 8	Install High Efficiency PTAC/PTHP	Yes	10,369	6.3	0	$1,576	$11,854	$240	$11,614	7.4	10,441
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**29**	**$384**	**$31,875**	**$1,200**	**$30,675**	**80.0**	**3,409**
ECM 9	Install High Efficiency Hot Water Boilers	No	0	0.0	29	$384	$31,875	$1,200	$30,675	80.0	3,409
Domestic Water Heating Upgrade			**1,586**	**0.0**	**8**	**$341**	**$201**	**$94**	**$107**	**0.3**	**2,486**
ECM 10	Install Low-Flow DHW Devices	Yes	1,586	0.0	8	$341	$201	$94	$107	0.3	2,486
Food Service & Refrigeration Measures			**1,612**	**0.2**	**0**	**$245**	**$230**	**$50**	**$180**	**0.7**	**1,623**
ECM 11	Vending Machine Control	Yes	1,612	0.2	0	$245	$230	$50	$180	0.7	1,623
Custom Measures			**-2,413**	**0.0**	**65**	**$490**	**$5,205**	**$0**	**$5,205**	**10.6**	**5,181**
ECM 12	Replace Electric Water Heater with Heat Pump Water Heater	Yes	3,693	0.0	0	$562	$2,070	$0	$2,070	3.7	3,719
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater	No	-6,106	0.0	65	-$72	$3,135	$0	$3,135	-43.5	1,462
TOTALS			**97,960**	**32.2**	**84**	**$16,007**	**$115,863**	**$14,319**	**$101,545**	**6.3**	**108,533**

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

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

Negative payback explained in section 4.8

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		**68,448**	**19.9**	**-14**	**$10,225**	**$37,171**	**$8,367**	**$28,804**	**2.8**	**67,310**
ECM 1	Install LED Fixtures	13,090	3.7	-2	$1,960	$8,476	$950	$7,526	3.8	12,908
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,106	0.4	0	$165	$819	$130	$689	4.2	1,086
ECM 3	Retrofit Fixtures with LED Lamps	54,252	15.8	-11	$8,101	$27,876	$7,287	$20,589	2.5	53,316
Lighting Control Measures		**16,534**	**4.8**	**-3**	**$2,468**	**$14,394**	**$3,685**	**$10,709**	**4.3**	**16,245**
ECM 4	Install Occupancy Sensor Lighting Controls	11,888	4.0	-2	$1,775	$11,244	$1,500	$9,744	5.5	11,680
ECM 5	Install High/Low Lighting Controls	4,646	0.9	-1	$694	$3,150	$2,185	$965	1.4	4,565
Unitary HVAC Measures		**10,369**	**6.3**	**0**	**$1,576**	**$11,854**	**$240**	**$11,614**	**7.4**	**10,441**
ECM 8	Install High Efficiency PTAC/PTHP	10,369	6.3	0	$1,576	$11,854	$240	$11,614	7.4	10,441
Domestic Water Heating Upgrade		**1,586**	**0.0**	**8**	**$341**	**$201**	**$94**	**$107**	**0.3**	**2,486**
ECM 10	Install Low-Flow DHW Devices	1,586	0.0	8	$341	$201	$94	$107	0.3	2,486
Food Service & Refrigeration Measures		**1,612**	**0.2**	**0**	**$245**	**$230**	**$50**	**$180**	**0.7**	**1,623**
ECM 11	Vending Machine Control	1,612	0.2	0	$245	$230	$50	$180	0.7	1,623
Custom Measures		**3,693**	**0.0**	**0**	**$562**	**$2,070**	**$0**	**$2,070**	**3.7**	**3,719**
ECM 12	Replace Electric Water Heater with Heat Pump Water Heater	3,693	0.0	0	$562	$2,070	$0	$2,070	3.7	3,719
TOTALS		**102,242**	**31.2**	**-10**	**$15,418**	**$65,919**	**$12,436**	**$53,483**	**3.5**	**101,825**

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

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

Figure 7 – Cost Effective ECMs

4.1 Lighting

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**68,448**	**19.9**	**-14**	**$10,225**	**$37,171**	**$8,367**	**$28,804**	**2.8**	**67,310**
ECM 1	Install LED Fixtures	13,090	3.7	-2	$1,960	$8,476	$950	$7,526	3.8	12,908
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,106	0.4	0	$165	$819	$130	$689	4.2	1,086
ECM 3	Retrofit Fixtures with LED Lamps	54,252	15.8	-11	$8,101	$27,876	$7,287	$20,589	2.5	53,316

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

ECM 1: Install LED Fixtures

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

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

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

Affected Building Areas: gymnasium and exterior fixtures.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

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

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

Affected Building Areas: all areas with fluorescent fixtures with T12 tubes: an office, two boys' restrooms, gym storage room and mechanical room.

ECM 3: Retrofit Fixtures with LED Lamps

Replace fluorescent 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. Be sure to specify replacement lamps that are compatible with existing dimming controls, where applicable. In some circumstances, you may need to upgrade your dimming system for optimum performance.

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 and incandescent Edison base 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		**16,534**	**4.8**	**-3**	**$2,468**	**$14,394**	**$3,685**	**$10,709**	**4.3**	**16,245**
ECM 4	Install Occupancy Sensor Lighting Controls	11,888	4.0	-2	$1,775	$11,244	$1,500	$9,744	5.5	11,680
ECM 5	Install High/Low Lighting Controls	4,646	0.9	-1	$694	$3,150	$2,185	$965	1.4	4,565

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

ECM 4: Install Occupancy Sensor Lighting Controls

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

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

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

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

Affected Building Areas: offices, classrooms, gymnasium, library, restrooms, and storage rooms.

ECM 5: Install High/Low Lighting Controls

Install occupancy sensors to provide dual level lighting control for lighting fixtures in spaces that are infrequently occupied but may require some level of continuous lighting for safety or security reasons.

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

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

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

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

Affected Building Areas: hallways, and stairwells.

4.3 Motors

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**148**	**0.0**	**0**	**$22**	**$1,257**	**$0**	**$1,257**	**56.0**	**149**
ECM 6	Premium Efficiency Motors	148	0.0	0	$22	$1,257	$0	$1,257	56.0	149

ECM 6: Premium Efficiency Motors

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

Affected Motors:

Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Additional Motor Description
Mechanical 2 New Building	New Building	2	Heating Hot Water Pump	1.5	

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

4.4 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		**12,045**	**7.2**	**0**	**$1,831**	**$25,531**	**$923**	**$24,608**	**13.4**	**12,129**
ECM 7	Install High Efficiency Air Conditioning Units	1,677	1.0	0	$255	$13,677	$683	$12,995	51.0	1,688
ECM 8	Install High Efficiency PTAC/PTHP	10,369	6.3	0	$1,576	$11,854	$240	$11,614	7.4	10,441

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

ECM 7: 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: corridor in addition.

ECM 8: Install High Efficiency PTAC/PTHP

Replace packaged terminal air conditioners and heat pumps (PTAC and PTHP) with high-efficiency units. A higher EER or SEER rating indicates a more efficient cooling system, and a higher HSPF rating indicates more efficient heating mode. 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 heating and cooling loads, and the estimated annual operating hours.

Affected Units: trailer classrooms.

