



Local Government Energy Audit Report

John Marshall School

July 31, 2019

Prepared for:

Elizabeth Public Schools
521 Magnolia Avenue
Elizabeth, New Jersey 07206

Prepared by:

TRC Energy Services
900 Route 9 North
Woodbridge, New Jersey 07095

Disclaimer

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

TRC Energy Services (TRC) reviewed the energy conservation measures and estimates of energy savings were reviewed 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 installation costs on our experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from RS Means. We encourage the owner of the facility to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Actual installation costs can vary widely based on individual measures and conditions. TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

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

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

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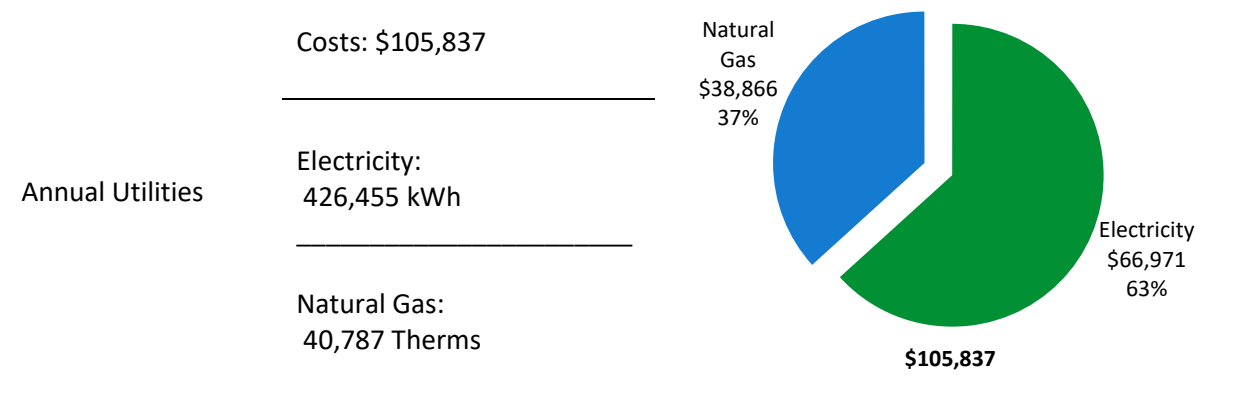
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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBP) has sponsored this Local Government Energy Audit (LGEA) report for John Marshall 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 Energy Services (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



ENERGY STAR® Benchmarking Score	11 <i>(1-100 scale)</i>	This building performs at or below the national average. This report contains suggestions about how to improve building performance and reduce energy costs.
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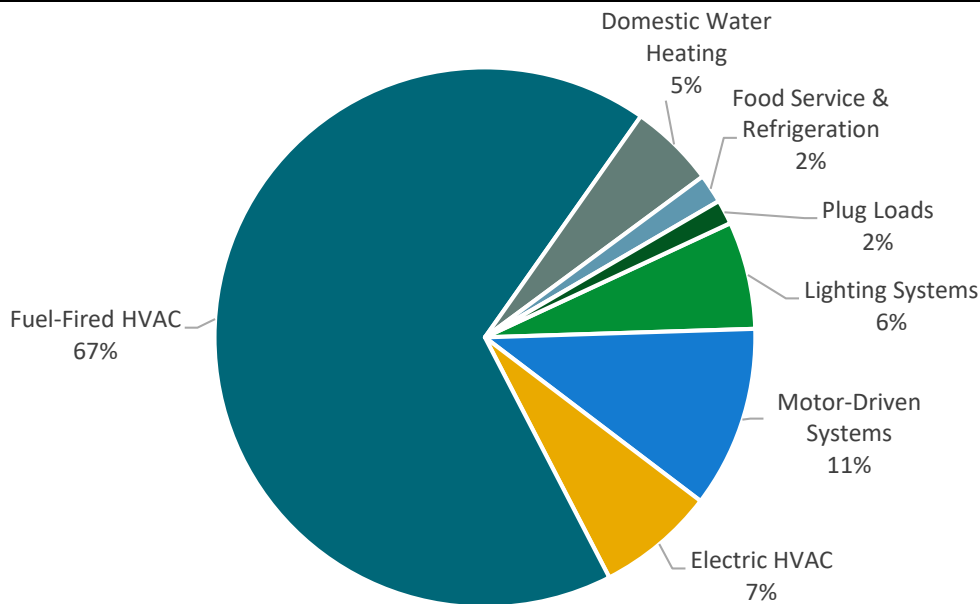


Figure 1 - Energy Use by System

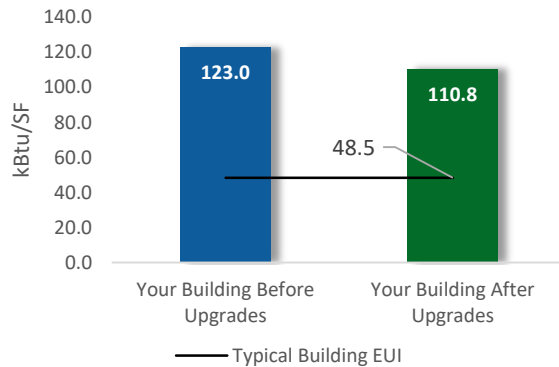
POTENTIAL IMPROVEMENTS



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.

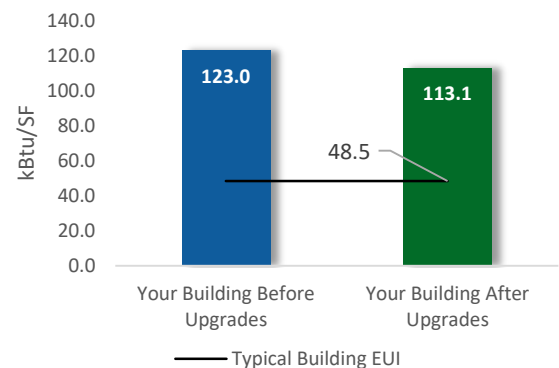
Scenario 1: Full Package (all evaluated measures)

Installation Cost	\$364,761
Potential Rebates & Incentives ¹	\$24,048
Annual Cost Savings	\$25,733
Annual Energy Savings	Electricity: 164,661 kWh
Greenhouse Gas Emission Savings	82 Tons
Simple Payback	13.2 Years
Site Energy Savings (all utilities)	10%



Scenario 2: Cost Effective Package²

Installation Cost	\$111,359
Potential Rebates & Incentives	\$12,348
Annual Cost Savings	\$20,973
Annual Energy Savings	Electricity: 134,348 kWh
Greenhouse Gas Emission Savings	67 Tons
Simple Payback	4.7 Years
Site Energy Savings (all utilities)	8%



On-site Generation Potential

Photovoltaic	High
Combined Heat and Power	None

¹ Incentives are based on current SmartStart Prescriptive incentives. Other Program incentives may apply.

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

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Lifetime Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Lighting Upgrades		63,077	16.2	-12	\$9,792	\$146,883	\$49,245	\$9,293	\$39,952	4.1	62,123
ECM 1	Install LED Fixtures	17,720	3.5	-2	\$2,760	\$41,396	\$28,618	\$3,800	\$24,818	9.0	17,560
ECM 2	Retrofit Fixtures with LED Lamps	45,356	12.8	-9	\$7,033	\$105,488	\$20,628	\$5,493	\$15,135	2.2	44,563
Lighting Control Measures		6,100	1.4	-1	\$946	\$7,566	\$4,862	\$415	\$4,447	4.7	5,993
ECM 3	Install Occupancy Sensor Lighting Controls	3,998	0.9	-1	\$620	\$4,959	\$3,512	\$415	\$3,097	5.0	3,928
ECM 4	Install High/Low Lighting Controls	2,102	0.5	0	\$326	\$2,607	\$1,350	\$0	\$1,350	4.1	2,065
Variable Frequency Drive (VFD) Measures		65,172	17.9	0	\$10,235	\$153,521	\$57,251	\$2,640	\$54,611	5.3	65,628
ECM 5	Install VFDs on Constant Volume (CV) Fans	35,166	9.9	0	\$5,523	\$82,839	\$25,924	\$2,640	\$23,284	4.2	35,412
ECM 6	Install VFDs on Chilled Water Pumps	16,242	5.8	0	\$2,551	\$38,260	\$14,082	\$0	\$14,082	5.5	16,356
ECM 7	Install VFDs on Heating Water Pumps	13,763	2.2	0	\$2,161	\$32,421	\$17,245	\$0	\$17,245	8.0	13,860
Electric Unitary HVAC Measures		5,114	3.4	0	\$803	\$12,048	\$74,645	\$0	\$74,645	92.9	5,150
ECM 8	Install High Efficiency Air Conditioning Units	5,114	3.4	0	\$803	\$12,048	\$74,645	\$0	\$74,645	92.9	5,150
Electric Chiller Replacement		25,198	33.8	0	\$3,957	\$79,142	\$178,758	\$11,700	\$167,058	42.2	25,374
ECM 9	Install High Efficiency Chillers	25,198	33.8	0	\$3,957	\$79,142	\$178,758	\$11,700	\$167,058	42.2	25,374
TOTALS (COST EFFECTIVE MEASURES)		134,348	35.6	-13	\$20,973	\$307,970	\$111,359	\$12,348	\$99,011	4.7	133,744
TOTALS (ALL MEASURES)		164,661	72.8	-13	\$25,733	\$399,161	\$364,761	\$24,048	\$340,713	13.2	164,268