4.5 Gas-Fired Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**29**	**$384**	**$31,875**	**$1,200**	**$30,675**	**80.0**	**3,409**
ECM 9	Install High Efficiency Hot Water Boilers	0	0.0	29	$384	$31,875	$1,200	$30,675	80.0	3,409

ECM 9: Install High Efficiency Hot Water Boilers

Replace older inefficient hot water boilers with high efficiency hot water boilers. 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. 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 boilers has a long payback and may not be justifiable based simply on energy considerations. However, the boilers have reached the end of their 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.

4.6 Domestic Water Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**1,586**	**0.0**	**8**	**$341**	**$201**	**$94**	**$107**	**0.3**	**2,486**
ECM 10	Install Low-Flow DHW Devices	1,586	0.0	8	$341	$201	$94	$107	0.3	2,486

ECM 10: Install Low-Flow DHW Devices

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

Device	Flow Rate
Faucet aerators (lavatory)	0.5 gpm
Faucet aerator (kitchen)	1.5 gpm
Showerhead	2.0 gpm
Pre-rinse spray valve (kitchen)	1.28 gpm

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

4.7 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**	**$245**	**$230**	**$50**	**$180**	**0.7**	**1,623**
ECM 11	Vending Machine Control	1,612	0.2	0	$245	$230	$50	$180	0.7	1,623

ECM 11: Vending Machine Control

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

4.8 Custom Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Custom Measures		**-2,413**	**0.0**	**65**	**$490**	**$5,205**	**$0**	**$5,205**	**10.6**	**5,181**
ECM 12	Replace Electric Water Heater with Heat Pump Water Heater	3,693	0.0	0	$562	$2,070	$0	$2,070	3.7	3,719
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater	-6,106	0.0	65	-$72	$3,135	$0	$3,135	-43.5	1,462

CM 12: Replace Electric Water Heater with Heat Pump Water Heater

A typical electric water heater uses electric resistance coils to heat water at a coefficient of performance (COP) of 1. Air source heat pump water heaters (HPWH) use a refrigeration cycle to transfer heat from the surrounding air to the domestic water. The typical average COP for a HPWH is about 2.5, so they require significantly less electricity to produce the same amount of hot water as a traditional electric water heater. There are two types of HPWH, those integrated with the heat pump and storage tank in the same unit, and those that are split into two sections (with the storage tank separate from the heat pump). The following addresses integrated HPWH.

HPWH reject cold air. As such, they need to be installed in an unconditioned space of about 750 cubic feet with good ventilation. Ideal locations are garages, large enclosed, unconditioned storage areas, or areas with excess heat such as a furnace or boiler room.[4] The HPWH will also produce condensate so accommodations for draining the condensate need to be provided.

Most HPWH operate effectively down to an air temperature of 40 °F. Below that temperature, an electric resistance booster heater is typically required to achieve full heating capacity. It is critical that the HPWH

[4] https://basc.pnnl.gov/code-compliance/heat-pump-water-heaters-code-compliance-brief#:~:text=HPWH%20must%20have%20unrestricted%20airflow,depending%20on%20size%20of%20system

controls are set up so that the electric resistance heat only engages when the air temperature is too cold for the HPWH to extract heat from it. HPWHs have a slow recovery. During periods of high demand, the electric resistance heating element, if enabled, may be energized to maintain set point, thus reducing the overall efficiency of the unit. It is recommended that a careful analysis of the hot water demand be conducted to determine if the application makes economic sense, and the HPWH heating capacity and storage are properly sized.

HPWH operate most effectively when the temperature difference between the incoming and outgoing water is high. Generally, this means that cold make-up water should be piped to the bottom of the tank and return water should be piped to the top of the tank in order to maintain stratification within the storage tank. Water should be drawn from the bottom of the tank to be heated. If there is a DHW recirculation pump, it should only be operated during high hot water demand periods.

ECM 13: Replace Gas Fired Water Heater with Heat Pump Water Heater

A gas fired water heater uses a burner to heat water. Air source heat pump water heaters (HPWH) use a refrigeration cycle to transfer heat from the surrounding air to the domestic water. Water heater efficiency is rated by the uniform energy factor (UEF). \For a relative comparison of water heater UEFs, the criteria for certifying a water heater in the ENERGY STAR® program are provided below. These values indicate that HPWH heaters are significantly more efficient than gas fired water heaters.

There are two types of HPWH: those integrated with the heat pump and storage tank in the same unit, and those that are split into two sections (with the storage tank separate from the heat pump). The measure considers an integrated HPWH.

ENERGY STAR® Uniform Energy Factor (UEF) Criteria for Certified Water Heaters *

Water Heater Type	Minimum UEF	Other
Integrated HPWH	3.3	
Integrated HPWH	2.2	120 Volt, 15 Amp circuit
Split System HPWH	2.2	
Gas Fired Storage	0.64	≤ 55-gal, Medium Draw Pattern
Gas Fired Storage	0.68	≤ 55-gal, High Draw Pattern
Gas Fired Storage	0.78	> 55-gal, Medium Draw Pattern
Gas Fired Storage	0.80	> 55-gal, High Draw Pattern
Gas Fired Storage	0.80	Residential Duty
Gas Fired Instantaneous	0.87	

** Note: Uniform Energy Factor (UEF): The newest measure of water heater overall efficiency. The higher the UEF value is, the more efficient the water heater. UEF is determined by the Department of Energy's test method outlined in 10 CFR Part 430, Subpart B, Appendix E.*[5]

[5] https://www.energy.gov/sites/prod/files/2014/06/f17/rwh_tp_final_rule.pdf

HPWH reject cold air. As such, they need to be installed in an unconditioned space of about 750 cubic feet with good ventilation[6]. Ideal locations are garages, large enclosed, unconditioned storage areas, or areas with excess heat such as a furnace or boiler room. The HPWH will also produce condensate so accommodations for draining the condensate need to be provided.

Most HPWH operate effectively down to an air temperature of 40 °F. Below that temperature, an electric resistance booster heater is typically required to achieve full heating capacity. It is critical that the HPWH controls are set up so that the electric resistance heat only engages when the air temperature is too cold for the HPWH to extract heat from it. HPWHs have a slow recovery. During periods of high demand, the electric resistance heating element, if enabled, may be energized to maintain set point, thus reducing the overall efficiency of the unit. It is recommended that a careful analysis of the hot water demand be conducted to determine if the application makes economic sense, and the HPWH heating capacity and storage are properly sized.

HPWH operate most effectively when the temperature difference between the incoming and outgoing water is high. Generally, this means that cold make-up water should be piped to the bottom of the tank and return water should be piped to the top of the tank in order to maintain stratification within the storage tank. Water should be drawn from the bottom of the tank to be heated. If there is a DHW recirculation pump, it should only be operated during high hot water demand periods.

Switching from a gas-fired water heater to a HPWH has the potential to reduce the sites overall greenhouse gas emissions. If the electricity for the HPWH is provided by an on-site photovoltaic (PV) system, then there are essentially no greenhouse gas (GHG) emissions. A 2016 study conducted at Cornell [7]calculated the kg of methane (CH_4) and carbon dioxide (CO_2) produced per GJ of water heated. The study compared HPWH to gas and electric fired, storage and tankless water heaters. The study also considered electricity produced from natural gas and coal fired electric plants. In all cases the study found that HPWHs produced less methane than all of the other water heaters. The study also found that HPWH produced less carbon dioxide than electric resistance water heaters but more carbon dioxide than tankless gas water heaters and about the same amount of carbon dioxide as storage gas water heaters. The summary tables provide the reduction in CO2 equivalent emissions based on the typical New Jersey electric utility.