* - All incentives presented in this table are based on NJ SmartStart equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

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

Figure 2 – Evaluated Energy Improvements

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

1.1 Planning Your Project

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

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

Pick Your Installation Approach

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

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

Energy Conservation Measure		SmartStart	Direct Install	Pay For Performance
ECM 1	Install LED Fixtures	X	X	
ECM 2	Retrofit Fixtures with LED Lamps	X	X	
ECM 3	Install Occupancy Sensor Lighting Controls	X	X	
ECM 4	Install High/Low Lighting Controls		X	
ECM 5	Install VFDs on Constant Volume (CV) HVAC	X	X	
ECM 6	Install VFDs on Chilled Water Pumps			
ECM 7	Install VFDs on Hot Water Pumps		X	
ECM 8	Install High Efficiency Electric AC		X	
ECM 9	Install High Efficiency Chillers	X		

Figure 3 – Funding Options



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

	SmartStart Flexibility to install at your own pace	Direct Install Turnkey installation	Pay for Performance Whole building upgrades
Who should use it?	Buildings installing individual measures or small group of measures.	Small to mid-size facilities that can bundle multiple measures together. Average peak demand should be below 200 kW. Not suitable for significant building shell issues.	Mid to large size facilities looking to implement as many measures as possible at one time. Peak demand should be over 200 kW.
How does it work?	Use in-house staff or your preferred contractor.	Pre-approved contractors pass savings along to you via reduced material and labor costs.	Whole-building approach to energy upgrades designed to reduce energy use by at least 15%. The more you save, the higher the incentives.
What are the Incentives?	Fixed incentives for specific energy efficiency measures.	Incentives pay up to 70% of eligible costs, up to \$125,000 per project. You pay the remaining 30% directly to the contractor.	Up to 25% of installation cost, calculated based on level of energy savings per square foot.
How do I participate?	Submit an application for the specific equipment to be installed.	Contact a participating contractor in your region.	Contact a pre-qualified partner to develop your energy reduction plan and set your energy savings targets.

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

Individual Measures with SmartStart

For facilities wishing to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate, you can use internal resources or an outside firm or contractor to perform the final design of the ECM(s) and install the equipment. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation.

Turnkey Installation with Direct Install

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

Whole Building Approach with Pay for Performance

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

More Options from Around the State

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

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

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

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

Ongoing Electric Savings with Demand Response

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

2 EXISTING CONDITIONS

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for John Marshall 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. This report also contains valuable information on financial incentives from New Jersey’s Clean Energy Program (NJCEP) for implementing ECMs.

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

2.1 Site Overview

On February 27, 2019, TRC performed an energy audit at John Marshall School located in Elizabeth, New Jersey. TRC met with Antonio Chirichiello to review the school operations and help focus our investigation on specific energy-using systems.

John Marshall School is a three-story, 45,000 square foot building built in 1930. Spaces include: classrooms, a gymnasium, offices, a cafeteria, corridors, stairwells, offices, a commercial kitchen, and basement mechanical space.

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

2.2 Building Occupancy

The school is occupied from September through June with the following operating hours. A typical weekday occupancy is 53 staff and 379 students.

Building Name	Weekday/Weekend	Operating Schedule
John Marshal School	Weekday	6:00 AM - 6:00 PM
	Weekend	Saturday: 7:00 AM - 2:00 PM (8 weeks only) Sunday: No Operation

Figure 4 - Building Occupancy Schedule

2.3 Building Envelope

Building walls are concrete block over structural steel with a brick facade. The dividing walls are wood frame and sheet rock. The roof is pitched with asphalt shingles and in good condition.

All windows are double glazed with aluminum frames. Exterior doors are metal. Both windows and doors are in good condition, not allowing excessive air infiltration.



Brick Façade and Windows



Pitched Roof

2.4 Lighting Systems

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. Additionally, there are some compact fluorescent lamps (CFL). T8 fluorescent lamps typically use electronic ballasts. Fixture types include 2-, 3-, or 4-lamp, 2- or 4-foot long troffer, and ceiling-mounted fixtures and 2-foot fixtures with U-bend tube lamps.

Spaces including the classrooms, hallway, and stairwells are lit using 4-foot T8 fixtures. Smaller spaces such as the closets and restrooms are lit using a combination of compact fluorescent lamps and 2-ft U-bend T8 fixtures.

The gymnasium has 400-watt, high bay-fixtures, and the exit signs throughout the school are 2-watt LED fixtures.

Exterior lights are predominantly wall-mounted 70-watt and 150-watt metal halide fixtures, with some 25-watt LED fixtures. Fixtures are controlled by a timeclock.



Ceiling-mounted T8 Fixtures



Hallway T8 Troffers



Outdoor Wall-mounted Fixtures



Outdoor Wall-mounted Fixture

2.5 Air Handling Systems

Unit Ventilators

There are 52-unit ventilators with supply fan motors. They are digitally controlled by a building management system. This system is original to the building and appears to be in fair operating condition.

Packaged Units and Air Conditioners

The gymnasium is served by a packaged AC unit with a cooling capacity of 30-ton and a direct gas fired furnace with a heating capacity of 437 MBh. The unit has an EER of 9.8 and was installed in 2003. The unit is beyond its useful life and has been evaluated for replacement.

Space temperatures are controlled by the building management system. The summer set points at the school are between 68°F to 70°F. The occupied cooling setpoint is 70°F, and the unoccupied cooling set point is 80°F.

There are a few offices that are cooled using window AC units. These are assumed to be 1.5 ton for analytical purposes as their actual capacities are unknown, and they are controlled locally.



Window AC



Gym Packaged Units

2.6 Steam to Hot Water Heating Systems

Two gas-fired 4360 MBh forced-draft Weil-McLain 80.56% efficient steam boilers provide a majority of the school's heating. Heat exchangers convert steam to hot water, which is circulated through the school using two constant speed 7.5 hp and two 3 hp constant speed hot water pumps. Hot water is circulated to the air handling units (AHU 1) and the unit ventilators. Space temperatures are controlled using building management system based on the outside air temperature. The occupied heating setpoint is 77°F, and the unoccupied heating setpoint is 60°F.

Hot water is supplied at 156°F when the outside air temperature is low, and the supply water temperature setpoint is reduced linearly when the outside air is above 68°F.

The boilers were installed in the year 2004.



Boilers



Hot Water Pumps



Radiators



Unit Ventilators

2.7 Chilled Water Systems

The chiller plant consists of two 65-ton McQuay air-cooled scroll chillers. Chilled water is supplied by two dedicated 15 hp constant speed primary pumps to the air handlers (AHU 1) and unit ventilators that have hot water and chilled water coils.

The chilled water supply temperature is reset based on outside air temperature. Chilled water is distributed at 42°F when the outside air temperature is above 68°F.

The chillers were installed in the year 2003, are beyond the useful life of the equipment, and have been evaluated for replacement.



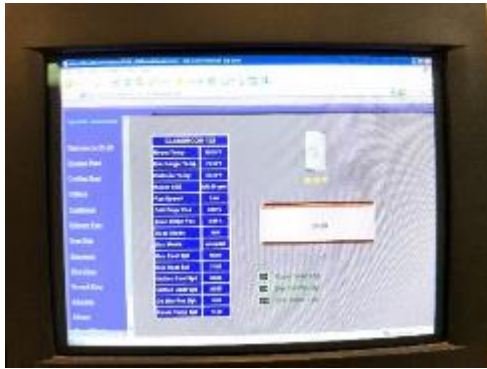
Chiller



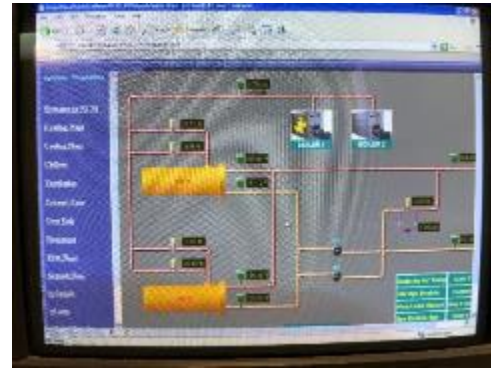
Air Handling Unit

2.8 Building Energy Management Systems (EMS)

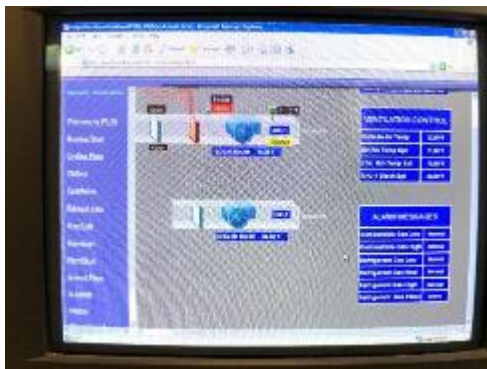
A Dynamic Automation EMS controls the HVAC equipment, boilers, chillers, unit ventilators, air handlers, and package units. The EMS provides equipment-scheduling control and monitors and controls space temperatures, supply air temperatures, humidity, heating water loop temperatures, and chilled water loop temperatures.