This measure has a negative simple payback due to the relative cost of electricity to natural gas. At this site the cost per Btu for natural gas is significantly lower than for electricity. Therefore, even though this measure will result in a net energy savings in terms of Btu at this site it will increase the overall cost for providing domestic hot water.

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[6] https://basc.pnnl.gov/code-compliance/heat-pump-water-heaters-code-compliance-brief#:~:text=HPWH%20must%20have%20unrestricted%20airflow,depending%20on%20size%20of%20system

[7] Greenhouse gas emissions from domestic hot water: Heat pumps compared to most commonly used systems. Bongghi Hong, Robert W. Howarth. Department of Ecology and Evolutionary Biology, Cornell University. Energy Science and Engineering 2016.

4.9 Measures for Future Consideration

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

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

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

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

Heating System Conversion from Steam to Hot Water

Replacing the steam boilers and heat exchangers with natural gas-fired, high-efficiency water boilers was of interest to facility personnel. This type of system upgrade/conversion has significant up-front capital costs. However, there are benefits with modular hot water boiler system designs with advanced control strategies. Advantages associated with configuring a boiler plant around several modular boilers include the better system performance at low load conditions, and the modular boilers will often take less space than multiple old large boilers.

As the existing boilers are approaching the end of their useful life, it is recommended that reconfiguring the boiler plant be further evaluated. We recommend that you work with your mechanical design team to select boilers that are sized appropriately for the heating load.

Replacing the boilers has a long payback, and it may not be justifiable based simply on energy considerations. However, one of the boilers has reached the end of its normal useful life. We also recommend working with your mechanical design team to determine whether a hot water heating system can operate with return water temperatures below 130°F, which would allow for operating condensing boilers at efficiencies above 90%. Energy savings results from improved combustion efficiency and reduced standby losses at low loads. Further analysis should be conducted for the feasibility of this measure. This measure is a capital improvement measure for future consideration.

5 Energy Efficient Best Practices

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

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

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

Energy Tracking with ENERGY STAR® Portfolio Manager®

You've heard it before—you cannot manage what you do not measure. ENERGY STAR® Portfolio Manager® is an online tool that you can use to measure and track energy and water consumption, as well as greenhouse gas emissions[8]. 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.

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

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.

Steam Trap Repair and Replacement

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

Thermostatic Radiator Valve Installations

We recommend investigating the installation of thermostatic control valves for existing radiators. Traditionally radiators have manual valves that are used to control the flow through the radiator. Replacing these manual valves with thermostatic control valves allows for automatic modulation of the steam or hot water flow to maintain the temperature setting. The valve will incrementally close as space temperature increases. This will allow a maximum temperature to be set per area/room. Using thermostatic control valves will result in energy savings by reducing the overheating of spaces throughout the facility.

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 sections 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 BAS 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.

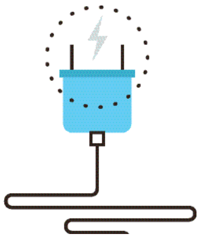
Refrigeration Equipment Maintenance

Preventative maintenance keeps commercial refrigeration equipment running reliably and efficiently. Commercial refrigerators and freezers are mission-critical equipment that can cost a fortune when they go down. Even when they appear to be working properly, refrigeration units can be consuming too much energy. Have walk-in refrigeration and freezer and other commercial systems serviced at least annually. This practice will allow systems to perform to their highest capabilities and will help identify system issues if they exist.

Maintaining your commercial refrigeration equipment can save between 5% and 10% on energy costs. When condenser coils are dirty, your commercial refrigerators and freezers work harder to maintain the temperature inside. Worn gaskets, hinges, door handles or faulty seals cause cold air to leak from the unit, forcing the unit to run longer and use more electricity.

Regular cleaning and maintenance also help your commercial refrigeration equipment to last longer.

Plug Load Controls



Reducing plug loads is a common way to decrease your electrical use. Limiting the energy use of plug loads can include increasing occupant awareness, removing under-used equipment, installing hardware controls, and using software controls. Consider enabling the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips[9]. Your local utility may offer incentives or rebates for this equipment.

Water Conservation

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

For more information regarding water conservation go to the EPA's WaterSense™ website[10] or download a copy of EPA's "WaterSense™ at Work: Best Management Practices for Commercial and Institutional Facilities"[11] 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.

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

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

[11] 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.

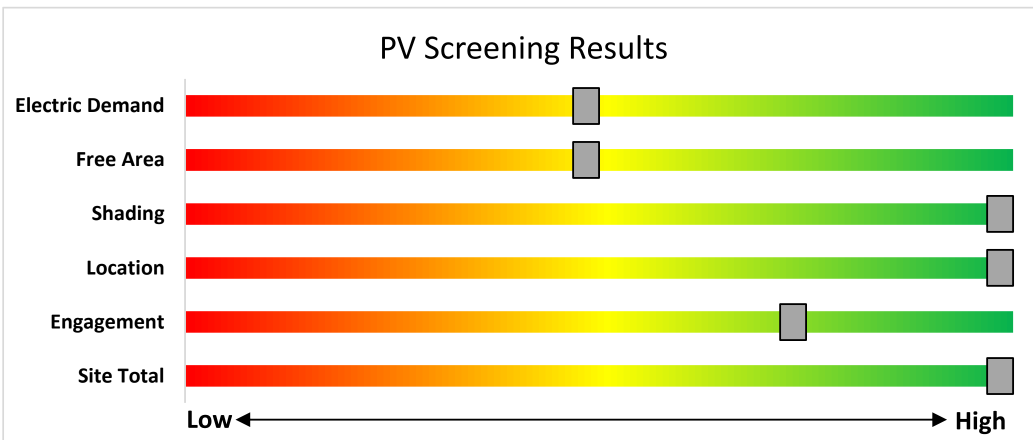
6.1 Solar Photovoltaic

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 high potential for installing a PV array.

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

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



Potential	High	
System Potential	97	kW DC STC
Electric Generation	115,563	kWh/yr
Displaced Cost	$17,570	/yr
Installed Cost	$252,200	

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.

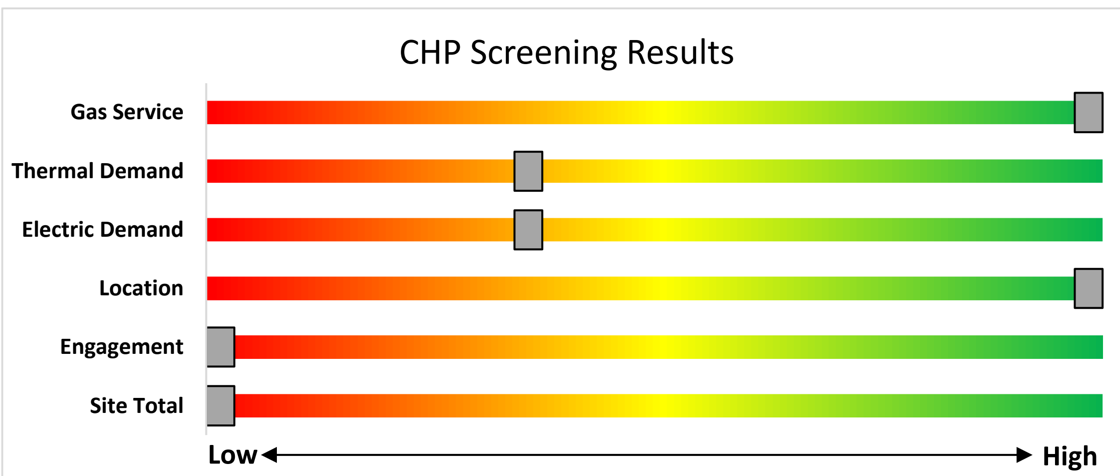


Figure 9 - Combined Heat and Power Screening

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 Electric Vehicles (EV)