BMS Screenshot



BMS Screenshot



BMS Screenshot



BMS Screenshot

2.9 Domestic Hot Water

Hot water is produced with a 71 gallon 75.1 MBh gas-fired storage water heater with an 80% efficiency. The hot water heater was installed in the year 2013 and is in good condition and well maintained.

Fractional hp circulation pumps distribute water to end uses. The circulation pumps operate continuously. The domestic hot water pipes are insulated, and the insulation is in good condition.



DHW



Circulation Pump

2.10 Food Service and Refrigeration Equipment

The kitchen has a mix of gas and electric equipment that are used to prepare lunches for students. Most cooking is done using a conventional gas-fired oven. Bulk prepared foods are held in several electric holding cabinets. Equipment is high-efficiency and is in good condition.

The kitchen has several stand-up refrigerator and freezer with either solid or glass doors. There are also refrigerator chests. All equipment is standard-efficiency and in good condition.

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



Convection Oven



Stand-up Refrigerator



Refrigerator Chest



Refrigerator Chest

2.11 Plug Load & Vending Machines

The utility bill analysis indicates that plug loads consume approximately 2% percent of total building energy use. This is lower than a typical building.

The staff seems to already be doing a great job managing the electrical plug loads. This report makes additional suggestions for ECMs in this area as well as Energy Efficient Best Practices.

There are approximately 37 computer work stations throughout the school. Plug loads throughout the building include general café and office equipment. There are classroom typical loads such as Smart Boards and projectors.

There are several residential-style refrigerators throughout the building that are used by staff to store food. These vary in condition and efficiency.

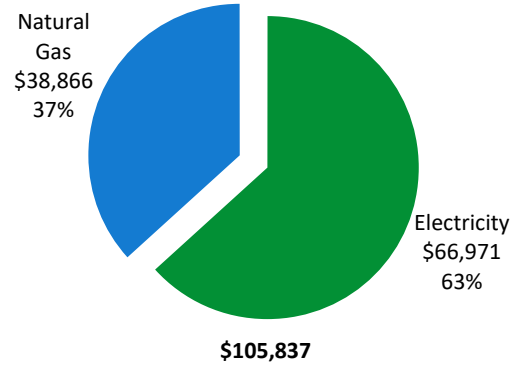
2.12 Water-Using Systems

Faucet flow rates are at 2.2 gallons per minute (gpm) or higher. Toilets are rated at 1.6 gallons per flush (gpf) and urinals are rated at 1.0 gpf.

3 ENERGY USE AND COSTS

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

Utility Summary		
Fuel	Usage	Cost
Electricity	426,455 kWh	\$66,971
Natural Gas	40,787 Therms	\$38,866
Total		\$105,837



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.

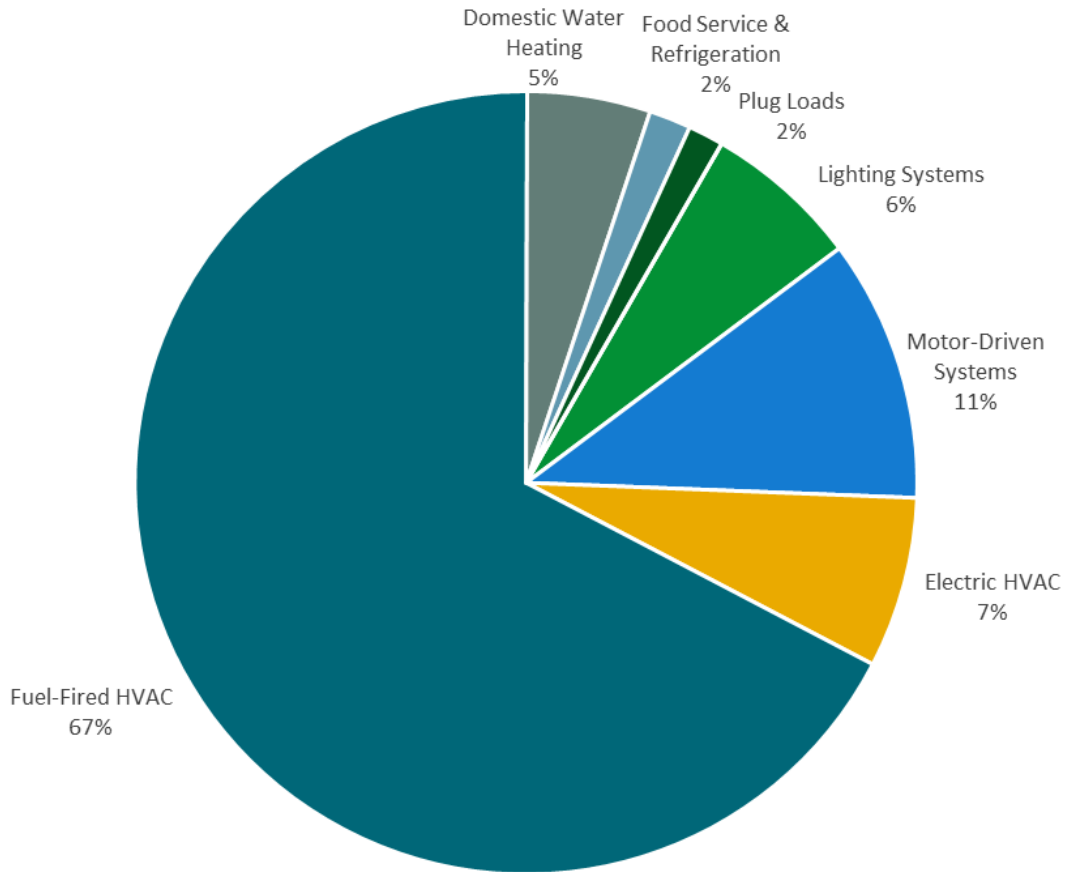
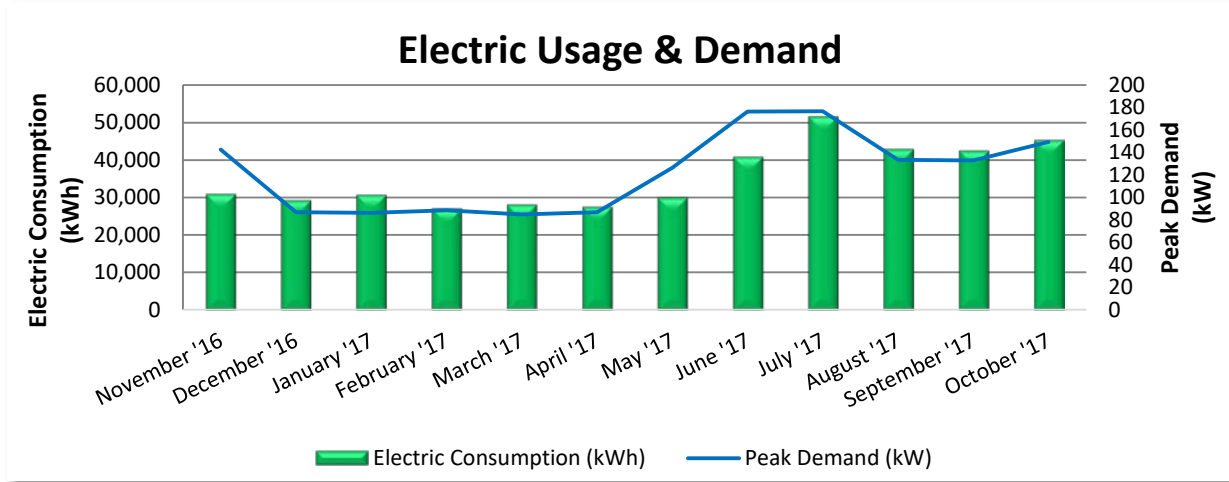


Figure 5 - Energy Balance

3.1 Electricity

PSE&G delivers electricity under rate class LPLS, with electric production provided by a third-party supplier.



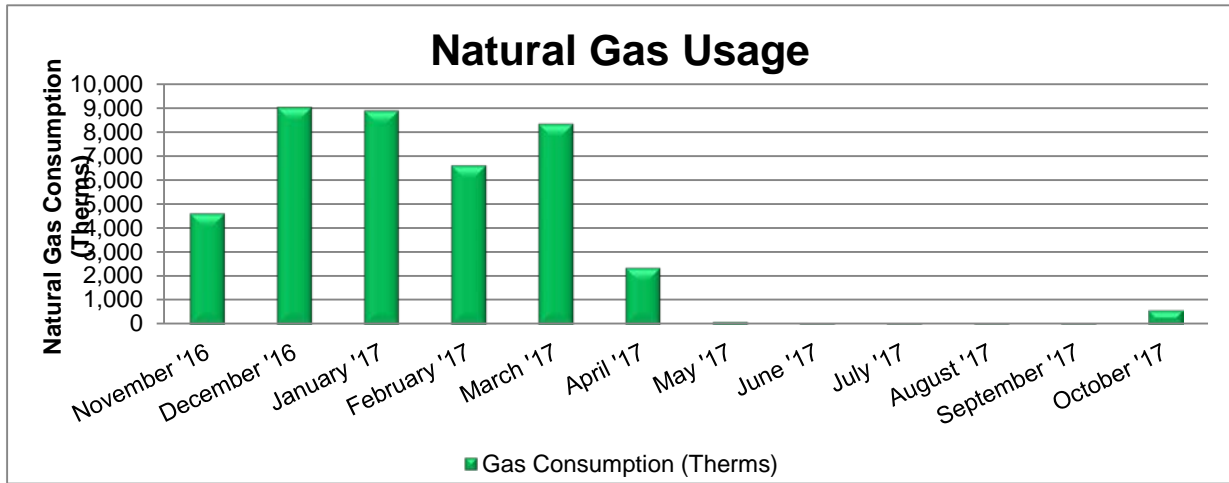
Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
11/14/16	30	31,024	143	\$531	\$4,575
12/15/16	31	29,309	87	\$324	\$4,172
1/18/17	34	30,770	86	\$322	\$4,394
2/15/17	28	27,156	89	\$330	\$3,981
3/17/17	30	28,223	85	\$318	\$4,111
4/18/17	32	27,584	87	\$327	\$4,065
5/17/17	29	30,080	126	\$476	\$4,521
6/16/17	30	40,946	176	\$665	\$7,583
7/18/17	32	51,691	177	\$666	\$8,865
8/16/17	29	42,993	134	\$503	\$7,274
9/15/17	30	42,514	133	\$505	\$7,199
10/16/17	31	45,333	150	\$592	\$6,414
Totals	366	427,623	177	\$5,558	\$67,155
Annual	365	426,455	177	\$5,543	\$66,971

Notes:

- Peak demand of 177 kW occurred in July 2017.
- The average electric cost over the past 12 months was \$0.157/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 rate class General Delivery - AMR, with natural gas supply provided by UGI Energy Service, a third-party supplier.



Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
12/1/16	30	4,624	\$4,252
1/1/17	31	9,032	\$7,148
2/1/17	31	8,879	\$7,210
3/1/17	28	6,612	\$5,840
4/1/17	31	8,336	\$6,623
5/1/17	30	2,374	\$1,739
6/1/17	31	130	\$963
7/1/17	30	51	\$934
8/1/17	31	43	\$940
9/1/17	31	51	\$934
10/1/17	30	51	\$954
11/1/17	31	605	\$1,327
Totals	365	40,787	\$38,866
Annual	365	40,787	\$38,866

Notes:

- The average gas cost for the past 12 months is \$0.953/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 county, 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.

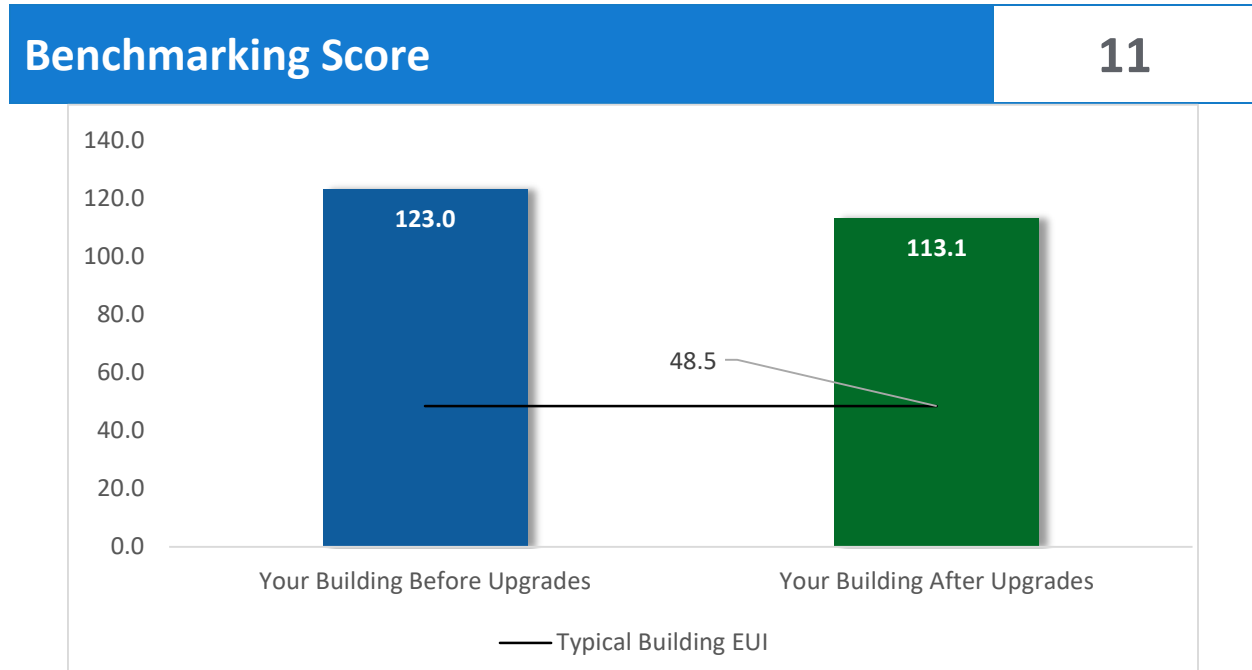


Figure 6 - Energy Use Intensity Comparison

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

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

Tracking Your Energy Performance

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

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

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

For more information on ENERGY STAR® and Portfolio Manager®, visit their website³.

³ <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1>

4 ENERGY CONSERVATION MEASURES

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

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

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

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

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Lighting Upgrades		63,077	16.2	-12	\$9,792	\$49,245	\$9,293	\$39,952	4.1	62,123
ECM 1	Install LED Fixtures	17,720	3.5	-2	\$2,760	\$28,618	\$3,800	\$24,818	9.0	17,560
ECM 2	Retrofit Fixtures with LED Lamps	45,356	12.8	-9	\$7,033	\$20,628	\$5,493	\$15,135	2.2	44,563
Lighting Control Measures		6,100	1.4	-1	\$946	\$4,862	\$415	\$4,447	4.7	5,993
ECM 3	Install Occupancy Sensor Lighting Controls	3,998	0.9	-1	\$620	\$3,512	\$415	\$3,097	5.0	3,928
ECM 4	Install High/Low Lighting Controls	2,102	0.5	0	\$326	\$1,350	\$0	\$1,350	4.1	2,065
Variable Frequency Drive (VFD) Measures		65,172	17.9	0	\$10,235	\$57,251	\$2,640	\$54,611	5.3	65,628
ECM 5	Install VFDs on Constant Volume (CV) Fans	35,166	9.9	0	\$5,523	\$25,924	\$2,640	\$23,284	4.2	35,412
ECM 6	Install VFDs on Chilled Water Pumps	16,242	5.8	0	\$2,551	\$14,082	\$0	\$14,082	5.5	16,356
ECM 7	Install VFDs on Heating Water Pumps	13,763	2.2	0	\$2,161	\$17,245	\$0	\$17,245	8.0	13,860
Electric Unitary HVAC Measures		5,114	3.4	0	\$803	\$74,645	\$0	\$74,645	92.9	5,150
ECM 8	Install High Efficiency Air Conditioning Units	5,114	3.4	0	\$803	\$74,645	\$0	\$74,645	92.9	5,150
Electric Chiller Replacement		25,198	33.8	0	\$3,957	\$178,758	\$11,700	\$167,058	42.2	25,374
ECM 9	Install High Efficiency Chillers	25,198	33.8	0	\$3,957	\$178,758	\$11,700	\$167,058	42.2	25,374
TOTALS		164,661	72.8	-13	\$25,733	\$364,761	\$24,048	\$340,713	13.2	164,268

* - All incentives presented in this table are based on NJ SmartStart equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