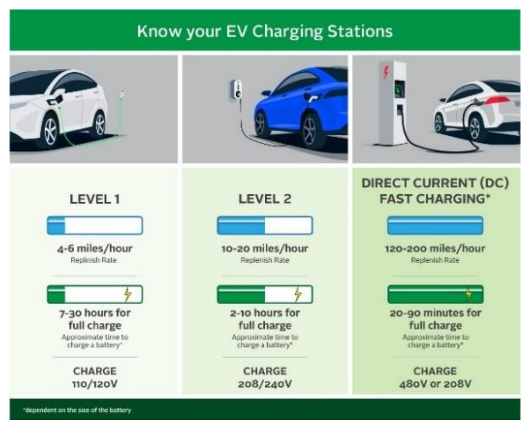
All electric vehicles (EVs) have an electric motor instead of an internal combustion engine. EVs function by plugging into a charge point, taking electricity from the grid, and then storing it in rechargeable batteries. Although electricity production may contribute to air pollution, the U.S. EPA categorizes all-electric vehicles as zero-emission vehicles because they produce no direct exhaust or tailpipe emissions.

EVs are typically more expensive than similar conventional and hybrid vehicles, although some cost can be recovered through fuel savings, federal tax credit, or state incentives.

7.1 Electric Vehicle Charging

EV charging stations provide a means for electric vehicle operators to recharge their batteries at a facility. While many EV drivers charge at home, others do not have access to regular home charging, and the ability to charge at work or in public locations is critical to making EVs practical for more drivers. Charging can also be used for electric fleet vehicles, which can reduce fuel and maintenance costs for fleets that replace gas or diesel vehicles with EVs.

EV charging comes in three main types. For this assessment, the screening considers addition of Level 2 charging, which is most common at workplaces and other public locations. Depending on the site type and usage, other levels of charging power may be more appropriate.



The preliminary assessment of EV charging at the facility shows that there is medium potential for adding EV chargers to the facility's parking, based on potential costs of installation and other site factors.

The primary costs associated with installing EV charging are the charger hardware and the cost to extend power from the facility to parking spaces. This may include upgrades to electric panels to serve increased loads.

The type and size of the parking area impact the costs and feasibility of adding EV charging. Parking structure installations can be less costly than surface lot installations as power may be readily available, and equipment and wiring can be surface mounted. Parking lot installations often require trenching through concrete or asphalt surface. Large parking areas provide greater flexibility in charger siting than smaller lots.

The location and capacity of facility electric panels also impact charger installation costs. A Level 2 charger generally requires a dedicated 208-240V, 40 Amp circuit. The electric panel nearest the planned installation may not have available capacity and may need to be upgraded to serve new EV charging loads. Alternatively, chargers could be powered from a more distant panel. The distance from the panel to the location of charging stations ties directly to costs, as conduits, cables, and potential trenching costs all increase on a per-foot basis. The more charging stations planned, the more likely it is that additional electrical capacity will be needed.

Other factors to consider when planning for EV charging at a facility include who the intended users are, how long they park vehicles at the site, and whether they will need to pay for the electricity they use.

The graphic below displays the results of the EV charging assessment conducted as part of this audit. The position of each slider indicates the impact each factor has on the feasibility of installing EV charging at the site.

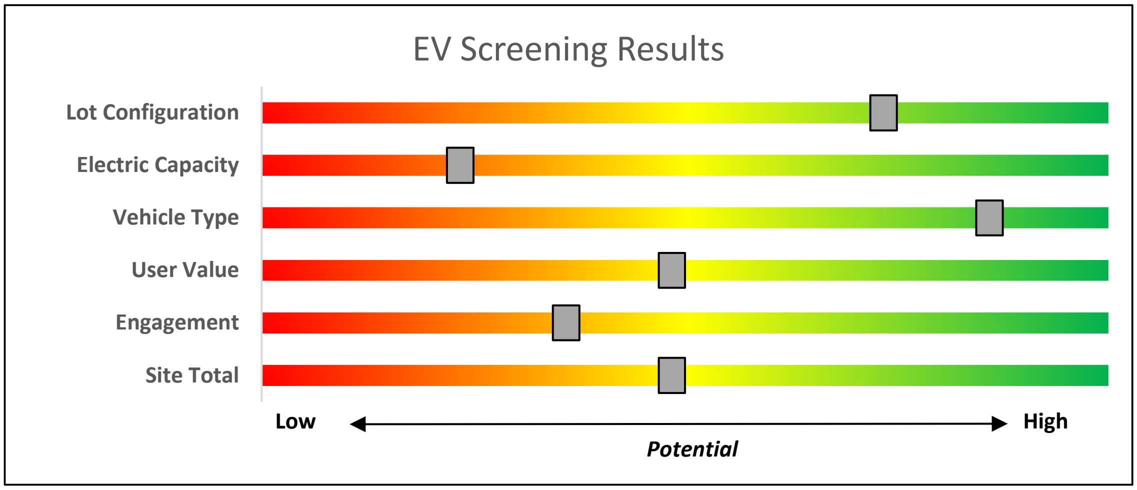


Figure 10 – EV Charger Screening

Electric Vehicle Programs Available

New Jersey is leading the way on electric vehicle (EV) adoption on the East Coast. There are several programs designed to encourage EV adoption in New Jersey, which is crucial to reaching a 100% clean energy future.

NJCEP offers a variety of EV programs for vehicles, charging stations, and fleets. Certain EV charging stations that receive electric utility service from Atlantic City Electric Company (ACE) or Public Service Electric & Gas Company (PSE&G), may be eligible for additional electric vehicle charging incentives directly from the utility. Projects may be eligible for both the incentives offered by this BPU program and incentives offered by ACE or PSE&G, up to 90% of the combined charger purchase and installation costs. Please check ACE or PSE&G program eligibility requirements before purchasing EV charging equipment, as additional conditions on types of eligible chargers may apply for utility incentives.

Both Jersey Central Power & Light (JCP&L) and Rockland Electric (RECO) have filed proposals for EV charging programs. BPU staff is currently reviewing those proposals.

For more information and to keep up to date on all EV programs please visit https://www.njcleanenergy.com/commercial-industrial/programs/electric-vehicle-programs

8 Project Funding and Incentives

Ready to improve your building's performance? New Jersey's Clean Energy Programs and Utility Energy Efficiency Programs can help. Pick the program that works best for you. This section provides an overview of currently available incentive programs in.