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

Figure 7 – All Evaluated ECMs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Lighting Upgrades		63,077	16.2	-12	\$9,792	\$49,245	\$9,293	\$39,952	4.1	62,123
ECM 1	Install LED Fixtures	17,720	3.5	-2	\$2,760	\$28,618	\$3,800	\$24,818	9.0	17,560
ECM 2	Retrofit Fixtures with LED Lamps	45,356	12.8	-9	\$7,033	\$20,628	\$5,493	\$15,135	2.2	44,563
Lighting Control Measures		6,100	1.4	-1	\$946	\$4,862	\$415	\$4,447	4.7	5,993
ECM 3	Install Occupancy Sensor Lighting Controls	3,998	0.9	-1	\$620	\$3,512	\$415	\$3,097	5.0	3,928
ECM 4	Install High/Low Lighting Controls	2,102	0.5	0	\$326	\$1,350	\$0	\$1,350	4.1	2,065
Variable Frequency Drive (VFD) Measures		65,172	17.9	0	\$10,235	\$57,251	\$2,640	\$54,611	5.3	65,628
ECM 5	Install VFDs on Constant Volume (CV) Fans	35,166	9.9	0	\$5,523	\$25,924	\$2,640	\$23,284	4.2	35,412
ECM 6	Install VFDs on Chilled Water Pumps	16,242	5.8	0	\$2,551	\$14,082	\$0	\$14,082	5.5	16,356
ECM 7	Install VFDs on Heating Water Pumps	13,763	2.2	0	\$2,161	\$17,245	\$0	\$17,245	8.0	13,860
TOTALS		134,348	35.6	-13	\$20,973	\$111,359	\$12,348	\$99,011	4.7	133,744

* - All incentives presented in this table are based on NJ SmartStart equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

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

Figure 8 – Cost Effective ECMs

4.1 Lighting

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Lighting Upgrades		63,077	16.2	-12	\$9,792	\$49,245	\$9,293	\$39,952	4.1	62,123
ECM 1	Install LED Fixtures	17,720	3.5	-2	\$2,760	\$28,618	\$3,800	\$24,818	9.0	17,560
ECM 2	Retrofit Fixtures with LED Lamps	45,356	12.8	-9	\$7,033	\$20,628	\$5,493	\$15,135	2.2	44,563

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 fixtures of a specific lighting type (e.g. linear fluorescent) to LED lamps to minimize the number of lamp types in use at the school, 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 as LED lamps last longer than other light sources and therefore do not need to be replaced as often.

Affected building areas: gymnasium, exterior fixtures.

ECM 2: Retrofit Fixtures with LED Lamps

Replace fluorescent pin-based and screw-in CFLs 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 direct replacements for most other lighting technologies.

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

Affected building areas: all areas with fluorescent fixtures with T8 tubes and CFL.

4.2 Lighting Controls

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Lighting Control Measures		6,100	1.4	-1	\$946	\$4,862	\$415	\$4,447	4.7	5,993
ECM 3	Install Occupancy Sensor Lighting Controls	3,998	0.9	-1	\$620	\$3,512	\$415	\$3,097	5.0	3,928
ECM 4	Install High/Low Lighting Controls	2,102	0.5	0	\$326	\$1,350	\$0	\$1,350	4.1	2,065

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

ECM 3: Install Occupancy Sensor Lighting Controls

Install occupancy sensors to control lighting fixtures in areas that are frequently unoccupied, even for short periods. For most spaces, we recommend lighting controls that 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, on the ceiling, or in remote locations. In general, wall switch replacement sensors are best suited to single occupant offices and other small rooms. Ceiling-mounted or remote-mounted sensors are used in large spaces, locations without local switching, and where wall switches are not in the line-of-sight of the main work area.

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

Affected building areas: offices, conference rooms, classrooms, gymnasium, library, restrooms, and storage rooms

ECM 4: Install High/Low Lighting Controls

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

Lighting fixtures with these controls operate at default low levels when the area is unoccupied to provide minimal lighting to meet security or safety requirements. 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 taken into account when selecting retrofit lamps and bulbs for the areas proposed for high/low control.

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

Affected building areas: hallways.

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

4.3 Variable Frequency Drives (VFD)

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		65,172	17.9	0	\$10,235	\$57,251	\$2,640	\$54,611	5.3	65,628
ECM 5	Install VFDs on Constant Volume (CV) Fans	35,166	9.9	0	\$5,523	\$25,924	\$2,640	\$23,284	4.2	35,412
ECM 6	Install VFDs on Chilled Water Pumps	16,242	5.8	0	\$2,551	\$14,082	\$0	\$14,082	5.5	16,356
ECM 7	Install VFDs on Heating Water Pumps	13,763	2.2	0	\$2,161	\$17,245	\$0	\$17,245	8.0	13,860

Variable frequency drives (VFDs) control motors for fans, pumps, and process equipment based on the actual output required of the driven equipment. Energy savings result from more efficient control of motor energy usage when equipment operates at partial load. The magnitude of energy savings depends on the estimated amount of time that the motor would operate at partial load. For equipment with proposed VFDs, we have included replacing the controlled motor with a new motor—unless the existing motor meets or exceeds IHP 2014 standards—to conservatively account for the cost of an inverter duty rated motor. If the proposed VFD measure is not selected for implementation, the motor replacement should be reevaluated.

ECM 5: Install VFDs on Constant Volume (CV) Fans

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

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

For air handlers with direct expansion (DX) cooling systems, the minimum air flow across the cooling coil required to prevent the coil from freezing must be determined during the final project design. The control system programming should maintain the minimum air flow whenever the compressor is operating.

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

Affected air handlers: Gym and AHU 1.

ECM 6: Install VFDs on Chilled Water Pumps

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

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

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

Affected pumps: Two 15 hp pumps.

ECM 7: Install VFDs on Heating Water Pumps

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

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

Affected pumps: Two 7.5 hp pumps and two 3 hp pumps.

4.4 Electric Unitary HVAC

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Electric Unitary HVAC Measures		5,114	3.4	0	\$803	\$74,645	\$0	\$74,645	92.9	5,150
ECM 8	Install High Efficiency Air Conditioning Units	5,114	3.4	0	\$803	\$74,645	\$0	\$74,645	92.9	5,150

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 at the school 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 equipment needs to be replaced, consider purchasing equipment that exceeds the minimum efficiency required by building codes.

ECM 8: Install High-Efficiency Air Conditioning Units

Replace standard-efficiency packaged air conditioning units with high-efficiency packaged air conditioning units. The magnitude of energy savings for this measure depends on the relative efficiency of the older unit versus the new high-efficiency unit, the average cooling load, and the estimated annual operating hours.

4.5 Electric Chillers

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings (\$)	Estimated Install Cost (\$)	Estimated Incentive (\$)*	Estimated Net Cost (\$)	Simple Payback Period (yrs)**	CO ₂ e Emissions Reduction (lbs)
Electric Chiller Replacement		25,198	33.8	0	\$3,957	\$178,758	\$11,700	\$167,058	42.2	25,374
ECM 9	Install High Efficiency Chillers	25,198	33.8	0	\$3,957	\$178,758	\$11,700	\$167,058	42.2	25,374

ECM 9: Install High-Efficiency Chillers

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

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

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

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

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

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

Energy Tracking with ENERGY STAR® Portfolio Manager®



You've heard it before - you can't manage what you don't measure. ENERGY STAR® Portfolio Manager® is an online tool that you can use to measure and track energy and water consumption, as well as greenhouse gas emissions.⁴ Your account has already been established. Now you can continue to keep tabs on your energy performance every month.

Lighting Controls

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

Motor Maintenance

Motors have many moving parts. As these parts degrade over time, the efficiency of the motor is reduced. Routine maintenance prevents damage to motor components. Routine maintenance should include cleaning surfaces and ventilation openings on motors to prevent overheating, lubricating moving parts to reduce friction, inspecting belts and pulleys for wear and to ensure they are at proper alignment and tension, and cleaning and lubricating bearings. Consult a licensed technician to assess these and other motor maintenance strategies.

Thermostat Schedules and Temperature Resets



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

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

Chiller Maintenance

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

AC System Evaporator/Condenser Coil Cleaning

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

HVAC Filter Cleaning and Replacement

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

Steam Trap Repair and Replacement

Steam traps are a crucial part of delivering heat from the boiler to the space heating units. Repair or replace traps that are blocked or allowing steam to pass. Inspect steam traps as part of a regular steam system maintenance plan.

Boiler Maintenance

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

Furnace Maintenance

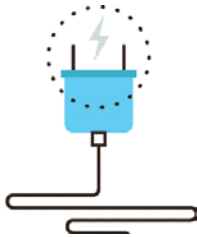
Preventative maintenance can extend the life of the system, maintain energy efficiency, and ensure safe operation. Following the manufacturer's instructions, a yearly tune-up should check for gas / carbon monoxide leaks; change the air and fuel filters; check components for cracks, corrosion, dirt, or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

Water Heater Maintenance

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.