8.1 Utility Energy Efficiency Programs

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

Prescriptive and Custom

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

Equipment Examples

Lighting
Lighting Controls
HVAC Equipment
Refrigeration
Gas Heating
Gas Cooling
Commercial Kitchen Equipment
Food Service Equipment
Variable Frequency Drives
Electronically Commutate Motors
Variable Frequency Drives
Plug Loads Controls
Washers and Dryers
Agricultural
Water Heating

The Prescriptive program provides fixed incentives for specific energy efficiency measures. Prescriptive incentives vary by equipment type. The Custom program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentives.

Direct Install

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

Incentives

The program pays up to 70% of the total installed cost of eligible measures.

How to Participate

To participate in Direct Install, you will work with a participating contractor. The contractor will be paid the measure incentives directly by the program, which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the Direct Install program, subject to program rules and eligibility, while the remaining percent of the cost is paid to the contractor by the customer.

Engineered Solutions

The Engineered Solutions Program provides tailored energy-efficiency assistance and services to municipalities, universities, schools, hospitals and healthcare facilities (MUSH), non-profit entities, and multifamily buildings. Customers receive expert guided services, including investment-grade energy auditing, engineering design, installation assistance, construction administration, commissioning, and measurement and verification (M&V) services to support the implementation of cost-effective and comprehensive efficiency projects. Engineered Solutions is generally a good option for medium to large sized facilities with a peak demand over 200 kW looking to implement as many measures as possible under a single project to achieve deep energy savings. Engineered Solutions has an added benefit of addressing measures that may not qualify for other programs. Many facilities pursuing an Energy Savings Improvement Program loan also use this program. Incentives for this program are based on project scope and energy savings achieved.

For more information on any of these programs, contact your local utility provider or visit https://www.njcleanenergy.com/transition.

8.2 New Jersey's Clean Energy Programs

Save money while saving the planet! New Jersey's Clean Energy Program is a statewide program that offers incentives, programs, and services that benefit New Jersey residents, businesses, educational, non-profit, and government entities to help them save energy, money, and the environment.

Large Energy Users

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

Incentives

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

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

How to Participate

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

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

Combined Heat and Power

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

Incentives

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

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

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

How to Participate

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

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.

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 (dc). The program is currently under development. 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.

Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) serves New Jersey's government agencies by financing energy projects. An ESIP is a type of performance contract, whereby school districts, counties, municipalities, housing authorities, and other public and state entities enter into contracts to help finance building energy upgrades. Annual payments are lower than the savings projected from the energy conservation measures (ECMs), ensuring that ESIP projects are cash flow positive for the life of the contract.

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

How to Participate

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

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

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

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

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

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

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

9 Project Development

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

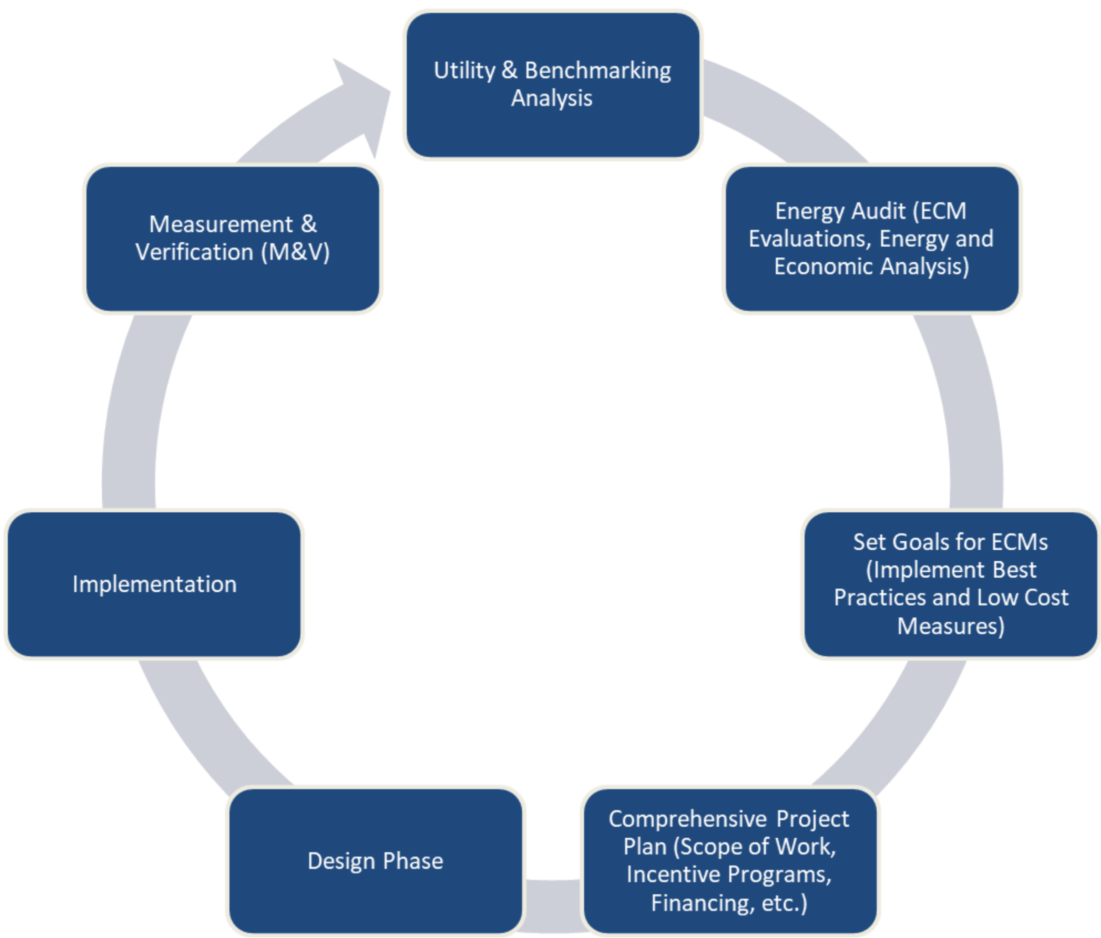


Figure 11 – Project Development Cycle

10 Energy Purchasing and Procurement Strategies

10.1 Retail Electric Supply Options

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

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

A list of licensed third-party electric suppliers is available at the NJBPU website[12].

10.2 Retail Natural Gas Supply Options

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

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

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

A list of licensed third-party natural gas suppliers is available at the NJBPU website[13].

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

[13] 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
Exterior 1	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell		30	4,380		None	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	30	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell		45	4,380		None	No	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	45	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	1	Metal Halide: (1) 250W Lamp	Photocell		295	4,380	1	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	75	4,380	0.0	964	0	$147	$471	$50	2.9
Exterior 1	2	Metal Halide: (1) 70W Lamp	Photocell		95	4,380	1	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	21	4,380	0.0	648	0	$99	$412	$100	3.2
Lobby 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
Lobby 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3, 5	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,380	0.1	185	0	$28	$298	$90	7.5
Classroom 110	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	S	32	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,380	0.0	97	0	$14	$153	$30	8.5
Classroom 110	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Classroom 114	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Classroom 115	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Classroom 116	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	S	32	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,380	0.0	97	0	$14	$153	$30	8.5
Classroom 116	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Classroom 117	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	S	32	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,380	0.0	97	0	$14	$153	$30	8.5
Classroom 117	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Classroom 118	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	S	32	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,380	0.0	97	0	$14	$153	$30	8.5
Classroom 118	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Classroom 119	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	S	32	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,380	0.0	97	0	$14	$153	$30	8.5
Classroom 119	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Classroom 120	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	S	32	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,380	0.0	97	0	$14	$153	$30	8.5
Classroom 120	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Corridor 1	6	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	6	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Corridor 1	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3, 5	Relamp	Yes	9	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,380	0.3	831	0	$124	$779	$405	3.0
Corridor 1	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 5	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	1,380	0.7	2,079	0	$310	$1,722	$750	3.1
Corridor 1	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 5	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,380	0.6	1,953	0	$292	$1,326	$660	2.3
Library 109	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

	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
Library 109	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.6	1,953	0	$292	$1,146	$275	3.0
Locker Room 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
Locker Room 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	185	0	$28	$189	$40	5.4
Restroom - Female 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	277	0	$41	$380	$65	7.6
Restroom - Male 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	277	0	$41	$380	$65	7.6
Restroom - Unisex 114	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	2,000	3	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,000	0.0	64	0	$10	$72	$10	6.6
Restroom - Unisex 115	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	2,000	3	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,000	0.0	64	0	$10	$72	$10	6.6
Storage 106	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	1,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	690	0.1	163	0	$24	$262	$40	9.1
Storage 108	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	1,000	3	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	1,000	0.0	32	0	$5	$72	$10	13.1
Exterior Trailer 1	4	Incandescent: (1) 60W PAR20 Screw-In Lamp	Wall Switch		60	1,000	3	Relamp	No	4	LED Lamps: PAR20 Lamps	Wall Switch	9	1,000	0.0	204	0	$31	$88	$8	2.6
Exterior Trailer 1	1	LED - Fixtures: Wall Pack	Photocell		45	4,380		None	No	1	LED - Fixtures: Wall Pack	Photocell	45	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Trailer 2	6	Incandescent: (1) 60W PAR20 Screw-In Lamp	Wall Switch		60	1,000	3	Relamp	No	6	LED Lamps: PAR20 Lamps	Wall Switch	9	1,000	0.0	306	0	$47	$132	$12	2.6
Classroom 1	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 2	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 3	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 6	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.4	1,109	0	$165	$708	$155	3.3
Classroom 6	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.1	326	0	$49	$262	$60	4.2
Classroom 7	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,000	0.0	109	0	$16	$55	$15	2.4
Classroom 8	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,000	0.0	109	0	$16	$55	$15	2.4
Classroom 8A	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,386	0	$207	$818	$185	3.1
Classroom 9	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom Trailer A TCU11	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom Trailer A TCU11	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,000	0.0	73	0	$11	$37	$10	2.4
Classroom Trailer A TCU12	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Classroom Trailer A TCU12	17	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3, 4	Relamp	Yes	17	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.5	1,570	0	$234	$1,161	$240	3.9

	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
Corridor 2	8	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	8	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Corridor 2	1	LED Lamps: (6) 5W CA10 Screw-In Lamps	Wall Switch	S	5	2,000		None	No	1	LED Lamps: (6) 5W CA10 Screw-In Lamps	Wall Switch	5	2,000	0.0	0	0	$0	$0	$0	0.0
Corridor 2	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 5	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,380	1.1	3,255	-1	$486	$1,686	$625	2.2
Elevator 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,000	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	36	0	$5	$37	$10	4.9
Exterior 1	3	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch		10	4,380		None	No	3	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	7	LED Lamps: (1) 20W Corn Bulb Screw-In Lamp	Photocell		20	4,380		None	No	7	LED Lamps: (1) 20W Corn Bulb Screw-In Lamp	Photocell	20	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	2	LED Lamps: (1) 30W Corn Bulb Screw-In Lamp	Photocell		30	4,380		None	No	2	LED Lamps: (1) 30W Corn Bulb Screw-In Lamp	Photocell	30	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	4	LED - Fixtures: Wall Pack	Photocell		45	4,380		None	No	4	LED - Fixtures: Wall Pack	Photocell	45	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	1	Metal Halide: (1) 70W Lamp	Photocell		95	4,380	1	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	21	4,380	0.0	324	0	$49	$206	$50	3.2
Janitorial 3	1	LED Lamps: (1) 12W A19 Screw-In Lamp	Wall Switch	S	12	1,000		None	No	1	LED Lamps: (1) 12W A19 Screw-In Lamp	Wall Switch	12	1,000	0.0	0	0	$0	$0	$0	0.0
Janitorial 4	1	LED Lamps: (1) 12W A19 Screw-In Lamp	Wall Switch	S	12	1,000		None	No	1	LED Lamps: (1) 12W A19 Screw-In Lamp	Wall Switch	12	1,000	0.0	0	0	$0	$0	$0	0.0
Kitchen 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.0	123	0	$18	$73	$20	2.9
Mechanical 2 New Building	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,000	3, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	690	0.1	139	0	$21	$380	$65	15.2
Multipurpose 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
Multipurpose 1	15	Metal Halide: (1) 400W Lamp	Wall Switch	S	458	2,000	1, 4	Fixture Replacement	Yes	15	LED - Fixtures: High-Bay	Occupancy Sensor	120	1,380	4.1	12,382	-3	$1,848	$7,827	$820	3.8
Office - Enclosed 4	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.4	1,109	0	$165	$708	$155	3.3
Office - Enclosed 5	2	Linear Fluorescent - EST12: 4' T12 (34W) - 4L	Wall Switch	S	144	2,000	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.1	458	0	$68	$353	$60	4.3
Office - Enclosed 5	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.4	1,109	0	$165	$708	$155	3.3
Office - Enclosed 8	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.2	488	0	$73	$489	$95	5.4
Office - Enclosed 9	2	Linear Fluorescent - T12: 8' T12 (75W) - 2L	Wall Switch	S	158	2,000	2	Relamp & Reballast	No	2	LED - Linear Tubes: (2) 8' Lamps	Wall Switch	72	2,000	0.1	378	0	$56	$257	$40	3.8
Office - Enclosed Principal	1	LED Lamps: (2) 10W A19 Screw-In Lamps	Wall Switch	S	10	2,000		None	No	1	LED Lamps: (2) 10W A19 Screw-In Lamps	Wall Switch	10	2,000	0.0	0	0	$0	$0	$0	0.0
Office - Enclosed Principal	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,000	0.0	73	0	$11	$37	$10	2.4
Restroom - Female 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	185	0	$28	$189	$40	5.4
Restroom - Male 2	2	Linear Fluorescent - EST12: 4' T12 (34W) - 2L	Wall Switch	S	72	2,000	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	229	0	$34	$254	$40	6.3
Restroom - Unisex 3	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	2,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	2,000	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
Restroom - Unisex Principal	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	2,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	2,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Unisex TCU11	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	2,000	3	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	9	2,000	0.0	112	0	$17	$17	$1	1.0
Restroom - Unisex TCU12	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	2,000	3	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	9	2,000	0.0	112	0	$17	$17	$1	1.0
Storage 2 Gym	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	1,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	1,000	0.0	0	0	$0	$0	$0	0.0
Storage 2 Gym	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	1,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	1,000	0.0	0	0	$0	$0	$0	0.0
Storage 2 Gym	1	Linear Fluorescent - EST12: 4' T12 (34W) - 4L	Wall Switch	S	144	1,000	2	Relamp & Reballast	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,000	0.1	95	0	$14	$118	$20	7.0
Storage Gym B	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	1,000	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,000	0.0	62	0	$9	$73	$20	5.8
Storage TCU11-A	1	Incandescent: (2) 60W A19 Screw-In Lamps	Wall Switch	S	60	1,000	3	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	9	1,000	0.0	56	0	$8	$34	$2	3.9
Storage TCU12	1	Incandescent: (2) 60W A19 Screw-In Lamps	Wall Switch	S	60	1,000	3	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	9	1,000	0.0	56	0	$8	$34	$2	3.9
Theater Auditorium	5	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	5	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Theater Auditorium	6	Incandescent: (12) 65W BR30 Screw-In Lamps	Wall Switch	S	65	2,000	3, 4	Relamp	Yes	6	LED Lamps: BR30 Lamps	Occupancy Sensor	10	1,380	0.3	769	0	$115	$1,990	$251	15.1
Theater Auditorium	12	LED Lamps: (2) 5W CA10 Screw-In Lamps	Wall Switch	S	5	2,000		None	No	12	LED Lamps: (2) 5W CA10 Screw-In Lamps	Wall Switch	5	2,000	0.0	0	0	$0	$0	$0	0.0
Theater Auditorium	4	LED Lamps: (19) 6W CA10 Screw-In Lamps	Wall Switch	S	6	2,000		None	No	4	LED Lamps: (19) 6W CA10 Screw-In Lamps	Wall Switch	6	2,000	0.0	0	0	$0	$0	$0	0.0
Theater Auditorium	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.0	123	0	$18	$73	$20	2.9
Classroom 20	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 21	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.4	1,109	0	$165	$708	$155	3.3
Classroom 22	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 23	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 24	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 25	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 26	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.5	1,663	0	$248	$927	$215	2.9
Classroom 27	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3, 4	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,380	0.4	1,109	0	$165	$708	$155	3.3
Corridor 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
Corridor 1	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	8,760	3, 5	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	6,044	0.8	10,693	-2	$1,596	$1,770	$825	0.6
Janitorial 1	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	1,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	1,000	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
Janitorial 2	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	1,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	1,000	0.0	0	0	$0	$0	$0	0.0
Office - Enclosed 2A	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	277	0	$41	$380	$65	7.6
Office - Enclosed 2B	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,000	0.0	73	0	$11	$37	$10	2.4
Office - Enclosed 2B	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.0	123	0	$18	$73	$20	2.9
Office - Enclosed Techers Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.0	123	0	$18	$73	$20	2.9
Office - Enclosed Techers Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.0	123	0	$18	$73	$20	2.9
Restroom - Female 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.0	123	0	$18	$73	$20	2.9
Restroom - Male 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.0	123	0	$18	$73	$20	2.9
Restroom - Unisex Teachers Rm	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	2,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	2,000	0.0	0	0	$0	$0	$0	0.0
Electrical Room 1	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	1,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	1,000	0.0	0	0	$0	$0	$0	0.0
Mechanical 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
Mechanical 1	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	1,000	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	65	0	$10	$69	$10	6.1
Mechanical 1	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,000	3, 4	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	690	0.2	323	0	$48	$526	$105	8.7
Office - Enclosed 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 4	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.1	326	0	$49	$262	$60	4.2
Storage 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
Storage 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	1,000	3, 4	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	690	0.2	244	0	$36	$335	$60	7.5
Stairs 1 B-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
Stairs 1 B-2	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Wall Switch	S	20	2,000		None	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Wall Switch	20	2,000	0.0	0	0	$0	$0	$0	0.0
Stairs 1 B-2	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,000	0.0	109	0	$16	$55	$15	2.4
Stairs 1 B-2	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,000	3, 5	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,380	0.2	488	0	$73	$444	$165	3.8
Stairs 2, 1-2	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
Stairs 2, 1-2	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Wall Switch	S	20	2,000		None	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Wall Switch	20	2,000	0.0	0	0	$0	$0	$0	0.0
Stairs 2, 1-2	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	3	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,000	0.0	73	0	$11	$37	$10	2.4
Stairs 2, 1-2	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,000	3	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,000	0.0	109	0	$16	$55	$15	2.4