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 strips⁵. 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 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™ website⁶ or download a copy of EPA's "WaterSense™ at Work: Best Management Practices for Commercial and Institutional Facilities"⁷ to get ideas for creating a water management plan and best practices for a wide range of water using systems.

Water conservation devices that do not reduce hot water consumption will not provide energy savings at the site level, but they may significantly affect your water and sewer usage costs. Any reduction in water use does however ultimately reduce grid-level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users.

⁵ 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>

⁶ <https://www.epa.gov/watersense>

⁷ <https://www.epa.gov/watersense/watersense-work-0>

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 school is unoccupied, and there is no other scheduled water usage.

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

Procurement Strategies

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

6 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 school'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.

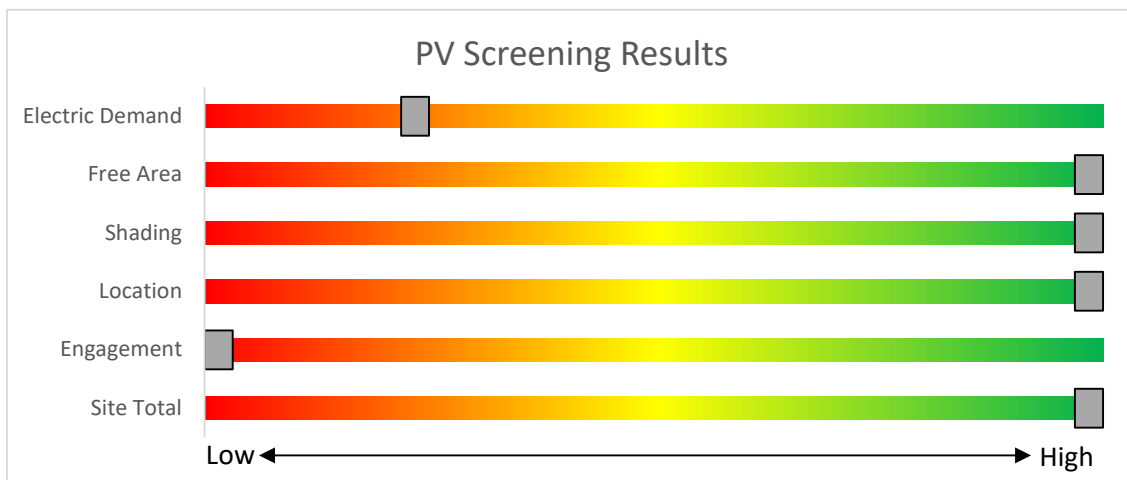
6.1 Solar Photovoltaic

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 school'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	123	kW DC STC
Electric Generation	146,538	kWh/yr
Displaced Cost	\$23,010	/yr
Installed Cost	\$319,800	

Figure 9 - Photovoltaic Screening

Solar Renewable Energy Credit (SREC) Registration Program

Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SREC Registration Program before starting construction. Once your PV system is up and running, you periodically earn credits, which can then be sold on the open market for up to 15 years.

If you are considering installing solar photovoltaics on your building, visit www.njcleanenergy.com/srec for more information about the SREC Registration Program.

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:

- **Basic Info on Solar PV in New Jersey:** www.njcleanenergy.com/whysolar
- **New Jersey Solar Market FAQs:** www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the New Jersey Market:** www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) generates electricity at the school 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 school has no potential for installing a cost-effective CHP system.

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

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

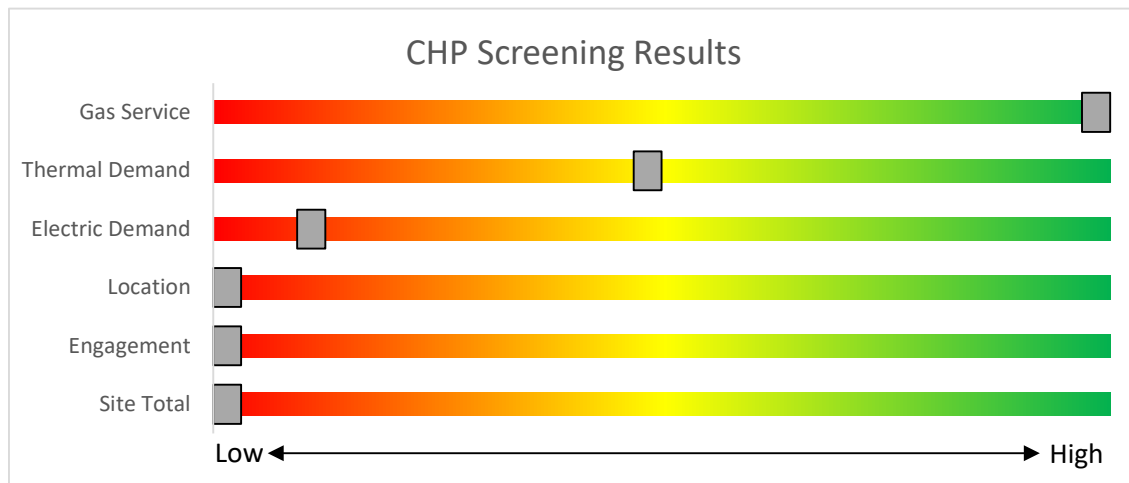


Figure 10 - Combined Heat and Power Screening

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

7 PROJECT FUNDING AND INCENTIVES

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

	SmartStart <i>Flexibility to install at your own pace</i>	Direct Install <i>Turnkey installation</i>	Pay for Performance <i>Whole building upgrades</i>
Who should use it?	Buildings installing individual measures or small group of measures.	Small to mid-size facilities that can bundle multiple measures together. Average peak demand should be below 200 kW. Not suitable for significant building shell issues.	Mid to large size facilities looking to implement as many measures as possible at one time. Peak demand should be over 200 kW.
How does it work?	Use in-house staff or your preferred contractor.	Pre-approved contractors pass savings along to you via reduced material and labor costs.	Whole-building approach to energy upgrades designed to reduce energy use by at least 15%. The more you save, the higher the incentives.
What are the Incentives?	Fixed incentives for specific energy efficiency measures.	Incentives pay up to 70% of eligible costs, up to \$125,000 per project. You pay the remaining 30% directly to the contractor.	Up to 25% of installation cost, calculated based on level of energy savings per square foot.
How do I participate?	Submit an application for the specific equipment to be installed.	Contact a participating contractor in your region.	Contact a pre-qualified Partner to develop your Energy Reduction Plan and set your energy savings targets.
Take the next step by visiting www.njcleanenergy.com for program details, applications, and to contact a qualified contractor.			

7.1 SmartStart



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

SmartStart routinely adds, removes, or modifies incentives from year-to-year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers

Electric Unitary HVAC

Gas Cooling

Gas Heating

Gas Water Heating

Ground Source Heat Pumps

Lighting

Lighting Controls

Refrigeration Doors

Refrigeration Controls

Refrigerator/Freezer Motors

Food Service Equipment

Variable Frequency Drives

Incentives

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

SmartStart Custom provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentives. Custom incentives are calculated at \$0.16/kWh and \$1.60/therm based on estimated annual savings. Incentives are capped at 50% of the total installed incremental project cost, or a project cost buy down to a one-year payback (whichever is less). Program incentives are capped at \$500,000 per electric account and \$500,000 per natural gas account, per fiscal year.

How to Participate

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

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

7.2 Direct Install



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

installation of selected measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

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

How to Participate

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

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

7.3 Energy Savings Improvement Program

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

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

How to Participate

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

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

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

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

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

7.4 SREC Registration Program

The SREC Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects *must* register their projects prior to the start of construction to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number, which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar Renewable Portfolio Standard. Purchasing SRECs can help them meet those requirements. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period fluctuates depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

8.1 Retail Electric Supply Options

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

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

A list of licensed third-party electric suppliers is available at the NJBPU website⁸.

8.2 Retail Natural Gas Supply Options

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

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

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

A list of licensed third-party natural gas suppliers is available at the NJBPU website⁹.