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
New Section - Corridor 1	Corridor 1	1	Supply Fan	1.0	84.0%	No	Unknown	Unknown	W	2,745		No	84.0%	No		0.0	0	0	$0	$0	$0	0.0
Classrooms - New Section	Classroom	9	Supply Fan	0.3	65.0%	No	Unknown	Unknown	W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Mechanical 1	2	Boiler Feed Water Pump	0.5	70.0%	No	Skidmore	P48J2EB7	W	2,555		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Mechanical 1	2	Combustion Air Fan	2.0	86.5%	No	Marathon	5K49NN2180	W	1,150		No	86.5%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen 1	Kitchen 1	1	Exhaust Fan	0.5	70.0%	No	Dayton	9K980	W	2,745		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 2 New Building	New Building	2	Heating Hot Water Pump	1.5	84.0%	No	Bell & Gossett	Unknown	B	2,555	6	Yes	86.5%	No		0.0	148	0	$22	$1,257	$0	56.0
Mechanical 1	Heywood Ave School	1	DHW Circulation Pump	0.3	65.0%	No	Unknown	Unknown	W	8,760		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Elevator 1	Heywood Ave School	1	Other	20.0	70.0%	No	Unknown	Unknown	W	80		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 2 New Building	New Building	1	Other	0.5	70.0%	No	Unknown	Unknown	W	900		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	Heywood Ave School	2	Other	0.5	70.0%	No	Unknown	Unknown	W	900		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Trailer 1	Trailer 1	2	Process Pump	0.5	70.0%	No	Unknown	Unknown	W	900		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Trailer 2	Trailer 2	2	Process Pump	0.5	70.0%	No	Unknown	Unknown	W	900		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0

Packaged HVAC Inventory & Recommendations

		Existing Conditions									Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Old section	Classroom 6	1	Window AC	2.00		10.30		Movincool	Classic Plus 26	W		No							0.0	0	0	$0	$0	$0	0.0
Old section	Exterior	1	Split-System	1.67		10.30		Midea	MCH-20FVM2	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Heywood Ave School	2	Split-System	1.50		10.80		Midea	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Heywood Ave School	14	Window AC	0.83		10.30		Frigidaire	FRA106BU1	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Trailer 1	1	Packaged Terminal HP	3.00	34.12	11.00	1 COP	Bard	Unknown	B	8	Yes	1	Packaged Terminal HP	3.00	34.12	9.60	3 COP	3.1	5,184	0	$788	$5,927	$120	7.4
Heywood Ave School	Trailer 2	1	Packaged Terminal HP	3.00	34.12	11.00	1 COP	Bard	Unknown	B	8	Yes	1	Packaged Terminal HP	3.00	34.12	9.60	3 COP	3.1	5,184	0	$788	$5,927	$120	7.4
Heywood Ave School	Heywood Ave School	4	Window AC	0.50		10.30		Veried	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Heywood Ave School	1	Window AC	0.60		10.30		Unknown	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Classroom 26	1	Window AC	0.63		10.30		Frigidaire	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Classroom 6	1	Window AC	2.00		9.00		Friedrich	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Heywood Ave School	2	Window AC	1.00		10.80		Veried	Veried	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Heywood Ave School	1	Window AC	0.50		10.30		Unknown	Unknown	B		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	New Section Classrooms	9	Unit Ventilator	4.50		10.30		Trane	TTR018D	B		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	New Section Corridor	1	Split-System	5.00		12.00		Trane	XE1200	B	7	Yes	1	Split-System	5.00		16.00		0.6	1,089	0	$166	$9,943	$525	56.9
Heywood Ave School	New Section Corridor	1	Split-System	1.50		10.00		Trane	XE1000	B	7	Yes	1	Split-System	1.50		16.00		0.3	588	0	$89	$3,734	$158	40.0
Heywood Ave School	Trailer 1	1	Electric Resistance Heat		17.06		1 COP	Unknown	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Heywood Ave School	Trailer 2	1	Electric Resistance Heat		17.06		1 COP	Unknown	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0

Space Heating Boiler Inventory & Recommendations

		Existing Conditions						Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
New Section	Mechanical 2	3	Non-Condensing Hot Water Boiler	240	Slant Finn	Unknown	B	9	Yes	3	Non-Condensing Hot Water Boiler	240	85.00%	AFUE	0.0	0	29	$384	$31,875	$1,200	80.0
Old section	Mechanical 1	2	Forced Draft Steam Boiler	3,040	HB Smith	28HE-S/W-12	W		No						0.0	0	0	$0	$0	$0	0.0

DHW Inventory & Recommendations

		Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Manufacturer	Model	Remaining Useful Life	ECM #	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
New section	Janitorial Closet	1	Storage Tank Water Heater (≤ 50 Gal)	AO Smith	ENT 50 100	W		No						0.0	0	0	$0	$0	$0	0.0
Old section	Kitchen 1	1	Storage Tank Water Heater (≤ 50 Gal)	AO Smith	ENT 40 100	W		No						0.0	0	0	$0	$0	$0	0.0
Old section	Mechanical 1	1	Storage Tank Water Heater (> 50 Gal)	AO Smith	BT-80 400	W		No						0.0	0	0	$0	$0	$0	0.0

Low-Flow Device Recommendations

	Recommendation Inputs					Energy Impact & Financial Analysis						
Location	ECM #	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
New Section	10	2	Faucet Aerator (Kitchen)	2.20	1.50	0.0	114	0	$17	$14	$4	0.6
New Section	10	8	Faucet Aerator (Lavatory)	2.50	0.50	0.0	1,308	0	$199	$57	$29	0.1
Old section	10	2	Faucet Aerator (Kitchen)	2.50	1.50	0.0	164	0	$25	$14	$4	0.4
Old section	10	16	Faucet Aerator (Lavatory)	2.20	0.50	0.0	0	8	$100	$115	$57	0.6

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	Manufacturer	Model	ENERGY STAR Qualified?	ECM #	Install ENERGY STAR Equipment?	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
Multipurpose 1	1	Refrigerator Chest	Powers	Unknown	Yes		No	0.0	0	0	$0	$0	$0	0.0
Kitchen 1	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	Unknown	Unknown	Yes		No	0.0	0	0	$0	$0	$0	0.0
Kitchen 1	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	M3 Turbo Air	Unknown	Yes		No	0.0	0	0	$0	$0	$0	0.0

Cooking Equipment Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	Manufacturer	Model	High Efficiency Equipement?	ECM #	Install High Efficiency Equipment?	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
Multipurpose 1	1	Insulated Food Holding Cabinet (1/2 Size)	Wittco	Unknown	No		No	0.0	0	0	$0	$0	$0	0.0
Kitchen 1	1	Electric Convection Oven (Half Size)	Blodgett	Unknown	No		No	0.0	0	0	$0	$0	$0	0.0
Multipurpose 1	1	Electric Steamer	Vollrath	Unknown	No		No	0.0	0	0	$0	$0	$0	0.0

Plug Load Inventory

Location	Existing Conditions					
	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Heywood Ave School	5	Coffee Machine	800	No	Unknown	Unknown
Heywood Ave School	70	Desktop	270	No	Varied	Varied
Heywood Ave School	10	Laptop	100	No	Varied	Varied
Heywood Ave School	30	Printer	100	Yes	Varied	Varied
Heywood Ave School	29	Smart Board	200	Yes	Varied	Varied
Heywood Ave School	6	Water Cooler	400	No	Intertek	BV-R
Heywood Ave School	2	Electric Space Heater	1,500	No	Varied	Varied
Heywood Ave School	8	Ceiling Fan	200	No	Unknown	Unknown
Multipurpose Rm	1	Large Fan	350	No	Patton	1010MP-I
Heywood Ave School	28	Fan	200	No	Varied	Varied
Heywood Ave School	2	Microwave	800	No	Unknown	Unknown
Server Area	1	Misc. Computer equipment	2,500	No	Unknown	Unknown
Restrooms	3	Hand Dryer	2,300	No	Varied	Varied
Office - Enclosed 8	1	Paper Shredder	75	No	Unknown	Unknown
Heywood Ave School	2	Copier	1,500	Yes	Varied	Varied
Heywood Ave School	8	Projector	200	No	Unknown	Unknown
Heywood Ave School	5	Mini Refrigerator	126	No	Varied	Varied
Teachers Room	1	Refrigerator	383	No	Unknown	Unknown
Classroom 3	1	Scanner	50	No	Unknown	Unknown
Heywood Ave School	2	Television	100	No	Unknown	Unknown
Office - Enclosed 1	1	Toaster	1,500	No	Unknown	Unknown

Vending Machine Inventory & Recommendations

Location	Existing Conditions		Proposed Conditions		Energy Impact & Financial Analysis						
	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
Office - Enclosed Teacher's room	1	Refrigerated	11	Yes	0.2	1,612	0	$245	$230	$50	0.7

Custom (High Level) Measure Analysis

Electric Tank Water Heater to HPWH

NOTE: HPWH calculation should not be used for existing water heaters with a storage capacity greater than 120 gal.

Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis										
Description	Area(s)/System(s) Served	SF of Area Served	Fuel Type	Input Capacity per Unit (kW)	Tank Capacity per Unit (Gal)	Description	COP	Tank Capacity per Unit (Gal)	Estimated Unit Cost	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Base Incentives	Enhanced Incentives	Total Incentives	Total Net Cost	Payback w/o Incentives in Years	Payback w/ Incentives in Years
Storage Tank Water Heater (≤50 Gal)	Kitchen 1	3,000	Electric	4.5	40	Heat Pump Water Heater	2.5	40	$2,069.90	0.00	3,693	0	$562	$2,070	$0	$0	$0	$2,070	3.68	3.68
			Electric																	
			Electric																	

APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

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

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ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Heywood Avenue School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 64,600
Built: 1930

For Year Ending: November 30, 2021
Date Generated: December 13, 2022

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

Property & Contact Information

Property Address	Property Owner	Primary Contact
Heywood Avenue School 421 Heywood Avenue Orange, New Jersey 07044	Orange Board of Education 451 Lincoln Avenue Orange, NJ 07050 (973) 677-6000	Jason E. Ballard 451 Lincoln Avenue Orange, NJ 07050 (973) 677-6000 ballarja@orange.k12.nj.us

Property ID: 21694608

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
52.6 kBtu/ft²

Source EUI
86.4 kBtu/ft²

Annual Energy by Fuel

Natural Gas (kBtu)	2,248,791 (66%)
Electric - Grid (kBtu)	1,149,984 (34%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	63.3
National Median Source EUI (kBtu/ft²)	103.9
% Diff from National Median Source EUI	-17%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	220

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 (II)	*Solar renewable energy credit*: a credit 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.