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

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

APPENDIX A: EQUIPMENT INVENTORY & RECOMMENDATIONS

Lighting Inventory & Recommendations

Location	Existing Conditions						Proposed Conditions						Energy Impact & Financial Analysis								
	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler room	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.3	1,202	0	\$186	\$438	\$120	1.7
Chiller room	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.1	601	0	\$93	\$219	\$60	1.7
Chiller room	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	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.1	255	0	\$40	\$189	\$20	4.3
Storage 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.1	255	0	\$40	\$189	\$20	4.3
Storage 2	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	\$0	\$0	\$0	0.0
Head custodian's office	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,760	2, 3	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,904	0.2	674	0	\$104	\$335	\$80	2.4
Head custodian's office - Restroom	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
Boiler room hall	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.1	301	0	\$47	\$110	\$30	1.7
Boiler room hall	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
Room 1	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
1 Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
1/3 closet hall	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Room 1 - Boys	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
Room 1 - Girls	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
Room 3	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
3 closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Room 2	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
2 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 4	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,760	2, 3	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,904	0.1	449	0	\$70	\$262	\$60	2.9
Room 8	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.2	637	0	\$99	\$299	\$70	2.3
8 restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Boys	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,760	2, 3	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,904	0.3	1,348	0	\$209	\$708	\$155	2.6
Room 6	11	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	11	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	760	0	\$118	\$402	\$110	2.5
7 storage	1	Compact Fluorescent: 4 pin bulb	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: 4-pin bulb	Wall Switch	18	2,760	0.0	24	0	\$4	\$109	\$0	29.6

Location	Existing Conditions						Proposed Conditions						Energy Impact & Financial Analysis								
	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
9 Kitchen	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.1	501	0	\$78	\$183	\$50	1.7
11 Girls	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	1,147	0	\$178	\$599	\$125	2.7
Room 12	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
12 closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
12 Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,760	0.0	88	0	\$14	\$72	\$10	4.6
Room 13	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
13 closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
13 bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,760	0.0	88	0	\$14	\$72	\$10	4.6
Room 14	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
14 closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
14 bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,760	0.0	88	0	\$14	\$72	\$10	4.6
Room 15	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
15 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Basement hall	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,760	2, 4	Relamp	Yes	14	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,904	0.7	3,144	-1	\$488	\$1,472	\$280	2.4
Basement hall	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
Stair 2	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.1	601	0	\$93	\$219	\$60	1.7
Stair 3	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.1	601	0	\$93	\$219	\$60	1.7
Room 101	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
101 Closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 102	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
102 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 103	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
103 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
105 Principal	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.1	510	0	\$79	\$416	\$75	4.3
105 Storage	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4

Location	Existing Conditions						Proposed Conditions						Energy Impact & Financial Analysis								
	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
105 Bathroom	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
106 Main office	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.1	382	0	\$59	\$380	\$65	5.3
Main Vestibule	2	Compact Fluorescent: Decorative fixture - 4 lamps	Wall Switch	S	52	2,760	2	Relamp	No	2	LED Lamps: Decorative fixture - 4 lamps	Wall Switch	36	2,760	0.0	95	0	\$15	\$138	\$8	8.8
107 Nurse	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.2	802	0	\$124	\$292	\$80	1.7
107 Bathroom	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
107 closet	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
108 Janitor	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
Room 109	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
109 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 110	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
110 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 111	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	1,904	2	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.3	830	0	\$129	\$438	\$120	2.5
111 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Gym	12	Mercury Vapor: (1) 400W Lamp	Wall Switch	S	455	2,760	1, 3	Fixture Replacement	Yes	12	LED - Fixtures: High-Bay	Occupancy Sensor	137	1,904	3.1	13,145	-3	\$2,038	\$9,839	\$1,870	3.9
Gym storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Gym storage	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.2	1,020	0	\$158	\$562	\$80	3.0
Girls bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Café storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Gym office	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Boys bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Faculty Dining	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.2	1,020	0	\$158	\$562	\$115	2.8
Faculty storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Gym	4	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	\$0	\$0	\$0	0.0
Music room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Music practice	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7

Location	Existing Conditions						Proposed Conditions						Energy Impact & Financial Analysis								
	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Stage	6	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	33	2,760	2	Relamp	No	6	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,760	0.1	291	0	\$45	\$195	\$36	3.5
Stage storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	100	0	\$16	\$37	\$10	1.7
Music office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
1st floor hall	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,760	2, 4	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	1,904	0.6	2,677	-1	\$415	\$1,217	\$210	2.4
1st floor hall	3	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	\$0	\$0	\$0	0.0
Room 201	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	1,904	2	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.3	933	0	\$145	\$493	\$135	2.5
201 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 202	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	1,904	2	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.3	933	0	\$145	\$493	\$135	2.5
202 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 203	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	1,904	2	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.3	933	0	\$145	\$493	\$135	2.5
203 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 204	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	1,904	2	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.3	933	0	\$145	\$493	\$135	2.5
204 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
206 Janitor	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
205 Guidance	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.2	637	0	\$99	\$299	\$70	2.3
207 Library	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2, 3	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,904	0.5	2,040	0	\$316	\$1,124	\$230	2.8
Closet	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
Room 209	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,760	2, 3	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.2	765	0	\$119	\$335	\$80	2.2
209 restroom	1	Compact Fluorescent: Screw-in 1 Lamp	Wall Switch	S	26	2,760	2	Relamp	No	1	LED Lamps: Screw-in 1 Lamp	Wall Switch	18	2,760	0.0	24	0	\$4	\$17	\$1	4.4
Room 210	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	1,904	2	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.3	933	0	\$145	\$493	\$135	2.5
210 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 211	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	1,904	2	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.3	933	0	\$145	\$493	\$135	2.5
211 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
Room 213	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	1,904	2	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.3	933	0	\$145	\$493	\$135	2.5
213 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7

Location	Existing Conditions						Proposed Conditions							Energy Impact & Financial Analysis							
	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 214	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	1,904	2	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,904	0.3	933	0	\$145	\$493	\$135	2.5
214 closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,760	2	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,760	0.0	200	0	\$31	\$73	\$20	1.7
2nd floor hall	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,760	2, 4	Relamp	Yes	14	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,904	0.7	3,144	-1	\$488	\$1,472	\$280	2.4
2nd floor hall	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
Elevator lobby	3	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	33	2,760	2	Relamp	No	3	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,760	0.0	146	0	\$23	\$98	\$18	3.5
Exterior	19	Metal Halide: (1) 70W Lamp	Timeclock		95	4,380	1	Fixture Replacement	No	19	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock	29	4,380	0.6	5,534	0	\$869	\$18,353	\$1,900	18.9
Exterior	1	Metal Halide: (1) 150W Lamp	Timeclock		190	4,380	1	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock	57	4,380	0.1	583	0	\$91	\$966	\$100	9.5
Exterior	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock		25	4,380		None	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock	25	4,380	0.0	0	0	\$0	\$0	\$0	0.0

Motor Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions							Proposed Conditions					Energy Impact & Financial Analysis						
		Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler room	Boiler	2	Combustion Air Fan	3.0	87.5%	No	W	1,696		No	87.5%	No		0.0	0	0	\$0	\$0	\$0	0.0
Boiler room	DHW	1	Water Supply Pump	0.1	60.0%	No	W	8,760		No	60.0%	No		0.0	0	0	\$0	\$0	\$0	0.0
Boiler room	Boiler	3	Boiler Feed Water Pump	1.0	75.5%	No	W	1,830		No	75.5%	No		0.0	0	0	\$0	\$0	\$0	0.0
Boiler room	Boiler	2	Heating Hot Water Pump	7.5	88.5%	No	W	1,696	7	No	91.0%	Yes	2	1.6	8,437	0	\$1,325	\$9,476	\$0	7.2
Mechanical room	Chiller	2	Chilled Water Pump	15.0	91.0%	No	W	1,696	6	No	93.0%	Yes	2	5.8	16,242	0	\$2,551	\$14,082	\$0	5.5
Roof	Gym	2	Supply Fan	7.5	89.5%	No	B	3,391	5	No	91.7%	Yes	2	4.4	16,585	0	\$2,605	\$9,521	\$1,200	3.2
Roof	Gym	2	Exhaust Fan	5.0	87.5%	No	B	3,391	5	No	89.5%	Yes	2	3.1	11,278	0	\$1,771	\$8,394	\$800	4.3
Classrooms	Classrooms	52	Supply Fan	0.3	60.0%	No	W	2,745		No	60.0%	No		0.0	0	0	\$0	\$0	\$0	0.0
Boiler room	AHU - 1	1	Supply Fan	5.0	87.5%	No		2,745	5	No	89.5%	Yes	1	1.5	4,565	0	\$717	\$4,197	\$400	5.3
Boiler room	AHU - 1	1	Exhaust Fan	3.0	87.5%	No		2,745	5	No	89.5%	Yes	1	0.9	2,739	0	\$430	\$3,812	\$240	8.3
Roof	Various spaces	7	Exhaust Fan	0.3	60.0%	No		1,920		No	60.0%	No		0.0	0	0	\$0	\$0	\$0	0.0
Ceiling	Unknown	1	Supply Fan	0.1	60.0%	No		2,745		No	60.0%	No		0.0	0	0	\$0	\$0	\$0	0.0
Boiler room	Boiler	2	Heating Hot Water Pump	3.0	86.5%	No	W	2,745	7	No	86.5%	Yes	2	0.6	5,327	0	\$836	\$7,768	\$0	9.3

Electric HVAC Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis							
		System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	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/EER)	Heating Mode Efficiency (COP)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Gym	1	Packaged AC	30.00		B	8	Yes	1	Packaged AC	30.00		9.50		2.7	4,364	0	\$685	\$66,479	\$0	97.0
Room	Room	5	Window AC	1.50		B	8	Yes	5	Window AC	1.50		12.00		0.8	750	0	\$118	\$8,166	\$0	69.3

Electric Chiller Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
		Chiller Quantity	System Type	Cooling Capacity per Unit (Tons)	Remaining Useful Life	ECM #	Install High Efficiency Chillers?	Chiller Quantity	System Type	Constant/Variable Speed	Cooling Capacity (Tons)	Full Load Efficiency (kW/Ton)	IPLV Efficiency (kW/Ton)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	AHUs and Unit ventilators	1	Air-Cooled Scroll Chiller	65.00	B	9	Yes	1	Air-Cooled Scroll Chiller	Variable	65.00	1.24	0.74	16.9	12,599	0	\$1,979	\$89,379	\$5,850	42.2
Roof	AHUs and Unit ventilators	1	Air-Cooled Scroll Chiller	65.00	B	9	Yes	1	Air-Cooled Scroll Chiller	Variable	65.00	1.24	0.74	16.9	12,599	0	\$1,979	\$89,379	\$5,850	42.2

Fuel Heating Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
		System Quantity	System Type	Output Capacity per Unit (MBh)	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years	
Boiler room	Boiler 1	1	Forced Draft Steam Boiler	#####	W		No							0.0	0	0	\$0	\$0	\$0	0.0
Boiler room	Boiler 2	1	Forced Draft Steam Boiler	#####	W		No							0.0	0	0	\$0	\$0	\$0	0.0
Roof	Gym	1	Furnace	437.00	B		No							0.0	0	0	\$0	\$0	\$0	0.0

DHW Inventory & Recommendations

Location	Area(s)/System(s) Served	Existing Conditions				Proposed Conditions						Energy Impact & Financial Analysis								
		System Quantity	System Type	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years		
Boiler room	Restrooms	1	Storage Tank Water Heater (> 50 Gal)	W		No								0.0	0	0	\$0	\$0	\$0	0.0

Commercial Refrigerator/Freezer Inventory & Recommendations

Location	Existing Conditions			Proposed Conditions		Energy Impact & Financial Analysis						
	Quantity	Refrigerator/ Freezer Type	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	Yes		No	0.0	0	0	\$0	\$0	\$0	0.0
Kitchen	3	Refrigerator Chest	Yes		No	0.0	0	0	\$0	\$0	\$0	0.0
Kitchen	3	Refrigerator Chest	Yes		No	0.0	0	0	\$0	\$0	\$0	0.0

Cooking Equipment Inventory & Recommendations


Location	Existing Conditions				Proposed Conditions		Energy Impact & Financial Analysis						
	Quantity	Equipment Type	High Efficiency Equipment?	ECM #	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years	
Kitchen	1	Gas Convection Oven (Half Size)	Yes		No	0.0	0	0	FALSE	\$0	\$0	#DIV/0!	
Kitchen	1	Insulated Food Holding Cabinet (Full Size)	Yes		No	0.0	0	0	FALSE	\$0	\$0	#DIV/0!	

Plug Load Inventory

Existing Conditions				
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified ?
John Marshal School	37	Computer	145.0	Yes
John Marshal School	30	Printer - Small	60.0	Yes
John Marshal School	5	Printer - Medium	80.0	Yes
John Marshal School	3	Printer - Large	200.0	Yes
John Marshal School	22	Projector	400.0	Yes
John Marshal School	4	Microwave	900.0	Yes
John Marshal School	2	Refrigerator - Small	60.0	Yes
John Marshal School	1	Refrigerator - Medium	80.0	Yes
John Marshal School	1	Refrigerator - Large	220.0	Yes
John Marshal School	2	Coffee Machine	400.0	Yes
John Marshal School	1	Toaster oven	1,200.0	Yes

APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

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



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ENERGY STAR® Statement of Energy Performance

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John Marshall Elementary School (20)

Primary Property Type: K-12 School
 Gross Floor Area (ft²): 45,000
 Built: 1930

For Year Ending: September 30, 2017
 Date Generated: April 02, 2019

ENERGY STAR® Score¹

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

Property & Contact Information			
Property Address John Marshall Elementary School (20) 521 Magnolia Avenue Elizabeth, New Jersey 07206	Property Owner Elizabeth Board of Education 500 North Broad Street Elizabeth, NJ 07208 908-436-5180	Primary Contact Luis Couto 500 North Broad Street Elizabeth, NJ 07208 908-436-5180 coutolu@epsnj.org	
Property ID: 6688948			
Energy Consumption and Energy Use Intensity (EUI)			
Site EUI 121.5 kBtu/ft²	Annual Energy by Fuel Electric - Grid (kBtu) 1,388,581 (25%) Natural Gas (kBtu) 4,078,521 (75%)	National Median Comparison National Median Site EUI (kBtu/ft²) 77.5 National Median Source EUI (kBtu/ft²) 115.8 % Diff from National Median Source EUI 57%	
Source EUI 181.6 kBtu/ft²		Annual Emissions Greenhouse Gas Emissions (Metric Tons CO2e/year) 357	

Signature & Stamp of Verifying Professional

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

Signature: _____ Date: _____

Licensed Professional

 () - _____



Professional Engineer Stamp (if applicable)

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	<i>British thermal unit</i> : 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	<i>Combined heat and power</i> . Also referred to as cogeneration.
COP	<i>Coefficient of performance</i> : 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	<i>Demand control ventilation</i> : a control strategy to limit the amount of outside air introduced to the conditioned space based on actual occupancy need.
US DOE	<i>United States Department of Energy</i>
EC Motor	<i>Electronically commutated motor</i>
ECM	<i>Energy conservation measure</i>
EER	<i>Energy efficiency ratio</i> : a measure of efficiency in terms of cooling energy provided divided by electric input.
EUI	<i>Energy Use Intensity</i> : 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	<i>United States Environmental Protection Agency</i>
Generation	The process of generating electric power from sources of primary energy (e.g., natural gas, the sun, oil).
GHG	<i>Greenhouse gas</i> : 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	<i>Gallons per flush</i>

gpm	<i>Gallon per minute</i>
HID	<i>High intensity discharge</i> : high-output lighting lamps such as high-pressure sodium, metal halide, and mercury vapor.
hp	<i>Horsepower</i>
HPS	<i>High-pressure sodium</i> : a type of HID lamp.
HSPF	<i>Heating seasonal performance factor</i> : a measure of efficiency typically applied to heat pumps. Heating energy provided divided by seasonal energy input.
HVAC	<i>Heating, ventilating, and air conditioning</i>
IHP 2014	US DOE Integral Horsepower rule. The current ruling regarding required electric motor efficiency.
IPLV	<i>Integrated part load value</i> : a measure of the part load efficiency usually applied to chillers.
kBtu	One thousand British thermal units
kW	<i>Kilowatt</i> : equal to 1,000 Watts.
kWh	<i>Kilowatt-hour</i> : 1,000 Watts of power expended over one hour.
LED	<i>Light emitting diode</i> : a high-efficiency source of light with a long lamp life.
LGEA	<i>Local Government Energy Audit</i>
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	<i>Metal halide</i> : a type of HID lamp.
MBh	<i>Thousand Btu per hour</i>
MBtu	<i>One thousand British thermal units</i>
MMBtu	<i>One million British thermal units</i>
MV	<i>Mercury Vapor</i> : a type of HID lamp.
NJBPU	<i>New Jersey Board of Public Utilities</i>
NJCEP	<i>New Jersey's Clean Energy Program</i> : 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	<i>Pounds per square inch gauge</i>
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	<i>Photovoltaic</i> : refers to an electronic device capable of converting incident light directly into electricity (direct current).

SEER	<i>Seasonal energy efficiency ratio</i> : a measure of efficiency in terms of annual cooling energy provided divided by total electric input.
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SEP	<i>Statement of energy performance</i> : a summary document from the ENERGY STAR® Portfolio Manager®.
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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.
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SREC	<i>Solar renewable energy credit</i> : a credit you can earn from the state for energy produced from a photovoltaic array.
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T5, T8, T12	A reference to a linear lamp diameter. The number represents increments of 1/8 th of an inch.
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Temperature Setpoint	The temperature at which a temperature regulating device (thermostat, for example) has been set.
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therm	100,000 Btu. Typically used as a measure of natural gas consumption.
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tons	A unit of cooling capacity equal to 12,000 Btu/hr.
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Turnkey	Provision of a complete product or service that is ready for immediate use
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VAV	<i>Variable air volume</i>
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VFD	<i>Variable frequency drive</i> : a controller used to vary the speed of an electric motor.
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WaterSense™	The symbol for water efficiency. The WaterSense™ program is managed by the EPA.
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Watt (W)	Unit of power commonly used to measure electricity use.
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